

Now a new way of understanding values is required. We are returning to a more traditional context of story as our source of understanding and value. It is somewhat fascinating to realize that the final achievement of our scientific inquiry into the structure and functioning of the universe as evolutionary process is much closer to the narrative mode of explanation given in the Bible than it is to the later, more philosophical mode of Christian explanation provided in our theologies.

It is of utmost importance that succeeding generations become aware of the larger story outlined here and the numinous, sacred values that have been present in an expanding sequence over this entire time of the world's existence. Within this context all our human affairs—all professions, occupations, and activities—have their meaning precisely insofar as they enhance this emerging world of subjective intercommunion within the total range of reality. Within this context the scientific community and the religious community have a common basis. The limitations of the redemption rhetoric and the scientific rhetoric can be seen, and a new, more integral language of being and value can emerge.

Within this story a structure of knowledge can be established, with its human significance, from the physics of the universe and its chemistry through geology and biology to economics and commerce and

so to all those studies whereby we fulfill our role in the earth process. There is no way of guiding the course of human affairs through the perilous course of the future except by discovering our role in this larger evolutionary process. If the way of Western civilization and Western religion was once the way of election and differentiation from others and from the earth, the way now is the way of intimate communion with the larger human community and with the universe itself.

Here we might observe that the basic mood of the future might well be one of confidence in the continuing revelation that takes place in and through the earth. If the dynamics of the universe from the beginning shaped the course of the heavens, lighted the sun, and formed the earth, if this same dynamism brought forth the continents and seas and atmosphere, if it awakened life in the primordial cell and then brought into being the unnumbered variety of living beings, and finally brought us into being and guided us safely through the turbulent centuries, there is reason to believe that this same guiding process is precisely what has awakened in us our present understanding of ourselves and our relation to this stupendous process. Sensitized to such guidance from the very structure and functioning of the universe, we can have confidence in the future that awaits the human venture.

God and Gaia

JAMES LOVELOCK

Gaia, mother of all, I sing, oldest of gods,
 Firm of foundation, who feeds all creatures living
 on Earth,
 As many as move on the radiant land and swim in
 the sea
 And fly through the air, all these does she feed
 with her bounty.
 Mistress, from you come our fine children and
 bountiful harvests,

Yours is the power to give mortals life and to take
 it away.

J. Donald Hughes,
Gaia: An Ancient View of Our Planet

PHOTOGRAPHS, LIKE BIOGRAPHIES, OFTEN
 reveal more of the artist than of the subject. Maybe

Lovelock, James, "God and Gaia," in *The Ages of Gaia: A Biography of Our Living Earth*, pp. 191–209. Copyright © 1988 by The Commonwealth Fund Book Program of Memorial Sloan-Kettering Cancer Center. Used by permission of W. W. Norton & Company, Inc.

this is why passport photographs, taken in mechanically operated booths, look so lifeless. How could a mere machine capture the soul of its subject, stiffly sitting and gazing into the blind eye of the camera? Trying to write about God and Gaia, I share some of the limitations of a mechanical camera, and I know that this [essay] will show more about myself than about my subjects. So why try?

When I wrote the first book on Gaia I had no inkling that it would be taken as a religious book. Although I thought the subject was mainly science, there was no doubt that many of its readers found otherwise. Two-thirds of the letters received, and still coming in, are about the meaning of Gaia in the context of religious faith. This interest has not been limited to the laity; a most interesting letter came from Hugh Montefiore, then Bishop of Birmingham. He asked which I thought came first, life or Gaia. My attempts to answer this question led to a correspondence, reported in a chapter of his book, *The Probability of God*. I suspect that some cosmologists are similarly visited by enquiries from those who imagine them to be at least on nodding terms with God. I was naïve to think that a book about Gaia would be taken as science only.

So where do I stand about religion? While still a student I was asked seriously, by a member of the Society of Friends, if I had ever had a religious experience. Not understanding what he meant, imagining that it referred to a manifestation or a miracle, I answered no. Looking back from 45 years on, I now tend to think that I should have said yes. Living itself is a religious experience. At the time, however, the question was almost meaningless because it implied a separation of life into sacred and secular parts. I now think that there can be no such division. In any relationship there are high points of delight, as well as pitfalls in the great plain of contentment. For me one high point came when I was asked by Jim Morton, the Dean of the Cathedral Church of St. John the Divine in New York, to serve as a participant in a religious celebration. I still recall with wonder being part of that colorful procession, with him and other clerics, dressed in medieval costume. The music of the choir singing that lovely hymn "Morning Is Broken" seemed to take on a new significance in the ambience of that sacred place. It was a sensual experience, but to me that does not make it less religious.

My thoughts about religion when a child grew

from those of my father and the country folk I knew. It was an odd mixture, composed of witches, May trees, and the views expressed by Quakers, in and outside the Sunday school at a Friends' meeting house. Christmas was more of a solstice feast than a Christian one. We were, as a family, well into the present century yet, still amazingly superstitious. So ingrained was my childhood conditioning about the power of the occult that in later life it took a positive act of will to stop touching wood or crossing fingers whenever some hazard was to be faced. Christianity was there not so much a faith, rather as a set of sensible directions on how to be good.

When I first saw Gaia in my mind I felt as must an astronaut have done as he stood on the Moon, gazing back at our home, the Earth. The feeling strengthens as theory and evidence steadily confirm the thought that the Earth may be a larger state of life. Thinking of the Earth this way makes it seem, on happy days, in the right places, as if the whole planet were celebrating a sacred ceremony. Being on the Earth brings that same special feeling of comfort that attaches to the celebration of any religion when it is seemly and when one is fit to receive. It need not suspend the critical faculty.

That is only what I feel about Gaia. What about God? I am a scientist and do not have faith, but neither am I the counterpart of those with faith, an atheist. I go along with E. O. Wilson who sees us as tribal carnivores who happened to have evolved to the point of forming civilizations. It takes a lot of hubris to imagine that we can ever reach the limits of our own intelligence; to think that we will ever be able to explain everything about the universe is absurd. For these reasons I am equally discomforted by religious faith and scientific atheism.

I am too committed to the scientific way of thinking to feel comfortable when enunciating the Creed or the Lord's Prayer in a Christian Church. The insistence of the definition "I believe in God the Father Almighty, Maker of Heaven and Earth" seems to anaesthetize the sense of wonder, as if one were committed to a single line of thought by a cosmic legal contract. It seems wrong also to take it merely as a metaphor. But I respect the intuition of those who do believe, and I am moved by the ceremony, the music, and most of all by the glory of the words of the prayer book that to me are the nearest to perfect expression of our language. When atheistic science

can inspire anything as moving as Bach's St Matthew passion or as seemly as Salisbury Cathedral I will respect it but not be part of it.

I have kept my doubts in a separate place for too long. Now that I write this [essay], I have to try somehow to explain, to myself as well as to you, what is my religious belief. I am happy with the thought that the Universe has properties that make the emergence of life and Gaia inevitable. But I react to the assertion that it was created with this purpose. It might have been; but how the Universe and life began are ineffable questions.

At a meeting in London recently, a wise man, Dr. Donald Braben, asked me: "Why do you stop with the Earth? Why not consider if the Solar System, the Galaxy, or even the Universe is a self-organized system? My instant answer was that the concept of the Earth, as Gaia, is manageable. We know that there is no other life in this Solar System, and the nearest star is utterly remote. There must be other Gaias circling other docile long-lived stars but, curious though I may be about them and about the Universe, these are intangible—concepts for the intellect not the senses. Until, if ever, we are visited from other parts of the Universe we are obliged to remain detached.

Many, I suspect, have trodden this same path through the mind. Those millions of Christians who make a special place in their hearts for the Virgin Mary possibly respond as I do. The concept of Jahweh as remote, all-powerful, all seeing is either frightening or unapproachable. Even the sense of presence of a more contemporary God, a still, small voice within, may not be enough for those who need to communicate with someone outside. Mary is close and can be talked to. She is believable and manageable. It could be that the importance of the Virgin Mary in faith is something of this kind.

Gaia is a religious as well as a scientific concept, and in both spheres it is manageable. Theology is also a science, but if it is to operate by the same rules as the rest of science, there is no place for creeds or dogma. By this I mean theology should not state that God exists and then proceed to investigate his nature and his interactions with the Universe and living organisms. Such an approach is prescriptive, presupposes his existence, and closes the mind to such questions as: What would the Universe be like without God? How can we use the concept of God as a way to look at the Universe and ourselves? How can

we use the concept of Gaia as a way to understanding God? Belief in God is an act of faith and will remain so. In the same way, it is otiose to try to prove that Gaia is alive. Instead, Gaia should be a way to view the Earth, ourselves, and our relationships with living things.

The life of a scientist who is a natural philosopher can be devout. Curiosity is an intimate part of the process of loving. Being curious and getting to know the natural world leads to a loving relationship with it. It can be so deep that it cannot be articulated, but it is nonetheless good science. Creative scientists, when asked how they came upon some great discovery frequently state, "I knew it intuitively, but it took several years work to prove it to my colleagues." Compare that statement with this one by William James, the nineteenth-century philosopher and psychologist, in *Varieties of Religious Experience*:

The truth is that in the metaphysical and religious sphere, articulate reasons are cogent for us only when our inarticulate feelings of reality have already been impressed in favor of the same conclusion. Then, indeed, our intuitions and our reason work together, and great world ruling systems, like that of the Buddhist or of the Catholic philosophy, may grow up. Our impulsive belief is here always what sets up the original body of truth, and our articulately verbalized philosophy is but a showy translation into formulas. The unreasoned and immediate assurance is the deep thing in us, the reasoned argument is but a surface exhibition. Instinct leads, intelligence does but follow.

This was the way of the natural philosophers in James Hutton's time in the eighteenth century and is still the way of many scientists today. Science can embrace the notion of the Earth as a superorganism and can still wonder about the meaning of the Universe.

How did we reach our present secular humanist world? In times that are ancient by human measure, as far back as the earliest artifacts can be found, it seems that the Earth was worshipped as a goddess and believed to be alive. The myth of the great Mother is part of most early religions. The Mother is a compassionate, feminine figure; spring of all life, of fecundity, of gentleness. She is also the stern and unforgiving bringer of death. As Aldous Huxley reminds in his book *The Human Experience*:

In Hinduism, Kali is at once the infinitely kind and loving mother and the terrifying Goddess of destruction, who has a necklace of skulls and drinks the blood of human beings from a skull. This picture is profoundly realistic; if you give life, you must necessarily give death, because life always ends in death and must be renewed through death.

At some time not more than a few thousand years ago the concept of a remote master God, an overseer of Gaia, took root. At first it may have been the Sun, but later it took on the form we have with us now of an utterly remote yet personally immanent ruler of the Universe. Charlene Spretnak, in her moving and readable book, *The Spiritual Dimensions of Green Politics*, attributes the first denial of Gaia, the Earth goddess, to the conquest of an earlier Earth-centered civilization by the Sun-worshipping warriors of the invading Indo-European tribes.

Picture yourself as a witness of that decisive moment in history, that is, as a resident of the peaceful, artful, Goddess-oriented culture in Old Europe. (Don't think "matriarchy"! It may have been, but no one knows, and that is not the point.) It is 4,500 B.C. You are walking along a high ridge, looking out across the plains to the east. In the distance you see a massive wave of horsemen galloping towards your world on strange, powerful animals. (The European ancestor of the horse had become extinct.) They brought few women, a chieftain system, and only a primitive stamping technique to impress their two symbols, the sun and a pine tree. They moved in waves first into southeastern Europe, later down into Greece, across all of Europe, also into the Middle and Near East, North Africa and India. They brought a sky god, a warrior cult, and patriarchal social order. *And that is where we live today*—in an Indo-European culture, albeit one that is very technologically advanced.

The evolution of these horsemen to the modern men who ride their infinitely more powerful machines of destruction over the habitats of our partners in Gaia seems only a small step. The rest of us, in the cozy, comfortable hell of urban life, care little what they do so long as they continue to supply us with food, energy, and raw materials and we can continue to play the game of human interaction.

In ancient times, belief in a living Earth and in a living cosmos was the same thing. Heaven and Earth were close and part of the same body. As time passed and awareness grew of the vast distances of space and time through such inventions as the telescope, the Universe was comprehended and the place of God receded until now it hides behind the Big Bang, claimed to have started it all. At the same time, as population increased so did the proportion forced to lead urban lives out of touch with Nature. In the past two centuries we have nearly all become city dwellers, and seem to have lost interest in the meaning of both God and Gaia. As the theologian Keith Ward wrote in the *Times* in December 1984:

It is not that people know what God is, and have decided to reject him. It seems that very few people even know what the orthodox traditional idea of God, shared by Judaism, Islam and Christianity is. They have not the slightest idea what is meant by the word God.

It just has no sense or possible place in their lives. Instead they either invent some vague idea of a cosmic force with no practical implications at all; or they appeal to some half-forgotten picture of a bearded super-person constantly interfering with the mechanistic laws of Nature.

I wonder if this is the result of sensory deprivation. How can we revere the living world if we can no longer hear the bird song through the noise of traffic, or smell the sweetness of fresh air? How can we wonder about God and the Universe if we never see the stars because of the city lights? If you think this to be exaggeration, think back to when you last lay in a meadow in the sunshine and smelt the fragrant thyme and heard and saw the larks soaring and singing. Think back to the last night you looked up into the deep blue black of a sky clear enough to see the Milky Way, the congregation of stars, our Galaxy.

The attraction of the city is seductive. Socrates said that nothing of interest happened outside its walls and, much later, Dr. Johnson expressed his view of country living as "One green field is like another." Most of us are trapped in this world of the city, an everlasting soap opera, and all too often as spectators, not players. It is something to have sensitive commentators like Sir David Attenborough bring the natural world with its visions of forests and wilderness to the television screens of our suburban

rooms. But the television screen is only a window and only rarely clear enough to see the world outside; it can never bring us back into the real world of Gaia. City life reinforces and strengthens the heresy of humanism, that narcissistic devotion to human interests alone. The Irish missionary Sean McDonagh wrote in his book *To Care for the Earth*: "The 20 billion years of God's creative love is either seen simply as the stage on which the drama of human salvation is worked out, or as something radically sinful in itself and needing transformation."

The heartlands of the great religions are now in the last bastions of rural existence, in the Third World of the tropics. Elsewhere God and Gaia that once were joined and respected are now divorced and of no account. We have, as a species, almost resigned from membership in Gaia and given to our cities and our nations the rights and responsibilities of environmental regulation. We struggle to enjoy the human interactions of city life yet still yearn to possess the natural world as well. We want to be free to drive into the country or the wilderness without polluting it in so doing; to have our cake and eat it. Human and understandable such striving may be, but it is illogical. Our humanist concerns about the poor of the inner cities or the Third World, and our near-obscure obsession with death, suffering, and pain as if these were evil in themselves—these thoughts divert the mind from our gross and excessive domination of the natural world. Poverty and suffering are not sent; they are the consequences of what we do. Pain and death are normal and natural; we could not long survive without them. Science, it is true, assisted at the birth of technology. But when we drive our cars and listen to the radio bringing news of acid rain, we need to remind ourselves that we, personally, are the polluters. We, not some white-coated devil figure, buy the cars, drive them, and foul the air. We are therefore accountable, personally, for the destruction of the trees by photochemical smog and acid rain. We are responsible for the silent spring that Rachel Carson predicted.

There are many ways to keep in touch with Gaia. Individual humans are densely populated cellular and endosymbiont collectives, but clearly also identities. Individuals interact with Gaia in the cycling of the elements and in the control of the climate, just like a cell does in the body. You also interact individually in a spiritual manner through a sense of wonder

about the natural world and from feeling a part of it. In some ways this interaction is not unlike the tight coupling between the state of the mind and the body. Another connection is through the powerful infrastructures of human communication and mass transfer. We as a species now move a greater mass of some materials around the Earth than did all the biota of Gaia before we appeared. Our chattering is so loud that it can be heard to the depths of the Universe. Always, as with other and earlier species within Gaia, the entire development arises from the activity of a few individuals. The urban nests, the agricultural ecosystems, good and bad, are all the consequences of rapid positive feedback starting from the action of an inspired individual.

A frequent misunderstanding of my vision of Gaia is that I champion complacency, that I claim feedback will always protect the environment from any serious harm that humans might do. It is sometimes more crudely put as "Lovelock's Gaia gives industry the green light to pollute at will." The truth is almost diametrically opposite. Gaia, as I see her, is no dotting mother tolerant of misdemeanors, nor is she some fragile and delicate damsel in danger from brutal mankind. She 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. Her unconscious goal is a planet fit for life. If humans stand in the way of this, we shall be eliminated with as little pity as would be shown by the micro-brain of an intercontinental ballistic nuclear missile in full flight to its target.

What I have written so far has been a testament built around the idea of Gaia. I have tried to show that God and Gaia, theology and science, even physics and biology are not separate but a single way of thought. Although a scientist, I write as an individual and my views are likely to be less common than I like to think. So now let me tell you something of what the scientific community has to say on this subject.

In science, the more discovered, the more new paths open for exploration. It is usual in science, when things are vague and unclear, for the path to be like that of a drunkard, wandering in a zigzag. As we stagger back from what lastly dawns upon our befuddled wits is the wrong way, we cross over the true path and move nearly as far to the equally wrong, opposite side. If all goes well, our deviations lessen and

the path converges towards, but never completely follows, the true one. It gives a new insight to the old tag *in vino veritas*. So natural is this way to find the truth that we usually program our computers to solve problems too tedious to do ourselves by setting them to follow the same trial-and-error, staggering, stumbling walk. The process is dignified and mystified by calling it "iteration," but the method is the same. The only difference is that, so quickly is it done, the eye never sees the fumbling.

We have lost the instinctive understanding of what life is and of our place within Gaia. Our attempts to define life are much in the stage of the drunkard's walk. The two opposing verges representing the extremes of iteration are illustrated by a splendid philosophical debate that has gone on for the past twenty years between the molecular biologists on the one side and the new school of thermodynamics on the other. Jacques Monod's *Chance and Necessity*, although first published in 1970, most clearly and beautifully conveys the clear, strong, and rigorous approach of solid science based firmly in a belief in a materialistic and deterministic Universe. The other verge is represented by those, like Erich Jantsch, who believe in a self-organizing Universe. It is concerned with the thermodynamics of the unsteady state of which dissipative structures such as flames, whirlpools, and life itself are examples. Although the participants are all well known and respected in the English-speaking world most of this entertaining debate has gone on in French, so many of us have missed the fun.

The essence of this contest is a rerun of the ancient battle between the holists and the reductionists. As Monod reminds us:

Certain schools of thought (all more or less consciously or confusedly influenced by Hegel) challenge the value of the analytical approach to systems as complex as living beings. According to these holist schools which, phoenix like, are reborn in every generation, the analytic attitude (reductionist) is doomed to fail in its attempts to reduce the properties of a very complex organization to the "sum" of the properties of its parts. It is a very stupid and misguided quarrel which merely testifies to the holists' total lack of understanding of scientific method and the crucial role analysis plays in it. How far could a Martian engineer get if trying to understand an earthly

computer, he refused on principle to dissect the machine's basic electronic components which execute the operation of propositional algebra.

These strong words were in the 1970 edition of *Chance and Necessity*. Maybe they are by now less extremely held, but they serve well to express what was and still is an important scientific constituency.

No one now doubts that it was plain, honest reductionist science that allowed us to unlock so many of the secrets of the Universe, not least those of the living macromolecules that carry the genetic information of our cells. But clear, strong, and powerful though it may be, it is not enough by itself to explain the facts of life. Consider Jacques Monod's Martian engineer. Would it have been sensible to have dashed in with a kit of tools and disassembled analytically the computer he found? Or would it have been better, as a first step, to have switched it on and questioned it as a whole system? If you have any doubts about the answer to this question then consider the thought that the hypothetical Martian engineer was an intelligent computer and the object he examined, you.

By contrast, in 1972 Ilya Prigogine wrote:

It is not instability but a succession of instabilities which allow the crossing of the no man's land between life and no-life. We start to disentangle only certain stages. This concept of biological order leads automatically to a more blurred appreciation of the role of chance and necessity to recall the title of the well-known work by Jacques Monod. Fluctuation which allows the system to depart from states near thermodynamic equilibrium represents the stochastic aspect, the part played by chance. Contrariwise, the environmental instability, the fact that the fluctuations will increase, represents necessity. Chance and necessity cooperate instead of opposing one another.

I wholly agree with Monod that the cornerstone of the scientific method is the postulate that Nature is objective. True knowledge can never be gained by attributing "purpose" to phenomena. But, equally strongly, I deny the notion that systems are never more than the sum of their parts. The value of Gaia in this debate is that it is the largest ecosystem. It can be analyzed both as a whole system and, in the reductionist manner, as a collection of parts. This analysis need disturb neither the privacy nor the

function of Gaia any more than would the movement of a single commensal bacterium on the surface of your nose.

Prigogine was not the first to recognize the inadequacies of equilibrium thermodynamics. He had many illustrious predecessors, among them the physical chemists J. W. Gibbs, L. Onsager, and K. G. Denbigh, who explored the thermodynamics of the steady state. But it was that truly great physicist, Ludwig Boltzmann, who pointed the way towards the understanding of life in thermodynamic terms. It was by reading Schrodinger's book *What Is Life?* in the early 1960s that I first realized that planetary life was revealed by the contrast between the near-equilibrium state of the atmosphere of a dead planet and the exuberant disequilibrium of the Earth.

When we cross from the sharp clarity of the real world into that nightmare land of dissipating structures, what do we learn that makes the next staggering lurch less erroneous than the last? I have gained from Prigogine's world view a confirmation of a suspicion that time is a variable much too often ignored. In particular, many of the apparent contradictions between these two schools of thought seem to resolve if viewed along the time dimension instead of in space. We have evolved from the world of simple molecules through dissipative structures to the more permanent entities that are living organisms. The further we go from the present, either into the past or the future, the greater the uncertainty. Darwin was right to dismiss thoughts about the origins of life; as Jerome Rothstein has said, the restrictions of the second law of thermodynamics prevent us from ever knowing about the beginning or the end of the Universe.

In our guts and in those of other animals, the ancient world of the Archean lives on. In Gaia also the ancient chaotic world of dissipating structures that preceded life still lives on. A recent and relatively unknown discovery of science is that the fluctuations at every scale from viscosity to weather can be chaotic. There is no complete determinism in the Universe; many things are as unpredictable as a perfect roulette wheel. An ecologist colleague of mine, C. S. Holling, has observed that the stability of large-scale ecosystems depends upon the existence of internal chaotic instabilities. These pockets of chaos in the larger, stable Gaian system serve to probe the boundaries set by the physical constraints to life. By this means

the opportunism of life is insured and no new niche remains undiscovered. For example, I live in a rural region surrounded by farmers who keep sheep. It is impressive how adventurous young lambs, through their continuous probing of my boundary hedges, can find their way through onto the richer, ungrazed land on my side. The behavior of young men is not so different.

My reason for wandering onto the battlefield of the war between holists and reductionists was to illustrate how polarized is science itself. Let me conclude this digressionary visit and return to the theme of this [essay], *God and Gaia*, and let me start by reminding you of *Daisyworld*—a model which is reductionist and holistic at the same time. It was made to answer the criticism of Gaia, that it was teleology. The need for reduction arose because the relationships between all the living things on Earth in their countless trillions and the rocks, the air, and the oceans could never be described in full detail by a set of mathematical equations. A drastic simplification was needed. But the model with its closed loop cybernetic structure was also holistic. This also applies to ourselves. It would be pointless to attempt to disentangle all the relationships between the atoms within the cells that go to make up our bodies. But this does not prevent us from being real and identifiable, and having a life span of at least 70 years.

We are also in an adversary contest between our allegiance to Gaia and to humanism. In this battle, politically minded humanists have made the word "reductionist" pejorative, to discredit science and to bring contumely to the scientific method. But all scientists are reductionists to some extent; there is no way to do science without reduction at some stage. Even the analyzers of holistic systems, confronted with an unknown system, do tests, such as perturbing the system and observing the response, or making a model of it and then reducing that model. In biology it is impossible to avoid reduction, even if we wished. The material and relationships of living things are so phenomenally complex that a holistic view is seen only when it suits the biota to exist as an identifiable entity such as a cell, a plant, a nest, or Gaia. Certainly, the entities themselves can be observed and classified with a minimum of invasion, but sooner or later curiosity will drive an urge to discover what the entities are made of and how they work. In any case, the idea that mere observation is

neutral is itself an illusion. Someone once said that the reason the Universe is running down is that God is always observing it and hence reducing it. Be this as it may, there is little doubt that a nature reserve, a wildlife park, or an ecosystem is reduced in proportion to the amount of time that we and our children perturb the wildlife by watching them.

In *The Self-Organizing Universe*, Erich Jantsch made a strong argument for the omnipresence of a self-organizing tendency; so that life, instead of being a chance event, was an inevitable consequence. Jantsch based his thoughts on the theories of those pioneers of what might be called the "thermodynamics of the unsteady state"—Max Eigen, Ilya Prigogine, Humberto Maturana, Francisco Varela, and their successors. As scientific evidence accumulates and theories are developed in this recondite topic, it may become possible to encompass the metaphor of a living Universe. The intuition of God could be rationalized; something of God could become as familiar as Gaia.

For the present, my belief in God rests at the stage of a positive agnosticism. I am too deeply committed to science for undiluted faith; equally unacceptable to me spiritually is the materialist world of undiluted fact. Art and science seem interconnected with each other and with religion, and to be mutually enlarging. That Gaia can be both spiritual and scientific is, for me, deeply satisfying. From letters and conversations I have learned that a feeling for the superorganism, the Earth, has survived and that many feel a need to include those old faiths in their system of belief, both for themselves and because they feel that Earth of which they are a part is under threat. In no way do I see Gaia as a sentient being, a surrogate God.

The philosopher Gregory Bateson expressed this agnosticism in his own special way:

The individual mind is immanent but not only in the body. It is immanent also in pathways and messages outside the body; and there is a larger mind of which the individual mind is only a subsystem. This larger mind is comparable to God and is perhaps what some people mean by God, but it is still immanent in the total interconnected social systems and planetary ecology.

As a scientist I believe that Nature is objective but also recognize that Nature is not predetermined.

The famous uncertainty principle that the physicist Werner Heisenberg discovered was the first crack in the crystalline structure of determinism. Now chaos is revealed to have an orderly mathematical prescription. This new theoretical understanding enlightens the practice of weather forecasting. Previously it was believed, as the French physicist Laplace had stated, that given enough knowledge (and, in this age, computer power) anything could be predicted. It was a thrill to discover that there was real, honest chaos decently spread around the Universe and to begin to understand why it is impossible in this world ever to predict if it will be raining at some specific place or time. True chaos is there as the counterpart of order. Determinism is reduced to a collection of fragments; like jewels that have fallen on the surface of a bowl of pitch.

Science has its fashions, and one thing guaranteed to stir interest and start a new fashion is the exploration of a pathology. Health is far less interesting than disease. I well recall as a schoolboy visiting the Museum of the London School of Hygiene and Tropical Medicine where there were on display life-sized models of subjects stricken by tropical illnesses. Although less well crafted, they were so strange and horrible as to make tame the professional horrors of Madame Tussaud's waxworks. The sight of full-sized models of the victims of elephantiasis or leprosy and the imagination of their suffering made bearable the adolescent agonies of a schoolboy. Contemporary science is similarly fascinated by pathologies of a mathematical kind. Theoretical ecology, as we have already discussed, is more concerned with sick than healthy ecosystems. The vagaries of weather are more interesting than the long-term stability of climate. Continuous creation never had a chance in face of the ultimate pathology of the Big Bang.

Interest in the pathologies of science has a curious link with religion. Mathematicians and physicists are, without seeming aware of it, into demonology. They are found investigating "catastrophe theory" or "strange attractors." They then seek from their colleagues in other sciences examples of pathologies that match their curious models. Perhaps I should explain that in mathematics, an attractor is a stable equilibrium state, such as a point at the bottom of a smooth bowl where a ball will always come to rest. Attractors can be lines, planes, or solids as well as points, and are the places where systems tend to set-

tle down to rest. Strange attractors are chaotic regions of fractional dimensions that act like black holes, drawing the solutions of equations to their unknown and singular domains. Phenomena of the natural world—such as weather, disease, and ecosystem failures—are characterized by the presence of these strange attractors in the clockwork of their mathematics, lurking like time bombs as harbingers of instability, cyclical fluctuations, and just plain chaos.

The remarkable thing about real and healthy living organisms is their apparent ability to control or limit these destabilizing influences. It seems that the world of dissipating structures, threatened by catastrophe and parasitized by strange attractors, is the foreworld of life and of Gaia and the underworld that still exists. The tightly coupled evolution of the physical environment and the autopoietic entities of pre-life led to a new order of stability; the state associated with Gaia and with all forms of healthy life. Life and Gaia are to all intents immortal, even though composed of entities that at least include dissipative structures. I find a curious resemblance between the strange attractors and other denizens of the imaginary world of mathematical constructs and the demons of older religious belief. A parallel that goes deep and includes an association with sickness not health, famine not plenty, storm not calm. A saint of this fascinating branch of mathematics is the Frenchman, Benoît Mandelbrot. From his expressions in fractional dimensions it is possible to produce graphic illustrations of all manner of natural scenes: coastlines, mountain ranges, trees, and clouds, all startlingly realistic. But when Mandelbrot's scientific art is applied to strange attractors we see, in graphic form, the vividly colored image of a demon or a dragon.

Gaia theory may seem to be dull in comparison with these exotica. A thing, like health, to be taken for granted except when it fails. This may be why so few scientists and theologians are interested in it; they prefer to explore the origins of life, or the Universe instead of the natural world, here and now, that surrounds them. I find it difficult to explain to my colleagues why I prefer to live and work alone in the depths of the country. They think that I must be missing all the excitement of exploration. I prefer a life with Gaia here and now, and to look back only to that part of its history which is knowable, not to

what might have been before it came into being. A friend has asked why, if this is so, I chose to spend so much of this book on the history of the Earth. I find it easiest to explain my reasons for this apparent inconsistency as a fable.

Imagine an island set in a warm blue sea with sandy beaches. The lush forest in the foreground gives way to small rocky mountain peaks as sharp and clear as a line drawing on the distant horizon. There is no sign of habitation, human or other. What at first sight looks like a village of white stone houses turns out, on closer inspection, to be a chalk outcrop, laser bright in the sunlight. Something looks odd, though; you blink, for the light is very bright, and look again. It is not an illusion, the trees are not green, they are a dark shade of blue.

The island in view is somewhere on Earth 500 million years from now. The exact details are unpredictable and unimportant to this travel tale, but we can say it is hotter than any seaside place on Earth today, with a sea temperature near 30°C; and it often reaches 60°C in the desert inland. There is little or no carbon dioxide in the air, but otherwise it is much the same as now with just the right amount of oxygen for breathing but not so much as to make fires uncontrollable. There has been a major punctuation, and the dominant life forms on the land surface are of a structure no botanist or zoologist of our time would recognize.

In a small meadow near the shore, a group of philosophers is gathered for one of those civilized meetings hosted by a scientific society. A symposium that leaves ample time for swimming and walking and just talking idly. A participant has a theory that their form of life, so unlike that of many of the organisms in the sea and of the microorganisms, did not just evolve but was made artificially by a sentient life form living in the remote geological past. She bases her argument on the nature of the nervous system of the philosophers and of land animals generally. It operates by direct electrical conduction along organic polymer strands, whereas that of the ocean life operates by ionic conduction within elongated cells (which we, of course, would recognize as nerves). The brains of the philosophers operate by semiconduction, in contrast to the chemically polarized systems of the sea organisms. In this new form of life, males do not exist as mobile sentient organisms, merely as a vegetative form that supplies the neces-

sary separate pathway for genetic information so that recombination can reduce the expression of error. Marriage is still a lifelong relationship, but with males rooted in the soil like plants it is more one of that between a loving gardener and the flowers. Our philosopher argues that such a system could never have originated by chance but must have been manufactured at some time in the past. Not surprisingly, her theory is not well received. Not only is it outside the paradigm of the science of those times, but the theologians and mythopoeists find the notion repugnant to their view of a single spontaneous origin of a living planet. To bring back the Creationist heresy is unacceptable.

These occupants of a future Atlantis have no need for speech or writing. The possession of an electronic nervous system makes speech redundant; they are able to use radio frequencies to communicate directly a wide range of images and ideas. In spite of these advantages and their superior wisdom, they are, like the whales of today, neither mechanically adept nor interested in mechanisms. This being so, the very idea of making as anything as intricate as a brain or nervous system as an artifact is beyond their

understanding, and therefore, in their minds, beyond the capabilities of a past life form.

The point of the fable is to argue that it is not necessary to know the intricate details of the origin of life itself to understand the evolution of Gaia and of ourselves. In a similar way, the contemplation of those other remote places before and after life, Heaven and Hell, may be irrelevant to the discovery of a seemly way of life. We may well have been assisted by the nature of the Universe to cheat chaos and evolve spontaneously, on some Hadean shore, into our ancestral form of life. It seems unlikely that we come from a life form planted here by visitors from elsewhere; or even arrived clinging to some piece of cometary debris from outer space. I like to think that Darwin dismissed enquiries about the origins of life not merely because, so sparse was the information available in his time, the search for life's origin would have had to remain speculative, but, more cogently, because he recognized that it was not necessary to know the details of the origin of life to formulate the evolution of the species by natural selection. This is what I have in mind when I talk of Gaia, as a concept, being manageable.

Breakthrough in Evolution Toward a Partnership Future

RIANE EISLER

SCIENCE FICTION WRITERS' VISIONS OF THE future are filled with incredible technological inventions. But by and large, theirs is a world singularly bereft of new social inventions. In fact, more often than not, what they envision takes us backward while seeming to go forward in time. Be it in Frank Herbert's *Dune*¹ or George Lucas's *Star Wars*, what we frequently find is actually the social organization of feudal emperors and medieval overlords transposed to a world of intergalactic high-tech wars.

After five thousand years of living in a dominator society, it is indeed difficult to imagine a different

world. Charlotte Perkins Gilman tried in *Herland*.² Written in 1915, this was a tongue-in-cheek utopia about a peaceful and highly creative society in which the most valued and rewarded work—and the top social priority—was the physical, mental, and spiritual development of children. The catch was that this was a world where all the men had wiped themselves out in a final orgy of war, and the handful of surviving women had, in an amazing mutation, saved their half of humanity by learning to reproduce themselves all by themselves.

But as we have seen, the problem is not men as a

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G

Gaia

Gaia ("Earth") is the name of a Greek goddess also called Ge, from whose name words like "geology" and "geography" are derived. The ninth-century B.C.E. Homeric Hymn calls Gaia "mother of all, eldest of all beings," while the *Theogony* of eighth-century B.C.E. Greek poet Hesiod describes the simultaneous birth of Eros ("love . . . breaks the limbs' strength") and "broad-breasted" Gaia, "immovable foundation of all things forever." Gaia immediately began to reproduce, "without any sweet act of love," her children, including the mountains and seas. Her most-beloved parthenogenetic child was Uranus, the sky, with whom she mated to produce Oceanus (ocean), Themis (justice), Mnemosyne (memory), and the other divine beings called the Titans.

Other classical writers offer creation myths in which Earth is not the primary actor. Pliny describes a primordial goddess, Eurynome, who whirled into existence a wind from which she created the serpent Opion, with whom she produced an egg from which the world hatched. Orphic literature calls the primordial mother Nyx ("night"), consort of the wind. But the myth of Gaia was favored by authors including Homer, Euripedes, and Pindar. Such frequent literary use does not prove that the Greeks gave priority to the Earth-goddess as the universal creative matrix; there is little known of Greek rituals to Gaia, who is presumed by some to be a pre-Hellenic divinity barely absorbed into the later pantheons.

Contemporary awareness of Gaia dates to 1969, when physician and inventor James Lovelock, researching with Dian Hitchcock ways of determining from afar the probability of life on Mars, argued that the red planet's atmospheric equilibrium – its elements rarely changing in proportion to each other – showed it unlikely to host life, while Earth's atmospheric signature is disequilibrium. When Lovelock expanded this observation into a vision of the Earth as a self-regulating system, his neighbor and friend, Nobel prize-winning novelist William Golding, named the hypothesis "Gaia." Prominent biochemist Lynn Margulis brought her knowledge to bear on the emergent theory and is now, with Lovelock, generally recognized as its co-founder. The hypothesis has inspired many contemporary theologians and theologians, its founders remaining aloof from, although not publicly disapproving of, such religious use of their ideas.

The non-mechanical vision of the Earth had been previously suggested by the Scottish founder of geology,

James Hutton, in the eighteenth century, and again by nineteenth-century Ukrainian scientist Vladimir Vernadsky. Like those forebears, Lovelock and Margulis argued that the Earth is understood better as a living being than as a machine. Rock, sea, cloud, tree, animal are, they argued, in continual and complex relation, with each affecting and subtly altering the others. Thus the exchange of planetary atmospheric gasses can be compared to an individual's breath, the water system to the circulation of blood, the ozone layer to the skin. Biota, atmosphere, ocean, and soil interact through feedback loops to maintain conditions conducive to life, a process known as homeostasis.

Both "living Earth" and "great machine" are metaphors that can be, and have been, understood literally. Lovelock and Margulis's use of the ancient goddess' name drew both fame and notoriety: general scientific scorn as well as an enthusiastic (although sometimes misinformed) embrace by nature mystics and citizens concerned about ecological issues. The controversial hypothesis – often stripped of the name of the goddess to become Earth System Science or Geophysiology – has gained increasing respect among some scientists but is derided by others as lacking sufficient scientific rigor.

While scientists debated, spiritual seekers embraced Gaia, often arguing that it descends from a primal religion. Paleolithic and other early human artifacts – especially the tiny but robust figurines called "Venuses" – are described as expressions of early worship of Earth's fecundity. The poetic language of Native American spiritual leaders like Claude Kuwanijuma (Hopi), who said that "The Earth remembers; the stones remember," similarly support contentions that tribal people sustain a connection or "participation mystique" (the term is from French anthropologist Levy-Bruhl) with the Earth. The sense of being part of a universal unity is traditionally associated with religious mysticism, which Evelyn Underhill and William James both describe as an experience of timelessness and a lack of boundary between self and world.

That Lovelock chose the name of a goddess for his living Earth derives from a consistent Western bias toward seeing the Earth as feminine. Under the influence of Greek Orphism, Persian Manicheism and other dualistic sects, "Earth" was set in opposition to "heaven." Other oppositions followed: evil/good, flesh/spirit, dark/light, moon/sun, with the former typically associated with the Earth and the female, the latter with the heavens and the male. The vision of the Earth as feminine attached itself to

essentialist visions of "femininity," so that the Earth was often transformed into a maternal, nurturing being. Some theorists, such as Rosemary Radford Ruether, Carolyn Merchant, and Shirley Nicholson, have turned this dualism on its head, arguing for an ecofeminist view of nature that claims traditionally feminine values (relationship, cooperation) as more natural than those traditionally accepted as masculine (domination, individualism). Rather than domination of the Earth by humanity, Gaian ecofeminists call for a modest recognition of humanity's place within a living Earth system.

The widespread public acceptance of the Gaia hypothesis – even while scientists argued over its merits – led to controversy in established religions, for acceptance of Gaia implies a pantheism or polytheism unacceptable to believers in established monotheisms. Yet some Christian thinkers, notably the Catholic monk Thomas Berry, see no opposition between honoring the Earth and worshipping a transcendent divinity, although such thinkers typically enforce the traditional distinction between "creator" and "creation." Non-theistic Buddhism has had an easier time with the Gaian vision, with the conception of *sangha* (community) easily enlarged to include the community of earthly life and that of *dharma* (duty) embracing ecological responsibility.

Less orthodox religious thinkers have eagerly explored the philosophical possibilities of the Gaia hypothesis; most prominent has been William Irvin Thompson of the Lindisfarne Association, who has articulated a Gaian politics and economics. Many neo-pagan groups in the U.S. and European countries employ Gaian vocabulary, including the Unitarian-Universalist "Gaian Community" of Kansas and the "Gaia House" meditation center in rural Devon, England. Some neo-pagans specifically employ the name of the Greek goddess in their ceremonies, while others, especially the ReClaiming Collective founded by Starhawk and the ReFormed Congregation of the Goddess established by Jade River, make ecological awareness a primary part of their worldview. Finally, a general-interest, Pagan, ecological magazine bears the name PanGaia and declares itself dedicated to "an Earth-wise spirituality."

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P Gaia Foundation and Earth Community Network

The Gaia Foundation (henceforth Gaia), a small international non-governmental organization based in London, is committed to the protection of cultural and biological diversity, ecological justice and Earth democracy. Gaia was established in 1984 by environmental and social innovators, mainly from Southern Hemisphere countries including José Lutzenberger (Brazil), Wangari Mathaai (Kenya) and Vandana Shiva (India), known as Gaia Associates. Their common vision is for a holistic approach to human development, with respect for cultural and biological diversity and the primacy of nature. Gaia, Earth Mother Goddess, is also the name chosen by James Lovelock for the hypothesis that the Earth operates as a living organism. This convergence of mythological and scientific thought is the basis on which indigenous knowledge systems are founded, and one of the underpinning messages of the Gaia Foundation (Gaia).

Gaia was privileged to begin its work in Amazonia through José Lutzenberger and Martin von Hilderbrand (Colombia) where it was initiated into the indigenous world of Earth-centered cosmologies, still intact. Common to all these cosmologies is the recognition that the Earth is part of a bigger universe, all of which is animated by "thought," consciousness, and spiritual force. Each element of the universe has guardian spirits with whom the shaman learns to communicate. Before any activity takes place, such as hunting, fishing, collecting food or medicine, the shaman asks permission from the guardian spirit of the species or the area to ensure the timing is appropriate. One of the fundamental principles which govern relationships within the human community and

with the wider Earth Community is reciprocity. This is the basis of all interactions in the universe, exchange and reciprocity.

This experience gave Gaia's founders an appreciation of how the modern human can nurture a sacred relationship with the Earth, where everything in the universe is understood to be imbued with the same spiritual energy, manifesting in different forms and levels of consciousness. While Gaia's work takes on many forms, the search is always for ways of stimulating a reverence for the Earth as a living being of which we are part.

Gaia's colleagues share the belief that industrial society has forgotten that we are an integral part of the wider community of life that has flourished on Earth. Our actions are based on the misperception that we are separate from and superior to the natural world. Consequently the way that industrial society functions is proving to be unsustainable and deeply damaging to the human spirit, other species, and the Earth herself.

There is a need for radical change in our worldview, behavior and understanding of the human role in the world. We need to recognize that we are members of the Earth Community: a spectacularly beautiful and intimately interrelated community of plants, animals, atmosphere, water, earth and energy. Each member is an expression of the ceaselessly creative whole that is the universe, and each has its unique part to play in the ongoing evolution of the Community.

As Einstein said, we cannot solve a problem at the same level at which it has been created. More efficient technology, recycling and reusing will not change the underlying cause of the problem: the crisis in the human-Earth relationship. We are an inextricable part of the wider Earth Community of species and elements, and if we harm any part of the whole we diminish the viability of the whole, and thereby ourselves.

The challenge facing our species as we move into the new millennium is to carry out the transition from a period of human devastation of the Earth to a period when humans are present to the planet in a mutually enhancing manner.

Toward this end, Gaia Associates met in 2003 to explore innovative ways of dealing with our escalating crisis in human consciousness. They asked themselves: What is it that will trigger enough of us to change our behavior to tip the balance away from self destruction? They concluded that the source of the problem is not that we need more information, but that we need to become conscious of the awesome evolutionary process of the Earth in which we are participating. The challenge is how to entice ourselves away from the mesmerizing industrial promises of instant gratification, and expose ourselves to experiences which transform our understanding of our role as humans in the wider Earth Community, such that our behavior changes.

It was out of this process that the "Earth Community Network" was founded – to provide individuals and communities with an experiential learning process in Earth Citizenship, and to promote Earth-centered systems of governance at all levels of society. The main sources of inspiration are nature (the primary text) and those cultural traditions that reflect equity and respect for the whole Earth Community. This is based on the understanding that for most of human history, our species evolved cultural systems that were highly adapted to their ecosystems through generations of accumulated knowledge, founded on observation and spiritual dialogue with the Earth Community over the millennia. During the last century, widespread documentation of these knowledge systems became available. Comparative analysis shows common archetypal patterns which provide us with the possibility of developing a unifying story. The Earth Community Network aims to explore this possibility together with Lovelock's Gaia Theory and the Universe Story of Thomas Berry and Brian Swimme.

Human transformation to a viable mode of being will require imagination and willingness to explore the unknown, so that fresh thinking can emerge.

Learning is not simply a logical conceptual process. We learn through all our senses, through experience and full-hearted engagement. Real learning is a transformation process. The learning centers in this network have evolved through decades of work with local communities from diverse cultural livelihood systems, mainly in Africa, Asia and South America. Against the ever-growing tide of industrial globalization, the challenge has been to enhance those governance systems that embody inter-generational equity, restorative justice, exchange and reciprocity with the community of life. These have been learned through observation of the Earth's laws, as basic principles by which the community and its relationship with the Earth is regulated. They therefore provide the foundation from which to develop a global governance system that coheres with the living Earth system, and can guide the industrial human back to Earth.

At the founding meeting of the Earth Community Network in Gaia House, London, May 2003, Thomas Berry spoke as a visionary for the Earth:

In the Twentieth Century the glory of the human has become the desolation of the Earth. The desolation of the Earth is becoming the destiny of the human. All human institutions, professions, programs and activities must now be judged primarily by the extent to which they inhibit, ignore or foster a mutually enhancing Earth-human relationship.

In these words he reminded us that sustaining life for future generations requires a more complex understanding of the dimensions that need to be nurtured by the life

process, as he pointed out that the universe provides beauty for the soul, wonder for the imagination, and intimacy for the emotions. It is simply a matter of awakening.

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Gaian Mass

In 1981, the Cathedral of St. John the Divine in New York City, the mother church of the Episcopal Diocese of New York, commissioned musician Paul Winter's "Missa Gaia" or "Earth Mass," an ecumenical liturgical composition aimed at expanding the traditional Christian celebration of the death and resurrection of Christ into a broader, consciously Earth-referent context. The Mass, recorded both in the institutional space of the Cathedral and in the wild space of the Grand Canyon, harmonizes human and non-human elements in a way that non-verbally communicates the message of a unified "whole Earth community." Drawing upon the voices of human chorus and sounds from humanmade instruments in conjunction with the "songs" of whales, wolves, and wind, the Mass embodies a theology of the senses that opens the way for participants to experience an intimate connection to the life community on a sensory, non-theoretical level.

The Mass itself has been performed each October since 1985 at the Cathedral of St. John the Divine on the Feast Day of St. Francis of Assisi (the patron saint of animals and, more recently, of ecology). An animal blessing is held in conjunction with the Mass, in which various beings from elephants and llamas to dogs and cats, even to fish and blue-green algae, process with humans down the aisle of the Cathedral to receive the Bishop's blessing. Over the course of two decades, the Mass has become a staple of "green worship," a common liturgy shared among humans of diverse religious backgrounds and in solidarity with other species. Winter's *Missa Gaia* has also come to stand for a kind of ecospiritual "interspecies ecumenism" that is

intended, ideally, to be translated from the worship space into practical "on the ground" action on behalf of the life community.

Winter has structured *Missa Gaia* explicitly as a "mass" and in doing so, he makes use of traditional, recognizable forms of liturgical music, such as a canticle, the Kyrie, the sanctus and the benedictus. The content of these traditional forms, though, has been "greened" to reflect the embrace of an ecological and cosmic consciousness. The canticle, for instance, takes the form of St. Francis's "Canticle of Brother Sun." There is also a "Sun Psalm" and other sections of the Mass that bear titles such as "Return to Gaia" and "For the Beauty of the Earth." The Mass' Earth anthem, "The Blue Green Hills of Earth," takes the conventional form of "anthem," but Winter infuses that form with "greener" content to emphasize planetary allegiance. This flexibility of form and content in composition not surprisingly translates into a flexibility of worship that includes liturgical dance and other modes of movement and gesture that enable the participants to play an active role in co-creating the ritual. There is also a flexibility of symbol, as evidenced by Gaian Mass celebrations, in which a 28-foot "world tree" has been pulled down the aisle of the nave, as a man stationed inside the tree beats a drum that has been built into its trunk. In other Mass celebrations, a gigantic planet Earth hangs above the transept and functions as the celebration's central sacred symbol.

The first performance of the Gaian Mass initially met with marked criticism from various institutional sources within the Christian community in the U.S. and Canada. This criticism is indicative of ongoing clashes in a number of religious communities between those who see the "greening" of religious practice as a force for spiritual and institutional regeneration and those who deem "greening" movements to be "heresy" and expressions of a dangerous "paganism." The late New York Roman Catholic Archbishop John Cardinal O'Connor castigated the Episcopal Diocese for promoting "biocentricity" through the Gaian Mass and for turning what are intended to be "celebrations of mankind" into celebrations of "snails and whales" (in Naar 1993: 24). Conservative clergy within the Episcopal Church were also rattled by the introduction of the Gaian Mass. A vocal clergy member from Pennsylvania chided the Cathedral of St. John the Divine for commissioning the Mass and quickly dismissed it as "a New Age gimmick whose novelty would soon wear thin" (in Naar 1993: 24). However, over time, it is telling that the same clergy person who initially dismissed the Mass eventually came not only to support its celebration but to refer to Reverend James Parks Morton, the former Cathedral Dean who commissioned the mass, as "a pioneer with the courage to challenge orthodoxy that was outdated" (in Naar 1993: 24). This shift in perspective highlights the fascinating negotiation process between tradition and change, in which clerical perspectives on the Gaian Mass have

morphed over the years from characterizing the celebration as "New Age apostasy" to embracing it as "innovative liturgical renewal."

The mainstreaming of the Gaian Mass both at the Cathedral of St. John the Divine and within the Episcopal Church reflects a climate of increased public acceptance of the growing partnership between religious organizations and the environment. Year after year, sold-out performances accomplish the formidable task of actually filling what is, incidentally, the largest gothic cathedral in the world, by packing 3000 to 4000 participants into each celebration. At a time when sociologists of religion cite grim statistics on the decline of mainline Christian congregations in the U.S. that suffer from anemic church attendance, the Gaian Mass's ecological message and body-active worship seem to have struck a chord with those who resonate with the comfort and beauty of traditional liturgical forms infused with ecospiritual content.

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SP Gaian Pilgrimage

A great pleasure I share with my wife, Sandy, is walking in the countryside enjoying the natural world. We are singularly fortunate to live in the southwest region of England where we can walk on the 630-mile path that winds its fractal way from the seaport town of Poole in Dorset. It goes west along the channel coast to Lands End and travels back east over the rugged cliffs of Cornwall and Devon to end where Exmoor meets the Bristol channel at Minehead in Somerset. This path is more than our longest trail, it is a contemporary pilgrim's way.

A pilgrimage implies something more than just a walk through the countryside. It suggests a goal, or a purpose, something spiritual. This trail, whatever the weather or the

season, always has the sea in view with its ever-changing color and motion. Such a view never ceases to uplift and enliven; but more than this, in the course of its undulations the path climbs a total of 91,000 feet, over three times the height of Everest. The effort sets free those natural opiates, the endorphins, which course through the blood and enhance the senses, so that we become aware of our part in the great system of the Earth, and then the trail is the pilgrim's way to Gaia.

The coast path proceeds uninterrupted for its whole length and it travels over rocks of widely different ages, from the fairly recent at Poole to the 300-million-year-old Devonian, where else but in Devon. To walk the path is to see displayed the fossil history of evolving life on its evolving planet, as in a live museum. At a time not accurately known, but over 600 million years ago, the Earth woke from its long three billion year sleep during which it was a habitat for microorganisms alone. The awakening brought forth the lively world we know of plants and animals, and our journey takes us back through more than half of the history of life forms such as animals and trees. But there is more to the coast path than a display of geology. What makes it so suitable as a pilgrim's way is that the shore and coastal strip between sea and land is the only remaining natural part of England where the plants and animals are primeval. All other parts of this densely crowded island people use for their own needs, as they do most of the inhabited Earth, so that everywhere it reflects their history, not the Earth's. Not only this, but the sea is also forever cutting away the land so that on the fresh faces of the cliffs we can see the timeline of the Earth's history revealed in the rocks and the fossils they bear. There is no better place to get to know our living planet, Gaia, and begin to glimpse our part in it.

The scientific Gaia theory views the Earth as a self-regulating system comprising all life, the air, the ocean and the rocks, that has always kept itself habitable. The theory has been much misunderstood by scientists and some have been unwise enough to condemn it without knowing what it was they condemned. The eminent physicist, Richard Feynman, said "Anyone who claims to understand quantum theory probably does not." The same is true, although for different reasons, of Gaia theory. Quantum theory is incomprehensible because the universe itself is far stranger than the human mind can contemplate. Gaia theory is difficult to understand because we are not used to thinking about the Earth as a whole system. We often forget that almost all of the science of the nineteenth and twentieth centuries was reductionist. The triumphs of evolutionary and molecular biology that revealed the nature of our genes, the fact that we can almost see the edge of the universe and know the intricate details of inner parts of atoms, all this has come from the patient professional dissection of nature into its component parts. Systems science, which is about the whole not its parts,

has illuminated physiology, the understanding of the way our minds and bodies work, but its successes are lost in the omnipresence of reductionism. Modern science is so steeped in reduction that it is often unaware that there is any other science; the Nobel Laureate biologist, Jacques Monod, even called holists (system scientists) stupid. Gaia theory is a systems science of the Earth, geophysiology, and it requires knowledge of the sciences ranging from astrophysics to zoology and with most other disciplines of science included.

Soon after the start of the trail in the county of Dorset we walk over chalk cliffs, a layer of white rock, more than 1000 feet thick, and made entirely of the shells of algae that lived in the ocean during a period before 65 million years ago. From the cliff-top vantage point we can look out to sea where the similar microscopic algae are now living in its surface, and wonder about their remote ancestors, whose shells sedimented onto the sea floor only to be uplifted and dried by the Earth's tectonic forces so as to become these cliffs. The path we tread is not dead ground; we tread on the living Earth. The chalk cliff represents the sequestering of about thirty atmospheres of carbon dioxide gas. Were most of the carbon dioxide in the atmosphere instead of in those fossil shells we would be on a dead planet half as hot as Venus. These algae did their part over tens of millions of years and so made sure that the carbon dioxide of the air was kept at a level conducive to a favorable climate and yet still sufficient for the needs of plants. Their skeletons, on which we stand, are the record of their contribution. Like the algae, all life, including us, evolves in a world that is made from the breath, the blood and the bones of our ancestors.

All living things are recondite and they are difficult to understand because we are not used to the circular logic of systems where cause and effect are inextricably tangled. Consider the complexity of the connection between blooms of algae living in the ocean, these chalk cliffs, and the climate. We could start by researching the way the different species of organisms in the ocean surface live with one another, but we would soon find that we needed to know the chemistry and physics of the ocean surface and the way the algae use the carbon dioxide to make their shells, and the way that CO₂ in the air keeps the Earth warm. But this would be less than half the story that the algae could tell. Through the inspiration of Gaia we discovered that algae could powerfully affect the climate in another way. Their response to the saltiness of the ocean causes them to synthesize the precursor of a gas, dimethyl sulphide, which plays a vital part in the cycle of the essential element sulphur between land and sea, but this gas is also part of Gaia's climate-control mechanism. Dimethyl sulphide oxidizes in the air to become tiny droplets of sulphuric acid, and without these, clouds would be fewer and less dense and the Earth a much hotter place. So we also need to know the chemical reactions in the air,

the physics of cloud formation, the way that clouds affect the Earth's radiation balance and the way all these related processes affect climate. More than this we still have to understand how climate feeds back on the growth of algal blooms, and this is just a small part of Gaia. No wonder the denizens of separated scientific disciplines are uncomfortable with this four-letter word, Gaia, which requires the understanding of a dozen or more apparently unconnected sciences.

As we walk on and leave the chalk cliffs behind we travel further back in time to the Jurassic period, made so familiar by Michael Crichton's novel *Jurassic Park*. We come first to the Purbeck limestone brimming with the man-sized spirals of fossil ammonites, and then on to the dark and somber cliffs of Kimmeridge shale. I recall the thrill of excitement felt when walking on a beach in this region and seeing, as if drawn in chalk, the white skeleton of an ichthyosaur on a flat black slab of shale. Walking on westward we come to Devon with its red sandstone cliffs dating back close to the time when the multicellular life of our world began. After Devon the westward trail takes us on to Cornwall and to Lands End. The cliffs now are of basalt and granite, there are no fossils in these rocks. They are the slag of past volcanoes and tectonic events. These dead rocks were once orange hot and molten but they are still part of our living planet. According to Gaia theory, plate tectonics and the persistence of water are the unique properties of a planet with abundant life. Further on, the trail turns east along North Cornwall's rugged coast until we reach the Cambrian rocks of Devon again where the uplands of Exmoor reach the sea. The trail ends in rocks of the Jurassic period at the Somerset town of Minehead, and from here we return home to the present and to think about our own relationship with Gaia.

Our planet is a unique member of the solar system. It is special not just because it bears life. The moon did not become a living system when the astronauts walked on it, nor would the discovery of an oasis of bacteria on Mars or Europa make them living planets. What makes the Earth special is not just the abundance and diversity of life but that our planet has always kept its material conditions habitable for them. On Earth the evolution of the living organisms and the evolution of their material environment have, since life began, gone forward tightly coupled together, and from this single evolution has emerged the self-regulation of the climate and chemistry, so that always the Earth was habitable. A consequence is that now and in the past the air, the ocean, and the rocks that go to make up the Earth's surface are utterly and impossibly different from those of a dead planet like Mars. They are as different as we ourselves are from a stone statue.

The coast path is a fine place to sense the presence of Gaia but a full understanding is probably beyond the most capable minds alive today. Gaia theory is not contrary to Darwin's great vision; but I suspect that it will be some

time before biologists and geologists collaborate closely enough for us to see the emergence of a truly unified Earth System science. The Oxford biologist, William Hamilton, in a television interview, referred to the Gaian view of evolution as Copernican, but added, we await a Newton to explain how it works.

Science is often said to be ethically neutral and the good or bad consequences of its application are attributed to those who apply it. The philosopher, Mary Midgley, reminded us that Gaia has influence well beyond science. She said,

The reason why the notion of this enclosing whole concerns us is that it corrects a large and disastrous blind spot in our contemporary world view. It reminds us that we are not separate, independent autonomous entities. Since the Enlightenment, the deepest moral efforts of our culture have gone to establishing our freedom as individuals. The campaign has produced great results but like all moral campaigns it is one sided and has serious costs when the wider context is forgotten (2000).

One of these costs is our alienation from the physical world. She went on to say:

We have carefully excluded everything non-human from our value system and reduced that system to terms of individual self interest. We are mystified – as surely no other set of people would be – about how to recognise the claims of the larger whole that surrounds us – the material world of which we are a part. Our moral and physical vocabulary, carefully tailored to the social contract, leaves no language in which to recognise the environmental crisis (2000).

President Havel of the Czech Republic expressed similar thoughts when he was awarded the Freedom Medal of the United States, and he took as the title for his acceptance speech, "We are not here for ourselves alone." He reminded us that science had replaced religion as the authoritative source of knowledge about life and the cosmos but that modern reductionist science offers no moral guidance. He went on to say that recent holistic science did offer something to fill this moral void. He offered Gaia as something to which we could be accountable. If we could revere our planet with the same respect and love that we gave in the past to God, it would benefit us as well as the Earth. Perhaps those who have faith might see this as God's will also.

Four billion years of evolution have given us a planet unsurpassed in beauty. We are a part of it and through our eyes Gaia has for the first time seen how beautiful she is. We have justified our ancient feeling for the Earth as an organism and should revere it again, and what better way

to do it than by a pilgrimage. Gaia has been the guardian of life for all of its existence; we reject her care at our peril. We can use technology to buy us time while we reform but we remain accountable for the damage we do. The longer we take the larger the bill. If you put trust in Gaia, it can be a commitment as strong and as joyful as that of a good marriage, one where the partners put their trust in one another and since they are, as Gaia is, mortal, their trust is made even more precious.

James Lovelock

Further Reading

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- See also: Epic of Evolution; Gaia; Gaia Foundation and Earth Community Network; Gaian Mass; Science.

Gandhi, Mohandas (1869–1948)

It is tempting to think that Gandhi may have been an "early environmentalist" and yet there seem to be insuperable problems in embracing this view. He was remarkably reticent on the relationship of humans to nature, and it is striking that he never explicitly initiated an environmental movement, nor does the word "ecology" appear in his writings. Though he was greatly animated by the subject of cow protection, the 50,000 pages of Gandhi's published writings have otherwise little to convey about trees, animals, vegetation, and landscapes.

It is also doubtful that Gandhi would have contemplated with equanimity the setting aside of tracts of land, forests, and woods as "wilderness areas." The enterprise of retreating into the forest was familiar to him from Indian traditions, but Gandhi spent an entire lifetime endeavoring to remain other-worldly while wholly enmeshed in the ugly affairs of the world. The problems posed, for example, by the man-eating tigers of Kumaon, made famous by Jim Corbett, would have left less of a moral impression upon him than those problems which are the handiwork of humans who let the brute within them triumph. It is reported that when the English historian Edward Thompson once remarked to Gandhi that wildlife was rapidly disappearing in India, Gandhi replied: "wildlife is decreasing in the jungles, but it is increasing in the towns."