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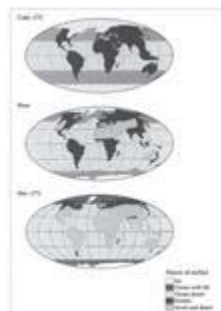
Goodness, Gracious, Great Balls of Gaia!

[Brian Hayes](#)

The Revenge of Gaia: Earth's Climate Crisis and the Fate of Humanity. James Lovelock. Foreword by Sir Crispin Tickell. xiii + 177 pp. Basic Books, 2006. \$25.

The Revenge of Gaia: The title of James Lovelock's new book calls to mind the fourth or fifth sequel of some horror movie, one with a monster that rises from the sea to maul Tokyo or New York. This mental image is not altogether inappropriate. The book is in fact a sequel, following several earlier titles by the same author: *Gaia*, *The Ages of Gaia*, *Healing Gaia*, *Homage to Gaia*. Furthermore, it *is* a horror story, meant to frighten us. Tokyo and New York and hundreds of other cities are in grave danger, Lovelock warns. And, as in most horror flicks, the real villain is not the tormented monster but human arrogance and greed.

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For the benefit of those who have not been following along through the earlier reels of this long-running saga, I'll give a thumbnail summary. Lovelock (together with Lynn Margulis) first proposed more than 30 years ago that the physical environment at the Earth's surface and the life-forms that inhabit the planet interact and coevolve to maintain a steady state. Various feedback loops and homeostatic mechanisms regulate climate and the chemistry of the atmosphere, providing a habitat that is both milder and more stable than what would be found on a lifeless planet at the same distance from the Sun. Stated in these terms, Lovelock's idea is provocative but not highly controversial; however, Lovelock does not state his thesis in quite these terms. As he tells it, the Earth and its residents don't merely interact but rather collaborate, actively working toward the common goal of

maintaining a favorable environment for life. In Lovelock's account, the "geophysiological" system is endowed with a will and a personality, not to mention a gender. She is Gaia, named for the Greek goddess of Earth, and her character seems to alternate between fairy godmother and beleaguered landlady; Margulis has called her a "tough bitch."

Lovelock is coy about just how seriously we should take his personification of the planet and biosphere. *Revenge*, like some of the other books, includes a disclaimer: "You will notice I am continuing to use the metaphor of 'the living Earth' for Gaia; but do not assume that I am thinking of the Earth as alive in a sentient way, or even alive like an animal or a bacterium. . . . It has never been more than metaphor—an *aide pensée*, no more serious than the thoughts of a sailor who refers to his ship as 'she.'" Yet elsewhere in the book, scores of other passages speak in such clear and unqualified terms of Gaia's motives and goals and struggles and emotions that the veil of metaphor becomes rather flimsy and tattered. The book's glossary (which one might suppose would be *definitive*) says this of "Gaia theory":

A view of the Earth that sees it as a self-regulating system made up from the totality of organisms, the surface rocks, the ocean and the atmosphere tightly coupled as an evolving system. The theory sees this system as having a goal—the regulation of surface conditions so as always to be as favourable as possible for contemporary life.

For many readers, this teleological insistence on goals raises a steep barrier to the acceptance of Lovelock's ideas. Toward the end of *Revenge*, Lovelock writes:

I know that to personalize the Earth System as Gaia, as I have often done and continue to do in this book, irritates the scientifically correct, but I am unrepentant because metaphors are more than ever needed for a widespread comprehension of the true nature of the Earth and an understanding of the lethal dangers that lie ahead.

I guess I must be among the scientifically correct, because I do find this habit irritating. And yet still I want to salvage what I can from this farrago of metaphors gone berserk, because Lovelock is not a crank, or not *only* a crank; he's quite a creative thinker.

In the 1960s Lovelock was working with a team at the Jet Propulsion Laboratory on methods of searching for life on Mars. Most of the effort was focused on instruments to be sent on spacecraft, but Lovelock had a shrewder plan: If life were abundant on Mars, he noted, we could detect it from right here, merely by examining the optical spectrum (and hence the chemical composition) of the planet's atmosphere. In science fiction, planets are dismissed as uninhabitable because their air is unbreathable; Lovelock turned this formula upside down, asking not whether the Martian atmosphere could support life but whether it showed signs of having been altered by the presence of life. Living things tend to upset chemical equilibrium. The atmosphere of an inhabited planet will be supercharged with reactive elements such as oxygen; in the absence of ongoing biological activity, these substances will eventually break down or recombine into more-inert forms, most notably carbon dioxide. The prevalence of carbon dioxide and the absence of oxygen in the Martian atmosphere were the planet's death certificate.

Turning the same observational method on the Earth tells us something important about life here at home: This would be a much different planet, even in its physical and chemical aspects, without its encrustation of living organisms. Biologists tend to emphasize how well plants and animals adapt to their environment, but organisms are not mere passive responders to external influence; equally important is the power of living things to change their environment. On an everyday basis, biological communities dramatically alter landscapes and microclimates and soils. On a planetary scale, life transforms the Earth in ways that could readily be detected from Mars. The best-known example is the oxygenation of the atmosphere, brought about by the blooming of photosynthetic bacteria about two billion years ago. Because of these organisms' exhalations, a gas that had been present only in traces came to make up a fifth of the atmosphere.

That living things shape their environment just as the environment shapes them is not so hard to accept. That this two-way interaction regulates the state of the planet in a way consistently favorable to life is much harder to swallow—even setting aside all questions of goals or intentions. The oxygenation of the atmosphere offers a case in point. Was the change favorable to life? For most of the organisms living at the start of that transition, oxygen was a poisonous pollutant, and its sudden abundance either killed them off or drove them underground. The new atmospheric chemistry seems a great beneficence only from the point of view of us latter-day obligate aerobes.

However implausible the "goal-seeking entity that regulates itself on life's behalf," Lovelock does have one powerful argument for the presence of some stabilizing or moderating influence: the mere continuity of life. Since the process of biology got started on this planet, it has never been interrupted, not even briefly, over a span that amounts to a fourth of the age of the universe. We—and here I mean "we" in the broadest sense possible—have withstood ice ages, cratering by comets or asteroids, and vast volcanic eruptions that flooded continents with lava and choked the atmosphere with sulfur. Even more remarkably (in Lovelock's estimation), the temperature at the planet's surface has remained within a range compatible with life even though the heat output of the Sun has increased by more than 35 percent over the history of the solar system.

This long-term stability, Lovelock argues, implies some kind of thermostat.

In the 1980s Lovelock and several colleagues described a computer model called Daisyworld that suggested one possible mechanism of thermostatic control. The model planet's surface is covered with two kinds of flowers. Black daisies absorb more sunlight and are adapted to a cooler environment; white daisies reflect heat and thrive in warmer conditions. Shifts in the abundance of the two species tend to automatically restore balance after any climatic perturbation. For example, if more heat pours down upon the planet, the rising temperature favors proliferation of the white daisies, which reflect more sunlight and thereby ameliorate the heating. Of course Daisyworld is merely a conceptual model; Lovelock does not imagine that the Earth's temperature is really controlled by populations of light and dark flowers, but he believes that subtler feedback loops have the same effect.

Since Gaia theory is founded on notions of self-regulation and stability, you might suppose that Lovelock would be a skeptic—or at least not an alarmist—when it comes to the global-warming controversy. On the contrary, *The Revenge of Gaia* is an unrelenting Jeremiad about the damage done by human excesses—especially the burning of fossil fuels—and about the hellfire retribution that Gaia will soon visit upon us. Returning to the Daisyworld model, Lovelock notes that homeostasis fails if conditions ever stray outside the habitable range; and once the flowers have wilted, they cannot be brought back to life. "The temperature and chemical composition cease to be regulated and the model system swiftly drops to the equilibrium state of the dead planet."

This process is described not merely as the failure of an inanimate controlling mechanism but as the illness or senescence of the goddess Gaia. She is suffering from a "fever brought on by a plague of people." Or perhaps Gaia is exasperated rather than sick: "Like an old lady who has to share her house with a growing and destructive group of teenagers, Gaia grows angry, and if they do not mend their ways she will evict them."

Is there any hope of forestalling this disaster? Lovelock has elaborate and specific prescriptions. (They take up nearly half the book.) First and most important is to give up burning carbon and shift the world economy to nuclear power. For long-distance transportation, he suggests we scrap the jet airliner and build a new generation of sailing ships. It's also crucial that we reduce the area of cultivated land, and so we should start manufacturing food from raw feedstocks or industrial by-products, with the eventual aim of abandoning agriculture altogether. These are all recommendations for the wealthy, industrialized nations. As for the rest of the world, it's too late for sustainable development, he says; the best we can manage is "sustainable retreat."

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In his darker moods, he seems to think it's too late even for sustainable surrender. "The prospects are grim," he writes, "and even if we act successfully in amelioration, there will still be hard times. . . . We are tough and it would take more than the predicted climate catastrophe to eliminate all breeding pairs of humans; what is at risk is civilization." In other words, stock up on flashlight batteries, canned goods and ammo. In the book's final vignette, "survivors gather for the journey to the new Arctic centres of civilization." They will travel by camel from one oasis to the next. Lovelock does not give a date for this scenario, but I get the impression he believes it is decades ahead, not centuries or millennia.

It's fair to say there's something for everyone in this book—something each of us can admire and embrace, and also something each of us can disdain or ridicule. For me it's pretty nearly an even mix. Given the persistence of life on Earth, I'm sympathetic to the idea that the global ecosystem must be reasonably stable and self-correcting. But self-regulation requires no purposeful, animating spirit; Lovelock's vision of Gaia twiddling the controls to keep us comfortable—or else deliberately turning up the heat to snuff us out—leaves me utterly baffled. Even as metaphor it's

nonsense. On the other side of the equation, I share Lovelock's worry that climate change will make the world a less congenial place for coming generations, yet I find his predictions wildly overconfident. In his discussions of theory, Lovelock puts much emphasis on the difficulty of understanding the behavior of nonlinear systems with feedback loops; he even exaggerates it a bit. And yet he does not hesitate to predict in detail not only the effect of CO₂ on climate but also the response of ecosystems to climate change and even the consequences for societies. It's his seeming certainty that makes me most skeptical. But then what do I know? Lovelock has a goddess whispering in his ear.

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