ALIENOCENE – THEORY/FICTION

LYNN MARGULIS, AUTOPOIETIC GAIA, AND THE NOVACENE

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In "The Independent Practice of Science,"

James Lovelock describes his earlier professional milieu as a salaried researcher at the National Institute for Medical Research [NIMR] in London in 1961, prior to his emancipation as an independent scientist. It was then that NASA sent him "an invitation to be an experimenter on the first lunar Surveyor mission. It was well known at the NIMR that I regarded science as a way of life in which science fiction was reduced to practice" (Lovelock 1980, 24). In United States patent law, *reduction to practice* technically means to move an invention beyond the initial stage of conception to the testing and application of a prototype. Lovelock speaks at the end of the 1970s as the inventor who engineered the Gaia hypothesis. Single-handedly and in collaboration with the American microbiologist Lynn Margulis, Lovelock would bring the Gaia concept forward as applied systems science. His Gaia discourse is the speculative practice of a systems engineer steeped in the technological imaginary of cybernetics and information theory. In *Novacene: The Coming Age of Hyperintelligence*, Lovelock admits that "I have never really been a pure scientist, I have been an engineer" (Lovelock 2019, 24).

Since Gaia's arrival in the early 1970s, Lovelock has steadily ascribed his derivation of that concept to an application of the cybernetics of physiological homeostasis to the planetary atmosphere. He wrote in his first published article

to place “Gaia” in the title: “The presence of a biological cybernetic system able to homeostat the planet for an optimum physical and chemical state appropriate to its current biosphere becomes a possibility” (Lovelock 1972, 579). His books and papers have regularly devoted discussion to the cybernetic status of feedback cycles and other non-linear operations: “The over-long delay in the understanding of cybernetics is perhaps another unhappy consequence of our inheritance of classical thought processes. In cybernetics, cause and effect no longer apply; it is impossible to tell which comes first, and indeed the question has no relevance” (Lovelock 1979, 52). Lovelock has consistently set Gaia forward as a control system or a self-regulating system persisting over geological time by maintaining a viable homeostasis of climatic conditions through the inter-modulation of the biota and their evolving environment: “Through Gaia theory, I see the Earth and the life it bears as a system, a system that has the capacity to regulate the temperature and the composition of the Earth’s surface and to keep it comfortable for living organisms. The self-regulation of the system is an active process driven by the free energy available from sunlight” (Lovelock 1988, 30). Nevertheless, the treatment of cybernetics in his first book looks beyond the horizon of living systems in a way that we can now read as anticipating the post-biotic destination of his last book: “The only difference between non–living and living systems is in the scale of their intricacy, a distinction which fades all the time as the complexity and capacity of automated systems continue to evolve. Whether we have artificial intelligence now or must wait a little longer is open to debate” (Lovelock 1979, 62).

Published in 2019 as Lovelock celebrated his 100th birthday, *Novacene* purveys a more abstract register of systems discourse. Explicit reference to cybernetics occurs in this text only when Lovelock expounds the origin of the term *cyborg*. He presses this well-worn cybernetic trope back into service for the imminent rise of "electronic life." Just as the notion of the Anthropocene—the time of humanity as a planet-altering force—has taken popular hold, Lovelock declares the coming demise of the Anthropocene with the rise of the Novacene—the closely approaching time of the cyborgs, the new epoch of digital life uniquely sprung from our machines and taking over the business of knowing the cosmos. "Live cyborgs will emerge from the womb of the Anthropocene. We can be almost certain that an electronic life form such as a cyborg could never emerge by chance from the inorganic components of the Earth before the Anthropocene" (Lovelock 2019, 85). Whether or not one finds Lovelock's futurism cogent, his speculative practice at this moment marks a resurgence of twentieth-century science-fiction figures. The cyborg imaginary that arises so fully formed in this text inverts Lovelock's prior creative template of reducing science fiction to practice. Technoscientific practice is now returning to science fiction. *Novacene* submits both biotic systems, living organisms, and metabiotic ecosystems, of which Gaia is the final iteration, to an AI-fueled transhumanist imaginary. The anticipatory sublimities of contemporary digital reality are now giving the future its marching orders.

The author of *Novacene* imbibed cybernetics during its long original moment, as it was being deeply mapped onto ideas of technological progress through the attenuation of the organic sphere. At the end of a career famed for developing the Gaia hypothesis, that rush of cybernetic intuition now reappears as the Novacene—the machinic obverse of Gaia's metabiotic cybernetics. Thanks to *Novacene*, the informatic component of Lovelock's Gaia stands out more distinctly, throwing Gaia's relation to the technosphere into sharper relief. But Lovelock had placed Gaia under Claude Shannon's informatic repurposing of Ludwig Boltzmann's entropy equation from the start. For instance, in the chapter "Cybernetics" in his first book, Lovelock writes a parallel equation between technological, social, and ecological systems: "whether we are considering a simple electric oven, a chain of retail shops monitored by a computer, a sleeping cat, an ecosystem, or Gaia herself, so long as we are considering something which is adaptive, capable of harvesting information and of storing experience and knowledge, then its study is a matter of cybernetics and what is studied can be called a 'system'" (Lovelock 1979, 61-62). The information-theoretic framing of Lovelock's Gaia primes his consideration of technology in relation to the Earth system. Both Lovelock and Margulis insist at first on placing the technosphere within the field of Gaia's operations. Yet even in this early treatment, for Lovelock, human technology is on the verge of departing from the "natural scene":

> . . . in a Gaian world our species with its technology is simply an inevitable part of the natural scene. Yet our relationship with our technology releases ever–increasing amounts of energy and provides us with a similarly increasing capacity to channel and process information. Cybernetics tells us that we might safely pass through these turbulent times if our skills in handling information develop faster than our capacity to produce more energy. (Lovelock 1979, 127)

In the first cybernetic synthesis of Wiener's circular operations with Shannon's calculus of information, the thermodynamics of energy flow pass into the informatics of data flow. Entropy turns into noise and is rethought as de-creative force. Lovelock invests throughout *Novacene* in a fully cosmic treatment of information as a fundamental constituent of the universe. Reading information as substance rather than pattern indulges information theory's tendency to hypostatize its primary entity. Information is given universal ontological status on a par with energy and matter. *Novacene* takes the informatic component of Lovelock's Gaian cybernetics to its logical conclusion: "I can't help wondering whether, when the cyborgs are the dominant species . . . they will discover a proof of my own view that the bit is the fundamental particle from which the universe is formed" (89).

I consider it a somber note that, in this long informatic pilgrimage, Lovelock ultimately abandons the biotic aspects of the Gaian system, and with them, any remaining vestiges of connection to the autopoietic Gaia concept that Lynn Margulis independently explored in some speculative writings of her own. The great interest in the way that Margulis developed Gaia's cybernetics concerns

what I have called a *neocybernetics* of Gaia (Clarke 2020). Through a series of personal encounters with Erich Jantsch (1980), and Humberto Maturana and Francisco Varela (1980), Margulis gradually articulated Gaia through the concept of autopoiesis. In her book *Microcosmos* (1986) co-authored with her son Dorion Sagan, even as Margulis joined Lovelock's critique of linear thinking, she also noted the persistence of linearity in the mechanistic paradigms shaping the computational use of information theory. Take, for instance, the fashionable application of what Margulis and Sagan deemed "computer-age analogies" to the reproductive operations of living systems: "amino acids are a form of 'input,' RNA is 'data-processing,' and organisms are the 'output,' the 'hard copy' controlled by that 'master program,' that 'reproducing software,' the genes" (1986, 264). Margulis and Sagan gravitate to the concept of autopoiesis precisely to rebut such equivocal bioinformatics: "we have held to a somewhat different and more abstract view. . . . Life, a watery, carbon-based macromolecular system, is reproducing autopoiesis. The autopoietic view of life is circular" (264).

Margulis and Sagan develop this neocybernetic, recursive view of Life in distinction to the linear transmission model that splinters life into bits and so renders its systemic integrities, its biological autonomies (Varela 1979), into informatic packets. Their aim is to conceive of the Gaian consortium as coupling the technosphere together with the biosphere. With an implicit allusion to Lovelock's critical involvement with NASA landers in the early days of Gaia, Margulis and Sagan envision a multiply-coupled autopoietic Gaia that crosses over

between biotic and metabiotic systematics. Their article "Gaia and the Evolution of Machines" notes that while humans are now entrained parts of the technosphere, that machinic network itself is a metabiotic yet non-autopoietic part of Gaia even in its tentative cosmic extension, by means of the technosphere, to the Martian surface:

> The Viking Lander on the surface of Mars does not maintain its own structure or actively preserve its boundaries. Alone, lacking communication, it is no longer autopoietic. But from 1975 to 1982, when all of its communication with the Earth was halted, even the Viking Lander was part of an autopoietic system. Machines, by themselves on Mars, are not autopoietic. Machines tended by their workers form part of the autopoietic systems of their makers. (Sagan and Margulis 1987, 19)

In contrast, Lovelock's Novacene scenario imagines an entirely informatic planet moving at warp speed away from Margulis's neocybernetic scheme for the radicalization of Gaia as the symbiotic planet. *Novacene* predicts that the biotic components of Gaia will persist only until the cyborgs take control of the technosphere and bring Gaia's biosphere under their coding regime:

> The appearance of abundant information as part of the Earth system has had a profound effect. The future world I now envisage is one where the code of life is no longer written solely in RNA (ribonucleic acid) and DNA, but also in other codes, including those based on digital electronics and instructions that we have not yet invented. In this future period, the great Earth system that I call Gaia might then be run jointly by what we see as life and by new life, the descendants of our inventions. (Lovelock 2019, 88)

At the dawn of the Novacene, the organic and electronic realms will share mutual interests in the other's prosperity: "For a while at least, the new electronic life might prefer to collaborate with the organic life which has done (and still does) so much to keep the planet habitable" (105). But the evolutionary dynamics of this scenario clearly predict the eventual obsolescence or dire marginalization of organic life as cyborg agency fashions a new post-Gaian planet according to its own standards of viability: "When the Novacene is fully grown and is regulating chemical and physical conditions to keep the Earth habitable for cyborgs, Gaia will be wearing a new inorganic coat. As it evolves to counter the ever-increasing output of the Sun, the Novacene system may grow hotter or colder than organic life can bear" (111). The creator of Gaia now lays his own brainchild down to rest on its deathbed: "Eventually, organic Gaia will probably die" (111). This cyborg scenario seems to determine that the biotic constituents of autopoietic Gaia will die sooner rather than later. And yet, had human agency held the technosphere under a more constrained biopolitical order, had the biosphere not been submitted to total infection by abiotic bits without autopoietic contingencies, Gaia's biota could well persevere as vital factors in the planetary order. Relative to the dying Gaia of the Novacene, even the stressed-out Gaia of the Anthropocene is granted a longer lease on planetary functionality.

If one would rather retain Gaia's processes as an extant metabiotic Earth system banking its maintenance in operation on the persistence of the biota, then one may prefer to consult Margulis's Gaia instead. Ever scrupulous in deflecting

credit for the development of Gaia to Lovelock and honoring his priority in its invention, nevertheless, as we have already begun to note, Margulis gradually developed her own manner of defining Gaia and expounding its wider implications. While Lovelock largely left these contributions unremarked, Margulis immersed her exposition of Gaia in the theory of autopoiesis. From our current vantage, it seems likely that she did so in order to keep Gaia's biotic feet on the ground during the 1980s, just as Lovelock was embarking on the construction of Daisyworld, a model biosphere and "cybernetic proof" of Gaian homeostasis initially run on a home computer (see Lovelock 1988, 42-64). Now that, decades later, Lovelock has pulled the veritable Gaia entirely up into the aether of informatic bits, we may see more clearly what drove Margulis's insistence on an autopoietic description.

Writing with Dorion Sagan, she observed the arrival of a "Gaian style of thought . . . in which perception is seen as a participatory phenomenon, and with which we become more aware of the sum of organisms within the biosphere. . . . Traditional human ideas are in contrast with Gaian perceptions that link people inextricably, and in subordinate fashion, to the biota, that is, to the sum of plant, animal, and microbial life. . . . In it, human beings and technology may be seen as environments in the biosphere" (Sagan and Margulis 1987, 16). By the beginning of the 1990s, Margulis had fully formulated the constructivist version of scientific epistemology implicit in the concept of autopoiesis and launched this style of Gaian thought against her immediate nemeses within the Anglo-American

biological academy, the Neo-Darwinists, who also formed the staunchest bastion against the Gaia hypothesis:

> A world philosophy based on the recognition of the autopoietic and nonmechanical nature of life *must* upset the believers in the fundamental myths of our technological civilization. . . . In the autopoietic framework, everything is observed by an embedded observer; in the mechanical world, the observer is objective and stands apart from the observed. (Margulis 1990, 226–27)

Conversely, the positivistic observer in putative scientific detachment from their object will take the biosphere to be dispensable for the technosphere, which may separate itself from it, or against which it may be sealed. All this misses what Margulis and Sagan call the *consortial* nature of systems based, directly or circuitously, on the dynamics of living organization:

> The consortial quality of the individual preempts the notion of independence. . . . Gaia is the same sort of consortial entity but she is far more complex. Consortia, associations, partnerships, symbioses, and competitions in the interaction between organisms extend to the global scale. Living and nonliving matter, self and environment are inextricably interconnected. (Sagan and Margulis 1987, 16)

Margulis recognized and expounded the link between Gaian thought and autopoietic systems theory. In her symbiotic or consortial theorization, humility, community, and mutuality are as profoundly systemic as are the principles of biological autonomy that ensure that differential living operations always occur

within a higher-order medium that either binds them into metabiotic consortia or leaves them aside as de-creative environmental noise. Lovelock's *Novacene* may be read as an ironic last twist on a career of systems thinking that closes up shop by deconstructing its own greatest creation.

Note:

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For further discussion of all references cited in this article, please consult Clarke (2020).

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