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### R.I.P. Lynn Margulis, Biological Rebel

By John Horgan | November 24, 2011 |

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*The biologist Lynn Margulis died on November 22 at the age of 73. I adapted the following essay about her from my 1996 book The End of Science.*



Lynn Margulis was among the most creative challengers of mainstream Darwinian thinking of the late 20<sup>th</sup> century. She challenged what she called “ultra-Darwinian orthodoxy” with several ideas. The first, and most successful, is the concept of symbiosis. Darwin and his heirs had always emphasized the role that competition between individuals and species played in evolution. In the 1960’s,

however, Margulis began arguing that symbiosis had been an equally important factor—and perhaps more important—in the evolution of life. One of the greatest mysteries in evolution concerns the evolution of prokaryotes, cells that lack a nucleus and are the simplest of all organisms, into eukaryotes, cells that have nuclei. All multi-cellular organisms, including humans, consist of eukaryotic cells.

Margulis proposed that eukaryotes may have emerged when one prokaryote absorbed another, smaller one, which became the nucleus. She suggested that such cells be considered not as individual organisms but as “composites.” After Margulis provided examples of symbiotic relationships among living microorganisms, she gradually won

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support for her views on the role of symbiosis in early evolution. She did not stop there, however. Like Stephen Jay Gould and Niles Eldredge, authors of the punctuated equilibrium hypothesis, she argued that conventional Darwinian mechanisms could not account for the stops and starts observed in the fossil record. Symbiosis, she suggested, could explain why species appear so suddenly and why they persist so long without changing.

Margulis's emphasis on symbiosis led naturally to a much more radical idea: Gaia. The concept and term (Gaia was the Greek goddess of the earth) were originally proposed in 1972 by James Lovelock, a British chemist and inventor. Gaia comes in many guises, but the basic idea is that the biota, the sum of all life on earth, is locked in a symbiotic relationship with the environment—the atmosphere, the seas and other aspects of the earth's surface. In fact, the biota chemically regulates the environment in such a way as to promote its own survival. Margulis was immediately taken with Gaia, and she joined Lovelock in promulgating the idea.

I met Margulis in May 1994 in the first-class lounge of New York's Pennsylvania Station, where she was waiting for a train. She resembled an aging tomboy: she had short hair and ruddy skin, and she wore a striped, short-sleeve shirt and khaki pants. She dutifully played the radical, at first. She ridiculed the suggestion of Ernst Mayr, Richard Dawkins and other ultra-Darwinians that evolutionary biology might be nearing completion, in terms of not requiring any major additions or revisions. "They're finished," Margulis declared, "but that's just a small blip in the 20th century history of biology rather than a full-fledged and valid science."

She emphasized that she had no problem with the basic premise of Darwinism. "Evolution no doubts occurs, and it's been seen to occur, and it's occurring now. Everyone who's scientific-minded agrees with that. The question is, *how* does it occur? And that's where everyone parts company." Ultra-Darwinians, by focusing on the gene as the unit of selection, had failed to explain how speciation occurs. Only a much broader theory that incorporates symbiosis and higher-level selection could account for the diversity of the fossil record and of life today, according to Margulis.

Symbiosis, she added, also allows a kind of Lamarckianism, or inheritance of acquired characteristics. Through symbiosis, one organism can genetically absorb or infiltrate another and thereby become more fit. For example, if a translucent fungus absorbs an alga that can perform photosynthesis, the fungus may acquire the capability of photosynthesis too and pass it to its offspring. Margulis noted that Lamarck has been unfairly cast as the goat of evolutionary biology. "We have this British-French business. Darwin's all right and Lamarck is bad. It's really terrible." Margulis acknowledged that symbiogenesis, the creation of new species through symbiosis, is not really an original idea. The concept was first proposed early in this century by the Russian biologist Marachovsky. Similar ideas were set forth in the 1920's by Ivan Emmanual Wallin in a book called *Symbioticism and Origins of Species*. "An absolutely beautiful, wonderful book that was totally ignored," Margulis declared.

Before meeting Margulis, I had read a draft of a book she was writing with her son, Dorian Sagan, called *What Is Life?* The book was an amalgam of philosophy, science and lyric tributes to "life: the eternal enigma." It argued, in effect, for a new holistic

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approach to biology, in which the animist beliefs of the ancients are fused with the mechanistic views of post-Newton, post-Darwin science. Margulis conceded that the book was aimed less at advancing testable, scientific assertions than at encouraging a new philosophical outlook among biologists. But the only difference between her and biologists like Dawkins, she insisted, is that she admitted her philosophical outlook instead of pretending that she didn't have one. "Scientists are no cleaner with respect to being untouched by culture than anyone else."

Did that mean that she did not believe science can achieve absolute truth? Margulis pondered the question a moment. She noted that science derives its power and persuasiveness from the fact that its assertions can be checked against the real world—unlike the assertions of religion, art and other modes of knowledge. "But I don't think that's the same as saying there's absolute truth. I don't think there's absolute truth, and if there is, I don't think any person has it."

Then, perhaps realizing how close she was edging toward postmodernism, Margulis took pains to steer herself back toward the scientific mainstream. She resented depictions of her as a scientific feminist, who was trying to replace masculine concepts of nature with feminine ones. She conceded that, in comparison to such concepts as "survival of the fittest" and "nature red in tooth and claw," her symbiosis views might *seem* feminine. "There is that cultural overtone, but I consider that just a complete distortion."

She rejected the notion—often associated with Gaia—that the earth is in some sense a living organism. "The earth is obviously not a live organism," Margulis said, "because no single living organism cycles its waste. That's so anthropomorphic, so misleading." Lovelock encouraged this metaphor, she claimed, because he thought it would aid the cause of environmentalism, and because it suited his own quasi-spiritual leanings. "He says it's an okay metaphor because it's better than the old one. I think it's bad because it's just getting the scientists mad at you, because you're encouraging irrationality."

Both Gould and Dawkins have ridiculed Gaia as pseudo-science, poetry posing as a theory. But Margulis is, in at least one sense, much more hard-nosed, more of a positivist, than they are. Gould and Dawkins each resorted to speculation about extraterrestrial life in order to buttress his view of life on earth. Margulis scoffed at these tactics. Any proposals concerning the existence of life elsewhere in the universe—or its Darwinian or non-Darwinian nature—are sheer speculation, she said. "You have no constraints on the answer to that, whether it's a frequent or infrequent thing. So I don't see how people can have strong opinions on that. Let me put it this way: opinions aren't science. There's no scientific basis! It's just opinion!"

She remembered that in the early 1970's she had received a call from the director Steven Spielberg, who was in the process of writing the movie *ET*. Spielberg asked Margulis if she thought it was likely or even possible that an extraterrestrial would have two hands, each with five fingers. "I said, 'You're making a movie! Just make it fun! What the hell do you care! Don't try to confuse yourself that it's science!'"

Toward the end of our interview, I asked Margulis if she minded always being referred to as a provocateur or gadfly, or someone who was "fruitfully wrong," as one

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scientist put it. She pressed her lips together, brooding over the question. “It’s kind of dismissive, not serious,” she replied. “I mean, you wouldn’t do this to a serious scientist, would you?” She stared at me, and I finally realized her question was not rhetorical; she really wanted an answer. I agreed that the descriptions seemed somewhat condescending.

“Yeah, that’s right,” she mused. Such criticism did not bother her, she insisted. “Anyone who makes this kind of ad hominem criticism exposes himself, doesn’t he? I mean, if their argument is just based on provocative adjectives about me rather than the substance of the issue, then...” Her voice trailed off. Like other mavericks I have met, Margulis could not help but yearn, now and then, to be a respected member of the status quo, whose work merely confirmed the prevailing paradigm. But without courageous rebels like her, science would never achieve any progress.

Photo credit Wikimedia Commons.

**About the Author:** Every week, John Horgan takes a puckish, provocative look at breaking science. A former staff writer at Scientific American, he is the author of four books, including *The End of Science* (Addison Wesley, 1996) and *The End of War* (McSweeney’s Books, January 2012).

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