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Eulah C. Laucks
President
P.O. Box 5012
Santa Barbara, CA.
93150-5012

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- Stephen B. Scharper

This issue of **Reprint Mailing** features *The Gaia Hypothesis: Implications for a Christian Political Theology of the Environment*, an essay by Stephen B. Scharper, from **Cross Currents**, the Journal of the Association for Religion and Intellectual Life, Summer, 1994. Dr. Scharper is faculty lecturer in religious studies at McGill University, Montreal.

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The Gaia theory offers an inspiring vision of planetary interrelatedness. But it may also diminish the human by neglecting our ability to build the world—or destroy it.

Stephen B. Scharper

The Gaia Hypothesis: Implications for a Christian Political Theology of the Environment

> Most of us sense that the Earth is more than a sphere of rock with a thin layer of air, ocean, and life covering the surface. We feel that we belong here, as if this planet were indeed our home. Long ago the Greeks, thinking this way, gave to the Earth the name of Gaia.
>
> —James Lovelock, *The Ages of Gaia*

As competing definitions or understandings of humanity's role in the patterns of ecological sustainability emerge, the place of the human in the world becomes increasingly crucial to explore. The deleterious use of human technology, at the service of industrial capitalism and socialism as well as militarism and consumerism during the modern era, has jeopardized many of the life-systems of the planet. Those interested in a Christian theology of the environment must navigate past the Scylla of an anthropocentric notion of creation in which humanity is seen as the driving, domineering, and superior species, and the Charybdis of a completely nonanthropocentric vision, which would leave to other species the task of cleaning up human environmental destruction, a task for which they appear ill-equipped. A political theology of the environment that utilizes social, economic, and cultural analysis in order to show how human agents may advance a society more in harmony with a gospel

STEPHEN B. SCHARPER is faculty lecturer in religious studies at McGill University, Montreal. Co-author with his wife, Hilary Cunningham, of *The Green Bible* (Orbis, 1993), he is president of the Religious Education Association of the United States and Canada. He wishes to thank Hilary Cunningham and Gregory Baum for their critical comments and suggestions.

vision of a just, peaceful, and sustainable society, thus becomes an important field of cultivation in light of the cultural and intellectual tumult spawned by our ecological insensitivity.

There are, of course, myriad frameworks for looking at the role of the human within the environmental crisis. Ecofeminism, environmental ethics, animal-rights advocacy, deep ecology, green politics, and sustainable development are but a handful. The Gaia hypothesis has become another such framework. Gaia is significant because it fuses scientific insight and religious imagination in a potentially energizing and transformative way, challenging persons across a broad spectrum of disciplines to deal in an integrative fashion with the ecological crisis. Moreover, just as the Copernican revolution forced humanity to alter its self-proclaimed centrality within the universe, so may Gaia hold the potential for a similarly foundational cultural transition.

The Gaia Hypothesis: What Is It?

First articulated by British atmospheric chemist James Lovelock, the Gaia hypothesis, succinctly, suggests that the Earth is a self-regulating, self-sustaining entity, which continually adjusts its environment in order to support life. Though a scientific theory, the Gaia hypothesis has, since its initial articulation in 1969, sparked a swirl of religious, New Age, and philosophical reflection, and challenged certain long-held assumptions about evolution, the importance of the human in determining environmental change, and the relationship between life and the environment.

While serving as a consultant for NASA during the 1960s, Lovelock worked on the Viking project, which assayed to determine whether life existed or was even possible on Mars. To probe these questions, Lovelock examined what sustained life on Earth, and, arguing from his strength as an atmospheric chemist, found his answer in the composition of the Earth's atmosphere, with its delicate balance of oxygen, hydrogen, nitrogen, methane, and traces of other elements.[1] In attempting to answer the question of life's existence on Mars, Lovelock concentrated on the nature of the Earth's atmosphere and argued that "the entire range of living matter on Earth, from whales to viruses, from oaks to algae, could be regarded as constituting a single living entity, capable of manipulating the Earth's atmosphere to suit its overall needs and endowed with faculties and powers far beyond those of its constituent parts" (Lovelock 1979, 9).

Unlike Mars, with an atmosphere composed mainly of carbon dioxide, the Earth, Lovelock concluded, had a dynamic and self-regulating atmosphere. Just like an oven thermostat that maintains a constant temperature, the Earth's atmosphere sustained a stable balance of gases and temperature supportive of life. Because Mars had no suggestion of such a matrix or dynamic atmosphere, Lovelock concluded, it is lifeless.

For Lovelock, life is not surrounded by a passive environment to which it has accustomed itself. Rather, life creates and reshapes its own environment (Margulis and Sagan 1986, 267). Whereas traditional Earth scientists maintain that the Earth's climatic pattern is more geological than biological, and is therefore less robust and more vulnerable to lasting injury, the Gaia thesis purports that the Earth is like a self-regulating animal, and may have organs that are especially important, such as the rain forest and wetlands, which are more vital to the global environment than are other parts of the system (Joseph 1990, 2). In other words, while Gaia may sustain the loss of its "big toe," i.e., the blue whale, it can ill afford to lose its "lungs," i.e., the tropical rain forests.

One could argue that historical antecedents of the Gaia theory reside in the work of G. F. Hegel, Baruch Spinoza, Alfred North Whitehead, and Herbert Spencer, all of whom spoke of nature in terms of an organism. Moreover, Aldo Leopold, deemed the father of the modern conservation movement, viewed the Earth as an "organism" possessing a certain degree of life. As philosopher Anthony Weston also points out, the Gaia theory has a particular relevance to our time, with its general systems theory and interplanetary expeditions (Weston 1987, 219). Evolutionary philosopher Elisabet Sahtouris notes that early in this century, the Russian scientist V. I. Vernadsky viewed the biogeochemistry of the planet as a unity, but his work was not known to Lovelock until after the Gaia thesis was proposed (Sahtouris, "The Gaia Controversy," 1989, 57). Lovelock himself points to the nineteenth-century Scottish scientist James Hutton, the father of geology, as a Gaia forerunner. Hutton spoke of the Earth as a "superorganism," and was one of the first scientists to conceive of the Earth in a systems context (Joseph 1990, 83).

With the help of Lynn Margulis, formerly married to Carl Sagan and a microbiologist at Boston University, Lovelock has refined his thesis, and has been able to reinforce his ideas scientifically with reference to Margulis's research on microorganisms. Known amusingly as "The Wizard of Ooze" owing to her investigation of microbes in swamps, mudflats, and marshes around the world, Margulis maintains that symbiosis and cooperation have been as central to biological evolution as has the competitive conflict for survival that marks Darwinian theory (Joseph 1990, 8).

For Margulis and Sagan, interrelation, rather than competition, is the leitmotif of nature. Like Lovelock, they see the biosphere as "seamless," a grand, integrated, and living organism. They assert that the first bacteria acquired almost all the necessary knowledge about living in an integrated schema. "Life did not take over the globe by combat," they contend, "but by networking" (Margulis and Sagan 1986, 15). Attempting to show the importance of microorganisms for Gaia, Margulis is quick to demonstrate that life on earth has existed on the planet for 3.5 billion years, and that for the first 2 billion, only bacterial microorganisms existed. Mammals, including the human, she goes on to speculate, may exist solely to provide warm homes for such microorganisms (15–18).

For Bunyard and Goldsmith, co-editors of the British journal *The Ecologist: Journal of the Post-Industrial Age,* the Gaia hypothesis suggests that the biosphere, together with the atmospheric environment, constitute a unified natural system. This system is the fruit of organic forces that are highly coordinated by the system itself. Gaia has, in effect, created herself, not in a random manner, but actually in an objective-seeking fashion. This is suggested by the fact that the system is highly stable and can maintain its equilibrium despite internal and external dilemmas. It is actually a "cybernetic" system and thus must be seen as a grand cooperative project. Bunyard and Goldsmith aver that if "Gaia is a single natural system that has created herself in a coordinated and goal-directed way, then Gaia is clearly the unit of evolution, not the individual living thing as neo-Darwinists insist" (Bunyard and Goldsmith 1989, 7). In fact, they speculate, Gaia might be evolution itself. Competition becomes not the primary feature, but a secondary one, and survival of the fittest becomes not a highly individualistic exercise, but a cooperative attempt to weed out certain species for the benefit of the organic commonweal. They insist that now there is more evidence for Gaia as an evolutionary process than there is for neo-Darwinism (1989, 9).[2]

While many environmentalists initially warmed to the Gaia theorists, perceiving them to be natural allies in the eco-struggle, Lovelock and Margulis proved to be reluctant eco-partners. One of the reasons for this distancing lies in the minimal place the human holds in the overall Gaia theory as articulated by Lovelock and Margulis. For the Gaia theory originators, Gaia is a self-regulating system, a "creature," which moves forward into the future regardless of what humans do.

In his first full-blown, popular articulation of his theory, *Gaia: A New Look at Life on Earth,* Lovelock clearly distinguishes himself from mainstream environmentalists. In this imaginatively written work, Lovelock asserts that, contrary to the gloomy forecasts of environmentalists, life on

Earth is robust, hardy, and extremely adaptable, as his analysis of Gaia regulation over the eons intimates. He suggests that large plants and animals are in fact probably less important than are bacteria deep in soils and seabeds. He compares "higher species," e.g., trees and mammals, to glitzy salesmen and show models used to display products; helpful but not essential. He goes as far as to say that even nuclear war would probably not affect Gaia drastically (Lovelock 1979, 40–43).

Pollution, for Lovelock, is as natural as are sea and sand, and is therefore not fulsome, but simply organic, an inevitable byproduct of "life at work." The early biosphere, he argues, must have experienced pollution and the depletion of resources, as we do in the modern world. He notes that the first entity to use zinc beneficially probably also produced mercury as a poisonous waste product. Microorganisms were later produced to break down the mercury, representing perhaps life's most ancient toxic waste disposal system (Lovelock 1979, 27–28).

While conceding that the devastation of modern industrial and technological development may prove "destructive and painful" for our own species, Lovelock doubts that it threatens the life of Gaia as a whole. (The ethical questions surrounding the "pain" for the human species are left unexplored.) In fact, he continues, "the very concept of pollution is anthropocentric and it may even be irrelevant in the Gaian context" (Lovelock 1979, 110). Acknowledging his lack of concern for the place of humanity within the Gaia framework, Lovelock admits that his work "is not primarily about people and livestock and pets; it is about the biosphere and the magic of Mother Earth" (112).

Yet Lovelock, in ascribing a peripheral role for humanity in the Gaian framework, neglects to take into account socio-economic factors of pollution. For example, in discussing Rachel Carson's galvanizing work, *Silent Spring,* which analyzed how DDT and other pesticides were destroying birds and other wildlife, Lovelock asserted that DDT "will probably be more carefully and economically employed in future" (115). (Lovelock's pollyannish perspective is belied by the increased sale of DDT to the Third World after its use was banned in North America.)

Contending that chlorofluorocarbons (CFCs) are also "natural," Lovelock initially dismissed the fears of environmentalists that human-made CFCs resulting from aerosol cans, refrigerators, and air conditioners could have any sizable impact on ozone depletion. Methyl chloride, produced by the seas, he countered, breaks down ozone, as do CFCs, showing that too much ozone is as dangerous as is too little for Gaia (Lovelock 1979, 80; 105). Gaia, he suggests, has the situation under control. Revealingly, however, Lovelock in 1988 conceded that he may have been wrong to oppose those who wanted to legislate a reduction in CFCs, saying that he would now support such legislative restrictions in light of the disturbing evidence of ozone depletion.

Lovelock's dismissal of the important ozone depletion problem, a condition he brought to light through his own research, is a fascinating case study.[3] It highlights how scientists, enthralled by their own theories, can ignore data and minimize mammoth problems which belie their visions. It uncovers the limiting subjectivity of science and its all-too-human dimensions, and demonstrates how science itself is susceptible to social, political, and psychological pressures. Convinced that Gaia was robust and all-controlling, Lovelock had difficulty admitting that the pesky unfeathered bipeds of the human race could significantly injure it.[4]

Philosophical Responses to Gaia

During the 1980s, in addition to sparking debate within the Earth sciences, Gaia served as a galvanizing concept for New Age persons, globalists, and religious figures concerned about the environment. Dean James Morton of the (Episcopal) Cathedral of St. John of the Divine in New York commissioned a Missa Gaia by the eco-music group, the Paul Winter Consort. Gaia Books in London, inspired by Lovelock's vision of the Earth as a single-living organism, prepared *Gaia: An Atlas of Planet Management* (Myers 1984) and *The Gaia Peace Atlas: Survival into the Third Millennium* (Barnaby 1988), with contributions from scientists, church leaders, politicians, population experts, doctors, and environmentalists, all dedicated to preserving the earth from decimation and arguing for the need to reharness human energy from war-making to earth-keeping.[5] Books on Buddhism and Gaia, and myriad reflections on Gaia goddess imagery from an ecofeminist perspective also emerged. These responses, which can be classified as pragmatic, philosophical, and theological, all discuss the role of the human within the Gaia framework, but with varying degrees of success.[6]

There are, at present, few sustained philosophical treatments of the Gaia hypothesis. This is not surprising, given the theory's newness and its scientific focus. Perhaps the philosophic community is waiting for the scientific community's verdict before embarking on an enterprise whose subject matter may prove ephemeral. At any rate, William Irwin Thompson, a philosopher and cultural historian, has made Gaia something of a personal vocation in recent years. Formerly professor at MIT as well as at York University in Toronto, Thompson is presently director of the Lindisfarne Association, a relatively loose-knit concatenation of intellectuals dedicated to engendering what they term a "global culture." Believing that scientific theory is inevitably grounded in a grander philosophical and cultural narrative, Thompson sees in Gaia a scientific yarn that could assist in stitching together a common planetary culture (Thompson 1991, 168).

For Thompson, our common understanding of "nature" is a fiction, a cultural construct influenced by Sierra Club calendars and the bucolic landscapes of eighteenth- and nineteenth-century British painters such as Paul Constable and Thomas Gainsborough. "Nature is the horizon of culture," Thompson avers, and depending on one's context, one's horizon will vary. Lovelock and Margulis help us to see this, he believes. Since in the Gaia framework, the division between animal, vegetable, and mineral is erased, all is "nature," wherever and whenever we look in the Gaian schema. The Gaia theory focuses on Earth processes, which offer insight into how culture operates and how we understand interrelationships among created realities (Thompson 1991, 172–73).

Although briefly involved in New Age currents, in the early eighties Thompson began looking for new avenues to a planetary consciousness and found in Gaia a promising vehicle. Believing that history is inevitably paradoxical, Thompson claims that humanity can never know fully what it is about; for the reasoning mind gains insight into one reality only by casting shadows upon another. The world is thus a structure of unconscious relations, and the relations of a global culture can only be the product of a process seemingly motored by avarice and fear. Gaia thus proffers a concrete cosmology within which these antinomies of history become comprehensible.

What is the role of the human in the Gaian framework? For Thompson, it appears to be simply to sit back and reconcile itself to a process in which we humans may be nothing more than a transitory phase. Rather than managing the planet, we are merely passengers on it, much like ants on a log, Thompson muses, drifting downstream, actively trying to steer that over which they have no control (Thompson 1991, 182). In promoting Lovelock and Margulis through his Lindisfarne Association, Thompson, it appears, is also promoting a limited role for the human in the Gaia process; he appears to be less involved in social action for the future sustainability of the planet than in "planetary consciousness-raising" through which we humans might reconcile ourselves to our microscopic function within the all-embracing Gaia.

Anthony Weston, with the department of philosophy at the State

University of New York at Stony Brook, has a particular interest in environmental ethics, as well as the ethics of technology and medicine. He has explored what he terms the sundry "Forms of Gaian Ethics" (Weston 1987). While claiming that Lovelock's Gaia hypothesis is suggestive, Weston points out that what precisely it "suggests" is nebulous. He notes that Lovelock and Margulis emphasize Gaia's powers, rather than our human responsibilities, and that Lovelock has at times characterized ecologists as "misanthropes" and "Luddites" (220). Weston suggests, however, that there are at least two other ethical approaches one can adopt with regard to Gaia: one more commensurate with contemporary philosophical ethics; the other more akin to "deep ecology."

First, Weston postulates, for the sake of argument, that one could regard Gaia not simply as a living entity but as a person, thereby forcing, not a recasting of our ethical assumptions, but merely an expansion of our understanding of person to include other realities. In this manner, we might challenge, not the ethical centrality of persons, but the presupposition that only humans can be counted as persons (223). While such an approach appeals to a long ethical history of the rights of persons, Weston finds it fulsomely anthropocentric in light of our current ecological situation, and also too facile a maneuver. For Weston, Gaia ultimately is not a person, but a novel locus of values (225).

Secondly, noting the correspondence between deep ecology and the Gaia theory, Weston comments that both view humans merely as just one species among many in the vast sweep of the Earth's processes, offering what deep ecologist Arne Naess calls a "total field" conception. In this understanding, we humans can only comprehend ourselves as elements of a much fuller and older life process. As such we sense the destruction of the Earth; we feel in our bowels, as it were, the destruction of the rain forest. Hence our visceral connection to Gaia helps us empathize and therefore resist the destruction of the planet.

Weston counters that such an approach presupposes a level of communication and identification among the Earth's species that even the Gaia theorists do not detect. The Gaia metaphor can be stretched too far to claim an intelligence for Gaia, an intelligence which simply may not exist (228). Weston also argues that such an approach devalues nonanimate matter, such as rocks and hills, and he worries about the environmental costs of such a devaluation. "Persons are not the only things that have value," he notes, "and neither is life itself" (228). For Weston, the answer lies not in substituting Gaia for another ethical framework, but in assimilating Gaia within the already existing variety of environmental values. Gaia doesn't necessarily have a single meaning or interpretation, but in its varied meanings, it could help point us toward the interrelationship of various value systems.

Theological Responses to Gaia

Douglas John Hall: Reintegrating Creation. In Amsterdam during May 1987, James Lovelock and Canadian Protestant theologian Douglas Hall, along with a handful of others, conferred for about a week to discuss the ecological crisis. Invited by the World Council of Churches as a follow-up to the call from Vancouver in 1983 to engage the churches in a commitment to "justice, peace, and the integrity of creation," the British scientist and the Canadian theologian emerged from their huddle with a discussion paper entitled "Reintegrating God's Creation." Intriguingly, Hall's paper does not deal with the Gaia hypothesis directly. Rather, he discusses the nature of the term "integrity of creation" and the human role in it in the light of our destructive ecological habits.

As a Christian theologian, Hall professes that he cannot, as some deep ecologists do, support those who advocate a human retreat from intervention in the world. Rather, he proposes a contextual and strategic theology, one which walks the narrow path between what he terms "prometheanism" (a destructive glorification of human power) and passivity (Hall 1987, 32).

Hall offers three roles for the Christian: steward (which he further develops in a book by the same title), priest, and poet. The steward enacts solidarity, accountability, and responsibility — all providing caring leadership. The priest represents God before the "creature" and represents the "creature" before God, acting as an empathetic and compassionate mediator in reintegrating a world broken by environmental despoliation. The poet, as rooted in the prophetic tradition of ancient Israel, celebrates the creaturely joys and visceral pain of being part of the created world, speaking not only for the human, but also for other creatures that inhabit the universe (34–36). For Hall, then, the role of the human is central to an environmental theology. But, although he was metaphorically in dialogue with Gaia during his conversations with Lovelock, he does not use Gaia as an overarching paradigm. In fact, neither he nor Lovelock ever refers to it in their working paper.

Rosemary Radford Ruether: Gaia and God. By far the most substantial work by a Christian theologian on some of the implications of the Gaia hypothesis, Ruether's *Gaia and God: An Ecofeminist Theology of Earth-Healing* vividly illustrates how the environmental crisis is forcing a major reexamination of the underpinnings of Western culture. From the thought of ancient Babylonian, Mesopotamian, Hebraic, Greco-Roman, early Christian, and Native American cultures, Ruether sifts for golden nuggets that might help us eschew ecological suicide. Undergirding Ruether's project is an examination of the underside of Western civilization's treatment of women and nature, showing how deeply embedded such destruction, domination, and deceit are in our culture.

While providing a helpful and terse overview of the Gaia hypothesis, Ruether does not tease out its ethical and theological ramifications directly. She notes that it has become an instrument of ecofeminists who find in an earth goddess a way of avoiding a pernicious male deity but sagely cautions against such an interchangeable approach to God.

Dedicated to eco-justice, Ruether is critical of militarism, sexism, consumerism, and systemic poverty and injustice, all of which constitute threats to organic life. Assuming that the earth forms a living system and averring that we humans are an "inextricable part" of that system, she opposes the Western conception of nature that is both nonhuman and nondivine (5) and claims that our ethical standards should reflect the interdependency proposed by Gaia. Lynn Margulis and James Lovelock have given us a new vision of the Earth in which cooperation is as important as competition. "Human ethics should be a more refined and conscious version of the natural interdependency, mandating humans to imagine and feel the suffering of others, and to find ways in which interrelation becomes cooperative and mutually life-enhancing for both sides" (57). For Ruether, both the Gaia theory of Lovelock and Margulis and the new cosmology of cultural historian Thomas Berry and mathematician Brian Swimme counter the Cartesian mechanistic view of nature, and help dissolve traditional dualisms that have had such deleterious consequences for both women and nature.

In this well-researched, encyclopedic study, Ruether accepts the emerging scientific stories, such as Gaia and the universe story, and unpacks their ethical implications. Outlining the human agenda in light of such scientific insights, she rehearses ideas that others in the ecological movement have also advanced: bioregionalism, reduced population, organic farming, an end to militarism and destructive technologies, global economic justice, communities of solidarity and alternative lifestyles, and an ability to listen to nature (a chief feature of Thomas Berry's thought) (265–72). Somewhat surprisingly, however, she does not squarely address the theological questions posed by Gaia.

Thomas Berry: Gaia in a Cosmological Context. For Thomas Berry, a Passionist priest and "geologian," the wellsprings of the Gaia theory are part of a continuum through which a new sense of the sacredness of the cosmos is emanating from modern science. With his own work deeply influenced by contemporary physics and astronomy, as evidenced by his recent collaboration with mathematician Brian Swimme on *The Universe Story,* Berry argues that theories of relativity, quantum physics, the uncertainly principle of Heisenberg, the sense of a self-organizing universe, and the more recent chaos theories have gotten us beyond Cartesian mechanistic thinking and into an interrelated understanding of our world. Gaia is a part of these developments.

In his article, "The Gaia Theory: Its Religious Implications," Berry claims that we need a Gaia theory, but we also need a cosmological context in which to place it. For Berry, the universe is the primary revelatory event: knowing and relating the story of the universe's unfolding, from the Big Bang or "primordial flaring forth" some 15 billion years ago to the present, becomes of primary religious significance. The human is now in the driver's seat of geological evolution, moving us out of the Cenozoic Era into either the "Technozoic" era, in which we continue to plunder the planet, or the "Ecozoic" era, in which we live within its functioning. For Berry, the choice is ours. Unlike Lovelock, Berry ascribes a momentous role to the human. Not only are we now the architects of evolutionary history, but also the beings in whom the universe becomes self-conscious, and through whom it is able to reflect upon itself. Such a massive role for the human in the cosmos has caused some to critique Berry's thought for its potentially dangerous anthropocentrism.

In essence, Berry uses the Gaia theory as a springboard for his own reflections on the mystical dimensions of the cosmos. More often than not, his religious views are more connected to the views of animistic or shamanistic faiths than to Christian tradition. As several commentators have pointed out, Berry's cosmological vision is rarely related to Christian categories, and his universal story lacks a coherent plan of social action, a point made by Jon Sobrino, Paul Knitter, and Gregory Baum.

A Christian Political Theology of the Environment

The Gaia theory raises a host of questions for those wishing to engage in a political theology of the environment. Many of these questions revolve around the role of the human in the Gaian schema. Are we humans mere blips, a short-lived, destructive species with little lasting impact on the planet, as Margulis, Lovelock, and William Irwin Thompson propose? Should we assimilate Gaia into a preexisting set of environmental values, reconciling ourselves to a pluriform ethical schema, as Anthony Weston suggests? Shall we take the cooperative model advanced by Gaia as a blueprint for an ethic of earth-healing, as advanced by Rosemary Ruether? Are we called to be stewards, priests, and poets in light of the ecological crisis, as proffered by Douglas John Hall? Or are we the self-consciousness of the universe, as postulated by Thomas Berry?

Beyond these questions, however, are pressing social justice issues and the concerns of a political theology of the environment. Is Gaia useful for a Christian social justice perspective on environmental destruction? Does Gaia provide a suitable framework for articulating the role of the human within such a social justice perspective? From the perspective of social justice the world is a political economy, a structure of power relationships in which there are "haves" and "have-nots." Can Gaia be understood as a political economy in which the poor nations, particularly of the South, bear the brunt of ecological destruction? A social justice perspective posits a preferential option for the poor. Is such an option viable within a Gaian framework? Lastly, a social justice perspective ascribes special responsibilities to persons and governments of Northern nations in effecting a just global community. Can Gaia sharpen our insight into North-South differences and help develop a model of action which takes into account these differences?

Gaia *is* helpful for a social justice perspective in several ways. As Lovelock himself comments, Gaia helps us to look at the world, not as a mechanistic Cartesian engine, but as an interrelated, vital, and cooperative enterprise in which interdependency rather than competition is the hallmark of life, revealing at the same time that the context in which human praxis is waged is also one of critical and unavoidable interconnectedness. Adding to the key insight of European political theology, Third World liberation theology, and feminist theology that a transformative theology must be contextual, Gaia forces us to expand our notion of context beyond social, economic, and political dimensions to include a critical planetary dimension.

Gaia has, however, serious limitations for a social justice perspective. It is ahistorical — agnostic in terms of human history. It lacks an analysis of existing power structures as well as historical patterns of inequality in which political praxis occurs. Moreover, it underestimates the destructive potency of the human species. By viewing humans as simply one life form among many, and a largely inessential one at that, Gaia woefully undervalues the human ability to destroy the life systems of the planet. Hence Gaia ultimately lacks a framework for critically assessing and challenging exploitative human activity.

Perhaps the ultimate value of Gaia lies in the fact that it prompts us to envisage our world in a novel, challenging, and inspirational way, as the burgeoning literature around it attests. The question as to whether or not the theory is "true" is, in the end, secondary to whether it helps us link justice and peace to the integrity of all creation. Gaia, I believe, can help us forge this still fragile but necessary nexus, as long as we remain aware of both its evocative power and its grave limitations.

Notes

1. Lovelock describes the provenance of the Gaia hypothesis in *Gaia: A New Look at Life on Earth* (New York: Oxford University Press, 1979), 1–24. Though Lovelock first presented the Gaia hypothesis at a 1969 scientific conference at Princeton, he did not publish his idea until 1972 in a letter to *Atmospheric Environment.*

2. In 1988, the Gaia hypothesis was subjected to its most sustained scientific scrutiny. In March of that year, the American Geophysical Union, the international association of geologists and geochemists, dedicated the entire week of its biannual Chapman conference to Gaia. Leading scientists from around the globe gathered to debate the premise and details of the Lovelock and Margulis findings. While it is hard to determine whether the majority of scientific skeptics were converted, the Gaia hypothesis has, since the conference, increasingly been called the Gaia *theory* in scientific circles (Sahtouris, "The Gaia Controversy," 1989, 55). Lawrence Joseph, the colorful journalistic chronicler of Gaia, observes that since the 1988 conference, about 100 scientific and technical articles have been written on the Gaia theory. Many of these articles seem less concerned with the verity of the theory than with its leading authors to novel questions and approaches in their respective specializations, some of which challenge the fundamental orientation of their disciplines (Joseph 1988, 13).

3. Ironically, it was Lovelock's own research in the Arctic using his important invention, the electron capture detector, that made the discovery of the first "ozone hole" possible. With the ability to detect freon and other halogenated compounds in the air, this device helped trigger ecological concerns over ozone depletion and ultraviolet radiation-engendered cancers (Margulis and Sagan 1984, 74).

4. On the ecological sensitivity barometer, Lynn Margulis fares little better than does Lovelock, partially owing to the minuscule role she also ascribes to the human within Gaia. As suggested earlier, because animals are "Johnny-come-latelys" to Gaia, Margulis intimates that animals, including humans, are merely delivery systems or incubators for the microorganisms that really control Gaia functioning (Margulis and Sagan 1984, 68). Margulis and Sagan claim that Gaia can still be seen primarily as a microbial production and that humans are relegated to "a tiny and unessential part of the Gaian system" (Margulis and Sagan 1984, 71). Not to deny completely a role for the human, Margulis proposes that humanity has the potential to be an anxious "early warning system" for Gaia, detecting how Gaia might be injured by various human activities or other changes. Moreover, we humans might be able to colonize other planets and deflect oncoming asteroids, thereby protecting Gaia. Such a diminutive role, she maintains, should not make us "depressed." Rather, "we should rejoice in the new truths of our essential

belonging, our relative unimportance, and our complete dependence upon a biosphere which has always had a life entirely its own" (Margulis and Sagan 1984, 73).

5. Interestingly, such volumes don't engage or challenge the Gaia hypothesis *per se;* they in effect use it as a springboard to show how humans must tread more respectfully on the planet. For a delineation of some of these Gaia-inspired religious and New Age developments, see Joseph 1988, 66–71.

6. For a pragmatic response to Gaia see Kit Pedler: *The Quest for Gaia,* 1991. Pedler argues that the Gaia theory is a new revolutionary force that has been unleashed on the world. Technologists, he argues, have made the egregious blunder of assuming that nature was passive and neutral, a vast piece of blank paper on which they could draw their dreams. Instead, Pedler contends, the life process that surrounds us is characterized by an intelligence capable of self-rectification and regulation, an insight provided by Lovelock (Pedler 1991, 10). Unlike the Gaia theory originators, Pedler ascribes a hefty role to the human in living within Gaia. Pedler contends that we must reorient ourselves to live in harmony with Gaia, otherwise we face extinction. For Pedler, we are in Gaia. There is no way to extricate ourselves from it; we are neither above nor superior to it. He suggests that no sustainable future for humanity can be attained unless human concerns are placed second to Gaian concerns.

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ECOLOGICAL BRINKMANSHIP

The Genetic Engineering of Microbes and Plants

Liebe F. Cavalieri

Today we are exposed to a continuous stream of scientific discoveries that are unveiling all kinds of secrets regarding the structure of matter and the basic mechanisms of life. One of these "breakthroughs" has given us the Flavr Savr tomato. This and other genetic engineering feats are the subject of this essay. What else can genetic engineering do? Do we need it? Are there any side effects? Can the same ends be accomplished in other ways? These questions need to be answered before we commit an important segment of the economy to a pathway that could lead to a fiasco from which, like nuclear power, it is hard to escape.

Genetic engineering is a new means of genetic modification quite unlike the old type, where the aphorism "like begets like" applies: A rose gives rise to a rose. It has ushered in a new era of manipulative biology, making it possible to create truly novel organisms by combining the hereditary determinants, or genes, of unrelated organisms with no holds barred. Cow genes have been inserted into bacteria; human genes have been inserted into mice; flounder genes have been inserted into tomatoes; chicken genes have been inserted into potatoes; virtually all types of combinations have been tried already. Such heritable manipulations reach in an unknown fashion indefinitely into the future. This radically new power has implications not only for the occupants of this planet but for the planet itself. Although genetic engineering can be applied to any organism, I will focus on its use for the modification of microbes and plants. Once released into the environment, these organisms are most difficult to control, and they sometimes act in unexpected ways. But first, a reminder of an earlier breakthrough that changed the course of humankind.

Liebe F. Cavalieri is environmental science research professor at Purchase College of the State University of New York. He has written The Double-Edged Helix: Genetic Engineering in the Real World *(Praeger, 1985).*

Some seventy years ago, physicists were trying to decipher the ultimate structure of matter by studying the nature and strength of the force that holds the atomic nucleus together. They were eminently successful. We have known the result of that research and lived with it for more than five decades. Today, scientists studying the cell nucleus have developed a new and equally portentous biological technology capable of altering the structure of living things. Might not the long-term effects of genetic engineering prove to be even more far-reaching than those of nuclear fission?

Both of these discoveries created new paradigms, replacing the old rules with entirely new ones.[1] Having been around at the dawn of genetic engineering, I feel compelled to place these physical and biological discoveries side by side, to compare the motivation of the scientists, examining then their innermost feelings and their excitement during the time of discovery, and, more important, to examine the connection between the science and the ultimate social and moral costs of its application in the real world. I wonder whether we are fully cognizant of how deeply the nuclear threat has permeated our lives: the way it has transformed the global scene into a complex geopolitical and social structure that has changed the meaning of existence at all levels. Will this experience help us deal with genetic engineering, which is still in a gestation mode, readying to offer its wares?

1. See Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970).

THE OLD AND THE NEW

When physicists were learning about the nature of matter, they were doing "pure" science. Very little was known except that two fundamental units made up the nucleus of the atom. The basic question was this: What is the nature of the force that keeps the nucleus from flying apart? In those early days, there was no thought of trying to capture and somehow use this energy. Indeed, Lord Ernest Rutherford, the eminent British theoretical physicist, said at the time, "We cannot control atomic energy to an extent which would be of any value commercially, and I believe we are not likely to be able to do so." It was during Christmas 1938 when the news reached the physics community: Einstein's theory had been proved; the uranium atom had been split with the concomitant release of a vast amount of energy. Following the initial euphoria, sober reflection set in when physicists recognized that the next step was obvious: the atomic bomb.

Insidiously, the power to create the bomb, originally in the hands of researchers, generated a new kind of power. The military stepped in, superseding any possibility of decision making by the physicists. Those who had created the technology and urged caution in its use were cast aside like so many sophisticated technicians. This was the beginning of an era in which science came to be the handmaiden of technology, by now a hardened reality. What can be done will surely be done, willy-nilly.

Molecular biologists in the early

Molecular biologists in the early 1940s were driven by scientific curiosity to try to find answers to basic questions about the way genes work.

Crops can be made tolerant to herbicides by inserting genes into them that will nullify the effects of the herbicide.

1940s (at the same time, ironically, that the first atomic bomb was detonated) were also driven by scientific curiosity to try to find answers to basic questions about the way genes work. After painstaking effort over several decades, the researchers discovered a new technique that provided a way of joining genes in the test tube and reinserting them into an organism. It was soon evident that the method could be used to create organisms with combinations of characteristics that could not arise by natural means, resulting from novel gene combinations.

This method, sometimes called recombinant DNA technology because the genes are made of DNA, was a breakthrough of momentous proportions, sending shock waves throughout the community of molecular biologists. The old, classical rules, which restricted mating and genetic exchange to members of a species, didn't apply anymore. Elated scientists realized that the discovery would lead to entirely new and uncharted areas. Because the technology could rapidly create genetic arrangements resembling changes that might occur naturally over eons through evolution, Nobelist David Baltimore proclaimed that "we can outdo evolution."

At another level, entrepreneurs foresaw marketable products. Despite Nobelist Walter Gilbert's insistence that "this time scientists will be in charge," large corporations are playing the power role that the military occupied in the case of nuclear energy. Corporate giants have already begun to get into the act in all areas of biotechnology, paving the way for a complete takeover of the industry. The bottom line is fast becoming the only basis for decisions.

THE CREATION OF A GENETICALLY ENGINEERED MICROBE

Microbial pesticides have come to the forefront in the last several years, following the advent of recombinant DNA technology. The expectation is that they will replace chemical pesticides, which are becoming increasingly ineffective and have been shown to be injurious both to human health and to various ecosystems. A typical example now under development is a bacterium that lives inside the corn plant, called *Clavibacter xyli cynodontis* (abbreviated Cxc). Cxc has been converted to a microbial pesticide by inserting into it the gene for an insect toxin from another bacterium (*Bacillus thuringiensis*, often referred to simply as Bt). Corn seeds are impregnated with the genetically engineered Cxc, and, as the corn plant develops, the bacteria spread throughout the plant. When a common caterpillar, the European corn borer, feeds on the corn plant, it ingests the genetically engineered Cxc as it tunnels through the plant and is killed or incapacitated.

There are problems, however. First, the corn borer will eventually develop resistance to the Bt toxin, rendering the genetically engineered microbe progressively less effective. Whether the lethal blow is delivered by a genetically engineered Cxc or by a chemical spray is irrelevant: *Development of resistance is a constant, unsolvable problem that stems from the basic nature of insect populations.* The best that can be done is to delay its onset.

Second, my own research shows that the use of microbial pesticides, either natural or genetically engineered, can have unexpected results.[2] In a case study I find that, under certain field conditions, the European corn borer population, in the presence of a microbial pesticide, can oscillate wildly from year to year, sometimes reaching population peaks far higher than if no pesticide had been applied and therefore doing more damage.

The Union of Concerned Scientists, the Environmental Defense Fund, and the National Wildlife Federation have been critical of the small-scale field tests that have been carried out by the company (Crop Genetics International) that is developing Cxc as a biopesticide. They are concerned about the natural and mechanical dispersal of Cxc in the field. The presence of the agent in corn plant residues and soil, which come in contact with other insects, has not been adequately investigated; nor has the possibility of transfer of the toxin gene from Cxc to related bacteria in the environment (genetic exchange does occur between related species). The killing of nontarget insects, many of which are beneficial, could cause significant ecological disturbances.

GENETICALLY ENGINEERED CROPS

In the genetic engineering of plants, herbicide tolerance is currently the holy grail.[3] In general, herbicides kill food crops as well as weeds. A crop with herbicide tolerance would be resistant to weed killers in quantities considerably larger than are now used. The crops survive, all the weeds die, and the herbicide manufacturers make a killing. Incidentally, the developers of herbicide-tolerant crop seeds include Monsanto, DuPont, Rhone-Poulenc, and Hoechst: All are major producers of herbicides. This is part of a new agricultural trend in which seeds and chemicals are controlled by one industry, allowing large corporations to sell both as an interdependent package. Of the world's seven leading pesticide firms, five are also ranked among the world's twenty-five largest seed companies. This toehold on agribusiness has monopolistic tendencies, to say the least.

Crops can be made tolerant to herbicides by inserting genes into them that will nullify the effects of the herbicide. The added genes could act by breaking down the herbicide or reducing the plant's sensitivity to it. An example of the former is the herbicide-tolerant cotton created by Calgene, containing a gene for an enzyme that degrades the herbicide Bromoxynil. Alternatively, a gene could be inserted that produces an essential cell component, already present, that is

2. L.F. Cavalieri and H. Kocak, *Journal of Theoretical Biology* 169 (1994): 179–87.

3. J. Rissler and M. Mellon, *Perils amidst the Promise*, Union of Concerned Scientists (1993).

Food derived from genetically engineered plants should be identified as such and should be viewed with caution.

destroyed by the herbicide, so that the plant will produce more of that component than the herbicide can destroy. Among the crops that have been rendered herbicide-tolerant are corn, soybeans, cotton, sugar beet, peanuts, wheat, sorghum, and tobacco.

The use of these genetically engineered (transgenic), herbicide-tolerant plants is not risk free. There is the possibility that the transgenic crop itself might become a new weed. For example, the inserted gene may work by causing enhancement of seed germination in early spring, so the crop plant gets a jump on later-germinating weeds. But it will also compete with other, slower-germinating crops that may be planted subsequently in the same fields, in effect acting as a weed. New weeds could also arise if the engineered plant pollinates related wild plants. A number of crop plants have weedy relatives that could thereby become resistant to the herbicide.

There is also the inevitable problem of resistance, just as there is with microbial pesticides. Weeds eventually develop resistance to herbicides as a result of their continual application. Under these circumstances, more and more herbicide must be applied; finally, the herbicide-tolerant strategy breaks down when both the crop plant and the weeds have become resistant to very high amounts. The harmful effects on human health of weed-killer residues in food crops and water escalate in parallel.

Herbicides are, in general, toxic substances. Anything that kills one form of life is likely to have an effect of some kind on other forms. For example, the effects on U.S. troops of Agent Orange, the herbicide used in the Vietnam War, are well known. Related chlorphenoxy chemicals, still in use in the United States, have been shown to cause nerve damage and to increase the risk of lymphatic cancer. Another type of herbicide, represented by paraquat, has been implicated as a possible cause of Parkinson's disease. Other herbicide types can cause birth defects, nerve damage, acute poisoning, headaches, and rashes.

Not only humans are at risk. Ecosystems are vulnerable because wildlife habitats such as bird sanctuaries are sensitive to foreign chemicals, which invade them through contaminated groundwater.

The corporations that are developing herbicide-tolerant plants maintained early on that the plants would reduce herbicide use and hence decrease risks to human health, although chemicals would still have to be used. They argued that plants were going to be made tolerant to new, "benign" pesticides. From a physiological standpoint, however, "benign" is a nebulous concept. It could mean that, for example, no rash or headache is evident after exposure. But so-called silent genetic mutations might occur, showing no clinical symptoms for years but eventually resulting in cancer. "No observable effects" is not a reassuring statement in this context.

Moreover, not all the resistances to which tolerance is being developed are "benign." Included are such war-horses as 2,4-D, an agent known to cause cancer. A case in point is the cotton engineered to be tolerant to Bromoxynil, which is classified by the Environmental Protection Agency as a developmental agent, giving rise to birth defects in animals. Bromoxynil-tolerant cotton presents a clear and present danger. Cottonseed oil is widely used in prepared food, but it is not controlled by the Food and Drug Administration (FDA) because cotton is not primarily a food crop. Consequently, the herbicides used on it can slip without notice into our food, exposing us to chemicals known to be dangerous.

Yet another sort of problem can arise in any genetically engineered plant or other organism. The foreign gene that is inserted may alter the metabolism of the modified organism in unforeseen ways. A cliché applies inside the cell: Everything is connected to everything else. A single change may have many consequences in addition to the one intended. Such pleiotropic effects are hard to predict because they depend not only on the inserted gene but also on its location in the resident DNA and on the actions of other genes. In food crops, genetic engineering can pose a number of potential risks to consumers. The FDA has published the following statements in the *Federal Register*:

- "Toxicants ordinarily produced at low levels in a plant may be produced at high levels . . . as a result of genetic engineering."
- "Another unintended consequence of genetic modification of a crop may be a significant alteration in levels of important nutrients. In addition, changes may occur in bioavailability of nutrient due to changes in form of the nutrient or the presence of increased levels of other constituents that affect absorption or metabolism of nutrients."
- "It is possible to introduce a gene for a protein that differs significantly in structure or function, or to modify a carbohydrate, fat or oil, such that it differs significantly in composition from such substances currently found in food."
- "Proteins transferred from one food source to another might confer on food from the host [recipient] plant the allergenic properties of food from the donor plant. The sensitive population [those who are allergic to the substance] is ordinarily able to identify and avoid offending food. However, if the allergens [allergy-causing substances] were moved into a variety of a plant species that never before produced that allergen, the susceptible population would not know to avoid food from the variety."

For a sensitive individual, the result could be fatal. The lesson is that food derived from genetically engineered plants should be identified as such and should be viewed with caution. Before it is placed on the market, we need to be sure that it has been thoroughly evaluated in terms of nutritional value, possible low-level toxicity, and possible allergic threats.

TESTING AND ENVIRONMENTAL RELEASE OF GENETICALLY ENGINEERED PLANTS AND MICROBIAL PESTICIDES

Genetically engineered plants and microbial pesticides are meant to be used in the open environment, where they come in contact with and may possibly disrupt ecological systems. The Ecological Society of America, whose members try to understand the web of complex interactions among the various living organisms

Although the probability of ecological disruption may be low, there is abundant evidence that the consequences can be very serious when an exotic species is introduced into the environment.

in nature, argues in a seminal position paper that although the genetic manipulation carried out in the laboratory may be precise and specific, the ultimate effect of the manipulation on the interrelationships among living organisms (insects, plants, birds, and so forth) is unpredictable.[4] I have already mentioned the possible creation of new weeds from engineered crops and the possible killing of nontarget predators by microbial pesticides. Removal of a predator allows unabated growth of its prey, which might be a destructive insect pest that was previously held at a low level. This is a particular problem in the case of crop plants engineered to kill an insect pest directly. Nontarget insects are likely to come in contact with these plants. The killing of nontarget insects is serious because 99 percent of all insects are beneficial. A host of other ecologically negative "side effects" are possible.

The proponents sometimes argue that genetically engineered organisms are likely to be weaker than their natural counterparts and will, therefore, not survive for long on their own—and by implication will cause no ecological disturbance. But you can't have it both ways. If the organism is designed to do something, it has to survive at least long enough to get the job done, and in that survival period it could have negative and possibly permanent effects. Serious concerns have arisen about a new transgenic, virus-resistant squash engineered by Upjohn. The squash contains genetic material from four plant viruses. These genes might recombine with other viruses that infect the crop, thereby producing new viruses that would present new kinds of crop threats. Once a new virus is released, the host plant's survival is immaterial.

Philip Regal, professor of ecology at the University of Minnesota, states, "There is no evidence that every artificial modification by recombinant DNA techniques will necessarily attenuate [an organism's] ability to function in nature." Ecologists further argue that although the probability of ecological disruption may be low, there is abundant evidence that the consequences can be very serious when an exotic species is introduced into the environment. Witness the kudzu vine, a foreign weed that invaded the South and cannot be eradicated, which is doing incalculable damage by overgrowing any vegetation in its path. Or the gypsy moth, capable of defoliating and destroying entire forests. Or the Medfly, or Dutch elm disease, to name a few prominent cases.

Small-scale field trials, which are the first step toward commercialization, are designed to test for efficacy of the agent in an isolated area carefully separated from other areas that might be vulnerable to any negative effects. Therefore, these tests are virtually useless from an ecological point of view because the total environment is excluded from the tests by design. They do not take into account the variable environmental conditions in which large-scale commercial applications are contemplated. Success in small-scale field trials does not provide, therefore, a basis for predictability when the scale of application is a hundred or thousand times larger and application occurs in many diverse environments. Moreover, the tests, which are carried out over limited periods, can say little or nothing about long-term efficacy or side effects.

A BIOTECHNOLOGY SURPRISE

In 1989, the *New England Journal of Medicine* reported illnesses and deaths caused by an amino acid, tryptophan, that was used as a food supplement. Eventually, some five thousand people became ill and thirty died. The product had been made by the Japanese firm Showa Denko, using genetic engineering techniques. Analyses revealed the product to be 99.6 percent pure, the impurity being a dimer, that is, two molecules of tryptophan joined together. No one had anticipated that a minor impurity might be toxic.

WHAT IS THE REAL PROBLEM?

There is a myth going around that genetic engineering of food crops will solve the problem of world hunger. In fact, most of the genetic engineering now being practiced for commercial purposes does not aim in that direction. Food crops such as cowpeas and cassava, which are most commonly used by the 1.1 billion undernourished people of the world, are largely ignored. The seeds of engineered crop varieties are expensive, and the crops require heavy subsidies in the form of fertilizers, pesticides, and irrigation. Poor farmers in underdeveloped countries will not be able to afford them. The real factor that limits the world's food supply is the loss of cropland through overexploitation, desertification, soil erosion, and conversion to habitable space. Diminishing agricultural land, coupled with population growth and inequitable trade and land-use practices, is responsible for world hunger.

Far more important than the addition or removal of genes from a handful of species is the preservation of the vast biodiversity that already exists. The destruction of centers of biodiversity and the replacement of primitive crop varieties, some of which have been nurtured for perhaps ten thousand years by native peoples, are causing species extinction at a rapidly accelerating rate. We are destroying the repositories of irreplaceable raw genetic material, the stuff of evolution necessary for improvement of crops.

When the corn blight destroyed a major portion of the corn crop in the southwestern United States in 1970, agronomists looked for wild varieties with corrective genes that could be introduced into the afflicted varieties. It seems to me that we are morally obligated to preserve the biodiversity of the earth. Biodiversity, unlike other natural resources, is a very fragile entity, qualitatively different from aquifers, fisheries, timber forests, and the ozone layer. All these resources can be renewed, or somehow repaired, albeit with the passage of much time and effort. But the loss of biodiversity is forever.

We often hear the phrase "we are borrowing the earth and its resources from our children and their children." Should we be concerned with the effects of present-day genetic-engineering decisions on future generations? In our quest

4. "The Planned Introduction of Genetically Engineered Organisms: Ecological Considerations and Recommendations," *Ecology* 70 (1989): 298–314.

To achieve ecological sanity, I believe that a good starting point would be a workable policy for sustainable agriculture.

to find solutions to our current pressing problems, we are all too anxious to resort to technological fixes that provide temporary solutions but do not take into account the complexity of natural systems. Is it right to divert our creativity to serve the short term and the privileged while ignoring possible long-term damage?

To achieve ecological sanity, I believe that a good starting point would be a workable policy for sustainable agriculture. There already have been successful experiments using alternative agricultural practices to replace chemicals.

A recent report of the National Research Council of the National Academy of Sciences emphasizes the development and use of alternative farming systems as a means of increasing productivity and decreasing environmental damage.[5] Greater diversity of crops will play a role in the development of a sustainable agriculture; the importance of new strains of today's major crops, whether classically bred or genetically engineered, will recede. Practices such as intercropping, cultivation of natural predators, animal/plant integration, crop rotation, constant monitoring for pests, and pheromone trapping will reduce the need for chemical fertilizers and pesticides. The National Academy of Sciences estimates that pesticide use could be reduced 75 percent in ten years without loss of productivity. More research is needed on benign methods like these. Sustainable agriculture is an essential goal for a viable future. It's time to put the emphasis on the real means that will get us there. ■

5. National Research Council, *Alternative Agriculture*, National Academy of Sciences (1989).

The following is an excerpt from Kenneth L. Woodward's comment in **Newsweek** (7/18/94) on Vaclav Havel's Independence Day speech in Philadelphia, where he was awarded the Liberty Medal:

"Havel warns it is not enough to create new international political organizations or to insist that 'the basis of a new world order must be universal respect for human rights.' Such imperatives are meaningless, he argues, unless grounded in an environment that respects a sacred dimension: 'The miracle of Being, the miracle of the universe and the miracle of our own existence .' Havel finds the rudiments for such a vision in postmodern science as well as in ancient religions. He cites two fashionable ideas: the notion that human beings 'are mysteriously connected to the universe . . . just as the entire evolution of the universe is mirrored in us' and the 'Gaia hypothesis,' which postulates that the Earth is a 'mega-organism' on which all of us depend. Taken together, these perceptions remind us that 'we are not here alone nor for ourselves alone, but that we are an integral part of higher, mysterious entities against whom it is not advisable to blaspheme.' "

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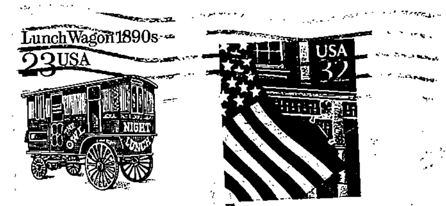

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P. O. Box 5012, Santa Barbara, CA. 93150-5012

Mary Laucks
8708 NE. 20th St.
Bellevue, WA. 98004