Requiem for a grand theory

On Gaia: A Critical Investigation of the Relationship between Life and Earth

By Toby Tyrell

PRINCETON UNIV. PRESS: 2013. 311PP. $35.00

Gaia, the brainchild of James Lovelock, was born in 1972. The historical constancy of Earth's chemical conditions and climate seemed just too much for chance alone. In Gaia it is postulated that the Earth's conditions were determined by the biosphere and regulated for the further benefit of life's persistence and activity. Gaia has motivated a huge number of biogeochemists to think about ecology on the planetary scale, and to examine what causes the movement and transformation of elements in global cycles. The theory has survived withering criticism and numerous international conventions — some to extend its reach and others to bandage a wounded Gaia with modifications and caveats. Even now, when students read Lovelock's first book on Gaia they engage with his insights enthusiastically.

In this book, Toby Tyrell — a professor of Earth science at the University of Southampton — offers a systematic, dispassionate, retrospective examination of Gaia. It will be hard to ignore the flaws in Gaia, illustrated nicely in a table showing the success and failure of Gaia relative to some alternative theories based on the geosciences and coevolution. In the face of data, Gaia fails in its idea that the Earth is held at conditions optimal for life. Using net primary production and biodiversity as metrics, Tyrell finds that the Earth is actually too cold for the maximum development of the biosphere. Gaia also fails in its postulate that the Earth is held at relatively stable conditions. True, the climate and biogeochemical cycles of the Holocene have been unusually stable, but over longer periods of time the biosphere has been buffeted by events that have dealt it quite a blow. What is remarkable is that life persisted at all — a statement of the power of evolution to rebuild the biosphere everywhere as long as life has endured somewhere.

Tyrell uses the 'anthropic principle' to dismiss any theory that suggests causes for the long-term favourability of planet Earth for the persistence of life. Such a theory cannot be falsified, because we have no replicate planets to examine where life has failed. Chance alone — however small — is a better mechanism to explain why we are all here today to have sex, eat at MacDonald's and discuss the value of such theories.

Gaia is correct in recognizing that life has determined some of the characteristics of the Earth that we take as normal — for instance, the near 21% content of oxygen in Earth's atmosphere. But Gaia is unnecessary to explain the persistent disequilibrium in Earth's atmosphere — the work of scores of biogeochemists for the past 40 years has elucidated the sources and regulation of methane, methylmercury and dimethylsulphide. The dominance of nitrogen in our atmosphere is not because denitrifiers put it there to maintain a favourable pH in the seas, but is due to the fact that denitrifiers obtain metabolic energy for growth and reproduction when they produce N_2. This is the stuff of standard Darwinian evolution.

Tyrell warns us of the dangers of Gaia. Those who believe that our planet is self-regulating will lack any motivation to stem the growing tide of human insults to Earth's atmosphere, oceans and terrestrial biosphere from a rising human population with great expectations for well-being. These libertarians need to know that their belief is groundless. CO_2 will increase in Earth's atmosphere as long as we add more of it from fossil fuel combustion than the oceans can absorb each year by Henry's Law.

Although many of the photographs would have benefitted from colour printing, the book is nicely produced, well referenced and easy to read. Each chapter begins with a roadmap of where it is headed and concludes with paragraph of what it has found. Tyrell makes it very clear where he stands on Gaia, but the path of his journey is well reasoned — not a diatribe.

With the appearance of this volume, I think we can close this chapter in the history of planetary ecology. Gaia is dead; it is time to move on. ❐

REVIEWED BY WILLIAM H SCHLESINGER

William Schlesinger is at the Cary Institute of Ecosystem Studies, Millbrook, New York 12545, USA. e-mail: schlesingerw@caryinstitute.org

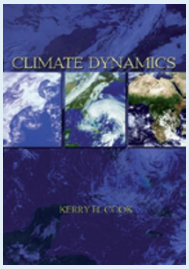
ON OUR BOOKSHELF

What's Wrong with Climate Politics and How to Fix It

By Paul G. Harris

POLITY: 2013. 296PP. £19.99

Governments have so far failed to stem global emissions of greenhouse gases. Political scientist Paul G. Harris diagnoses what is wrong with climate politics and prescribes ways to revive our ailing planet before it's too late. In doing so, he proposes a new kind of climate diplomacy with people at its centre, national policies with focus on the responsibilities of individuals alongside those of nations and a campaign for simultaneously enhancing human well-being and environmental sustainability.



Climate Dynamics

By Kerry H. Cook

PRINCETON UNIV. PRESS: 2013. 216PP. £44.95

Climate change research requires an understanding of the climate system. This textbook offers an introduction to the dynamics of Earth's climate, targeted at the undergraduate level, assuming no background in atmospheric or ocean sciences. The climate system is described, introducing terminology and climate variables and processes. The book then progresses to the atmospheric, ocean and hydrological cycles, and the how and why of climate change.