Timeline

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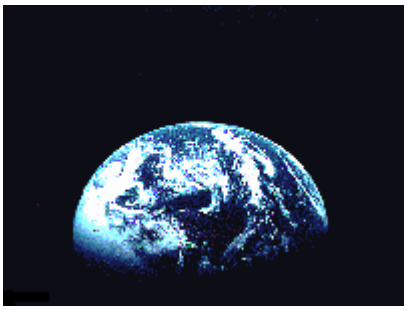

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A Walk Through Time
From Stardust to Us

Imagine a walk where every foot transports you a million years in time. Just such a mind-expanding premise inspired this landmark book, developed from the acclaimed *Walk Through Time* exhibit on tour around the world.

Just published by John Wiley & Sons, the book portrays the remarkable drama of the history of the universe and life on Earth.

Over 150 beautiful four-color illustrations and an absorbing narrative highlight significant events and themes in Earth's life story. The original exhibit itself is recreated as a timeline that runs throughout the book, pinpointing key stages in the evolutionary drama and where they fall in the vast sweep of time.

Readers will gain a new appreciation of the rich complexity of the life processes of the planet eons before the appearance of large-scale plants and animals. On the mile-long scale of the original Walk, for example, microbial life appears a little more than 1000 feet after the Walk begins and remains the sole life form for most of the mile. Humans appear in the last three feet!

By relating life's story according to the true timeline of evolution, *A Walk Through Time* highlights just what latecomers we humans are to Earth's family of life, and shows the surprising ingenuity and stamina of the microbial life that preceded us and still supports the life all around us. The book also reveals the stunning effects the human species has wrought in so short a span of time, precipitating what could rapidly become the largest species extinction in 65 million years.

All along the way, readers are informed of the most important recent discoveries, exploring, for example, the exuberant creativity of early life forms and learning about their surprisingly cosmopolitan lives, interconnected in a teeming web of symbiotic relationships described as the first "world wide web" of information exchange; the many mysteries being unraveled as scientists probe the code of DNA; how the universe coalesced into galaxies and planets; and how microscopic animals can survive in such superheated environments as deep-sea vents in the ocean and deep inside Earth. Most importantly, it becomes apparent that we can no longer perceive Earth as an inert lump of rock with an assembly of different life forms, but must understand that our planet is comprised of one comprehensive, intricately woven life system.

Those who read *A Walk Through Time* will gain a new understanding of the wondrous history of the development of life, a feeling of awe and inspiration for the complexity and beauty of the processes that have made life possible over billions of years, and a greater appreciation for the growing impact the human species is having on the future of all the myriad forms of life, including our own.

The preface and epilogue for the book were written by Sidney Liebes, Ph.D., a physicist with research and teaching careers at Princeton and Stanford Universities. He recently retired as a research manager and senior scientist at

Hewlett-Packard Laboratories. Dr. Liebes was the initiator and creator of the original *Walk Through Time* exhibit.

A Cosmic Prologue was written by Brian Swimme, Ph.D., a mathematical cosmologist, author of *The Universe Story* (with Thomas Berry), and creator of the video series, *Canticle to the Cosmos.* Dr. Swimme is a member of the graduate faculty of the California Institute of Integral Studies in San Francisco.

The main narrative for the book was written by Elisabet Sahtouris, Ph.D., an evolutionary biologist and consultant to the United Nations. She has taught at the University of Massachusetts and M.I.T. and served as a science writer for the Horizon/NOVA television series.

Copies of the 224-page hard-cover volume will be in bookstores nationwide this fall in time for holiday gift-giving. Readers of Timeline can order books directly from the Foundation at the special price of $25.00 which includes tax and shipping.

If you have access to the internet, you can get current information about the book as well as the *Walk Through Time* exhibit and its future appearances at http://www.globalcommunity.org/wtt/

The Human Predicament: Where Do We Stand Now?

Excerpts from a talk by Anne Ehrlich

Anne Ehrlich is a senior research scientist in biology at Stanford University. She has co-authored ten books, the most recent of which is The Betrayal of Science and Reason, *which she says that she and her husband, Paul, wrote to counteract the large body of misinformation that they call "brownlash." She serves on several boards, including the Pacific Institute for Studies in Environment, Development and Security, and the Sierra Club. The following are excerpts from a talk Ehrlich gave earlier this year at the Foundation for Global Community's Center in Palo Alto.*

I am going to talk about the human predicament in general and where we are right now, looking at population, resources, and the environment situation of the world at this interesting time. The Cold War is over. Much has changed in the last few years, some things for the better, some for the worse. If nothing else, the world is much more aware of the problems that we face, and that obviously is the first step to solving them. So that's part of the good news.

Also good news is that, although we have a population explosion, it's not going as fast as it has been or as fast as we thought it might only five years ago. In fact, the slowdown is fairly dramatic if you look at it over a long time span. Back in the 1960s, the global population was growing at more than 2 percent per

year. It dropped to only about 1.7 percent in the 1980s and sort of hung there without much change during that entire decade. And then in the ’90s, it began dropping again. Now we’re down to about 1.5 percent per year, maybe slightly below, and birth rates are falling rather rapidly. Interestingly enough, they’re falling virtually everywhere in the world, particularly in the developing world, which is, of course, where they have been high in recent decades. Even in the part of Africa south of the Sahara, which until almost1990 showed absolutely no sign of a slowdown, rates are dropping in quite a few countries, and in some they’re dropping rather rapidly.

However, the population explosion is not over yet. We still have many decades of growth ahead of us because of a phenomenon called “population momentum.” If you have a population that has been growing rapidly in the past, it takes a long time to wring that growth out because each generation is larger than its parent generation or the grandparent generation. And all those children have to grow up and become parents themselves. And then they live for a generation or two before they begin to die of old age.

So in spite of lower birth rates, world population will still pass six billion some time in 1999. Thus, if the United Nations’ population projection proves accurate, we will be adding three and a half billion more people to the world in the next 50 years—not exactly an inconsiderable number! How are we going to manage that extra three and a half billion people in the next 50 years, and what do we do in the 50 years after that? Will the population reach a peak and then begin to decrease? Will it peak sooner? We don’t know. But in any case, if we are wise we had better make plans for accommodating those additional people, not only up to 2050 but for the centuries after that.

What are the conditions of life for people on this planet today? They’re not all rosy everywhere, as I’m sure you know, but there are some positives. Though the income gap between the richest and the poorest people in the world is still widening, things have improved in the last 40 years even for the poorest people on the planet. Fewer people in absolute terms and as a percentage of the total population are undernourished today than 30 or 40 years ago. Access to safe drinking water is a serious problem in many poor countries, but is slowly improving. Access to sanitation is also improving but it is still too low.

Infant mortality has been dropping steadily. Literacy rates have risen, though in many countries not far enough. Life expectancy has continued to increase. Use of contraceptives has spread around the world, even though there are at least a hundred million couples who still lack access to contraceptives. The fact that more than half of the world’s women are using contraceptives is a major victory.

What about food? The outlook is not encouraging. Production of major grains in the world has virtually tripled since 1950, a really spectacular record when you think about it. But there has been no increase in grain production per capita since about 1985, an ominous fact that most of the world hasn’t particularly noticed, in spite of Lester Brown [of

WorldWatch Institute] who keeps telling us we're in trouble. Moreover, most of the grain increase has gone to the richer half of the population, not to the poorer; and much comes to us indirectly in the developed countries because we consume our grain by feeding it to cows first—a very wasteful way to do it. And, as people around the world become more prosperous, they add more meat to their diets. This means that world grain production has to increase even more rapidly than it would just to meet the demand for a growing population.

Food production depends not only on high-yield crops, fertilizers, and pest protection, but also on the resources that underpin the whole system—land, soil, water, and natural pest control. Studies by UN agencies have found significant degradation of productive land—cropland, pasture, and forest—on every continent. The UN studies found levels of degradation as high as 65 percent on Africa's land and as high as 75 percent in Central America. Slight degradation of the land can be repaired with time and effort, but with extreme degradation, there's just no hope of ever recovering productivity on the land; it's basically destroyed for practical purposes. Land degradation undermines our attempts to raise food production; it's a serious problem and is increasing everywhere.

Much of the land that has been put to the plow recently is in tropical, moist forests, which cannot long sustain agriculture. Earlier attempts to farm arid lands in the former Soviet Union failed disastrously. In the moist tropical forest, particularly in places like Brazil but also in Africa, what you see is a pattern like this: settlers move in, cut down the forest and burn it or sell off the logs if they can, and plant crops. They raise crops for five years perhaps, and then their soil is exhausted. Maybe they can raise cattle for a little while longer, but then the soil is so degraded that it's of no use for anything, and it's abandoned. Meanwhile, there are settlers opening further land. The forests are being cut down in this process at a rapid rate for very little gain.

On lands that are productive and can sustain agriculture over a long term, the Green Revolution did succeed in doubling, tripling, and even quadrupling yields in the major crops. The optimists are out there saying "Oh, yes, we'll double and triple grain yields again—don't worry." But there's no encore in sight that matches that kind of performance. What we can do is extend Green Revolution technology to other crops, more obscure ones, particularly ones that are grown in the tropics. But that's a relatively small contribution. Biotechnology is often mentioned as the hope of the future, but what it's good for is doing things like improving pest resistance or resistance to drought or tolerance to saline soils—things that will make marginal increases here and there but are not going to double or triple the global grain crop in the foreseeable future. One way that might increase food production fairly rapidly without a lengthy scientific program that takes years of crop development and field testing is to improve the way food is stored in developing countries, where up to 50 percent or more is lost to insect and rodent pests.

Altogether, we face a crunch in the food situation in the next few decades. As yet, this crisis hasn't gotten much public

attention. I suppose what it's going to take is a big failure or a shortfall in the crops in a vulnerable year, such as we have right now. If that happens, you can expect that, first, food prices will go up. That won't hurt Americans very much, but it will hurt the poor of the world because they are already living on the edge. They are hungry simply because they can't afford to buy enough food. But a worldwide food shortage will create a problem for food aid, too: if supplies are short, who's going to supply free grain for the poor? Nor will the food increases come from the ocean: Seventy percent of our marine fisheries are fully or over-exploited.

The rate, the scale, the combinations of changes that we are exerting on this planet, are completely unprecedented. Small wonder we're losing biodiversity; small wonder we have endangered species! We're paving over, plowing under, cutting down, poisoning and flooding natural ecosystems, while blocking movement or transporting alien specimens. And now we're adding climate change to the things that we do to all the other organisms we share the planet with. Tens of thousands of species are lost every year. Most of them are obscure; you never hear of them. They're different kinds of worms or insects or mites, little creepy, crawly things you wouldn't even think of as having any value. Yet they do. They're part of an ecosystem. Many of those tiny creatures live in the soil, and they're what makes it fertile. Biologist E. O. Wilson calls them "the little things that make the world work."

It's been estimated by biologists that we will probably lose 10 percent of the number of species in the world by 2020. Imagine the potential values we haven't yet discovered among the many organisms that are out there. Other cultures may know, but we need to explore what those cultures know before the organisms themselves disappear. And the drug companies are very interested in what happens in tropical forests, which is a great source of new drugs.

But the most important potential loss, to biologists at any rate, and the one that the general public knows least about and appreciates least, is that of ecosystem goods and services which organisms interacting and functioning within the ecosystem provide for us. These include such things as the composition of the atmosphere—the gases that we like to breathe. Indeed, oxygen itself is the result of biological activity over billions of years. Another service is moderation of climate and weather, including the hydrologic cycle. So when we cut down the forests in a watershed, streams may dry up, the weather changes, it is hotter and drier, we have floods and droughts that we didn't know we could have. Natural systems also help recharge aquifers. If you pave over an area, it's a funny thing—the water doesn't get down to the water table. But when you deforest an area, rainwater doesn't soak in and reach the water table either; it runs off in floods, eroding soil and silting up the rivers.

Another service is soil building, nutrient cycling, and waste disposal, which are all functions of the cycles run by organisms. We have learned to harness some of the same organisms to do it for us in our sewage treatment plants. This cycle of

nutrients allows us to grow our crops and maintain an agricultural system. Without it, no agriculture. Detoxification is also a natural process. Most of the toxic substances that we so wantonly spew around in our environment are broken down by organisms. The vast majority of pests and diseases that could attack us are controlled by nature. Too often, in fact, we use pesticides and antibiotics so freely that they lead to the development of resistance and make the pest and disease problems much worse than they might have been. Finally, natural ecosystems provide us with food, wild game, fish, forest products, and the vast genetic library that is the source of all these goods and services and of the dazzling variety of life that one finds in nature.

Most of our environmental problems increasingly are global ones, as is our economy and, to some extent, our culture. As communications improve, we can e-mail someone around the world in a flash. We can see people around the world when we turn on TV. The world is being knit ever closer together. In some ways it's a danger, but in many ways it is a key to the future, and a key to solving our problems together. The world is in our hands in a very real sense, as is the future of our children and our grandchildren. Will we continue to encourage smaller families everywhere? Will we try to make our food production system more sustainable even while we have to keep expanding our harvests? Will we develop a more sustainable, efficient energy system and help the rest of the world to find it, too? Will we encourage our industries to move towards a zero emissions behavior—no more toxic wastes? Will we act to preserve the remaining fragments of natural ecosystems the planet has and strive to restore some of the degraded ones while it's still possible? Will we protect and restore our oceanic resources or drive the fisheries to extinction?

These are the choices we have to make now in order to avoid spoiling this beautiful, unique, and amazingly livable planet. We need to educate our politicians, our business leaders, everyone, as well as our children. On this imperative I hope you will help. The good news shows that we can accomplish miracles when we understand what needs to be done.

Living on the Edge of Evolution

"My biggest insight was that the intellectual work concerning values to guide cultural change was secondary to the fact that the very effort was already transforming the people involved — understanding that every person was essential: each held a part of the answer."
A seminar participant

Five years in development, a new program entitled *Living on the Edge of Evolution* was recently launched in a three-day training seminar for course leaders at our Sequoia Seminar retreat facility in Ben Lomond, California.

The program consists of a day-long introductory workshop, eight weekly meetings, and a weekend seminar. It involves a variety of experiences and approaches, including lectures, small and large group discussion, individual and group exercises, reading, daily practices, and meditation. A printed invitation to the new program describes its purpose and goals.

"The power of culture over our lives is pervasive. It influences practically everything we do—from the trivialities of what we eat and how we dress, to the profundities of how we try to achieve meaning and purpose in our lives.

"In our culture, the prevailing attitudes, values, and beliefs that guide our collective behavior—from unbridled materialism to rampant individualism — are devastating the life systems and human communities of the Earth. The American Dream has become a global nightmare.

"But with this crisis comes profound opportunity. A whole new population — more idealistic and globally oriented— has emerged in the world in the last decade. These people share a number of attitudes and beliefs: an interest in self-actualization and spirituality; a desire to live a simpler lifestyle; a need for society to rebuild communities; a sense of nature as sacred; and a concern for the global environment. Attitudes and beliefs like these form the basis of what is called an integral culture. A leading study suggests there are about 25 million Americans who think this way, presenting a real possibility of positive cultural change. Our mission is to make this possibility a reality.

"All culture is ultimately rooted in our understanding of who we are, where we have come from, and where we are going. We believe the root of our cultural crisis is that our current answers to these age-old questions are obsolete. What information—from science, the wisdom traditions, and contemporary thought—can help us discover more adequate answers?"

Living on the Edge of Evolution is a participative exploration of how, together, we can evolve an integral culture.

Attending the training seminar in August were 47 people from California, Colorado, Georgia, Maryland, Massachusetts, Oregon, Washington, and British Columbia. If you live in one of these areas and would like to attend a Living on the Edge of Evolution course, please write to Amy Beare or Joe Kresse at the Foundation for Global Community, 222 High St., Palo Alto, CA 94301 or call (800) 707-7932.

Another training seminar for course leaders is planned for 1999. If you would be interested in attending, contact either Amy or Joe.

Putting a Price Tag on Mother Nature

by Donella Meadows

Well, folks, now we know. Nature is worth $33 trillion a year. That's a medium estimate. The real value could be as low as $16 trillion or as high as $54 trillion.

To put those numbers in perspective, the value of the entire output of the world economy each year is $18 trillion. That comes to $3,000 a year, on average, for each human on the planet. Nature provides goods and services worth somewhere between $2,600 and $9,000 per person per year. The calculation was made by a team of ecologists, economists, and geographers from 12 prestigious universities and laboratories in three countries. It was published in the journal *Nature.*

If you are uncomfortable with this exercise, if you are thinking, "Hey, wait a minute, there's something wrong with the whole concept of putting a dollar value on all life," good for you. You are a sane person in a crazy world.

The most obvious wrong is taking something that is so clearly beyond value and reducing it to money terms. It's like valuing the Taj Mahal or St. Peter's Church by yearly tourist revenues. It's a confusion of value with price, beauty with numbers, the sacred with the profane.

Furthermore, the living biosphere is more than a magnificent creation (or the product of 12 billion years of evolving wisdom) that many of us consider sacred. It's also, quite pragmatically, our life-support system. Measuring it in dollars is like calculating the rent you owe your mother while you're still in her womb. As ecologist David Ehrenfeld said to *The New York Times*, when asked to comment on the new nature-valuation, "I am afraid that I don't see much hope for a civilization so stupid that it demands a quantitative estimate of the value of its own umbilical cord."

Or, as E.F. Schumacher said two decades ago, "To press noneconomic values into the framework of the economic calculus is a procedure by which the higher is reduced to the level of the lower and the priceless is given a price. All it can do is lead to self-deception or to the deception of others; for to undertake to measure the immeasurable is absurd. What is worse and destructive of civilization is the pretense that everything has a price."

There are, of course, plenty of people who are stupid or soulless enough to think that everything has a price. They are the ones who do cost-benefit analyses to prove that an old-growth forest is worth more as logs than it is standing and living. They can't see why a billion-dollar gold mine should be stopped just because it would poison waters for miles downstream. They look at soaring land values in San Diego County and have no trouble with the concept that condominiums are worth more than the creatures that still live in the remaining scraps of coastal sage scrub.

Let's admit it, there's some of that crassness in all of us when it comes to building our homes, driving our cars, earning our livelihoods. We're products

of our civilization. We all succumb to the delusion that we live from dollars.

That's why the scientists who tried to calculate nature's value did it. They know they're trying to measure something that is invaluable, and they are also well aware that scientifically their attempt is full of heroic assumptions. Their paper is full of caveats and cautions, the most important of which is that their estimate is certainly much too low.

They did the best they could. They divided the Earth up into 16 categories, such as coastal ocean, open ocean, tropical forest, and grassland. For each they estimated the value of 17 kinds of "ecosystem services" supplied by that type of land- or seascape. That list of services is their most useful contribution, because it reminds us of what nature does for us without charge.

Pollination, for example. Imagine having to go out and carefully brush, one by one, against the gazillions of apple blossoms that open in the orchards of New England. Waste treatment—what would happen if countless bacteria and other critters didn't eagerly consume our sewage, whether in a treatment plant or a running stream? Soil formation—I suppose we could grind up rock and throw fertilizer into it, but that wouldn't be living, self-perpetuating, renutrifying soil.

Here are some of the other ecosystem services on the list. Climate regulation. Nutrient cycling. Control of pest populations. Species protection. (Think of what it costs to keep an endangered animal alive in a zoo, compared to a native habitat.) Food and raw materials, lumber, paper, fish, game (one of the few items on the list that has established market values). Maintenance of the mind-boggling library of genetic resources. Then there's the imponderable category the authors call "cultural"—the aesthetic, artistic, educational, spiritual, and scientific value to us of our living world.

The number the scientists came out with for the value of these services is not even close to a good measure of their real value. It is, however, a clear measure of the desperation of the scientists. They have been trying to tell us for decades the value of what we are thoughtlessly destroying. Now they're trying to speak in a language they think we can hear.

They admit that their estimate is rough. It could be too low by a factor of 10 or a hundred or a thousand or a million. But it's much more accurate than the value the market now gives to the natural systems that support us—zero.

Donella H. Meadows, a systems analyst, author, and adjunct professor of environmental studies at Dartmouth College, writes a syndicated article each week to "present a global view, a connected view, a long-term view, an environmental and compassionate view." Timeline readers who feel that these articles deserve the widest possible distribution are encouraged to contact their local newspaper editor and suggest the paper carry them. Meadows can be reached at The Global Citizen, Box 58, Plainfield, NH 03781.

Blips on the Timeline

The term "blip" is most often used to describe a point of light on a radar screen. Gathered with the assistance of Research Director Jackie Mathes, here are some recent blips which indicate positive changes toward a global community.

Protecting Species

A complete list of the world's 1.5 million known species, with links to relevant scientific papers, should be available on the World Wide Web by early next century. Known as the Global Biological Information Facility (GBIF), the $300-million project is the most ambitious ever in biodiversity conservation, and will link information stored in museums and research institutes around the world. "Most countries do not even know what bio-diversity they have, so they can't mobilize their scientific resources effectively to conserve it," said Jim Edwards of the U.S. National Science Foundation, who chairs the working group. With the global information readily accessible, it is expected that rich nations, which hold the most biological information but are home to relatively few species, will cooperate to assist poorer countries where most species are found.

Public Pressure

The Securities and Exchange Commission (SEC) packaged a set of proposed new regulations that would stifle the ability of any shareholder to challenge corporate misconduct. The proposed rules would have made it virtually impossible to sustain critical shareholder advocacy campaigns on issues such as apartheid in South Africa, the sale of tobacco to American youths, environmental degradation, and the use of slave labor abroad. Public pressure and strong media interest in the case resulted in defeat of the proposed new regulations, and new ones were approved that will let shareholder resolutions, including corporate employment issues, be put to investor votes at annual meetings.

Aiming Higher

As a Stanford University freshman, Chris Bischof became a volunteer mentor and tutor for high school students in the neighboring community of East Palo Alto. For his senior thesis he created Shoot for the Stars, a successful program that linked participation in an after-school basketball program with attendance at daily study hall sessions. After earning a master's degree in education, Chris started to work on his dream to open a college preparatory school. "The concern is that many students in this community are not having high expectations set out for them," said Chris. "If you have low expectations, you're most likely going to settle for that lower norm. There was a tremendous need to be able to offer a challenging academic environment for students in the community." In 1996, Eastside College Preparatory School opened with eight eighth grade students. Now there are 20 students, three teachers, several volunteers, and a principal—Chris. It could have been difficult for Chris as a white to sell the idea in a predominantly minority area, but to Eastside parents, what matters is the quality of education offered.

Corporate Cooperation

Thirteen mega-corporations with world-wide revenues of $340 billion are breaking ranks with industry and teaming up to sound the alarm about global warming and climate change. The new coalition, called the Pew Center on Global Climate Change, includes British Petroleum, Boeing, Lockheed Martin, Toyota, 3M, United Technologies, Whirlpool, Sun Oil, Enron, Maytag, and three electricity firms. Financing will come from a grant by Pew Charitable Trusts, a leading environmental philanthropy. The center will focus on educational programs and advertising campaigns about global warming.

Science and Spirit:
Integrating the Sacred and the Secular

A talk by Will Keepin

Will Keepin, Ph.D., is a mathematical physicist. He was Hewlett Fellow at Princeton University and research scholar at the Royal Swedish Academy of Sciences and the Energy Foundation. He has completed the Grof Transpersonal Training and has extensive group facilitation experience, having led over 80 experiential workshops in the United States and abroad. He has published 25 articles and is on the adjunct faculty at the California Institute of Integral Studies. He is co-director of the Shavano Institute in Boulder, Colorado, where he manages the project "Leading with Spirit: Transformational Leadership for Social Change." Recently, Keepin gave the following talk on the physicist David Bohm at a Foundation workshop.

At the cutting edge of science now, there is a cross-disciplinary theme that's emerging in field after field—in biology, physics, nonlinear dynamics, artificial life, complexity theory. This new idea is that beyond the physical realm, there exist invisible patterns and principles that somehow organize what we observe and experience. This development is very exciting, because it is pointing western science in an unprecedented direction toward the existence of a realm beyond the observed, material, empirical world. Science is discovering that something transpires behind that which appears.

I want to talk about this development in one particular field, physics, and the work of David Bohm. Bohm was a colleague of Einstein's at Princeton University. But he lost his job at Princeton and had to leave the United States during the McCarthy hearings era because he refused to testify against Robert Oppenheimer, with whom he'd gotten his Ph.D. Because of that he was essentially exiled. He went to Brazil for a while, and Israel, and ended up in London for the last 35 years of his life. Most of his work was done at the University of London.

Bohm was driven by a deep passion to understand the nature of the Universe. He felt this was the true purpose and spirit of science—a quest for deep understanding of the truth of existence.

He was disturbed by the fact that many scientists saw science as a kind of discipline for prediction and control of the Universe, or of its systems, whereas he felt that its primary purpose was in effect a kind of spiritual quest.

In Bohm's own work, he not only delved into scientific experiments and theories—and he was a master at both—but he also carried his quest into other disciplines. He looked into art, for example, to try to understand the order in art and to glean which aspects of reality artists are trying to capture. He also had extensive dialogues with spiritual masters, including a twenty-year dialogue with Krishnamurti, the Indian sage. He had many conversations with the Dalai Lama and other masters, exploring their epistemologies of inner inquiry—their "way of knowing." In addition to the scientific way of knowing, he wanted to explore these other ways so that he could "triangulate," so to speak, on the nature of reality—taking into account the broadest possible range of data and forms of inquiry.

Bohm had noticed a fundamental contradiction in modern physics which didn't seem to concern most physicists: The twin pillars of modern physics, Quantum Theory and Relativity Theory, were contradictory at their foundation. Quantum Theory required the nature of reality to be discontinuous, nonlocal, and noncausal. In contrast, Relativity Theory required reality to be continuous, local, and causal. So here were these fundamental properties of the nature of the Universe that were in utter contradiction.

Contemplating this, Bohm asked, "Well, what do these two branches of modern physics have in common? What is unifying here?" And the answer emerged: wholeness. Both theories proposed that the universe is an integral whole, and that the laws of physics apply everywhere, from the microscopic to the macrocosm. So, he said, let's start with wholeness itself, and build a theory from that foundation which is consistent with the data of both Quantum Theory and Relativity Theory.

And what he came up with—over a thirty-five year period—was a proposal that the essence of the universe is what he called the holomovement. "Movement" meant that the nature of existence is a process of continual change, and "holo" meant that it has a kind of holographic structure, in which each part contains the whole. To quote Bohm precisely: "The cosmos is a single, unbroken wholeness in flowing movement." Notice that the holomovement is similar to a synthesis of two ancient spiritual principles: (1) the Buddhist teaching of impermanence—the notion (also from Heraclitus) that the nature of manifest existence is perpetual change, and (2) the microcosm is the macrocosm, as characterized for example in the Hindu mythological image of Indra's Net, wherein reality is represented as an infinite lattice of glistening jewels, each of which reflects all the others.

So for Bohm, the nature of the cosmos is a single, unitive process—an unbroken, flowing wholeness in which each part of the flow contains the entire flow. Each part of the flow replicates the totality of the flow—a structure analgous to

"holons" as discussed extensively in the work of Ken Wilber.

Furthermore, Bohm proposed that there are two fundamental aspects to the holomovement: the explicate order and the implicate order. Now why—after we've just said it's a single wholeness—are we introducing two aspects to it? Does this mean we are creating a duality in what is actually a unity? No, because the explicate and implicate order only appear as distinct—although convincingly so—because of our perceptual limitations. Human beings have five fundamental senses plus the thinking mind, and the subset of the wholeness that is directly perceived by these human faculties constitutes what Bohm calls the explicate order. Everything else—that which we don't directly see, hear, taste, feel, touch, or think—constitutes the implicate order. Human perception is limited and so there needs to be this distinction between what is directly perceptible and what isn't.

To illustrate the relationship between the implicate and the explicate order, consider the following example that Bohm himself articulated. Take two concentric cylinders, one larger than the other, and fill the annular column between them with with a thick transparent liquid like glycerin. Now place a small droplet of ink on the top surface of the glycerine, and begin rotating the inner cylinder (while the outer cylinder remains fixed). As the rotation continues, the ink droplet gets stretched out and becomes longer and thinner, and ever fainter. Eventually, it disappears altogether. At this point, the natural conclusion to draw is that the order, or organization, of the original ink drop has been lost—rendered chaotic—and the ink appears to be randomly distributed throughout the glycerin in microscopically small particles. However, if you now rotate the inner cylinder in the opposite direction, the ink structure will begin to reappear very faintly, and as you keep rotating, it gets stronger and thicker and eventually comes all the way back—the ink droplet reconstructs itself completely.

Bohm used this example to illustrate the relationship between the explicate and implicate order. Before rotation begins, the ink drop is plainly visible, its order is explicate, or "unfolded." After sufficient rotation, the ink drop disappears, yet its order is still preserved, albeit hidden. The order is now "enfolded" in the glycerine, or implicate. The key point is that the order may not be visible, but it is there nonetheless. Thus Bohm posits a vast realm called the "implicate order" that lies beyond what we directly perceive in the physical universe. Indeed, throughout science, often times we see certain processes that we don't understand, or in which we don't see any order, or where we observe what we call "random" behavior. But this is no guarantee that what we're observing is random. There may be an underlying hidden order, which may (or may not) by some process become an explicate order perceptible to our scientific instruments. In Bohm's eloquent words, the key lesson here is that "a hidden order may be present in what appears to be random."

At first blush, it's natural for us to suppose that the implicate order is some kind of secondary, ethereal reality—floating around somewhere in space,

whereas the primary reality is the physical universe as our senses perceive it and science describes it. However, for Bohm, precisely the opposite is the case. The implicate order is the fundamental reality, and the explicate order is secondary. The explicate order is akin to the foam on the waves of the ocean, and the implicate order is the ocean itself. The implicate order is profoundly vast, with a kind of interpenetrating wholeness that far transcends the known physical universe.

The implicate order thus extends throughout space and time but also beyond space and time. This is very important. Space is not some giant vacuum through which matter moves. For Bohm, matter and empty space are intimately interconnected, and they are both part of the explicate order. The implicate order is beyond space and time altogether, although it's accessible at every point in space-time. It's present everywhere, but visible nowhere. You can think of the implicate order as a synonym for the unseen realms, for that which is neither manifest nor visible to our five senses—in short, a synonym for the spiritual realm. We don't directly perceive it except through inner intuitions and contemplative forms of practice.

There is another vital aspect of Bohm's thinking. He says that the nature of reality has three fundamental components. Science has generally dealt with only two of them: matter and energy. These two are equated in the famous equation from Einstein: $E = mc^2$. This equation essentially affirms that energy and matter are different forms of the same thing. What Bohm said is that there is a third element. He gave it a simple name: "meaning." For Bohm, meaning is as significant as matter and energy.

So Bohm proposes a tripartite structure to reality: matter, energy, and meaning. Moreover, each of these basic notions enfolds the other two.

Thus, "energy" consists not only of explicate energy, but also includes implicate matter and implicate meaning. Put another way, energy "enfolds" both matter and meaning. Similarly, matter enfolds energy and meaning. And finally, meaning enfolds both matter and energy.

In Bohm's words, "Each of these basic notions enfolds the other two. This implies, in contrast to the usual view, that meaning is an inherent and essential part of our overall reality, and is not merely a purely abstract and ethereal quality having its existence only in the mind." What we call the evolution of consciousness is basically the unfolding of meaning as it becomes manifest in the explicate order.

So the idea here is that the invisibles of life—purpose, yearning, intention, love, despair, all of the intangibles of life—are no less real for being intangible. They are just as real, but they cannot be measured in the scientific laboratory. Scientific instruments are nothing more than the extension of our five perceptions. Microscopes and telescopes are just bigger eyes. Microphones are bigger ears. What Bohm is saying is that these instruments perceive only a tiny portion of the totality of existence. Conventional science misses the implicate order altogether. Meaning lives

in the implicate order and is just as real as matter and energy.

Another aspect of Bohm's model is the holographic aspect. To illustrate, consider an example from mathematical physics—fractal geometry—called the Mandelbrot set ($Z_{n+1} = Z_n^2 + Z_0$).

The Mandelbrot set represents a modern scientific discovery of an ancient principle from alchemy: "As above, so below." In physics, this phenomenon is called "nested sets of self-similar structures." Yet it has been known by mystics for eons: "As within, so without." Deeply embedded within universal structures are a series of complete replicas of the original, on vastly smaller scales. The microcosm replicates the macrocosm.

Let us pause to reflect on the implications of this for the philosophy of reductionism in science. Reductionism says you can understand a thing by breaking it down into its fundamental parts; you can fragment reality into elementary building blocks. Yet here we see that the part is as complex as the whole! So the entire philosophy of reductionism is put into serious question here.

To pursue the spiritual implications of this example more deeply, let's take a flight of fancy. Imagine that this Mandelbrot set is a model of the cosmos, and here is the equation which gave rise to it. The Mandelbrot structure itself represents the explicate order, and the equation that creates it represents implicate order. Deeply embedded within the large set in Figure 1 is a tiny replica of it which represents you, a tiny speck amidst this vast expanse. Now, imagine that you explore your interiority, via meditation and other spiritual inquiry, and through this process you discover your true nature; you discover the fundamental process that gives rise to your existence. In this case, that would mean that you discover the underlying simple equation, or process, that gives rise to your form. And then you suddenly have a major insight, a major "Aha!" You realize the process that gives rise to your particular existence is none other than the very same process that gives rise to the entire cosmos. You discover that your true nature is identical with the underlying spiritual nature of the cosmos. You and the cosmos are one.

I know this example is a metaphor, but it represents the actual nature of spiritual awakening in tradition after tradition. For example, in Hinduism, the "Atman" represents the spiritual nature of the individual, and "Brahman" is the spiritual nature of the cosmos. The fundamental enlightenment experience is that Atman is Brahman—the two are identical. In Zen, the great master Dogen says: "We study the self to forget the self, and when we forget the self, we become one with the ten thousand things." The self we forget is just our physical and conditioned forms—it's our body, personality, ego, vocation, it's all of those things. In the example above, it's represented by the Mandelbrot set itself. But when we forget this self, we become one with the "ten thousand things" because we become one with that which gives rise to all of existence. Similarly, according to the gospel of Thomas, Jesus said: "When you make the two one, and when you make the inner as the outer and the outer as the inner and the above

as the below,...then shall you enter the Kingdom." And finally, in Tantric Buddhism: "The entire drama of the universe is replicated in the human body. When you come to know the truth of the body, you come to know the truth of the cosmos." And this is meant literally, but at a consciousness level, not a physical level. If you explore the nature of consciousness, you discover in your own being everything that goes on in the cosmic scale. As transpersonal psychologist Stanislav Grof emphasizes, "Each of us is everything."

Thus far this model embodies a significant limitation in the way it's presented: it is static, like taking a snapshot of an evolving cosmos. But imagine now that the implicate order is changing over time, and the resulting explicate order also unfolds in time. And the two are coupled, so that each affects the other. Hence there is a coevolution of the implicate and explicate order.

This implies that by working in the implicate order, by working with spiritual law in the invisible realms, you can actually have an input into what's happening in the explicate order. And in so doing, you can have an effect not only on your own destiny, but also an impact beyond the confines of your own ego-identity. So, in a sense, if you heal yourself in a deep and genuine way, it will have a profound healing effect on the larger whole. The leaf can heal the tree.

What are the practical implications of all this? First, we are witnessing the dawning of a new science of deep interconnection, in which the cosmos is a grand evolutionary holographic mystery, and each of us somehow embodies the whole. More importantly, however, this all points to the transformative power of serving the world from a spiritual foundation. When our actions are led by spirit, and we serve the explicate world from our inner foundations in the implicate order, then our work becomes profound and transformative. This is what Gandhi and Martin Luther King understood so deeply in their implementation of spiritual law in the secular world. This doesn't mean you have to become a Gandhi, just as you don't have to be an Einstein to be a good scientist. The transformative principles for social change and cultural evolution that Gandhi and King applied are accessible to us all, through the vast and invisible doorway of our own hearts.

A Garden Beyond Paradise

by Rumi

Everything you see has its roots in the unseen world.
The forms may change; the essence remains the same.
Every wondrous sight will vanish,
every sweet word will fade.
But do not be disheartened.
The source they come from is eternal,
Growing, branching out, giving new life and new joy.

Why do you weep?
That source is within you,
and this whole world is springing up from it.

The source is full, its waters are
ever-flowing.
Do not grieve. Drink your fill.
Don't think it will ever run dry, this is
the endless ocean.

From the moment you came into
this world,
A ladder was placed in front of you,
that you might escape.
From earth you became plant.
From plant you became animal.
Afterwards you became a human being,
Endowed with knowledge, intellect,
and faith.
Behold the human body, born of dust.
How perfect it has become.
Why should you fear its end?
When were you ever made less by dying?

When you pass beyond this human form,
no doubt you will become an
angel and soar
through the heavens.
But don't stop there—even heavenly
bodies grow old.
Pass again from the heavenly realm,
And plunge into the vast ocean
of consciousness.
Let the drop of water that is you become
a hundred mighty seas.

But do not think that the drop alone
becomes the ocean.
The ocean, too, becomes the drop.

—Rumi

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