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HISTORY OF SCIENCE

The Gaia letters

Contextualized correspondence traces the emergence of a provocative hypothesis

By **Paul Falkowski**

Writing Gaia, edited by Bruce Clarke and Sébastien Dutreuil, is a fascinating read that reproduces and contextualizes a four-decade-long conversation between environmental scientist James Lovelock and evolutionary biologist Lynn Margulis from which emerged the provocative Gaia hypothesis, which posits that Earth and all its inhabitants can be thought of as a single, synergistic, self-regulating system.

The book opens with a foreword by the late Lovelock, in which he discusses a conversation he had in 1967 with William Golding—the Nobel Prize–winning author of *Lord of the Flies*—about Erwin Schrödinger's book *What Is Life?* "According to this book," observes Lovelock, "life was a process that reduced the entropy of a system while excreting entropy to the environment." Lovelock wanted to understand how Mars, with an atmosphere composed almost entirely of carbon dioxide, is of "high entropy" and therefore probably lifeless, whereas Earth, containing both methane and oxygen, is of "low entropy" and sustains life. "If you intend to put forward an idea like that," Golding replied, "you had better give the low-entropy system that is our planet a proper name, and I suggest the name Gaia."

The book goes on to document the four-decade-long correspondence between Lovelock and Margulis, which began in 1970, when Margulis, on the advice of her ex-husband Carl Sagan, first wrote to Lovelock, seeking his assistance in fleshing out research questions related to the contribution of biological entities to the planetary atmosphere. (That letter, unfortunately, is not included in this collection.)

The first letter in the book, dated 11 September 1970, from Lovelock states, "I am in the course of writing a paper on the Earth's atmosphere as a biological cybernetic system." The editors explain that by 1969, Lovelock had begun to think about Earth as a planetary ecosystem, and the term "biological cybernetic system" became a "shorthand trademark" for Gaia.

Writing Gaia
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510 pp.

Although much of the correspondence is relatively trivial, detailing, for example, when and where they would meet, the editors did an exceptional job of culling the myriad letters and—with help from students and colleagues—interpreting the correspondence and revealing how the Gaia hypothesis evolved.

By the early 1970s, we learn, Margulis had become a major force for developing the idea that Earth systems function through feedbacks between life and the geosphere and gave Lovelock increasing confidence in the notion that "Gaia has the equivalent of a central nervous system." This notion would eventually lead to heated debates among many scientists, and the concept was, and still is, challenged, if not downright dismissed as an untestable hypothesis.

Arguably, one of the key questions surrounding the Gaia hypothesis is how original it was. The editors address this issue, discussing the contributions of Vladimir Vernadsky, a Soviet scientist who was one of the pioneers in a field that would become geobiology. Vernadsky published *Biosfera* in Russian in 1926, which was informally translated into English in the 1980s but not formally published in English until 1998.

James Lovelock and Lynn Margulis grappled with the possibility that Earth's life and its geosphere are intertwined in a single, synergistic system.

In the foreword of the 1998 edition, Margulis wrote, "[Vernadsky] illuminates the difference between an inanimate, mineralogical view of Earth's history, and an endlessly dynamic picture of Earth as the domain and product of life, to a degree not yet well understood." Lovelock disagreed; to him, Gaia was original. In June 1986, he wrote of Vernadsky to Margulis, saying, "he was a middle weight expressing his ideas in a vague and all-inclusive manner and with the support of little or no testable evidence."

Regardless of its originality, Lovelock persisted in developing Gaia as a theory and, to his death, defended the notion of a positive feedback between the biosphere and geosphere. He and Margulis thought the concept was as seminal as Darwin's theory of evolution. Indeed, in 1995, Lovelock wrote, "Where organisms affected their personal environment then the tendency could be inherited and could become extensive, even global."

At almost 500 pages, *Writing Gaia* is a weighty read. The more casual reader can skim the correspondence and read the editors' excellent summaries. Others will find the details of the correspondence a fascinating illustration of how ideas between scientists evolve. I am sure this tome will be used by many students and scholars to understand the history of geobiology, writ large, in the 20th century. ■

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