

Key Words: North America, physical geography, regions.

References

- Fenneman, N. M. 1931. *Physiography of Eastern United States*. New York: McGraw-Hill.
- . 1948. *Physiography of Western United States*. New York: McGraw-Hill.
- Hunt, C. 1974. *Natural regions of the United States and Canada*. San Francisco: W. H. Freeman and Company.
- Omernik, J. M. 1987. Ecoregions of the conterminous United States. *Annals of the Association of American Geographers* 77:118–25.

The Earth's Biosphere: Evolution, Dynamics, and Change. Vaclav Smil. Cambridge, MA: MIT Press, 2002. viii and 346 pp., maps, diags., photos, apps., and index. \$32.95 cloth (ISBN-0262194724).

Reviewed by Mark Cowell, Department of Geography, University of Missouri, Columbia, MO.

The inspiration and benchmark for Vaclav Smil's *The Earth's Biosphere* is *Biosfera*, V. I. Vernadsky's (1926) pioneering—although often neglected—articulation of the view that places life at the center of the history and functioning of the planet's geochemical and energetic systems. Vernadsky was among the first to argue that organisms have not been a mere adaptive response to inorganic processes, but have actively shaped the nature of the atmospheric, oceanic, and terrestrial realms since the earliest days of the Archean. He stressed a holistic, empirical approach to earth science, discarding the prevailing reductionism in favor of a perspective that integrates the processes of thermodynamics, chemistry, and biology into an understanding of Earth as an evolving system. *Biosfera* presented an array of early twentieth-century evidence for the uniqueness of Earth in the cosmos and exploring issues such as the significant planetary role of microorganisms, the physical and chemical limits to life, and the magnitude of global parameters, such as the volume of living matter and its thermodynamic efficiency.

Smil closely follows this tradition in his new book, documenting seventy-five years of scientific progress in building on the foundations laid by Vernadsky and reinforcing the value of his holism. *The Earth's Biosphere* is a wide-ranging synthesis of contemporary knowledge about life on Earth: its unified molecular basis, its metabolic and evolutionary diversity, its presence throughout many extreme environments, and its continual change. Smil brings together many of the latest findings and debates—specialized research into genetic sequencing, satellite monitoring of sunspot cycles, and links between ocean-sediment cycling and climatic history, among many others—to offer an engaging and accessible account of the biosphere's structure and functioning.

A primary task Smil undertakes in this volume is to provide an informed context for comprehending the magnitude of human-induced transformations of the

biosphere. His approach to this issue reflects that of the entire book:

How will these human actions affect the long-term integrity of the biosphere? . . . What we need is not more clever arguing, and what we cannot get, given the inherent complexities of biospheric transformations and major uncertainties concerning their outcomes, is a confident, albeit probabilistic, appraisal of our prospects. What can be done is to outline the best evidence concerning the most likely impacts and then to qualify it by pointing out persistent ignorance and uncertainty. This combination does two things: it alerts us to a multitude of nontrivial risks while tempering our verdicts and hence making it less likely that we will opt for hasty or extreme solutions. (p. 251)

Thus, throughout the first eight chapters, Smil lays out what we know about the operation of the biosphere and how we came to know it, and emphasizes where our knowledge remains inadequate. This scientific humility and clear presentation of the history of ideas (both right and wrong) is one of the book's main strengths, and gives added credibility to the concluding pair of chapters that offer even-handed, yet passionate arguments for the need to confront the accumulating anthropogenic threats to biospheric integrity.

The introductory chapter traces the rise of scientific and public awareness of the concept of the biosphere during the twentieth century. It pays particular attention to the Russian scientists, such as Vernadsky, who first championed the significance of the biosphere, and to the slow dissemination of these ideas into Western science. Smil offers a much richer account of the role of science in the growing environmental consciousness movement of the late twentieth century than those that too often begin with *Silent Spring*. He weaves together events and ideas, including the International Geophysical Year (1957–1958), UNESCO's Man and the Biosphere program, and recent calls for global-scale management, placing special emphasis on the role of satellites in revolutionizing environmental measurement and monitoring.

The subsequent pair of chapters focuses on biological organization, demonstrating commonalities among the diverse forms of life in the biosphere. Chapter 2 examines “Life in the Universe,” highlighting its “attributes, constraints, and probabilities.” The breadth of discussion is remarkable, moving from the chemistry of DNA to quantifying the habitability of different planets, and considering debates as profound as the mechanics of life’s origin and the existence of extraterrestrial life. Yet these strands are all coherently integrated to identify the molecular and energetic bases of life, and the cosmological parameters that limit its occurrence. Chapter 3, “Life’s Diversity and Resilience,” tackles evolutionary questions, but from the atypical perspective of functional groups, rather than taxonomic classes. This focus on the emergence of unique metabolic pathways—photosynthesizers versus chemotrophs, for instance—leads to a summary of some of the latest intriguing findings on evolutionary history that have “uprooted the traditional Darwinian tree of life (there is no single cell at the root) and radically changed its appearance” (p. 86). The chapter concludes with an update on attempts to catalog current levels of biodiversity and to reconstruct past catastrophic declines resulting from long-term climatic change and asteroid impacts.

Smil then turns to the biosphere’s interactions with energy and matter. Chapter 4, “Energizing the Biosphere,” reviews the solar and terrestrial energy balances, also touching on issues like the faint early sun and plate tectonics. The introduction to the radiation balance illustrates a fondness for empirical specificity that recurs throughout the text: “Although the disc with the Earth’s diameter (12.74 Mm) intercepts a mere 4.5×10^{-10} of the Sun’s total irradiance, the rate of this intercept, 174.26 PW, and its annual aggregate, 5.4×10^{24} J, are vastly larger than any other natural or anthropogenic flow on the Earth” (p. 102). Chapter 5 sketches the workings of the material cycles that flow through the biosphere, including those of water, carbon, nitrogen, sulfur, phosphorus, calcium, silicon, and iron. In addition to documenting the reservoirs, flows, and rates of these varied cycles, this chapter admirably details their connections to the metabolic processes of organisms within the biosphere. Smil offers numerous examples that show the intricacies of these processes and their fundamental relevance to issues of contemporary global change. A nice case in point is his description of the problems with proposals to control global warming by fertilizing the oceans with iron.

Like the “Domain of Life” section of *Biosfera* (Vernadsky 1926), Smil’s chapter 6, “The Biosphere’s Extent,” explores the range of conditions in which life may be found. It poses the question, “[H]ow extensively has life permeated the realms of the atmosphere, hydrosphere, and biosphere?”

While parts may come off as a biospheric *Guinness Book*—the highest floating bioaerosol, the deepest oceanic phytoplankton, the most acidophilic bacterium—the chapter clearly portrays and enthusiastically appreciates these varied extreme adaptations. Chapter 7, subtitled “Quantifying Life’s Presence and Performance,” describes the history and means of estimating biomass and rates of productivity. In addition to documenting current estimates for the varied trophic levels and a large range of different organisms, this section provides a nice discussion of the reasons for uncertainty and variations in these values. Chapter 8 emphasizes several selected organizational principles with broad applicability in the biosphere, including the quarter-power scaling of metabolisms, biomes, and symbiotic relationships, and concludes by summarizing recent investigations that seek to clarify the links between biotic diversity and stability.

The significance of holistically integrating the foregoing phenomena becomes plainly evident as Smil addresses issues of “Civilization and the Biosphere.” His concluding chapters are a succinct, rational, and eloquent summary of the breadth and depth of human modification of the biosphere. Smil conveys the seriousness of many transformations, ranging from atmospheric change and invasive species to the cumulative impacts of soil erosion, but also offers guardedly hopeful prospects for the future. Unlike his largely detached moderation of the numerous debates presented in earlier chapters, Smil actively engages two here—the economic valuation of “biospheric services” (e.g., Costanza et al. 1997), which he rejects as anthropocentric and biologically meaningless, and the need for planetary-scale management. Smil concludes that “[E]ffective planetary management is largely beyond our intellectual and social capabilities—but we are doing it anyway. . . and we are doing much worse compared not just to what we should be doing, but to what we could have already done” (p. 259). He convincingly argues that limits to material consumption are necessary and possible with social commitment, but recognizes this is

a difficult task in a civilization in which biological orthodoxy worships random mutation and does not believe in purpose, and in which economists, using personal preferences, reduce value to taste . . . But we should and can do better: life with dignity for billions of people cannot be sustained without a considerable toll on the biosphere, but we know that life with dignity does not have to be predicated on a massive destruction of the biosphere’s irreplaceable functions. (p. 262)

The Earth’s Biosphere is unconventional: it is loaded with empirical reference material, but places it in an unusually broad, holistic framework. It will challenge

many readers, both students and professionals, with its diversity of topics and command of detail; some subjects will be very familiar, others more foreign, but it will reward with fresh insights and provoke new mental links between topics that are often treated as unrelated. The book is extensively illustrated with attractively designed diagrams, drawings, photographs, and maps and contains a useful list of relevant Websites. Nearly half of its 1,100+ references date from 1997 or later, particularly from sources such as *Nature* and *Science*. It is a worthwhile companion and update to classics like *Man's Role in Changing the Face of the Earth* (Thomas 1956) and *The Earth as Transformed by Human Action* (Turner et al. 1990).

Key Words: biosphere, earth systems science, human impacts on the environment.

References

- Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O'Neill, J. Paruelo, R. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253–260.
- Thomas, W. L. Jr, ed. 1956. *Man's role in changing the face of the Earth*. Chicago: University of Chicago Press.
- Turner, B. L. II, W. C. Clark, R. W. Kates, J. F. Richards, J. T. Mathews, and W. B. Meyer, eds. 1990. *The Earth as transformed by human action: Global and regional changes in the biosphere over the past 300 years*. Cambridge, U.K.: Cambridge University Press.
- Vernadsky, V. I. 1926. *Biosfera*. Leningrad: Scientific Chemicotechnical Publishing. Reprint in English, *The biosphere*. New York: Copernicus, 1998.

Disabling Globalization: Places of Power in Post-Apartheid South Africa. Gillian Hart. Berkeley, CA: University of California Press, 2002. xi and 385 pp., maps, notes, app., bib., and index. \$21.95 paper (ISBN 0-520-23756-0).

Reviewed by John Western, Department of Geography, Syracuse University, Syracuse, NY.

"You can't judge a book by its cover." Maybe you can. Trevor Makhoba's cover art is wondrously well chosen. One of apartheid's enormous, out-of-town black ghettos swarms glumly over low hills. The colors are flat and somber and oppressive. In the foreground, a family is being evicted. There stand the armed police in their olive-green uniforms, and overhead clatters a camouflaged helicopter. This is 1964. Yet, do not some patches of bright blue punctuate the cloud layer above? And so, with hindsight, we know that eventually a democratically elected African National Congress (ANC) government will be at the helm of a new South Africa, and all will be well—or will it?

For what can today's more representative leaders possibly hope to achieve? No longer is South Africa the terrible unique case: now it is just another "South" country struggling with its own desperate income inequality and trying to progress in an unyielding, dog-eat-dog, neoliberal world. What room for maneuver does the government—or, more importantly, governments, at various scales—actually enjoy? In this most unequal of countries, how much redistribution in favor of the long-oppressed is advisable or even possible? Or, can new jobs perhaps help redress the balance? And on what terms should they be solicited?

Hart's research focuses on job creation in two small metropolitan areas in KwaZulu-Natal, where, over the past twenty years, local leaders have, with some executive discretion, orchestrated investment from Taiwan and, more recently, the People's Republic of China. This

activity went on during apartheid rule and has been ongoing since. Many in the cast of characters span both eras. Thus, one might fairly ask, was such establishment of small-scale textile manufacturing indeed aimed in any measure at bettering local lives?

One of the strengths of this study is its attention to the differences in the two locales chosen, Ladysmith-Ezakweni and Newcastle-Madadeni. Local histories, local dispossessions, local political accommodations or resistances have shaped rather different outcomes. Has less politically quiescent Ladysmith done better? Has a more politically fractured Newcastle fallen back? The very fact of "differentially contentious" outcomes offers some solace to those who hope that locality can, as it were, negotiate with a rampant globalization. Cannot a *disabling* of globalization (as in the book's title) be effected?

The volume commences with a brief and clear introduction that explains how, when, and why the study was pursued. Then comes a long chapter 1, which first observes the paradox of a leftist liberation movement coming to power and then "embracing neoliberalism" and then follows with a dense, often highly theoretical discussion of space, power, and change. Chapter 2, "The Land of Our Comfort," I greatly liked. In setting the scene of northwest KwaZulu-Natal, the narrative is highly informative, flows well, and treats colonial- and apartheid-era horrors both unhyperbolically and unsentimentally. I particularly appreciated the full quotations from Hart's conversations with Govan Mbeki at the end of his days.