Introduction: The Growing Anthropocene Consensus

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This book aims to get the Anthropocene right in three senses. First, it conveys the scientific evidence of our altered Earth, showcasing how the concept of the Anthropocene captures the magnitude and complexity of the planet's dangerous transformation. Second, we try to get the Anthropocene right in human terms, exploring the kaleidoscope of experiences, contingencies, and decisions that led to the Anthropocene, from the deep history of our relationship with infectious diseases to recent nuclear disasters. These histories are echoed and expanded through fiction with two short stories bringing the vast scales of geology and Earth System science "to earth" in emotional and ethical terms, especially around the issues of colonialism and inequality. Finally, we talk about what hope might look like in this pretty hopeless situation, proposing mutualistic cities, greater equity, and new political forms. "Right" in this book means being as *accurate* as possible in describing the physical phenomenon of the Anthropocene; as *balanced* as possible in weighing the complex human developments, some willed and some unintended, that led to this predicament; and as *just* as possible in envisioning potential futures.

In other words, this book brings together many stories about our singular situation. Deep-time narratives plunge us back to Earth's origins and trace our species' long struggle with dangerous microbes. Narratives on shorter timescales unfold the way Earth System scientists have come to see our planet; the way the indigenous people see the winds sweeping over a Mexican isthmus; and how different modern political systems shape the natural world. The nuclear disaster at Chernobyl and tiny Crawford Lake in Canada make star appearances. Imaginative tales of a

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fleeing spaceship, a living mountain, and flourishing futuristic cities also figure here. We even get a hands-on account of reorienting a cultural institution to absorb the startling truth that global cultures and planetary change have converged. What holds all these tales together? In a nutshell, the *reality* of the Anthropocene. Recent discoveries show that in the mid-twentieth century, Earth entered a different – and, for human beings, difficult – new stage due to things people have done and in all too many cases are still doing. To try to make sense of this human-altered Earth, the contributors here – scientists, humanists, social scientists, writers, and institution builders – have joined together to tell stories of our transformed world. We represent a democracy of voices, all responding to a single, shared, complex danger.

But what is the "Anthropocene"? In some ways it is an accidental concept, a high-profile improvisation made in 2000 by the Nobel Laureate and atmospheric chemist Paul Crutzen (though the term and concept had been used independently, in a more low-key manner, by biologist Eugene Stoermer). Accidental or not, this concept crystallized the growing perception of global change, set in train by human activities. So great is this change that Crutzen suggested a new geological epoch. Just two decades on, overwhelming evidence has been assembled to show that around 1950 our planet entered another distinct chapter in its approximately 4.54-billion-year history. The complex, integrated Earth System has moved away from the relative stability of the Holocene epoch to a less stable, less benign, and still evolving phase with, in many ways, no precedent in Earth's long history.[1]

Humans will not find it easy to live in the Anthropocene. It now seems clear that life as we have experienced it for the last ~12 millennia (known

[1] Earth System science approaches Earth as a single, integrated system in which the atmosphere, hydrosphere, cryosphere, lithosphere, pedosphere, and biosphere – and now the human sphere – mutually impact one another in complex ways. See Will Steffen, Katherine Richardson, Johan Rockström, et al., "The emergence and evolution of Earth System science," *Nature Reviews Earth & Environment* 2020; 1, 54–63. https://doi.org/10.1038/s43017-019-0005-6. In this book, we follow the convention of capitalizing both "Earth" and "System" to make it a proper noun, as explained by Will Steffen in "The evolution of Earth System science," blog post, *Future Earth* (December 14, 2015): https://futureearth.org/2015/12/14/the-evolution-of-earth-system-science/

as the Holocene) is going to be changing very rapidly, and largely for the worse. The air carries a third more carbon dioxide and so the climate will, almost certainly, soon be hotter than it has ever been in the history of *Homo sapiens*. The seas are rising. Global biodiversity is shrinking rapidly, thinning our life support system. People weren't around 65 million years ago when the last great extinction event occurred, but now our numbers and needs leave little habitat for other species. Fresh water is becoming scarce. Topsoil is being lost at the rate of at least 36 billion tons every year, endangering food supplies.[2] The pressure on the systems that nurture, shelter, and fuel us will become ever more intense in the years to come as human populations and demands rise. These intensifying pressures will impact our societies unevenly and unfairly, but no part of the globe will be unchanged.

The Anthropocene, with these novel ingredients, is a very new part of Earth's history, but to make sense of it, we need to look at more than the last few decades. We need to place it in the context of our planet's past, beginning roughly 4.54 billion years ago. We also need to place it in relation to the deep past of human history, in which *Homo sapiens* evolved some 300,000 years ago, to emerge slowly as a dominant force and then to explode into a planet-changing species in the mid-twentieth century. The extraordinary transformations of the Earth System that we are seeing today have taken place, effectively, within a single human lifetime. In terms of speed of change, the nearest comparison in the last half-billion years of Earth history is the meteorite impact that brought the Mesozoic Era to an abrupt close. Suddenly the age of dinosaurs was at an end. Now *we* are the meteorite, and it seems just as difficult to alter our trajectory as it would be to alter the course of a ten-kilometer-wide rock hurtling through space.

Understanding this very recent, massive human impact means explaining how the long course of human history formed a platform for the recent rise of the powerful anthropogenic forces that accelerated Earth's transformation in the twentieth century. As we examine the

[2] Pasquale Borrelli, David A. Robinson, Larissa R. Fleischer, et al., "An assessment of the global impact of 21st century land use change on soil erosion," *Nature Communications* 2017; 8 (1) DOI: 10.1038/s41467-017-02142-7

narrative leading from the earliest patterns of humankind to the vertiginous growth of economies, inequality, and human populations, we also seek stories that resist this destructive trajectory. Not all individual actions nor all social systems pushed the Earth System beyond Holocene norms. Some were mutualistic with their environment. These counterpoints to the dominant trajectory are also Anthropocene stories. They suggest that our arrival at this new epoch was not foreordained. Further, they provide political and cultural resources for imagining how we might, with a bit of luck and much determination, reshape our societies to mitigate the Anthropocene's harshest effects. If human activities are the equivalent of that ten-kilometer-wide rock hurtling through space, renarrating our human stories to account for pathways not taken is one means of cushioning the impact. To have any hope of understanding this new reality and transforming our societies, we need to span the enormity of geological time and deep human history, while also delving into the intimate and immediate exchanges between organic and inorganic systems and human behavior, values, ideas, and institutions. In the collective experiment in these pages, we wobble a course toward the kind of multidisciplinary understanding that is needed to grasp – and perhaps to cope with – our collective predicament.[3]

In short, the aim of this book is to give readers a handle on the Anthropocene both as a scientific concept and as a human dilemma. We assume no specialist knowledge. Instead these essays are gestures of inclusion from an array of people who care, as almost everyone does, about a habitable Earth. We aim to be generous. Our goal is not to impress readers with erudition or righteousness, but to open vistas on our common planetary dilemma. The very term "Anthropocene" implies that Earth's story and human stories can no longer be told without reference to one another. Earth's story and ours have converged in an

[3] For expanded discussions of this approach, see Julia Adeney Thomas, Mark Williams, and Jan Zalasiewicz, *The Anthropocene: A Multidisciplinary Approach*, (Cambridge: Polity Press, 2020) and Jan Zalasiewicz, Colin N. Waters, Erle C. Ellis, et al., "The Anthropocene: comparing its meaning in geology (chronostratigraphy) with conceptual approaches arising in other disciplines," *Earth's Future* March 2021; 9(3) https://doi.org/10.1029/2020EF001896

unprecedented way as human activities relentlessly alter biogeochemical systems and etch themselves into Earth's surface.

But stitching Earth's story and human stories together is no easy task. We speak and write from different perspectives and in different ways. Not even our citation styles are the same, something that this book doesn't try to mask. Each chapter uses the conventions most familiar to that particular author or set of authors. This is a deliberate choice. We want to make evident the scratchy textured way in which this new knowledge is being cobbled together. We also want to be as clear as we can, explaining terms, using metaphors, examples, and anecdotes to make larger points. These pieces are meant to intrigue, even as they show the bleak enormity of our collective destructiveness.

Facing this new world is tough. It doesn't require a history degree to know that in bad situations, the hydra-headed monster of fear, distrust, and contentiousness often rears its head, sowing dissent in a seemingly zero-sum game. Shouting past one another (or worse) is a common human reaction. But many studies have shown that trust brings better results.[4] That is what we've attempted here, recognizing that trust needs a shared foundation. As the contributors to this book try to explain to one another – and to our friends, students, and colleagues – what the Anthropocene looks like from where each of us stands, we all reference a common denominator. That common denominator is a shared respect for the scientific evidence – emerging from geology, Earth System science, and allied fields – that supports the Anthropocene concept. This reality is the foundation of our work. I think each of us has wished, privately and sadly, that the evidence was less compelling and that the science deniers were right. It would be a wonderful thing if Earth's resources were infinite and the stability of the Earth System assured. It would be glorious if our numbers and desires could grow forever, if all people on Earth now and in the future could live lives of increasing, heedless bounty, equitably shared. Many modern histories and theories

[4] Elinor Ostrom, the first woman economist to win a Nobel Prize, is one of among the many possible citations here. See, for instance, Elinor Ostrom, Joanna Burger, Christopher B. Field, Richard B. Norgaard and David Policansky, "Revisiting the commons: local lessons, global challenges," *Science* Apr. 9, 1999; 284(5412), 278–282.

of human society promised as much, but the discovery of the Anthropocene has ruptured that hopeful human trajectory.[5] Now, realistically, the sky *is* our limit; the thinning stratosphere, biosphere, pedosphere and much else constrain human possibilities. Even where our essays describe different aspects of how we got here, all take the physical reality of the Anthropocene and its difficult, complex challenges as our starting point – even though we'd happily wish them away if that were possible.

In short, the distinctive quality of all true Anthropocene stories is that they respond to geologists' evidence of the recent, global, near-synchronous, durable, human-made layer in the Earth's crust and to the corresponding findings in Earth System science showing that the old Holocene Earth System has been destabilized, and is now lurching toward dangerous thresholds and state shifts. The aim of each contributor here is to recount a story of the Anthropocene that is both true to the science as currently understood and true to that contributor's particular concerns. While sociologists, for instance, needn't become stratigraphers, they need to understand how stratigraphy's findings alter our view of societies. Conversely, stratigraphy, which once paid little attention to, say, economic systems, now must consider global capitalism's impact on the formation of strata. Our stories are rightly plural, rich, and nuanced, but on our altered planet they can no longer be rendered as soliloquies.[6]

Perhaps it goes without saying that there are other helpful ways of approaching the world. Certainly this book doesn't claim that the Anthropocene is the *only* useful concept. "Ecological crisis," "global warming," "pollution," and a host of other terms frame our challenges differently. Rubrics such as "early human migration and land use change," "the invention of agriculture and the rise of states," "climate

[5] Clive Hamilton introduced the helpful concept of "rupture" in "The Anthropocene as rupture," *The Anthropocene Review* 2016; 1–14, https://doi.org/10.1177/2053019616634741

[6] For an interesting exploration of this issue, see Roberta Biasillo and Claudio de Majo, eds. "Storytelling and environmental history: experiences from Germany and Italy," *RCC Perspectives: Transformations in Environment and Society* 2020, (2). doi.org/10.5282/rcc/9116.

change and capitalism," "species transfer and imperialism," or, simply, "modernity" provide other angles of understanding. What we *do* claim, however, is that the Anthropocene is a specific and distinctive framework, particularly helpful in connecting the local with the planetary and deep history with the future, and most particularly in orchestrating knowledge of the whole of the Earth System and its stratigraphic markers with all human activities from myth-making to microchip manufacture. The concept of the Anthropocene directs our attention to the magnitude of the many changes on Earth, and to their integration and interrelatedness, beginning with the minutely local and extending to the planetary across eons. It pushes us away from siloed-thinking to systems-thinking. Along with South Asian environmentalist and scholar Sharachchandra Lele, we see the need to move beyond a "narrowed framing of the problem: one value (sustaining future generations), one problem (climate change), one goal (reduce carbon emissions), and one solution (renewables)."[7] And that calls for a full understanding of the range of pressures we are putting on the planet, long- and short-term timescales, and of our interdependence with nature and one another. In short, this volume sees the Anthropocene as requiring new ways of systems-thinking from all disciplines, governments, and civic institutions: new knowledge for a new planet.

THE OCCASION FOR OUR BOOK: GROWING CONSENSUS

Altered Earth: Getting the Anthropocene Right appears at an important moment. Born in 2000, the concept of the Anthropocene has "grown up" on a human timescale of a little more than two decades. This book marks its maturity. It coincides with the growing consensus that the Anthropocene is an evidenced, accurate, and useful framework for understanding our planetary predicament.

The year 2022 sees the culmination of the Anthropocene Working Group's efforts. This group, known as the AWG, was created in 2009 to investigate the geological plausibility of Paul Crutzen's intuition. By 2019,

[7] Sharachchandra Lele, "Environment and well-being: a perspective from the global south." *New Left Review* 2020; 123, 41–63.

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after a decade of evidence-gathering and debate, a binding vote by 88 percent of the AWG confirmed its consensus that Earth has entered a new phase marked by a distinctive, near-global stratal unit, reflecting the sudden rise in human population, globalization, and industrialization over the last 70 years or so. In December 2022, the AWG plans to meet to finalize its formal proposal. The proposal will rely on mounds of evidence, including the core samples collected by geologist Francine McCarthy and her team, as described in Chapter 9 and on display at Berlin's Haus der Kulturen der Welt (the HKW or House of World Culture) as described in Chapter 10. If committees higher up the geostratigraphic feeding chain approve, the Anthropocene would officially join the Eocene, the Pleistocene, and other such units on the great canvas of the Geological Time Scale charting the Earth's lifespan.

Other international organizations are also embracing the concept, shifting their frameworks away from "climate change" to "the Anthropocene." In 2018, the United Nation's Intergovernmental Panel on Climate Change (IPCC) acknowledged the Anthropocene as the overarching framework for understanding planetary change. Just as our book appears, the IPCC, currently in its sixth assessment cycle, will release its 2022 "Synthesis Report" for policy makers, drawing together the massive efforts of three working groups and three special reports.[8] Other United Nations organizations have adopted the Anthropocene as well. The 2020 UN Human Development Report was titled *The Next Frontier: Human Development and the Anthropocene*, explicitly recognizing that we face not a solvable problem, but a complex, many-faceted predicament that needs to be navigated.[9]

Important academic and civic institutions are taking this new description of our planetary reality as their point of departure. For instance,

[8] Intergovernmental Panel on Climate Change (IPCC) "AR6 Synthesis Report: Climate Change 2022." www.ipcc.ch/report/sixth-assessment-report-cycle/ (accessed September 2021).

[9] UN Human Development report: The Next Frontier: Human Development and the Anthropocene (http://hdr.undp.org/en/content/human-development-report-2020; accessed September 2021). See Julia Adeney Thomas, "Why the 'Anthropocene' is not 'climate change' and why it matters." *AsiaGlobal Online* 10 January 2019. www.asiaglobalonline.hku.hk/anthropocene-climate-change/ (accessed September 2021).

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historian of science Buhm Soon Park persuaded the South Korean government to fund the Center for Anthropocene Studies at KAIST (Korea Advanced Institute of Science and Technology), one of the country's premier universities. In these pages, you will read how Bernd Scherer, Director-General of the HKW, decided to reorient his institution to confront the Anthropocene, gaining support from the German government. In May 2022, the HKW hosts a meeting of the AWG and exhibits the core samples supporting its conclusions. As Scherer notes, these core samples are artifacts of both culture and nature or, more precisely, the culture–nature conjunction that is the Anthropocene.

Likewise, the social sciences, humanities, and literature are reconsidering their narratives in relation to Earth's transformation. Recently, political theorists Duncan Kelly, Mark Beeson, John S. Dryzek, Jonathan Pickering, and Manuel Arias-Maldonado have laid the groundwork for a politics of the Anthropocene.[10] Anthropologists too are alert to the challenge. In *Overheating*, for instance, anthropologist Thomas Hylland Eriksen deploys the lens of accelerating change to show how current environmental, economic, and identity crises have converged.[11] Studies of specific communities by anthropologists Marisol de la Cadena, Anna Lowenhaupt Tsing, Cymene Howe and Dominic Boyer, among others, remind us that we live in "a world of many worlds."[12] Historians have also pivoted to the Anthropocene. In 2000, the same year that Paul Crutzen coined "Anthropocene," historian John R. McNeill published *Something New Under the Sun*, grappling with how planetary and human history have

[10] Manuel Arias-Maldonado, "Bedrock or social construction? What Anthropocene science means for political theory," *The Anthropocene Review* 2020, 7(2), 97–112. doi:10.1177/2053019619899536; *Antropoceno: La política en la era humana* (Madrid: Taurus, 2018); and Manuel Arias-Maldonado and Zev Trachtenberg, eds., *Rethinking the Environment for the Anthropocene: Political Theory and Socionatural Relations in the New Geological Epoch* (Abingdon: Routledge, 2019). See also Duncan Kelly, *Politics and the Anthropocene* (Cambridge: Polity, 2019) and John S. Dryzek and Jonathan Pickering, *The Politics of the Anthropocene* (Oxford: Oxford University Press, 2019). Nigel Clark and Bronislaw Szerszynski provide an overview in *Planetary Social Thought: The Anthropocene Challenge to the Social Sciences* (Cambridge: Polity, 2021).

[11] Thomas Hylland Eriksen, *Overheating: An Anthropology of Accelerated Change* (London: Pluto Press, 2016).

[12] This lovely phrase is the title of Marisol de la Cadena and Mario Blaser, eds. *A World of Many Worlds* (Durham, NC: Duke University Press, 2018).

come together.[13] Since then, this discipline has puzzled over why, when, and how humans came to overwhelm the great forces of nature, questions engaged here by Dipesh Chakrabarty, Kyle Harper, Kate Brown, and myself. All of these approaches to the Anthropocene are helpful but insufficient without works of imagination. This is where the volume's short stories told by Clive Hamilton and Amitav Ghosh come in.

None of these perspectives individually is the complete story. Indeed, there can be no complete story. The Anthropocene is still unfolding conceptually and physically. For our communities, its instigations and effects are uneven and heterogeneous – and will continue to be so. No totalizing vision, no single cause, no easy solution is possible.

ORGANIZATION

Altered Earth is divided into three parts. In the first part, Jan Zalasiewicz and I lay out the stakes for the physical sciences and the human sciences respectively. Part II consists of eight "stories" from different scientific and humanistic points of view. Part III, the final section, looks to the future.

In the first part, stories of human beings (the *anthropos*) and stories of planetary time (*cene*) are brought together. From the most official vantage, the Anthropocene story belongs to stratigraphers, the men and women strangely fascinated by layers of rock and what they tell us about time. These geologists explore the Anthropocene as part of Earth's vast history and as a very recent layer of the planet's crust, one that attests to humanity's sudden, brutish imprint with the twentieth-century "Great Acceleration."[14] As told by geologist Jan Zalasiewicz, former chair of the AWG, the central protagonist in this long story is the Earth System itself,

[13] John R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000).

[14] The Great Acceleration refers to the evidence produced by the International Geosphere Biosphere Program (IGBP) charting the abrupt, synchronous social and physical impacts on the planetary system in the twentieth century. See Will Steffen, Angelina Sanderson, Peter Tyson, et al., *Global Change and the Earth System: A Planet Under Pressure*, The IGBP Book Series (Berlin, Heidelberg, New York: Springer-Verlag, 2004), and Will Steffen, Wendy Broadgate, Lisa Deutsch, et al., "The trajectory of the Anthropocene: The Great Acceleration," *Anthropocene Review* 2015; 2:1, 81–98.

with its dramatic changes over eons and the swift, recent rupture of Holocene norms. But, the Anthropocene also nominates human beings as players in the planetary drama. Depending on how that human story is framed in relation to Earth's history, various people, societies, or our species as a whole can be seen as lucky primates, blind fools, greedy sods, despicable culprits, innocent casualties, and sometimes all these at once. The activities that laid the foundation for the twentieth-century Anthropocene can be said to begin when our ancestral species mastered fire, even before *Homo sapiens* emerged, or at any number of times thereafter. Humanity's story can be told collectively, incorporating us all across time and space, or as a multitude of stories emphasizing the differences among cultures, politics, technologies, ideas, and much else. What is no longer possible in the Anthropocene is a human story unconstrained by planetary limits.

The next eight contributions tell more particular stories. In Chapter 3, scientist Will Steffen takes us far into outer space to see not just Earth, the blue, vibrant, tangible sphere we inhabit, but the Earth System, the intangible, evolving, integrated complex that is our planetary home. This relatively new idea – Earth System in the singular – guided Crutzen's initial recognition of the Anthropocene and remains a conceptual twin-star to the geological understanding of our planet's abrupt alteration. Originally, Crutzen had thought that the late-eighteenth-century Industrial Revolution in England might serve as the starting point of the Anthropocene, but data from Steffen's Great Acceleration graphs in 2004 changed his mind. Only in the mid-twentieth century did human pressures on the Earth System swoop upward. There had been, in other words, a long gestation for anthropogenic Anthropocene forces. Just how long is the question of the next chapter.

In Chapter 4, historian Kyle Harper does a deep dive into human history to find the antecedents of our ascendency. We are, he finds, a mucky bunch, ridden with many more disease-causing pathogens than our nearest relatives, the chimpanzees. It might seem unlikely that such germ-ridden creatures would ever thrive, but thrive we have, despite – or perhaps because of – our complex relationship with pathogens. One way to tell human history is to see it as a long, slow struggle against these evolving, invisible agents of misery until, finally, we managed to disinfect

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much of the planet and sent our numbers soaring. However, as Harper warns and recent history shows, no victory in the evolutionary arms race between pathogens and hosts is ever permanent.

In Chapter 5, anthropologists Cymene Howe and Dominic Boyer take on the triumphal story of "green" energy. The winds of the Mexican Isthmus of Tehuantepec have attracted high-tech investors bent on "solving" climate change by building turbines across indigenous lands. These entrepreneurs speak the linear language of climate change: a single problem, a single solution, and off we go. Their top-down, siloed approach mimics the relations of power that gave rise to the Anthropocene in the first place and ignores the way indigenous people understand the wind. Once the reductive picture of climate change is expanded to include biodiversity, land use, competing ideas of a good life, and the symbolic, community-creating capacity of winds, we begin to grasp the irresolvable conundrums of the Anthropocene.

In Chapter 6, one of the world's leading novelists, Amitav Ghosh, tells something of the same story, but as dark parable: the terrible assault of the Anthropoi on the sacred Living Mountain and those who once flourished in its shadow. Into the Valley come strangers, the Anthropoi with their armies and their savants who justify their actions. Desecration follows. Worst of all, the Valley-dwellers come to desire the life of the Anthropoi. They join in waves, climbing, digging, and exploiting the Living Mountain they once revered, even as its snows melt, crevasses widen, and avalanches destroy the Valley floor. The lone exception is one old woman who can still feel the Mountain's heartbeat with the soles of her feet and knows no one can master it. "The Ascent of the Anthropoi" lays bare modernity's consoling lie that growth is the key to justice and that instrumental knowledge trumps the sensuous acceptance of life.

In Chapter 7, political scientist Manuel Arias-Maldonado picks up on Ghosh's dark vision: in the Anthropocene, whether we will or no, we have all become Anthropoi. Few remember the old way of life. A new collective political actor has been born: humanity as a whole. The political challenge for this new actor is nothing less than stabilizing the Earth System. Given this urgent task, Arias-Maldonado makes the case for pivoting away from past recriminations and directing our energies

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toward creating international institutions able to cope with the unprecedented emergency. By mapping the ways liberal democracy, eco-authoritarianism, and green communitarianism currently address Anthropocene challenges, he shows that each offers some mitigation strategies, but none is entirely satisfactory. The situation calls for creativity, forbearance, and clear-eyed recognition that, in the sliver of time remaining to us, we can, if we pull together, build better societies in keeping with planetary limits.

The next two chapters deal in different ways with the sharpest and most globally synchronous of the Anthropocene's many geological proxy signals: artificial radionuclides. Nuclear detonations and nuclear reactor accidents have left their mark in the stratigraphic record. Historian Kate Brown takes us into the dark world of state secrets, widespread suffering, and heroic doctors, local officials, and scientists in the USSR and Russia after the Chernobyl nuclear plant meltdown of 1986. She shows that from a ground-level view this disaster engulfed – and still engulfs – human and non-human communities in different ways and at different speeds. The greatest harm is done not by the immediate fallout from a nuclear accident, but by the persistent low-level radiation in soil, food, and infrastructure. Despite the nuclear industry's insistence, backed by the UN, that the death-toll of Chernobyl was low, her research shows how radiation continues its deadly work. Nor is the Chernobyl meltdown the only nuclear problem in Ukraine. In an old bombing range nearby, a deformed and blighted pine tree signals the disturbing fact that a decade before the Chernobyl plant was even built, nuclear fallout contaminated these forests. Nuclear radiation's lingering effects preclude narrative closure for Brown's story just as the continuing impact of the Great Acceleration precludes forecasting the Anthropocene's trajectory. Today, fracking for oil and natural gas, as a recent investigation shows, sloshes radioactive brine in the name of "clean" energy.[15]

[15] Justin Noble, "America's radioactive secret: Oil-and-gas wells produce nearly a trillion gallons of toxic waste a year. An investigation shows how it could be making workers sick and contaminating communities across America," *Rolling Stone* (21 January 2020) www.rollingstone.com/politics/politics-features/oil-gas-fracking-radioactive-investigation-937389/ (accessed September 2021).

Geologist Francine McCarthy uses a different archive to tell her Anthropocene story in Chapter 9. She and her research team have been studying the sediment beneath the waters of Crawford Lake in southern Ontario, Canada. Due to the lake's great depth and lack of strong currents, delicate layers of light and dark sediment are laid down each year like tree rings. Each pair is called a varve. These varves tell a thousand years of history. Some stories are local, such as the ecosystem disruptions by Iroquoian farmers beginning in the late thirteenth century and by a lumber mill that began operating in the late nineteenth century. The most recent layers, however, tell a new story of human activities on a global scale. These recent varves are evidence of the Anthropocene and the Great Acceleration's abrupt and world-wide impact, even on this small lake in rural southern Ontario. Along with other teams searching for an appropriate stratigraphic marker, known as the Global Boundary Stratotype Section and Point (GSSP) or "Golden Spike," the Crawford Lake team will present its evidence to the AWG in 2022. Their core sample will figure in the Berlin exhibition at the HKW, a testament to the power of the *anthropos* on the planet.

Part II closes with the story of the transformation of Berlin's House of World Culture, the HKW. Established to showcase international art in 1989, the HKW had been dedicated to human creativity. But more than a decade ago, director Bernd Scherer questioned the implied separation of culture from nature. As he recognized, world culture's biggest creation now is our altered Earth System. As described above, his work reaches a culmination in 2022, when the HKW hosts a meeting of the AWG and exhibits the ice cores and other evidence of our human-altered world.

The Anthropocene is like nothing that's happened before. Human beings have always been biological, chemical, physical, and geological agents altering the world around us. Never has humanity placed its stamp on the planet in ways comparable to a meteorite. People, by our sheer numbers, productivity, and consumption, are now Earth System agents. No place escapes human influence; gyres of plastic swirl in the oceans; remote patches of rainforest and desert, never having felt the tread of human feet, now feel the impact of our predation as biodiversity dwindles and the climate changes. Forests burn to provide for

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impoverished swidden farmers; vast underground reservoirs are drained by parched cities and needy farmers. Rising nitrogen and phosphate production, concrete-intensive building, energy use, mobility, communications, urbanization, and global flows of toxins are at the heart of our ever-escalating pressure on the Earth System. The mass of human-made things outweighs the living biomass.[16] On the planetary scale, the Anthropocene's narrative arc hurtles toward Hothouse Earth where human habitation may be impossible. Yet the pace is not the same everywhere. More locally, human life-worlds are changing at different speeds. Understanding the disjunctures between quickness and slowness, change and continuity, top-down developments and particular local values are important to the task of figuring out how we might, with ingenuity, flexibility, and a bit of luck, turn this humiliating tragedy into a tale of fortitude and resilience with decency. Is there a guaranteed – or even a likely – happy ending? Sadly, no.

The last section of *Altered Earth* turns to the future. In his fictional contribution, Clive Hamilton imagines a mission to Mars speeding away from an uninhabitable Earth. Among the chosen few on board are Pearl and Denis, two young people at odds with the captain's decision to leave the vast majority behind to die. With clear-eyed honesty, this sympathetic pair recognize the ethic of what might be termed "shared life," the intricate web of mutually nurturing living beings. In other words, without us all, we are nothing. Trapped in a metal tube flying through space, what can they do with their yearning? Such a scenario is not beyond the realms of possibility; anyone watching the news can see that the ambition to settle another planet is no longer a science fiction fantasy – although the more aggressive term "colonize" is a better word than "settle." If we could build on Pearl and Denis's understanding of our shared predicament, we might be able to create an alternative story, one that does not end with a privileged few monopolizing all hope of refuge.

It is to that end that our book concludes with a vision of mutualistic cities put forward by Mark Williams and colleagues. Most of Earth's

[16] Emily Elhacham, Liad Ben-Uri, Jonathan Grozovski, Yinon M. Bar-On, and Ron Milo "Global human-made mass exceeds all living biomass," *Nature* 2020; 588, 442–444. https://doi.org/10.1038/s41586-020-3010-5

human population are urban dwellers. Today, there are 33 megacities with more than 10 million inhabitants, 10 million being the total worldwide human population at the beginning of the Holocene. Our hope lies in turning these dense communities from net-consumers to net-producers of biodiversity, clean air, better soils, and fresh water. If such regenerative processes can be established, we'll be a lot closer to stabilizing the Earth System. Williams' chapter, co-authored with a multidisciplinary group of scholars, makes a distinction between mutualistic cities and other approaches. Unlike "smart cities" that rely on sophisticated technology to monitor and respond to environmental conditions, and unlike "sustainable cities" that stress reduction and reuse, the concept of a "mutualistic city" is modeled on the biological systems where all organisms benefit one another. The focus is on regenerative cycles and virtuous feedback loops. If we could begin to develop such mutualistic cities, the anthroposphere would begin to meld back into Earth's biosphere, lithosphere, hydrosphere, and atmosphere; and, human beings might, as Williams says, be drawn to new roles redefining "success" not as "high-paying jobs, let alone massive wealth" but as "dense circles of friendship and honour within communities." If the basis of hope is action, this vision maps our next steps.

STORIES

Our collective effort might be compared with the old parable of the blind men and the elephant.[17] Each contributor responds truly and perceptively to the bit in their hands. The person stroking the ivory tusk says that "elephant" is a hard, sharp-pointed cylinder, but the man with his hands on the creature's side describes "elephant" as a large, rough wall. Their friend holding the tail laughs at his fellows, and declares "elephant" to be just like a tasseled cord for drawing heavy curtains. This surprises the man with the trunk, who declares that there's nothing

[17] One of the earliest written versions of this story is found in the Buddhist text *Ud 6:4 Sectarians (1) (Tittha Sutta)* discussing the limits of perception. The blind men describing the elephant to the Buddha use different metaphors than the ones I use here. www.dhammatalks.org/suttas/KN/Ud/ud6_4.html (accessed September 2021).

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tasseled about this strong, snake-like being. And on and on. All these people have their hands on part of the same "elephant," but to understand what they confront, they must come together and share what they know. Our Anthropocene, like their elephant, is what we hold in common. While our stories are rightly plural, rich, and nuanced, they can no longer be soliloquies on our altered planet. We all speak to this new reality of the Anthropocene and with one another. We want to step up, and say "Well, it's an elephant alright," and we hope you'll join us in trying to grasp our common predicament.[18]

[18] I thank Clive Hamilton for suggestions on this final line.

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