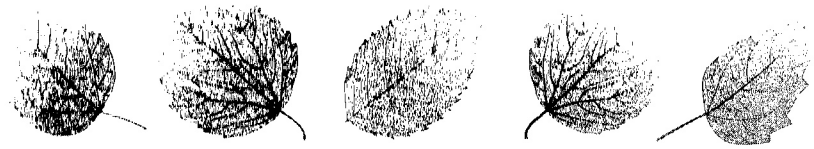
ALSO BY JEREMY RIFKIN

The Green New Deal
The Zero Marginal Cost Society
The Third Industrial Revolution
The Empathic Civilization
The Hydrogen Economy
The European Dream
The Biotech Century
The End of Work



THE AGE OF RESILIENCE

REIMAGINING EXISTENCE ON A REWILDING EARTH

Jeremy Rifkin

ST. MARTIN'S PRESS
NEW YORK

9

BEYOND THE SCIENTIFIC METHOD: COMPLEX ADAPTIVE SOCIAL/ ECOLOGICAL SYSTEMS MODELING

What we are discovering about the nature of nature is so at odds with the conventional scientific narrative underlying the Age of Progress that it's not altogether surprising that our long-held approach to scientific inquiry is under siege. This deeply flawed scientific paradigm to wresting nature's secrets didn't just emerge pell-mell or by chance. It was forcefully introduced into the public arena by a single individual over four centuries ago and became the rule of thumb not only for understanding nature but also for commandeering it for near-exclusive use by the human family.

Francis Bacon, born in London in 1561, has long been regarded as the patron saint of modern science. In his opus the *Novum Organum*, Bacon excoriated the ancient Greek philosophers. Looking over the history of Western civilization since Platonism was introduced into the social space, Bacon concluded that its central themes had done nothing to improve the human lot. He argued that the Greeks, for all their musings, had not "adduced a single experiment which tends to relieve and benefit the condition of man."[1]

Bacon cut new ground by championing the "how" of things as the cornerstone of philosophy and cast his lot with secular power over divine revelation. He believed that a human being's most basic agency was the ability to separate oneself from nature, observe it impartially from a distance, and wrest its secrets

to amass "objective knowledge" about the world, "enlarging of the bounds of Human Empire to the effecting of all things possible."[2]

For Bacon, the mind is a nonmaterial agency whose raison d'être is to have dominion over the material world. He pursued reason while crusading to restore the Lord's initial pledge to Adam and Eve that they shall have dominion over nature. In his own words, "the world is made for man, not man for the world."[3] Bacon outlined the rudiments of what would become the scientific method, boasting that with this new approach, human beings have "the power to conquer and subdue" nature and "to shake her to her foundations."[4] The goal, he prophesied, is to "establish and extend the power of dominion of the human race over the universe."[5]

Bacon's reputation as the father of modern science continued to grow and his scientific method would become a reality with the establishment of the Royal Society in London in 1660 followed by similar scientific societies and academies across Europe and later around the world.

Bacon's naïvely simplified, inductive, objective, detached, and linear approach to scientific inquiry that has accompanied the Age of Progress seems so sophomoric in hindsight in how to approach the natural world. The ever-evolving dissipative patterns and processes of intermingling self-organizing systems that make up our Earth's life force—now beginning to be understood—have spawned a new scientific method more attuned to our awakening understanding of the world.

A NEW SCIENCE FOR A REWILDING EARTH

Crawford Stanley Holling was a Canadian ecologist who served on the faculty of the University of British Columbia and later at the University of Florida. In 1973, he published a new theory on the emergence and workings of the natural environment entitled "Resilience and Stability of Ecological Systems." Holling introduced the concept of "adaptive management" and "resilience" in ecological systems theory and, along with other pioneers, laid the foundation for a radical new scientific method that would fuse ecology and society and come to challenge the guiding principles of conventional economic theory and practice.[6] The theory is called complex adaptive social/ecological systems (CASES).

We use the acronym CASES as an apt description of the type of inquiry used in complex adaptive social/ecological systems. A case is a situation that calls for an "investigation and/or a question to be settled" and is more descriptive of the

new approach to scientific inquiry that is far more adaptive to the coming era than "experiments."[7] Although a mouthful to digest, the new theory and practice is beginning to reshape the way society thinks about time and space and how our species relates to the natural world.

Holling proposed that "the behavior of ecological systems could be defined by two distinct properties: resilience and stability."[8] His thesis was simple and elegant while not shying away from exploring the complexity of relationships that animate the natural world and our own species' interaction with it. His resilience theory has since spread into virtually every discipline: psychology, sociology, political science, anthropology, physics, chemistry, biology, and the engineering sciences. The commercial sectors and industries have also begun to follow suit: particularly in the fields of finance and insurance; manufacturing; ICT and telecom; electric utilities; transport and logistics; construction; urban planning; and agriculture.

But, most important, ground zero of the "New" Great Disruption lies at the intersection of economics and ecology. Holling explains that:

> Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition resilience is the property of the system and persistence or probability of extinction is the result. . . . **Therefore, a major strategy selected is not one maximizing either efficiency or a particular reward, but one which allows persistence by maintaining flexibility above all else.** A population responds to any environmental change by the initiation of a series of physiological, behavioral, ecological, and genetic changes that restore its ability to respond to subsequent unpredictable environmental changes. . . . The more homogeneous the environment in space and time, the more likely is the system to have low fluctuations and low resilience. . . . A management approach based on resilience . . . would emphasize the need to keep options open, the need to view events in a regional rather than a local context, and the need to emphasize heterogeneity.
>
> Flowing from this would be not the presumption of sufficient knowledge, but the recognition of our ignorance; not the assumption that future events are expected, but that they will be unexpected. The resilience framework can accommodate this shift of perspective, for it does not require a precise capacity to predict the future, but only a qualitative capacity to devise systems that can absorb and accommodate future events in whatever unexpected form they may take.[9]

Over the next thirty years, Holling's initial foray into resilience and adaptation theory was modified, amplified, and qualified by others, adding increasing sophistication to the doctrine. In 2004, he coauthored a revised rendition of the theory of resilience and adaptation cycles entitled "Resilience, Adaptability and Transformability in Social-Ecological Systems." In the modified schema, Holling and his colleagues placed increasing attention on the "transformability" of natural systems. That is, the system may not be able to maintain itself, forcing a transformation to a new self-organizing system.

This revised interpretation of resilience is important because the early consideration of the word may have mistakenly given the impression that resilience is a measure of how much disruption a complex adaptive social/ecological system can take and still recover its original state. While that is certainly a consideration, resilience covers a more expansive temporal span in the lifetime of a biological community that extends far into the future and includes a succession of ecological transformations. Ecologists use the term *ecological succession* to describe the birth, maturation, demise, and transformability of biological communities.

The earliest stage of an ecological community is often referred to as the pioneering stage where life begins to bud in a region that has been left barren after cataclysmic events like volcanic eruptions and lava flows, wildfires, floods, and a shift in the climate, for example, between glacial and interglacial periods. New pioneering stages in ecological communities also occur in the wake of human exploitation of environments, for example, via logging, strip-mining, and the spread of toxic waste in the groundwater. In these early stages of ecological succession, we see the emergence of soil, plants, lichens, and mosses, followed by grasses, shrubs, and shade trees. Herbivores follow, eating off the vegetation, and later carnivores appear, eating the herbivores. Each new stage forces an adaptation by all of the previous elements in the evolving biological community in an emerging self-organizing system.

The last stage of succession in the life cycle of a biological community is called the mature stage or the climax community. In a climax community, there is little yearly accumulation of organic matter. The annual production and use of energy are relatively balanced and the climate is relatively stable across the seasons. There is a diversity of species interacting across complex food chains. There is close to a 1:1 ratio between gross primary production and the overall respiration of the community and between energy captured and used from sunlight and released in decomposition, as well as a delicate balance between the capture of soil nutrients and the return of nutrient litter

back to the soil. Each species is continually adapting over time to the changing adaptations of every other species, not purposefully but by necessity.

An ecological community's resilience rests in "the diversity of the drivers, and in the number of passengers." Lance H. Gunderson, of the Department of Environmental Sciences at Emory University, makes the telling observation that the resilience of an ecological community depends on overlapping influences by multiple processes, "each one of which is inefficient in its individual effect but together operating in a robust manner."[10]

Resilience, then, be it in human or ecological communities, has, since Holling penned his initial theory, been generally misconstrued as the ability of the system to respond to massive disruptions with sufficient robustness to allow it to bounce back to its initial equilibrium. But what we have learned in previous chapters is that in nature, society, and the universe, when agencies interact, they never return to where they were because the interactions themselves change the dynamic regardless of how slight they may be. Every interaction changes the relative relationship of each actor to the other, as well as affecting the multiple systems in which they are embedded. At best, one can talk of a relative "bounce-back" to a new state whose actions, agencies, and relationships are roughly comparable as to be able to identify the ecological community as more or less similar in its attributes, processes, dynamics, and populations as before.

The point is that resilience never means reestablishing the exact status quo. The passage of time and events is always changing the patterns, processes, and relationships, no matter how small the footprint, in nature as in society. Resilience should never be thought of as a "state of being" in the world, but rather a way of acting on the world. Adaptivity, in turn, is the temporal agency by which an individual organism, an entire species, or a larger biological community embed themselves in all of the interacting processes and patterns that make up the earth's microbiomes, ecosystems, and biomes on an interactive planet.

Much of the confusion here lies with the way resilience has come to be defined by society—especially in the social sciences disciplines. Learning to be resilient has come to be associated with a therapeutic means of adjusting to trauma that undermines a person's sense of agency, often with the unstated hope of retrieving one's personal and collective life to a semblance of what it was before the disruption. But as anyone who has ever experienced trauma of this sort can attest, the road to recovery and resilience is never backward. One can never go back, but only forward to a new sense of agency that comes from the emotional and cognitive lessons learned.

To complicate matters, resilience is often seen as a way to overcome vulnerability. Yet, to be vulnerable does not always mean being endangered. It also speaks to our ability to be open to the other. To be vulnerable can also mean to take risks, to leave one's comfort zone, and enrich one's sense of personal agency by experiencing the unknown and nurturing more diverse relationships and patterns of living. Resilience is never simply about regaining control but rather of openness to establishing new venues of embeddedness.

Fiona Miller of the Department of Research Management and Geography at the University of Melbourne points to the difficulty of living in the Age of Resilience: "The challenge from a [social] resilience perspective is to learn to live with change and develop the capacity to deal with it instead of trying to block it out."[11] This is the juncture where humanity lets go of efficiency and grabs hold of adaptivity as the temporal means to reestablish its relationship with the earth from one of expropriation to reharmonization. It is the dividing line that takes us from the Age of Progress to the Age of Resilience.

Although not yet acknowledged from within the profession, the economics citadel is collapsing, mostly because of two factors: first, the threat of climate change and increasing pandemics have taken command on a scale that eclipses whatever metrics remain in the economics arsenal to tackle these crises; second, a bewildered humanity has lost faith in the willingness of the business community to right the wrongs that have plunged the human race and our fellow creatures into the throes of an environmental holocaust.

The economics discipline, if it is to survive, will need to metamorphize into a wholly new way of thinking of its relationship to the natural world. That makeover will require, in part, a reassessment of some of the long-held tenets of the discipline, including general equilibrium theory, cost-benefit analysis, the narrow definition of externalities, and its misleading concepts of both productivity and GDP. At the root of this transformation will be the need to temper and even challenge the profession's overriding preoccupation with efficiency and begin to develop tools and business models that bring the discipline in line with adaptivity. Above all, the business community will need to walk back the whole of its relation to and understanding of the natural world as a "resource" and, instead, reenvision nature as a "life force" of which our species is only one of a legion of species whose own journey on Earth is of commensurate value to our own.

More difficult still, our species would need to acknowledge that it's not "all about us" and that if truth be told, all the other species who inhabit the planet with us would be better off if humans were to disappear into the long list of species who have descended into the fossil record before us. Admittedly, this is a tough assessment to confront but an honest evaluation of where things stand. Humbling for sure, but necessary if we are to rewrite our species' future. The question is: How do we begin anew?

Where better to start remodeling economic theory than to follow the science that accompanies the Age of Resilience and that is extricating other academic disciplines from the doldrums of conventional scientific inquiry that conditioned the Age of Progress. Complex adaptive social/ecological systems offer up far more than a new theory of scientific inquiry. The new science amounts to an ontological leap in the way we think about the meaning of existence. The best way to appreciate the significance of this cognitive transformation is to compare this new mode of scientific inquiry with the accepted scientific method to which generations were trained.

Although defining the scientific method has been a slippery and even murky process, there are a number of common denominators that are generally agreed upon. Here is how the *Stanford Encyclopedia of Philosophy* describes the nature of scientific methodology: "Among the activities often identified as characteristics of science, are systemic experimentation, inductive and deductive reasoning, and the formation and testing of hypothesis and theories." The scientific method is accompanied by a set of goals, including "knowledge, predictions, or control" as well as a set of overriding values and justifications known to every student: "objectivity, reproducibility, simplicity, or past success."[12]

The approach that CASES takes to scientific inquiry differs fundamentally from the conventional scientific method. To begin with, the scientific method, as touched on earlier, often focuses on isolating a single phenomenon and observing the workings of its components and parts in order to understand the assemblage of the whole. Second, the conventional approach to scientific inquiry, though long touted as unbiased in its investigation of nature, is anything but. Students come to the lab armed with a set of preconceived notions about the nature of nature and human beings' relationship to the natural world. For example, every student is told to always be "objective" and leave preconceived biases at the door, not realizing that objective comes from the word "object." The unspoken bias is to examine the world as made up of an assortment of objects that are passive and even inert in nature and with little or no agency. Third, nature is often viewed as "resources" to be exploited for societal gain.

By contrast, in the complex adaptive social/ecological systems approach, nature is experienced as "open dynamical systems that are able to self-organize their structural configuration through the exchange of information and energy."[13] Complex adaptive systems also learn to be adaptive to new circumstances, patterns, and environments, and the processes by which they transform themselves into new states—known as emergence.

Researchers Rika Preiser, Reinette Biggs, Alta De Vos, and Carl Folke, in a 2018 journal article entitled "Social-Ecological Systems as Complex Adaptive Systems," summarized the state of the art of complex adaptive social/ecological systems as reflected in the hundreds of studies, reports, and articles by scientists and researchers across multiple disciplines. The following are some of the defining characteristics that distinguish complex adaptive systems inquiry from the traditional scientific method:

> From characteristics of parts to systemic properties: This involves a shift from studying the characteristics of parts in isolation to looking at systemic properties that emerge from the underlying patterns of organization. Systemic properties are destroyed when dissected because emergent properties cannot be decomposed into the properties of their constituent parts.
>
> From objects to relations: Systems properties emerge through dynamic patterns of interaction. Thus, the underlying organizational processes, connections, and emergent behavioral patterns are important to understand.
>
> From closed to open systems: Complex phenomena are embedded in networks and hierarchies through which there is a continuous exchange of information, energy, and material. Therefore, there is no clear inside or outside of SES [Social Ecological Systems] because all entities are connected through processes of organization on different spatial and temporal scales.
>
> From measuring to capturing and assessing complexity: Complex phenomena are constituted relationally through dynamic interactions that form emergent patterns of behavior. Thus, a perceptual shift is necessary that enables us to capture and understand relationships that cannot be measured in terms of material causes. Moreover, through the dynamic mapping and assessing of relations, connections, and multiple complex causal pathways, we can trace configurations and characterize networks, cycles, and cross-scale interactions. These efforts can elucidate how SES are constituted relationally and how patterns of behavior emerge. This can in turn facilitate our ability to anticipate adaptive and transformative behavior and pathways.
>
> From observation to intervention: CAS [Complex Adaptive Systems] are contextualized and constituted relationally, and information about systems properties and dynamics cannot be separated from the organizational properties defining a system. The study of SES implies a process of framing the boundaries of the system that is observer-dependent and entails intervention that is quite different from that of objective observation.[14]

A CASES approach to scientific inquiry falls short of the kind of predictability that science has hitherto sought. Any attempt to establish a boundary on a self-organizing system misses the underlying truth that all self-organizing

Where better to start remodeling economic theory than to follow the science that accompanies the Age of Resilience and that is extricating other academic disciplines from the doldrums of conventional scientific inquiry that conditioned the Age of Progress. Complex adaptive social/ecological systems offer up far more than a new theory of scientific inquiry. The new science amounts to an ontological leap in the way we think about the meaning of existence. The best way to appreciate the significance of this cognitive transformation is to compare this new mode of scientific inquiry with the accepted scientific method to which generations were trained.

Although defining the scientific method has been a slippery and even murky process, there are a number of common denominators that are generally agreed upon. Here is how the *Stanford Encyclopedia of Philosophy* describes the nature of scientific methodology: "Among the activities often identified as characteristics of science, are systemic experimentation, inductive and deductive reasoning, and the formation and testing of hypothesis and theories." The scientific method is accompanied by a set of goals, including "knowledge, predictions, or control" as well as a set of overriding values and justifications known to every student: "objectivity, reproducibility, simplicity, or past success."[12]

The approach that CASES takes to scientific inquiry differs fundamentally from the conventional scientific method. To begin with, the scientific method, as touched on earlier, often focuses on isolating a single phenomenon and observing the workings of its components and parts in order to understand the assemblage of the whole. Second, the conventional approach to scientific inquiry, though long touted as unbiased in its investigation of nature, is anything but. Students come to the lab armed with a set of preconceived notions about the nature of nature and human beings' relationship to the natural world. For example, every student is told to always be "objective" and leave preconceived biases at the door, not realizing that objective comes from the word "object." The unspoken bias is to examine the world as made up of an assortment of objects that are passive and even inert in nature and with little or no agency. Third, nature is often viewed as "resources" to be exploited for societal gain.

By contrast, in the complex adaptive social/ecological systems approach, nature is experienced as "open dynamical systems that are able to self-organize their structural configuration through the exchange of information and energy."[13] Complex adaptive systems also learn to be adaptive to new circumstances, patterns, and environments, and the processes by which they transform themselves into new states—known as emergence.

Researchers Rika Preiser, Reinette Biggs, Alta De Vos, and Carl Folke, in a 2018 journal article entitled "Social-Ecological Systems as Complex Adaptive Systems," summarized the state of the art of complex adaptive social/ecological systems as reflected in the hundreds of studies, reports, and articles by scientists and researchers across multiple disciplines. The following are some of the defining characteristics that distinguish complex adaptive systems inquiry from the traditional scientific method:

> From characteristics of parts to systemic properties: This involves a shift from studying the characteristics of parts in isolation to looking at systemic properties that emerge from the underlying patterns of organization. Systemic properties are destroyed when dissected because emergent properties cannot be decomposed into the properties of their constituent parts.
>
> From objects to relations: Systems properties emerge through dynamic patterns of interaction. Thus, the underlying organizational processes, connections, and emergent behavioral patterns are important to understand.
>
> From closed to open systems: Complex phenomena are embedded in networks and hierarchies through which there is a continuous exchange of information, energy, and material. Therefore, there is no clear inside or outside of SES [Social Ecological Systems] because all entities are connected through processes of organization on different spatial and temporal scales.
>
> From measuring to capturing and assessing complexity: Complex phenomena are constituted relationally through dynamic interactions that form emergent patterns of behavior. Thus, a perceptual shift is necessary that enables us to capture and understand relationships that cannot be measured in terms of material causes. Moreover, through the dynamic mapping and assessing of relations, connections, and multiple complex causal pathways, we can trace configurations and characterize networks, cycles, and cross-scale interactions. These efforts can elucidate how SES are constituted relationally and how patterns of behavior emerge. This can in turn facilitate our ability to anticipate adaptive and transformative behavior and pathways.
>
> From observation to intervention: CAS [Complex Adaptive Systems] are contextualized and constituted relationally, and information about systems properties and dynamics cannot be separated from the organizational properties defining a system. The study of SES implies a process of framing the boundaries of the system that is observer-dependent and entails intervention that is quite different from that of objective observation.[14]

A CASES approach to scientific inquiry falls short of the kind of predict
ability that science has hitherto sought. Any attempt to establish a boundar
on a self-organizing system misses the underlying truth that all self-organizin

systems are patterns among other patterns that spread out in time and space and across the earth's operating spheres, impacting one another in subtle and profound ways that rarely can be foreseen. The most important lesson of applying CASES thinking is to partially let go of the obsession with "prediction" and settle for "anticipation" and "adaptation."

Even many of the findings on the future of climate change are generally after the fact. Scientists in the field admit that changes in the earth's spheres and ecosystems brought on by global warming are difficult to forecast before the effects are seen. That's because the positive feedback loops on a warming planet are so pervasive, with cascading effects rippling out in every direction, that forecasting becomes problematic.

For example, for decades climate scientists paid no attention to the permafrost that covers 24 percent of the entire northern hemisphere landmass until they noticed the effect that global warming was having on the melting of the ice.[15] They realized that under the ice lay vast carbon deposits—the remains of lush animal and plant life that flourished in the northern climes before the beginning of the last Ice Age. Even more troubling, they noticed that the melting of the ice was accelerating because the opaque white layer of the ice that had previously reflected the sun's energy back into space upon melting was leaving behind large swaths of exposed black earth that was absorbing more of the heat from global warming emissions and hastening the melting process—again, another positive feedback loop.

They began measuring the CO_2 and methane emissions that were seeping up from under the ground and realized that the leakage was increasing at an exponential rate, threatening a dramatic increase in global warming emissions that might rival the CO_2 emissions from industrial activity over the past two hundred years. Here was a new reality that had not previously been predicted—an unknown unknown. We finally began to grasp the difficulty of predicting the course of evolving self-organizing complex systems in a radically changing climate and how they might affect society.

The way forward, then, is to at least "partially" shift the focus of scientific inquiry from prediction to adaptation. There is still a significant role to play in making predictions, although that path is narrowing with the cascading rewilding of the earth in the throes of global warming. At the same time, the science of adaptation is ripe to play a role in redirecting society's response to climate change. After all, adaptation is the way every other species adjusts to the unpredictable changes in an ever-evolving world. Adaptivity is not a new concept in science. It's only that it's getting a second life because of the increasing risks facing society.

FROM PREDICTION TO ADAPTATION

John Dewey was one of the founders of the philosophy of pragmatism and among the first to shine a light on the merits of adaptivity as an approach to scientific exploration and problem solving. Dewey had little patience with scientific orthodoxy with its emphasis on objectivity and detachment. He was even less disposed to the deductionist approach of scientific inquiry, which often starts with predetermined hypotheses followed by experiments to test their validity. He also had a particular aversion to the researcher as a spectator. For Dewey, the seeker of knowledge always starts his or her inquiry into a problem by being an active participant, experiencing the issue up close and being affected by it.

The early pragmatists, who included Charles Sanders Peirce and George Herbert Mead, were interested in "actionable" knowledge that could be used to solve a problem and set a new course. Dewey and the other pragmatists were also predisposed to the interconnectedness of experience, understanding that problems are never isolated events that can be easily separated from the many relationships to which they are attached and therefore need to be taken up in a holistic manner.

Dewey eschewed the very notion of the duality of theory and practice and instead "viewed knowledge as arising from an active adaptation of the human organism to its environment."[16] Dewey and other early pragmatists gave fresh life to the importance of adaptivity as a keystone attribute of all living creatures.

While adaptivity gained some traction during the Progressive Era at the onset of the 20th century, it was soon overrun by the efficiency crusade. Managing the future by optimizing the use of time struck a more powerful chord in the heyday of the Industrial Revolution with its mania for managing future outcomes. Now, with a fossil fuel–driven industrial revolution in a death throe and insiders even questioning its guiding principles, adaptivity is suddenly experiencing a revival.

Efficiency, on the other hand, which until recently seeped into every business conversation, has become more muted of late as society reels from crisis to crisis and now faces the prospect of escalating pandemics and climate-related disasters. Talk of unlimited opportunities has given way to discussions on mitigating risks, and efficiency has begun to take a backseat to adaptivity on a rewilding Earth. The Age of Progress, which provided an overarching frame for modernity and a narrative by which successive generations planned and lived their lives, has quietly receded from the public discourse, without

so much as a requiem. Everywhere, the talk is of adaptivity and resilience, particularly in the scientific magazines and journals.

In the depths of the COVID-19 pandemic, *National Geographic* magazine thought it fitting to run a piece on "Adaptation and Survival" in nature. The article cited the various types of adaptation flora and fauna take on to enhance their own resilience, reproduction, and survival. These examples offer creative approaches to adaptation that might spur imitative practices in the business community and society at large.

The *National Geographic* editors led off with everyone's favorite wild animal, the koala, noting that they have adapted to eating only eucalyptus leaves, which happen to be very low in protein value in addition to being toxic to many other species, giving them a noncompetitive source of nourishment.

Some adaptations can be structural, in the form of a physical attribute. For example, succulent plants have adapted to hot dry desserts by "storing water in their short, thick stems and leaves."[17]

Other adaptations are behavioral. Gray whales travel thousands of kilometers each year from the cold waters of the Arctic to the warm waters of Mexico to give birth to their calves and then double back to the Arctic to feed in its nutrient-rich waters.

England's peppered moth, *Biston betularia*, is a classic example of an animal's adaptation to a change in environment. Before the Industrial Revolution in the 19th century, most peppered moths were cream colored with dark spots and only a small number were either black or gray. But, as the soot from industrial activity began to settle on trees, the darker-colored moths came to dominate in numbers because they blended into the darker surface. Birds couldn't see the dark moths and settled for eating the white moths, which resulted in black moths becoming the dominant type.

Sympatric speciation is where a variety of near-identical species share the same habitat because each is adapted to a special diet and therefore is not competitive with others. A variety of orchids live in Lake Malawi in Tanzania. One variety of orchid feasts on algae, another on insects, and a third on fish.

Harvard Business Review was among the first to give a shout-out to adaptivity as the new defining business value moving forward. In a provocative article entitled "Adaptability: The New Competitive Advantage," the authors, Martin Reeves and Mike Deimler of the Boston Consulting Group, noted that the most successful corporations have built their businesses "around scale and efficiency—sources of advantage that rely on an essentially stable environment."[18] But, as they explained, in a world of increasingly unpredictable risks

and instabilities, these tried-and-true values become an albatross. Rather, adaptivity becomes the intrinsic value if an enterprise is to survive. This means the willingness to experiment and accept failures, even if it chokes off short-term revenue. It is the way to regroup and stay in the game.

As well, adaptivity favors leaving centralized bureaucracies behind with their vertically integrated economies of scale, noting that they are too rigid and brittle to survive a world hurtling from crisis to crisis. The authors favor "creating decentralized, fluid and even competing organizational structures" and suggest that such an approach "destroys the big advantage of a rigid hierarchy." They argue that the switchover to seeding an expansive set of alternative business platforms gives a company a diverse number of options, allowing the enterprise the agility it needs to adapt to the fast-changing circumstances in a high-risk environment.[19]

Although the flurry of excitement around rethinking the business model more along the lines of adaptivity and resilience has been more glib than substantive, there are a few green shoots emerging that portend the vast changes ahead. Make no mistake about the significance of complex adaptive thinking applied to social/ecological systems. This is a systemic change in the way society understands, approaches, and reintegrates our species back into the rhythms of a living planet as adaptive agents seeking resilience. The hope is to be counted among the species that survive and flourish in the Anthropocene.

Conventional economics and the workings of the capitalist system, in both theory and practice, won't survive in their current form with the transformation brought on by initiating complex adaptive systems modeling. The profession's guiding assumptions are deeply at odds with the way an animated Earth operates. Some of industrial capitalism's values and ways of provisioning communication, energy, mobility, and habitats will remain as our species readapts to the earth's plethora of agencies and systems, but much of the remnants that make up the bulwark of neoclassical and neoliberal economic theory will disappear, along with the current model of industrial capitalism and the narrative of the Age of Progress.

Complex adaptive system modeling will also require a remake of what we've come to think of as academia. The academic and professional disciplines that emerged in the Enlightenment and matured alongside the Age of Progress were each an end to themselves with their own narratives, language, metrics, and rules of engagement. And each, to some extent, attempted to understand the whole of reality from their own limited perspective.

In regard to pedagogy, virtually every school system and institution of higher

education, at least until recently, have been tightly defined by academic silos. Scholars are penalized for wandering beyond the confines of their academic disciplines in their published studies and books, and often ridiculed for being "generalists" and soft in their erudition.

Admittedly at the university level, and even in some progressive secondary school systems, interdisciplinary studies have become a marginal part of the curriculum, but are still generally taught as an optional course or seminar rather than being embedded into the heart of the academic experience, signaling a pedagogic transformation that would bring teachers, scholars, and students together under the aegis of complex adaptive systems modeling. In recent years, the realities of climate change and the resulting public awareness of the interconnectivity of all phenomena on Earth, as well as a growing understanding of the multiple planetary agencies that affect and adapt to one another, have taken our collective humanity into a historic crisis. This state of affairs can only be understood by adopting complex adaptive systems modeling, which, in turn, requires an interdisciplinary approach to knowledge in the academic community and across curricula.

So, is a resilient economy governed by adaptivity just the newest fad with a limited life span? Unlikely, because the risks and realities associated with a warming climate is not a temporary phenomenon. All of the collective effort of humanity to forestall climate change, at least up to now, has been largely for naught. And now, our scientific community is warning us that a dead planet is no longer an impossibility. While our species will need to continue to push toward mitigation of global warming emissions, it will also have to find ways to continually adapt to the existential change brought on by the warming climate. Laying the foundation for a resilient society is, perhaps, the only surety our species can confidently embrace and take into the future.

All of which brings us back to the question of how best to learn to adapt, become resilient, survive, and perhaps flourish in ways quite different from what we have been accustomed to when we think of a life well lived. Public awareness has only just begun to own the terms adaptivity and resilience, but with little attempt to dig below the surface and rethink what life would be like in this kind of future.

Our forager-hunter ancestors might provide some guidance as they proved to be highly adaptive and resilient through ice ages and interglacial flows, the conditions that would challenge even the hardiest of our species today. Scientific research over the past twenty years has brought to light the eye-opening evidence that *Homo sapiens* may be one of the most adaptive species on Earth.

THE *HOMO SAPIENS* MIND:
Wired for Adaptivity

In the mid-1990s, biologists, cognitive scientists, and anthropologists unearthed new data suggesting that "the evolved structure of the human mind is adapted to the way of life of Pleistocene hunter-gatherers and not necessarily to our modern circumstances."[20] In 2014, scientists from New York University and the Smithsonian National Museum of Natural History published a study on the evolution of our early ancestors that amended earlier theories. For a long time, the consensus among evolutionary biologists was that the genus *Homo* emerged at "the onset of African aridity and the expansion of open grasslands."[21] The savannas favored adaptive traits, including large, linear bodies, elongated legs, large brain sizes, reduced sexual dimorphism, increased carnivorism, and unique life-history traits, including longevity, extensive toolmaking, and increased social cooperation.[22]

New fossil discoveries have further revised the theory of *Homo* origins. According to the scientists involved in the study, "new environmental data sets suggest that *Homo* evolved against a background of long periods of habitat unpredictability that were superimposed on the underlying aridity trend." The study found that "the key factors to the success and expansion of the genus rested on dietary flexibility in unpredictable environments, which, along with cooperative breeding and flexibility in development, allowed range expansion and reduced mortality risks."[23] The researchers came to their conclusion by refining a detailed climate model of the past, and compared it to the *Homo* fossil record, and what they discovered is that the *Homo* lineage did not originate during a calm, cool, stable climate period, as previously thought.

Richard Potts, one of the researchers and the director of the Human Origins Program the Smithsonian Institution, summed up their findings, saying that it was unstable climate conditions that "favored the evolution of the roots of human flexibility in our ancestors," adding that the "origin of our human genus is characterized by forms of adaptability."[24] The use of the term *unstable climate* does a disservice to how destabilizing was the period, which covers the most recent 2.3 million years on Earth. This is the era in which our hominin ancestors evolved, ending with *Homo sapiens*.

During this period, ice ages followed by thaws were the norm. The *National Geographic* reminds us that "by eight hundred thousand years ago, a cyclical pattern had emerged: Ice Ages last about one hundred thousand years, followed by warmer interglacials of ten thousand to fifteen thousand years each.

The last ice age ended about ten thousand years ago," taking our species into the relatively temperate climate of the Holocene and the advent of an agricultural way of life.[25]

Potts said in an interview with the magazine *Scientific American* that in this geological period of wild extremes in the weather, it was human ingenuity, the ability to think of creative ways to adapt to these harsh conditions, that was key to our species' survival. Potts is convinced that "the evolution of the human brain is the most obvious example of how we evolved to adapt."[26]

Summing up his research on human origins, Potts suggests that:

> Our brains are essentially social brains. We share information, we create and pass on knowledge. That's the means by which humans are able to adjust to new situations, and it's what differentiates humans from our earlier ancestors, and our earlier ancestors from primates. You had *Homo sapiens* going into colder environments than even the Neanderthals could tolerate, at the same time that they were migrating into deserts, tropical forests, steppes and glacial environments. . . . How this thin, long-limbed hominid could make it in all these different environments, to me that is a story about how you become adaptable.[27]

Whether our species' adaptive capacities can adjust to the speed at which global warming is changing the hydrological cycle of the earth is the underlying question of our age.

Human adaptability to wildly changing climate regimes is our strong suit. It's what has made us one of the most resilient species on Earth. This is perhaps the most heartening news of our time and should be acknowledged and embraced with gusto at the outset of the Age of Resilience, with a qualification. The same adaptability that allowed our species to prevail during wild gyrations of the climate has been our undoing as well.

The cognitive attributes that allowed us to adapt to wildly changing climates during long stretches of the Paleolithic era, when we were forager-hunters, have been put to use over the past 11,700 years in the relatively predictable temperate climate of the Holocene to reverse course and force the natural world to adapt to our desires. This, too, is about adaptation. Beginning with the Agricultural Revolution, and more recently transitioning into the Industrial Revolution, we retooled our adaptive instincts from living with the changing seasons to storing surplus. That surplus multiplied exponentially during the two hundred years that marked a fossil fuel–based industrial civilization, or what we call the Age of Progress.

That is not to say that the fruits of the Industrial Revolution weren't a boon for large numbers of people, especially in the Western world. Arguably, most of us in the highly developed nations are far better off than our ancestors were before we began the industrial age. It's also fair to say that nearly half the population of the world (46 percent), living on less than $5.50 per day, the dividing line that defines poverty, is at best only marginally better off than their ancestors, and perhaps no better off.[28] Meanwhile, the wealthiest human beings have triumphed. By 2017, the accumulated wealth of the eight richest individuals in the world equaled the total wealth of half the human beings living on the planet—3.5 billion people.[29] Gandhi best captured the choice before us. He put it this way: "Earth provides enough to satisfy every man's need but not any man's greed."[30]

I PARTICIPATE, THEREFORE I EXIST

If animist consciousness was anchored in blood ties, ancestor worship, and eternal return, religious consciousness around salvation in heaven, and ideological consciousness around material progress and technological immortality on Earth, what then is the foundational bedrock of biophilia consciousness? The universalization of biophilia takes the human narrative from a fixation with autonomy to an attachment to relationality. René Descartes's classic utterance, "I think, therefore I am," is already passé as a younger generation growing up in virtual and physical worlds conditioned by layers of laterally embedded interconnectivity are more disposed to the maxim, "I participate, therefore I exist." In this new era of ceaseless adaptivity among multiple interactive agencies, the concept of autonomy gives way to the principle of relationality. If the earth we inhabit is one of interlapping patterns rather than hard forces butting up against one another, the very idea that each of us is an autonomous agent seeking hard ground with which to protect our sovereignty in a world of competing agencies is all but dead and buried—so too our long-held ideas formed in the Age of Progress about the nature of equality.

In the Age of Progress, equality only bears weight as a derivative of autonomy. One can't champion equality without first believing in autonomy. To the extent that one believes himself or herself to be an autonomous agent, he or she will demand equality. It goes with the territory. If every individual's basic nature is to seek autonomy, the urge to be treated as an equal will inevitably follow as a vigilant shadow companion, always on guard to ensure that one's autonomy is secured.

Ideological consciousness is so tightly tethered to autonomy as to be inseparable. The whole of the Age of Progress rides atop this foundation. Thus, "human rights" becomes the marker by which autonomy is sought and secured. Every individual asserts the unalienable right to be autonomous in body, mind, and spirit. Human rights, then, if played out on a grand scale, would envision nearly eight billion autonomous human agents left undeterred and free to pursue their existence as they see fit with the proviso that they don't do harm to others' rights to autonomy.

But what if none of us are autonomous agents, either in the political sense or, deeper still, in the marrow of our biological being? What we have learned in the preceding chapters is that while each of us and every living creature is unique, not a single one of us is autonomous, at least not from a biological perspective. We are, every one of us, an embodiment of all the relationships

within which we have been immersed over a lifetime from the emergence of the embryo to death's door and even beyond.

The interactive approach to understanding the nature of nature and human nature forces a basic rethink of the philosophical and political narrative that ran afoot the Age of Progress. If reality is a deeply participatory experience at every moment and throughout our lifetime, then one's experience of self can only be in relationship to the other. It follows naturally that the more rich, varied, and immersive the relationships, the deeper we become embedded in what we call "existence."

Biophilic consciousness is the deepest expression of equality—not equality born of autonomy, but of inclusivity. The purest expression of equality comes not from recognition afforded in legal charters and declarations but by the simplest acts of empathy. Deeply feeling another's struggle to flourish as if it were one's own creates the most intimate bond—the feeling of oneness on life's journey. The philosopher Martin Buber put it best. In such moments, there is no "mine and thine," but only "I and thou."[43] The empathic embrace is the ultimate political leveler. It casts aside every differentiation, leaving only bonded companions.

The evolution of empathy over history is characterized by the increasing elimination of "the other" until there is only "one for all and all for one." Within this context, the evolution of empathy and the evolution of equality are inseparable. We, "the body politic," become immersed in one another's lives at the most basic political level—the communities to which we are attached. Our empathic engagement—that is, our biophilia consciousness—becomes the sensibility by which we steward rather than merely manage the life force of that small part of the earth's biosphere where we live out our existence.

In the Age of Progress, we came to regard individual sovereignty as the basis of democracy, although they are not a comfortable fit. If everyone is truly sovereign and an island to themselves, and not beholden to others, in what regard would they hold democracy? Why bend to any other sovereign's will? It's the ability to recognize oneself in the other that animates democracy. Empathy is the binding element of democracy. If empathy is the deepest expression of equality, then it follows that it is also the emotional spark of democracy.

The empathic reach has traveled alongside the evolution of democracy at every stage of its development. The more empathic the culture, the more democratic its values and governing protocols. The less empathic the culture, the more totalitarian its values and governing institutions. All of this seems obvious, which makes it all the more inexplicable how little attention is given

over to the relationship between empathy and democratic processes in the governing of society. The extension from representative democracy to distributed peerocracy and from sovereign governance to extended bioregional governance will likely succeed to the extent that the body politic embraces an empathic biophilia consciousness.

The idea of resilience, from an empathic perspective, is also quite different from how we have been accustomed to thinking of the term in the past. It's worth reemphasizing that being resilient traditionally has meant having the moral character to bounce back from misfortune and personal tragedy and recover one's autonomy. Translated, that means having the physical, mental, and emotional stamina to restore one's selfhood, rather than being beholden to others or life's circumstances or simply cast adrift. Resilience means not being vulnerable to destabilizing external circumstances, whatever their origins—but rather, being strong.

For the relational self, resilience comes from being open and vulnerable to "the other" rather than being self-contained and autonomous. It's openness to sharing life-affirming experiences that creates a rich web of relationships that strengthens one's own resilience. Biophilia consciousness extends one's deep participation to the whole of nature, letting its life-affirming force shore us up and take us along with the flow of life's passage.

This notion of resilience is not a recent revelation. Two centuries before E. O. Wilson introduced the concept of biophilia consciousness, the great German philosopher and scientist Johann Wolfgang von Goethe offered up biophilia consciousness as a counternarrative to Newton's sterile vision of a dead, rational, and mechanistic universe. Goethe believed that one's selfhood and resilience is a composite of the relationships one experiences that weave him or her into the fabric of life. He wrote, "We are surrounded and embraced by her [nature]—incapable of stepping out of her, incapable of penetrating deeper into her."[44]

Goethe was awed by the simple fact that every creature is unique yet connected in a single unity, noting that "each one of her [nature] creations has its own character . . . that all together make one." Goethe experienced nature as ever changing, continually in flux, always evolving, and creating ever new realities. Unlike the rational scientists of the period, Goethe's nature was not fixed and unchanging but, rather, pulsing with novelty and replete with surprises and synergies. In short, brimming with aliveness. He observed that:

"For permanence she [nature] has no use, and puts her curse on all that stands still. . . . She spits forth her creatures out of the Nothing and does not tell them whence they come and whither they go. Let them run; she knows the course."[45]

Goethe felt the empathic experience centuries before the feeling had a

name. He wrote, "To find my way into the condition of others, to sense the specific mode of any human existence and to partake of it with pleasure" is to affirm the oneness of life.[46] Reflecting on his own life and times, he concluded that the "beautiful feeling that only mankind together is the true man, and that the single individual can be joyful and happy only when it has the courage to feel itself as part of one."[47]

For Goethe, "being one" didn't stop at the edge of our species, but rather, extended to all of nature. Goethe gave us the earliest read on what today we call biophilia—empathizing with all of life. Our individual resilience draws from our biophilia embeddedness. It's the realization of that indestructible bond that makes us resilient to the misfortunes that come our way.

Bear in mind that empathy is not just an emotive feeling but a cognitive experience that organizes one's thinking about the very nature of existence and one's relationship to it. We've each come to know about our existence by experiencing the other. If there were no others, there would be no reference by which to make comparisons or even understand that one is alive and truly exists. Our very existence is only validated by the other.

Our empathic neurocircuitry is continuously prodding us to transcend ourselves, to experience life, and to use that experience to make connections and adjust to the world around us. We know the importance of empathy, because were it absent in our neurocircuitry we would not be able to feel the fragility of another person's life and their drive to flourish. It's at these moments that we come to understand the awe of existence. And without awe we would have no way to wonder. And without wonder, we would be absent imagination. And without imagination, we would not be able to experience transcendence. And without the ability to transcend ourselves, we would not be able to empathize with another. This is the great interactive ensemble by which we know our existence. This ensemble is not experienced linearly, but rather, as a whole. Awe, wonder, imagination, and transcendence, brought on by the triggering of the empathic drive, allow each of us to continuously reach beyond ourselves in search of the meaning of existence. These are the fundamental qualities bound up in the empathic impulse. They are what makes each of us human.

In a sense, the search for meaning is with us at every moment of our lives, whether consciously thought about in that way or not. To the extent that the empathic impulse is nurtured, one's life is experienced and lived more thoroughly. We know this to be true because when we look back on our lives at the end, the most vivid experiences that come to mind, at least the ones that give our lives meaning, are the moments of empathic embrace—they are the markers of our search for personal meaning.

Think of the great philosophers of the Enlightenment and modern era who viewed bodily experience as inconsequential at best and corrupting at worst, preferring to cast their lot with mathematical certainty and pure reason rather than empathic transcendence as the alpha and omega of human existence. This misguided view of the essence of our humanity has done untold damage to our collective psyche and even greater damage to the natural world and the prospects of our fellow creatures.

Thankfully, these perverse ideas about the nature of human nature are fast losing currency because we are now waking up to where they have led civilization—a sure sign that our thinking about how our species navigates its journey has begun to turn around. We can see it in the soul-searching rethinking currently going on in the scientific community about how best to approach the deepest questions about the meaning of existence and how our species fits in. In a way, the new approach to scientific exploration and explanation that comes under the rubric of complex adaptive social-ecological systems is a testimonial to the way we are reconditioning our thinking about cognition. Recent studies of how systems thinkers think find that they "express an elevated capacity for the allocentric components of cognitive and affective empathy."[48]

In the Age of Resilience, we will need to deepen our empathic drive and reach out to the next stage of empathic extension—a biophilia consciousness that brings our species back into the family of life. The litmus test will be how we nurture and prepare our children and they their children to let the sense of awe awaken, even to the terrifying ways the earth is convulsing. That renewed sense of awe, although frightening, is also potentially liberating. If met head-on, it can trigger a new and more enveloping sense of wonder, spark our collective imagination, ready us to explore new paths toward adapting to nature's calling, and become resilient—to not just survive but to flourish in unexpected ways with our extended evolutionary family.

COMING HOME

We are the great wanderers of history, cast off on a thousand and one journeys over continents and oceans, braving treacherous climactic disturbances and perils of every kind, in a restless search of our place, our attachment in the world. Our outsized brain atop a bipedal body has been both our bane and our blessing. If any species on Earth deserves to be thought of as an anomaly, it most certainly is us. No other species, to our knowledge, is consumed with the question of the "why of things," although all our species' relatives are well

equipped to manage the "how of things." Why the empathic impulse deeply embedded in our neurocircuitry? Why, of all the creatures, do we alone experience awe and wonderment and know of our own mortality?

We've come to believe that beyond ourselves is simply inchoate matter—resources—whose existence takes on import only in relation to our hedonist drives and gratifications. Still, the empathic pulse beats relentlessly in our neurocircuitry, surfacing repeatedly during our individual lifetimes and expanding outward in historical periods to embrace ever larger numbers of our species, only to fall back again, taking us into darkness.

What keeps us going if it's not to find our place of secure attachment in this world? What does it mean to be burdened by such angst? If alien beings were to look in on us and witness our plight, they might likely observe that our most unusual trait is our search for universal intimacy, a term that might seem like a contradiction. How can one experience both universality and deep intimacy at the same time? Yet, that appears to be our cross to bear or, to turn it around, perhaps a transcendent gift of incalculable weight.

The journey has been long, exhilarating, and tortuous at times, and now, at the very moment where we sense the end of our earthly existence, we are beginning to find our way home. We are awakening as a species to biophilia consciousness, the feeling and experience of universal intimacy, of being one with the life force of the earth.

Owen Barfield, a British philosopher in the 20th century, captured the essence and drama of the human saga, cutting it into three decisive stages, each marked by a foundational change in human consciousness along with the adoption of a new worldview.

Our forager-hunter ancestors felt little differentiation from their fellow species. They lived their lives in deep participation with the natural world, continually adapting to the immediacy of the earth's rhythms, seasons, and cycles. They lived communally, organizing their social life in cohorts rather than hierarchies. They saw the world with animist eyes. They experienced their fellow creatures as related spirits whose existence was little differentiated from their own and even deeply intertwined. Animist consciousness brooked no place for what later generations would come to see as "history," being content with the eternal return of annual and seasonal cycles.

As there was little differentiation in roles, with communal life shared and with no surpluses to dispose of that might give rise to distinctions and hierarchies, selfhood remained largely undeveloped. They lived as a communal "we" rather than a collection of individualized selves in what psychologists today might call an "undifferentiated, oceanic oneness." Their consciousness

was lived out in a duality of biophilia and biophobia commensurate with their deep participation in nature.

The journey since has taken our species into the Neolithic era of primitive agriculture and pastoralization and, later, the great hydraulic agricultural civilizations and more recently the Industrial Age, ultimately separating our species from nature, which came to be thought of as a passive reserve of resources of little value until expropriated and transformed into useful goods by our hands. Today, our species lives in ever more integrative societies made up of more differentiated skills and division of labor embedded in more extensive infrastructures, servicing billions of human beings, all living side by side, increasingly walled off from the rest of the world. Currently, the average American spends 90 percent of their day indoors—often in artificially cooled and warmed temperatures with electric lighting—far removed from the natural world our ancestors, living as hunter-gatherers, called home for upward of 95 percent of our species' existence on Earth.[49]

The sense of security living in a second artificially contrived environment of our own making, and now even in virtual worlds and the metaverse, was always an illusion. We alienated ourselves from our ancestral abode, and deceived ourselves into believing we had secured an autonomous existence, only to experience the price of our folly—the entropy bill brought on by global warming emissions and the sixth extinction of life in Earth's history. Still, there is a lesson here.

Climate change and increasing global pandemics have taught us that everything we do in this world intimately affects everything else and vice versa. We have become aware that no human being is an island to themselves, an autonomous agent acting on the world but, rather, dependent, one way or another, on every other living agency and the dynamic of the earth's spheres for our existence. This nonnegotiable reality has been a driving force in the furthering of biophilic consciousness—the feeling of deep empathic resonance with life—doubly so now that our very future is in question.

Barfield believed that our species is on the cusp of a third great stage of human consciousness—a reassertion of our kinship with the natural world. But this time around, the biophilic empathic leap is a self-aware choice to re-participate wholly and unreservedly with the rest of life on the planet . . . to experience universal intimacy. This comes not out of blind superstition but, rather, out of a deep empathic, mindful, and cognitive understanding of our abiding attachment to life. It is a long journey of epic proportions that is bringing our species back home once again, grounded and hopefully renewed and ready for the great struggle before us of reanimating the breath of life. The earth beckons.

ACKNOWLEDGMENTS

I began researching the critical themes in *The Age of Resilience* in 2013 and have spent the better part of eight years immersed in the research. Books are always a collaborative adventure. In this regard, I'd like to especially acknowledge the editorial assistance of Claudia Salvador, who serves as chief of staff of our various endeavors. Claudia's contribution has been immeasurable, from researching, categorizing, and aligning literally thousands of journal articles, studies, and reports, to overseeing the voluminous endnoting process. Claudia's wise and insightful editorial suggestions appear throughout the book and have helped refine the final work.

Thanks to Daniel Christensen, our office's former chief of staff, for his contributions in the early research stages that went into the book, as well as to Joey Bilyk for his assistance in the final stages. I'd also like to extend my appreciation to Jon Cox for his deep dive into the mechanics of the manuscript and his editorial suggestions for streamlining the book.

I'd like to thank my domestic literary agent, Meg Thompson, for her support and wise counsel throughout the process, and for keeping the book on track. Also, I'd like to thank my foreign literary agent, Sandy Hodgman, for liaising with our foreign publishers and ensuring a wide global audience for the book.

Many thanks, also, to Kevin Reilly for shepherding the manuscript through the various editing stages leading up to publication, eliminating roadblocks, making suggestions along the way, and keeping the book on track. Also, thanks to Rima Weinberg for her astute editing in the final stages.

I'd also like to acknowledge my editor, Tim Bartlett at St. Martin's Press, for his enthusiastic support of the project and his personal commitment to bring the critical themes of the book to the reading public. Having an editor who cares deeply about the existential crises facing humanity at this seminal point in our species' history has been a source of great encouragement.

Finally, as always, I'd like to thank my wife, Carol Grunewald, above all, for her input to the story lines and content and the numerous conversations we've shared over the years, which helped shape my own thinking in approaching this project.