

12

Principles of Gaian Governance: A Rough Sketch

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Characterizing the Earth holistically as a self-regulating system, Gaia theory represents a creative synthesis that simultaneously builds upon and transcends reductionist science. At least four general readings of Gaia theory are possible. First, by substantially impacting (or “regulating”) the planet’s geochemistry, living organisms contribute to sustaining the habitability of the biosphere. In particular, the presence of life tends to alter a planet’s climate and atmospheric chemistry in ways that favor the continuation of life (Resnik 1992). Stated in this way, Gaia theory qualifies as a scientific hypothesis in that it is, in principle, falsifiable. Second, and more radically, Earth itself may be understood as a complex, bounded, self-organizing, adaptive living system (Margulis and Sagan 1995). Third, the evolving biosphere is self-organizing with emergent properties, but not necessarily along a homeostatic track (Volk 1998). Fourth, and most radically, Gaia is conceived by some as an evolutionary planetary intelligence that operates to the benefit of the whole, or perhaps even according to some larger purpose (Russell 2008). Of the four readings, the first is the most broadly accepted and has helped to spawn a paradigmatic shift in the natural sciences, most evident in the new integrative field of Earth system science. This chapter begins with the first interpretation, articulating Gaia theory in the more general language of systems theory. In particular, it highlights some implications of three essential characteristics of living systems—holism, autopoiesis, and symbiotic networks—for global governance. The chapter then proceeds to inquire into some of the ways that Gaia might find expression in political culture, with special attention to how Gaian thinking might elucidate questions of global justice and kindle the political imagination.

Gaia and Political Culture

Gaia's cultural allure was evident at the outset. James Lovelock (2000) was astonished to receive twice as many letters in response to his first book on Gaia from people interested in its religious aspects as from those with a more scientific bent. Had Lovelock named his theory something along the lines of "homeostatic Earth systems theory," he surely would not have received such a response. Gaia, Earth goddess and mother of creation, simultaneously evoked the ancient transcultural theme of a living Earth while tapping into a contemporary hunger for a sense of connection and wholeness. While the literary, religious, and philosophical dimensions of Gaia theory have been widely explored, the political implications have received little attention. What concepts, metaphors, and promptings might Gaia theory offer us as we explore modes of governance commensurate to the task before us? This chapter embarks on an exploration of this question.

From a Gaian perspective our blue planet functions much like an organism—a self-contained living system embedded in the larger solar system, with internal metabolic systems of temperature and chemical modulation and an atmospheric membrane that separates it from outer space. Interestingly this holistic perspective of the Earth has emerged just at a time when the twin phenomena of globalization and environmental destruction call us to adopt a planetary perspective. Gaian thinking awakens us to the crucial fact that human systems are embedded in and utterly dependent on this greater whole. Because the Earth system is the wider context in which our social, political, and economic systems operate, and because our actions now have planetary consequences,¹ we are increasingly compelled to develop forms of governance that are compatible with the larger system that environs and sustains us. This monumental task will most likely to occupy generations to come. Therefore this discussion will be suggestive, tracing only the broadest implications of Gaia theory for contemporary social and political theory.

Systems Theory and Gaian Governance

Gaia theory, which views the Earth as a complex and bounded system, draws upon the more general field of systems theory, the basic tenets of which open up fresh possibilities for considering questions of global governance. Much contemporary political discourse is grounded in an

atomistic, reductionistic model that sees the world as constituted by discrete institutional entities and problems, approaching these problems largely in isolation from one another. For instance, international environmental law, which consists of a myriad of separate regimes for hundreds of issues ranging from toxic waste exports to fisheries management, is itself rooted in an atomistic demarcation of the planet into sovereign nation-states. By highlighting the embeddedness of human systems in the living Earth system, Gaian thinking fosters a kind of meta-position from which a systemic perspective on global environmental governance might emerge. In broad terms, global environmental problems represent a collision of human systems with the larger Gaian system. In contrast to the mechanical billiard-ball metaphors that inform much of modern political discourse, the Gaian image of a living Earth may be more amenable to the problems at hand. Moreover, as a scientific alternative to modern reductionism, Gaia provides important concepts and metaphors that can help move us toward a viable future.

Systems theory, which has been adapted to a range of fields including engineering, education, finance, health, psychology, and natural science, postulates three broad types of systems.² *Hard systems* include many of the technologies associated with industrial life such as electrical grids, transport systems, and telecommunications. Because of their mechanical character and their linear logic, hard systems are known for their short-term efficiency, predictability, and performance. *Living systems*, of which Gaia is the largest known instance, are nested systems of biota and their environments. These complex systems cannot be understood in terms of the linear, reductionist logic of nonliving systems. They require a more dynamic, holistic approach. *Human systems*, like living systems of which they are a part, are nested and complex, evolving, reproducing themselves, and dying. Purpose, which is not an obvious property of hard or living systems, is essential to human systems.

Human systems problems, because they have multiple interacting causes and involve many actors with differing perspectives, are generally exacerbated when addressed in terms of hard-systems logic and methods. When hard-systems thinking looks at human systems, it is partially blind because it ignores purpose, subjectivity, and complex interdependence. Imagine, for instance, the consequences of approaching familial relationships with the orientation of a car mechanic. On a societal scale, technological fixes and other hard-systems solutions to human systems problems often generate more intractable problems down the road.

Examples include arms races, the so-called Green Revolution, and tall smokestacks that reduced local pollution but created the new problem of transboundary acid rain. The global repercussions of hard-systems thinking are becoming evident just as living-systems thinking, including Gaia theory, counsels an alternative model.

Holism

Living and human systems are bounded entities, distinguishable yet never entirely separate from their environments. A cell, the simplest living system, is a “membrane-bounded, self-generating, organizationally closed metabolic network” (Capra 2002). That network includes complex macromolecules, such as proteins, enzymes, RNA, and DNA. The permeability of the cell’s membrane gives it access to the nutrients and waste depositories it needs to survive, while also making it vulnerable to incursions from outside. In Gaia theory the atmosphere functions as a membrane that simultaneously separates Earth from outer space, while being porous enough for both sunlight and meteors to enter the system. All living systems, including human systems and Gaia, maintain a degree of structural integrity without ever being fully independent.

This radical interdependence stands in sharp contrast to prevailing political and psychological notions of independence. Just as modern psychology valorizes the autonomous ego, modern political thought is premised upon individual rights and state sovereignty. Systems theory calls all of these into question. In the words of V. I. Vernadsky, the Russian systems scientist, “human independence is a political, not a biological concept” (quoted in Primavesi 2000: 6). The autonomous individual, reliant upon billions of bacteria, is a fiction. Human well-being is also utterly dependent on local ecosystems and the Gaian system, including the ceaseless decompositional and generative work of plants, phytoplankton, bacteria, fungi, earthworms, and other organisms. Current economic and political institutions reflect a mode of consciousness that is essentially oblivious to this radical embeddedness. The apparent incompatibility of the dominant human systems with Gaian equilibrium suggests a need for modalities of governance rooted in a systemic understanding of interdependence—with other nations, species, and Gaia itself.

Serendipitously, Gaia theory’s planetary perspective enters the scene just as the global impacts of human systems are becoming evident. For the first time humanity has become a geophysical force with planetary effects. The rate of species extinction is between 1,000 and 10,000

faster than in the pre-industrial era, rivaling the last great wave of extinctions that wiped out the dinosaurs 65 million years ago (UNEP 2002). Climate scientists predict that global temperatures will rise between 1.5 and 6 degrees Celsius in the coming century, a warming on the order of the shift from the depths of the last ice age to the present interglacial period (IPCC 2007). Most key resources—including forests, minerals, petroleum, fresh water, topsoil, and fisheries—are being depleted at unsustainable rates.

Like life itself, human beings have evolved the capacity to inhabit virtually every corner of the Earth. Globalization of some form therefore seems to be part of our destiny. Yet, as part of a greater whole, we must harmonize our social, economic, and political systems with Gaia. International environmental law represents only a piecemeal movement in this direction. Because it sidesteps the crucial questions of purpose and process that give rise to the destruction, green diplomacy cannot offer a systemic solution. By rigorously explicating the networks of systemic interdependence that underpin the Earth's functioning, Gaia theory challenges us to locate human systems with the living whole. How might Gaia theory inform our search for modes of globalization that are compatible with the larger Gaian system?

Some environmentalists are uncomfortable with the notion of Gaia because they believe it encourages complacency. They worry that people will assume that Gaia, like any good mother, will simply clean up their mess. Yet such an assumption would be a tragic and shortsighted misreading; Gaia theory is concerned with the systemic functioning of the planet, not the welfare of any particular species. From a Gaian perspective we are far more expendable than bacteria. While some may find solace in Gaia's capacity for adaptation over the aeons, any future equilibrium state will almost certainly be far less favorable to our species than the present one. For most of Gaia's 3.8 billion years, glacial periods were frequent and species diversity far lower than at present. So a healthy dose of prudence is in order—not for Gaia's sake, but for our own. In Lovelock's words (1990: 212), Gaia is "stern and tough, always keeping the world warm and comfortable for those who obey the rules, but ruthless in her destruction of those who transgress." Gaia theory helps to reveal those rules to us.

Living systems are maintained through the dynamic interaction of their subsystems. In the Gaian system the main chemical subsystems involve the cycling of carbon, nitrogen, oxygen, and sulphur (Lovelock 1990). The largest human system, the global political economy, involves the

dynamic interaction of corporations, governments, international organizations, banks, and nongovernmental organizations. In both cases the systems are self-making: they generate high degrees of order through complex relationships among their parts and with the environment, rather than as a consequence of external agency. Gaia theory tells us that viable human systems must function as a nested subsystem within the Earth system. While this insight may seem absurdly obvious, the mounting global ecological mega-crisis suggests that sometimes the obvious bears repeating.

Autopoiesis

Gaia theory suggests that the Earth system has been *autopoietic*, or self-making, over the course of billions of years. Autopoiesis, a term coined by Maturana and Varela (1998) from the Greek words for “self” and “making,” highlights the self-generative nature of metabolic networks in living systems. The system continually makes and remakes itself, maintaining its structural integrity and organic functioning through exchange with its environment. The minimal autopoietic entity is a bacterial cell, and the largest one known is Gaia (Primavesi 2000). An autopoietic system undergoes unceasing change while preserving its web-like pattern of organization. During the first two billion years bacteria ruled the planet and devised all of life’s essential processes: reproduction, photosynthesis, fermentation, nitrogen fixation, respiration, and locomotion (Capra 2002).

Despite the proliferation of life forms over the millennia, many of Gaia’s essential characteristics have remained relatively stable. *Homeostasis*, the tendency toward constancy, is another property of living systems. Lovelock’s Gaia hypothesis predicts that Earth’s climate and chemical composition remain in homeostasis over long periods of time until some internal contradiction or external force causes a jump to a new stable state (Lovelock 1990). Most external forces have been asteroid or comet impacts, to which Gaia responds, whether gradually or rapidly, by moving into a new stable state. Human activity since industrialization represents a new kind of internally induced planetary crisis, one that seems to call for a conscious autopoietic response. Given the looming global eco-crisis and our utter dependence on Gaia, we might be curious to learn about how Gaia has handled past planetary crises.

Earth’s first internally induced environmental crisis probably occurred with the invention of photosynthesis, when the consumption of carbon

dioxide by bacteria threatened to destabilize Gaia's homeostatic balance. The ensuing accumulation of oxygen, one of their waste products, however, opened up a tremendous niche for oxidizing consumers, and the subsequent growth of more complex organisms (Margulis and Sagan 1995). These complex life forms in turn replenished the atmosphere's most important greenhouse gases: carbon dioxide and methane. Thus Gaia responded to the "crisis" of photosynthesis by generating a new atmospheric homeostasis.

Another crisis is suggested by the recent "snowball Earth" discovery, which coincidentally represents the strongest geological evidence against Gaia theory (Hoffman and Schrag 2000). Around 600 million years ago, just before the appearance of recognizable animal life, the entire Earth, including the tropics, apparently froze over for 10 million years or more. Geothermal flux from radioisotope decay in the Earth's mantle and the buildup of atmospheric carbon dioxide from volcanism prevented the oceans from freezing to the bottom, but ice grew to a depth of several kilometers as global temperatures plummeted to -50 degrees Celsius. Eventually carbon dioxide from volcanoes accumulated to record levels, warming the Earth and melting the ice, causing an extreme climate reversal that brought about a fierce greenhouse effect. This event seems to conflict with Gaia theory's predictions of homeostatic stability.³

Yet some interpretations of snowball Earth are consistent with Gaia theory. First, Gaia theory predicts that crises will be followed by long periods of stability; ten million years would qualify as a long period of stability, even if life didn't exactly flourish during that time. Snowball Earth thus offers a cautionary tale, reminding us that Gaian homeostasis does not always provide a comfortable home. Second, the extreme glaciations of snowball Earth occurred just before a rapid diversification of multicellular life, culminating in the Cambrian explosion of biodiversity around 550 million years ago. Paradoxically the long periods of isolation and extreme environments on a snowball Earth could have stimulated genetic change (Hoffman and Shrag 2000), and this crisis and apparent anomaly to Gaia theory could have facilitated the evolutionary lineage of our own species. Rather than falsifying Gaia theory, snowball Earth may be an odd and extreme chapter in Gaia's self-making.

The nature of feedback among tightly linked networks means that very small causes can quickly amplify into large effects; complex systems therefore have only limited predictability. Nonlinearity is therefore not just a mathematical concept linked to exponential change as a

consequence of feedback mechanisms, but an ontological property of living systems with important implications for global environmental politics. A dramatic example occurred with the discovery of the Antarctic ozone hole in 1985. Scientists' predictions of incremental global ozone loss as a result of chlorofluorocarbons (CFCs) were overturned with the dawning recognition that these so-called miracle compounds could catalyze a chain reaction in the stratosphere, with one CFC molecule destroying as many as 100,000 molecules of ozone (Litfin1994). In this case, because the human systems were relatively simple with only a small number of firms producing CFCs, international negotiators found it comparatively easy to address the problem via the Montreal Protocol and its subsequent amendments. Yet even with full compliance, this shining success story of environmental diplomacy will not return the ozone layer to pre-1985 conditions for another century. Moreover Gaia's long-term responses to the effects of ozone depletion, such as the massive death of phytoplankton, remain unclear. The potential for irreversibility is a corollary to nonlinearity.

If rapid planetary change is possible, as geologic history suggests, then an attitude of prudence and humility is appropriate. Gaian thinking therefore supports the precautionary principle: if the risk is high, then we should act to prevent harm even in the absence of scientific certainty. Because Gaia is the systemic vessel of all living and human systems, our actions should be especially constellated toward ensuring the stable functioning of Gaian systems. Nonlinearity means that in the presence of systemic perturbations, surprises are likely. Recognizing that surprises, by definition, cannot be anticipated, the wisest perspectives and policies will be those that enhance the resiliency of human and other living systems (Janssen 2002). This means understanding, as much as possible, the nature of those systems, attuning our systems to the larger Gaian system and taking precautionary action to limit harm.

Like living systems, human systems are autopoietic, tending to reproduce themselves and evolve new equilibrium states in response to changing conditions. In his essay on social autopoiesis, sociologist Niklas Luhmann (1990) describes human systems as self-generating communicative networks. These networks have both material and cultural effects, generating external social structures like corporations and states as well as internal structures of meaning like rights and roles. For example, the global economy is continually reproduced through networks of communication involving advertising, production, entertainment, financial transfers, and education, each of which has structural correlates in

subjective consciousness and intersubjective experience. What happens when autopoietic human systems disrupt the Gaian equilibrium?

According to Gaian scientists, when the activity of an organism favors both Gaia and itself, it will tend to spread; eventually, both the organism and the associated environmental change may become planetary in scope (Lovelock 1990). We may therefore be tempted to optimistically infer from humanity's relatively rapid globalization that this trend is favorable to (or at least compatible with) Gaia. This logic, however, ignores the vastly different time scales associated with human vs. Gaian processes. A period of 100,000 years, for instance, is many times longer than all of human history, yet represents less than 0.003 percent of Gaia's lifetime. Only in the last part of the twentieth century did the human species become a geophysical force operating on a planetary scale; only in the last decade was human-induced climate change conclusively observed. The sobering fact is that we cannot know exactly when or how the Gaian system will respond to these rapid changes. The geological record evinces a pattern of punctuated equilibrium, with long periods of homeostasis followed by sporadic catastrophes, which in turn spark intense periods of innovation leading to new stable states. Gaian theorists believe that once a system shift gets underway, it moves into a new and very different state quickly, taking as little as a century to establish into a new geochemical equilibrium. Species diversity, however, will take millions of years to rebound. After the Cretaceous-Tertiary asteroid impact biological diversity is believed to have taken between five and ten million years to recover. Therefore it is prudent to bear in mind the converse of the optimistic inference mentioned above: any species that impairs Gaia's functioning may precipitate not only its own demise but that of many others, even as the web of life innovates toward a new homeostasis.

The concept of autopoiesis raises an important philosophical question. If a living system somehow "makes itself," does it do so purposefully? Because it hinted at such a possibility, Lovelock's original formulation of the Gaia hypothesis met with intense scientific criticism, especially from neo-Darwinists. Some critics interpreted him as proposing a sentient Gaia able to consciously control the Earth with foresight and planning. In his later formulation Lovelock illustrated the principle of homeostasis through a simple model that involved dynamic interaction but not intentionality. For instance, the automatic self-regulation of the carbon cycle, which has stabilized atmospheric concentrations of carbon dioxide at 0.03 percent, requires no foresight and planning. Yet this number is very different from the 95 to 98 percent concentrations of

carbon dioxide on Venus, Mars, and pre-life Earth (Lovelock 1990). The Earth's improbable atmosphere is a consequence of feedback between biota and nonliving systems.

The feedback mechanisms that generate Gaian homeostasis require neither intention nor altruism, but rather only a reciprocal flow of influence.⁴ Whenever the rate of change in a system is getting faster, positive feedback is at work. This kind of reinforcing feedback is important when a new equilibrium is getting established, but it can also lead to a pernicious spiraling effect, as in avalanches, stock market booms, and cattle stampedes. On a Gaian scale, for instance, because water vapor is itself a greenhouse gas, increased evaporation on a warming planet may increase the temperature further. When positive feedback gets out of control, the resulting runaway system can only be stopped if either the external environment or the internal negative feedback halts the positive feedback loop. Damping, or negative feedback, prevents the system from running away with itself. For instance, the absence of predators in an ecosystem will lead to an overpopulation of their prey; their numbers in turn will not be able to subsist on the given food supply, so they will fall to a sustainable level. In each of the cases above the feedback is an automatic function. The system is responsive, yet no purposeful agent is postulated as responsible; Gaia theory does not entail teleology.⁵ Questions of larger purpose and intention in living systems are simply beyond the bounds of scientific methodology.

Purpose, however, is essential to human systems. It consists of the most cherished values that inform and orient our systems. While a human system's purpose might be unexamined, misunderstood, ignored, debated, and even disguised, reconfiguring it from its base requires identifying its drive and implicit values. The global economy is a self-reproducing network of networks, but can we point to a basic purpose or set of purposes that drive it? Growth, development, prosperity, and wealth—these are different words for what many would agree is the underlying purpose of the system. Growth as systemic purpose is evident in its almost universal acceptance—across the political spectrum from left to right, and around the world from North to South.⁶ While disagreement on *how* to pursue economic expansion abounds, there is a striking consensus on the fundamental objective itself. Under the prevailing capitalist ideology, the alternative to growth is economic collapse, both at the level of the firm and the state.⁷ Yet systems thinking tells us that the growth imperative is a positive feedback mechanism, and therefore runs

the risk of creating runaway processes that can only be stopped when either the external environment or an internal instability halts them. Systems theory does not predict exactly when or how that might happen, but it does warn us about positive feedback loops in general.

If human systems are to persist as a global subsystem of Gaia, then we will need to align our purposes with the functioning of Gaia. The longer we wait, the greater the risk. If economic growth is the purpose of the global economic system, then reconfiguring the current system means first and foremost rethinking our purposes. For human systems to be harmonious with the wider Gaian system, ecological sustainability must become a core human purpose.

Symbiotic Networks and Gaian Governance

Gaia theory depicts the Earth system as a many-layered isomorphism, a vast autopoietic network of nested communities. Thus, when biologist Lewis Thomas asked himself, “What is the Earth most like?” he answered, “It is *most* like a single cell” (Thomas 1974). Living systems, from the cell to Gaia, are constituted through symbiotic networks whereby dissimilar entities coexist in a mutually beneficial arrangement. Contrary to the neo-Darwinist view of life as a harsh competition for survival, Gaia theory upholds cooperation as much more the rule than competition. Bacteria, the most long-lived class of organisms and the basis of all subsequent life, are inherently social; “they live by collaboration, accommodation, exchange, and barter” (Thomas 1974: 6–7). Gaia theory tells us that life did not colonize the planet by combat but by networking (Margulis and Sagan 2001).

Like other living systems, human systems consist of networks. On a global scale the human system comprises innumerable networks of production and consumption, diplomacy and warfare, advertising and entertainment, and education and ritual. Many (if not most) social systems are more rooted in cooperation than competition: for example, the family, global transportation, and postal networks. Yet the overarching premise of the global economy is competition. Firms compete with one another for resources and markets, workers compete for jobs, and countries compete for investment. Both capitalism and traditional Darwinian biology also presume the natural environment as a stable background in which individuals compete and to which they must adapt. Even Marxist political economy, an ostensibly more cooperative approach, depicts history as class struggle and nature as valueless material to which human

labor brings value. In contrast to modern approaches to political economy, Gaia interprets life as the ability of cooperative networks to simultaneously adapt to, alter, and enhance their environments to their mutual benefit. Both the unrelenting drive to compete, an intrinsic consequence of the growth imperative, and the notion of environment as inert backdrop are therefore at odds with Gaia theory. A sustainable global economy, by way of contrast, would consist of symbiotic networks acting in harmony with Gaia.

In living systems, networks continuously reconstitute their elements in cyclical processes. In ecosystems, and in Gaia as a whole, recycling is the rule; one species' waste is always another species' source of nourishment. The Earth's major nutrients—carbon, hydrogen, oxygen, and nitrogen—are cycled and recycled. Cyclical exchanges of energy and resources in a living system are sustained by pervasive cooperation. Neither for Gaia, nor for any local ecosystem, is there an "out there" into which "waste" can be dumped. Such concepts as garbage and pollution are foreign to Gaia. Yet existing political approaches to waste (whether solid, atmospheric, toxic, biomedical, or nuclear) pursue safer technologies and disposal practices without ever questioning the very concept of waste itself. This is true for all levels of mainstream "waste management," from municipal policies to international treaties. Indeed industrial societies are based upon "the toilet assumption"—the implicit belief that waste can be simply "flushed away" (Slater 1970). Gaia theory reiterates the message of global environmental degradation: there is no "away."

What might Gaia tell us about principles of governance? Contrary to the fears of some that a Gaian politics would be reductive (to biology or the planet) and therefore invite abuse by demagogues, a thoroughgoing Gaian politics would be radically democratic, a nested system of governance from the neighborhood to the global level (Madron and Jopling 2003). There are no authoritarian regimes in Gaia, only mutually enhancing symbiotic networks. Unlike the current system, premised upon the growth imperative, Gaian democracies would be oriented toward purposes of sustainability and justice, and modeled on a network vision of participatory governance and forms of leadership that empower people. The prevailing command-and-control culture in business and politics would be replaced by a culture of dialogue. Autopoiesis, or self-making, would take on new meaning with the globalization of democracy as people organize themselves according to Gaian principles.⁸

The rise of network society, from global civil society to the Internet, coincides with the decline of the sovereign nation-state. State sovereignty

is being radically reconfigured, by global networks of communications, finance, crime, terrorism, disease transmission, ecology, and transnational activism (Litfin 1997; Hawken 2007). From a Gaian perspective the nation-state is neither large enough to inspire a planetary identity nor small enough to nurture the kinds of local identity and civic involvement that are essential to participatory governance. This does not mean that the nation-state will cease to exist, but only that it may be incorporated into broader cross-cutting networks of supranational, regional, and local forms of governance.

Yet we are wise to remember that while Gaia theory can be helpful in reorienting our thinking about human systems, it is not a panacea. Systems language and concepts offer an integrative way of understanding current problems and redirecting our actions down a more sustainable path, but they do not lay the stones along that path. For this reason Lovelock warns that we need to be wary of opportunists whose use of ecological language is merely a mask for ulterior aims (1979). Gaia theory can help us with the essential task of seeing the big picture, but it does not resolve the thorny problems of practical politics. In this sense Gaia may be more important for its broader contribution to our ethical and political imagination than for its direct policy effects. Gaia theory does not so much represent a holy grail as a powerful corrective wind to reorient our sails.

Gaia and Global Justice

In displacing humans from the center or apex of creation, Gaia theory offers both scientific and metaphysical support for an alternative to modernity's anthropocentric outlook. For some environmental theorists this is its most significant contribution to green politics (Dobson 1990). Yet this antianthropocentric message does not translate easily into a strategy for social and political change for the simple reason that human action is unlikely to harm Gaia's overall health. As Lovelock states, "On a planetary scale, life is near immortal" (1986:28). If Gaia is a self-making system, then there is no palpable need for human action. If "nature is in control," as some ecological thinkers infer from the Gaia hypothesis (Spretnak and Capra 1985, cited in Dobson 1990), then apathy or even environmentally destructive behavior may be morally acceptable inferences from Gaia theory.

Along these lines, some anti-environmentalists cite Gaia theory in support of their views. Ron Arnold, for instance, whose *Ecology Wars*

has been called “the bible of the wise-use movement,” takes great solace in “Lovelock’s clear-sighted vision of a self-protecting Earth managed for ages by self-knowing human stewards” (cited in Botkin 2001: 41–42). He cites the autopoietic resilience of Gaia in order to justify both current industrial practices and his own caustic attack on environmentalism. Rather than decentering humanity, “wise-use” proponents understand Gaia theory as giving free reign to human systems. The primary flaw in this logic, however, is that Gaian time scales are on the order of aeons, whereas human systems rarely consider anything longer than a generation. Contrary to anti-environmentalists’ wishful thinking, Gaia’s resilience says nothing about the resilience of human systems.

A core message of Lovelock’s theory is that even if human-induced perturbations to Gaia were good for the biosphere—which seems highly unlikely—they could be disastrous for us. As Andrew Dobson articulates, “While the Gaia hypothesis might indeed lead us to contemplate our humble place in the grand scheme of things and thus to a ‘decentering’ of the human being, we quickly return to center stage as humility turns into fear for survival” (1990: 45). I would add that humility could be born not only of fear, but also from a sense of awe and gratitude for the larger systems that environ us. While undercutting anthropocentrism, Gaia theory has the paradoxical effect of highlighting, rather than diminishing, our place in the Earth system.

Yet Gaia theory raises some disconcerting ethical questions. If value in the Gaian system is related to the continuance of life in general, then must our ethical concern extend beyond humans to other creatures? To the planet? In some ways our concern for Gaia comes not so much from ethical obligation but from an enlarged sense of pragmatism: we want to save our own skins. Gaia will survive, but our interference may catapult her into a new and less hospitable state. Thus Gaian pragmatism evokes some general ethical principles. “Is” may not dictate “ought,” but it can be suggestive. If, for instance, species diversity and a stable concentration of greenhouse gases *are* critical for a healthy functioning of the Gaian system, then we *should* prevent species extinctions and reduce our use of fossil fuels. If risks *are* high, then action to prevent harm *should* be taken, even in the absence of full scientific certainty. If current practices *do* risk destabilizing the Earth’s climate and life support systems, then we *should* take precautionary action and change them. Thus Gaia theory, when combined with a commitment to viable human systems, seems to call into question the traditional fact/value distinction.

At a minimum, Gaian thinking supports a precautionary approach: if we value human life, to wait for full scientific certainty before curtailing behavior that might destabilize planetary life support systems would be foolhardy to say the least.

If Gaia focuses our attention on the Earth, what happens to our generally accepted ethical commitments to other people? What, for instance, of questions about justice under conditions of extreme global inequality? At first, we might think that if Gaia is the object of our concern, then we must sidestep thorny questions like North–South inequity and get onto the business of “saving the planet.” Because Gaia’s big-picture perspective challenges anthropocentrism, we might be tempted to ignore the comparatively small questions of justice and equity. And because the Gaian scale of global heating seems to dwarf other environmental concerns, we might be tempted to ignore the comparatively minor problems of pollution and conservation of local ecosystems.

Ironically, James Lovelock falls prey to both temptations in his latest book, *The Revenge of Gaia* (2006). Were he not a reputable scientist and were his prognostications not also supported by a host of peer-reviewed research on the rapidly unfolding crisis of human-induced climate change, his book would read like an alarmist science fiction fantasy. While he has done a great service in sounding the alarm, his policy prescriptions reflect an uncanny combination of a profound understanding of Gaian-scale natural systems alongside a disturbing insensitivity to social, ethical, psychological, and even smaller scale ecological questions. Lovelock’s foremost policy recommendation is a rapid and large-scale transition to nuclear energy, ignoring the highly problematic questions waste disposal, weapons proliferation, terrorism, and affordability for developing countries. Some of his technological fixes, like pumping aerosols or launching gigantic mirrors into the atmosphere to reflect incoming solar radiation, are astonishing in their deviation from the precautionary thinking that seems to follow from a thoughtful application of Gaian thinking to human systems. Lovelock’s proposal for a “sustainable retreat” into cities and a large-scale transition from agricultural land-use patterns to forests as carbon sinks is premised on a far-fetched scheme for laboratory-based food production by high-tech chemical firms. In the context of concerns about democracy and global justice Lovelock’s most troubling proposal is for an enforcement body for restoring Gaia’s health that would be controlled by the wealthy countries. Here he exemplifies the worst fears of developing countries:

that the rich minority, who caused the climate catastrophe in the first place, will use their power and wealth to preclude or block their own economic development. Like a good doctor Lovelock has diagnosed the immediate causes of the patient's (Gaia's) fever, but his prescriptions would benefit enormously from a good injection of holistic medicine.

Human systems are now too deeply intertwined with the Earth system for one-sided engineering panaceas and technocratic elitism to solve Gaian-scale problems: ethics, politics and psychology have become integral aspects of the Gaian system. While Gaia's planetary perspective may undercut humanism in the big picture, the pragmatic requirements of moving toward sustainability have the paradoxical effect of highlighting questions of justice and equity. Under the unacknowledged assumption that infinite growth on a finite planet was possible, we could anticipate that economic growth would eventually "trickle down" to everyone. But the recognition is dawning: the overconsumption of the North cannot be globalized without Gaian-scale consequences.

Even so, trends are at odds with this recognition. With 80 percent of the human population, developing countries represent the wave of the future. They are not going to change their development trajectories in the absence of a compelling moral and practical exemplar, nor without financial and technological assistance from the wealthy countries. Justice therefore becomes a matter of "geoecological realism" (Athanasίου and Baer 2002). As Dobson suggests, a return to a weak anthropocentrism is required in order to transform Gaian thinking from either pure science or mystified philosophy into a practical worldview with a strategy for social change (1990). Even if human beings are constituted by bacterial colonies, and even if human history represents only a tiny fragment of Gaia's lifespan, politics and economics are ultimately about people. Gaia's planetary perspective reminds us that we are all in this together. Therefore importing Gaian insights into the social and political arena requires that we pay attention to the needs and aspirations of other people—especially those who represent the wave of the global future.

Being in this together, however, does not mean that our ethical and political dilemmas have an easy Gaian answer. If politics is about who gets what, where, when, and how, then Gaia theory offers little guidance except to say that as a species, our well-being depends on Gaia's well-being. Marcel Wissenburg, who finds in Gaia theory no redeeming political value, offers the following assessment:

“Gaianism” is a modern variant of philosophical determinism. It supposes that everything depends upon everything else, that all of nature is a one whole, that the whole rules itself, and that no part of it is autonomous. Gaianism necessarily leads to one of three courses of action: quietism, totalitarianism, or “anything goes” (1993: 9).

As suggested earlier, quietism and “anything goes” are only options if we are not concerned with the future of our species. Similarly we see that the risk of a Gaian totalitarianism, which would subject all human interests to the nonhuman interest of Gaia, is not so real once we recall that Gaia *per se* is not at risk. What *are* at risk, however, are the relatively comfortable Gaian conditions under which extant human cultures have evolved. Preserving those conditions is a monumental task, one that will demand sincere and focused attention to questions of distributive justice. Gaia theory therefore does not preclude questions of ethics and distributive justice. Indeed, since human systems are themselves living systems and subsystems of Gaia, Gaia theory can elucidate our search for equitable and sustainable modes of governance.

Science, a key source of both legitimation and conceptual models, has always provided grist for the political mill. As Theodore Roszak observes, “It is one of the glories of science that it can give back to the culture from which it grows” (1992: 30). Until recently the scientific metaphors that dominated the modern Western political imagination were drawn from an atomistic, mechanical, and reductionistic worldview. Nation-states, firms, and people were conceived as independent, acquisitive individuals competing for resources, power, and wealth; nature was either a backdrop to our human dramas or a source of wealth to be exploited by industrious humans. No doubt, importing science into political life can have pernicious effects, as it did with social Darwinism. Yet, just as the Enlightenment application of Newtonian science fostered democracy and a particular vision of human progress, so too does Gaia theory bring an emancipatory potential to our current situation.

Gaian concepts of holism, autopoiesis, symbiotic networks, and nonlinearity offer a very different language from mechanistic science and neo-Darwinian biology for understanding human systems. As David Abram suggests, Gaia theory has powerful implications for virtually every realm of human endeavor because it calls for a new way of perceiving our world. Whereas the modern separation of mind and matter upholds “a cultural program of environmental spoilage without

hindrance of ethical restraint, [Gaia theory] shifts the locus of creativity from the human intellect to the enveloping world itself” (Abram 1990: 79). Human creativity, in its most harmonious and sustainable expression, would be a co-evolutionary impulse coherent with and evoking the larger Gaian creativity from which it emanates. If we take seriously the implications of our embeddedness in Gaia, we recognize that “we exist *in* this planet rather than *on* it” and we recover a sense of the Earth as “the forgotten ground of all our thoughts and sensations” (ibid.). In the most literal sense we exist within Gaia because we live within her atmosphere. A Gaian mode of perception calls into radical critique the instrumental, exploitative relationship with the world that informs prevailing human systems. Yet, as Abram remarks, Gaia is not merely an abstract theory; we experience Gaia only in particular places and through the medium of our embodied sensual awareness.

Gaia theory is emerging just as the challenges of globalization are becoming acute. As Vaclav Havel (1997) observes, we experience a sense of helplessness before these challenges because “our civilization has essentially globalized only the surface of our lives.” Our external lives—our communication, transportation, financial exchanges, agriculture, and medicine—are globalized, but our inner lives orbit inside the myopic constraints of egoism and parochial identities. Gaia theory revitalizes our vision of the human condition, calling us back from our isolation, connecting us to the wondrous whole of creation and evoking a greater sense of responsibility. Gaian thinking provides one channel through which our inner identities and modes of perception can develop to meet the challenges of our externally globalized world. Embracing our embeddedness in the whole of creation and “trusting [our] own subjectivity as the principle link with the subjectivity of the world” (Havel 1997: 93), we claim our *responsibility* as *an ability to respond* to planetary challenges.

Gaia theory not only provides new ideas for understanding natural and human systems, it also introduces new concepts and metaphors to the political imagination. Symbols can be powerful sources of motivation, and the image of the Earth as a living, self-regenerating being is an especially powerful one. If affect precedes cognition, as many psychologists claim, then the emotional appeal of Gaia theory may surpass its more practical contributions to sustainability.

Gaia and the Political Imagination

An Internet search for “Gaia theory” yields nearly two million websites, while a search for “Gaia” turns up nearly twenty million. Of the latter, most are about environmentalism and various forms of spirituality, but their topics also include the arts, urban planning, tourism, feminism, and even sporting goods. Gaia is ubiquitous among environmental activists and spiritual seekers. The popular embrace of Gaian imagery in rationalistic and technologically advanced societies may seem surprising. Yet, because Gaia has deep mythopoetic roots, perhaps we should not be so surprised. Gaian thinking represents a return to a cosmology of human embeddedness rather than human exceptionalism. Indeed the philosophy of human exceptionalism—a premise of modernity’s secular faith—is an extreme historical aberration. While the Enlightenment offered tremendous advances in science, technology, and human rights, it was also a great forgetting of different ways of knowing. Gaia theory is consonant with the organic worldview and the Great Chain of Being of premodernity, a worldview that carried with it certain moral taboos about how to treat a living Earth (Merchant 1983).

Gaia theory is cotemporaneous with the dawning recognition of the nexus between globalization and ecology, but also with the rise of feminism and Earth-based spirituality. Gaia theory, by virtue of its name-sake and its content, resonates with strands of both of these movements. Some see in Gaia the rebirth of paganism, others the return of the goddess, and still others an ally in the politics of ecofeminism (Spretnak 1982; Hardin 2004). These approaches to Gaia have wrought intellectual and political fractiousness around questions of essentialism, gender equality, and historical interpretation (Biehl 1991; Merchant 1995). Yet, perhaps more important, these strands of the environmental movement have given Gaia theory “the emotional and moral force it may need to become politically relevant” (Roszak 1992).

Gaia theory at once revives an ancient symbol and endows it with scientific legitimacy, synthesizing empiricism with poetic inspiration. In much the same way that the image of the Earth as seen from space inspires environmentalism, Gaia is a symbol of wholeness, interdependence, and dynamic complexity. For many, Gaia also evokes awe and reverence, restoring a sense of connection to the cosmos that Western culture abandoned when it displaced the medieval conception of the

Great Chain of Being with a mechanistic worldview. By evoking a sense of the sacred, Gaia challenges modernity's utilitarian orientation while simultaneously leaning on its appeal to science. Yet in the context of a rational, technological culture, a simplistic revival of this ancient symbol runs the risk of shallowness. A spiritual symbol is not merely cognitive or sentimental, but rather it must stir us in the deepest parts of our being and reconstitutes our actions and relationships.

Vaclav Havel, former president of the Czech Republic, finds in Gaia theory his inspiration for an alternative discourse of human rights, one that is rooted in a Gaian spirituality rather than secular anthropocentrism. While he upholds the discourse of human rights as an integral part of a new world order, he distances it from the language of the departing era. For Havel (1997: 181), the authority of a world democratic order can only be built on "the revitalized authority of the universe." Gaia theory, he suggests, offers an important source for this revitalized authority because it brings us to "the awareness of being anchored in the Earth and in the universe, the awareness that we are not here alone or for ourselves alone but are an integral part of a higher, mysterious entity.... Only someone who submits to the authority of the universal order of creation, who values the right to be a participant in it, can genuinely value himself and his neighbors, and thus honor their rights as well" (1997: 171–72). Gaia need not only inform questions of environmental governance; it can also inspire a wider context for envisioning human rights.

Thus far our analysis has been largely conceptual, yet the gravity of the situation calls for pragmatic solutions. Where, if anywhere, are the vibrant experiments in Gaian governance? No doubt, small groups of people everywhere are taking up the challenge of revising the purposes and functioning of human systems in light of Gaia. In his recent book, *Blessed Unrest*, Paul Hawken (2007) likens the decentralized global movement for ecological sustainability and socioeconomic justice to Gaia's immune system. While Hawken's geophysiological metaphor may be too literal for some, it is possible that the range of movements he explores, ranging from organic agriculture to fair trade to indigenous rights to recycling, may represent embryonic experiments in Gaian governance.

Perhaps the most radically holistic of these experiments is the global ecovillage movement, which seeks to establish socially and ecologically viable alternatives on the grounded understanding that current systems

cannot last. Ecovillages have taken root in every climate and on every continent; their belief systems are rooted in every major world religion, plus paganism and atheism. Underlying this diversity is a shared commitment to a holistic worldview consistent with systems theory (Litfin, forthcoming). While the movement remains small—comprising several hundred recent communities in industrialized countries and perhaps 15,000 traditional villages with ecovillage design principles in the developing world—it is growing rapidly. If these communities were isolated experiments, disconnected from one another and from larger global processes, they might not be of interest to the study of international politics. Since 1995, however, with the formation of the Global Ecovillage Network (GEN), they have come together to share and disseminate information about sustainable living practices. 1

Both as conceptual underpinning and imaginal metaphor, Gaia circulates widely in the ecovillage movement. There are ecovillages with “Gaia” on several continents, and “whole Earth” images are popular in ecovillages everywhere. In the 1990s Ross and Hildur Jackson, founders of GEN working in Denmark, started three “Gaian” entities: Gaia Trust, which funnels financial assets from investments into seed grants for ecovillages; Gaia Technologies, which develops sustainable technologies, and Gaia Villages, which conducts research on the global ecovillage network. More recently the leadership of GEN has formed a collective—Gaia Education—that has developed a four-week comprehensive course on Ecovillage Design Education. A related venture is Gaia University, which began offering undergraduate and graduate degree programs in 2006. If any icon can be said to elicit universal appeal in the global ecovillage movement, it is Gaia. More important, the basic principles of Gaian governance outlined in this chapter are most evident in the global ecovillage movement: holism, symbiotic networks, participatory democracy, cyclical processes tending toward zero waste, and local experience grounded in planetary awareness.

The growth imperative has become a planetary malady, calling into question the viability of prevailing human systems. As we stand perched between hope and despair in our search for new models of governance, Gaia theory offers good pointers. First, our well-being is utterly contingent on the equilibrium of the larger Gaia system, along with its constitutive symbiotic networks and cyclical processes. Second, Gaian-scale crises can precipitate systemic shifts that dwarf human time frames. Third, we share a common bacterial ancestry with all other species, yet

our capacity for *conscious* autopoiesis seems to be our distinguishing mark. In a time when fear and despair threaten our capacity for positive action, Gaia can serve as a source of faith, humility, and inspiration, reminding us that we are an integral part—and an astonishing result—of an evolutionary process that has been unfolding on our home planet for four billion years. We are the means by which Gaia is growing into self-awareness, and current conditions may be the labor pains of that birth of consciousness.

Gaia enlarges our vision of human purpose beyond the growth imperative, and reorients our action beyond the personal and local onto a planetary spatial and temporal scale. And because Gaia acts locally as well as globally, a Gaian awareness makes us more, not less, intimate with the particular landscapes of our dwelling. Yet, as David Spangler (1993) rightly warns, invocations of Gaia run the risk of becoming empty slogans if we do not allow them to *inhabit* us. If we sincerely want to reinvent our relationship with the Earth, we cannot simply deploy images of Gaia to meet emotional, religious, political, or commercial needs without allowing them to transform us in unexpected and radical ways. Both as scientific theory and cultural image, Gaia has the potential to become an intensely fertile idea for our time.

Notes

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1. Until the last decades of the twentieth century, the environmental consequences of human activity were almost entirely local and regional. Beginning in the 1980s, people became aware of a new category of problems whose causes and effects are both local and planetary. The most obvious of these global environmental problems are global climate change and stratospheric ozone depletion. Others, like deforestation, desertification, and loss of biodiversity are clearly local and regional but are global in their full impact. Losing species, for instance, is a local matter, whereas the current wave of mass extinction is a global crisis for the Earth's biosphere as a whole.

2. This threefold typology is adapted from Madron and Jopling (2003) and Checkland (1981).

3. I am grateful to Stephen Warren, a glaciologist and atmospheric scientist at University of Washington, for pointing out to me this apparent anomaly to Gaia theory. For a comprehensive exploration of Snowball Earth, see <http://www.snowballearth.org>.

4. The discussion in this paragraph is drawn from Madron and Jopling (2003).

5. But neither can Gaia theory rule it out. The question of purpose informs the observation that Gaia theory is a spectrum of ideas, ranging from the axiomatic to the speculative. At one end of the spectrum is the undeniable claim that life has dramatically shaped the Earth system. Moderate views understand Gaia as a self-organizing system or, more radically, a single planetary being. More speculative Gaian thinkers believe that an underlying intelligence is directing the co-evolution of Gaia's physical and living systems.

6. One might argue that economic growth is actually a means to more deeply held values of convenience and efficiency, values that have been so taken for granted that they have only recently received the serious analysis they deserve (see Tierney 1993; Princen 2005). While a focus on growth as a systemic human purpose should not preclude such an analysis, because economic growth is almost universally held as the primary means to these cherished values, it warrants special consideration.

7. An important counterpoint to the growth consensus is being promoted by a new generation of ecological economists who are elaborating upon John Stuart Mill's classic arguments for a steady-state economy. See Daly and Farley 2003 and <http://www.ecoeco.org/>, the website for the International Society for Ecological Economics, which was founded in 1989.

8. Even if Gaia theory were proved false, these political changes would be beneficial. Thus, in terms of human action and well-being, Gaia may be more important as a galvanizing metaphor than as a scientific theory.

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