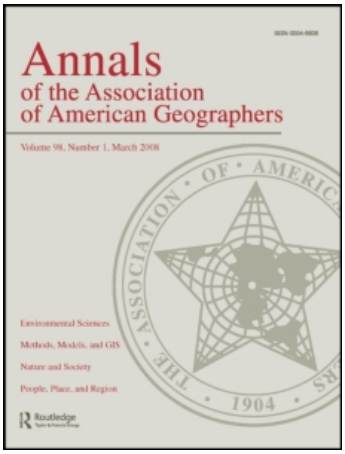

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Climate Change: The Health of a Planet in Peril

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BOOK REVIEW ESSAY

Climate Change: The Health of a Planet in Peril

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A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change. Bert Bolin. New York: Cambridge University Press, 2007. xiv and 277 pp. $36.99 paper (ISBN 978-0-521-08873-2).

Science as a Contact Sport: Inside the Battle to Save the Earth's Climate. Stephen Schneider. Washington, DC: National Geographic Society, 2009. viii and 295 pp. $28.00 cloth (ISBN 978-1-4262-0540-8).

The Hot Topic: What We Can Do About Global Warming. Gabrielle Walker and Sir David King. Orlando, FL: Harcourt Books, 2008. $14.00 paper (ISBN 978-0-15-603318-3).

The Forgiving Air: Understanding Environmental Change (2nd ed.). Richard C. Somerville. Boston: American Meteorological Society, 2008. xxii and 202 pp. $22.00 paper (ISBN 978-1-878220-85-1).

Fixing Climate: What Past Climate Changes Reveal About the Current Threat—And How to Counter It. Wallace Broecker and Robert Kunzig. New York: Hill and Wang, 2008. xvi and 253 pp. $15.00 paper (ISBN 978-0-8090-4502-0).

Dire Predictions: Understanding Global Warming—The Illustrated Guide to the Findings of the IPCC. Michael E. Mann and Lee R. Kump. London: DK Publishing, 2009. 208 pp. $25.00 paper (ISBN 978-0-1360-4435-2).

The Atlas of Climate Change: Mapping the World's Greatest Challenge. Kirstin Dow and Thomas E. Downing. Berkeley: University of California Press, 2007. 112 pp. $21.95 paper (ISBN 978-0-520-25558-6).

The Great Warming: Climate Change and the Rise and Fall of Civilizations. Brian Fagan. New York: Bloomsbury Press, 2008. xx and 283 pp. $17.00 paper (ISBN 978-1-59691-601-2).

The Politics of Climate Change. Anthony Giddens. Cambridge, UK: Polity Press, 2009. viii and 264 pp. $22.95 paper (ISBN 978-0-7456-4693-0).

The Global Deal: Climate Change and the Creation of a New Era of Progress and Prosperity. Nicholas Stern. New York: Public Affairs, 2009. viii and 248 pp. $26.95 cloth (ISBN 978-1-58648-669-3).

Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity. Mike Hulme. Cambridge, UK: Cambridge University Press. xxxix and 392 pp. $80.00 cloth (ISBN 978-0-521-89869-0); $28.99 paper (ISBN 978-0-521-72732-7).

Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity. James Hansen. New York: Bloomsbury USA, 2009. xvi and 304 pp. $25.00 cloth (ISBN 978-1-60819-200-7).

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Published by Taylor & Francis, LLC.

> Today, our Mother Earth is wounded and the future of humanity is in danger.
>
> —Peoples Agreement from the World People's Conference on Climate Change and the Rights of Mother Earth (22 April 2010, Cochabamba, Bolivia)[1]

By the end of the twentieth century, the related but not synonymous phrases "global warming" and "climate change" moved beyond the scientific community into society at large. As the second decade of our new century opens, major online purveyors of hard-copy and electronic books offer some 6,000 titles related to climate change and global warming.[2] Online search engines reveal close to 90 million pages on the World Wide Web.[3] It is impossible for contemporary readers to digest this "blizzard of information" (Walker and King, x), including opinions and disinformation, from sources whose numbers are growing faster than they can be read. Here we review a selection of contemporary books on climate change that inform the present and, for those looking back from decades ahead, answer the question, "What *were* they thinking?"[4]

Glacken (1967) suggested that three themes have persisted in Western thought on human relations with environment: the designed Earth, Earth's influences on individuals and society, and human impacts on Earth. These themes are relevant to global climate change. Setting aside the question of Earth being purposefully designed, the design of Earth, of the land, sea, and atmosphere that constitute the biosphere as the home of humankind, is an enduring theme of geography as a discipline. One cannot understand the dynamics of global warming and climate change without recourse to the fundamental design of Earth (as tentatively as we might comprehend it). The design involves historical and contemporary interactions among plate tectonics, ocean dynamics, atmospheric processes, ecology, evolution, and humans. Climate change also evokes the influence of climate on humans, society, and civilizations. How will Earth—and specifically climate—influence human history? Finally, human effects on climate—through land-use change to urban heat islands to global emissions of greenhouse gases (GHG)—is among the major challenges to our future on Earth, perhaps the greatest.

It is useful to see climate change and global warming in a wider perspective. Smil (2008) set climate change within a range of threats to humankind, which he characterizes as "key risks," each with different real and perceived probability. Certain risks, hopefully remote, could be sudden and fatal (an asteroid collision). For others, human intervention would be possible, diverting the event or diminishing vulnerability. Interestingly, many of Smil's "key risks" have a climate change dimension to them, but those same risks could have other causes as well. For instance, climate change is not unique in threatening biodiversity.

If climate change is salient for human futures, what is the role of science in alerting society and in the decisions that must follow? Pielke (2007) suggests four alternative roles for scientists in public policy and decision making, a framework more nuanced than this summary. The pure scientist provides knowledge usable by all sides of an issue, take it or leave it; atmospheric physics underlying climate change studies might fit in this category. The issue advocate undertakes science that addresses a specific agenda; many of the books cited here fit this category, reaching beyond science to advocacy. So, too, would the work of industry-supported climate change skeptics. The science arbiter addresses questions raised in the decision realm without necessarily drawing normative conclusions; presidential science advisors and many committees of the U.S. National Academy of Science play this role (e.g., National Research Council Panel on Strategies and Methods for Climate-Related Decision Support 2009; National Research Council, America's Climate Choices: Panel on Advancing the Science of Climate Change 2010a, 2010b, 2010c). Finally, the honest broker offers choices for decision making, putting science at the disposal of stakeholder concerns and policy debates. Assessment of climate change impacts, for example, is a process by which scientific knowledge is brought to bear on policy in an honest broker mode. Pielke (2007) further suggested the importance of value consensus and scientific uncertainty influencing science's role in policy. If there is value consensus and low uncertainty, the science arbiter and pure scientist may have a prominent role; if not, the issue advocate and honest broker may be more salient. Among the most important sources for scientific information for public policy on climate change are working groups of the Intergovernmental Panel on Climate Change (IPCC), an international scientific consortium commissioned by the World Meteorological Organization and the United Nations Environmental Programme as a result of the United Nations Framework Convention on Climate Change (UNFCCC), developed at the Earth Summit (United Nations Conference on Environment and Development) in Rio de Janeiro in 1992 (Bolin).

Because global warming is a metaphorically fatal disease for Earth as a human home, a medical analogy is apt:

What are the etiology, symptoms, sequelae, diagnosis, role of denial and acceptance, progression, treatment, side effects, and prognosis in the case of global warming? How do we know that Earth's health is threatened, and what do we do about it?

Global warming refers to increasing temperature of air, land, and ocean; present and accelerated warming is largely attributable to increases in radiative forcing by atmospheric trace gases that create the "greenhouse" effect in comparison to other potential positive (warming) factors such as solar output, now at a temporary minimum (Hansen). Negative forcings (cooling), on the other hand, include aerosols from natural (volcanoes) and human (sulfates) sources.[5] On a geologic timescale, changes in orbital characteristics of Earth affect the intensity and regional and seasonal distribution of solar energy (Broecker, Somerville). Understood from well-grounded principles of atmospheric physics, global warming as a net positive radiative forcing—much of it attributable to human action—causes change in climate, the long-term status of the atmosphere (vs. weather, its short-term status) measured as temperature, pressure, winds, disturbances, precipitation, and other phenomena, plus ocean warming (Somerville, Broecker, Mann and Kump).

Human GHG emissions are thus the major causal agent, global warming the disease, and climate change the major symptom.[6] Sequelae (resulting impacts) include melting glaciers; rising sea level and coastal inundation; increased storm frequency and intensity; droughts and floods; habitat and biodiversity loss; adverse changes in ocean, forest, and agricultural productivity; human disease and death; and what appear to be positive benefits such as longer high-latitude growing seasons and an ice-free Arctic for transportation. The importance and distributional equity of these impacts are important value judgments that are informed—but not determined—by science (Broecker, Giddens, Hansen, Stern, Walker and King).

Diagnosis proceeds from empirical evidence of symptoms, such as relative atmospheric and ocean warming (based on paleoclimatic investigations using surrogate measures as well as contemporary direct observation and measurement), and identification of sequelae, including the rapidity of their progression (MacCracken, Moore, and Topping 2008). Increasing levels of diagnostic confidence follow progress in scientific knowledge (Broecker, Hansen, Schneider).

As with any potentially fatal disease, denial is followed by acceptance. The concept of global warming as a result of fossil fuel use is over a century old (Bolin, Somerville). Decades-old warnings about the dangers of warming have become more urgent (Walker and King, Mann and Kump, Schneider, Hansen), yet denial continues (not just by skeptics but among the uninformed who view climate change fears as exaggerated and politicians pandering to interested parties whose wealth is threatened). So we continue with business as usual.[7] As acceptance emerges among scientists and the public, there might be increasing opportunities to address the disease and change its trajectory,[8] although "not in my backyard" is an emerging response to locating alternative energy facilities like windmills.

Progression of the disease involves the pace of GHG accumulation and resulting climate change. There is little reason to assume linear development; accelerated impacts and surprises are likely in systems with complex feedbacks. Scientific and policy judgment about unavoidable and acceptable levels of GHGs is highly contentious. Some analyses cite target levels of global warming, say one or two Celsius degrees, implying certain GHG levels and recognizing higher warming in polar areas. Hansen argues for a return to 350 parts per million (ppm) of CO_2 compared to the present 380 ppm and preindustrial level of about 280 ppm. Stern works with a stabilization level of 500 ppm CO_2 equivalent[9] to estimate costs of not acting quickly on mitigation (500 ppm equates to a high probability of 2°C warming with an almost even chance of warming above 3°C).

Treatment includes diminution of the causal agent through mitigation of GHGs as well as alleviation of symptoms by adaptation to negative impacts of climate change. The Conference of the Parties under the UNFCCC, IPCC deliberations, and scientific meetings are the "grand rounds" and "consultations" of climate change. Treatments must be global in scope; adaptations range from local to national to regional in dimension. Pushing the analogy, successful treatment addresses the whole organism, not just organs and organ systems. Global action beyond the interests of nations and industries is required, addressing the confounding challenges of scale in space and time and of science and policy. Treatments also have side effects; there are winners and losers, in society and in space, as well as issues of intergenerational equity (Dow and Downing, Giddens, Stern, Hulme, Hansen).

Prognosis might derive from comparison of different planetary conditions on Mars and particularly Venus as an exemplar for runaway GHG warming (Broecker, Somerville, Hansen). Prognosis might also be informed by analogy: How has climate change affected human society in the past (Fagan; see also Glantz 1998; Lynas

2008)? Most prognoses are based on climate models and extrapolation from them given this singular experiment with "Only One Earth" (Ward and Dubos 1972). General circulation models (GCMs) of the atmosphere and ocean (nearly twenty of them implemented by fifteen research teams worldwide) are used to create scenarios of future climate based on storylines and emission scenarios for future changes in society, demography, economy, technology, and environment (now termed *representative concentration pathways*; Moss et al. 2010). Results of the continuously evolving models are tested using IPCC data standards in retrodicting historical climate and suggesting plausible futures (Solomon et al. 2007). The GCMs suggest future climate realizations based on emission pathways, often presented as ensembles of model runs. These scenarios have uncertainties, as do the applications of scenario data (often downscaled or linked to mesoscale models) for places, regions, and components of society and environment. There are also integrated assessment models that incorporate climate scenarios linked to impact assessment and feedbacks to emission pathways; many have important regional differentiation (Knight and Jäger 2009).

Scientific prognosis can suggest alternative futures, but their importance and desirability are human value judgments with civil society as well as national and international economic, political, and legal systems as loci (Giddens, Hulme, Stern; Walker and King; see also Burns and Osofsky, 2009). In addition to political will, major stumbling blocks to addressing the climate change challenge are economic: How much can be accomplished with no regrets (e.g., energy conservation that saves funds), and is it worth a certain percentage of today's income (e.g., investing in energy alternatives to fossil fuels) to prevent a larger cost of climate change in the future? Arguments focus on discounting future costs and benefits: Environmentalists would argue that Earth's future and innocent future generations deserve a discount rate of zero; others suggest waiting until society is wealthier and technology more advanced, essentially applying a high discount rate that devalues future damage compared to present costs of mitigation (Stern; Walker and King).

The prognosis also involves questions of curing and coping. Given the contemporary and accelerating trajectory of GHG emissions and the life of GHG stocks in the atmosphere, there is little chance of global warming being cured in terms of returning to a preindustrial GHG level or maintaining a climate as we have known it. Hopefully, we will halt the progression of the disease and cope with climate change in the context of other stresses, adaptation in turn being mutually interdependent with vulnerability (Fagan; see also Leichenko and O'Brien 2008). How bleak a future is acceptable?

Where does one begin? Suggestions of books for exploration roughly follow the sequence already outlined. There will be no better record of scientific knowledge, community consensus, and uncertainties regarding climate change than the periodic assessments of the IPCC; the fifth report is in preparation against a 2012 deadline. The most current of the IPCC assessment reports and related documents (IPCC n.d.) have been available gratis via the World Wide Web and in hardcopy publications. These review documents are voluminous and technical, but the *Synthesis Reports* from the third and fourth IPCC assessments (IPCC 2001, 2007) plus the Summary for Policymakers included in syntheses and individual working group reports are quite comprehensible.

The IPCC is a remarkable organization with an open process that draws on the voluntary contributions of thousands of scientists nominated by governments. The history of international meetings and congresses leading to its formation is recorded from the semiautobiographical[10] perspective of the first IPCC chair, the late Swedish meteorologist Bert Bolin. *A History of the Science and Politics of Climate Change* documents the history of scientific understanding of radiative gases in the atmosphere, the greenhouse effect, the carbon cycle, development of scientific networks, the Global Atmosphere Research Programme, the emergence of climate change on the global scientific agenda, and the negotiations leading to formation of the IPCC. Bolin reports the emerging evidence of human impacts on climate and increasing urgency to mitigate GHG emissions. Bolin's concluding remarks asserting "the importance of trustworthy scientific knowledge in climate negotiations" (p. 248) point strongly to the Pielke "honest broker" role of science in public policy, but IPCC assessments are also built from the work of the "pure scientist." Bolin spoke with understated resolve: "A viable solution of the dilemma as described urgently requires joint action" (p. 250).

In *Science as a Contact Sport*, the late Stephen Schneider (2008) provides a lively "inside" view of the IPCC process; he also addresses "in your face" interactions of climate scientists with skeptics, policymakers, and the media. There are robust disagreements in science, but the major issues in Schneider's story are the profound challenges of achieving consensus in the scientific community (some observers see the IPCC as reflecting a conservative, even least-common-denominator

viewpoint) and the opportunities, tribulations, and frustrations of the public scientist, one who is both a "good scientist" in his or her own right and an outspoken advocate and messenger for science. For example, Schneider's role in the development of IPCC quantitative evaluations of uncertainty is documented, as is his frustration with media reporting on science, some exceptions duly noted.[11] *Science as a Contact Sport* provides an often-amusing opportunity to see big and important science from a participant's viewpoint, that of an "issue advocate."

Both the Bolin and Schneider books assume basic knowledge about climate change. In *The Hot Topic*, science writer Gabrielle Walker and physical chemist and former U.K. science advisor Sir David King provide the general reader with one of the most accessible discussions of the scientific basis of climate change and policy issues relevant to coping with impending challenges. Without being alarmist, Walker and King make a compelling case for action, not only at the international level but also by individuals and communities. They provide among many other insights a summary of the IPCC picture of a world with a mean temperature that is incrementally hotter than today's.[12] An important message is that global averages have significantly different regional manifestations, and short of the kinds of ultimate catastrophe Hansen fears, a warming globe will be an increasingly unpleasant home for humankind. Walker and King also provide a brief digest of technical and policy alternatives as well as a useful appendix of "Climate Myths, Half-Truths, and Misconceptions" (pp. 231–40).[13]

The clarity of Richard Somerville's deeper presentation of the basics of meteorology and climatology, the development of this knowledge, the dynamics of global warming and climate change, and challenges to society is unsurpassed among the books reviewed. He soberly conveys the importance and urgency of dealing with global warming, offering somewhat less exposition on the challenges of implementing global GHG mitigation than written elsewhere. A comprehensive glossary and annotated bibliography of recommended books are valuable. Somerville's title, *The Forgiving Air*, derived from a poem praising the abundance of Earth, could well be a misnomer. When Earth presents our climate future, Somerville writes, "Only then will we finally learn whether humanity has indeed committed 'dangerous anthropogenic interference' to the point that our planet's climate can no longer be characterized as 'the forgiving air' " (p. 162).

In another important semiautobiographical work, the collaboration of Wallace Broecker (geoscientist) and Robert Kunzig (professional science writer), *Fixing Climate*, traces the climate change issue backward in geologic time as well as forward, as viewed from Broecker's scientific career. Broecker is famous for his work on paleoclimate, abrupt climate change, and the ocean conveyor belt, including "Broecker's Big Idea"—that abrupt ocean current alterations could quickly change climate. Broecker warns about the potential collapse of the North Atlantic thermohaline circulation as a result of melting glaciers, a threat to the surface currents that help warm the western coasts of Europe in the winter—the prospect of a cold Europe in a warmer world (see also Mann and Kump, pp. 60–61). The prospects of megadroughts, sea level rise, and other threats are documented. The authors' observations about policies and technologies to address global warming parallel other reviewed work. Particularly important is another "good scientist" realizing the importance of the global warming challenge such that he, too, would become, in Pielke's term, an issue advocate. In the authors' words, "no significant solution to the CO_2 problem can emerge until governments worldwide . . . impose either an emissions cap or a direct tax on CO_2" (p. 230). "The moral stain, if there is one, lies not in our having achieved what we have by burning fossil fuels; it lies in our not taking responsibility for the consequences" (p. 231).

Two volumes carry special interest for their presentation of climate change with an emphasis on graphics and maps. In *Dire Predictions: Understanding Global Warming*, Michael Mann (meteorologist)[14] and Lee Kump (geoscientist) take the reader through the basics of global warming and climate change, climate projections, impacts, vulnerability and adaptation, and potential solutions, concluding with the authors' statement of alarm: "Climate change is one of the greatest, if not the greatest challenge ever faced by human society. But it is a challenge that we must confront, for the alternative is a future that is unpalatable, and potentially unlivable" (p. 197). The volume roughly follows the IPCC structure but adds important material that elaborates and enriches, including myths, relevant questions, a biographical profile (of Hansen, reviewed later), social and ethical questions, mitigation technologies, and a useful glossary. The volume benefits from the design prowess of the publisher, known for exceptionally well-illustrated travel guides.

The Atlas of Climate Change, a product of two geographers, Kirstin Dow and Thomas Downing, is a logical

complement to *Dire Consequences* in its graphic presentation of climate change. Emphasis is on evidence for climate change and the geographical distribution of impacts, in an atlas format. This book is less detailed than *Dire Consequences* but shares with it the inclusion of a glossary and a strong focus on responses. A strength here is maps and graphics that emphasize the world patterns, a clear message that contributions to global warming, impacts of climate change, and opportunities and commitments for responses exhibit important spatial variation. Mitigation alternatives are treated more briefly than in *Dire Consequences*, but a recent, well-illustrated book for popular audiences by Gore (2009), drawing on a large community of contributors, addresses options for mitigation in more detail, including technology and policy. It is a good start for individuals who might then pursue a more technical literature.

Vulnerability to climate change results from exposure, sensitivity, and capacity; the concept of resilience is key. Adaptation refers to mechanisms that decrease vulnerability and enhance opportunity (see IPCC documents for elaboration in the climate change context). Notable recent contributions to vulnerability and adaptation include two edited books from the Assessment of Impacts and Adaptations to Climate Change (AIACC), an international project based at START, the global-change SysTem for Analysis, Research, and Training (Leary, Adejuwon et al. 2008; Leary, Conde et al. 2008). On documenting and assessing vulnerability, see *Sustainable Communities on a Sustainable Planet* (Yarnal, Polsky, and O'Brien 2009). In addition, a useful edited volume resulted from a 2008 Royal Geographical Society conference on adaptation (Adger, Lorenzoni, and O'Brien 2009). These books are helpful waymarkers from the evolving literature exploring the processes, conditions, costs, and limitations of adaptation, particular in comparison with mitigation as an approach to climate change. There is a consensus that adaptation is obligatory given the irreversible climate change already underway. Some peoples, places, and systems will be vulnerable beyond adaptation, costs of climate change that might be avoidable if human society acts swiftly and decisively.[15]

In the assessment of climate change impacts, examining climate-induced change in the context of other environmental and social stress is imperative (Knight and Jäger 2009). Climate is not alone changing, nor is it the only threatening process. Leichenko and O'Brien (2008) take this maxim to a global dimension. For these authors, climate change is prominent among many systemic and cumulative environmental changes (Turner et al. 1991) that interact with stresses of globalization, defined as "a movement toward greater economic, political and cultural integration across nations" (Leichenko and O'Brien 2008, 7). "Double exposures," then, refers to a convergence of environmental change and globalization in regions, sectors, social groups, or ecologies, creating harmful synergisms that contribute to growing inequality, increasing vulnerability, and unsustainable change (11). Leichenko and O'Brien provide a conceptual framework for analysis of how such interactions are manifested and for addressing challenges of global change, differential impacts, vulnerability reduction, opportunities for improved collaborative processes, and exploitation of new opportunities provided by global communications and connectivity.

The Great Warming is one of several volumes that anthropologist Brian Fagan has written on climate and human history (e.g., Fagan 2000). The signal importance of Fagan's recent contribution is that it demolishes the myth of the medieval warm period (centering on the end of the first millennium of the modern era) as one of benign if not salubrious climate. Fagan journeys around the contemporary planet to show that the story was mixed, place and history made a difference, and drought in many areas led to catastrophe, what Fagan refers to as "the hidden villain of the Medieval Warm Period" (p. 232). Fagan argues that our reaction to present warming and climate change must be informed by history, and the specter of contemporary disaster will only be avoided by "massive intervention on a truly international, and long-term, scale" (p. 240).

One of the most serious concerns about climate change is the potential for surprise in the pace or impacts of climate change, including the irreversible unleashing of impacts at various temperature thresholds or tipping points such as rapid GHG emission from melting permafrost or release of oceanic methane hydrates leading to runaway greenhouse effects (Hansen). MacCracken, Moore, and Topping (2008) present two concerns: the present and potential level and rate of climate change compared to the past and the acceleration of change toward possible irreversible thresholds short of runaway warming, including issues of rapid changes in weather and climate, melting of sea ice and sea level rise, coastal impacts, and ecosystem changes. Pittock's (2008) short chapter on "Ten Reasons Why Climate Change May Be More Severe Than Projected" deserves special attention; many of the factors documented drive the urgency with which other authors see threats from climate change.

In a welcome excursion into the climate change realm, sociologist Anthony Giddens wrote *The Politics of Climate Change*. In it, Giddens calls for profound changes in thinking—about politics, the role of the state, technology, markets, and social movements. This book is rich and provocative, full of intriguing morsels. He offers the "ensuring state" that can produce reliable and predictable outcomes; "political convergence" of goals; and "economic convergence" in which solutions also offer competitive advantage, along with a "development imperative" that ensures equity for poorer countries. The "precautionary principle" (equated with "better safe than sorry") limits innovation ("he who hesitates is lost"); there is virtue, Giddens argues, in risk-taking. Is there more to "sustainable development" than sloganeering (p. 63)? "Foregrounding" must bring climate change to the front of the public agenda, whereas "backcasting" calls for planning to achieve a desired future. Giddens argues for a vanguard of states to address climate change, in recognition that contemporary civilization is, unlike predecessors, global in scope. The "Giddens Paradox" is posited: Because global warming dangers are not immediate and visible, people will do nothing; when the dangers are manifest, it will be too late.[16] Giddens offers hope that the challenge can be addressed on multiple fronts.

In 2006 economist Nicholas Stern finished a voluminous report to the U.K. government on the costs of climate change (Stern 2007), a report that urged early and decisive action to minimize huge future costs. *The Global Deal* derives from that report and the reaction to it, presenting Stern's argument in a highly accessible format, far too rich to capture here. Stern argues that GHG emissions represent a major market failure in that the prices of fossil fuels do not reflect their true cost to society and environment, now and particularly in the future; essentially, the negative externalities are manifest as climate change imposed on future generations differentially across the globe. As in the Giddens Paradox, Stern notes that there are major time lags in the chain of effects from emissions to atmospheric stocks of GHG to warming to climate change to impacts affecting society and economy, making difficult the decision to act now. He examines prices of mitigation and adaptation, speaks to the costs and ethics of inaction, and reviews available policies, suggesting a global deal that could achieve a goal of 500 ppm CO_2 equivalent, a warming level that still carries the risk of surpassing some disastrous tipping points. In considering a combination of mechanisms (taxes, emissions permit trading, and technical regulations), effectiveness, efficiency (via market mechanisms), and equity (no population can have significantly higher than global mean emissions) are obligatory. Stern's deal has goals for rich countries (including return toward global-average per capita emissions) and poor as well, accounting for imported emissions through trade (virtual trade in CO_2). Among many other details, including initiatives available at the individual and community levels, Stern addresses challenges of achieving and sustaining agreement, noting that "we will need political leadership which is not only thoughtful and measured but also courageous and inspirational. That leadership must set out the compelling scientific and economic case for strong action . . . starting now, we can dramatically reduce . . . risks at reasonable cost . . . allow[ing] us to . . . rise to the challenge of a planet in peril" (p. 209).

As the science becomes increasingly unequivocal, why is there no global consensus on actions to address global warming and climate change? Various initiatives from conferences to international conventions are documented in the volumes reviewed. Concerns include the recalcitrance of the United States to ratify the Kyoto Accords or enact climate change legislation and the lack of formal commitments at the 2009 Copenhagen Convention. Is climate change a challenge separate and apart from us, a river to be bridged, or is it part of a rich network of human relationships with environment?

In *Why We Disagree About Climate Change*, climatologist Mike Hulme takes a sociological framework examining climate change as an idea as well as a phenomenon by addressing multiple discourses involved: a battleground about the practice of science, a justification for commodifying the atmosphere, an inspiration for social movements, and a threat to security.[17] Hulme's is a powerful and eloquently written volume deserving far more than a brief summary, a book informed by the evolution of the author's scientific career and ideas and a splendid example of a growing literature on climate change from social science and humanities perspectives. Hulme begins with the social meanings of climate and then documents the evolving science of climate change (a concise complement to similar material in other books). Then Hulme takes seven perspectives on the topic: "science, economics, religion, psychology, media, development, and governance" (p. xxxv). Thoughtful annotations about recommended books follow each chapter. Hulme's final chapter casts climate change differently from many writers while incorporating common themes (urgency for action, the complexity of the problem), suggesting that climate change is not simply a problem to be solved (disease to be cured)

but an opportunity for creative rethinking about "political, social, economic and personal projects over the decades to come" (p. 362). For Hulme, "Our engagement with climate change and the disagreements that it spawns should always be a form of enlightenment" (p. 364).

One book among those discussed should become a *Silent Spring* for our time, James Hansen's *Storms of My Grandchildren*.[18] A well-written combination of semiautobiography, history, science, and exhortation, this book comes from a person who warned three decades ago that global warming and climate change would occur more rapidly than anticipated (as they have). Of all the semiautobiographies, this book has the most moving link to life and family: Hansen deeply fears for the future of his grandchildren, Sophie, Connor, and Jake, as well as their contemporaries. Like many authors, Hansen is a "good scientist" whose work is highly respected. His peer-reviewed papers on climate change encourage increasing urgency in addressing climate change, leading to this book's assertion that "Coal emissions must be phased out as rapidly as possible or global climate disasters will be a dead certainty" (p. 172). Reasoned, passionate, at times polemical, and even creative (the book includes a short science fiction story about Earth viewed from the year 2525), Hansen makes the strongest case he can for understanding and acting on climate change now, suggesting lower CO_2 concentration targets (350 ppm) than presently envisaged by other writers and in policy discussions. Hansen anticipates critical tipping points to emerge at GHG levels far short of the levels under current discussion and negotiation. Although many scientific concepts are explained in context, this book is not the best place to begin understanding the basics. Rather, this volume should be a part of the journey when you are comfortable with the fundamentals and confronting the immensity of the challenge and your role in it. By the time you set Hansen's volume down, there is a good chance you will say, "I trust that the world (and especially the United States) is listening and taking action," and failing that, "I surely hope that Hansen is wrong." So far, time is proving him right.

Key Words: assessment, climate change, global warming, politics, sustainability.

Notes

1. See http://pwccc.wordpress.com/2010/04/28/peoples-agreement/#more-1584 (last accessed 6 May 2010).
2. For example, Amazon.com recently listed more than 6,000 printed books and 365 books available for its Kindle reading system; BarnesandNoble.com offered more than 5,500 books as well as 148 electronic items on the same date (consulted 2 May 2010). Some of these items are the works of climate change skeptics (it is only a natural cycle; it is a hoax to get money for researchers) and deniers (the climate isn't so sensitive to GHGs or the benefits outweigh the negative impacts); most items express serious and well-informed concern.
3. Google.com yielded 87 million citations in a search on "climate change" OR "global warming"; Yahoo.com noted 90 million (consulted 2 May 2010).
4. It is simply impossible within the scope of this essay to trace the links between climate change and issues of (and vast literature on) related topics such as sustainability, energy, environmental stewardship, global futures, and the like (see Speth 2004 as an example). These linkages are explored in many of the books cited, from which readers can launch excursions down paths of interest. This reviewer makes no concession to journalistic demands of fairness and balance: The reader will have no problem locating claims that global warming is at best beneficial and at worst a hoax, and space limitations mean that relevant debate is not reflected here. Many of the books reviewed speak to these controversies. My selections unabashedly reflect mainstream science; the choices of them and views expressed here are mine alone and are not necessarily shared by the Association of American Geographers or its members. Sincere apologies and regrets are extended to the many climate change research colleagues whose work could not be cited here: Absence of your work is by no means an indicator of its value, now and in the future.
5. A graphic of comparative forcings produced by the IPCC is useful: see http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-human-and.html (consulted 6 May 2010).
6. Ruddiman (2005) posited that contemporary orbital factors should be leading to global cooling but that over a long period human changes to climate, primarily through agriculture prior to fossil fuel use, have overcome this trend. In a related way, the concept of "global dimming" suggests that aerosols from fossil fuels and deforestation have masked GHG-induced global warming; air pollution control has the potential to increase global warming and reveal the true magnitude of the challenge. Conversely, purposeful injection of atmospheric aerosols could be a "geoengineering" solution to global warming.
7. An illustration of business-as-usual appears in the caption of Robert Mankoff's *New Yorker* cartoon (9 September 2002) of a public speaker: "And so, while the end-of-the-world scenario will be rife with unimaginable horrors, we believe the pre-end period will be filled with unprecedented opportunities for profit."
8. See Moser and Dilling (2007) on communicating climate change and facilitating the changes that must occur.
9. Other GHGs, such as methane and water vapor, are compared to CO_2 based on their relative level of radiative forcing and longevity in the atmosphere—that is, global warming potential.
10. The term *semiautobiographical* often refers to a work that combines autobiography and fiction. Here I use the term to describe books that speak to scientific knowledge,

science as a social process, and the interaction of science and society from the perspective of a participant such as Bolin. A strength of several of the reviewed volumes comes from documenting the author's direct involvement, works that incorporate science, history, and career experience (Broecker, Schneider, Hansen).

11. For a specific look at scientific disputes and to a limited extent their reflection in the media, Mooney's (2007) *Storm World* documents the vigorous arguments about the impact of global warming on hurricane frequency and intensity.
12. Lynas (2008) also elaborates what Earth would look like at one, two, and onward to six degrees warmer. See also McKibben (2010) for an apocalyptic view of "Eaarth."
13. See Dessler and Parson (2010) for an elaboration of the political issues.
14. Mann is one of the permanent contributors to the World Wide Web site, http://www.realclimate.org.
15. Important sources for examining issues of emissions, mitigation, and potentials for adaptation at the national level are the National Communications and National Adaptation Programmes of Action submitted to the UNFCCC (n.d.).
16. Readers will recognize the same paradox as focal in Diamond's (2005) "practical lessons" from study of the collapse of societies. Al Gore's message is not yet heard where it needs to be (Gore 2006); perhaps our future will be that of the Nacirema (Thompson 1972).
17. A good example of climate change as a security risk is Schubert et al. (2008), a book of that title produced for the German Advisory Council on Global Change. This volume has sections that are conceptual, for example, introducing the concept of a "conflict constellation," and regional, citing specific "hotspots of climate change."
18. Recognizing the seminal importance of Rachel Carson's (1962) book.

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