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THE COMING DESERT

Kropotkin, Mars and the Pulse of Asia

ANTHROPOGENIC CLIMATE change is usually portrayed as a recent discovery, with a genealogy that extends no further backwards than Charles Keeling sampling atmospheric gases from his station near the summit of Mauna Loa in the 1960s, or, at the very most, Svante Arrhenius's legendary 1896 paper on carbon emissions and the planetary greenhouse. In fact, the deleterious climatic consequences of economic growth, especially the influence of deforestation and plantation agriculture on atmospheric moisture levels, were widely noted, and often exaggerated, from the Enlightenment until the late nineteenth century. The irony of Victorian science, however, was that while human influence on climate, whether as a result of land clearance or industrial pollution, was widely acknowledged, and sometimes envisioned as an approaching doomsday for the big cities (see John Ruskin's hallucinatory rant, 'The Storm Cloud of the Nineteenth Century'), few if any major thinkers discerned a pattern of *natural* climate variability in ancient or modern history. The Lyellian world-view, canonized by Darwin in *The Origin of Species*, supplanted biblical catastrophism with a vision of slow geological and environmental evolution through deep time. Despite the discovery of the Ice Age(s) by the Swiss geologist Louis Agassiz in the late 1830s, the contemporary scientific bias was against environmental perturbations, whether periodic or progressive, on historical time-scales. Climate change, like evolution, was measured in eons, not centuries.

Oddly, it required the 'discovery' of a supposed dying civilization on Mars to finally ignite interest in the idea, first proposed by the anarchist geographer Kropotkin in the late 1870s, that the 14,000 years since the

Glacial Maximum constituted an epoch of on-going and catastrophic desiccation of the continental interiors. This theory—we might call it the ‘old climatic interpretation of history’—was highly influential in the early twentieth century, but waned quickly with the advent of dynamic meteorology in the 1940s, with its emphasis on self-adjusting physical equilibrium.¹ What many fervently believed to be a key to world history was found and then lost, discrediting its discoverers almost as completely as the eminent astronomers who had seen (and in some cases, claimed to have photographed) canals on the Red Planet. Although the controversy primarily involved German and English-speaking geographers and orientalists, the original thesis—postglacial aridification as the driver of Eurasian history—was formulated inside Tsardom’s *école des hautes études*: St Petersburg’s notorious Peter-and-Paul Fortress where the young Prince Piotr Kropotkin, along with other celebrated Russian intellectuals, was held as a political prisoner.

Exploration of Siberia

The famed anarchist was also a first-rate natural scientist, physical geographer and explorer. In 1862, he voluntarily exiled himself to eastern Siberia in order to escape the suffocating life of a courtier in an increasingly reactionary court. Offered a commission by Alexander II in the regiment of his choice, he opted for a newly formed Cossack unit in remote Transbaikalia, where his education, pluck and endurance quickly recommended him to lead a series of expeditions—for the purposes of both science and imperial espionage—into a huge, unexplored tangle of mountain and *taiga* wildernesses recently annexed by the Empire. Whether measured by physical challenge or scientific achievement, Kropotkin’s explorations of the lower Amur valley and into the heart of Manchuria, followed by a singularly daring reconnaissance of the ‘vast and deserted mountain region between the Lena in northern Siberia and the higher reaches of the Amur near Chita’,² were comparable to the Great Northern Expeditions of Vitus Bering in the eighteenth century or the contemporary explorations of the Colorado Plateau by John Wesley

¹ ‘It was assumed that for all practical purposes and decisions, climate could be considered constant.’ Hubert Lamb, *Climate, History and the Modern World*, London 1995, p. 2. This essay will appear in a forthcoming book, edited by Cal Winslow, *A Search for the Commons: Essays for Iain Boal*, to be published by PM Press.

² George Woodcock and Ivan Avakumovic, *The Anarchist Prince: The Biography of Prince Peter Kropotkin*, London 1950, p. 71.

Powell and Clarence King. After thousands of miles of travel, usually in extreme terrain, Kropotkin was able to show that the orography of northeast Asia was considerably different from that envisioned by Alexander von Humboldt and his followers.³ He was also the first to demonstrate that the plateau was a 'basic and independent type of the Earth's relief' with as wide 'a distribution as mountain ranges'.⁴

Kropotkin also encountered a riddle in Siberia that he later tried to solve in Scandinavia. While on his epic trek across the mountainous terrain between the Lena and the upper Amur, his zoologist comrade Poliakov discovered 'palaeolithic remains in the dried beds of shrunken lakes, and other similar observations gave evidence on the desiccation of Asia'. This accorded with the observations of other explorers in Central Asia—especially the Caspian steppe and Tarim basin—of ruined cities in deserts and dry lakes that had once filled great basins.⁵ After his return from Siberia, Kropotkin took an assignment from the Russian Geographical Society to survey the glacial moraines and lakes of Sweden and Finland. Agassiz's ice-age theories were under intense debate in Russian scientific circles, but the physics of ice was little understood. From detailed studies of striated rock surfaces, Kropotkin deduced that the sheer mass of continental ice sheets caused them to flow plastically, almost like a super-viscous fluid—his 'most important scientific achievement', according to one historian of science.⁶ He also became convinced that Eurasian ice sheets had extended southward into the steppe as far as the 50th parallel. If this was indeed the case, it followed that with the recession of the ice, the northern steppe became a vast mosaic of lakes and marshes (he envisioned much of Eurasia once looking like the

³ Prince Kropotkin, 'The Orography of Asia', *The Geographical Review*, vol. 23, nos. 2 & 3, February–March 1904.

⁴ Woodcock and Avakumovic, *The Anarchist Prince*, pp. 61–86. On his recognition of the plateau as a fundamental landform, see Alexander Vucinich, *Science in Russian Culture: 1861–1917*, Palo Alto 1970, p. 88.

⁵ Woodcock and Avakumovic, *The Anarchist Prince*, p. 73. In later years, there would be fierce debate over historical fluctuations in the level and areal expanse of the Caspian, but the controversy, like so many others, was unresolvable in the absence of any technique for dating land features. From mid-century, however, the hypothesis of creeping desertification in Central Asia was familiar to the educated public: for an example, see Frederick Engels, *The Dialectics of Nature* [1883], New York 1940, p. 235.

⁶ Tobias Kruger, *Discovering the Ice Ages: International Reception and Consequences for a Historical Understanding of Climate*, Leiden 2013, pp. 348–51.

Pripet Marshes), then gradually dried into grasslands and finally began to turn into desert. Desiccation was a continuing process (*causing*, not caused by, diminishing rainfall) that Kropotkin believed was observable across the entire Northern Hemisphere.⁷

An outline of this bold theory was first presented to a meeting of the Geographical Society in March 1874. Shortly after the talk, he was arrested by the dreaded Third Section and charged with being 'Borodin', a member of an underground anti-tsarist group, the Circle of Tchaikovsky. Thanks to this 'chance leisure bestowed on me', and special permission given by the Tsar (Kropotkin, after all, was still a prince), he was enabled to obtain books and continue his scientific writing in prison, where he completed most of a planned two-volume exposition of his glacial and climatic theories.⁸

This was the first scientific attempt to make a comprehensive case for *natural* climate change as a prime-mover of the history of civilization.⁹

⁷ 'The desiccation I speak of is not due to a diminishing rainfall. It is due to the thawing and disappearance of that immense stock of frozen water which had accumulated on the surface of our Eurasian continent during the tens of thousands of years that the glacial period had been lasting. Diminishing rainfall (where such a diminution took place) is thus a consequence, not a cause of that desiccation.' Kropotkin, 'On the Desiccation of Eurasia and Some General Aspects of Desiccation', *The Geographical Journal*, vol. 43, no. 4, April 1914.

⁸ His brother Alexander oversaw the publication of the first volume, 828 pages in length: *Issledovanie o lednikovom periode* [Researches on the Glacial Period], St Petersburg 1876. A short review appeared in *Nature* on 23 June 1877. An incomplete draft of the second volume was seized by the secret police and not published until 1998: Tatiana Ivanova and Vyacheslav Markin, 'Piotr Alekseevich Kropotkin and his monograph *Researches on the Glacial Period* (1876)', in Rodney Grapes, David Oldroyd and Algimantas Grigelis, eds, *History of Geomorphology and Quaternary Geology*, London 2008, p. 18.

⁹ The famed California geologist Josiah Whitney (after whom the peak is named) had also been advocating a concept of progressive desiccation since at least the early 1870s. He dismissed the popular idea that deforestation was responsible for climate change, instead proposing that the Earth had been simultaneously drying and cooling for several million years. This theory put him in the odd position of arguing that the modern climate of the American West was colder than during the Ice Age; a contradiction he resolved by rejecting evidence for the existence of continental ice sheets. In his view, Agassiz and others had confused the strictly local phenomena of glacial advance with global refrigeration. See Whitney, *The Climatic Changes of Later Geological Times: A Discussion Based on Observations Made in the Cordilleras of North America*, Cambridge, MA 1882, p. 394.

As noted earlier, Enlightenment and early Victorian thought universally assumed that climate was historically stable, stationary in trend, with extreme events as simple outliers of a mean state. In contrast, the impact of human modification of the landscape upon the atmospheric water cycle had been debated since the Greeks. For instance, Theophrastus, Aristotle's heir at the Lyceum, reportedly believed that the drainage of a lake near Larisa in Thessaly had reduced forest growth and made the climate colder.¹⁰ Two thousand years later, the Comtes de Buffon and de Volney, Thomas Jefferson, Alexander von Humboldt, Jean-Baptiste Boussingault and Henri Becquerel (to give just a short list) were citing one example after another of how European colonialism was radically changing local climates through forest clearance and extensive agriculture.¹¹ ('Buffon', wrote Clarence Glacken, 'concluded it was possible for man to regulate or to change the climate radically.')12 Lacking any longterm climate records that might reveal major natural variations in weather patterns, the *philosophes* were instead riveted by the innumerable circumstantial reports of declining rainfall in the wake of plantation agriculture on island colonies. In the same vein, Auguste Blanqui's older brother, the political economist Jerome-Adolphe Blanqui, later cited Malta as an example of a man-made island desert and warned that the heavily logged foothills of the French Alps risked becoming an arid

¹⁰ Theophrastus of Eresus, *Sources for His Life, Writings, Thought and Influence: Commentary Vol. 3.1, Sources on Physics (Texts 137–233)*, Leiden 1998, p. 212.

¹¹ Already by the mid-eighteenth century, colonial officials were crusading for the establishment of forest reserves to prevent desiccation of the rich plantation islands of Tobago and Mauritius. Richard Grove, the historian who has done most to establish the colonial origins of environmentalism, cites the example of Pierre Poivre, *commissaire-intendant* of Mauritius. Poivre gave a major speech in Lyon in 1763 on the climatic dangers of deforestation. 'This speech may go down in history as one of the first environmentalist texts to be based explicitly on a fear of widespread climate change': Grove, 'The Evolution of the Colonial Discourse on Deforestation and Climate Change, 1500–1940', in *Ecology, Climate and Empire*, Cambridge 1997, p. 11. Seventy years later, July Monarchy propagandists invoked the desertification of North Africa by the Arabs as an excuse for conquest of Algeria. The French promised to change the climate and push back the desert by massive afforestation: Diana Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa*, Athens, OH 2007, pp. 4–5, 77.

¹² Buffon believed that land clearance changed temperature as well as rainfall. Since Paris and Quebec City were at the same latitude, he suggested that the most likely explanation for their different climates was the warming that resulted from draining the wetlands and cutting down the forests around Paris: Clarence Glacken, *Traces on the Rhodian Shore*, Berkeley 1976, p. 699.

'Arabia Petraea'.¹³ By the 1840s, according to Michael Williams, 'deforestation and consequent aridity was one of the great "lessons of history" that every literate person knew about.'¹⁴

Two of these literate people were Marx and Engels, both of whom were fascinated by the Bavarian botanist Karl Fraas's cautionary account of the transformation of the eastern Mediterranean climate by land clearance and grazing. Fraas had been a member of the impressive scientific retinue that accompanied the Bavarian Prince Otto when he became King of Greece in 1832.¹⁵ Writing to Engels in March 1868, Marx enthused about his book:

He maintains that as a result of cultivation and in proportion to its degree, the 'damp' so much beloved by the peasant is lost (hence too plants emigrate from south to north) and eventually the formation of steppes begins. The first effects of cultivation are useful, later devastating owing to deforestation, etc. This man is both a thoroughly learned philologist (he has written books in Greek) and a chemist, agricultural expert, etc. The whole conclusion is that cultivation when it progresses in a primitive way and is not consciously controlled (as a bourgeois of course he does not arrive at this), leaves deserts behind it, Persia, Mesopotamia, etc., Greece. Here again another unconscious socialist tendency!¹⁶

Similarly Engels, later referring to deforestation of the Mediterranean in *The Dialectics of Nature*, warned that after every human 'victory', 'nature takes its revenge': 'Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it has quite different, unforeseen effects which only too often cancel the first.'¹⁷ But

¹³ Jérôme-Adolphe Blanqui quoted in George Perkins Marsh, *Man and Nature* [1864], Cambridge 1965, pp. 160 ff, 209–13.

¹⁴ Michael Williams, *Deforesting the Earth: From Prehistory to Global Crisis*, Chicago 2003, p. 431.

¹⁵ Karl Fraas, *Klima und Pflanzenwelt in der Zeit: ein Beitrag zur Geschichte Beider* [Climate and Plant World Over Time: A Contribution to History], Landshut 1847. Fraas was an important influence on Perkins Marsh and his famous thesis in *Man and Nature* that humanity was catastrophically reshaping nature on a global scale.

¹⁶ Marx to Engels, 25 March 1868, in *Collected Works*, vol. 42, Moscow 1987, pp. 558–9.

¹⁷ Engels, 'The Part Played by Labour in the Transition from Ape to Man', in *The Dialectics of Nature*, pp. 291–2. Even in the case of contemporary industrial civilization, he wrote, 'we find that there still exists here a colossal disproportion between the proposed aims and the results arrived at, that unforeseen effects predominate, and that the uncontrolled forces are far more powerful than those set into motion according to plan': p. 19.

if nature has teeth with which to bite back against human conquest, Engels saw no evidence of natural forces acting as independent agents of change within the span of historical time. As he emphasized in a description of the contemporary German landscape, culture is promethean while nature is at most reactive:

There is devilishly little left of 'nature' as it was in Germany at the time when the Germanic peoples immigrated into it. The earth's surface, climate, vegetation, fauna, and the human beings themselves have infinitely changed, and *all this owing to human activity*, while the changes of nature in Germany which have occurred in this period of time without human interference are incalculably small.¹⁸

In contrast to the seventeenth century, when earthquakes, comets, plagues and arctic winters reinforced a cataclysmic view of nature amongst the great savants like Newton, Halley and Leibniz,¹⁹ weather and geology in nineteenth-century Europe seemed as stable from decade to decade as the gold standard. For this reason, at least, Marx and Engels never speculated on the possibility that the natural conditions of production over the past two or three millennia might have been subject to directional evolution or epic fluctuation, or that climate therefore might have its own distinctive history, repeatedly intersecting and overdetermining a succession of different social formations. Certainly they believed that nature had a history, but it was enacted on long evolutionary or geological time-scales. Like most scientifically literate people in mid-Victorian England, they accepted Sir Charles Lyell's uniformitarian view of earth history, upon which Darwin had built his theory of natural selection, even while they satirized the reflection of English Liberal ideology in the concept of geological gradualism.

The long international controversy starting in the late 1830s over Agassiz's 'discovery' of the Great Ice Age did not put this reigning anthropogenic model into question, since geologists were vexed for decades by the problem of Pleistocene chronology: unable to establish the

¹⁸ *Collected Works*, vol. 25, Moscow 1987, p. 511.

¹⁹ Both Newton and Halley believed in 'a succession of earths, a series of creations and purgations. Historical periods were punctuated by cometary catastrophes, with comets serving as divine agents to reconstitute the entire solar system, to prepare sites for new creations and to usher in the millennium': Sara Genuth, 'The Teleological Role of Comets', in Norman Thrower, ed., *Standing on the Shoulders of Giants: A Longer View of Newton and Halley*, Berkeley 1990, p. 302.

order of succession amongst glacial drifts, or estimate the relative age of the ancient human and megafaunal remains whose discovery was a staple sensation of mid-Victorian times.²⁰ Although 'glacial research prepared the way for insight into the reality of short-term changes in climate gauged against geological time', there was no measure of the Ice Age's temporal distance from modern climate.²¹ Cleveland Abbe, the greatest American weather scientist of the late nineteenth century, expressed the consensus view of the 'rational climatology' school when he wrote in 1889 that 'great changes have taken place during geological ages perhaps 50,000 years distant' but 'no important climatic change has yet been demonstrated since human history began.'²²

Desiccation of Asia and Mars

Kropotkin radically challenged this orthodoxy by asserting a continuity of global climatic dynamics between the end of the Ice Age and modern times; far from being stationary as early meteorologists believed, climate had been continuously changing in a unidirectional sense and without human help throughout history. In 1904, on the thirtieth anniversary of his original presentation to Russian geographers, and amidst much public interest in recent expeditions to inner Asia by the Swedish geographer Sven Hedin and the American geologist Raphael Pumpelly, the Royal Geographical Society invited Kropotkin to outline his current views.

In his article, he argued that recent explorations like Hedin's had fully vindicated his theory of rapid desiccation in the post-glacial era, proving that 'from year to year the limits of the deserts are extended'. Based on this inexorable trend from ice sheet to lake land and then from grassland to desert, he proposed a startlingly new theory of history.²³ East

²⁰ Anne O'Connor, *Finding Time for the Old Stone Age: A History of Palaeolithic Archaeology and Quaternary Geology in Britain, 1860–1960*, Oxford 2007, pp. 28–30.

²¹ Kruger, *Discovering the Ice Ages*, p. 475. In the early twentieth century, varve (annual lake-sediment layer) and tree-ring chronologies began to be used to calculate the age of deglaciation events, but it was not until the refinement of carbon-14 analysis in the postwar period that reliable dating became possible.

²² James Fleming, *Historical Perspectives on Climate Change*, Oxford 1998, pp. 52–3.

²³ For an overview of the century-long controversy about desiccation in Central Asia, see David Moon, 'The Debate over Climate Change in the Steppe Region in Nineteenth-Century Russia', *Russian Review*, no. 69, 2010. Contemporary perspectives include François Herbet, 'Le problème du dessèchement de l'Asie intérieure', *Annales de Géographie*, vol. 23, no. 127, 1914; and John Gregory, 'Is the Earth Drying Up?', *The Geographical Journal*, vol. 43, no. 2, March 1914.

Turkestan and Central Mongolia, he claimed, were once well-watered and ‘advanced in civilization’:

All of this is gone now, and it must have been the rapid desiccation of this region which compelled its inhabitants to rush down to the Jungarian Gate, down to the lowlands of the Balkhash and Obi, and thence, pushing before them the former inhabitants of the lowlands, to produce those great migrations and invasions of Europe which took place during the first centuries of our era.²⁴

Nor was this just a cyclical fluctuation: *progressive desiccation*, emphasized Kropotkin, ‘is a geological fact’, and the Lacustrine period (the Holocene) must be conceptualized as an epoch of expanding drought. As he had already written five years earlier: ‘And now we are fully in the period of a rapid desiccation, accompanied by the formation of dry prairies and steppes, and man has to find out the means to put a check to that desiccation to which Central Asia already has fallen a victim, and which menaces Southeastern Europe.’²⁵ Only heroic and globally coordinated action—planting millions of trees and digging thousands of artesian wells—could arrest future desertification.²⁶

Kropotkin’s hypothesis of natural, progressive climate change had a differential reception: greeted with more scepticism in continental Europe than in English-speaking countries or amongst scientists working in desert environments. In Russia, where his contributions to physical geography were well known, there had been intense interest, following the great famine of 1891–92, in understanding whether drought on the black-soil steppe, the new frontier of wheat production, was a result of cultivation or an omen of creeping desertification. In the event, the two internationally recognized authorities on the question, Aleksandr Voeikov—a pioneer of modern climatology, and an old colleague of Kropotkin’s from the Geographical Society in the early 1870s—and

²⁴ Kropotkin, ‘The Desiccation of Eur-Asia’, *The Geographical Journal*, vol. 23, no. 6, June 1904.

²⁵ Kropotkin, *Memoirs of a Revolutionist* [1899], Boston 1930, p. 239.

²⁶ Kropotkin, ‘The Desiccation of Eur-Asia’. Desiccation, of course, is a geomorphological fact in many landscapes, but the impressionistic archaeology of European explorers neither proved causal relationships between ruins and desertification, nor established a comparative chronology. Petra, for instance, is an oft-cited example of catastrophic climate change, but the city-state’s decline was actually the result of changing trade routes and a 333 AD earthquake that destroyed its elaborate water-supply system.

Vasili Dokuchaev—celebrated as ‘the father of soil science’—found little evidence of either process at work. In their view, the steppe climate had not changed in historical time, although the succession of wet and dry years might be cyclical in nature. Voeikov, like many other contemporary scientists in Europe, was intrigued if not convinced by the ideas about climate variability advanced by the brilliant German glaciologist Eduard Brückner.²⁷

Brückner’s 1890 landmark book *Climatic Changes Since 1700* (unfortunately never translated into English) argued the case for multi-decadal climatic fluctuations in historical times.²⁸ In stunningly modern fashion, unequaled in rigour until the work of Emmanuel Le Roy Ladurie and Hubert Lamb, he combined documentary and proxy sources like grape harvest dates, retreating glaciers and accounts of extreme winters with an analysis of the previous century of instrumental data from different stations to arrive at a picture of a quasi-periodic, 35-year cycling between wet/cool and dry/warm years that regulated changes in European harvests, and perhaps world climate as a whole. Brückner, who knew very little about meteorology and nothing about the general circulation of the atmosphere, was extremely disciplined in avoiding the conjectures and anecdotal claims that contaminated the next generation of debate about climate change, and wisely refused to speculate on the causality of what became known as the ‘Brückner cycle’. In countries whose scientific culture was largely German (most of central Europe and also Russia at the turn of the century), Brückner’s cautious model of climate oscillation was preferred to Kropotkin’s climatic catastrophism.²⁹

In the English-speaking world, on the other hand, Kropotkin’s 1904 article—seemingly buttressed by recent scientific research on the fossil great lakes and dry rivers of the American West, the Sahara and Inner Asia—was generally received with great interest. Its most immediate and remarkable impact, however, was extra-terrestrial. Percival Lowell, a wealthy Boston Brahman, had abandoned his career as an orientalist

²⁷ David Moon, *The Plough that Broke the Steppes: Agriculture and Environment on Russia’s Grasslands, 1700–1914*, Oxford 2013, pp. 91–2, 130–3.

²⁸ Eduard Brückner, *Klimaschwankungen seit 1700*, Vienna 1890, p. 324.

²⁹ Nico Stehr and Hans von Storch, ‘Eduard Brückner’s Ideas: Relevant in His Time and Today’, in Stehr and von Storch, eds, *Eduard Brückner: The Sources and Consequences of Climate Change and Climate Variability in Historical Times*, Dordrecht 2000, pp. 9, 17.

in 1894 to build an observatory in Flagstaff, Arizona where he could study the *canali* on Mars ‘discovered’ by Giovanni Schiaparelli in 1877 and later ‘confirmed’ by several leading astronomers. Until Lowell, these hallucinatory channels or fissures were believed by most to be natural features of the Red Planet, although the Belfast journalist and science-fiction writer Robert Cromie had already suggested in an 1890 novel that the canals were oases created by an advanced civilization on a dry and dying world.³⁰ Five years later, in his sensational book *Mars*, Lowell proposed that Cromie’s fiction was observable science: because of their geometry, the canals must be an artificial irrigation system built by intelligent life. Moreover, Martian civilization had obviously put an end to ‘nations’ and warfare in order to build on a planetary scale. But ‘what manner of beings they may be we lack the data even to conceive.’³¹

Newspaper readers across the globe were electrified, composers wrote Mars marches, and an English journalist named Wells found the plot for a book that continues to fascinate and terrify readers. Lowell quickly acquired implacable scientific foes, such as the co-discoverer of natural selection and acquaintance of Kropotkin, Alfred Russel Wallace; but with the popular press as an ally, he soon convinced public opinion that a Martian civilization was fact, not speculation. He liked to astound audiences with photographs of the ‘canals’, always apologizing for the blurred images.³² But what was the nature and history of this alien civilization? Lowell may have met Kropotkin when the latter gave a series of lectures on evolution at Boston’s Lowell Institute in 1901, but whatever the case may be, the 1904 paper on progressive desiccation struck Lowell like a lightning bolt. Here was a master narrative to explain not only the ‘tragedy of Mars’ but also the fate of the Earth. Lowell argued that because of its smaller size, planetary evolution was accelerated on Mars, thus

³⁰ Robert Cromie, *A Plunge into Space*, London 1890.

³¹ ‘To talk of Martian beings is not to mean Martian men. Just as the probabilities point to the one, so do they point away from the other. Even on this Earth man is of the nature of an accident. He is the survival of by no means the highest physical organism. He is not even a high form of mammal. Mind has been his making. For aught we can see, some lizard or batrachian might just as well have popped into his place early in the race, and been now the dominant creature of this Earth. Under different physical conditions, he would have been certain to do so. Amid the surroundings that exist on Mars, surroundings so different from our own, we may be practically sure other organisms have been evolved of which we have no cognizance.’ Percival Lowell, *Mars*, Boston 1895, p. 211.

³² Alfred Russel Wallace, *Is Mars Habitable?*, London 1907.

providing a preview of how the Earth would change in eons to come. 'On our own world', he wrote in the 1906 book *Mars and Its Canals*, 'we are able only to study our present and our past; in Mars we are able to glimpse, in some sort, our future.' That future was planetary desiccation as oceans evaporated and dried into land, forest gave way to steppe, and grasslands became deserts. He agreed with Kropotkin about the velocity of aridification: 'Palestine has desiccated within historic times.'³³

Two years later, in popular talks published under the title *Mars as Abode of Life*, he devoted a lecture to 'Mars and the Future of Earth', warning that 'the cosmic circumstance about them which is most terrible is not that deserts are, but that deserts have begun to be. Not as local, evitable evils only are they to be pictured, but as the general unspeakable death-grip on our world.' His prime example, not surprisingly, was Central Asia: 'The Caspian is disappearing before our eyes, as the remains, some distance from its edge, of what once were ports mutely inform us.' Someday, the only option left to humans in this 'struggle for existence in their planet's decrepitude and decay' would be to emulate the Martians and build canals to bring polar water to their last oases.³⁴ Lowell, a skilled mathematician but a hapless geologist, liked to impress visitors to Arizona with the Petrified Forest as an example of desiccation at work, although the tree fossils dated from the Triassic Period, 225 million years earlier. Likewise he took for granted the evidence for unidirectional and rapid climate change on Earth.

In fact, Kropotkin's theory, based on landscape impressions and the hypothesis of a Eurasian ice sheet, was a speculative leap far ahead of any data about past climates or their causes. Indeed it was essentially untestable. Theoretical as contrasted to descriptive meteorology, for example, was still in its swaddling clothes. By coincidence, Kropotkin's paper was published almost simultaneously with an obscure article by a Norwegian scientist named Jacob Bjerknæs that laid down the first foundations for a physics of the atmosphere, in the form of a half dozen fundamental equations derived from fluid mechanics and thermodynamics. 'He [Bjerknæs] conceived the atmosphere', observes a historian of geophysics, 'from a purely mechanical and physical viewpoint, as an "air-mass circulation

³³ Percival Lowell, *Mars and its Canals*, New York 1906, pp. 153, 384. I have been unable to ascertain Kropotkin's opinion of Lowell's thesis. By scientific temperament he was more likely to have agreed with his friend Wallace.

³⁴ Lowell, *Mars as Abode of Life*, New York 1908, pp. 122, 124, 142–3.

engine”, driven by solar radiation and deflected by rotation, expressed in local differences of velocity, density, air pressure, temperature and humidity.’ It would take more than half a century for these conceptual seeds to grow into modern dynamic meteorology; in the meantime, it was impossible to propose a climate model for Kropotkin’s theory.³⁵

Quantitative evidence for understanding past climate was likewise a bare cupboard. Brückner had used instrumental records with impressive skill, but only for the period after the French Revolution. In 1901, the Swedish meteorologist Nils Ekholm, writing in the *Quarterly Journal of the Royal Meteorological Society*, had soberly surveyed the available pre-instrumental documentary evidence and found that much of it was simply worthless: ‘Almost the only weather phenomenon of which the old chronicles give trustworthy reports are severe winters.’ Comparing Tycho Brahe’s pioneering instrumental weather readings in 1579–82 from an island off the Danish coast with modern measurements from the same location, he found some indications that winters were milder and that Northern European climate in general was more ‘maritime’ than three centuries earlier. But this was the limit of disciplined inference: ‘The character in other respects and the cause of this variation are unknown. We cannot say if the variation is periodical, progressive or accidental, nor how far it extends in space and time.’ Since Ekholm reasonably assumed that insolation had been constant for at least a million years and that the Earth’s orbital variability had had minimal influence over the last millennium of climate, the most likely cause of climate change (based on the famous experiments of his colleague Svante Arrhenius) was a fluctuation in atmospheric carbon dioxide and thereby the greenhouse effect.³⁶

Pathological science

But there was an avid appetite amongst scientists and geographers, as well as the general public, for bolder theories, and as the Royal Society had undoubtedly hoped, Kropotkin’s paper, aside from gifting Lowell’s Mars mania, stimulated a far-reaching debate that lasted until the eve of

³⁵ Gabriele Gramelsberger, ‘Conceiving Processes in Atmospheric Models’, *Studies in the History and Philosophy of Modern Physics*, vol. 41, no. 3, September 2010.

³⁶ Nils Ekholm, ‘On the Origins of the Climate of the Geological and Historical Past and Their Causes’, *Quarterly Journal of the Royal Meteorological Society*, vol. XXVII, no. 117, January 1901.

the First World War. Lord Curzon, the Viceroy of India, even waded into the controversy, siding with the explorers who had seen desertification first hand rather than with ‘untravellers scientists’ who denied climate change.³⁷ One of the eminent travellers and scientists who embraced the evidence for progressive desiccation was Europe’s other red prince, Leone Caetani, whose *Annali dell’Islam* (10 volumes, 1905–29) became the foundation stone for Islamic studies in the West. A skilled linguist, he had travelled widely in the Muslim world before being drawn into left-wing politics. Although a Papal prince, he became a parliamentary deputy for the anti-clerical Radical Party, and in 1911 joined with the majority faction of the Socialists to oppose the invasion of Libya. After the rise of fascism, he moved to Canada and continued work on the *Annali*.³⁸ Caetani hypothesized that the originally fertile Arabian Peninsula was the home of all Semite cultures, but aridification and subsequent overpopulation had forced one group after another to migrate; indeed, desiccation was the environmental motor force behind the expansion of Islam. Hugo Winckler, the famed German archaeologist/philologist who had discovered Hattusa, the lost capital of the Hittites, arrived at the same idea independently, and the ‘Winckler–Caetani’ or ‘Semite Wave’ theory subsequently became a touchstone of pan-Arab ideology in the 1920s and 30s.³⁹

The most fervent adherent to the desiccation hypothesis, however, was the Yale geographer Ellsworth Huntington, a former missionary in Turkey and a veteran of the 1903 Pumpelly Expedition to Transcaspia

³⁷ Curzon’s comments described in Sidney Burrard, ‘Correspondence’, *The Geographical Journal*, vol. 43, no. 6, June 1914. Curzon was speaking in defence of his friend Sir Thomas Holdich of the Royal Engineers, who became a convinced desiccationist after a lifetime surveying the Northwest Frontier of India.

³⁸ When the workers on the family estates occupied the land during the *Biennio Rosso*, Caetani abdicated his titles to his younger brother and emigrated to Vernon, a town at the foot of the magnificent Selkirk mountains in British Columbia where in his younger days he had once hunted grizzly bears. After his death in 1935, his wife and daughter, an accomplished artist, became legendary recluses: see Sveva Caetani, *Recapitulation: A Journey*, Vernon, BC 1995; and ‘Sveva Caetani: A Fairy Tale Life’, available online.

³⁹ See Premysl Kubat, ‘The Desiccation Theory Revisited’, *les carnets de Ifpo* (Institut français du Proche-Orient), 18 April 2011, www.ifpo.hypotheses.org/1794; and Nimrod Hurvitz, ‘Muhibb ad-Din al-Khatib’s Semitic Wave Theory and Pan-Arabism’, *Middle Eastern Studies*, vol. 29, no. 1, January 1993.

and the 1905 Barrett Expedition to Chinese Turkestan. His observations from the latter mission confirmed those of earlier travellers in Xinjiang and supported Kropotkin's theory: 'All the more arid part of Asia, from the Caspian Sea eastward for over 2,500 miles, appears to have been subject to a climatic change whereby it has been growing less and less habitable for the last two or three thousand years.'⁴⁰ At first Huntington vigorously defended Kropotkin's ideas to the letter, but in his 1907 book, *The Pulse of Asia*, he amended the theory in one decisive regard. Considering the menu of possible climate hypotheses—'uniformity, deforestation [anthropogenic change], progressive change, and pulsatory change'—he now voted for the last. Climate change, Huntington argued, took the form of great, Sun-driven oscillations of centuries-long duration: wet periods followed by mega-droughts.⁴¹ Although he attributed the idea to reading Brückner, his cycles were an order of magnitude longer in frequency and had the epic effects ascribed to progressive desiccation by Kropotkin.

Like Lowell, Huntington was a superb publicist. He aggressively sought further evidence for the cyclical thesis in Palestine, Yucatan and the American West, where he worked with tree-ring pioneer Andrew Douglas (Lowell's former assistant at the observatory) in the ancient California sequoias.⁴² From each new investigation came an article or book bolstering his claim that societies and civilizations rose and fell with these climatic oscillations. 'With every throw of the climatic pulse which we have felt in Central Asia, the centre of civilization has moved this way or that. Each throb has sent pain and decay to the lands whose

⁴⁰ Ellsworth Huntington, 'The Rivers of Chinese Turkestan and the Desiccation of Asia', *The Geographical Journal*, vol. 28, no. 4, October 1906.

⁴¹ Geoffrey Martin, *Ellsworth Huntington: His Life and Thought*, Hamden, CT 1973, pp. 92–3.

⁴² Douglas (1867–1962) had been Lowell's principal assistant in the 'mapping' of the Martian canals before becoming interested in the possible relationship between sunspot activity and rainfall. He refined the use of ring-width in trees as a proxy for weather, an endeavour properly called dendroclimatology. But his techniques also opened the possibility of dating ancient trees or, for that matter, wooden beams in *pueblo* ruins. In the beginning, only a floating (relative) chronology was possible, but in 1929 Douglas discovered 'HH-39', a beam from an Arizona ruin that allowed him to tie together a continuous series of measurements from 700 AD to the present, and thus permit the first calendrical dating of a prehistoric archaeological site.

day was done, life and vigour to those whose day was yet to be.’⁴³ (Owen Lattimore, author of the classic 1940 work *The Inner Asian Frontiers of China*, parodied Huntington’s image of ‘hordes of erratic nomads, ready to start for lost horizons at the joggle of a barometer, in search of suddenly vanishing pastures.’⁴⁴)

Huntington’s majestic oscillations were an unexpected gift to searchers for ultimate causations in history, and *The Pulse of Asia* helped inspire Arnold Toynbee’s famous theory of civilizational cycles driven by responses to environmental challenges.⁴⁵ But Huntington’s sweeping claims made others nervous. Both the Royal Geographical Society and Yale University (which was considering promoting him to a professorship) discreetly canvassed the opinions of major authorities. The explorer Sven Hedin derided the whole idea of desiccation: ‘Men and camels, country and climate—none has undergone any change worth mention.’⁴⁶ Albrecht Penck, one of the giants of modern physical geography, gently observed of Huntington that ‘sometimes his thoughts run ahead of his facts. He works more with a vital scientific imagination than with a critical faculty.’⁴⁷

Eduard Brückner in Vienna, whom Huntington acknowledged as one of his masters, was also polite but devastating in his assessment:

He takes his data from historical works without examining it properly. He is not sufficiently aware to what degree he may use data as facts. In particular the archaeological results are by no means definitive enough as he himself explains in his work *The Pulse of Asia* . . . He has shown several times the desire to fit the facts to his theory. During my visit to Yale Dr

⁴³ Ellsworth Huntington, *The Pulse of Asia*, Boston 1907, p. 385. For his original endorsement of Kropotkin’s ideas, and his subsequent modification of them, see Huntington, ‘Climatic Changes’, *The Geographical Journal*, vol. 44, no. 2, August 1914.

⁴⁴ Owen Lattimore, ‘The Geographical Factor in Mongol History’, [1938] in *Studies in Frontier History: Collected Papers, 1928–1958*, Oxford 1962.

⁴⁵ Toynbee wrote an appreciative foreword to Geoffrey Martin’s biography of Huntington.

⁴⁶ Philippe Fôret, ‘Climate Change: A Challenge to the Geographers of Colonial Asia’, *Perspectives* 9, Spring 2013. In his 1914 book on Russian Central Asia, Aleksandr Voeikov described Huntington’s ‘pulse of Asia’ theory as ‘an inanity’: Voeikov, *Le Turkestan Russe*, Paris 1914, p. 360.

⁴⁷ Martin, *Ellsworth Huntington*, p. 86.

Huntington showed me the results of his investigations in respect to the rings of old trees in their relationship to fluctuations of climate. He has collected very interesting material, but again I had the impression that he concluded more from his curves than a cautious man ought to conclude. He claimed in several cases that he saw a parallelism in the curve where I could not see one.⁴⁸

Huntington did not receive the promotion and left Yale.

Brückner's critique anticipated Irving Langmuir's famous definition of 'pathological science' as research 'led astray by subjective effects, wishful thinking or threshold interactions'.⁴⁹ In addition to the usual sins of confusing coincidence with correlation and correlation with causality, Huntington and his several prominent co-thinkers—especially the Clark University geographer Charles Brooks—were addicted to circular argumentation. 'Huntington', Le Roy Ladurie wrote in his *Histoire du climat*, 'explained the Mongol migrations by the fluctuations in rainfall and barometric pressure in the arid zones of Central Asia. Brooks carried on the good work by basing a graph of rainfall in Central Asia on the migration of the Mongols!'⁵⁰ In another instance, Brooks, who followed Huntington in believing that tropical climates could not support advanced civilizations, concluded that the existence of Angkor Wat proved that the climate of Cambodia in 600 AD must have been more temperate.⁵¹

As for spectacular ruins in the deserts, the geographer and historian Rhoads Murphey demonstrated in a 1951 article, *contra* Huntington, that in the case of North Africa there is little evidence of climate change since the Roman period. Instead, he explained the desolate landscapes where wheat fields and Roman towns once flourished as a result of the neglect or destruction of water-storage infrastructures. (Huntington seemed to have forgotten the dependence of desert societies upon groundwater rather than rain.) In a classic example of the kind of 'natural experiment' that Jared Diamond would decades later urge historians to adopt, Murphey cited the example of the Air Massif in Niger where the French

⁴⁸ Martin, *Ellsworth Huntington*, p. 86.

⁴⁹ Transcript of his lecture in *Physics Today*, October 1989, p. 43.

⁵⁰ Emmanuel Le Roy Ladurie, *Histoire du climat depuis l'an mil*, Paris 1967, p. 17.

⁵¹ Charles Brooks, *Climate Through the Ages: A Study of the Climate Factors and Their Variations*, London 1949 (rev. edn, original 1926), p. 327.

forcibly evicted the rebellious Tuareg population in 1917: 'As population decreased, wells, gardens and stock were allowed to deteriorate, and within less than a year the area looked exactly like the other areas which have been used as evidence of progressive desiccation.'⁵²

For all this, the Kropotkin/Huntington debate about natural climate change in history might have left a more fruitful legacy if it had stayed within the domain of physical geography. Huntington, however, fused his distinctive ideas about climate cycles with the extreme environmental determinism advocated by the German geographer Friedrich Ratzel and his American disciple Ellen Churchill Semple. They argued that cultural and ethnic characteristics were mechanically and irreversibly imprinted upon human groups by their natural habitats, especially climate. Huntington also became mesmerized by the bizarre ideas of a professor of German in Syracuse named Charles Kullmer who believed that human mental activity, both individual and social, was governed by the electrical potential of barometric depressions. As Huntington's biographer explains: 'Kullmer measured the number of nonfiction books taken from libraries and the barometric pressure at such time; "high pressure means more serious books, and low pressure fewer."' Huntington, 'electrified' by Kullmer's findings, wrote 'I have pondered a great deal over the Italian Renaissance; and now I am wondering whether by any chance that was associated with some change in storm frequency.' Huntington subsequently tested Kullmer's thesis by having a friend's children type three dictated stanzas of Spencer's *The Faerie Queene* every day for months while their father recorded the barometric pressure. Huntington then compared the pattern of errors: 'There seems to be a connection between weather and mental ability far closer than we have hitherto suspected. I am at work just now trying to apply this to Japan.'⁵³

But Huntington soon put barometry aside, concluding that it was actually temperature, perhaps in collusion with humidity, that determined human mental acuity and industrial efficiency. This 'meteorological Taylorism', as James Fleming calls it, was then subsumed by Huntington's

⁵² Rhoads Murphey, 'The Decline of North Africa since the Roman Occupation: Climatic or Human?', *Annals of the Association of American Geographers*, vol. 41, no. 2, 1951.

⁵³ Martin, *Ellsworth Huntington*, pp. 102–3, 111.

passion for eugenics and racial engineering.⁵⁴ While an ailing Kropotkin, who had returned to Russia in 1917 to support the anarchist movement, was racing to finish his magisterial scientific testament, *Glacial and Lacustrine Periods*,⁵⁵ Huntington was publishing increasingly bizarre papers on the adaptability of white men to the Australian tropics and the impact of climate on human productivity in Korea. A few years later, he was struggling to understand the effect of overpopulation on Chinese character, decrying the immigration of Puerto Ricans to New York, and pontificating in *Harper's* about 'Temperature and the Fate of Nations'.⁵⁶ In effect, Huntington, like Ratzel, Semple and many others, was aggrandizing the climatic race theories of Herodotus and Montesquieu—the first convinced that Greece was man's perfect habitat; the other, France—into an all-encompassing meteorological anthropology.

In the 1910s and 1920s, the heyday of scientific racism (of which Huntington was a fervent proponent), these ideas were easily embraced by mainstream scholarship; by the late 1930s, however, a new generation of academics began to recoil from the dark implications of environmental determinism alloyed with white supremacy and its apotheosis, fascism. As his biographer gingerly observes: 'Huntington's insistence on a hierarchy of innate competence, and consistent inquiry into the eugenic cause in the 1930s, was perhaps unfortunate. When he proposed on the eve of World War II that Caucasians with blond hair and blue eyes were possessed of greater longevity than others, his utterance seemed peculiarly *non sequitur*.'⁵⁷ (The Nazis, meanwhile, were integrating desiccationist ideas into their rationale for the removal and mass murder of the populations of Poland and the USSR. The Slavs were simultaneously condemned for failing to drain the post-glacial wetlands east of the Vistula and for allowing them to turn into desert—*Versteppung*.)

⁵⁴ Fleming, *Historical Perspectives on Climate Change*, p. 100. He adds: 'Although Huntington's thought was indeed influential in its time, since then his racial bias and crude determinism have been largely rejected. Nonetheless, his categorical errors seem destined to be repeated by those who make overly dramatic claims for weather and climatic influences': p. 95.

⁵⁵ It was published in Russian in 1998. An English-language anthology of Kropotkin's scientific writings—on geography, glaciology, ecology and evolution—is long overdue.

⁵⁶ See 'Appendix A: The Published Works of Ellsworth Huntington' in Martin, *Ellsworth Huntington*.

⁵⁷ Martin, *Ellsworth Huntington*, pp. 249–50.

Only the master race could arrest the great drying.⁵⁸) Huntington's wild theories and crude determinism, together with the absence of reliable historical weather data, began to taint the enterprise of climate history for most geographers and historians. In 1937, the physicist Sir Gilbert Walker, who had spent a lifetime searching for structure in weather data, wrote an obituary for climatic determinism, a theory he equated with astrology: 'I regard the widespread faith in the effective control of weather by periods as based partly on a mistaken handling of plotted data and partly on an instinct that survives in many of us, like the faith in the effect of the Moon on the weather, from the time when our forefathers believed in the control of human affairs by the heavenly bodies with their fixed cycles.'⁵⁹

In the postwar period, moreover, 'a new disciplinary consensus' emerged amongst climatologists: 'Namely that the global climate system contained overriding equilibrating processes providing resilience against secular climate fluctuations.'⁶⁰ Meanwhile, the natural archives of deep Eurasia that hid the secrets of its climate history were off-limits: the only Westerners to visit the Tarim Basin during the Cold War were CIA agents (Lop Nor was the Chinese nuclear test site). Finally in 2010–11, more than a century after the controversial expeditions of Stein, Heden and Huntington, an interdisciplinary team of Chinese, American, Swiss and Australian researchers spent a field season in the Tarim Basin, modelling relict hydrologies and sampling such potential climate archives as sediments from the now vanished Lake Lop Nor and dead trees interred in sand dunes.

Their results were published at the beginning of this year. Desiccation, it turns out, is a modern phenomenon, not an ancient curse: 'The Tarim Basin was continuously wetter than today at least as early as AD 1180 until the middle AD 1800s.' This falls within the parameters, generously construed, of the Little Ice Age, and the researchers attribute the wetting to a southward shift of the boreal westerlies that produced enhanced snowfall in the mountains that feed the Tarim and its sister rivers. It

⁵⁸ David Blackbourn, *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany*, New York 2006, pp. 278, 285–6.

⁵⁹ Sir Gilbert Walker, 'Climatic Cycles: Discussion', *The Geographical Journal*, vol. 89, no. 3, March 1937.

⁶⁰ Stehr and von Storch, 'Eduard Brückner's Ideas', p. 12.

was this ‘greening of the desert’, not its relentless expansion, that was a mainspring of late medieval and early modern history:

We propose that wetting of the interior Asian desert corridor stimulated southward migration of winter rangeland, which was essential in fuelling the horse-driven Mongol conquests across Eurasian deserts. In addition, wetter-than-present Asian deserts may have aided in the spread of pastoralism out of the Mongolian heartland, strengthening cultural and economic affinities among the Mongols and Turkic-speaking groups on the periphery of the steppe.⁶¹

Since the late nineteenth century, however, the progressive warming of interior Asia has produced a net drying which the researchers warn may be a prelude to the future northward expansion of the deserts. Meanwhile, other climate scientists have expressed concern that precipitation regimes in western Asia may be radically changing as well. A research group based at Columbia University’s Lamont-Doherty Earth Observatory, which has been studying contemporary and historical megadroughts, recently published a paper warning that the disastrous 2007–10 drought in Syria, the most severe in the instrumental record and a principal catalyst to social unrest, was likely part of ‘a longterm drying trend’ associated with rising greenhouse emissions.⁶² This uncomfortably accords with an earlier study which predicted that the entire climatological Fertile Crescent, from the Jordan Valley to the Zagros foothills, might disappear by the end of the century: ‘Ancient rain-fed agriculture enabled the civilizations to thrive in the Fertile Crescent region, but this blessing is soon to disappear due to human-induced climate change.’⁶³ The Anthropocene, it seems, may vindicate Kropotkin after all.

⁶¹ Aaron Putnam et al., ‘Little Ice Age Wetting of Interior Asian Deserts and the Rise of the Mongol Empire’, *Quaternary Science Reviews*, 131, 2016, pp. 333–4, 340–1. One of the co-authors is the Lamont-Doherty Earth Observatory’s ‘pope’, Wallace Broecker, who first proposed the theory of the meridional overturning circulation in the North Atlantic—the famed ‘conveyor belt’.

⁶² Colin Kelley et al., ‘Climate Change in the Fertile Crescent and Implications of the Recent Syrian Drought’, *Proceedings of the National Academy of Sciences*, vol. 112, no. 11, 17 March 2015.

⁶³ Akio Kitoh, Akiyo Yatagai and Pinhas Alpert, ‘First Super-High-Resolution Model Projection That the Ancient “Fertile Crescent” Will Disappear in This Century,’ *Hydrological Research Letters* 2, 2008.