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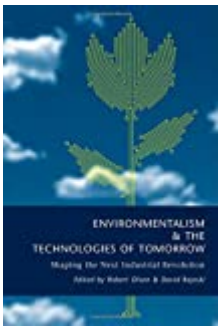

Robert Olson, David Rejeski, eds. *Environmentalism and the Technologies of Tomorrow: Shaping the Next Industrial Revolution.* C.: Island Press, 2005. xiii + 195 pp. $45.00 (cloth), ISBN 978-1-55963-765-7; $24.95 (paper), ISBN 978-1-55963-769-5.

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Sustainability: A Revolution in Progress

In tribute to the tenth anniversary of the journal *Environmental History*, the January 2005 edition presented a series of thirty essays dedicated to answering the question, "What's next?" Scholars and colleagues were asked to submit their views, insights, and desires for the future of this academic field. Comments were as lively as they were thoughtful, ranging from concern for emerging nanotechnologies to better insight into national and global development.

Environmentalism and the Technologies of Tomorrow: Shaping the Next Industrial Revolution, edited by Robert Olsen and David Rejeski, is a series of 17 essays that attempts to address the question: "What's next?" in technology and environmental studies. It is a slim, well-crafted work that reflects the high ethical, intellectual, and professional values of its contributors. The book is the result of an agreement between the Woodrow Wilson International Center of Scholars and the Environmental Protection Agency. The authors are professionals representing national and international business, government, and academic circles. The variety and intensity of their commitment to a sustainable world economy and environment contribute to the book's remarkable coherence in ideology and viewpoint. It celebrates the dedication and persistence of talented professionals engaged in research, litigation, and production working toward a common goal of global sustainability. The concept of sustainability is one that runs through the book; the editors refer to it as a lens through which the enormous task of caring for the environment can be viewed.

The book has a simple three-part structure: the essays are grouped around sub-themes addressing the transition to sustainability, new technologies, and new governance. The editors introduce the book by inviting the reader to juxtapose the current evolution in technology against the industrial revolution of the nineteenth century. They suggest that at this point in time we have an unprecedented opportunity, a second chance, to harness technological change in novel ways that respect the integrity of the planet's natural resources without inhibiting human creativity and civic organization. Acknowledging the suggestion in some circles to return to simpler technologies, these writers contend that rapidly advancing change in information systems, human develop-

ment, market systems design, production, and delivery and governance can speed the transition to sustainability with minimal loss in human productivity or resources. In fact, harnessing the energies of thinkers and visionaries across the spectrum of the arts and sciences can trigger novel responses to current elusive and inadequate solutions. This book bases its assumptions on the insights of history, and reminds contemporary workers in the environmental field not to neglect the hard-won insights of the past.

The first chapter, "Creating a Sustainable Future: Are We Running Out of Time?" by James Gustave Speth, opens with reference to the Global 2000 Report prepared during the Carter administration. Readers are recommended to review this document; it can be accessed on the Internet. As Speth noted, this report and others prepared at this time were chillingly accurate in their predictions. After twenty-five years, the world community is much more aware of the global implications of deforestation, species extinction, degrading water ecosystems, and climate change. While recent generations have scrambled to come up to speed on monitoring these life systems, we have not yet put in to action the steps necessary to move world cultures to a sustainable future. Steps that are moving us in the right direction include stabilizing demographics, reduction in poverty and illiteracy, closed-loop technologies and manufactures, ethical consumption practices, growing eco-economies, and shifts to new governing institutions focused on sustainability and accountability.

Finally, Speth acknowledges "the most fundamental transition of all–a transition in culture and consciousness" (p. 18). I think it is this transition, the threshold where human civilization and the natural world meet, that gives contemporary environmental historians reason to pause and reflect on the challenges ahead. In chapter 8, Brad Allenby writes: "Forget 'natural history'– increasingly there is only human history. And that trend will only intensify: the evolution of information technology, economic structures and globalization, nanotechnology, and biotechnology will have far, far more to do with the structure of the future than any environmental policy we may think about" (p. 81).

While the editors attempted to group these essays so that emerging technologies are addressed in part 2, new technology and its place in a sustainable eco-economy pervade the thinking throughout the book. In chapter 2, "An Eco-Economy in Harmony with Nature," Lester Brown states: "[I]f an economy is to sustain progress, it must satisfy basic principles of ecology. If it does not, it will decline and eventually collapse. There is no middle ground. An economy is either sustainable or it is not" (p. 21). Recognizing that there is no precedent for moving a market-based economy to one that operates within an ecological framework, Brown outlines the major features of such a system. This would include more efficient use of resources and materials; increasing dependence on wind, solar, and hydrogen-based sources of power; diversified systems of transport; closed systems of recycling; efficient distribution of water; sustainable yield harvests; and balanced populations.

One of the first new technologies to be considered is the hydrogen-based fuel cell. I invite readers to delve into the growing literature documenting this evolution. Remarkable achievements in fuel-cell technology are already of note as public utilities and public transport facilities gravitate to new and hybrid sources of power. The October 19, 2005 Internet edition of the *Stanford Report* highlighted the educational progress being made in teaching the mechanics of the hydrogen fuel cell. Professor Fritz Prinz and his student colleagues presented papers that week at an Electrochemical Society conference in Los Angeles, announcing innovations that are enhancing fuel-cell performance. This year, Professor Prinz will publish a textbook for mechanical engineers, one of the first of its kind.

On the front page of the October 23, 2005 *Houston Chronicle*, Dina Cappiello's article, "Wind farm may yield windfall for Texans," reported the leasing of 11,000 acres of the Gulf of Mexico for the construction of gigantic wind turbines capable of generating enough power to sustain 40,000 households. This project rivals others proposed for Long Island and Nantucket Sound. Cappiello reported that this lease is the first granted by any government agency in the nation for an offshore wind project. In his article noted above, Lester Brown mentions the remarkable investment opportunities that will become available in the "new economy" as industries move to systems and technologies consistent with ecological principles.

Chapter 3, "A New Age of Resource Productivity," by Amory B. Lovins and L. Hunter Lovins, returns the reader to the industrial revolution to consider how technology has changed the relationship between labor and the environment. The authors note that the pattern of scarcity that drove the first revolution has reversed itself. Today, natural resources are scarce while human resources are abundant. That reversal dictates a reorien-

tation of effort to safeguard the ecosystem services that make the current economy possible in the first place. Reducing waste is essential. This includes sources of energy, tools, facilities, and vehicles. Ultimately, natural systems should provide the model for resource productivity. As the authors note: "If we can't use it and can't sell it, we shouldn't produce it; we should design it out" (p. 35).

Part 2 introduces the reader to a series of innovations that have the power to transform our lives. Chapter 4, "Environmental Implications of Emerging Nanotechnologies," by Mark R. Riesner and Vicki L. Colvin, gives a foresight into the emerging world of the atom and its amazing roles in biological and chemical processes. In turn, these novel processes promise to have a profound influence on a wide range of environmental practices. Key applications include membrane science, catalysis, contaminant sensing, energy production and storage, and contaminant immobilization. Membrane science is a key technology critical to the development of the hydrogen fuel cell. Risk management of nanomaterials is in its infancy and promises to bring to light new research in bioaccumulation.

Chapter 5 took me by surprise. While previous chapters were challenging and demanded careful attention, this is the chapter that stopped me in my tracks and made me realize that what these authors are trying to describe is an environmental agenda light-years away from the events leading to Earth Day in 1970. "Ecological Computing," by Feng Zhao and John Seely Brown, describes the development of a vast, autonomous, co-evolving, self-configuring global sensing system grid, "an enormous digital retina" many generations beyond the Internet. Tied to intelligent browsers, it will allow humans to "go where we cannot" to monitor life systems at all levels of complexity in order to pose questions unimagined in previous generations (p. 54). This grid, already in development, will create vast harvests of information, making it simpler and less invasive to listen to earth's heartbeat. Tiny wireless sensors, deeply embedded in the physical world, could be used to track pollutants, to allow for transportation vehicles to communicate to one another about road conditions, to track variance in agricultural conditions, and to efficiently coordinate the manufacturing and transfer of commodities. The authors explain: "Ecological sensing systems are blended into the physical environment through sensors, actuators, and logical elements; they are invisible, untethered, adaptive, and self-organizing. This is where the computational world meets the physical world" (p. 58).

The first thought that came to my mind when reading this article was that of life support: we seem to be talking about implementing an immense intensive care program of an unprecedented scale to save the life of our planet. I was heartened to see several references to William Cronon's work by contributors to the anniversary edition of *Environmental History*. I reviewed the essays compiled for *Uncommon Ground: Rethinking the Human Place in Nature*, to prepare myself for this review.[1] Susan Davis's article, "Touch the Magic," a reflection on Sea World, closely approximated my first reactions to the Cockrell Butterfly Collection and Moody Gardens in Texas. It saddened me then to think that in the event of a holocaust, silent or not, these constructed environments could serve to help restore the beauty of the natural world.

At this time, we are not talking about constructing simple recreational sites or saving degraded wilderness areas. A planet controlled by human design raises sharp, new ethical and social questions that require time and thought. Browsing through *Uncommon Ground*, I re-read Anne Whiston Spirn's article, "Constructing Nature: The Legacy of Frederick Law Olmsted." She wrote: "Recognition demands that renewal accompany use, that we not just abandon those places whose original appeal or value has been destroyed through human use but also take responsibility for creating life-sustaining habitats ... [celebrating] the human ability to shape them and promote the possibility of fostering similar qualities in ordinary landscapes."[2] The planet as a landscape for human design takes her thesis to a very different level. Are the odds in our favor? These authors think they are.

For instance, as guardians of the past, historians now have at their fingertips new ways of modeling data to duplicate past events. Computer simulations of the past can generate valuable clues about our future. This year, to better inform myself of the advances in science and technology, I have been poring through current issues of *Scientific American*. The July 2005 volume included an article, "Simulating Ancient Societies," by Timothy A. Kohler, George J. Gumerman and Robert G. Reynolds. This article described the efforts of archaeologists, using computer simulation, to explore human prehistory. Building on earlier work by researchers at the Massachusetts Institute of Technology, current scholars chose to work on a Mayan culture dominant in the Southwest between 300 and 900 A.D. Using models simulating individual households within a landscape, programmers supplied rules of behavior while leaving room for new behaviors to emerge based on data inputs. One behav-

ior that was monitored was the sharing of maize, particularly in times of scarcity. Measuring these behaviors helped refine our understanding of the relationship of that culture to the environment, providing valuable clues for methods of sustaining natural resources in the future.

Genetics will also play a prominent role in the maintenance of natural resources. Again, popular magazines and the daily news bearing headlines of extraordinary achievements worldwide permeate our culture. Chapter 6, "Genetics and the Future of Environmental Policy," by Gary E. Marchant, examines the rapid advances in genetic engineering. Researchers predict direct applications in environmental protection and resource productivity. Microarrays profiling gene expression after exposure to toxic materials will make a manifold difference in public health while tightening the standard for acceptable risk. In time, genetics may play a role in raising toxic resilience and disease prevention in populations.

Chapter 8, "Engineering the Earth," by Brad Allenby, brings closure to the controversial picture of the future described in part 2. He builds on the stark observation that "a principle result of the industrial revolution and its associated changes in human demographics, technology systems, and economic systems has been the evolution of a planet in which the dynamics of most major natural systems are increasingly dominated by human activity" (p. 81). What is required now is the development of coupled human-natural systems with earth systems engineering and management (ESEM) capacity. No single course of action–political, economic, scientific–is sufficient in itself to carry the future. He acknowledges that the emergence of such systems raises profound ethical and religious questions. Calling to mind the Florida Everglades, he notes that the ecosystem, while in restoration, will hereafter always be a product of human design and choice. The dialogue between human and natural systems will not go away. He closes his statements with the note: "For our choice is not whether we want an anthropogenically influenced, engineered earth; that is already decided. Rather, our choice is whether to respond ethically and rationally to the challenge history has created for us" (p. 86).

Part 3 of this book organizes nine essays devoted to the topic, "New Governance." I include chapter 7 with this group, bringing the count to ten, more than half the book. That is indicative of the central role that the authors assign to industry and government in the success of future environmental strategies. Working through the ideas presented in this book, I made a list of key concepts that could have been used to organize this paper. These included lens, sustainability, standards, cooperation, economy, network, systems, industry, and justice. I asked myself what one word I would use to summarize the intent of these authors. The writers themselves would most likely point and click "sustainability." I would choose the word "design." It implies the best that human nature has to bring to the natural world: creativity, industry, ingenuity, and a steady belief in our ability to better our circumstances. In whatever environment one labors, the design of our effort will determine how successfully we engage ourselves in creating a balanced, sustainable existence for earth's inhabitants.

Respectfully imposing my own logic (or design, if you will) to order the themes of this half of the book, chapter 13, "Advancing Corporate Sustainability: A Critical New Role for Government," by David V.J. Bell, addresses the growing awareness by governments worldwide of the leading role industry and the private sector must take to achieve a sustainable market economy. He writes: "Advancing corporate sustainability is one of the most important roles government can play over the generation ahead. Government has an enormous opportunity to leverage constructive change by facilitating a business transition to an economy that is much more efficient, much more fair, and much less damaging. But to take advantage of this opportunity, government itself will need to innovate" (p. 124). In chapter 12, William McDonough and Michael Braungart discuss "The Guardian Reborn: A New Government Role in Environmental Protection." While respectfully acknowledging the tremendous achievements attained by the EPA in past decades, the authors suggest that today regulation and oversight are secondary to support for strong and innovative design in management and industry. This implies promoting innovative supply and manufacturing systems based on a cradle-to-cradle design, or closed-loop systems that support and renew nature.

These essays echo the theme of chapter 7, "The Future of Manufacturing: The Implications of Global Production for Environmental Policy and Activism." Timothy J. Sturgeon explains current trends in the global market and its potential for raising environmental standards. Systems design is an important component of futurist conceptions of the global economy and governance. He notes: "[C]onsolidation of larger portions of the world's manufacturing in a handful of large contract manufacturers and huge first tier turn-key suppliers provides important points of leverage for policymakers and activists. Pressure brought to bear on a global supplier is pressure

brought to bear on a substantial chunk of the world's manufacturing base" (p. 78).

In chapter 15, "Is Free Trade Too Costly?" Denis Hayes observes that while the American culture and economy is slowly absorbing and incorporating concepts of sustainability, the forces governing world trade continue to perpetuate an environment that promotes poverty and the illegal tradeoff of toxic emissions. Material growth needs to be modified by newer models of prosperity which include recycling of basic materials, renewable sources of energy, healthy world diets, and very carefully designed, efficient systems of commerce and transportation. He closes by noting that holding high standards in these areas is the most important gift America can offer the world. In chapter 16, "Greening the Global Financial System," Hazel Henderson looks at global financial markets and comments on the need for a fundamental reform to foster global sustainable development, "to promote the globalization of human rights, social justice, environmental sustainability, and opportunities for human development" (p. 153). Today, the United Nations Earth Charter is widely considered to be the companion treaty to the Universal Declaration of Human Rights.

The relationship of industry to government is complicated by different political and legal structures worldwide. This makes generalizations difficult. The appropriate role of government is particularly contentious in democratic, representative societies. At the same time, the need for strong leadership in the environmental arena remains the same irrespective of who's the boss. The qualities of environmental leadership are discussed in chapter 10, "Environmental Leadership in Government," by Joanne B. Ciulla. She notes that if our cultures have not succeeded in grooming leaders capable of moving the environment to the forefront of public and private practice, it is because the structures of government have not sufficiently empowered the role of environmental oversight with a place at the highest levels of government.

In chapter 13, David Bell writes: "In most countries, the government is the largest landowner, the largest fleet owner, the largest single employer, and the largest landlord or owner and operator of buildings.... Just as most governments try to conduct government operations and public enterprise according to sound business practices, sustainability principles should now be seen as integral to this process" (p. 126). He concludes by stating: "Virtually all of the major roles of government can be marshaled into a comprehensive effort to advance corporate sustainability"(p. 132). John Elkington continues the theme of government's role in advancing corporate sustainability. Chapter 14, "Government in the Chrysalis Economy" briefly describes the "waves" of public pressure that have pinpointed the critical roles government and industry play in creating sustainable economies. The term "Chrysalis Economy" is used to define an emerging economy based on very different patterns of wealth accumulation. Defining current corporate types as locusts, caterpillars, butterflies, and honeybees, Elkington explains how governments must respond to the patterns of commerce each type promotes in order to further the agenda of just economic sustainability.

In chapter 9, "A Long Look Ahead: NGOs, Networks, and Future Social Evolution," David Ronfeldt discusses the emergence of the network as an increasingly effective construct for mobilizing industry leaders, policymakers, and social activists. Networking is the product of previous social groups including the tribe, the institution, and the market. These structures play important roles in shaping human affairs, but their effects are strengthened and modified within the larger scope of the network. Networks are key providers of data and information, fortifying and renewing the efforts of workers and social activists worldwide.

Editors Olson and Rejeski conclude the book with a final chapter devoted to "The Challenge Ahead." Summarizing the contributions of their colleagues, they point out that we are in the midst of a self-perpetuating technological revolution whose acceleration and rate of change far exceed our experience with the industrial revolution of past generations. The impacts are expected to be much greater, holding great promise and untold dangers. Further, societies of earlier generations did not have the political, legal, or administrative infrastructure necessary to buffer the negative impacts of industrialization. Today we have the structure, but it is still too early to determine whether or not current standards are adequate to meet upcoming challenges. Assuming three possible scenarios for the co-evolution of technology and governance ""Old Ways,"" Catch-Up," and "New World"–Olson and Rejeski support the growth of hybrid government strategies, strong international regimes, a high level of organizational education, institutionalized mechanisms favoring the "long view" for goals and accountability, proactive technological progress with adequate controls, strong environmental leadership in all sectors, and integrative systems and management.

Moreover, the idea of sustainable development needs

to be elevated to a position higher than environmental protection, and far more effort in government needs to be devoted to identifying potential environmental impacts of emerging technologies. This means that education in technology and science lags behind the speed of development; governments and industry will compete for workers with the necessary skill sets; proactive policies emphasizing science and technology need to move ahead of legal issues; and the legal profession needs to position itself at the head of the technology curve, taking charge of setting emerging regulatory precedents. Lastly, the authors emphasize that more attention needs to be given to proactive, anticipatory research, and that more extensive public education in science is needed so that citizens can make informed decisions about important policy issues.

The authors close with the comment: "In today's world, highly creative people have better places to invest their idealism, energy, and know-how than in tired public sector institutions pursuing mediocre objectives.... Extracting the most from our technological future depends on extracting the most from human imagination. That is unlikely to happen until we are charged with some bold, audacious environmental goals" (p. 174).

I saved chapter 11 for last, mainly because it devoted attention to "time," a subject close to the hearts of historians. Stewart Brand looks at the important relationship between time and change in his intriguing essay, "Time Matters." Referring to the "pathologically short attention span" (p. 109) our rapidly accelerating technological society imposes on culture, Brand suggests that what is needed is a very different concept of time, one in which the present moment is measured in tens and hundreds of years. Many current social problems need time to resolve, which in turn requires a very different scope for government and social intervention. The concept of "the long term" needs to be refined and understood to encourage thinking in terms of investing multiple life-spans on extended projects whose results will not be realized until many generations in the future.

To emphasize his point, Brand talks about the reactions created by the construction of "The Clock of the Long Now" designed by computer designer Daniel Hillis in 1993 to run ten thousand years. It is this type of thinking that challenges historians across the disciplines to join others at the leading edge of change to bring order and coherence to the sequence of events that mark the way to a sustainable future.

Notes

[1]. William Cronon, ed., *Uncommon Ground: Rethinking the Human Place in Nature* (New York and London: W. W. Norton and Company, 1995).

[2]. Anne Whiston Spirn, "Constructing Nature: The Legacy of Frederick Law Olmsted," in *Uncommon Ground*, 112.