

Defiant Earth

The Fate of Humans in the Anthropocene

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1 The Anthropocene Rupture

A rupture in Earth history

First, the science. The Geological Time Scale divides the Earth's history into ages, epochs, periods, eras, and eons in ascending order of significance. The International Commission on Stratigraphy is considering officially adding a new epoch, the Anthropocene, to the scale. Stratigraphers – geologists who specialize in the study of rock layering – are perhaps the most tradition-bound members of a somewhat conservative profession; yet their decision has the most radical implications.

The principal reason for Earth scientists' belief that the planet has shifted out of the previous epoch, the Holocene, lies in the rapid increase in the concentration of carbon dioxide in the atmosphere and its cascading effects throughout the Earth System. The system-changing forces of ocean acidification, species loss, and disruption of the nitrogen cycle add to the case. Human disturbance of the climate system is now detectable from the beginning of large-scale coal burning at the onset of the Industrial Revolution. The

rise in atmospheric concentrations of carbon dioxide was gradual for the next 150 years, but became steep after World War II. Now a range of indicators shows sharp and unambiguous human disturbance to the Earth System from the end of World War II.¹ The post-war period stands out, writes Earth scientist Will Steffen, “as one of the most remarkable in all of human history for its rapidity and pervasiveness of change.”² Other Earth System scientists express it a little differently: “The last 60 years have without doubt seen the most profound transformation of the human relationship with the natural world in the history of humankind.”³

Long-term trends in global economic growth, resource use, and waste volumes show a sharp upturn after World War II, a period dubbed the “Great Acceleration” and that continues today. For this reason, expert opinion now dates the beginning of the new epoch from around 1945 rather than the end of the eighteenth century as first proposed.⁴ From a strictly stratigraphic point of view (the one most germane to the official decision on the new epoch), a million years hence the sharpest marker in the rock record will be the sudden deposition of radionuclides across the Earth’s surface as a result of nuclear explosions in 1945, known as the “bomb spike.” Although the nuclear age has not itself changed the functioning of the Earth System, the layer of radionuclides laid down in 1945 does mark the dawn of the era of US global hegemony and the astounding period of material expansion of the post-war decades, that is, of capitalism’s sublime success. We now understand what that success meant for the Earth System. It is measured most simply and strikingly by the Keeling Curve, showing the secular increase in carbon dioxide concentrations in the atmosphere. Earth scientist James Syvitski puts it succinctly:

“By any unbiased and quantitative measure humans have affected the surface of the Earth at a magnitude that ice ages have had on our planet, but over a much shorter period of time.”⁵ The course of the Earth System has been changed irrevocably.

To understand why these changes are effectively permanent consider global warming alone. Humans have redistributed the Earth System’s stock of carbon, a vital element that profoundly affects the climate. Large reserves of carbon that had over millions of years been immobilized as fossils deep beneath the Earth’s surface have been dug up, burned, and released in the system, where they will remain mobile in the atmosphere, oceans, and biosphere. It will probably be hundreds of thousands of years before most of this carbon can be rendered immobile again. In the meantime, the pulse of carbon dioxide emitted into the atmosphere over a century or two is bringing changes that have everlasting consequences. Because they naturally draw carbon dioxide out of the atmosphere, the oceans are already a third more acidic than they were before humans began burning fossil fuels on a large scale. Over a time-scale of many thousands of years, rising acidity disturbs the natural process of deposition of calcium carbonate on the deep seafloor.⁶ The destabilization of ice masses, such as glaciers and the Greenland ice-sheet, is not something that can be reversed except over tens of thousands of years. The possibility of an ice-free Earth over the next few centuries, bringing much higher sea levels, cannot be ruled out. Such a reconfiguration of the Earth System can be undone only over many millennia, if at all. In the words of 22 earth scientists writing in *Nature*, “the next few decades offer a brief window of opportunity to minimize [but not prevent] large-scale and potentially catastrophic climate

change that will extend longer than the entire history of human civilization thus far.”⁷

A long time after humans disappear, or shrink to a position where we are no longer interfering in the Earth System, the great processes that drive planetary change – orbital forcing, plate tectonics, volcanism, natural evolution, and so on – will overwhelm human influences. But the planet will not settle into a state that looks anything like the Holocene – the 10,000-year epoch of mild and constant climate that permitted civilization to flourish. It has been diverted onto a different trajectory. Experts are already suggesting that the changes caused by humans in recent decades are so profound and long-lasting that we have entered not a new epoch but a new *era* – the Anthropozoic era – on a par with the break in Earth history brought by the arrival of multicellular life.⁸

So 1945 marks the turning point in the sweep of Earth’s history at which the geological evolution of the planet diverged from one driven by blind forces of nature to one influenced by a conscious, willing being, a new human-geological power. We are accustomed to the idea of humans as the agents that make history, and use the term “pre-history” for the period from the emergence of early humans to the invention of writing. Now we must concede what seemed impossible to contemplate – humans as agents changing the course of the *deep* history of the Earth, or rather of the Earth’s deep future, an event giving rise to what might be called “post-history.”

Although we are preoccupied with what the Anthropocene may mean for the future of humans, the present decades mark a transition in which Earth’s biogeological history itself enters a new phase, because the Earth’s history has become entangled with

human history so that “*the fate of one determines the fate of the other.*”⁹ In a few short decades we have seen the entire history of the Earth – from its formation through to its eventual vaporization when the Sun finally explodes – split irrevocably into two halves – the first 4.5 billion years in which Earth history was determined by blind natural forces alone, and the remaining 5 billion years in which it will be influenced by a conscious power long after that power is spent. If humans disappear, then the great forces that drive the Earth System will continue and eventually erase the more obvious impacts of humans on the landscape. Even so, signs of the influence of humankind – its rise, fall, and enduring legacy – will be evident, not least in a disturbance in the rock record, a freakish band of a few hundred thousand years somewhere in the middle of the 10 billion-year record of the Earth.

Volition in nature

In all previous instances, transitions from one division to the next in the Geological Time Scale came about because of the gradual evolution of natural forces or, at times, a single massive event. These forces are unconscious and unintentional so that the feedback effects from one element to another are not filtered but exert their influence directly (albeit in complex ways). However, if the human imprint on the Earth System is so far-reaching that *Homo sapiens* now competes with the forces of nature in its impact on the way the planet as a whole functions, the human imprint is the effect of a force fundamentally unlike physical ones such as weathering, volcanism, asteroid strike, subduction, and solar fluxes. This

new “force of nature” contains something radically different – the element of volition.

Global anthropogenic impacts, such as increases in carbon dioxide in the atmosphere and disturbance to the nitrogen cycle, do not just happen but are the consequences, intended or otherwise, of *decisions* taken by human minds. In nature, as we have always understood it, the forces of nature are unconscious and involuntary; no decisions are made, so to comprehend humanity as a geological force we need to consider its distinctive quality, its volitional element. Humankind is perhaps better described not as a geological force but as a *geological power*, because we have to consider its ability to make decisions as well as its ability to transform matter. Unlike forces of nature, it is a power that can be withheld as well as exercised.

So for the first time in the Earth’s 4.5 billion-year history we have a non-physical force (which brings about physical effects) mixed in with physical forces, although it is not so much *added* to the pre-existing natural forces but in some sense *infuses* them and modifies their operation. And this new force can be integrated only imperfectly into the system of geodynamics used to explain the geological evolution of the planet. The uncertainty about how this new force will behave is the primary reason for the wide variation in projections of global warming over the twenty-first century. And it now seems certain that as long as humans are on the planet all future epochs, eras, periods, and so on will be hybrids of physical forces and this new power. No wonder there has been deep uneasiness in some sections of the geology profession about adding this weird division to official geochronology.

The inference that the Anthropocene is a profoundly new

kind of division in the Geological Time Scale, and that 1945 marks an ontological shift in the deep history of the planet, can be reached another way. In deciding to add the Anthropocene to its geochronology the International Commission on Stratigraphy needs to agree, on the basis of stratigraphic indicators, that it is best classified as a geological *epoch*, as proposed. Some leading scientists are suggesting that deeming it an epoch – longer than an age but shorter than a period – is a conservative but appropriate decision. But they note that if society does not respond soon to the signs of climate disruption, then it may be necessary to upgrade the Anthropocene from an epoch to a period, or even to a new era, the Anthropozoic era, to succeed the current era, the Cenozoic, which began 66 million years ago.¹⁰

In other words, we are entering a geological episode whose designation depends not only on gathering and evaluating the available data, but also on human impacts on the Earth System that *have not yet occurred*. The verdict on the Anthropocene reached by the International Commission on Stratigraphy could be invalidated not by the *discovery* of new evidence that already exists, but by the *generation* of new evidence that may appear in the next few decades. That is impossible for every previous decision concerning the Geological Time Scale. The new geological epoch is radically distinct from all previous ones, so that 1945 may be thought of as the boundary that marks a break in Earth history of the greatest profundity; it divides the life span of Earth into two halves ontologically. In other words, the being-nature of the object itself has changed.

The historian Dipesh Chakrabarty has made the striking observation, pregnant with implications, that the arrival of the

Anthropocene means that human history and geological history have converged, calling into question the modern conception of history as, in Jacob Burckhardt's words, "the break with nature caused by the awakening of consciousness."¹¹ The initial divergence of the two histories can be traced to the emergence of the science of geology in the eighteenth century. Acceptance of its implications was slow. In the 1854 edition of *Encyclopaedia Britannica* we find "A Chronological Table from the Creation of the World to the Year 1854." It begins: "B.C. 4004 Creation of the World, according to the Hebrew text of the Scriptures." After centuries in which the European story of humans was part of the story of the Earth in the cosmology of Genesis, or similar myths of cosmogenesis in other cultures, it was geology's discovery that the Earth is much older than humans, indeed much older than life, that gave the Earth its own history. It was only after nature acquired its own history that humans could acquire a history in the modern sense. An understanding of an independent human history became the foundation of all modern social sciences, so the convergence – or better, the collision – of human and Earth histories in the Anthropocene kindles the suspicion that all social sciences and their philosophical foundations have been built on an understanding of the historical process that is no longer defensible.

The convergence means that, contrary to our attempts to make ourselves free of the natural world, our future is tied to the fate of the Earth. Our disturbance of the Earth System has rendered it more unstable and unpredictable. Whereas industrialism's essential aim has been to bring the natural world under human supervision, in practice the effect has been to leave it *less* controllable. If, as climatologist Kevin Trenberth has written, "all weather

events are affected by [human-induced] climate change because the environment in which they occur is warmer and moister than it used to be,"¹² every extreme event now has a human fingerprint. Flood, famine, fire, and pestilence can no longer be purely natural, so the theological distinction (also commonplace among the secular) between moral evil and natural evil collapses. What, we might now ask, does it mean to write insurance policies exempting the insurer from liability for "acts of God"? Humankind is now confronted with a momentous decision: to attempt to exert *more* control so as to subdue the Earth with greater technological power – the express purpose of some forms of geoengineering – or to draw back and practice meekness, with all of the social consequences that would follow.

Earth System science

The idea of the Anthropocene was conceived by Earth System scientists to capture the very recent rupture in Earth history arising from the impact of human activity on the Earth System as a whole.

I ask the reader to stop and read the above sentence again, taking special note of the phrases "very recent rupture" and "the Earth System as a whole." Understanding the Anthropocene, and what humanity now confronts, is entirely dependent on a firm grasp of these concepts. As we will see, "the Anthropocene" has quickly become so encrusted with misreadings, misconceptions, and ideological co-optations that most who come to it for the first time are liable to be seriously misled. It is of the utmost importance to understand that the "Anthropocene" is not a term coined to

describe the continued spread of human impacts on the landscape or further modification to ecosystems; it is instead a term describing a *rupture* in the functioning of the Earth System as a whole, so much so that the Earth has now entered a new geological epoch.

Whatever conclusions one might draw as to the ultimate causes and the solutions to the Anthropocene, an understanding of the basic science of it must come first. Such an understanding requires not much more than a careful reading of the half-dozen seminal papers in scientific journals, and yet most who lurch into print on the subject have not taken the time. (Ian Angus has now provided a superb overview of the science in the first part of his book *Facing the Anthropocene*.¹³)

First named by atmospheric chemist Paul Crutzen in the year 2000, the Anthropocene is the name for a proposed new epoch to be added to the official Geological Time Scale that segments the entire history of the Earth.¹⁴ As we saw, the scale is divided into ages, epochs, periods, eras, and eons, like Russian dolls, with “ages” as the smallest. The Anthropocene epoch succeeds the Holocene, the one that for the last 10,000 years has given the Earth a remarkably clement and stable climate.

It became possible to conceive the idea of a human-induced rupture in the functioning of the Earth System only after the development of the new scientific paradigm of Earth System science, the roots of which lie in new strands of scientific thinking dating from the 1970s and 1980s that coalesced in the 1990s. Those strands included: the application of systems modeling to Earth’s resources by Meadows and others in the 1970s; James Lovelock’s Gaia hypothesis, first advanced in 1979; early biophysical modeling of the Earth’s biosphere in the 1980s; the startling results of

Antarctic ice-core drilling in the same decade; the formation of the International Geosphere-Biosphere Programme in 1983–6; and the creation of the Intergovernmental Panel on Climate Change in 1988.¹⁵ We might also mention the impact of the images of the Earth taken from space by the Apollo space missions in the late 1960s, although they are subject to readings other than the usual romantic one.

The concept of the Anthropocene applies to the new object of the *Earth System*, an object that only came into view in the 1980s and 1990s with the emergence of Earth System science. This claim may seem implausible. Haven’t scientists, and before them natural philosophers, conceived of the Earth as a functioning system for much longer, perhaps as early as the eighteenth century? No. A globe with a crust and some biota on it does not a system make. It’s worth noting that the notion of a *global* climate (one of the components of the Earth System) became widely accepted by scientists only after World War II. Except for a few speculative commentaries, “climate” had previously been considered a local and regional phenomenon. In the nineteenth century “the climate” was understood as the long-term average of the weather in a region or country. A popular handbook still being published in 1961 argued that “the notion of a global climate made little sense” because the weather is too changeable between the poles and the tropics.¹⁶ Until the 1970s climatology was a profession limited in size and mostly found in geography departments, one that confined itself to the compilation of statistics on regional weather.¹⁷

The new Earth System thinking that emerged fully in the 1990s and 2000s is the integrative meta-science of the whole planet understood as a unified, complex, evolving system beyond

the sum of its parts. It is a transdisciplinary and holistic approach assimilating earth sciences and life sciences, as well as the “industrial metabolism” of humankind, all within a systems way of thinking, with special focus on the non-linear dynamics of a system.¹⁸ It represents a markedly novel way of thinking about the Earth that supersedes ecological thinking.¹⁹ The latter, which emerged fully in the 1960s and 1970s, is the biological science of the relationships among organisms and between communities of organisms and their local environments. Ecology studies the local and regional; Earth System science studies the Earth as a total system.

Crucially, the new concept of the Earth System encompasses and transcends previous objects of study such as “the landscape,” “ecosystems,” and “the environment”; it is the Earth taken as a whole in a constant state of movement driven by interconnected cycles and forces, from the planet’s core to the atmosphere and out to the Moon, and powered by the flow of energy from the Sun. It is a single, dynamic, integrated system, and *not* a collection of ecosystems.

As we will see, a great deal of confusion arises from the elision of the new object of the Earth System with these earlier objects of study. Rather than Earth System thinking displacing ecological thinking, it is more correct to say that Earth System science is the name for systematic thinking about the new object of the Earth System, which is not the same object to which ecological thinking is properly applied. The gulf between the two remains even when the local environments of ecological thinking are aggregated up to the “global environment”; the global environment thought this way is not the Earth System. The Anthropocene is emphatically not a new name for a more intense phase of human disturbance

of local and regional ecosystems. The concept was envisioned in 2000 to capture the qualitative leap from disturbances of ecosystems to disruption of the Earth System.

Since Thomas Kuhn published his landmark book *The Structure of Scientific Revolutions* in 1962, analysts have been too eager to identify a “paradigm shift” in one area of science or another. Yet it seems to be justified in the case of Earth System science, for if a paradigm is a distinct set of assumptions and patterns of thought, then there can be little doubt that Earth System science meets the criterion.

Scientific misinterpretations

As we will see, most commentary by social scientists on the Anthropocene begins from a mistaken understanding of the science behind the concept. The confusion is perhaps forgivable because much of the analysis from *scientists* begins from the same misconception. Most scientists who go into print on the issue are not Earth System scientists and read the new concept through old disciplinary lenses. If we want to understand the Anthropocene we must listen to the scientists who have learned to think in terms of the Earth System.

The distinctiveness of Earth System science as a paradigm-shifting meta-science has become apparent in debates over various attempts to invent new starting dates for the Anthropocene. These debates have shown up the gulf between Earth System science and traditional geographical, geological, and ecological thinking, which are inadequate when applied to the Earth System as

a whole. Grasping the idea of the Earth System – emphasizing the co-evolution of its “spheres,” the atmosphere, the hydrosphere (watery parts), the cryosphere (icy parts), the biosphere (life and its surrounds), and the lithosphere (the Earth’s crust) – requires a kind of gestalt shift, one big “Aha” moment, or usually several smaller ones. Without it the Earth is understood as the aggregation of ecosystems more or less modified by humans. In the absence of such a gestalt shift it is possible to read the idea of the Anthropocene into older forms of disciplinary thinking in the geological, archaeological, paleo-anthropological, ecological, or human geographical traditions.

And so, soon after the concept was proposed, a number of scientists and social scientists began to put forward interpretations of the Anthropocene that, mostly unwittingly, *deflated* the significance of the new epoch and the threat it poses to humankind and the Earth.

When first proposed by Earth System scientists, it was suggested that the beginning of the Anthropocene should be dated from the late eighteenth century when, due to the large-scale burning of coal, there was a now-detectable increase in greenhouse gases in the atmosphere and so the beginning of modern global warming. In 2003, paleo-climatologist William Ruddiman published a paper arguing that the Holocene–Anthropocene shift occurred not at the end of the eighteenth century with the Industrial Revolution but 5,000–8,000 years ago with the onset of forest clearing and farming, which led to enhanced levels of carbon dioxide and methane in the atmosphere.²⁰ However, Ruddiman’s interpretation of the data turned out to be unpersuasive because human impact on the Earth System (as opposed to the landscape)

5,000 to 8,000 years ago is not discernible in the data, and certainly was not large enough to upset the stability of the Holocene Earth. Reviewing the evidence, the Intergovernmental Panel on Climate Change came to the same conclusion.²¹

Ruddiman’s interests were scientific but the dispute has wider implications. One is that if humans have been a planetary force since civilization emerged, then industrialism and the extensive burning of fossil fuels did not represent anything fundamentally new in the human project; nor is it a rupture in Earth history. If humans have been transforming the Earth System for many thousands of years, then it is in our nature to do so. The Anthropocene is therefore a “natural” event rather than the result of certain forms of social organization coupled with techno-industrial hubris. It does not reflect any kind of human failure.

Several scientists have attempted to interpret the Anthropocene as no more than another name for the continued impact of humans on the landscape or ecosystems. Erle Ellis claims that since humans “have been reshaping the terrestrial biosphere” for millennia “the entire past 11,000 years of the Holocene might simply be renamed the Anthropocene.”²² For Earth System scientists the new epoch is presented as a geological epoch *in contrast to* the Holocene. Bizarrely, Ellis defends the view that humans are not a destructive force but have always been “sustained and permanent stewards of the biosphere.” (Tell that to the thousands of species humans have extinguished.) None of the leading exponents of Earth System science believes that changes in the terrestrial biosphere alone can bring about a new epoch, and even less so if we are thinking of vegetation and landscape ecology. After considering differing conceptions of the biosphere, two Earth System scientists conclude that “the

terrestrial biosphere, in isolation, is not the right place to be looking for a planetary-scale tipping point; one must consider the coupled dynamics of the Earth system as a whole, including evolution.”²³

Elsewhere, Ellis – a landscape ecologist rather than an Earth System scientist – makes a shopping list of human impacts covering domestication of animals, genetic modifications, combustion of fossil carbon, changes to the nitrogen cycle, artificial lighting, soil tillage, nuclear power, earthworks, and transport of materials – all of which “taken together” are “shifting the planet into a new epoch of geologic time; the Anthropocene.”²⁴ Seen this way, the Anthropocene is nothing new and nothing to worry about; indeed, as we will see, Ellis is among a number of political conservatives who *welcome* it.

A view from archaeology on the starting date controversy also begins with a pre-Earth System science understanding. In a paper titled “The Onset of the Anthropocene,” published in the journal *Anthropocene*, the abstract begins:

A number of different starting dates for the Anthropocene epoch have been proposed, reflecting different disciplinary perspectives and criteria regarding when human societies first began to play a significant role in shaping the earth’s ecosystems.²⁵

One need not read past this sentence to know that the authors have misconstrued the new epoch completely, and that their conclusions about the onset of the new epoch must be mistaken. It’s the very last letter, the “s” in ecosystems, that gives it away. The Anthropocene does not begin when humans first play “a significant

role in shaping the earth’s ecosystems”; it begins when humans first play a significant role in shaping the *Earth*, that is, the Earth that evolves as a totality, as a unified, complex system comprised of the tightly linked atmosphere, hydrosphere, cryosphere, biosphere, and lithosphere. It is not about changes to ecosystems except insofar as ecosystem change is a component of the disruption of the spheres that constitute the Earth System.

The archaeologists argue that “the beginning of the Anthropocene can be usefully defined in terms of when evidence of significant human capacity for ecosystem engineering or niche construction behaviors first appear in the archeological record on a global scale.” These behaviors are traced to the domestication of plants and animals beginning 10,000 years ago. In a similar distortion two other archaeologists, peering through their accustomed lens, see the Anthropocene as no more than a part of a “single complex continuum” over 50,000 years due to “human geographic expansion.”²⁶

If through an archaeological lens some see an Anthropocene in domestication of plants and animals, and through Ellis’s landscape ecology lens it is seen in evidence of landscape change, both diminish the significance *and changed nature* of the human impact on the Earth System that the Anthropocene concept captures. Their visions are inclined to lull the reader into the belief that the Anthropocene is no more than an interesting new way of expressing the traditional understanding of the human relationship to the natural environment. Yet the Anthropocene concept would not have been possible without the emergence of Earth System science in the 1980s and 1990s as a way of understanding the novel role of humankind in the Earth System, as distinct

from the understanding embedded in traditional environmental science.

It is also possible to misread the nature and significance of the Anthropocene by viewing it through the lens of social geography. In what is known as the “pre-Columbian Anthropocene hypothesis,” Simon Lewis and Mark Maslin locate the start of the new epoch in 1610, based on a complex narrative covering the colonization of South America, introduced diseases, depopulation, forest regrowth, transcontinental trade, species exchange, and pollen counts, all of which are said to be associated with a small dip in the atmospheric concentration of carbon dioxide in that year.²⁷ However, the analysis failed to show numerically that the dip (*sic*) in carbon dioxide changed the functioning of the Earth System or was caused by human activity. A number of Earth System scientists pointed out that in the pre-industrial Holocene there were many comparable dips in the atmospheric carbon dioxide concentration, and that a change of 10 parts per million is well within the range of natural variability in the Holocene, and pales into triviality beside the jump in the concentration from 280 parts per million in 1800 to 400 today.

Finally, soil scientists have entered the debate, arguing that evidence of anthropogenic modification of soils going back 2,000 years defines the start of the Anthropocene.²⁸ Yet this argument from pedology is also based on a total misconception of the definition of the proposed new epoch, namely: “The Anthropocene is, by definition, the period when human activity acts as a major driving factor, if not the dominant process, in modifying the landscape and the environment.” This argument has been taken apart by two other soil scientists. Yet they too reproduce its essential flaw

when they interpret the Anthropocene as the initiation of “significant human environmental impact . . . on the Earth’s surface.”²⁹ To repeat: it’s not “the landscape,” it’s not “the environment,” and it’s not “the Earth’s surface.” It’s the system as a totality.

That so many scientists, publishing in prestigious journals, can misconstrue the basic definition of the Anthropocene as nothing more than a measure of the “human footprint” on the landscape is a sign of how far Earth System science has to go in changing the way many scientists understand the Earth. A common feature of these misreadings of the Anthropocene through the lenses of ecology, social geography, archaeology, and pedology – that is, by treating the new epoch as a continuation of landscape or ecosystem change going back centuries or millennia – is that they divorce it from modern industrialization and the burning of fossil fuels. In this way they deny that the Anthropocene represents a *rupture* in Earth history, and deprive it of its dangerous quality. It is rendered benign.

Curiously, this scientific misreading of the Anthropocene accords with the views of some analysts in the social sciences and humanities. In their important volume *The Shock of the Anthropocene*, historians Christophe Bonneuil and Jean-Baptiste Fressoz claim that those who speak of the Anthropocene “should not act as astonished ingénues who suddenly discover they are transforming the planet.”³⁰ They write that the new epoch has a “long history” and is in effect another term for “environmental disturbance” so that there were “Anthropocene societies” in the eighteenth century.³¹ The argument elides the recent rupture in geochronology with early industrial ecological damage, which effectively denies that anything new has happened. The danger of

this approach is that to paint the new situation as no more than a continuation of the past misses the true novelty of the dispensation and invites application of out-of-date social analysis and strategies to a world that has transcended them. The Anthropocene rupture will require original political thinking. To draw an analogy, in the insurrectionary year 1848 Karl Marx would not have argued that one should look to the lessons of peasant revolts for an understanding of the situation or a political response. (Ian Angus presents a Marxist view of the Anthropocene that, whatever one may think of the politics, stays true to the new science of the Earth System.³²)

The view that the new epoch is just another name for human disturbance to the environment has recently been reprised by law professor Jedediah Purdy in a “death-of-nature” tome that seems to have been written without reading *any* scientific papers on the topic at all, instead preferring to find the evidence for the new geological epoch in Thoreau’s 1854 transcendentalist classic *Walden*. And so Purdy can begin with the dispiritingly postmodern claim that the idea of the Anthropocene “despite its scientific trappings” is really a “cultural idea,”³³ before devoting the rest of the book to “a history of how Americans have shaped their landscape” and the ideas it gave rise to. In other words, he constructs a history of the new epoch before the new epoch actually began.

The essential failing is that the paradigm shift of Earth System science is not recognized, and so some scientists read the Anthropocene into the old disciplines with which they are comfortable. It is not that the old disciplines have been disproved or even made redundant when applied to the old objects, such as the landscape, ecosystems, and the environment. A new object

has appeared, the Earth System. Its arrival gave rise to the new paradigm of Earth System science, and the new science shaped our understanding of the new object. While recognized by Earth System scientists and a few pioneers in science studies, others treat the Earth System and so the Anthropocene as if it were a further articulation of the old object (landscapes or ecosystems) and its study the continued development of established environmental sciences. So, unlike the “typical” scientific revolution, it has not been the case that the new evidence contradicts the prevailing theory, but that the focus of interest shifted due to the appearance of new phenomena – Earth System processes that transcend the bounds of ecosystems and operate at a global level. These new phenomena required a new object. For this, new concepts were needed.

As I have suggested, beyond its scientific importance, the appearance of this new object, the Earth System, has ontological meaning. It invites us to think about the Earth in a new way, an Earth in which it is possible for humankind to participate directly in its evolution by influencing the constantly changing processes that constitute it. It therefore brings out the conception of a joint human–Earth story, one explored later in this book.

The ecomodernist gloss

Most who read the Earth System scientists’ papers on the Anthropocene – and especially the projections of climate scientists – understand the new epoch as a consequence of the industrial growth process whose harms will range from severe to calami-

tous. Severe harms are evident already. However, a rising chorus of writers and intellectuals actually *welcomes* its arrival, expressing a certain excitement or exhilaration. At the entrance to the first major scientific conference devoted to the new epoch in 2012, a huge sign proclaimed “Welcome to the Anthropocene.” I interpreted the slogan as ironic. It was only over the next two or three years that I realized it was not dark humour but a true expression of the sentiment of those who see disturbance of the Earth System as a wonderful opportunity for humankind to prove our ingenuity and technological faculty.

Perhaps the excitement is a reaction to postmodern anomie, to the essential boredom and hollowness of modern life in affluent countries or, among intellectuals, a restless desire in an era of stifling intellectual orthodoxy, where nothing big happens or seems possible, to go somewhere risky whatever the moral cost. Like soldiers marching off to World War I, these influential voices embrace the prospect of leaving the safety of their Holocene home and embarking on the foreign adventure of the Anthropocene.

This kind of scientific adventurism seems to underlie the collaboration known as Future Earth, which foresees a sustainable and equitable world in which we may all thrive. Some leading geoengineering researchers are enthusiastic at the prospect of humans assuming control of the planet. David Keith is perhaps the foremost scientific advocate of solar geoengineering, that is, coating the Earth with a layer of sulphate particles in the upper atmosphere to reduce the amount of sunlight reaching the planet. He writes of his “delight” in humankind’s “new powers to shape the planetary environment,” hoping we will use them to “build a thriving civilization.”³⁴

The most prominent among those who view the Anthropocene as an event to be celebrated rather than lamented or feared are those environmentalists, concentrated in the United States, who brand themselves “ecomodernists.” It is worth dwelling on their worldview because they may be seen as the most articulate representatives of the dominant economic-political system. If those at the pinnacle of corporate and political power – meeting perhaps at Davos – were to express a view of the Anthropocene, they would take their cue from them. (John Bellamy Foster and colleagues see ecomodernists as the most apologetic strand of the social sciences. Their political quiescence and faith in the prevailing system seems to deepen as the natural scientists become more alarmed.³⁵)

For the ecomodernists, instead of final proof of the dangers of hubris, the new epoch is greeted as a sign of humankind’s ability to renovate and control nature. They take to heart the observation, made by Isabella in Shakespeare’s *Measure for Measure*, that “It is excellent to have a giant’s strength” without noticing the caveat, “but it is tyrannous to use it like a giant.” And so in this eco-Promethean view, the Anthropocene is not evidence of human short-sightedness or foolishness, nor of global capitalism’s rapaciousness, but presents an opportunity for humans finally to come into their own. Several years ago they began to speak of the *good* Anthropocene: there are no planetary boundaries that limit continued growth in human populations and economic advance because “human systems” can adapt and indeed prosper in a warming world. History proves our flexibility and the Anthropocene is another challenge for us to overcome.

In this view, as we enter the Anthropocene we should not fear transgressing natural limits; the only barrier to a grand new era for

humanity is our own self-doubt. Recapitulating Francis Bacon's 1627 vision of *New Atlantis* in which science and technology become the foundations of a Utopia, leading ecomodernist Erle Ellis urges us to see the Anthropocene not as a crisis but as "the beginning of a new geological epoch ripe with human-directed opportunity."³⁶ Romantic critics of technology, and the gloomy scientists they draw on, stand in the way of the vision's realization. Humanity's transition to a higher level of planetary significance is "an amazing opportunity" and "we will be proud of the planet we create in the Anthropocene."³⁷ Coordinated and promoted by the Breakthrough Institute, the San Francisco think tank that forms the institutional heart of ecomodernism, the vision has been condensed into *An Ecomodernist Manifesto* in which signatories transcend the modest aim of a *good* Anthropocene to envision a "*great* Anthropocene."

For the ecomodernists, if we are capable of developing technologies to control the climate and regulate the Earth as a whole, then why not? Planetary engineering reframes global warming. No longer a vindication of environmentalist warnings that humans have gone too far, climate change becomes the spur to final victory for the human mastery project. Just as Francis Bacon understood Nature as a passive entity to be manipulated once her secrets had been extracted (by putting her "on the rack" if necessary) and saw the exercise of human creative power facing no constraints, so the ecomoderns understand the Earth as a system that can be subdued with knowledge and technological power. And so the idea of engineering the climate system is attracting the support of conservative political actors, including think tanks with histories of climate science denial.³⁸

Some might admire the ecomodernists' audacious claim to

human omniscience and omnipotence, and the adroitness with which they turn the negative consequences of the growth project into a new and higher form of positivity. As humanists with a Whig view of history (history as the inevitable rise of liberty and enlightenment), the ecomodernists claim to found the good Anthropocene argument on science rather than faith or politics. In this respect it can be shown that their vision of the future is based on misconstrued science. Peter Kareiva and colleagues express their central scientific claim: "Nature is so resilient that it can recover rapidly from even the most powerful human disturbances."³⁹ The belief that ecosystems can "bounce back" is carried over to their interpretation of the Anthropocene. Ellis puts it plainly: "Humans have dramatically altered natural systems ... and yet the Earth has become more productive and more capable of supporting the human population. ... *there is little evidence to date that this dynamic has been fundamentally altered.*"⁴⁰

In fact, the essential insight of the most eminent Earth System scientists is exactly the reverse – the dynamic between humans and the Earth *has* been fundamentally altered, because there has been a phase shift in the functioning of the Earth System as a whole. We have, as a number of leading Earth System researchers put it, entered a "*no-analogue state*" – the Earth has never been here before. The Holocene conditions that provide the platform for the idea of the "good Anthropocene" have been relegated to the past because the system's operation has been disrupted. Whatever its validity in the Holocene, the argument that ecosystems are resilient and can "bounce back" from human disturbance is simply not relevant to shifts in geochronology.

Throughout the late eighteenth and nineteenth centuries the

new science of geology was dominated by uniformitarianism, the idea that the Earth is shaped by slow-moving forces that gradually transform it over very long time periods. Determined to distance the new science from biblical accounts of instantaneous creation and divinely sent floods, the emerging profession was reluctant to accept any theory of catastrophism in which a transition from one period in Earth history to the next may be due to some natural paroxysm. In the end, the evidence for catastrophic changes (due, for example, to asteroid strikes) could no longer be resisted and geologists accepted that gradual change can at times be interrupted by cataclysms. Today the Geological Time Scale includes several transitions from one era or epoch to the next caused by catastrophic events, ones so rapid that most existing life forms cannot adapt and die out.

Geologically speaking, the Anthropocene event, occurring over an extremely short period, is an instance of catastrophism, so that the ecomodernists' conception of the Earth as resilient and able to bounce back from even large disturbances is a uniformitarian understanding. The "good Anthropocene" is therefore an anachronism in the precise sense. The ecomodernists' belief in gradual change in Earth history echoes their commitment to gradual social change. Both science and politics are construed in ways supportive of the prevailing system; both ecosystems and American society have proven themselves to be adaptable and resilient, and combine to deliver stability and prosperity. Human ingenuity and technological solutions have fixed glitches in both systems in the past and will do so in the future.

It's worth noting for later that if the ecomodernists are successors to Bacon in their commitment to a "second creation" by tech-

nological means, they do not share the Baconian presupposition that the ability to remake nature is a divine gift. So, if not from God, from where does the authority derive to master the Earth? The ecomodernists argue as secular humanists: the authority to take control of nature is self-granted, a power ceded to humans for the first time by Enlightenment philosophy.

I hope it is by now apparent just how vital it is to recognize that the Anthropocene is a very recent *rupture* in Earth history and so in human history.

An epoch by any other name

In the debate among social scientists and humanities scholars over the Anthropocene, no aspect of it has attracted more ire than the term itself. Dozens of papers, books, and commentaries have been devoted to attacking the meaning and implications of assigning the new epoch to humanity in general, to an undifferentiated *anthropos*. There are two linked anxieties. First, the term "Anthropocene" distributes responsibility to everyone and away from those actually answerable for bringing on the new epoch, the nations of the North and especially those in control of the economic-political system. As a result, the Anthropocene concept risks, in the words of its critics, "serving as a legitimizing philosophy for an oligarchic geopower."⁴¹

Second, even if all humans were responsible, by locating the cause in the activities of "abstract humanity" we inevitably shift from actual history into "species thinking," that is, thinking in terms of the imagined universal qualities of the human species,

instead of evolving social, economic, and political structures, and in particular the history of capitalism. The term implies a narrative of humans-as-a-whole rising to planetary supremacy, so that the new epoch, the Anthropocene, emerges out of the nature of the species as such.⁴² I will consider this second anxiety in chapter 2.

One of the implications of the attack on the term is that Earth System scientists – in particular the Nobel Prize-winning atmospheric chemist Paul Crutzen who first blurted it out – made a mistake and should have understood the political implications of what they were doing. A Marxist critic, Jason Moore, suggests they should have been more sensitive to the “actually existing” historical relations in choosing an appropriate name, rather than one that results in “the erasure of capitalism’s historical specificity.”⁴³ He replaces the scientists’ flawed neologism with his own, the “Capitalocene,” as if the naming of geological divisions belonged to sociology.

In my view, while the basic point is worth making, the outrage over Crutzen’s coinage has been a distraction from deeper questions. In the first place, the term “Anthropocene” is here to stay. Social scientists are free to comment on the implications of a name, and it is their role to analyze the forces that brought about the new epoch; but it is the scientists addressing the International Commission on Stratigraphy whose role it is to name divisions in the Geological Time Scale, including the Holocene’s successor. Earth System scientists are scientists, so we would expect them to choose a “politically neutral” term. (Yes, it only *seems* politically neutral.) Moreover, some of those at the center of Anthropocene science are fully aware of the roots of the new epoch in capitalist industrialization in Europe and its extraordinary post-war

acceleration due to rampant consumerism and the power of the fossil-fuel lobby. They are also apprised, because they study the regional statistics, of the profoundly unequal distribution of causes and impacts, although it is true that some make gratuitous declarations about what should be done. Paul Crutzen has rightly been chastised for suggesting at the end of one of his seminal pieces that the answers to the Anthropocene are to be found in science and engineering, including geoengineering.⁴⁴

The angst over the term reflects the continuing influence of the “semiotic turn” in the social sciences and humanities, and its emphasis on the power of language. Yes, words matter; but there are forces much more powerful than words, and to excoriate scientists for terminological naivety exaggerates the importance of the choice of the name for a new division in the Geological Time Scale in a way that implicitly supplants the prerogative of Earth science to name epochs with the claims of certain social sciences. In doing so, the latter are stating that the Anthropocene idea is only another way of capturing what we have been saying for a long time. Only those who have not yet grasped that a *rupture* has occurred in the social world as well as the physical one can see it this way.

Some historians want to reclaim the new geological epoch for their discipline, complaining that today “it is the sciences of the Earth system, and no longer historians, who name the epoch in which we are living.”⁴⁵ This must be an epistemological mistake; the Anthropocene describes a *geological* epoch and not a social-historical one. If geological history and human history have “converged,” then it does not mean that geology has become social science. Historical epochs will map onto recent geological history in varying ways, and the new geological epoch will influence how

we think about history. But merging geochronology with human history leads down a path in which changes to the functioning of the Earth System must be explained as changes in social relations. Of course we can understand the Industrial Revolution as the outgrowth of earlier transformations – of mercantile capitalism, colonialism, and transatlantic trade – but to suggest (as Moore does) that the Anthropocene therefore began in the sixteenth century, even though there were no detectable signs of disturbance to the Earth System until the nineteenth century, is to discount scientific facts altogether, which suggests something disquieting about the evolution of the humanities and social sciences. Moore takes this tendency to a risible extreme when he condemns the Anthropocene's "fundamentally bourgeois character."⁴⁶

Beyond all of the arguments above, there is a more pragmatic reason for attaching the new epoch to an undifferentiated *anthropos*. If the preponderance of blame once lay with Europe and America, it no longer does. Focusing only on climate change (though the same applies to other human contributors to Earth System disturbance), China's 1.4 billion people now have around the same *average* carbon emissions as Europeans. China's annual greenhouse gas emissions now easily exceed those of the United States, and China's total historical emissions will soon be larger than those of the United States. With India's 1.3 billion people next in line (the two account for almost 40 percent of the world's population), by the middle of the century the South will be responsible, both contemporaneously and historically, for much more damage to the global climate system than the North as it copies the northern model of environmental harm in the pursuit of poverty-alleviation and affluence. By 2050 at the latest the objections to

"Anthropocene" will seem very dated. If the "Anthropocene" was a Eurocentric idea when it was coined, it is now Sino-Americo-Eurocentric, and in a decade or two it will be Indo-Sino-Americo-Eurocentric.

None of this exonerates the North from its historical responsibility and its shameful reluctance to respond to the danger once it became undeniable. Even so, it must be accepted that the old world of North and South is vanishing. "Aha," some will reply, "but China's emissions do not count because a large portion of them is emitted making consumer goods exported to the North." The intention of this argument is to keep China firmly in the exploited South by continuing to attribute sole blame for climate change to the North and the capitalist world-system it established and still enforces. Yet the example of China shows it's time to abandon this "dependency theory" developed in the 1960s and 1970s to explain continued subservience of the South after decolonization, and later elaborated into world-system analysis (according to which the globe is organized around an international division of labor and capital in which the "core" of rich countries exploits the "periphery" of poor ones). For a start, the share of China's emissions arising from export manufacture has been around 30 percent, but it is declining as China reorients its economy toward domestic consumption, which year on year erodes the basis of the argument. Moreover, China *chose* the path of export-oriented industrialization as an act of pure national sovereignty and it did so as the quickest way of enriching itself. Corporations in the North did not force their dirty factories on China; China chose to allow them in as a means of soaking up its low-cost labor. Foreign corporations, even the most powerful ones, often found themselves at

the mercy of hard-nosed domestic players. In addition, the United States has funded much of its public debt by borrowing from China's central bank, and in 2008 found that its ability to respond to the financial crisis was severely constrained by its indebtedness to China. To characterize China's astonishing economic growth rates in the 1990s and 2000s, and so its enormous greenhouse gas emissions, as the result of neo-colonial manipulation puts radical critique before actual history.

As an aside, there were historical precedents for nations of the South asserting their sovereignty. In the 1960s, South Korea successfully pursued a sovereign path of export-oriented industrialization and modernization in order to overcome its own "backwardness."⁴⁷ The economic strategy was not imposed on it by the United States (which had a great deal of influence after the Korean War). Nor was Korea forced to take the rich nations' dirty industries. The Korean state actively set out to take them. In fact, under military strongman President Park Chung-hee, Korea explicitly rejected the urging of the United States and the precursor of the World Bank to pursue exports of traditional commodities (rice and silk) and instead invested in state-sponsored, export-oriented manufacturing industries. To put the decision into effect, President Park called in the most powerful members of the mercantile class and told them that unless they took their capital out of trading enterprises and invested it in manufacturing he would throw them in jail. Korea was no client state.

So, far from being a product of "unequal relations of power, exchange and distribution in world society,"⁴⁸ China's massive greenhouse gas emissions are an expression of its sovereign power. If anything, compared to the United States, and certainly to

Europe, global power and economic strength has tilted in China's favor, as will be attested to by many in Africa, where Chinese corporations have bought up huge swathes of land and resources. China's coal-fueled growth has given it *too much* power over others. Attempts to keep China in the exploited South confront these incontestable facts. The widening split within the South at international climate change negotiations has been apparent for some time. At the Copenhagen climate change conference in 2009, China effectively abandoned the small-island states and the most vulnerable countries to ruthlessly pursue its own economic and geopolitical interests. The understanding of the globe that emerged in the 1950s and 1960s as one divided between North and South has been overturned by history, and the *rupture* of the Anthropocene arrives to challenge social science to build new theories.

If these arguments fail to convince the reader that China itself is responsible for the environmental damage caused by its industrialization, perhaps a last one will. If China's emissions generated by manufacturing exports are to be discounted because consumers in the North benefit from them, what are we to do with emissions generated in Australia in the production of iron ore, nickel, alumina, and coal destined for export? Should the consumers of these resources in India and China be responsible for the emissions in Australia? Of course not. In fact, many believe that Australia should take responsibility not only for the emissions in Australia from mining and transporting coal but for the emissions from burning that coal, even though they occur in other countries.

As each year passes, responsibility for anthropogenic climate change shifts from the North to the South, where "responsibility"

is measured not only in the international greenhouse gas accounting system but also in the moral accounts (whose ledgers are locked away in the historical memory). Although there is some distance still to travel, like the North the large industrializing nations of the South increasingly have the ability to choose to do otherwise – and some do, led by China itself. If with his neologism Paul Crutzen is guilty of implicitly blaming humanity in general for the sins of the North, he can be accused at worst of being two or three decades premature. It's true, and vital to understand, that the model of capitalist modernization pursued by China, India, and other nations of the South is thoroughly European in origin. Yet, if the *anthropos* of "the Anthropocene" conceals its European pedigree, we may today speak of an *anthropos* with Chinese characteristics.

Although I have focused on practical defenses of the deployment of an undifferentiated *anthropos* to designate the new epoch there is a deeper reason, one I flag here and develop throughout the book. If the Anthropocene concept emerged from the new discipline of Earth System science, its core insight was to conceive of the Earth no longer as a collection of ecosystems, landscapes, catchments, and so on, but as a single, total functioning system. From an Earth System viewpoint, there are on Earth no divisions between North and South or between nations, cultures, genders, and races. There are only humans with more or less power to disturb it. If the Anthropocene is a rupture in the history of the Earth as a whole, then it is also a rupture in the history of humans as a whole.

It goes without saying that beginning with *divisions* among humans is indispensable for understanding all kinds of problems in the world, just as fixing on ecosystems rather than the Earth

System as a whole is the only way to answer certain kinds of environmental questions. "That is all very well," the skeptical reader may be asking, "but if the Earth System recognizes only humans-in-general what exactly are these beings?" Clearly, the modern conception of the human that grew out of the Enlightenment will no longer do and in what follows I hope to provide some suggestions as to how we might formulate an answer to the epochal question: what is this being who has changed the course of the Earth itself?