THINKING THROUGH CLIMATE CHANGE

A PHILOSOPHY OF ENERGY IN THE ANTHROPOCENE

ADAM BRIGGLE

Palgrave Studies in the Future of Humanity and its Successors

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Thinking Through Climate Change

A Philosophy of Energy in the Anthropocene

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Palgrave Studies in the Future of Humanity and its Successors
ISBN 978-3-030-53586-5 ISBN 978-3-030-53587-2 (eBook)
https://doi.org/10.1007/978-3-030-53587-2

Cover illustration: andrey_l / ShutterStock

This Palgrave Macmillan imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

[I]f the choice is to be good, the reasoning must be true and the desire correct.
—Aristotle on "Intellectual Virtue" in *Nicomachean Ethics*

Measure *is alien to us; let us own it; our thrill is the thrill of the infinite, the unmeasured. Like a rider on a steed that flies forward, we drop the reins before the infinite, we modern men, like semi-barbarians – and reach* our *bliss only where we are most*—in danger.
—Friedrich Nietzsche on "Our Virtues" in *Beyond Good and Evil*

Preface

The Earth's climate has always been changing. On my office wall, I have a picture of me with my children Max and Lulu on the North Rim of the Grand Canyon. The Colorado River has cut through layers of rock: Coconino, Toroweap, Redwall…all the way down to the Vishnu Basement. To run your eyes a mile down to the thin ribbon of water is to travel back in time 2 billion years. The Grand Canyon is pure movement—crashing tectonic plates, exploding volcanoes, the Kaibab Plateau lifting up like a blister, storm clouds gathering, and generations of rivers erasing generations of mountains. The climate roamed from hot to cold, from sea to desert.

The Grand Canyon is a good place to see the climate system at work. The climate system is the interaction of the lithosphere (rocks), cryosphere (ice), atmosphere (air), hydrosphere (water), and biosphere (life). It is how these spheres move around each other and in and out of each other. This restless movement is energy. The climate system is a grand energy flux.

Humans are new to Earth, having only been around for about 200,000 years. To give you some perspective, the *youngest* rocks at the Grand Canyon are about a *thousand times older* than *Homo sapiens*. Yet, we have become agents of planetary change; the energy flux that is the climate is now marked with human fingerprints. How did this happen and what does it mean? Can we learn to become responsible stewards of

the climate? Is this too much for us? Have we overreached, or are we only just beginning to realize our potential? *Thinking Through Climate Change* is my attempt to get at these questions.

There are many ways to think through climate change. Energy is the golden thread that I follow. For the past few hundred years, industrialized societies have been pulling carbon out of the lithosphere and putting it into the atmosphere where it traps heat via the greenhouse effect leading to global warming. Much of this extra energy is absorbed by the oceans. Indeed, the extra heat accumulating in the oceans is equivalent to the energy of *five* atomic bomb explosions *every second*.

In 1960, atmospheric CO_2 concentrations stood at 309 ppm. In 2020, CO_2 concentrations topped 415 ppm, higher than at any time in the past 800,000 years. Anthropogenic (human-induced) climate change has current and projected impacts on Earth systems that are wide-ranging. These will in turn impact humans in many ways: food security, access to water, heat stress, extreme weather, disease, migration, war, and more. This is why climate change is a defining issue for the future of humanity and planet Earth.

Climate change is the unintended consequence of the making of a high-energy civilization or petro-culture. Life in the twenty-first century is powered by machines that consume enormous amounts of calories and that move carbon from rock to air. There are lots of good books about the history and politics of these technologies. Yet the machines are not the most important factors. What really matters are the ideas and values behind the machines. That's what this book is mostly about.

Animating our high-energy civilization is the modern concept of energy as a universal currency and as the capacity to do work—a capacity that humans lack and must acquire in order to live a good life. These concepts of energy are claimed by scientists, economists, and engineers nowadays, but they have deep philosophical roots. Indeed, for me, climate change is not just a subject for philosophical reflection; it is the culmination of Western philosophy. Philosophy is a conversation about energies (human, natural, and divine). This conversation birthed the machines that have altered the climate of our planet. Who said philosophy doesn't have an impact?!

I am grateful to everyone who helped me with this project. My wife, Amber, contributed many valuable ideas during our "date night" discussions. I want to thank her for her creativity, support, and encouragement. Max and Lulu are also endless sources of wonder and inspiration. I want to thank them for our adventures in the "Emma Dean," the camper we took to so many National Parks as I thought about this book.

I workshopped many of the ideas in these pages in graduate and undergraduate courses on energy, environment, and climate change. I am indebted to my students for their thoughtful contributions, gentle criticisms, and convivial conversations. Many thanks as well to the following people who all helped me in various ways: Robert-Jan Geerts, Jen Rowland, Terra Rowe, Maggie (Keith) Brown, Robert Frodeman, Glen Miller, Daniel Sarewitz, Mike Cochran, Maya Rao, Dominic Boyer, and Imre Szeman. I am especially grateful for the help and support provided by Carl Mitcham, and I owe a special debt of gratitude to my friend and former PhD student Giovanni Frigo who did so much to advance my thinking about energy.

As a public servant, I am grateful to the residents and taxpayers of the state of Texas and to the University of North Texas. I hope that this book represents a valuable use of the time and freedom afforded to me in my privileged place as a professor at a public university.

When I was despairing about the prospect of ever finding a publisher, Steve Fuller stepped in to save the day. I am especially grateful for his encouragement, energy, ideas, and advice. I am fortunate to consider Steve a friend and mentor. I'd also like to thank the anonymous reviewers for Palgrave Macmillan who offered valuable ideas for improving the text. Finally, I want thank the editors at Palgrave Macmillan, especially Philip Getz and Amy Invernizzi.

Denton, TX, USA Adam Briggle

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Introduction

The most thought-provoking thing about our thought-provoking time is that we are still not thinking
Martin Heidegger *1954*

There is a crack in reality. Our name for it is *energy*. From Heraclitus to Lao Tzu to Albert Einstein, deep thinking about *energeia*, *qi*, or E has led to mystery. In *Frankenstein*, Mary Shelley imagined electricity giving rise to the living-dead. To comprehend the quantum energies at the base of reality, the physicist Erwin Schrödinger conjured a thought experiment about a cat that is also simultaneously alive and dead. It is a paradox, a superposition, a contradiction.

My thesis comes in two parts. Here's the first half: As we build a civilization that uses more and more energy, the crack in reality gets wider and weirder. Climate change is this growing uncanniness. The ice at the Earth's poles has long pulsed in and out with the seasons like a pair of frosty lungs. Scientists have a word for systems that change like the seasons: *stationarity*. It means that the properties that give rise to change are

A. Briggle, *Thinking Through Climate Change*, Palgrave Studies in the Future of Humanity and its Successors, https://doi.org/10.1007/978-3-030-53587-2_1

themselves unchanging. Climate change is the death of stationarity (Milly et al. 2008). It's not just change; it is change in the way things change.

Stable ground is shifting like melting permafrost. The *permanent*, it turns out, isn't. The ship of civilization always rose and fell with the tides, but it was anchored to something deep. Now the bottom is falling out. We are falling. We are building such a heavy, such a weightless, world.

I wrote this book in dialogue with students in my college courses. One salient fact framed all of our conversations: Young people today are growing up on a different planet from the one I knew as a kid. A good way to see this is to look at the cumulative global emissions of carbon dioxide from fossil fuels. Since 1751, 1.54 trillion tons of CO_2 have been emitted. Note from Table 1.1 how long it took to emit the first quarter versus the last quarter.

CO_2 emissions reached record highs again in 2018 and 2019. This tells us two things. First, the human condition is accelerating. Second, we are not taking climate change seriously, which is to say that we are not reckoning with the speed or scale of our own actions. We *know* about the problem, but we don't really *believe* it. We have the science, but not the imagination. If ever there was a time to stop and think, well, now might be it.

That brings me to the second half of my thesis, which is about how this growing crack in reality *appears* to the denizens of a high-energy civilization. As energy grows bigger and stranger, things seem oh-so-normal. Like live wires wrapped in plastic, we are insulated from our powers. How easily we forget just how weird things are. We are yawning through a metaphysical revolution. After reading the dire headlines, we switch on the cartoons. It's so real it's unreal. So big yet so forgettable. Like I said, it's a paradox.

Climate change requires a change of mind. We have to live in the paradox, the *fullness* of our reality. This book aspires to help you do that.

Table 1.1 Cumulative global CO_2 emissions

Global CO_2 emissions	Historical period	Total years
First 25%	1751–1968	217
Second 25%	1968–1988	20
Third 25%	1988–2005	17
Fourth 25%	2008–2017	9

Source: Author's own table, data from Our World in Data, https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

It explores the origins of our high-energy civilization and the big questions it faces. My children were born on this new planet. When we discuss climate change as it appears, say, in California or Australia wildfires, they tell me it is scary. Then they ask, "Are we going to be ok?" That is the biggest question of them all.

To be sure, such questions have scientific, technical, and economic dimensions. Yet there is no formula to decide our future for us. We have choices to make, and they will hinge on our visions of moral responsibility, justice, freedom, knowledge, risk, and what it means to be human. The more powerful our science and technology become, the more philosophical issues they raise. Thinking through climate change is a philosophical task, one that requires us to dig down to fundamental issues and zoom out to see the contexts in which other ways of knowing (e.g., science, engineering, and economics) take shape (see Gardiner 2010; Gardiner et al. 2011; and Jamieson 2014).

There is so much information about climate change that it's like drinking from a firehose: overwhelming and confusing. I want to provide orientation by climbing up high, so that we can look down and see the many ways of seeing our situation. I categorize these ways of seeing or worldviews into the orthodox on one hand and the heterodox on the other hand. This is just a first-order divide, because there is diversity within both the orthodoxy and the heterodoxy. The orthodoxy deeply conditions how we think and act. That makes it worth understanding. However, the crack is growing and paradoxes are accumulating that might topple the orthodox order. That makes it worth considering heterodox views.

Here is the book in a nutshell. We are in a moment of exponential growth. Our future is either green growth or degrowth. Either we figure out how to make a project of infinite growth sustainable or we find some measure, that is, a sense of proportion and limit. The former is the orthodox view. The latter is the heterodox view. Energy consumption is expected to double by 2050. Clearly, we are gambling on the orthodoxy of green growth. Climate change is calling our bluff. We should understand the logic of the orthodoxy and pray that it is sound, because it is the hand we are playing in a game with existential stakes (Table 1.2).

Table 1.2 The book in a nutshell

	Discourse	Logic	View of humanity	Primary energy	Future	Ethics
Virtues	Heterodox	Doctrine of the mean, proportionality, limits	One among the earthly creatures	Control of self	Degrowth	Ends and means, fittingness
Volts	Orthodox	Infinity, linearity, growth	Gods in the making	Control of world	Green growth, decoupling	Means only, convenience

Now let me offer a more extended summary of the book. It begins with an obvious point that climate change is driven by energy. This is why most stories center on technology: fracking, solar panels, nuclear power, wind turbines, batteries, and more. (As we'll see, even the agricultural and land use dimensions of climate change are about energy. The conservationist Aldo Leopold (1945) was right to call the land "a fountain of energy.") The discussion is all about energy transitions, especially from fossil fuels to renewable or carbon-free sources. But in the debates about the means, we lose sight of the ends. In other words, this is all a debate *within* the orthodoxy, which is limited to instrumental ethics (i.e., we can evaluate means as better or worse, but not ends). To think through climate change, we have to understand energy in broader terms.

The most important energy transition is the one that took us from a world of virtues to a world of volts. Like any energy transition this is messy and incomplete, but it is vital. The virtues are intimately related to the original meaning of 'energy' in the West, one that denoted proportion or fit. The virtues are governed by the doctrine of the mean, which tells us when there is deficiency and when there is excess. There can be too little and *too much*. At some point, there is a phase change and, paradoxically, what was better is now worse. There is a limit, a threshold, a line you shouldn't cross.

I use 'volts' as shorthand for the modern scientific notion of energy. There is no upper bound to volts, no limit or sense of proportion. Its logic is linear, where things keep going up and up with no phase changes. The transition from virtues to volts, then, is from finitude to infinity. It brings with it a shift in our self-understanding from humans as one earthbound creature among others to humans as gods in the making. This is the metaphysical or religious story beneath the stories about energy and climate. The transition from virtues to volts is the golden thread that I trace in this book.

Our world of volts is the orthodoxy. We might also call it simply modernity or humanism. Here is the logic of the orthodoxy in a nutshell. Humans are weak in claw and muscle, but strong in brain. To survive, we figure out ways to control the Fates and their minions: cold, heat, hunger, disease, and aging. After millennia of searching, we have found the winning formula to set us on a path toward absolute security, control, and

freedom. That formula is E for energy, the modern scientific notion of a universal currency and capacity to do work. (This is what I call 'volts' for short, it is the 'fire' that Prometheus stole, but this is the *real deal*.) We actually don't know what E is, but we know how it functions. We can measure it, quantify it, and exploit it to make our lives longer, healthier, more productive, more convenient, and above all more secure.

This is a story that begins in poverty and has its logical conclusion in the project known as transhumanism—the overcoming of all limits, including our bodies and our home planet. Because there is no upper bound or threshold to volts, growth is the grand totem. It's not just the essence of capitalism as a social order; it is the scientific picture of reality as a matrix of E and the ethical picture of progress as commanding more and more E. To get a sense of how strong the orthodoxy is, consider how crazy you'd have to be to run on a political platform of ramping *down* production and consumption. Yeah, right! The trajectory is "To infinity and beyond."

The titans of our economy and high priests of the energy orthodoxy know this. Bill Gates is pumping billions of dollars into research on endless, clean energy. Jeff Bezos, founder of Amazon and the world's wealthiest man, has said that his most important project isn't online shopping or streaming entertainment. Rather, it is Blue Origin, an aerospace manufacturing company that is making rockets for extraterrestrial resource extraction and space colonization. Bezos is worried that our growing energy demands will outrun our limited supply here on the third rock. Like me, he sees two basic choices: either we cap how much energy we use or we head for the stars. Bezos, the epitome of the energy orthodoxy, wants growth rather than stasis. His hero is Captain Picard from *Star Trek*—he has even shaped his appearance to look like Picard. As the tagline for Blue Origin reads, "Earth, in all its beauty, is just our starting place."

But what about climate change, that growing crack in reality? True, energy is about controlling fate and our scientific machines have given us so much control. Yet control is only half the picture, and as a result, the orthodoxy is a doctrine of half-truths. Powerful spells have a way of getting out of control. There are jokers in the high-tech hand we are playing.

The oldest stories in philosophy are about energy, and those stories are about a cosmos that is deeply ironic. The first philosophers tried to understand change: the seasons, the growing child, and the decaying fruit. They reasoned that there must be something that undergoes the change but is not itself changed. That is energy: an ever-changing sameness. A paradox. Energy is a wildcard; it's both the brute force of nature and her twisted sense of humor. Sure, any good book about energy and climate will have to be full of numbers. But it also has to account for what cannot be counted.

A high-energy society is bound to get tangled in its own contradictions. Paradoxes are springing up like the troubles from Pandora's Box. Before turning to the orthodox view, then, I start with some of the paradoxes that run like fissures through our bedrock certainties. In one of the first theories of energy, Heraclitus said that all is fire. Picture again the wildfires pulling civilization back to Earth and Bezos' rocket boosters heading for the stars. Which fire is our future? Trapped in indeterminacy like Schrödinger's cat, it's both.

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Part I

Energy Paradox

[I]n physics today we have no knowledge of what energy is.
Richard Feynman, Lecture on Physics, 1963

2

The Unnatural Growth of the Natural

We are inverted utopians: while utopians cannot produce what they imagine, we cannot imagine what we produce.
Günther Anders *1956*

Human beings have become a dominant force on Earth. Many scientists believe that we have created a new geological epoch: the Anthropocene, or the age of humanity. Other scientists think that this is arrogance. After all, the title 'epoch' is given to thick stacks of rocks piled up across tens of millions of years. Yes, we are rearranging the face of the planet, but this is a mere blink of geological time. If we don't learn how to control the energies that we have unleashed, we may soon wipe ourselves out. In that case, all that we'll leave behind is a vanishingly thin line in the rocks. Geologists call such short-lived disruptions *events* not *epochs* (Brannen 2019).

Whether event or epoch, when did this new chapter in Earth history begin? Some think it started when hunters eradicated wooly mammoths and giant ground sloths. Others set the beginning at colonialism or the industrial revolution. One panel of scientists pegged it to the

A. Briggle, *Thinking Through Climate Change*, Palgrave Studies in the Future of Humanity and its Successors, https://doi.org/10.1007/978-3-030-53587-2_2

mid-twentieth century invention of nuclear weapons. Thousands of atomic explosions have carpeted the Earth with a telltale sheet of radiation. Alien archeologists in the future could visit here, dig down through layers of rock, and discover our signature written in plutonium-239. "Ah," they would say in their alien accents, "the Age of HUUMAHNS."

We are leaving other traces too, including micro-plastics and heavy metals. Industrial farming, deforestation, and massive dams alter landforms in ways that may leave a geological mark. The fossil record will show a precipitous drop in biodiversity, what many consider to be Earth's sixth mass extinction event (Kolbert 2014). Some few animals, however, will suddenly dominate the fossil record. The domestic chicken, for example, is native to south-east Asia, but in the Anthropocene their bones are piling up everywhere. We consume 60 billion chickens annually. The aliens might call this the Chickenocene.

Whatever we call it, no one can doubt the scale of human impacts or the speed with which they have happened. Indeed, some prefer to call this age the Great Acceleration. *Homo sapiens* has been on the planet for 200,000 years, but only in the last 200 years or so (0.1% of our history) have things gone crazy.

On graphs, the Great Acceleration looks like hockey sticks with their long shafts lying flat on the x-axis of time followed by the blade jutting steeply upward along the y-axis. The y-axis can represent socio-economic trends like human population, Gross Domestic Product (GDP) per capita, water use, fertilizer consumption, travel, and telecommunications. It can also represent Earth systems trends that show the same recent, sudden spikes: atmospheric concentrations of carbon dioxide and methane, ocean acidification, marine fish capture, surface temperatures, tropical forest loss, and species loss (Fig. 2.1).

Many factors are pushing those curves upward along the y-axis, but a central driver is energy. Our control of nuclear and fossil energies has fundamentally changed the human condition and our relationship to our home planet. This has happened very suddenly. For the vast majority of the human story, we had only the energy of our muscles, including the muscles of slaves. About 10,000 years ago we harnessed the energy of animal muscles. Over time we invented waterwheels and windmills.

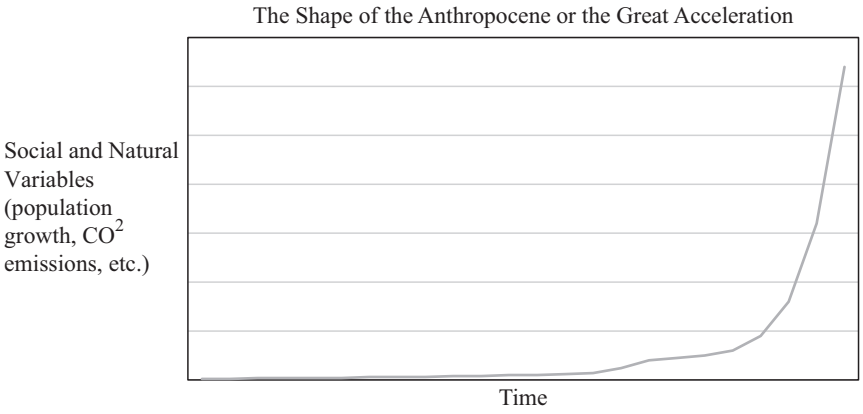

Fig. 2.1 The shape of the Anthropocene or the Great Acceleration

These energy transitions introduced big changes. The energy analyst Vaclav Smil (2010) estimates that peak unit capacities of prime movers rose by a factor of 150,000 in the 3000 years prior to the twentieth century. That's impressive. But those 3000 years pale in comparison to just the last one hundred. In the twentieth century alone, peak capacities rose ten times as much, by a factor of 150,000,000! Like the Sorcerer's Apprentice, we have cast a powerful spell that threatens to get out of control. In that story, the master returns in the nick of time to save the day. We, by contrast, are on our own.

We consume 100 million barrels of oil globally every day. And global energy consumption is expected to double by 2050. In the United States, natural land is being converted into human development at a rate of two football fields every minute (Lee-Ashley 2019). Roughly 70% of the Earth's surface has been shaped by human activities. Urbanization or the building of the 'technosphere' is proceeding at a breakneck speed. We are going to build the equivalent of a new New York City *every month* for the next thirty years. China poured more cement from 2011 to 2013 than the United States did during the entire twentieth century (Smil 2013). Roughly 8 million tons of plastic are washed into the ocean annually, meaning that by 2050 plastics might outweigh all the fish in the ocean (World Economic Forum 2016). Biologists on the remote Midway

Islands estimate that every year albatrosses carry 5 tons of plastics to the islands *in their stomachs* (Alfonsi 2019). As I was writing this chapter, hundreds of thousands of Californians were forced to flee hellish wildfires and millions went without power due to intentional blackouts. It was a dystopian scene. The new abnormal.

I could keep listing the stats, but that's enough to get at the problem. All these numbers are so big that they defy belief.

The scale of the Anthropocene and the speed of the Great Acceleration pose a fundamental dilemma spotted by the German philosopher Günther Anders early in the atomic age. For nearly all of history, our abilities to imagine (*vorstellen*) outstripped our abilities to produce (*herstellen*). We could dream big, but we lacked the energy to build big. Now, things are inverted. Our productive powers exceed our imaginative ones. We are making a world that we cannot comprehend. The scholar Timothy Morton (2013) puts this in terms of 'hyperobjects,' phenomena that are so massively distributed across time and space as to confound our usual way of making sense of things.

Climate change is the prime example. It is there in the flood or the wildfire, but it is also not there. We can neither escape it nor keep our attention trained on it. Despite billions of dollars of scientific research, we have still never *experienced* or *felt* the climate. What we experience is weather, and it's always changing, so what's the big deal? That might explain why fossil fuels remain at around 80% of the world's energy mix—the same as it was back in 1987 (Harder 2019). The global economy hasn't decarbonized any faster during the era of climate science than it did in the two decades prior to all that knowledge (Pielke 2019).

Are we even *capable* of grasping what we are doing? As Nietzsche asked in his parable of the madman from *The Gay Science*, "Is not the greatness of this deed too great for us?" (1882, para. 125).

Climate change is everywhere and nowhere. It is now, but it can't be now because the *now* is the time of weather. After Hurricane Dorian devastated the Bahamas in 2019, the homeless survivors looked like victims of bad weather rather than climate. You can see how we might react to a climate apocalypse like the proverbial frog in the boiling pot of water comfortably slipping into oblivion.

Before he was forced to flee Nazi Germany in 1933, Anders married the political thinker (and fellow student of Martin Heidegger) Hannah Arendt. In her 1958 book *The Human Condition*, Arendt worried that we may soon no longer be able to "understand, that is to think and speak about the things which nevertheless we are able to do."

Hans Jonas (1984), another student of Heidegger's and a lifetime friend of Arendt, argued that all previous ethics could assume "that the range of human action and therefore responsibility was narrowly circumscribed." Our high-energy machines have altered the scale of our action and since ethics has to do with action, our ethics must change. But we may simply not be wired for this. If you strap someone into a functional magnetic resonance imaging machine (fMRI) and watch as they think about themselves, their medial prefrontal cortex lights up. We *care* deeply about ourselves. The lights get dimmer and dimmer as we think about people further removed from this central ego—family, friends, and acquaintances (see Walsh 2019). Thinking about a stranger in the Bahamas who lost their home hardly creates any spark at all.

It's not just spatial scales that challenge our moral psychology. It's also time. The prefrontal cortex even dims when you think about yourself in the future. As economists know, we discount the near future, which means it is worth less. The far future is entirely worthless, but of course what we call the "far future" is no time at all for the planet. There's the problem: we are geological agents unable to think geologically. Time and space are slipping from our grasp. This is why "global weirding" is a good term for what is happening.

Anders (1957) wrote that your first thought upon waking up in the morning should be 'Atom.' You should call to mind the enormous powers pulsing under the seemingly steady day-to-day world. "For you should not begin your day," he continued, "with the illusion that what surrounds you is a stable world." Your second thought should be: "The possibility of the Apocalypse is our work. But we know not what we are doing." Even the experts are ignorant when it comes to the whole. We cannot "realize the reality which we can bring into being." There is a gap between our actions and our imagination. Weird things are falling through the crack.

What was a gap in the time of Arendt and Anders is now a chasm. We have altered the energy balance of the entire planet. Now our first thought