Neo-*Naturphilosophie*

Michael Ruse's *Gaia: Science on a Pagan Planet* (University of Chicago Press, 2013)

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John Nelson, a cartographer and specialist in data visualization, has used NASA satellite photos of Earth to create animated GIFs in which the planet seems to breathe.[1] Seasonal cycles are compressed down to moments, green turns to brown and back to green, and snow cover in the northern hemisphere expands and contracts rhythmically, at about the same pace as human breathing. It's hard to watch the animations and not come away with the impression that the planet is, in some sense, alive. Of course, we all know (don't we?) that it's not *really* alive. But Nelson's work makes us wonder how our intuitions about this sort of thing might be influenced by spatiotemporal scale. If we could live our lives at a vastly larger spatial and temporal scale, would planet Earth seem just as obviously alive to us as any cell? Nelson's animations dispose one to look more favorably on the Gaia hypothesis.

James Lovelock and Lynn Margulis teamed up in the early 1970s to defend and promote the Gaia hypothesis. Lovelock was a chemist and inventor with wide scientific interests, who at the time was probably best known for developing the electron capture device. Margulis, a biologist, was known for her theory that eukaryotic cells first formed when some prokaryotes swallowed up others with whom they had a symbiotic relationship. Together, Lovelock and Margulis argued that Earth is a self-regulating, homeostatic system. "Gaia" was their name for the living planetary organism.

Why did the broader, non-scientific public respond so warmly to Lovelock's and Margulis's idea, while much of the professional scientific community reacted so dismissively? In his new book, Michael Ruse explains the mixed reception of Lovelock and Margulis's Gaia hypothesis by giving us an intellectual history. What Ruse offers is not just history of science, but a history of ideas as seen from high altitude. Early in the preface, he tells us that this "is not really a book about Gaia. It is, rather, a philosophical and historical meditation on the nature of science itself" (p. ix). Ruse argues that in order

[1] http://uxblog.idvsolutions.com/2013/07/a-breathing-earth.html. Last accessed 7 April, 2014.

to understand a scientific disagreement, you need to know something about the relevant history of philosophy, about the dominant metaphors, the state of play of other scientific debates at the time, past and present religious tendencies, and even the pseudoscientific ideas from which professional scientists are keen to distance themselves. This need for the big picture is a theme of much of Ruse's work, and Gaia lends itself to this approach. Ruse, who is more sensitive than most to the complicated roles that metaphor plays in science, is the right philosopher for this particular job.

Ruse makes it clear that Gaia developed out of a relatively straightforward idea that's both scientifically respectable and uncontroversial. On the one hand, living things depend on certain aspects of the (apparently) nonliving environment, such as ocean and atmospheric temperatures, or the acidity of the oceans and soils. But living organisms, in the aggregate, also do all sorts of things that make a difference to their environmental conditions, giving rise to interesting feedback loops. To rehearse just one of several examples that Ruse canvasses: Living things affect the albedo of the earth's surface. Ice and snow have relatively high albedo, meaning that they reflect more of the sun's energy back into space, exerting a net cooling effect on the planet. Living organisms, such as trees, provide a lower albedo surface covering. Holding other variables fixed (and there are many other variables to consider), plants can have a warming effect merely by spreading to cover more of the planet's surface. The albedo effect is just one way living things can make a difference to the abiotic environmental conditions that they depend on. Scientists continue to investigate the details of these bio-geological feedback loops, and no one doubts their importance to the history of life on Earth. But Lovelock and Margulis took things further. They argued that these feedback loops are such that the planet is a self-regulating, homeostatic system.

Early on, Ruse quotes Stephen Jay Gould as complaining that "Gaia strikes me as a metaphor, not a mechanism" (p. 32). Ruse rightly responds that it's no criticism of the Gaia hypothesis—or any hypothesis, for that matter—to observe that it's metaphorical. Lots of scientific ideas, from natural selection to selfish genes, are metaphorical. Ruse thinks that the part of the story about why professional scientists reacted so negatively to the Gaia hypothesis while "the general public loved it" has to do with the power of the metaphor:

> Talk about homeostasis and the self-regulation of gases-topics vaguely remembered from high-school chemistry—can be pretty tough going. What's the difference between acidity and alkalinity? Who cares? Albedo? Move on please! But talk about Earth as an organism—living, breathing, weeping, sweating, farting (don't laugh, it's coming up), and possibly dying—grabs the imagination (p. 35).

Like Nelson's GIFs of the "breathing" Earth, this does grab the imagination. Still, I think there might be a difference between the Gaia hypothesis and some other familiar examples of scientific metaphors. It's a truism that metaphorical claims, taken literally, are just false. For example, we might say that an achievement is a feather in someone's cap. But it's literally false that the achievement is a feather. If we pressed Darwin on the metaphor of natural selection, he'd surely acknowledge that it's not literally true that nature consciously selects anything in the same way that animal breeders do. But the metaphor is nevertheless fruitful, and highlights something important, in spite of being literally false. What's not clear at all is whether Lovelock and Margulis would likewise be willing to concede the literal falsehood of the claim that Earth is alive.

What was it about Gaia that proved to be the sticking point for other scientists? Some of the harshest critics of Gaia, such as Richard Dawkins, seemed unable to make heads or tails of the claim that the planet is a living organism. Part of the reason for their perplexity is that Lovelock and Margulis are defining 'life' in a nonstandard way. For many biologists, a necessary condition for being a living organism is involvement in evolutionary processes. All familiar living organisms belong to evolving populations. They have ancestors. They interact in complex ways with other living organisms. None of this seems true of planet Earth. The planet has no ancestors or offspring, belongs to no biological population, and participates in no evolutionary processes. If you accept the mainstream evolutionist definition of 'life,' then it's hard to take very seriously the suggestion that the planet is a living thing. This helps explain the negative reaction from Lovelock and Margulis's scientific colleagues. It may also explain why everyone else

assumed that the suggestion could only be metaphorical. If a claim seems obviously false, it might be charitable to treat it as metaphorical.

Lovelock and Margulis depart from the view that involvement in evolutionary processes is necessary for being a living organism. Instead, they emphasize homeostasis and self-regulation. In Chapter 7, Ruse tells us that Lynn Margulis was deeply impressed by the work of Humberto Maturana and Francesco Varela, the two researchers who introduced the notion of "autopoiesis" (or self-production) into the discussion. An autopoietic system is one characterized by an inside and an outside. One could say that such a system achieves a degree of independence from everything else, but only by taking in needed materials from the outside and excreting unwanted materials back into the environment. Paradoxically, it depends on the environment to maintain its independence. The paradigm case of an autopoietic system is a single cell. But the hypothesis that the earth is such a system does not seem completely crazy, though it needs defending. And if autopoiesis is the hallmark of life, then Gaia suddenly looks a lot more plausible. Not only that, but the claim that Earth is alive would come out literally true. Of course, that last "if" is a big one.

Ruse misses an opportunity here to do some nitty-gritty philosophizing about the definition of life, and to introduce readers to the ongoing discussion of that topic (see, e.g. the papers collected in Bedau and Cleland 2010). He presents the basic issues clearly enough, and he does emphasize that the Gaia controversy was partly a philosophical and conceptual disagreement. But there is some interesting work in the neighborhood that he does not engage with. For example, Evan Thompson's recent book, *Mind in Life* (2010), updates and offers a sustained defense of the work of Maturana and Varela. Thompson makes the case for the view that autopoisesis is sufficient for life, and he goes to some length to address the concerns of evolutionists. Ruse's oversight here is understandable, given that other philosophers of biology have not paid much attention to Thompson's work, rooted as it is in the continental philosophical tradition. Nevertheless, if I were going to defend the Gaia hypothesis today, I'd start with Thompson's work on autopoiesis.

Ruse does trace an unexpected historical connection between Gaia and the nineteenth century German tradition of nature philosophy associated with figures like

F.W.J. Schelling. We learn that James Lovelock got the term 'Gaia' from his friend and neighbor, the novelist William Golding. Golding, it turns out, had some sympathy for Rudolf Steiner's anthroposophy, the intellectual movement vaguely inspired by German idealism and *Naturphilosophie*. Steiner and his followers have given us both Waldorf schools and biodynamic farming. Anthroposophy (especially the biodynamic farming practices, which look like organic farming, but with a heavy admixture of new age pseudoscience) is the sort of thing that many scientists want nothing to do with, and Lovelock himself claims not to have been influenced by it in any way. But anthroposophy is friendly toward the organicist vision of nature that Lovelock went on to defend. Golding was an early fan of the Gaia hypothesis and lent considerable moral support. These surprising details make for an engaging narrative.

Lovelock and Margulis had at least one potential philosophical ally whom they might not have known about. As far as I am aware, Hans Jonas had no direct connection with Lovelock or Margulis, and as a student of Heidegger who struck off in his own direction during the postwar years, he inhabited an intellectual world that didn't overlap much with theirs. So it's not at all surprising that Jonas makes no appearance in Ruse's account. Still, a comparison of the Gaia hypothesis with Jonas's philosophy of nature could be illuminating. To start with, they were all playing for the same philosophical team, at around the same time. In *The Phenomenon of Life*, first published in 1966, Jonas was trying to develop a scientifically respectable view of the world that was organicist and teleological. With respect to the definition of 'life', Jonas was on exactly the same philosophical page as Margulis. He was emphasizing metabolism and the "needful freedom" of living organisms in a way that foreshadowed the work of Maturana and Varela, and later Thompson. And like Lovelock and Margulis, Jonas's work was plugged into the budding environmental movement. For Jonas, one of the main philosophical motivations for working out a defensible philosophy of nature with a strong teleological and biocentrist flavor was to provide metaphysical foundations for an ethic of environmental caution, which he developed in *The Imperative of Responsibility*. (Vogel 1995 offers an overview of Jonas's project.) Jonas's work, which was rooted more in Jewish tradition, didn't have the pagan resonances of Gaia, but it did influence the Green

political movement in Europe. These parallel revivals of *Naturphilosophie* in different traditions (and different disciplines) at about the same time are striking.

What about the normative issues? Suppose that Lovelock and Margulis were right, and the planet is a living thing. What if anything does that suggest concerning human beings and our obligations concerning the rest of nature? One possibility is that our species is Gaia's brain or central nervous system, and that our special function is to guide and maintain the planet. (Try not to dwell too much on the fact that our species only just recently evolved on a planet that's four billion years old.) This brain metaphor leads to a view about the role of humans that is not too far away from Jonas's. But the Gaia hypothesis is just as compatible with the view that our species is a kind of cancer or parasite eating away at Gaia from within. Remarkably, Ruse finds passages in which Lovelock seems to flirt with both of these views. Lovelock goes from saying that people are "pollution" (1979, p. 114) to saying that we are a "Gaian central nervous system" (1979, p. 138-9). But Lovelock isn't the only one to be conflicted about environmental metaphors. Consider the familiar notion of ecosystem health. That metaphor suggests, on the one hand, that human beings have a role to play as healers, and that restoration ecology and conservation biology are goal-directed applied sciences, rather like medicine. But those who use the metaphor also know that human activities are the main threat to ecosystem health. How can we be both doctor and disease? Perhaps the double-sidedness of these metaphors is part of their appeal.

Readers who approach Ruse's book from the direction of environmental ethics and policy will find that he draws some connections between Gaia and some of the familiar holistic views in environmental thought, such as Leopold's land ethic and deep ecology. He does, however, miss something important with respect to ecofeminism. According to Ruse, the chief difference between ecofeminism and deep ecology is that "the former puts the blame on males rather than on all of humankind" (p. 139). This is way too breezy, and it misses one of ecofeminism's most important insights, which is that we all too often think of the relationship between human beings and nonhuman nature in gendered terms. Our culture is constantly telling us that nonhuman nature is feminine. If this is right, then there is an important conceptual connection between patriarchy and humanity's project of controlling the rest of nature. The very term 'Gaia' is a perfect

illustration of what the ecofeminists were talking about: our deeply engrained tendency to use relationships between men and women as a metaphor for humanity's relationship to nature. There might seem to be something progressive about pagan Gaia-worship, which treats the planet as a female deity, but ecofeminists remind us that we should be suspicious. Note that the idea that the planet is female is completely gratuitous. It's inessential to the claim that the planet is a living thing.

At the very heart of Lovelock and Margulis's view is the claim that Earth is a self-regulating, homeostatic system. Fascinatingly, Ruse traces the idea of a self-regulating system back to the industrial revolution, and the centrifugal governor that Matthew Boulton and James Watt installed on their steam engine (p. 71). As the engine speeds up, centrifugal force operates a mechanism that closes the steam valve, causing the engine to slow down again. How plausible is this idea that the planet as a whole regulates, say, its own temperature in somewhat the same fashion?

Working with a student, Andrew Watson, Lovelock developed a hypothetical model called "daisyworld" in order to show how feedback loops can give rise to a genuine homeostatic system. Imagine a planet just like ours, but with only two species: lighter and darker colored daisies. Darker (low albedo) flowers absorb the sunlight and thus tend to be warmer than their surroundings. Lighter colored (high albedo) daisies reflect more sunlight and tend to be cooler than their surroundings. Suppose that daisies of both varieties can grow at temperatures between five and forty degrees Celsius, with optimal growing temperatures somewhere in the middle of that range. At temperatures near the lower end of that range, natural selection will favor darker colored daisies, and at higher temperatures, it will favor lighter ones. Lovelock and Watson used a computer model to show that the system would regulate its own temperature in a nonmysterious way. Let the temperature fall, and the darker colored daisies will tend to proliferate, and their tendency to warm things up will push the system back toward equilibrium. Let things warm up too much, and the lighter colored daisies will tend to proliferate. The daisyworld model is really just a thought experiment, but it does show how a feedback loop of the sort that scientists already believe in could in principle work to maintain temperature in a range that's favorable for the very living things that are doing the maintaining. Whether things on Earth actually work this way is a further question.

Although Ruse's treatment of the Gaia hypothesis is always charitable, he can't resist sneaking in a serious criticism of the daisyworld model: As the dark daisies proliferate and the planet warms up, why couldn't they evolve greater heat tolerance? (pp. 219-220).

The biologist W.F. Doolittle raised a concern about Gaia that will resonate with many environmentalists: If the planet is a self-regulating homeostatic system, then it might not matter what we humans do to it. The planet will always find a way to "fix itself" (Ruse pp. 29-30). Doolittle's objection misses the mark but nevertheless reveals something important. The reason why it misses the mark is that a homeostatic system can still be sensitive to disturbance. There will be a certain range of disturbances that it can handle. They might knock it out of equilibrium for a time, but the system will—like daisyworld—work its way back into its natural state. That's compatible with saying that more extreme disturbances will overwhelm the system and knock it out of equilibrium for good. Ordinary organisms are like this: We endotherms are good at maintaining a stable body temperature in the face of fluctuations outside, but extreme hot or cold temperatures can do us in. So the claim the planet is a homeostatic system does not imply, *pace* Doolittle, that it will always fix itself, no matter how badly we trash it. But here's the deeper issue: The claim that a system is homeostatic is most plausible when we have some understanding of which disturbances (whether from within or without) the system can handle and which it can't. When it comes to individual organisms, we have a pretty good sense of how to draw this distinction. But it's by no means clear how to do that with the planet as a whole.

Ruse's own assessment of Gaia is mixed, though he is scarcely able to conceal his enthusiasm for Gaia as a topic for philosophers to think about: "Failure as science is balanced by success as philosophy" (p. 223). Crucial to this assessment is Ruse's reading of the Gaia hypothesis as a revival of nineteenth century *Naturphilosophie*, and as carrying forward a much older organicist tradition in philosophy that finds some purposiveness, some teleology, in the living whole. In Lovelock and Margulis's picture, the health and flourishing of the planet is its own internal goal. Like any other living thing, Gaia has a good of its own. This holism contrasts sharply with two more familiar takes on teleology: the theological view that locates purposiveness in the intentions of a supernatural designer, and the much thinner naturalistic view that the only purposes in nature exist

because of the way that natural selection has shaped biological devices "for" doing certain jobs. Ruse's engaging and accessible treatment of the Gaia controversy leaves one with the sense that we might not have heard the last of this organicist tradition in biology and philosophy.

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