

and where our understanding is still incomplete, should be interested in this volume—from high school through graduate school and beyond.

High points include the explanation of acid rain, its evolution since the late 1800s, and how changes in energy sources and pollution control have and are affecting it. Surprisingly, the deteriorated forests of the world are rebounding from severe destructive effects. According to Smil's overview, recovery of lakes may be faster than had been once thought. In only a few pages, the global warming issues are put into great perspective—the author clearly shows how the arguments supporting global warming can be so confusing when other cycles of life have actually caused global cooling (via sulfate aerosol formation).

Although this is an excellent book, there are a number of areas that I found a little frustrating. Many of the complex cycles are presented as clearly and as well as I have seen. Even so, it seems that the clarity that could be provided is just slightly missed. In several instances, there appear to be adequate data to show a complete mass balance. Yet in only a few cases was a clear mass balance presented. For example, in discussing the missing carbon in the world carbon cycle that has been sought for several decades, an incomplete mass balance could have clarified the many values discussed.

There are few minor shortcomings in this excellent presentation of complex material. As our world becomes more crowded and challenging, we will all benefit from people like Smil who take the time to provide overview and insight into how we are influencing our planet, what is known, and the holes that presently exist in our knowledge.

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THE FLIGHT OF THE IGUANA: A SIDELONG VIEW OF SCIENCE AND NATURE. *A Touchstone Book.*

By David Quammen. *New York: Simon & Schuster.* \$13.00 (paper). xvii + 302 p; ill.; no index. ISBN: 0-684-83626-2. [Originally published in 1988.] 1998.

GAIA'S BODY: TOWARD A PHYSIOLOGY OF EARTH.

By Tyler Volk. *New York: Copernicus (Springer-Verlag).* \$27.00. xvii + 269 p; ill.; index. ISBN: 0-387-98270-1. 1998.

In his 1989 treatise on geophysiology, Lovelock built on the holistic Gaian theory of global biological self-regulation to propose a physiological rather than physical perspective of the earth system. Of special importance in this time of burgeoning human intervention in the environment are the implications of a geophysiology for detecting and coping with anthropogenic impacts on the stability and

viability of the global ecology. For me, it suggested that danger would be signaled by how hard the system was working to maintain equilibrium rather than the sheer quantities of substances such as carbon in the system.

In *Gaia's Body*, Volk makes a powerful effort to lay out the relationships that the Gaian systems bear to astronomical, geological, atmospheric and biological quantities. He weaves a tapestry of solar radiation, plate tectonics, and atmospheric chemistry, all bound by engaging prose and simple but illuminating illustrations. On the fly cover Stephen Schneider notes that Volk has combined accomplished science with artistic passion to make his case. I think the art was necessary, because without the circumlocutions that literary style provides, it would be impossible to describe such a vast system in so few words, a poesy of the spheres.

As might be expected, the book required several concepts to engage a system ranging in scales from microbe to solar system. Changes in scale are managed in terms of Koestler's holarchy principle. Since the atmosphere is the most responsive of the circulation systems in Gaia's body, its incorporation into any model connects that model to the global system (p 22). The atmosphere provides docking for influences as diverse as ocean circulation and local ecologies. It renders the book useful for globalist and regionalist alike, whether they are oceanographers or atmospheric scientists, biologists or archaeologists.

The Gaian system is set in motion by turning from "causes" to "influences," allowing a dynamic of interaction to flow. Cycling ratios are used throughout, which is very helpful in grasping the scale and interactions involved in the flow of Gaian life blood. Life regulation of the biosphere is measured by a number of atmospheric chemistry variables. Life reverses the annual beat of carbon dioxide that marks the Earth's annual cycle. The carbon cycle is amplified 200 times what it would be without life. Oxygen is maintained at 21 percent where there would otherwise be virtually none.

In a bold stroke Volk approaches his subject with a measured humor and personal anecdote that adds a lively character to his presentation. He also provides up-to-date news on the inner deliberations of the Gaian study community, which I found to be a helpful context for his arguments.

For all of his holism, Volk presents a microbial Gaia. It is not a social Gaia, and he does not get into how hard the system is working, in so many words. He comes close, however. The data on cycling ratios are bumping up against this critical issue and thus his book lays the groundwork. Perhaps Volk will take a step toward the social Gaia in his next book, which I await with anticipation.

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