

VIEWPOINT

A modern way of looking at the world: It's alive

Gaia theory seeing Earth as an organism is gaining credibility in the scientific realm



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EDITOR'S NOTE: This is the first of a two-part series.

Environmentalists have rallied behind the space image of planet Earth since the moon landing of 1969. In this same fateful year, James Lovelock was introducing his vision of the Earth as an organism — which he called Gaia — at a scientific meeting in New Jersey. He retrieved the name "Gaia" from the Greeks, who used it to describe the planet as a living entity, Mother Earth. In fact, many cultures, especially tribal ones, have revered an Earth Spirit, generally perceived as female. The spiritual wing of the environmental movement draws upon such images as a reason to cherish the wilderness.

But Lovelock, an independent scientist who worked for NASA in the 1960s to consider how to test for life on Mars, added a heavy dose of chemistry to the concept, thus making it more palatable to Western science.

With the help of biologist Lynn Margulis, he sketched out a world in which plants and animals (many of them microscopic) regulate the climate, mainly through their chemical interactions with the atmosphere. Possible mechanisms are described in Lovelock's 1979 book "Gaia," a 150-page treatise written for the general public.

The modern resurrection of this ancient idea is changing the way scientists and environmentalists view the world.

Adherents can no longer see the atmosphere, for instance, as dead space in which we can carelessly dump chemicals. The world became acutely aware of this in the past decade, when it realized that spraying chlorofluorocarbons into the air was destroying the ozone layer. (Interestingly, it was an invention of Lovelock's that allowed us to measure the CFC buildup in the atmosphere.)

The 20th century version of Gaia starts from the premise that the Earth's climate has remained relatively stable despite evidence that the sun's luminosity has increased by one-quarter or more since life began here. Sure, we've had ice ages and times of warming, but always within a range that can accommodate life.

This web of life — known as the biosphere — actively changes its environment in a way that allows for self-regulation of climate, the theory holds. This self-regulation would be the planetary equivalent of humans' ability

to maintain a stable body temperature.

How does the biosphere accomplish such a feat?

Lovelock compares the atmosphere to a bird's feathers or a cat's fur — part of a living system, but not actually alive itself. Carrying this idea along, rivers could be seen as the veins and arteries of Gaia, while mangroves and other wetlands may be the kidneys that cleanse the system. We already have the concept of the rain forest as the lungs of the world.

As yet, there is no definitive model assigning roles for every organism, or even every ecosystem. Keep in mind that science is still discovering species in distant rain forests and in subterranean realms, and that there are systems within the human body — the lymph system, for instance — which remain largely veiled in mystery.

Speculating about the unknowns has proven a fruitful avenue of thought, though, and even some scientists who remain skeptical about Gaia theory appreciate it for generating research ideas. It is leading to a basic shift in scientific thinking.

For instance, geologists long subscribed to the theory that energy from wind and sea breaks up rocks into sand and soil particles. While these inorganic forces surely contribute to the creation of dirt, a Gaian thinker would focus on the activity of plants and soil microbes in this process.

I've seen plants, usually preceded by moss or fungi, establish themselves on rocks, in brick walls, in concrete crevices. Once there, they release chemicals, including acids, from their roots that further break down the minerals in which they've set up house.

Sometimes the process continues, with offshoots or other plants coming along to the increasingly hospitable territory, and dead plants becoming the nutritious fodder on which newcomers can feast. In no time, there's a thriving plant community — one that may eventually evolve into an even more complex form, such as a forest. And forests are generally accepted to influence their local climate by maintaining a stable soil temperature and even increasing rainfall.

With this scenario in mind, it becomes easier to see how the biosphere can



The gases covering the Earth, known as Gaia to some, greatly influence its temperature. And the gases composing the atmosphere are in large part a product of the life forms, which have regulated the planetary climate over the ages, according to Gaia theory.

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influence the climate on a global scale, as life's many local contributions add up.

An overall effect of life on Earth has been to create an abundance of oxygen and a general lack of carbon dioxide, as Lovelock explains.

Carbon dioxide makes up about 98 percent of the atmospheric composition of Venus and 95 percent that of Mars, for instance, compared to a scant 0.03 percent for Earth. And neither of our neighbors contain appreciable amounts of oxygen in their atmospheres, while Earth's level has hovered around its current 21 percent since soon after plants joined the system. (Plants, of course, take up carbon dioxide and release oxygen.)

The atmospheres of Venus and Mars can be explained by the laws of chemical equilibrium, while that of Earth's doesn't follow the rules. This line of thinking inspired Lovelock to reject the possibility of life on Mars, a stance that didn't win him many friends at NASA. But the

realization led him to look more closely at the Earth's talent for transformation.

Lovelock traces Gaia's ability to maintain a relatively stable temperature range to life-induced changes over the ages. Carbon dioxide levels, for instance, have fluctuated slightly; this could prove especially important because of its "greenhouse" effect that inspires some to compare it to a blanket over the planet.

The Earth's ability for self-regulation comes through as the key feature in half a dozen interpretations of the Gaia hypothesis found in scientific articles by reviewers writing in the October 1992 issue of BioScience.

However, as the authors note, some evolutionary biologists scoff at the idea of a "population of one" existing. The ability to reproduce is considered part of the definition of life.

Along these lines, I can't help thinking of the Biosphere 2 project in Arizona, where futuristic thinkers are trying to seal some of the Earth's ecosystems into a capsule suitable for space travel. Spores? Eggs? Could this mean humans may evolve into Gaia's ovaries?

It's easy to let our imaginations roll once we open our mind to consider the possibility of being part of a much bigger picture.

Can you see yourself in that satellite image of Earth?

Part two will take a Gaian approach to the issues of biodiversity and global warming.