

The Birth of the Anthropocene

JEREMY DAVIES



UNIVERSITY OF CALIFORNIA PRESS

Introduction

This is a book about how to take the measure of a crisis. It is hard to grasp the scale of the modern environmental crisis, and part of the reason is that many things that had once seemed almost immutable are now changing rapidly.

The sea, for instance, is getting deeper. The world's oceans are likely to grow in height by between 40 and 120 centimeters before the end of the present century, letting them spill onto coastal land, where cities have always clustered. The cycle of the seasons is changing. The times are out of joint for plants like the early spider orchid, which has evolved to deceive mining bees into "pseudocopulation" as its only means of pollination: warmer springs mean that the bees emerge too early to be seduced by the flowers that depend upon them. Similar decouplings threaten many other lifecycles, like those of the birds who now hatch their eggs too late to catch the caterpillars that feed their young. Even the map of the world is being redrawn. The rivers that sustained the Aral Sea have been diverted for irrigation, shrinking it to barely a tenth of its former size. Sand and salt from the exposed lake bottom, mixed with pesticides, heavy metals, and defoliants, now blow onto the surrounding farmlands, making crop yields plunge and afflicting local farmers with asthma, tuberculosis, eye problems, typhoid,

and cancer, and with kidney ailments from the saltiness of their drinking water.¹ Taken all together, this revolution that raises the oceans, reschedules the year, and turns water to land is bringing about a new epoch in the history of the world.

That last sentence might sound more declamatory than insightful, but in geology the word *epoch* has a specific technical meaning. A geological epoch is a midsize section of the planet's history. Students of the earth's biology and physical processes are now increasingly persuaded that the planetary system as a whole is undergoing an epoch-level transition. Earth's atmosphere, oceans, rocks, plants, and animals are experiencing changes great enough to mark the ending of one epoch and the beginning of another. The present environmental crisis is epochal in this particular, specialized sense. It is hard to comprehend its magnitude, but if we regard current environmental changes as the birth pangs of a new epoch, and if we give that epoch its place in geological time, in the long history of the earth itself, we might start to make sense of what we are facing. Recognizing what is now ending and what is beginning can help us respond to the predicament of living in the fissures between one epoch and another. The incipient new division of geological time has already been given a name: the Anthropocene. The idea of the Anthropocene epoch lets us understand the ecological crisis of the present day in the context of the distant past.

The central argument of this book is that the idea of the Anthropocene provides both a motive and a means for taking a very, very long view of the environmental crisis. It gives the ecological upheavals of the present day their proper place in the history of the planet. If you want to grasp the force, the scale, and the shape of the catastrophe as it unfolds, look for how it opens a fresh chapter in the long sequences of planetary time. To make sense of climate change, biodiversity loss, rain forest logging, and the rest, pay attention to how the current and imminent states of the world compare to those seen in the various epochs that went before.

If contemporary environmental changes add up to the birth of a new geological epoch, then earth scientists should ready themselves to adjust the geological timescale, the diagrammatic summary of the history of the planet upon which the whole science of geology rests. For now, the Anthropocene is not included on the official chart of the timescale that is maintained by its designated custodians, the International Commission on Stratigraphy. But a simplified and abbreviated version of that chart, with the Anthropocene added to it, would look like the diagram in figure 1.

Geological epochs such as the proposed Anthropocene are subsections of larger time units: periods, like the current Quaternary; eras; and ultimately eons. Epochs can themselves be subdivided into units called ages (not shown in this simplified diagram). All of these divisions and subdivisions come with fixed start dates and end dates, specified with greater or lesser margins of uncertainty according to the present state of geological knowledge. Evidently, when stratigraphers—experts in the physical sequences of rock strata upon which geological time sequences are built—postulate the beginning of a new epoch, they are making a quite specific claim. They envisage introducing one new piece, of a certain size and shape, into the carefully wrought mosaic of the geological timescale. The significance of the new interval, like that of all the older ones, would depend in large part on when it was said to have begun. Its hierarchical status, too, would matter greatly: to declare a new epoch would be a smaller step than creating an Anthropocene period, but an epoch would loom larger in geologic time than a mere Anthropocene age. So when it is used by stratigraphers, the word *Anthropocene* designates an interval that would occupy one particular place within the immense volume of geological time.

As yet the stratigraphers' debates about the Anthropocene, and the ins and outs of their conclusions, have never been examined at all closely from outside the tradition of the earth sciences. One of my aims in this book is to introduce other readers to the perspective on environmental history that has

| EON | ERAS | PERIODS | EPOCHS | |
|---|---------------------------------|-------------------------------------|-------------------------------|------------|
| Phanerozoic <i>since 541 million years ago</i> | Cenozoic <i>since 66 mya</i> | Quaternary <i>since 2.58 mya</i> | Anthropocene | |
| | | | Holocene | |
| | | | Pleistocene | |
| | | Neogene <i>23–2.58 mya</i> | Pliocene | |
| | | | Miocene | |
| | | | Oligocene | |
| | | Paleogene <i>66–23 mya</i> | Eocene | |
| | | | Paleocene | |
| | | | Mesozoic <i>252–66 mya</i> | Cretaceous |
| | Jurassic | | | |
| | Triassic | | | |
| | Paleozoic <i>541–252 mya</i> | Permian | | |
| | | Carboniferous | | |
| | | Devonian | | |
| | | Silurian | | |
| Ordovician | | | | |
| Cambrian | | | | |

Figure 1. Phanerozoic eon.

emerged from those debates. That perspective—which begins with an assessment of the geological traces that the last few centuries will leave behind in the distant future—has the potential to be enlightening for anyone concerned about the environment, not just geologists. But this book also has a much larger aim. I argue that the stratigraphers’ version of the Anthropocene can yield a new way of understanding and responding to the modern ecological catastrophe. The catastrophe is so far-reaching that it cannot really be under-

stood without setting it in the context of geologic time. That means that the long view provided by geology can change the basics of environmental politics for the better. The Anthropocene of the stratigraphers opens a window onto the geological past, and the politics of the environment can be put on a new footing by the stratigraphic vision of the new epoch.

With contemporary politics in mind, the most immediate and most telling point of comparison for the Anthropocene is the Holocene epoch, the 11,700-year span of time that in the established version of the geological timescale still continues to the present day. I believe that in order to make sense of this comparison between the Holocene and the Anthropocene we will also need to look much further back into the geological past, where monsters abound. But the first crucial point is that introducing an Anthropocene epoch to the geological timescale (and placing its starting point somewhere in the last few centuries) would mean declaring that the Holocene is now arriving at its end. This book, then, will eventually be just as much about the terminal crisis of the Holocene as it is about the birth pangs of the Anthropocene, or rather, I emphasize that those two things are one and the same. The Holocene matters because it is the only geological epoch so far in which there have been symphony orchestras and hypodermic needles, moon landings and gender equality laws, patisseries, microbreweries, and universal suffrage—or, to put it plainly, the agricultural civilizations that eventually made all of those things possible. With its demise, the civilized rights and pleasures previously confined to the Holocene will have to negotiate radically changed ecological conditions if they are to endure, let alone if they are to be extended more generously to more people. That is the political problem of the Anthropocene.

It is always intellectually stimulating to find that you are positioned in the interstices of two different worlds. The idea of the Anthropocene makes this state of being in between epochs the starting point for political thinking. In the last chapter of this book, and in the conclusion, I argue that

environmentalists should think of themselves as being caught up in the transition between two geological intervals, and that the goal of environmentalism should be to negotiate a way through this transition. That means demoting the ideal of “sustainability” from its status as the greens’ highest objective. Instead, environmental movements will need to be concerned above all with environmental injustice and with fostering ecological pluralism and complexity in the face of the simplifying tendencies of the Holocene’s final phase. The birth of the Anthropocene should be attended by vigilant resistance against the searing away of multifaceted socioecological systems and their replacement by vulnerable, saturated monocultures. Or to put it more positively, the jerky crossing between epochs can be cushioned by upholding states of life—both ecosystems and human societies—that are variegated, intricate, and plural, ones in which lively forces of all kinds contend with and interweave with one another.

The word *Anthropocene* is descended from the Greek *ἄνθρωπος* (*anthropos*), meaning either “man” or “human.” It is a recent addition to the vocabulary of environmental politics: it was coined, or at least it came to something like widespread notice, only at the end of the twentieth century. But since then it has prospered in a remarkable way. In some academic circles it has lately become a much-used and fashionable term. In the most advanced circles of all it has already gone on to the next stage and is considered rather worn-out and *déclassé*. Among both the enthusiasts and the skeptics the word has been tossed into debate much more frequently than it has been explained or defined. More often than not, it has been used without the intention of any very specific allusion to the work of the stratigraphers that provides its significance in the context of this book. That’s fine, of course. There is no reason why the word should not be used in a whole range of diverse, contested, and even incompatible ways. For the sake of clarity, however, I would like to set out, before going any further, some of the things that “the Anthropocene” will not mean in the pages that follow.

Firstly, the Anthropocene, in this book, is not the name of a fall from Eden. It does not describe the period in which human acts have brought about the end of nature by pollution and despoliation: it is not a rhetorical device to make clear the extent of human depravity. It follows that the Anthropocene is not the kind of thing that it is possible to “mitigate,” like an oil spill. Secondly, and conversely, the Anthropocene is not a breakthrough from tedious natural stasis. It is not the transcendence of the earth’s old limits, the sundering of its chains. It does not stand against all previous epochs and periods, looking glamorous and disreputable where they were worthy and dull. It is one epoch among many on the same footing, rather than one-half of the earth’s history.

Thirdly, despite its name, the Anthropocene is not an anthropocentric concept. The epoch does not get its name because nature is now completely subordinated to human agency, as if clouds now form and swallows now fly only after getting permission from human beings. The name suits it because human societies exert a novel and distinctive degree of sway in the physical world, but other creatures still continue independently to exert their own powers and to pursue their own interests in this new field of action. Humanity is not at the center of the picture of the Anthropocene, opposing, by its powers of mind, the passive matter that encircles it. Instead, human societies are themselves constructed from a web of relationships between human beings, nonhuman animals, plants, metals, and so on. Nor, fourthly, is the Anthropocene a concept that reduces humankind to an undifferentiated mass. I will return—at some length—to that point. To say that the earth is undergoing an epoch-level physical transition, in which the activities of sundry groups of humans are playing key roles, does not imply in the least that all human beings have thus far acted in unison, or that they are all collectively responsible for the new state of affairs.

Finally, in arguing for the importance of looking at the environmental crisis in the context of geological time, I am not at all advocating a distanced,

Olympian perspective on the human condition. Even though the requisite context is prodigiously broad, paying attention to it does not mean rising above the present emergency in a spirit of enlightened impartiality. It does not mean drawing a contrast between the mere fleeting turbulence of humankind's concerns and the eternal currents of the great stream of life, and then looking with cool equanimity to the remote past and future where civilization is as nothing. In fact, it can mean exactly the opposite. Against the facile amorality of the truism that nature will not miss humankind after humans' inevitable demise, the idea of the Anthropocene may yield above all a sense of locatedness in time, a sense of being caught in one particular historical moment.

In a word: no more clean breaks that put humans on one side and nature on the other and, thereby, merge each antagonist into a uniform blob. I argue in this book that the birth of the Anthropocene does something quite different. It redistributes agencies, reconfigures systems, and reorders the loops of consequence and assimilation out of which the workings of the earth are made. The transition from one epoch to another is a generalized disruption, a drawing up of new accounts.

The opponents of the Anthropocene (of whom there are already many) often worry that the new word implies a bleak and narrow-minded picture of the world. In that picture, the planet has become a merely artificial construct, passively molded by human activity, and the best remaining hope for humanity is to allow a scientific elite to administer global affairs from the top down, so that natural resources may be exploited in the most efficient way and affluent consumer lifestyles may be kept afloat for as long as possible. I share those critics' dislike of such a scenario. But this book puts forward a very different world-picture. Here, the world is seen as characteristically full of devious chains of cause and effect; of intricate braids that link economies to ocean currents and ecosystems to plate tectonics; and of what climatologists call "teleconnections," far-distant perturbations that prove to be coupled by hid-

den bonds—although here the teleconnections can take the form of trade routes and cash flows as well as seesaws in atmospheric pressure. Feedback circuits let subtle evolutionary and chemical modifications have worldwide effects. Human societies exert their influence on the planet and so provoke the latest twist in a chancy, surprise-filled geological history.

The recognition that the world is in the midst of an epoch-level transition is of a piece with the general tenor of earth science research over the last forty years. During that time, a conceptual framework usually called *neocatastrophism* has come to the forefront of the earth sciences. I propose in this book that the idea of the Anthropocene should be seen as another product of that neocatastrophist turn. Neocatastrophism has enlivened modern geoscience by dispatching the belief that the planet took on its current shape only through the gradual and continuous operation of familiar processes like erosion and sediment buildup. The new geology lets into the picture abrupt die-offs and bursts of species formation, climatic and geomorphological upheavals, and high-speed collisions with extraterrestrial bodies. Bit by bit, the life of the earth before human civilization has come to look ever more dramatic and incident-packed. There was no stately, teleological progress toward the arrival of humans. Instead, the story has been full of sharp twists and transformations. Built into the earth system are a multitude of concatenated feedback mechanisms. These feedback mechanisms have repeatedly amplified even comparatively small initial changes in unpredictable ways, making nonhuman history as contingent and chaotic as the history of kingdoms and empires.

This new understanding of the earth system has greatly influenced climate scientists, for instance. As they keep struggling to explain, the reason to be concerned about global warming is not that the composition of the atmosphere is now altering rapidly for the first time ever, or that it is disrupting the eternal harmony of the climate system to frighteningly unknowable effect. On the contrary, it is that the atmosphere and the climate have

changed swiftly and mightily from time to time in the past. These changes have tended to bring with them a new configuration of living things, one that—however fine in itself—has been to the old one like a conquering army to a fallen city. That ominous historical record is the reason why contemporary perturbations to the climate system are at the heart of the dangers posed by the birth of the Anthropocene.

Neocatastrophism has introduced us to a whole list of geophysical forces—asteroids, ocean currents, volcanoes, and the like—that, under the right circumstances, can suddenly come to exert a much greater and more destabilizing influence than usual on the workings of the earth system. The idea of the Anthropocene, as I want to construe it, simply adds human agency to that list. The Anthropocene gets its name from humans, the *anthropos*, because its distinguishing characteristic (for now) is the dramatic influence that human societies are having on the physical world. It is not the case that human interventions in the earth's organic makeup, or in the processes governing its soil or water or atmospheric cycles, are still dwarfed by any mightier forces that transcend humankind's paltry strength. Far from it. Human societies are now among the most powerful of the ecological forces that operate on, above, and below the surface of the earth.

In this light, perhaps the most incisive account of the new epoch so far has come not from a scientist or a campaigner but from a poet, the Canadian Don McKay. McKay's rich body of work has been characterized most of all by his interests as a birder. In his two most recent collections, however—*Strike/Slip* and *Paradoxides*—his line of sight has turned lower and slower. Geology has become the keynote of his poetry, which has hunkered down among fossils, rocks, and tales drawn from deep time (that is, by analogy with “deep space,” the abyss of time that stretches back from a few thousand years ago to the beginnings of the earth). McKay has written poems about hexagons of quartz that formed long before the first mathematics, about stumbling across a trilobite on the shore of the North Atlantic, about the

imponderability of hundred-million-year timescales and the wearing away of mountains. In a lecture in 2008 he reflected on the uses of the Anthropocene. “All poets take naming seriously,” he observed, and for him, giving a name to the Anthropocene creates for us “an entry point into deep time.” The preceding geological epochs seem to run backward from this new one “like rungs on a ladder” descending within a few steps into a time before human existence. With a quantity of blunt sarcasm, McKay lays out what seems to me the profoundest significance of the birth of the Anthropocene:

If we think of ourselves as living in the Anthropocene Epoch, we realign our notion of temporal dwelling. Generally, time is viewed in relation to humanity’s place in it, and consists of a present, where we live, and a recent past called history, which is felt to be important for informing the present and helping us understand ourselves better. When we speak of the past with reverence or chagrin, it is this shallow past we mean. Before history there is a vague distant past called prehistory, comprised of a jumble of relics and catastrophes, dinosaur bones mixed with clovis points, missing links, Lucy and The Flintstones cohabiting in the caves of Lascaux, Australopithecus confused with archaeopteryx, and the whole *mélange* construed as a sort of amniotic stew from which we, the Master Species, miraculously emerged. The name “Anthropocene,” paradoxically enough, puts a crimp in this anthropocentrism, making the present a temporal unit among other epochs, periods and eras. . . . On the one hand, we lose our special status as Master Species; on the other, we become members of deep time, along with trilobites and Ediacaran organisms. We gain the gift of de-familiarization, becoming other to ourselves, one expression of the ever-evolving planet. Inhabiting deep time imaginatively, we give up mastery and gain mutuality.²

The Anthropocene sweeps humankind into the turbulent flow of geohistory. It announces a new intimacy with the older rungs on the ladder. “We”—and there will be much need to examine the implications of that collective pronoun—join the trilobites as actors in the long drama of life on earth: as

another planetary force exerting its powers of survival and transformation. More than anything else, the Anthropocene is a way of thinking with deep time.

The best guides to this wild drama of deep time are the most fastidious and bookkeeping of figures in the profession of geology: the stratigraphers, who devote their labors to the precise demarcation and time-tabling of the deposition of rock layers all around the world. They have sought to measure the nascent epoch against the strict and cautious criteria that they have established for the formalization of geological intervals. The willingness of some stratigraphers to take on that task has given rise to the most vivid, the most radical, and the most disconcerting of all conceptions of the Anthropocene as it comes into being. It is their Anthropocene, a brand-new epoch to join the dozens that preceded it, that is my subject here.

In the first chapter that follows, I draw attention to the place of deep time in contemporary environmental news reporting. News stories often describe modern-day environmental changes as being unprecedented for thousands or even millions of years. That sounds not only sinister but also potentially confusing to anyone who is not an expert in earth history—a category that includes the great majority of people who are concerned about environmental issues. I criticize some unhelpful ways of imagining deep time, and describe how an alternative, geological perspective has grown up since the late eighteenth century. I also explore the question of just how much influence human societies currently have over the workings of the living planet. The idea of the Anthropocene itself enters the scene in chapter 2. Since the earth system scientist Paul Crutzen coined the word at the end of the twentieth century, its use has spread ever more widely. I trace the most important of those uses, and the backlash against the term that has developed in the last few years, before arguing that at least some versions of the Anthropocene are not guilty of the charges—of anthropocentrism and antidemocratic arrogance—that have been brought against it.

Chapter 3 looks in detail at just one way of thinking about the Anthropocene. This is the stratigraphic version of the term, the one that takes it literally as a potential new addition to the geological timescale. I explore how the implied relationship between the Anthropocene and the *anthropos* changes when the word is taken in a stratigraphic sense, and I describe the thought experiment that underpins the stratigraphers' approach: if alien geologists were to arrive on the earth in a hundred million years' time, what fossilized traces of present-day events would they find? I spend a long while on the seemingly hairsplitting question of when exactly the new epoch should be said to begin, because that question proves to be a way of addressing the crucial issue of how geological designations can reflect the environmental history of the world over the last several centuries.

Those first three chapters describe how the idea of the Anthropocene can open up a window on geological time. The final two chapters offer a look through that window. The main part of each one is a broad-brush narrative time line. Chapter 4 surveys the Phanerozoic eon, the 541-million-year interval within which the Anthropocene ultimately belongs, and chapter 5 surveys the Holocene epoch, the Anthropocene's immediate predecessor. The aim of those narratives is to give life and significance to the geological timescales that are the necessary points of reference for the new epoch, timescales that might otherwise look blankly intimidating to many environmentally conscious people who do not happen to be professional geologists. Along the way, chapter 4 considers the place of *Homo sapiens* in deep time, and chapter 5 considers the place of civilization in the period since the end of the last ice age. In the conclusion, I tease out the political implications of the idea of the Anthropocene epoch. It can be both a polemical slogan and a conceptual basis for environmental politics. Talk of sustainability, and of respecting the ecological limits to growth, tends to imply a forlorn attempt to escape from temporal constraints. In contrast, a stratigraphic perspective makes the specifics of the present crisis the point of origin for

environmentalism. A politics grounded on the attempt to dwell within and to shape the terminal crisis of the Holocene epoch would be transnational in its spirit and committed to analyzing the inequalities of power that often trigger environmental catastrophe. Its aim would be to foster a raucously democratic pluralism in the ecosystems of the birth of the Anthropocene.

Versions of the Anthropocene

Since the beginning of this century, one way of referring to the crisis that I described in the previous chapter has become ever more popular and ever more controversial. The word *Anthropocene* has come into fashion, and in doing so it has picked up a variety of incompatible meanings, each implying different concepts and commitments. The word's complexity means that there is little to be gained by talking about "the Anthropocene" without specifying which version of it you mean. It is especially unfruitful to denounce the word in blanket terms if your real target is only one particular way of using it. Even so, and for understandable reasons, the concept of the Anthropocene has recently been indicted wholesale by a number of writers. Hostile critics have accused it of a domineering universalism: of downplaying the differences between Albertan oil barons and Malagasy subsistence fishers by suggesting that it is human beings in general who are responsible for ecological degradation. Thinking historically about how planetary systems operate, however, sheds a different light on the central issues in that controversy. I believe that one version of the Anthropocene in particular might prove to be a useful and enabling one for contemporary green politics. The stratigraphic approach to the Anthropocene, which contemplates

introducing the word as the name of a new interval in the geological timescale, provides a way of thinking about power relations as they exist both among human beings and between all kinds of geophysical forces.

“WE’RE NOT IN THE HOLOCENE ANYMORE”

As witnesses tell the story, it goes like this. At a conference on earth system science outside Mexico City, early in the last year of the twentieth century, participants talked about the Holocene, the geological time span that officially includes the present day. One listener apparently felt a sudden, curious revulsion. Paul Crutzen was an illustrious scholar of the earth sciences, most celebrated for work that enabled the discovery of the hole in the ozone layer. He had received the Nobel Prize in chemistry a few years earlier. Now he was struck simultaneously by a novel idea and by a word to express it. “Stop using the word *Holocene*,” he told the conference delegates. “We’re not in the Holocene anymore. We’re in the . . . the . . . the Anthropocene!” (The precise form of his words varies slightly from telling to telling.) The room fell quiet; “everyone was shocked.” Then a buzz of conversation arose. “Someone came up to Crutzen and suggested that he patent the term.”¹

The anecdote about Crutzen’s impulsive declaration offers a seductively memorable starting point for the study of the Anthropocene, a name evidently intended to mean something like “the human epoch.” But historians of science are constitutionally skeptical of Eureka moments, and the most convincing accounts of how scientific paradigms change usually give low priority to singular flashes of inspiration such as this. In this case, Crutzen himself has worked to make it clear that the emergence of the concept was more drawn-out and more complicated than the story about the conference might suggest. He swiftly wrote up his vision of the Anthropocene in the modest setting of the in-house newsletter of the International Geosphere-Biosphere Programme (the organizers of the Mexico conference) for May 2000. That brief article was coauthored with Eugene Stoermer, an American

ecologist—a student, principally, of photosynthesizing algae—because Crutzen had learned that Stoermer had been using the same term informally since the 1980s. Together, Crutzen and Stoermer listed earlier analogues to their theory: George Perkins Marsh’s prescient conservationist treatise *Man and Nature; or, Physical Geography as Modified by Human Action*; the declaration of the “Anthropozoic era” by the Italian geologist Antonio Stoppani in 1873; and the work of Vladimir Vernadsky, the pioneering theorist of the biosphere and of its culmination in a noosphere, or “sphere of reason.” Later they adduced the biologist E. O. Wilson, and the science writer Andrew Revkin, who offhandedly proposed an “Anthrocene” age in the early 1990s. Others have traced similar ideas back to the dawn of geological science, in the work of the eighteenth-century naturalist the Comte de Buffon.²

Crutzen and Stoermer’s article in the *IGBP Newsletter* made clear the grand scope of their idea. Barring some global catastrophe, they wrote, “mankind will remain a major geological force for many millennia, maybe millions of years to come.” Thus, “it seems to us more than appropriate to emphasize the central role of mankind in geology and ecology by proposing to use the term ‘anthropocene’ for the current geological epoch.” In their view the new epoch began in the late eighteenth century, when an appreciable rise in atmospheric methane and carbon dioxide levels began the season in which “the global effects of human activities have become clearly noticeable.” They added, “Such a starting date also coincides with James Watt’s invention of the steam engine in 1784.”³ It would turn out that the question of how to define the beginning of the Anthropocene could not, by any means, be resolved as easily as that. Even so, this first sketch of the human epoch is a document of enduring significance.

In January 2002 Crutzen recapitulated his view of the Anthropocene in a far more widely circulated journal, *Nature*. It is this article that best marks the emergence of the concept into widespread scientific awareness. To date, it

has been cited well over a thousand times. Although it was even shorter than the *Newsletter* discussion and said many of the same things, Crutzen found room for two important new points. The first was a brief acknowledgment, missing from the first piece, that the changes apparently bringing about a new epoch “have largely been caused by only 25% of the world population.” The second was a bold gesture toward the kind of “environmentally sustainable management” that might be suited to the Anthropocene: “This . . . may well involve internationally accepted, large-scale geo-engineering projects, for instance to ‘optimize’ climate.”⁴ Both of these themes—the need to recognize that people in different parts of the world have made very dissimilar contributions to global change, and a distinct inclination toward geoengineering as a way of dealing with global warming—would remain prominent in discussions of the Anthropocene.

Crutzen’s seminal *Nature* article is the canonical statement of the first version of the Anthropocene. The tone is clear, humane, and confident; cognizant of the power of technology; socially engaged, although not polemical; pessimistic but not despairing in its assessment of the state of the planet; and magisterial in the way that it evaluates the sum of human environmental influence. The concept of humanity’s epoch struck a chord, and the idea quickly began to circulate, filtering into a whole range of earth science disciplines and, before long, beyond them. Crutzen’s term began to appear in articles about human geography and geopolitics and in books for general audiences by environmental writers.

Many readers have continued to find things of value in the idea of the Anthropocene as it stood in those two early articles. But it is essential to any serious engagement with the Anthropocene to recognize that Stoermer’s and Crutzen’s first brief sketches do not by any means represent the only possible version of the concept, its unchanging real essence, or its true scientific meaning. On the contrary, the idea has been fissiparous from the start. Different fields have received it in various different ways. We can

perhaps speak of more or less mainstream accounts—provided we keep in mind that the consensus about what constitutes the mainstream can alter rapidly—but no single version of the Anthropocene can reasonably be described even as a generally dominant one.

The clearest illustration of that principle is the fact that Crutzen’s own ideas have changed significantly. In collaboration with the environmental historian John McNeill, among others, he came to argue that the Anthropocene began in a more piecemeal fashion than he had proposed at first. In his revised account, atmospheric CO₂ continues to serve as “a single, simple indicator to track the progression of the Anthropocene,” but the new epoch is said to have emerged in two stages. Stage 1 began in “the 1800–1850 period,” with the breakthrough development of fossil-fueled industrialization in Britain. But the revised account acknowledges that, until the middle of the nineteenth century, CO₂ concentrations did not in fact pass outside the range within which they had been fluctuating for ten thousand years. More generally, the new model characterizes stage 1 human environmental impacts as burgeoning rapidly rather than growing explosively. Truly vertiginous economic growth, in this account, was incipient in the period of high Victorian liberalism from the 1850s onward but was held back by the world wars and Great Depression. Stage 2 of the Anthropocene, then, begins with a “Great Acceleration” after 1945, when the momentum of the “human enterprise” multiplied precipitately. This analysis is based on a dozen much-reproduced graphs that show levels of population, worldwide GDP, fertilizer consumption, paper consumption, foreign direct investment, international tourism, and so on undergoing a nearly vertical takeoff in the middle of the twentieth century. For Crutzen and his colleagues, these graphs represent the Anthropocene’s transition from its larval to its adult stage, because they correlate with the exponential increase of human pressures on “Earth’s life-support system.”⁵ The Anthropocene in its full sense is even younger than it had at first appeared.

NEW MEANINGS

Crutzen's two versions of the Anthropocene were not alone. In the decade after the term was coined it was put to many other uses, and these embraced a far wider range of definitions. While Crutzen was moving the Anthropocene's start date closer to the present, another distinguished student of the planet's atmosphere was carrying it much further back. "The Anthropocene actually began thousands of years ago," William Ruddiman argued, "as a result of the discovery of agriculture and subsequent technological innovations in the practice of farming." Ice-core records seem to show anomalous greenhouse gas concentrations during the current interglacial, or warm spell between ice ages, compared to preceding ones. Guided ultimately by changes in the earth's position relative to the sun, these concentrations should have reached a peak not long after the last ice age and then trended downward, but instead CO₂ levels (from eight thousand years ago) and methane levels (from five thousand years ago) show a small, unexpected rise.

Humans, in Ruddiman's view, were responsible. Forest clearance in Eurasia for agriculture and fuel explains the CO₂ anomaly, an extra forty parts per million in the preindustrial atmosphere, and East Asian rice paddies produced the additional methane. Thus, preindustrial farmers unwittingly postponed the next ice age, which would otherwise have begun to take hold in northeast Canada thousands of years ago.⁶ It is a startling hypothesis, and one that has provoked much debate. At present the developing consensus is against it. Interglacials other than those on which Ruddiman focused provide better analogues to the present one, and they seem to make the changing composition of its air appear much less anomalous. Ruddiman himself, however, continues to hold the line on his early Anthropocene hypothesis. This version of the Anthropocene does have one important similarity to both of those proposed by Crutzen. In all three cases, the new epoch is understood as the time since human activities took atmospheric carbon dioxide levels outside the range they would have occupied in humans' absence. The

enormous difference in the dating of that change, however, points to the two scholars' radically opposed assessments of how humans have influenced the way the world works.

Many other early Anthropocenes, distinct from Ruddiman's, have also been proposed. One extreme in the dating of the epoch, at least so far, places its origin at 1.8 million years ago, at an earlyish date for the mastery of fire by hominins. The rationale is that this was the crucial technological achievement—because cooking renders the digestion of animal protein more efficient—that allowed for the evolution of a new line of large-brained, tool-using apes. Elsewhere the Anthropocene has been defined as the interval since the extinction of most genera of megafauna over most of the world, between about fifty thousand and ten thousand years ago, at the hands of newly arrived human hunters. Another, less bleak option identifies its onset with the domestication of animals and plants, making the Anthropocene approximately coeval with the Holocene and just a little older than Ruddiman suggested. Or the Anthropocene could be two millennia old and recognizable in the changes to much of the world's soil—through manuring, irrigation, terracing, and so on—associated with the empires of the time of Christ.⁷

Decisions about historical periodization very often encode deep interpretive commitments. In this case, the general rule is that the earlier the proposed starting date for the Anthropocene, the more emphasis its proponents place on human actions themselves, as opposed to the ecological consequences that follow from them. Bruce Smith and Melinda Zeder—supporters of an Anthropocene defined by species domestication—are the thinkers who take this position most explicitly. Smith and Zeder believe that one should identify the Anthropocene with the emergence of “significant human modification of the earth's ecosystems on a global scale,” rather than looking only for “massive and rapid . . . human impact” like that seen in the past two centuries. This lower bar implies a conceptual reversal. In a word,

“the focus should be on cause rather than effect, on human behaviour [rather than] environmental degradation.” For them, the Anthropocene is a way of naming the whole interval during which humans around the world have significantly shaped or engineered their habitats. Whereas Crutzen and Stoermer proposed the term as a framework for assessing the general state of the planetary system, Smith and Zeder employ it as a heuristic device for “gaining a greater understanding of the . . . role played by human societies in altering the earth’s biosphere.”⁸ Their focus is on the human capacity to change the world, not on the changes themselves.

Another version of the Anthropocene came about as the concept was picked up in the humanities. For scholars of politics and culture, the most obvious questions to ask are less about the origins of human environmental impact and more about the implications of the Anthropocene for social organization. The landmark contribution in this vein has come from the historian and postcolonial theorist Dipesh Chakrabarty. For Chakrabarty, the Anthropocene’s significance lies in the fact that postcolonial and Marxist scholars’ radical critiques of globalization, capitalism, and imperialism are all inadequate in confronting the idea of a new geological epoch. No matter how compelling they are on their own terms,

these critiques do not give us an adequate hold on human history once we accept that the crisis of climate change is here with us and may exist as part of this planet for much longer than capitalism. . . . A critique that is only a critique of capital is not sufficient for addressing questions relating to human history once the crisis of climate change has been acknowledged. . . . Whatever our socioeconomic and technological choices, whatever the rights we wish to celebrate as our freedom, we cannot afford to destabilize conditions (such as the temperature zone in which the planet exists) that work like boundary parameters of human existence.⁹

The Anthropocene, in this reading, means recognizing the fact that the environmental crisis constitutes a major challenge for the kind of politics

that resists the inequities of the existing world order. Yet Chakrabarty is not so cynical as to say that analyses of social and economic injustice must be abandoned under the pressure of the Anthropocene. “Critiques of capitalist globalization have *not*, in any way, become obsolete in the age of climate change,” he insists. But climate change means that on their own they are no longer enough. What he proposes instead is a double perspective, an attempt “to mix together the immiscible chronologies of capital and species history.” Historians still need to tell “the story of capital, the contingent history of our falling into the Anthropocene,” with its themes of liberation and injustice and its chronological range of several hundred years. At the same time, however, they now need to trace another longer, deeper history of human-kind as a species, and of human interactions with the rest of the planet’s life, over timescales of thousands and millions of years.

In the course of making this argument, Chakrabarty turned back to the first presentation of the idea of the Anthropocene. He cited, with qualified approval, the last two sentences of the article in the *IGBP Newsletter* with which Crutzen and Stoermer introduced the concept. That article concluded with a flourish. “To develop a world-wide accepted strategy leading to sustainability of ecosystems against human induced stresses will be one of the great future tasks of mankind,” Crutzen and Stoermer had written. “An exciting, but also difficult and daunting task lies ahead of the global research and engineering community to guide mankind towards global, sustainable, environmental management.”¹⁰

When Chakrabarty reproduced those sentences, the idea of the Anthropocene ran into trouble—because there is much to take issue with in the political standpoint implied by Crutzen and Stoermer’s words. A truly global community of researchers and engineers can hardly be said to exist, given how unevenly the money to support scientific research is distributed across the world. And it is plain that no one appointed such a community to the task of guiding “mankind” anywhere. The relevant researchers are a

disputatious body of thinkers and investigators, not vatic universal steersmen. Crutzen and Stoermer's hope that a single strategy for sustainability will be accepted worldwide likewise appears utopian at best. Who would have the power to declare that the world had accepted any given strategy, and what would happen to those who remained unwilling to agree? Perhaps most importantly, the pair's proposals for "environmental management" seem like exactly the way of thinking that the Anthropocene undermines. How can we plan for the "sustainability of ecosystems *against* human induced stresses" once we have recognized that most ecosystems have already been profoundly remodeled, with human activities placed in a central role? "Human induced stresses" are a part of the system, like the stresses brought on by the changing of the seasons. The managerialist belief that it is humankind's duty to regulate the natural world from the outside sits oddly with the recognition that the fundamental biogeochemical matrices of the planet are now fused with human activity. But when Chakrabarty repeated Crutzen and Stoermer's words in an essay on the future of postcolonial studies, it became clear that this line of thought was a tenacious feature of the discourse on the Anthropocene.

Chakrabarty's brief for a dual approach to environmental analysis, linking a critique of capitalist globalization to a longer history of humans as a species, was plainly an exciting one. But several of his readers came to suspect that the two strands of his approach could not readily be woven together in the way that he envisaged. Intertwining them sounds welcome, but what if the latter (species-based) one just encircles and subsumes the former (political) one? Chakrabarty's initially unwary invocations of the "shared catastrophe that we have all fallen into" as the basis for a "new universal history of humans" suggested that that danger was real. "Unlike in the crises of capitalism," he wrote, "there are no lifeboats here for the rich and the privileged (witness the drought in Australia or recent fires in the wealthy neighborhoods of California)."¹¹ A rich Californian whose house burns down

faces emotional trauma and a home insurance excess, but she hardly shares the experience of a drought-stricken cattle pastoralist in South Sudan. “No lifeboats”? As Chakrabarty’s critics have been happy to point out, this is untrue both literally and metaphorically. The militarization of disaster areas like Katrina-struck New Orleans, and the financialization of catastrophe through disaster reinsurance, have already proved capable of preserving—indeed reinforcing—capitalist hierarchies in zones of ecological emergency. In the eyes of his critics, then, Chakrabarty had been drawn away by Crutzen and Stoermer’s seductive idea from some of the indispensable tenets of postcolonial studies.

THE BACKLASH

Chakrabarty’s groundbreaking discussions of the Anthropocene have become a lightning rod for attacks on the whole concept of the human epoch. In the years since his first essay on the subject appeared in 2009, the idea of the Anthropocene has become both much more widely employed and much more widely criticized. The concept started to reach the mainstream in 2011. A collection of essays on the topic appeared that year in a themed issue of the *Philosophical Transactions of the Royal Society*. There, Crutzen and his collaborators reflected on how the word had spread over the previous decade. “Since its introduction,” they wrote, “the term Anthropocene has become widely accepted in the global change research community, and is now occasionally mentioned in articles in popular media on climate change or other global environmental issues.”¹² Had they been writing a few years later, they could have noted much more than such occasional mentions. The year 2011 itself saw a flurry of major conferences, as well as enthusiastic feature articles in *Science*, *National Geographic*, the *Economist*, and elsewhere, and the term began to crop up regularly in newspapers for the first time. Since then, there have been museum exhibitions and radio programs, academic research networks and chapters in textbooks, and, most remarkably,

no fewer than three new scholarly journals: students of the new epoch may now turn to the *Anthropocene Review* (which has swiftly become the leading forum for discussion of the concept), *Anthropocene*, and *Elementa: Science of the Anthropocene*.

The Anthropocene has become fashionable in academic circles—very fashionable, in fact. In principle any discussion of anything that has taken place in the last few hundred years or so can be tagged with the phrase “. . . in the Anthropocene” and thereby made to sound (however transiently) up to date. The organizers of the latest conferences on the topic struggle to accommodate presentations of the most diverse and miscellaneous kind. Various words have been coined on the Anthropocene model: *Capitalocene*, *Sustainocene*, *Cosmoscene*, *Econocene*, *Homogenocene*. Some scholars, inevitably, have even decided that the time has come to speak of the “post-Anthropocene.” And as the word itself has come into prominence, so the backlash has developed. If the concept has been associated with the idea that the whole world must be “guided” into adopting a single approach to environmental management, or with the claim that global warming’s floodwaters will bear “no lifeboats” for the rich, then some suspicion is understandable. The opponents of the Anthropocene have warned that the whole notion may be politically naive if not implicitly unjust, and may diminish rather than improve the chances of equitable and efficacious responses to ecological crisis.

The argument against the Anthropocene is by now well established.¹³ In two words, the accusation is that the idea is universalist and technocratic. It is universalist because it makes it sound as if we are all in this predicament together. It neglects humanity’s division into a multitude of unequal social groups, and the ways in which wealth, nationality, ethnicity, gender, class, and so on mediate the relationships between those groups. In its simplifying view, the human species—the *anthropos* in general—becomes instead an abstract, homogeneous mass, collectively damaging the planet through

vaguely defined habits of industrialization, resource exploitation, and over-consumption. Those habits are supposed to put at risk the well-being of the whole human race, meaning that the only solution is to set aside class resentment and work together as one for the greater good of the whole. The Anthropocene wrongly implies that humanity is united in culpability, in vulnerability, and in the need for self-protection. For the opponents of the concept, that makes it an essentially bourgeois idea. It performs the archetypal bourgeois maneuver of representing the sectional interests of a single group as being in everybody's interests. It comforts the prosperous with the thought that blame attaches collectively to all human beings. Thus it lends itself to a blinkered preoccupation with overpopulation as the supposed root of all the world's ills, which means blaming the poor for a crisis to which they have in fact contributed very little.

According to this critical view, scholars of the Anthropocene rely upon a simplified, one-step model of historical change whereby the Holocene epoch was replaced everywhere and all at once by a human-controlled earth system. Their attempts to attach a date to that transition are bound to prove futile, because in reality different parts of the world have undergone very different experiences of modernization and development at very different times. But the Anthropocene deals only in aggregate environmental consequences, pushing the subtleties of causation into the shadows. That makes it deterministic: it presents human nature itself, the technological impulse of the *anthropos*, as a full and adequate explanation for the course of history. The Anthropocene theory of history is correspondingly depoliticized and preoccupied with scientific inventions. It fetishizes the Industrial Revolution as the sole origin of modernity; and in doing so, it misrepresents that revolution as simply a technological leap forward, neglecting industrialization's economic underpinnings. In a skeptical analysis, this habitual occlusion by Anthropocene enthusiasts of the politics of empire and capitalism is itself a deeply political act. Choosing this way of understanding the crisis

predetermines the kind of solutions that will be proposed: modernist, high-tech, top-down ones. It is no coincidence that Crutzen himself has been among the world's most prominent advocates for geoengineering. The discourse of the Anthropocene is technocratic because it makes it sound as if there is no alternative to the rule of experts. It is a counsel of despair, sacrificing freedom and wilderness to managerial diktat. It implies that if we are to survive, then those who make political decisions must defer to a scientific and technical elite, who can specify the objective physical constraints on how humanity may make use of its life-support systems.

For those reasons, its critics charge, the concept of the Anthropocene can be suspected of a general affinity with approaches to rationing—of carbon emissions, fish quotas, and so on—that suit the developed world much better than the poor. It is an intellectual bedfellow of those hapless regulatory regimes that seek to conserve ecosystems by commoditizing them, like ecosystem-services markets and the European Union's chaotic emissions-trading scheme. At worst, it could lend an air of respectability to a process of environmental triage that would calmly sacrifice Tuvalu and the Marshall Islands to the greater good. Most fundamentally, though, it plays a philosophical double game. It pretends to describe human beings merging into nature as a geologic force, but in fact it is deeply dualistic. In portraying humans as a unified species—as the bearers of a singular human essence—it singles them out from the rest of the world. It sets the Anthropocene, the artificial age made by humans, squarely against the entire natural history of the world that preceded it.

That, or something like it, has been the standard critique of the Anthropocene so far. Gerda Roelvink sums it up: “In their announcement of the Anthropocene, scientists are calling us to consider ourselves not as a number of different groups but as a single, universal, and transhistorical collective—as a species. . . . This understanding of species fits all too easily with the modernist assumption of human mastery over nature.”¹⁴ Humanity reduced

to an undifferentiated species, and such species thinking as a warrant for depoliticized, technology-driven management of “nature”: that is the danger of the Anthropocene.

Yet Roelvink’s complaint can be turned straight back against her. Her accusation itself takes “scientists” for nothing other than “a single, universal, and transhistorical collective” serving the interests of human mastery over nature. As we have seen, the reality is that researchers who have worked with the idea of the Anthropocene are, emphatically, members of “a number of different groups” much given to disagreeing with one another and to changing their minds about things. Not all takes on the Anthropocene are the same. Some are universalist and technocratic. Others, I argue, are quite the contrary. The crucial flaw in the case against the Anthropocene has been a widespread failure to recognize that the word *Anthropocene* does not express any single, agreed-upon idea. Instead, by the time the backlash started the term had already taken on a considerable number of mutually irreconcilable senses. Worse still, critiques of the politics of the Anthropocene have mostly aimed their fire at the simplest and most sketchily formed version of the concept, the first-draft Anthropocene of Crutzen and Stoermer’s original *Newsletter* article and Crutzen’s brief 2002 follow-up in *Nature*. Otherwise thoughtful dissents have taken those two texts as adequate representatives of Anthropocene thinking as a whole, or even been so naive as to assume that what is found there *is* the theory of the Anthropocene, its only possible form. The stronger charges may well be unfair even to those texts, which are provisional and suggestive enough to be interpreted in several different lights. But in any case there is little to suggest that every possible version of the Anthropocene is politically compromised in the same way.

The skeptical responses to the Anthropocene from some theorists of politics and social difference need not persuade anyone to abandon the term, but they should make researchers who draw on it refine and sharpen their

analysis. The charges that the idea of the new epoch might stigmatize the poor, pander to elitist technocratic fantasies, disguise political or historical realities, or work against equitable responses to environmental problems are unsettling ones. They demand to be taken very seriously indeed. Any worthwhile version of the Anthropocene has to be underpinned by a historically nuanced account of how power relations operate, both across the earth system as a whole and between human beings. Scholars working in fields like postcolonial studies can make a vital contribution to that way of framing the new epoch. In what follows I have kept in mind the radical critique of the Anthropocene and sought to avoid speaking of humankind as an undifferentiated whole.

After all, there is still plenty to gain from rethinking the meaning of the Anthropocene. Even if the term has already passed further into popular awareness than any other geological concept since plate tectonics, its rise is probably far from complete as yet. Certainly, it is a sufficiently large and bold idea to bear a level of scrutiny many times greater than it has received so far. At the time of this writing, journalists still never use the word for a general audience without glossing its meaning, and it was canonized by an entry in the *Oxford English Dictionary* only in the summer of 2014. The environmental crisis has pushed into the limelight a whole series of words and phrases that condense the meaning of various contested concepts. All problematic in their way, they nevertheless show how language has been reshaped in the effort to come to terms with that crisis: *global warming*, *acid rain*, *the hole in the ozone layer*, *biodiversity*, *sustainable development*, *carbon footprint*. As yet, all of those terms are far more familiar than *the Anthropocene epoch*, even though the latter is as far-reaching a concept as any. But it remains to be seen whether the Anthropocene will exert a galvanizing force on public debate, as talk of the ozone hole did in the 1980s, or if it will instead become distracting and even misleading, as has become the case with invocations of “sustainable development.”

GEOLOGICAL LIFE

Worthwhile accounts of the Anthropocene will be ones that illuminate instead of obfuscating the patterns of human-caused environmental change. Those patterns are political through and through. To find a way forward, then, it might be best to go back to the most important texts in the controversy about the politics of the Anthropocene and to reread Dipesh Chakrabarty's work. No objection to the Anthropocene has yet found a way of dealing with the central challenge that Chakrabarty poses. He recognizes that resistance to current forms of capitalist globalization, and to their profit-driven exploitation of disempowered communities and vulnerable ecosystems, is a prerequisite for the creation of a livable and equitable world. But he insists—convincingly—that anticapitalist resistance is not sufficient to that end. The environmental disaster is bigger than capitalism. It destabilizes “boundary parameters of existence” that are independent of the logic of capitalism. It involves climate changes that will almost certainly continue for far longer than capitalism as we know it. It has been caused by industrializing socialist states as well as by the Western powers.

For Chakrabarty, the Anthropocene signifies the division and incompatibility between the two problems of “globalization and global warming.” The latter problem exists on a deeper level than the former, and it affects humankind en masse. Just revealing potential ill effects of the Anthropocene narrative, as Roelvink and others try to do, does not get rid of that division. In other words, even if the Anthropocene really does have unwelcome political consequences like stigmatizing the poor and promoting antidemocratic techno-fixes, it still might accurately describe the grim implications of the fact that all living conditions on the planet are under threat. So it looks as if we are faced with an impasse. Justified hostility to the claim that “we’re all in it together” versus justified recognition that equal fossil-fueled prosperity for everybody appears ecologically impossible. The time of modernity versus the epoch of humankind. The political history of capital versus the

geophysical history of carbon. Is this deadlock the end of the road for the idea of the Anthropocene?

No. The alternative is to reconceive the Anthropocene not as a signal of built-in contradiction and conflict between radical social critique and species thinking but as the very concept that unites the two. The birth of the new epoch is, precisely, an opportunity to think about human and nonhuman power relations simultaneously. The way to revise Chakrabarty's analysis, and to take it forward in a new direction, is to question or destabilize a distinction that was implicit throughout his early work on the Anthropocene. This is the distinction between life and nonliving matter. That distinction seems at first to constitute a stable and unambiguous binary opposition; but in another light, life and nonlife appear only as different moments within the interwoven cycles through which the earth system functions.

We can see the importance of the life/nonlife distinction to Chakrabarty's thought in passages like the following: "Climate scientists posit that the human being has become something much larger than the simple biological agent that he or she always has been. Humans now wield a geological force. . . . Humans are biological agents, both collectively and as individuals. They have always been so. . . . But we can become geological agents only historically and collectively."¹⁵ This conception lies at the heart of the story that Chakrabarty tells. The Anthropocene, for him, is the result of this rupture in which humans were transformed from merely "biological" agents into a power that is both biological and "geological." Marxist, postcolonialist, and environmental-justice thinkers deal adequately with humans insofar as they are biological creatures like all other species, but their approaches are inadequate to humans considered in their modern collective or "universal" form as a geological force. To put it more explicitly still: as well as our biological existence, "we now also have a mode of existence in which we—collectively and as a geophysical force and in ways we cannot experience ourselves—are 'indifferent' or 'neutral' . . . to questions of intrahuman

justice.” Humans have become a “nonhuman, nonliving agency,” in “a collective mode of existence that is justice-blind.”¹⁶ The opposition that Chakrabarty set up between the Anthropocene and the politics of liberation stemmed fundamentally from the way he envisaged this historical switch from the biological to the geological, from the living to the nonliving.

This seemingly clear binary contrast is, nonetheless, an incomplete, temporary, and conditional one. We can see that by thinking about the agencies that actually participate in the earth system. It might appear that the planet’s workings are (or that they were, before humans) made up firstly of an inanimate geological base or framework, composed of phenomena like plate tectonics, volcanism, climate, erosion, and sedimentation; and secondly of a decorative organic superstructure, both supported and determined by the geophysical realities to which it is obliged to accommodate itself. It is true, after all, that the earth’s biomass is tiny compared to the mass of its atmosphere, water, or rock layers. Nonetheless, that way of thinking has to a great extent been swept away by recent students of the earth’s systems. Earth, in contrast to dead planets like Venus, has remained far out of chemical equilibrium for billions of years. It does so because life has now been an integral part of the planet’s makeup for more than three-quarters of its existence.

Living organisms are concentrated at the active interfaces between the atmosphere, hydrosphere, and lithosphere. And chemical processing in the biosphere is usually far more rapid than elsewhere, as organisms photosynthesize, eat, respire, excrete, and die. For those reasons, many of the main cycles through which the planet functions are *biogeochemical* ones in which life and inorganic processes are inextricably combined. The earth operates in entangled loops of carbon, nitrogen, calcium, oxygen, water, phosphorus, and so on. Those loops involve journeys that pass through living bodies or that are facilitated by organic processes. The erosion of rock is the deep, fundamental driver of the carbon cycle and is a basic part of the plate tectonic

cycle. It is forcefully accelerated by the bacteria, lichens, and fungi that eat away at stone surfaces. The atmosphere contains reactive oxygen only because oxygen has been excreted by bacteria for more than two billion years. The production of free oxygen, alongside other biological processes, brought perhaps as many as two-thirds of the earth's (nonanthropogenic) minerals into being.

Living things shape rivers and coastlines by colonizing and stabilizing sediments. They accumulate into landscape-size geological features: soil, peat bogs, coal seams, limestone cliffs. The hydrological cycle involves plant transpiration, water capture in vegetation-dependent soils, and gas emissions from algae that inflect cloud formation. Ice ages seem to be brought about partly through the operation of a “biological pump.” In this mechanism, small changes in the earth's position relative to the sun increase the heat differential between tropics and poles, so that stronger winds blow between them and carry more iron- and nutrient-bearing dust into the oceans. That dust fertilizes microorganisms whose calcium- and carbon-rich bodies and shells sink when they die (or when they are eaten and excreted), thus sequestering carbon from the atmosphere and chilling the whole planet. The albedo, or reflectivity, of a land surface depends upon the vegetation by which it is covered; its albedo partly governs temperature and precipitation levels, and these climatic factors in turn influence the evolution of the vegetation. The presence or absence of large herbivores can dramatically alter the ground cover. Thus those herbivores too are geological forces, just like earthworms and beavers.

In short, life has *always* been a geophysical force; equally, the geology of the earth, unlike that of Venus, has been influenced by the laws of biological evolution for an inordinate length of time. The “biological agents” to which Chakrabarty referred have always been “geological agents” as well, and it is a rare “nonliving agency” that does not have a trace of life about it. (Indeed, the very existence of life demonstrates that self-replicating systems can

emerge out of inorganic chemical processes.) Living things on the one hand, and geophysical things like rocks and climate on the other, are, at root, inseparable parts of the ecological cycles that operate on and around the surface of the earth. Biological and geological phenomena are not two different kinds of being upon which two different regimes of politics might be founded. Although the birth of the Anthropocene does change the way in which the forces of life and of geophysics are arranged, it does not affect their underlying unity.¹⁷

Chakrabarty conceived of the human species as leaping across a divide from the biological to the biological-and-geological, and he proposed that one side meant politics whereas the other side meant both politics and apolitical collective action. A consideration of the makeup of the earth's biogeochemical systems obliterates that divide. What looked at first like a difference of kind between life and nonlife becomes only a difference of scale between kindred geophysical forces—and indeed Chakrabarty's own recent work has turned to focus more explicitly on such questions of scale.¹⁸ The consequence is that the deadlock between politics and the Anthropocene no longer stands. As that deadlock vanishes in the stronger light of history, it becomes possible to see plainly both the drawback of Chakrabarty's analysis and the great importance of his central insight. He was right—and boldly pioneering—to declare that emancipatory politics in the twenty-first century must undergo a challenging alteration as the result of an upheaval in the geological condition of the earth. But it is not the case, thankfully, that such geological upheavals belong on a plane entirely different from that of the normal struggles for advantage that go on constantly between living things. On the contrary, the two have always been knitted together throughout the planet's ecological systems. And struggles for advantage between living things are what politics deals with.

Politics is the right mode in which to address geological problems after all. It need not be circumscribed or replaced by a geological way of seeing

that treats species as undifferentiated wholes, because the geological way of seeing is itself political. Instead of opposition, there is continuity. Struggles between humans, from wage bargaining in Cuba to electoral corruption in Albania, are plainly political matters. Struggles involving both human and nonhuman lives, from the patenting of rice genes in America to the seizure by gunmen of South Korean ships fishing illegally off Somalia, are equally political. And no less political than either of these are struggles involving geophysical forces, from earthquakes triggered by groundwater extraction in Spain to the effects of pollution on the Indian monsoon. Normative analysis, blind neither to justice nor to injustice, is equally relevant at every stage. The birth of the Anthropocene is a many-sided disruption and reconfiguration of innumerable relationships within the earth system. Nothing about it should tempt us to ignore the fact that human-to-human relationships are among those being disrupted and reconfigured.

The Anthropocene does not, after all, require a turn away from the critique of sociopolitical power relations (globalization, capitalism, imperialism, and so on) toward a universal history of the human species. Instead, to understand the Anthropocene means widening the focus of sociopolitical critique and working toward *an analysis of the power relations between geophysical actors, both human and nonhuman*. It is much easier to propose this wide-angled analysis than to put it into practice, of course. But at least it does not mean abandoning the core concerns of postcolonial studies and global justice movements.

Understanding the Anthropocene depends on getting beyond interpretations of contemporary world politics that remain confined by the idea of the human (by a concern with economics, discourse, identity, and so on defined solely in human terms)—but broad interpretations of modernity that fail to take environmental factors into account are plainly inadequate, anyway. By contrast, even if political ecologists and scholars of the Anthropocene have started off on the wrong foot, they can get back on good terms

as soon as both sides agree that when they talk about power relations they will sometimes mean the relations among geophysical forces, and sometimes the relations among people (which are also a type of geophysical force). They will pay attention to power relations like those determining the energy content of Hadley cells as they yield or withhold rain over water-stressed grasslands, and the balance of forces between friction and gravity in glaciers as they head toward the sea. They will recognize that contests like those cannot neatly be separated these days from other power relations, like the fluctuating influence of the Dinant Corporation over the democratic process in Honduras, the capacity of Dow Chemical to obstruct Indian corporate liability law over Bhopal, or the ability of Thai fishing peoples to defy government efforts to seize their land in the wake of a tsunami.

As I have stressed throughout this chapter, though, different conceptions of the Anthropocene have very different implications. If we want to trace the birth of the new epoch as a shifting, interwoven play of ecological powers, we will need to choose carefully the version of the Anthropocene that best enables such an analysis. No doubt there are plenty of options. If there are many interpretations of the Anthropocene, and if only some of them are politically counterproductive or philosophically incoherent, then there should still be several different ways of thinking about the Anthropocene that are stimulating and worthwhile. I do not want to be exclusive, then, but only selective, if from this point onward I focus on just a single conception of the new epoch.

We have seen that the unnerving conclusions drawn by Dipesh Chakrabarty can be set to one side by reflecting on geohistorical processes. That suggests it is well worth considering the Anthropocene specifically as a phenomenon in earth history. The rest of this book deals with a version of the Anthropocene that takes Crutzen's original proposal more literally than Crutzen himself seems to have intended. Perhaps a new epoch is indeed beginning, in the formal geological sense of that word.

THE STRATIGRAPHIC TURN

“We are assembled,” wrote the stratigrapher Jan Zalasiewicz in December 2009, “to critically consider the case for a formal Anthropocene, and to make recommendations to our parent body (the Subcommittee on Quaternary Stratigraphy [SQS] of the International Commission on Stratigraphy [ICS]), through them to the ICS itself, and then on to its parent body, the International Union of Geological Sciences (IUGS).” The fellowship assembled for this purpose was the new Working Group on the Anthropocene, chaired by Zalasiewicz. The significance of its remit was out of all proportion to the simplicity of its organization (“We do not have a budget,” the chair reminded the group).¹⁹ For that reason, this nested thicket of abbreviations is well worth disentangling.

The IUGS is one of the world’s major scientific organizations, the professional representative body of a million earth scientists. The Commission on Stratigraphy is its largest constituent part, an organization that is essentially dedicated to finessing the one-page diagram that underpins geological science. That diagram is the International Chronostratigraphic Chart, the embodiment of the geological timescale that sets out how the history of the earth is formally divided.²⁰ Condensing the whole body of stratigraphic research, the chart defines, names, and dates each recognized major interval of geologic time and determines their hierarchical status and the way in which they fit inside one another. (Even putting the Anthropocene aside, disputes about where the divisions should go sometimes convulse the geological community. Stratigraphers, like poets, take naming seriously.) Definition ideally involves selecting a change—usually the appearance or disappearance of a fossil species—in a single column of rock somewhere on earth that can represent an interval’s starting point. Take the Oligocene epoch of 34 to 23 million years ago, in which the mighty tropical rain forests of the postdinosaur epochs receded and the modern Antarctic ice sheets formed. The Commission on Stratigraphy defines its moment of origin as that of the

formation of a layer of rock now found partway up a quarry on Mount Conero, Italy, “at the base of a greenish-grey 0.5m thick marl bed.”²¹

The Commission on Stratigraphy operates some sixteen subcommittees. The correlation of stratigraphic data for the last 2.6 million years is the job of the Subcommittee on Quaternary Stratigraphy. It was at the request of this last body that Zalasiewicz and the paleobiologist Mark Williams—then occupants of next-door offices at the University of Leicester—set up the unfunded Anthropocene Working Group, which in practice consists of forty academics, Crutzen among them, communicating mostly by email. “The work involved should not be onerous,” they told potential participants. “However, it should be interesting, and of use to the scientific community.”²² With this gentle flattery, the idea of the Anthropocene underwent a crucial transition.

Crutzen’s inspired outburst, “We’re not in the Holocene anymore. We’re in the . . . the . . . the Anthropocene!” had implicitly been a claim about stratigraphy, an alternative to the definitions laid down by the International Commission on Stratigraphy. But it is clear from his two foundational articles that assembling a brief for an actual revision of the Commission’s great chart of earth time was by no means his priority. His own expertise was in atmospheric chemistry, and as the concept percolated through specialist literatures over the next few years, geologists themselves used the term relatively infrequently. The move toward stratigraphic formalization began with an article coauthored by twenty-one members of the Geological Society of London—not as large as the IUGS, but the oldest geological society in the world—with Zalasiewicz at their head. What had hitherto been a “vivid but informal metaphor,” they wrote, could equally be scrutinized according to the “criteria used to set up new epochs.” If the Anthropocene met those criteria, as seemed quite possible, the International Chronostratigraphic Chart might be amended accordingly.²³ The article marked a significant new departure from Crutzen’s original idea and from all the ways in which that

idea had previously been received. The working group was the result of that proposal.

Many things follow from this attempt to take the Anthropocene so literally as to incorporate it into the geological timescale, to turn it into a formal unit of geohistory. In Smith and Zeder's terms, it makes for an Anthropocene that is defined by *effects* rather than by *causes*—and by its effects not primarily for human beings but for the earth's ecological assemblage as a whole. What Zalasiewicz contemplated, in essence, was a way in which to carry out a profound displacement of the human in thinking about the Anthropocene. One would start not with human influences on the environment, not with an attribution of responsibility or blame, but with the fact of ecological change as such. So many changes, of specified magnitude, to this or that geophysical phenomenon: the sedimentation of rivers, the population distribution of phytoplankton, the acidity of oceans, the pollen content of the air. This suite of changes would then be weighed and interpreted, and their interactions reconstructed—at this stage analyzing the interspecies and intraspecies relationships of one very populous hominoid species would be crucial—in order to assess whether, and in what way, they could be said to constitute the beginning of a new epoch. Look at the earth system changes first, and let them lead you, as they undoubtedly will, to an ecology of the human species. Then pass beyond the confines of the human again, in order to grasp these processes of transformation in the terms of geologic time. This is what the stratigraphers proposed.

In order to carry out this immense conceptual displacement, a certain indirectness is needed. Instead of assessing the type and scale of present-day ecological change directly, and deciding on that basis whether the Anthropocene label is justified, one must imaginatively transfer oneself to the far future. After all, the beginning of every other epoch has been defined in distant retrospect. Stratigraphers of the Anthropocene must concentrate much less on how dramatic any given environmental change is at present

than on how readily discernible it will be millions of years from now, which largely means how well traces of it will be preserved in sedimentary rocks. Some bureaucratic oddities follow from this. For instance, because marine and lacustrine deposits are usually much better preserved than those on land (which the weather erodes), stratigraphers generally focus their attention on the rock layers that build up at the bottom of oceans and lakes. Likewise, stratigraphy prioritizes hard-bodied organisms, which fossilize far more readily than soft-bodied ones, and it emphasizes the species at the base of past food pyramids over the much less abundant apex predators.

Songbirds, squid, and big cats, for those reasons, are in themselves poor stratigraphic markers for the Anthropocene. Environmentalists who are justifiably concerned about their survival might be perplexed by stratigraphers' preoccupation with fluctuations in the distribution of calcareous and siliceous marine microorganisms. But the infinitely complex interlocking of ecosystem processes means that this is much less of a problem than it first appears. Disturbances at one level will often have repercussions in another. The near-total collapse of the gargantuan Newfoundland cod population, caused by industrial overfishing, might be visible in the fossil record not directly but through changing species compositions near the bottom of the food web, where zooplankton numbers have come under pressure from booming populations of the foraging capelin that the cod once preyed upon. Levels of world GDP and of foreign direct investment—things to which Crutzen and McNeill's version of the Anthropocene gave priority—do not fossilize. By circuitous routes, however, they affect the things that do. The stratigraphic approach to defining the indicators of the Anthropocene is at once the subtlest and the most concrete of the many that have been proposed.

A second concomitant of the stratigraphic method might be equally hard to swallow at first. Stratigraphers like the dates for the beginning of new intervals to be singular, worldwide, and as exact as possible. In the present case, they have generally envisaged a formalized Anthropocene with one

particular year specified as its starting point. And although a variety of candidate years have been discussed, all of them are relatively recent ones. In line with the Smith and Zeder rule that a focus on worldwide environmental effects rather than causes implies a young Anthropocene, the stratigraphers' proposed start dates all fall within the last few centuries. Opponents of the Anthropocene have generally denounced this way of dating the new epoch as a gross simplification, one that neglects both the deep roots of ecological change and the gradual and geographically variable nature of industrial modernization. But perhaps those opponents have not yet asked themselves whether they really wish to accuse geologists of being intellectually uncomfortable with the idea of long-drawn-out change. As we will see, the stratigraphic version of the Anthropocene does not remotely imply a one-step model of environmental transformation.

I have argued in this chapter that several different versions of the Anthropocene are possible. Still other uses of the term will no doubt emerge in the future. But the turn toward stratigraphic formalization provides the most fertile way so far to interpret this epoch-making play of power relations among human and nonhuman forces. The stratigraphic approach reinvents the Anthropocene by giving it a place amid the complex mosaic of the geological timescale. What remains is to elucidate the stratigraphic conception of the new epoch and to use that conception as a way of changing the debate about the politics of the Anthropocene. Taking our cue from the geologists will mean paying attention to the lineaments of a history that goes back much further than 1784, even if a date like that eventually proves to be a good candidate for the epoch's formal starting point. To interpret the Anthropocene stratigraphically means placing it in the context of geological time. This is the method that will help us see why contemporary environmental problems have started to load the pages of daily newspapers with references to the events of a hundred thousand or three million years ago.

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