The Hannover Principles

Design for Sustainability

Prepared for EXPO 2000
The World's Fair
Hannover, Germany

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INTRODUCTION

The City of Hannover, Germany, has been designated as the site of the world exposition in the year 2000. Hosting the world's fair on the eve of the next millennium is both a great challenge and a great responsibility. By choosing "Humanity, Nature, and Technology" as the theme for EXPO 2000, the city has decided to directly address the difficult issue of imagining and encouraging a sustainable future. Ideally, humanity will redefine itself, its placement in nature, and refine the role of technology within the environment.

In order to insure that the design and construction related to the fair will represent sustainable development for the city, region, and world, the City of Hannover has commissioned "The Hannover Principles" to inform the international design competitions for EXPO 2000. The Principles are to be considered by designers, planners, government officials and all involved in setting priorities for the built environment. They will help form the foundations of a new design philosophy underlying the future of proposed systems and construction for the City, its region, its global neighbors and partners in the world exposition.

World history offers many examples of societies with environmentally sustainable structures and communities which have endured for thousands of years. However, we have also pursued other paths which have led to ecologically unsustainable practices. For the development and improvement of humankind, it is imperative to renew a commitment to living as part of the earth by understanding development and growth as processes which can be sustained, not exploited to impractical limits.

It is hoped that the Hannover Principles will inspire an approach to design which may meet the needs and aspirations of the present without compromising the ability of the planet to sustain an equally supportive future.

DEFINITIONS

Sustainability:

The concept of sustainability has been introduced to combine concern for the well-being of the planet with continued growth and human development. Though there is much debate as to what the word actually suggests, we can put forth the definition offered by the World Commission on Environment and Development: "Meeting the needs of the present without compromising the ability of future generations to meet their own needs."

In its original context, this definition was stated solely from the human point of view. In order to embrace the idea of a global ecology with intrinsic value, the meaning must be expanded to allow all parts of nature to meet their own needs now and in the future.

Design:

The Hannover Principles aim to provide a platform upon which designers can consider how to adapt their work toward sustainable ends. Designers include all those who change the environment with the inspiration of human creativity. Design implies the conception and realization of human needs and desires.

Design for Sustainability:

Designing for sustainability requires awareness of the full short and long-term consequences of any transformation of the environment. Sustainable design is the conception and realization of environmentally sensitive and responsible expression as a part of the evolving matrix of nature.

PROLOGUE

Human society needs to aspire to an integration of its material, spiritual and ecological elements. Current technologies, processes and means tend to separate these facets rather than connect them. Nature uses the sun's energy to create interdependent systems in which complexity and diversity imply sustainability. In contrast, industrialized society extracts energy for systems designed to reduce natural complexity. The challenge for humanity is to develop human design processes which enable us to remain in the natural context. Almost every phase of the design, manufacturing, and construction processes requires reconsideration. Linear systems of thought, or short-term programs which justify ignorant, indifferent, or arrogant means are not farsighted enough to serve the future of the interaction between humanity and nature. We must employ both current knowledge and ancient wisdom in our efforts to conceive and realize the physical transformation, care and maintenance of the Earth.

In this spirit the Hannover Principles have been assembled, after extensive consultation with representatives from the design, environmental, and philosophical communities. It is hoped that, if accepted, they will evolve to adapt to the concerns of different cultures and countries across the globe, so that all may find a way to endure and build into the future without compromising the future's ability to meet its own challenges.

THE HANNOVER PRINCIPLES

1. Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.

2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognizing even distant effects.

3. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.

4. Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist.

5. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes or standards.

6. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.

7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.

8. Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.

9. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity.

The Hannover Principles should be seen as a living document committed to the transformation and growth in the understanding of our interdependence with nature, so that they may adapt as our knowledge of the world evolves.

GUIDELINES

The Hannover Principles are a set of maxims that encourage the design professions to take sustainability into consideration. They are descriptive of a way of thinking, not prescriptions or requirements. The guidelines below demonstrate the City of Hannover's intention to apply these principles as elements of the overall design competitions associated with EXPO 2000. They take the form of a framework, based on the enduring elements of Earth, Air, Fire, Water, and Spirit, in which design decisions may be reviewed and evaluated. The guidelines offer critical instruction on the responsibility of designers.

It is hoped that those who enter the competitions will bring to their task uncommon ability, skill and care, assuring that their creative acts will be able to blend aesthetic concerns with ecological principles and provide a new inspiration for the challenge of design. In this way, design becomes a didactic tool to demonstrate that sustainable thinking can be put into practice in the real world.

ELEMENTS

The five elements provided a structure for the ancient world. The world can still be perceived along these lines, and they are presented here as an outline to frame the primary concerns of the environmental program for the EXPO site.

Earth. In design, the earth is both the context and the material. For the EXPO site a balance must be struck between context and material which provides a meaningful and livable diversity of scale. A full range of experience from the "urban" to the "wild" is essential to the landscape within which human culture evolves.

Design solutions should benefit flora and fauna as much as humans, upon the notion that natural processes take care of themselves best when left alone. The overall sense of community, linking humanity and nature, should be enhanced. A premium value should be placed on unbuilt space, particularly existing undeveloped lands. Re-use and expansion of the existing fabric may offer alternatives to new construction that will preserve the natural landscape.

New construction, when necessary, should be seen as an extension of the present built fabric, not as independent, self-contained development. Building materials need to be considered for their broadest range of effects, from emotive to practical, within a global and local context. Local production should be stressed, along with approaches that emphasize the regional, cultural, and historical uniqueness of the place. Designers should consider the interaction and implementation of diverse materials within local climate and culture in a meaningful and productive way. They are encouraged to consider the use of indigenous materials and the practical and effective utilization of modern technology, including advanced glazing, energy efficient fixtures and appliances, and non-toxic water treatment systems.

All materials used must be considered in the following terms:

• Buildings should be designed to be flexible enough to accommodate many human purposes, including living, working or craft, allowing the materials to remain in place while serving different needs. After the EXPO, the use of the site will change. Design should include alternatives for how the site can be adapted to post-fair requirements.

• Materials should be considered in light of their sustainability; their process of extraction, manufacture, transformation and degradation through proper resource management and biodiversity on a global and local scale. All materials should be considered in terms of their embodied energy and characteristics of toxicity, potential off-gassing, finish and maintenance requirements.

• Products used shall not be tested on animals.

• Recycling of materials is essential. But recycled materials should not be encouraged if they are the result of a product designed for disposability. Provision should be made for the disassembly and re-use of all products by the manufacturer if necessary. The reuse of entire structures must be considered in the event that building fails to be adaptable to future human needs.

• Materials should be chosen to minimize hazardous chemicals.

• Solid waste left after maximal avoidance must be dealt with in a non-toxic manner. In nature, waste equals food. The aim is to eliminate any waste which cannot be shown to be part of a naturally sustainable cycle.

• Life-cycle analysis of all materials and processes is important. (Life-cycle assessment is a process in which the energy use and environmental impact of the entire life cycle of the product, process, or

activity is catalogued and analyzed, encompassing extraction and processing of raw materials, manufacturing, transportation and maintenance, recycling, and return to the environment.

• The design should qualify the environmental and economic costs such that the benefit of the project in relation to expense is understood in both the short and long terms.

Air. The air is the element whose degradation we can sense most immediately. When the air is bad, all can feel it. Local atmospheric pollution may have felt global consequences, so the overall design must not contribute to further atmospheric denigration of any kind. Designs must be evaluated in terms of their atmospheric effects, including those on ozone depletion and global warming. Alteration of the micro-climate is equally significant. Any possibility for the design to counter-balance or contribute to remediation of existing environmental damage should be explored.

• Air pollution implications of all design systems will be considered in the evaluation of designs. General air quality issues should also be considered to insure that no off-site or on-site air pollution results from the design.

• Wind patterns in all seasons should be evaluated for both detrimental and beneficial effects on site configuration.

• Noise pollution should be accounted for and minimized.

• Building design must accommodate ventilation systems suitable to the issues of air quality. This may involve strategies which show concern for dangerous outdoor air conditions as well as efficient indoor air exchange.

• Natural ventilation patterns must be considered at every scale from the urban to the domestic as an alternative to artificial climate control.

• The health effects from indoor air quality problems must be considered during the design process.

Fire. Fire is the most dramatic symbol of the human ability to harness natural energy. Energy is required to achieve comfort and convenience and to transform materials to useful effect. Designers are encouraged to instill their designs with the ability to operate based on on-site renewable energy

sources, insofar as is possible, without reliance on fossil fuels or remote electrical generation. It is possible, given technologies and materials available today, to create buildings which maintain comfort levels passively without fossil fuels. This should be considered a minimum condition of energy design.

• The design should be aware of its interaction with renewable natural energy flows. Solar energy should be evaluated in terms of its efficiency and its enjoyment by inhabitants and visitors throughout the annual cycle. This implies an understanding of solar access and care for proper screening and shading techniques.

• Possibilities for on-site energy production must be considered, and accommodations should be incorporated into design.

• Buildings should, wherever possible, be net exporters of energy.

• Water heating shall be from renewable resources and be efficiently incorporated into the design.

• Transportation requirements will be considered in terms of their impact on overall energy consumption. Pedestrians and bicyclists should have priority. Mass transit should be efficient and available, and private automobile use should be discouraged. Allowances for automobiles should be carefully considered for their present and future implications with regard to energy use, urban planning and social effect. Auto services should anticipate alternative fuel strategies.

• The relationship of the design and the power grid should be considered. Minimum impact on energy demand from the grid is a goal, as well as the value of decentralized energy sources.

• The energy "embodied" in the building materials can have a significant impact on the energy consumption of the project. Embodied energy refers to all the energy necessary to extract, refine, transform and utilize the materials.

Water. Water is the most basic element of life on the planet— it will be celebrated as a fundamental life-giving resource. Opportunities to create understanding and enjoyment of water will be encouraged throughout the design of buildings, infrastructure and landscapes. Elements which celebrate the profound value of this resource on both material and spiritual levels deserve serious consideration.

Designs will recognize the communal, cultural, historical, spiritual and poetic possibilities of the use of water and its central role as a precondition for life.

• Water use must be carefully accounted for throughout the entire design process.

• Water sources must be protected from contamination and careful consideration given to efficiency techniques at every step.

• Potable water consumption should only be used for life-sustaining functions.

• Water from aquifers, rain water, surface run-off water, gray water, and any water use for sewage transport or processing systems should all be considered within a cyclical concept.

• Waste water must be returned to the earth in a beneficial manner. Organic treatment systems should be considered.

• No ground water contamination should result from any use of water resources related to the construction or operation of any of the project's facilities.

• Design shall consider rainwater and surface run-off water as a possible resource for inhabitants and in building systems.

• Design should minimize impermeable ground cover.

• Gray water can be treated and applied to practical or natural purposes suitable to its characteristics.

• Water use in any process related activity shall be put back into circulation, and toxic chemicals or heavy metals should be minimized. All discharges of process-related water shall meet drinking water standards.

• Water, if used for sewage treatment or transportation, shall be restored to drinking water standards prior to distribution or re-use.

Spirit. This most ineffable of elements is also the most human. Concern for sustainability is more than a matter of compliance with industrial regulation or environmental impact analysis. It embraces a commitment to conceive of the work of design as part of a wider context in time and place. The design for EXPO 2000 must embody the form of the theme "Humanity, Nature and Technology," illustrating and fostering the sense of place essential to any human experience of the meaning of sustainability. To present the message of the value of all life and the rightful human place as a part of this, people must be able to experience the feeling of belonging to the earth firsthand. Living in sustainable architecture is nothing less than an appeal to accept our place in the world, mediated between human and natural purposes.

The presence of the element of spirit ensures that design will be seen as only part of the solution, never the whole. Building on the principle of humility, the design philosophy here should realize its inherent limitations in trying to plan and direct both human and natural processes. Design may encourage a sense of permanence and community, but it cannot legislate it. Similarly, no assumed laws of nature can be the only criteria for evaluating a design. The solution must present an aesthetic statement which sets up human society as a conduit toward the further understanding of nature, not as an affront or an enemy to it.

One of the most prevalent arguments against holding EXPO 2000 in Hannover is the fear that the impact of the expected 50 million visitors might degrade the city and its environs. At the same time, it is essential that the principles of sustainability to which Hannover has committed itself could be articulated in such a way that they reach some of the billions of the earth's inhabitants who will have no opportunity to reach the site at all. Therefore, designers are encouraged to consider approaches to decentralizing the fair, such that the plan could incorporate pavilions or centers in other countries, scattered across the globe, that might be linked by electronic means such as "tele-presence" communications technology. It may then be possible for the wisdom of thousands of encouraged "sustainable" solutions and examples to be shared and enjoyed among the world's people in a "sustainable world's fair".

The philosophy behind these guidelines is to point those who partake in EXPO 2000 in the direction of greater concern and conception of the enduring human place in nature.

DESIGNING THE COMPETITION

Designing for Sustainability implies an ecological method whose composite fabric has implications and opportunities for the structuring of the competition rules and regulations. We propose that a spirit of cooperation and interconnectedness that personifies the Hannover Principles of Design guide the design of the competition as well. We suggest that the competition be phased in three steps:

Phase 1: A symposium comprised of all competitors and a committee of international advisors to review the idea of sustainable design and to share information. The Hannover Principles will be presented, debated and expanded there.

Phase 2: An independent design development competition based on the criteria contained herein, and the results of the symposium in Phase 1. After Phase 2 the jury would select three proposals, which would be further developed in Phase 3.

Phase 3: Ecological success depends in the end on cooperation, not competition. So we envision the last step to be a collaborative, cross-disciplinary effort by the three winners, the Planungsbeirat of the City of Hannover, and committee of international advisors, to produce a workable, appropriate design in which none of the principles are compromised.

This strategy will result in an interdependent, democratic process to build on the diversity of solutions. This will achieve a plurality of ideas and visions which truly must work together to offer a model of realistic sustainable design for the 21st century. But in sustainable terms, a century is quite a short time. In the year 2000, one ends, and another begins. More significant is the possibility that an ethos for design may begin to evolve enabling human settlements to endure throughout the next millennium, or even longer.

The Hannover Principles

Design for Sustainability

Part II:

BACKGROUND MATERIAL

This background material is intended to supplement the principles and guidelines set up to frame the issues to be considered in the fulfillment of the design program for EXPO 2000 in Hannover. Because of the ecological imperative associated with the event and its long-term goals, it is important that the design criteria not be seen as a checklist .

What follows is intended to be a discourse of inspiration, *an essay of clues*, to encourage creative responses to the suggested program. It is not meant as a historical or critical analysis of the thinking alluded to, but a suggestion of potential sources. No one knows the right answers to the challenge of sustainability as of yet. Here we present the reasons the sustainable vision is essential, and some tools to begin to shape it.

It is important from the outset to question the very project itself. Does the world need yet another world's fair? The strongest argument against EXPO 2000 from the point of view of the environmentally conscious public is: who needs it? What kind of arrogant display of human invention and knowledge could be necessary in a world with so many pressing ecological and social problems? And in a nation with so much rebuilding to do, how could such pageantry be justified?

EXPO 200 could be an opportunity to define goals as we attempt change the way we live and relate to the earth. We recommend that EXPO 2000 be built only if it is courageous enough to address the world's problems, concentrating on the ecological links between local and global issues. Every piece of material used in the construction should have a sustainable origin, and this should be documented so visitors can understand how many countries and geographically disparate industries are represented. The presence of the diverse cultures of the world should be ensured, but with a serious attempt to avoid the mistakes so prevalent in previous fairs, *despite* their good intentions.

The problems as well as the promises of each culture need to be presented to educate visitors as to the interconnected issues of the global situation. This could be manifest in an allegorical design which mirrors the world situation according to various models: Haves/have-nots, North/South, developed/developing, indigenous/colonial. But whatever part of the human and natural world is presented, it should be done in an inviting, not an alienating manner. Any evaluation will require an assessment of the successes and failures of previous world expositions.

SUMMARY OF BACKGROUND MATERIAL

• EXPO 2000 as an idea is facing a lot of public criticism. To convince the public, it needs to be an event that depicts a worthy cause. That cause should be environmentally sound and sustainable development.

• The challenge of a world eco-exposition is a serious one. There exists no road map to produce it. The document we have produced has been carefully assembled to encourage a new way of thinking about very pressing problems. History and philosophy are necessary to frame the situation with insights of the past.

• Most discussion of environmental aspects of the exposition address human needs, and then natural needs. We believe that these two sides of the question are inseparable from one another. A whole new kind of philosophy on our connection to the surrounding world needs to be established to break through the barrier of dualistic thinking.

DECENTRALIZATION OF EXPO 2000

I. What Ever Happened to the Future? Learning from Previous World's Fairs

• Every previous world's fair has tried to be an optimistic vision of the solutions of the future. Each of them tended to fail because of their unwillingness to consider the problems of their time. The changing troubles of the twentieth century world were veiled over by cleansed, shiny dreams of a world made better with new technology.

• EXPO 2000 must be different, because it will specifically address the ecological problems of our time, and teach the world by example what can be done about them.

II. EXPO 2000 as Global Village

• Here we propose the possibility that EXPO 2000 might be decentralized around the world, so that people may participate in the project without needing to bring too many millions of people to

Hannover. This makes sense on ecological grounds as well as informative ones, as it will bring the message of sustainability to as many people as possible.

• The case of transportation is discussed as a specific example of how decentralized thinking may be applied to EXPO 2000.

THE MEANING OF SUSTAINABILITY

III. Sustainability Explored

• Sustainable development is a tentative concept that has not been defined very well. The best examples of it come from simpler societies, with cities and towns designed so they fit into the landscape, using the natural flows of energy.

• But no simple return to vernacular architecture can help us now. We know too much about the global and interconnected aspects of the world's problems. Any local land use plan will have global implications, and these need to be investigated.

IV. From the Urban to the Wild

• Many attempts at designing new towns and landscapes have tried to plan for a range of scale from dense structures to the wilderness.

• Many have failed because they tried to implement specific solutions based on principles too distant from experience.

• Ecological realities like waste management and solar energy opportunities must be integrated into the EXPO site, not tacked on to a separate aesthetically motivated plan.

• A new type of thinking about design is necessary to expand scientific industrial thinking to include the idea of the living machine.

V. Life-Cycle Analysis: the Quantification of Environmental Responsibility

• Life-cycle analysis in design implies the study of the entire cycle of material to construction to adaptation or recycling of structures which will be built.

• Usually this information is considered part of environmental impact analysis, but we want it to be an intrinsic part of the design. Quality of life needs to be implied in the design itself, not legislated by a list of rules.

HISTORICAL AND PHILOSOPHICAL ROOTS

VI. The Evolution of the Industrial Age — What Went Wrong?

• The rise of industrialism brought a society built on the extraction of energy from nature. The ecological society will consider energy use as part of nature, eliminating the concept of waste. The idea of returning design to nature is not a new one. But nature cannot be fixed by our statistics; it remains unquantifiable. Nor can we reduce it to stereotypes of balance or harmony.

VII. Rights and Responsibility

• Human rights have been expanded into natural rights in ecological thinking. We need to design for the needs of all species, not just our own needs.

• Ecological thinking has a social and a philosophical side. The social approach looks for roots of the problems in social structures, and the philosophical approach looks for these roots in the way we think about the world. Both approaches need to be considered by the designer, in understanding the competition and in delivering a solution.

• Responsibility for the ecological situation means that we need to be able to gauge the effects of a design far into the future.

VIII. Humility in Design

• The built fabric of our world tends to alienate people from nature. It simultaneously encourages us to imagine that we comprehend systems more complex than we can ever know.

• When our designs affect the natural world, we must be humble enough to acknowledge the unknown.

• We gauge the success of a design by the experience of it through time. It cannot be judged against a pre-existing checklist of criteria.

IX. Cooperation as Excellence

• There should be no single winner to the competition. We advocated a diverse group of designers who can offer a stronger combination of diverse kinds of expertise than any one person.

• Previous world's fair projects are discussed as positive examples of solutions that evolved through cooperative working relationships.

• The sustainable imperative demands that designers work together in a spirit of affirmation and optimistic support.

DECENTRALIZATION OF EXPO 2000

I. What Ever Happened to the Future? Learning from Previous World's Fairs

For the EXPO 2000 we need structures whose conceptual use will endure as much as the built fabric. Think of the reminders of world's fairs past... what is left of them. The Eiffel Tower is perhaps the best example, as it is the surviving centerpiece of the exposition of 1889. Though once considered an eyesore, it has now become the emblem for an entire nation. Harmonizing beauty with the promise of engineering, it was for its time the world's tallest building. It is doubtful today that we need to prove this kind of point with the fair of the century's end, but creating an emblem for the site and the moment could be an important part of the solution.

It has not worked this way for all such fairs. Little is left of the great Columbian Exposition of 1893, and the one surviving monument of New York's 1939 World's Fair is a hollow aluminum globe, left to corrode as the remnant of a site which has faded into public obscurity. To be considered sustainable a fair must become a community, merging with the surrounding land- and city-scape once its celebratory role is reduced.

The Disneyland effect is a direction to be avoided here. EXPO 2000 should not become a theme-park for the sensitive promises of tomorrow — it should prove the value of the sustainable path by trying to put this into practice. Yet how is this different from, say, the world's fair of 1939, which had as its theme

"The World of Tomorrow"? This celebration introduced television, home air conditioning, the fluorescent light, and the promise of leisure, which only World War II put at bay. "It is important to remember," said the narrator at the exhibit on the future of the automobile, "that the people of 1960 will have more time, more energy, and more tools to have fun." Now we know firsthand the liberation and destruction the car has wrought on modern civilization. The future from the perspective of the year 2000 should embrace *criticism as well as promise.*

In 1939 the most popular exhibit was Futurama, built by General Motors as a model of a future city based on the ideas of Le Corbusier, with a city center at the intersection of two highways symmetrically surrounded by skyscrapers. Another model was Democracity, a radial plan based on the geometrically precise suggestions of Ebenezer Howard's garden city, where rings of greenbelts alternated with industry and housing out from the city center to the wilds beyond. Each of these images has to some degree been put into practice over the intervening fifty years, but neither has done much to promote any organic sense of place. They remain fantasies or plans, distanced from experience through the minds of their creators.

It must be stressed that putting a model up for display as an ideal tends to separate it from its context and may detract from its exemplary value. Witness "main street USA" at Disneyland, Disneyworld, or Euro-Disney, where something is built that looks like a friendly town, but more resembles a bleak shopping mall hidden behind a quaint facade, where all is for entertainment and consumption, without encompassing the full range of human life which made such a place so significant for those visitors who can remember when towns were more than intersections, more necessary than abstract plans. (One of the only residents of main street USA was Walt Disney himself.) Later, when Disney introduced EPCOT (the Experimental Prototype Community of Tomorrow) in Florida, they sidestepped the challenge of creating a real community. People do not live there, so visitors are seduced by displays of optimistic forward-looking ideas as advertisements for the giant corporations that pay for them.

If EXPO 2000 is to engage in prediction and imagination of how we might live further into the centuries, it should do so by example. That is why the design should aim from the outset to link the key elements of humanity, nature, and technology through the litmus test of sustainability.

The kind of world exposition we need now is nothing that blindly co-opts the insights of the world's people to suggest that they all agree and are ready to join together into a common future. Diversity of cultures and of solutions to living with nature need to be celebrated, and this means real conflicts need to be addressed. Previous world's fairs have more often tried to simulate harmony while cloaking over dispute. At the Vancouver Expo of 1986, General Motors sponsored something called the "Spirit Lodge," aiming to integrate the voice of native peoples into the fair's stated message of benign and wonderful technology for the coming future. A Kwakwaka'wakw storyteller addresses a giant plastic raven and demands that the wise bird tell him what has gone wrong with the world:

"Maybe all the modern changes of the last century are *your* trickery. Then again, perhaps change is an illusion, thin as smoke. For what has really changed? Our machines have changed, but our dreams remain the same."

The Native American ponders the situation and has a sudden conversion over to the technological worldview:

"I took another look at this world's fair and saw that the new science of transportation seeks nothing new. It reaches for the same old dream that my Grandmother knew was good. It reaches for the magic canoe. Each small improvement brings us closer to that day, when we will only have to step inside, wish where we want to go, take one stroke, and we'll be there. The dream is as real and as old as life. For life and the freedom to move are as one."

This facile appropriation of indigenous modes of thinking to justify technological progress is easy to see through. But the important point is that all previous world expositions have imagined that they were presenting encouraging visions of how the world would embrace a wonderful tomorrow. These symbols of world achievement have always been built to bolster our confidence, not educate us as to the seriousness of our problems. To meet these goals, the previous world's fairs have always been full of a lot of lies.

In Hannover in the year 2000, we want to be honest about the prospects of future civilization by creating an exemplary place of possibility. But the harsh realities of our global social and ecological crises should not be ignored or hidden behind the smiling veil of corporate or ideological sponsorship. Even the ideology of "sustainability" must contain criticism of itself and its limitations. This exposition will achieve greatness only if it makes people think, not just gives visitors a giddy feeling of how fascinating the unknown future will be. EXPO 2000 is a cause for education as much as for celebration.

We start from the premise that the last several world's fairs have been failures at realistically addressing the historical occasions that gave rise to them. Alexander Wilson describes it well in *The Culture of Nature*:

"It is a failure of imagination. The modernist vision of EPCOT Center and the Canadian EXPO's of 1967 and 1986 discards the history of genuinely utopian initiatives of the world's peoples in favor of an ideology of growth and development. For all the scientific exactitude of these futurist plans, they are incapable of moving beyond a rigid technological determinism. A future of emancipation, on the other hand, can only be reclaimed by a society willing to debate its own survival. This century's world's fairs stand squarely in the way of that debate and condemn us to a recurrent and eternal present."

II. EXPO 2000 as Global Village

There has been some discussion that the very idea of an event involving an expected 50 million people represents an impossible premise for sustainable development. Witness some of the unnecessary building done for the sake of the Olympic games: In Lake Placid, NY, huge stadiums and winter sports arenas have been built for a demand that will never return, unless the winter games are brought back to this tiny town in the midst of the nation's largest wilderness park. What remains is empty overdevelopment, and the city struggles to find ways to attract visitors to fill all the empty hotels and convention centers. Too much was planned and constructed, and the imagined growth in the region simply cannot be sustained.

How can Hannover avoid this? There is the possibility of temporary but architecturally significant structures, like those of the Columbian Exposition of 1893. There is also the possibility of adapting existing structures. A third possibility is the conception of a fair which makes use of the virtual realities characteristic of today's global system. Work and life occur not always in person, but across a global network of communication lines. Could a sense of ecological community be based on this electronic web of connections as much as the inherent web of food and energy chains?

Certainly Marshall McLuhan thought so. The Canadian communication theorist saw possibilities for a brand new tribalism in the world shown on television and the promise of the computer. In the early 1960s he praised the wide reach and personal touch of the kind of world we now take for granted: "Ours is a brand-new world of all-at-onceness. 'Time' has ceased, 'space' has vanished. We now live in a *global* village…a simultaneous happening. We are back in acoustic space. We have begun again to structure the primordial feeling, the tribal emotions from which a few centuries of literacy divorced us."

These are strong words. They suggest a full-scale historical cycle, in which the best of the past may be recovered with the latest of machines. By accepting electronic technologies as instruments to coax participation out of us, we might constitute a complete human community out of virtual materials and invisible networks. The key is choosing the right tools, or perhaps more accurately, finding the right side of our tools — the side which invites us into new encounters by remaining ambiguous, as opposed to the other side which overburdens us with a fountain of information and precision beyond our ability to assimilate.

Those who work on electronic networks, to say nothing of business by telephone, understand how entire cycles of work and society can be created without ever meeting face to face. This is the way much of our linkage from the local to the global is perceived. (The international flow of resources, manufacturing, and design is much harder to perceive.) But McLuhan is quite optimistic. Although he anticipated the global information explosion, he did not think much about how restrictive the new technology really is. Only the privileged throughout the world's nations have access to computers and modems—they are more expensive than typewriters and telephones.

There are many problems with the world formed out of electronic, virtual links between people who never actually meet each other. The lack of genuine contact certainly contributes to the alienation and detachment characteristic of modern society. But we do not want to suggest that information technology is only a problem. We hope that it is possible to find a way to adapt this prevalent technology to encourage real community building and the exchange of information between people who would otherwise have little chance to participate in this new technological development. If sustainable concerns are brought into the progress of cyberspace in its current, early stages, it might develop into a technology which could encourage, and not stifle, community.

But if EXPO 2000 could find a way to encourage mass communication from remote outposts in the world with the central facility in Hannover (or between regional sites), this could become a realistic fair of the global village. Imagine a pavilion in Sri Lanka where a farmer could go in and communicate directly with other farmers in Nigeria or Uruguay, discussing what to look for in a variety of rice. The conversation could be much quicker than that mediated by a traveling expert from the West. Such decentralized access points could be part of the fundamental design of the event, recognizing that if community is to become a global concept, it must manifest the invisible and instantaneous ways communication can flow across the planet.

Analysis may reveal that inviting many millions to one site would be an ecological disaster. If so, the celebration need not be rejected. It may instead take place all over the world, with Hannover as a point of inspiration, rather than a physical gathering. Though this fair is based on ecology, it is not opposed to technology, but should instead show how it can be directed to sustainable ends. So if developing "virtual presence" means of communication through high-definition computer screens and interactive three dimensional graphics prove to be feasible in the coming years, their role in promoting real communication between people of different cultures should be considered. It could be a special priority of the fair to get this technology to people who would otherwise be unable to afford or experience it.

THE EXAMPLE OF TRANSPORTATION

Design for sustainability involves radically changing the principles which guide the process of design. Our primary aim is to present the framework necessary for the adoption of such thinking. The application of specific formal and conceptual design decisions should remain the responsibility of the designers who will participate in the EXPO competitions. The Principles imply a structural metaphor of interconnected concerns suggesting linked global, bioregional, and local imperatives. It is like a set of interconnected circles located within the larger circle of global sustainability. It is informed by current understanding of the world and allows for creative evolution. Here are a series of imperatives from local to global scales and back again:

Local Imperative: Promote Zero-Emission Vehicles

A city's land use defines its transport system more than any traffic planner or engineer can. Michael Renner writes in *Rethinking the Role of the Automobile* that "a more comprehensive transportation policy must recognize that transportation needs are not abstract. What people need is access to jobs, homes, and services. More compact and integrated communities can provide such access without long commutes. If urban design - creating new communities as well as reshaping existing urban landscapes - can become an integral component of future transportation policies, the contrasting individual interests in mobility and societal interests in fuel supply, security, environmental protection, and urban integrity may be reconciled."

• The Kronsberg site should be restricted to zero emission vehicles.

• The public transportation should be extensive and accessible, reaching all aspects of an integrated land use plan.

• It should run on clean renewable energy sources. Current technologies point to hydrogen power realized from solar collection, electric power from solar, wind, tidal or geothermal sources, and magnetic levitation from superconductors. Each of these technologies should be evaluated with life-cycle analysis. EXPO must employ the most efficient system available at the time. However, "efficiency" must be assessed in terms of the functioning of the system as a whole, not only its expediency. Therefore an evaluation of the transport system must consider its side effects on the site, region and world as well as its specific practical performance.

- The City of Hannover should encourage the use of public transportation by offering transportation vouchers to residents and manufacturers who practice sustainable and responsible habitation.
- Bicycles should be given priority within the EXPO village. Connections to public transport should encourage bicycle use. Transport vehicles should provide space for bicycles. Roadways should be designed to encourage bicycle use as a primary means of individual transportation.

Bioregional Imperative: Respect Natural Borders

A bioregion may be defined as a structural unit, forming a cluster of ecosystems arranged topographically and climatically to produce a distinct and identifiable region. Translate this as a means of understanding human transportation structures, so that each aspect of the bioregion must be understood as it operates and contributes to the whole. For example, the EXPO will need the capacity to move many people by public transportation over a limited period of time. Even if the number of people traveling to EXPO is reduced, this will greatly exceed the eventual transportation needs of the EXPO village after the fair. Framing this need as a bioregional constraint offers many possibilities, including the following:

- Link the concept that nature produces no waste with the understanding that the force of evolution is a creative one by designing transport vehicles of flexible utility.
- Specifically, design non-polluting mass transportation for use during EXPO.
- From the beginning, design this transportation system to be incorporated into existing infrastructures where possible. After the fair, install the surplus transport vehicles in a sister city in former eastern Germany that would benefit from the new technology. By supporting the bioregional needs of reunification and the short-term needs of the EXPO, we can establish a clean transportation system for both the EXPO village and her sister city.
- Encourage public transportation to the EXPO by offering incentives to those who travel by train or some other means of collective, alternative fuel vehicle.

Global Imperative: Promote Remediation

Estimate the number of people who will come to the fair and offset the CO_2 produced by planting trees. The establishment of a remediation level commensurate with the profound impact of the EXPO will allow the new EXPO village to grow after the fair and still keep air pollution under

control. Furthermore, as new non-polluting methods of transportation evolve, existing forests will be a resource for the developing communities. These forests must be harvested sustainably, as a model of responsible resource management, to ensure long-term viability.

Global Imperative: Reduce transportation loads through advances in communication

A challenge: bring fewer people to the site yet make EXPO more accessible to more people. Initially this may seem to be contradictory, but through advances in Virtual Presence it may be possible to link up people in very distant places through three-dimensional interactive computer environments. By the year 2000 this technology may improve enough to offer a real alternative in communication. This strategy might also:

- Reduce CO_2 emissions that would result from transport to the EXPO.
- Reduce human load on the EXPO site and the Hannover metropolitan area.
- Revitalize existing Fair grounds as communication satellites
- Promote an interconnected worldview based upon biomes rather than national borders.
- Make the EXPO accessible to a broad range of people for whom the transportation costs would otherwise be economically prohibitive and ecologically untenable.
- Promote environmentally responsible technology in developing nations.

Solution in terms of the nested circles of scale

From a consideration of the issue of transportation, an ecological approach reveals that the solution recommends electronic communication as much as moving people from one place to another. The Hannover Messe (industry) and CEBIT (computer fair) are already the largest in Europe and happen every year. If we aim for an audience of 20 million rather than the 50 million expected, ecological effect may be kept under control. Through the latest telepresence technologies which make virtual communication more real than ever before, the improvement in electronic linkage will be tremendous. People from all over the world will be able to participate in the message of EXPO 2000 without needing to travel to the city of Hannover in person. Such tools have just as much potential to alienate their users as earlier advances, but it is a challenge to those developing and managing them to make the new techniques part of a sustainable global vision.

THE MEANING OF SUSTAINABILITY

III. Sustainability Explored

Sustainability is a loaded and slippery term. It names those activities which can be continued far into the future, defining a way of life that will last. The trouble is that it is nothing new—business and industry have always hoped that whatever course they choose will be the sustainable course, one that will not push them out of business. In a sense, there is no practical need to scold business too much. If environmental considerations are something that can really be addressed, they have to encourage business activity, rather than forbid it. Business will not change overnight. Will it change fast enough to respond to ecological needs? That is another question.

"Sustainable development" implies a kind of growth that will be able to go on. Will there be a point when we will have to chastise growth itself? That is just what the industrial community does not want to hear. This is why the definition of sustainable development is couched so carefully by the Brundtland Commission: "Meeting the needs of the present while not compromising the ability of the future to meet its own needs." If humans in the future decide it is time to forsake the Earth, this definition says nothing to stop it. The phrase is intentionally weak, to garner the most chance of acceptance. It says: at least make it possible so that the future will have a choice. They should not regret their past.

World Bank economist Herman Daly points out the kinds of definitions of sustainability that he finds to be counterproductive. They include "sustainable development is development that sustains the highest rate of economic growth without inflation." That's just business as usual, described a little differently, so that our present notion of growth will keep its course. Or: "Sustainability considers the expanding needs of a growing world population, implying a steady and necessary growth." It implies that development will need to be continuous and steady, instead of requiring any leveling off to meet a carrying capacity. Formulations like these are inadequate, so Daly himself proposes three specific rules of sustainability to make sense in economic terms:

1. Harvest renewable resources only at the speed at which they regenerate.
2. Limit wastes to the assimilative capacity of local ecosystems.
3. Require that part of the profit be put aside for investment in a renewable substitute resource.

And for him, sustainable development does not follow from more free trade between production and consumption ecosystems across global lines. For a nation to create a sustainable economy, it must step back from the global economy. Sustainability requires a smaller scale bound in which to be tested. It will begin as an experiment, not as law. This is the remarkable potential of EXPO 2000. Imagined as a sustainable community, it will be a model for the planet of what a sustainable settlement might look like in our increasingly complicated world.

Examples of sustainability are not hard to cull from the history of world cultures. But most often they are small scale social solutions that involve a small number of people who do little or no damage to their surrounding habitat. And often there is no design or designer which guides the inhabitation of the place. But now the complex of human/nature interactions is more intricate and overlapping, and the scale of change gets faster all the time. We cannot simply set up a benign situation and let an innovative solution slowly evolve to meet ecological constraints. Design is necessary, but a very special kind of design that does not claim to control more than it knows.

We find hopeful, if distant, examples in works such as Bernard Rudofsky's *Architecture without Architects*. Villages, cities, fortresses, and monasteries are presented from traditional cultures across the globe. Buildings are arranged so that the flows of wind are channeled and harnessed, not blocked and diverted. It is clear that they have had the luxury of time: no one commissioned these structures and demanded them built and ready for use in a year or two. Intervention was slow enough to be tested by the strength of natural forces and the sobering spirit of time. Still, the structures of less mechanistic cultures are those that have endured the longest, suggesting that sustainable building relies less on an absolute coherent plan than on the cooperation between designers and end-users.

Often they were the same people. But a change in attitude can also link the two groups. In the Himalayas, for example, the mostly stone houses are never considered fixed, finished buildings. They evolve as the usage changes, with new rooms and structures built to flow out of existing walls, gradually forming the irregular urban fabric where no angle is exactly ninety degrees and no street follows an exact grid, even though these principles may have had a hand in the original thought behind the town. (Now the Sherpa have cut down all of their previously renewable forests to fuel the tourist trade.) Similarly, the beloved and varied landscape of European country villages was not planned by any overseeing authority, but developed slowly and tentatively. Communities organized themselves, and because each environmental intervention took so much longer then than now, the expectation from the change was so much less. The coherence of regionalism can avoid the kitsch problem associated with the blanket appropriation of nostalgic models of land planning.

When we ask for a design cognizant of long-term sustainability, we mean something that will be able to adapt to the unknown future. Thus it cannot legislate so much that what is not known will be made invisible at some later date. The plan must leave room for changing human understanding of what nature means.

The forthcoming Agenda 21 Document, which will comprise the main policy statement from the June UNCED conference in Brazil, states:

(Section I, Chapter 6 of Agenda 21; document A/CONF.151 /PC/100/ Add.7).

"By the year 2025, 60% of the Earth's population will live in cities. Degradation of the environment and human living conditions is already seen in cities, particularly in developing countries. Cities also generate 60% of gross national product worldwide, and can develop the capacity to sustain their productivity.

"Proposals the United Nations is considering focus on sustainable planning and management methods that will meet the housing, water, sanitation, safety, and waste management needs for billions of people.

"Solutions to problems caused by human settlements are linked to issues of energy, air, and water on a global scale. International organizations and funding sources should provide both human and financial resources. Traditionally, funding for human settlements has been low."

This is rather vague, but illustrative of why the sustainable settlements of the future will need to be very different from the beautiful organic examples prevalent in the historical record of vernacular architecture from around the globe. The environmental criteria for sustainability are today simply global in scope, as we know too much about the damage the totality of the human species can inflict upon the world. The greenhouse effect and the widening ozone hole are two graphic and unintended consequences of worldwide industrialization—no one planned them, yet they are the clear results of the combination of all our energy interventions. A way of life based on building which will last must also consider the full range of atmospheric in which local events affect global. The planetary must be combined with the regional. This is a standard by which the picturesque examples of previous such communities cannot be judged, as every new development we begin is much more connected to the global network of resource use than any Italian hill town or Yemenite fortress. Every bit of energy expended in the creation of the project must be accounted for, and the goal of the elimination of all waste should hold from the material side to the spiritual side.

The strategy for sustainability published by the International Union for the Conservation of Nature (IUCN), *Caring for the Earth*, takes an ecological tack in the definition of sustainable development: "improving the quality of human life while living within the carrying capacity of supporting ecosystems." The carrying capacity of an ecosystem, biome, or bioregion is challenged differently by less industrial cultures with a high population growth and density, or a more industrial culture with a more stable population but with much higher per capita energy use. *World Resources 1992-93* lists the general direction resource use within carrying capacity limits needs to be explored:

"Sustainable development necessitates protecting the natural resources needed for food production and cooking fuels, while expanding production to meet the needs of growing populations. These are potentially conflicting goals, and yet failure to conserve the natural resources on which agriculture

depends would ensure future shortages of food. Sustainable development means more efficient use of arable lands and water supplies, as well as development and adoption of improved agricultural practices and technologies to increase yields. It aims to avoid overuse of chemical fertilizers and pesticides, so that they do not degrade rivers and lakes, threaten wildlife, and contaminate human food and water supplies. It means careful use of irrigation, to avoid waterlogging of cropland. It means avoiding the expansion of agriculture into marginal soils that would rapidly erode."

The full effects of each intervention on the fragile and heavily used north German environment, part of the temperate forest biome, needs to be considered at each step. The large scale ramifications of an event that will draw millions to the region by car, bus, train and plane need to be carefully managed so that a sudden onslaught of visitors does not irreparably degrade the site.

Germany, with a population of 77,573,000 is the twelfth largest country in the world. At 1.4 trillion dollars, it is fourth highest in GNP, and at 1.14 billion tons CO_2 equivalent, the country is sixth highest in greenhouse gas emissions. With a land area of only 137, 801 square miles, Germany is the fifty-seventh largest country on the planet. The incongruity of population and available land makes environmental pressures among the country's top concerns. Most of Germany is part of the temperate forest biome, which covers only 4% of the world's surface, despite its preference by humans as habitat. So from the point of view of other species in this type of life community, preserving forests is of utmost importance. Forest damage from acid rain is visible throughout the nation, and as much as 50% of all trees are thought to be damaged. Heavy metals and toxic effluents lace the waters, and air quality is often threatened. And much of the wooded area is so rigorously managed that nothing near the optimal level of biodiversity is encouraged.

An example of the possible ecological richness this habitat could sustain may be found in Poland's Bialowieza National Park, an area of 47.4 square kilometers, protected by a buffer zone, 15 kilometers wide, of managed forest. Among the mammals thriving there are lynx, wolf, wild boar, elk, red deer, roe deer, and the celebrated European bison, re-introduced after near extinction in 1929. The unique value of this fragment of an ancient forest has been appreciated by the nation under successive forms of government, and is respected around the world as well. Perhaps some analogous kind of recovered habitat could be planned for the distant future as part of EXPO 2000. With the merging of East and West Germany in 1990, the West inherited a land of severe environmental degradation. By 1996, even the eastern parts of Germany will need to meet the waste, water, and air pollution standards of the European Community. EXPO 2000 would be an ideal time to celebrate the meeting of these requirements as Germany sets itself up as a model of sustainability for the next millennium.

IV. From the Urban to the Wild

A complete fair will offer the full range of landscape experience from civility to the wilderness. It is over the full course of possible interactions with the ecology that the meaning of nature is articulated. We need a range of built scales, like the non-modular rhythms of the natural world, not imposed, but suggested. Previous attempts to plan for diversity have usually legislated too much, and made it all look far too artificial.

Most famous in modern times is the garden cities movement, led by Ebenezer Howard, which tried to specify not only the physical layout of the ideal urban form, but also took a stab at defining the socio-economic and philosophical basis for a modern way of life which would bring its inhabitants into contact with nature even as industrialization grew. Agriculture and industry were to be linked in a design where financial equity would be shared with the residents. The socialists Charles Fourier and Robert Owens had come up with similar ideas in the middle of the nineteenth century, but they usually envisioned a single building surrounded by productive land. Not having firsthand experience with building the environment, their ideas were more sophisticated than their models. Howard's visions were diagrammatic and geometric, not so much specifying building type as how open space, streets, and built sections were to be laid out. The idea was socialist, but the picture was orderly and somewhat totalitarian. The notion that new developments could be conceived not as suburban sprawl, but as independent self-sufficient communities offered a profound alternative to the rapidly growing urban centers. Here is how Howard described Welwyn, a garden city seen as a satellite of London in 1919:

"The town will be laid out on garden city principles, the town area being defined and the rest of the estate permanently preserved as an agricultural and rural belt. Particular care will be taken, in the arrangement of the town, to reduce internal transport and transit, whether of factory and office workers, or of goods, to the practicable minimum. A population of 40-50,000 will be provided for, efforts being made to anticipate all its social, recreative, and civic needs. The aim is to create a self-contained town, with a vigorous life of its own independent of London."

Though garden cities did try to mix housing, workplaces, and commerce, it was wrong to imagine that they could be closed systems, autonomous and detached from the rest of suburban sprawl. Macro-economic catastrophes like the Great Depression began to control their fiscal situation, and it was difficult to maintain the co-ownership over any length of time. Welwyn was eventually taken over by a developer, and now it is primarily a residential suburb. Another of Howard's garden cities at the outskirts of Oslo, Norway, at Ullevål, originally conceived as worker housing, is now considered so picturesque that only the most wealthy can afford to live there. That is a mark of both its success and

failure: Superior to the more lifeless suburbs that followed it, the garden cities now are valued nostalgically, more as places of residential luxury than anything else. They had the forces of a growing economic system against them, and they had to defer to external demographic change before their own sustainability could be tested.

The great modernist Le Corbusier had his own principles for how the city could embrace its location, and in principle they do not seem so different from the kind of things proposed today:

1. We must decongest the center of our cities.
2. We must augment their density.
3. We must increase the means for getting about.
4. We must increase parks and open spaces.

So much for principles! The problem is in the lack of concern for the "edges" between these conflicting aims, and the street separation between the parts of the plan. Corbusier enjoyed huge high-rises overlooking independent countryside, and when you look at the places where he was allowed free reign, such as his whole new cities in northern India, you see the imposed exact geometry of modernism turning away from a nature left unconsidered outside the city walls. This kind of rigid separation encourages the idea that human interests are separate from natural interests, assuming they will always conflict. This division precludes creative solution, and speaks again for the virtue of modesty in urban planning. Lewis Mumford later called Corbusier's well-articulated vision the picture of the "anti-city:"

"The first mistake was the overvaluation of mechanization and standardization as ends in themselves without respect for human purpose. The second was the theoretical destruction of every vestige of the past, without preserving any links in form or visible structure between past and future, thereby magnifying the importance of the present and at the same time threatening with destruction whatever permanent values the present might in turn create... This is the error of the disposable urban container. Finally Corbusier's concept carried to its extreme the necessary reaction against urban overcrowding: the mistake of separating and extravagantly over-spacing facilities whose topographic proximity is essential for their daily use."

Corbusier's greatest contribution to planning was to liberate the plan from pre-conditioned constraints. With the new materials of reinforced concrete and steel, he demonstrated that whole new environments could be conceived, based on the designer's experience of the site. His best work is on a smaller scale where the sculptural nature of his architecture defines fascinating spaces. He just tried to expand these ideas too far, beyond the limits of their indifference to context. And yet the mainstream application of

his ideas proved even worse than the monumental models: Suburbia as it has turned out lacks any organic focus, because it is seen as a place to live, not to work, thereby separating livelihood from home. How could anything but alienation result?

The backlash to the sterility of New Town theory can be said to have begun with the work of Jane Jacobs, who argues as a writer from outside the architectural profession that the congestion and mixed use of older cities supports a vitality and genuine community which the planned does not. The original city was based on the intermingling of people from different social classes and the cultural value of chance meetings in streets with a past. Can such a traditional way of life be simulated? A successful community needs a *locus mundi* where an identifiable center for human interaction and interchange is scaled to social and cultural demographics. There needs to be a well point where unplanned communication can occur.

Is the recovery of tradition compatible with the ecological imperatives of using solar-based renewable energy and eliminating the concept of waste? The planners who build on Jacobs' approach, such as Leon Krier, Peter Calthorpe, and Andres Duany and Elizabeth Plater-Zyberk, are less motivated by ecological worry than by the social boredom of most post-World War II building worldwide. There are so many aspects involved in design that even well-intentioned planning strategies may go awry. It is important that design not constrain the human or natural economy; people should be free to determine spatial utility.

Design should never dictate, but be didactic only as part of a larger environmental education. If ecological constraints are too strong, it may be best not to build anything new, but instead retrofit what we have so that as little damage is done as possible, while ensuring that the city allows for the presence of nature throughout its fabric. Corridors of green such as Frederick Law Olmstead's nineteenth-century "emerald necklace" in Boston and Washington now may be seen to have value for wildlife in itself, not just for human enjoyment, but the strategy is still the same. It should be stressed that the diversity of scales and habitats should be accessible to everyone. Habitats should not be arranged as if in a museum, but readily experienced in daily life.

It is a great challenge to link environmental conscience with enduring design. John Todd, founder of the New Alchemy Institute on Cape Cod, Massachusetts, has worked for several decades on "living machines" conceived as miniature earths containing many components of a food chain. More than greenhouses, they represent a synthesis of solar, wind, biology and electronics for cultivating food and sustaining a comfortable environment. He imagines them all over the future human environment:

"A living machine is a device made up of living organisms of all types, usually housed within a casing or structure of 'gossamer' materials. Like a conventional machine it is comprised of interrelated parts with separate functions and used in the performance of some type of work.... They are engineered with the same design principles used by nature to build and regulate its great ecologies in forests, lakes, prairies, or estuaries. Their primary energy source is sunlight. Like the planet they have hydrological and mineral cycles. They are, however, totally new, contained environments.

The full expression of the living machines is far from being realized. I predict that it will become an integral part of the architecture and design of towns, villages, and city neighborhoods. Urban agriculture will be widespread and productive. Sewage will be treated and recycled in living machines. With plants, animals, soil, water, and purifying gases, these structures will become the workhorses of a solar age."

The following table demonstrates how living machines differ from conventional technologies in regard to energy use:

	Living Machines	***Conventional Technology***
primary sources:	the sun	fossil fuels, nuclear power
secondary sources	radiant energy internal biogenesis of gases	combustion and electricity
capture of external energy	intrinsic to design	rare
internal storage	heat, nutrients, and gases	batteries
efficiency	low biological transfer efficiency in subsystems, high in overall aggregate efficiency	high in best technologies low when total infrastructure is calculated
lifespan	long, to centuries	short, to decades
recycling	internal and intrinsic	pollution control devices if anything
material	parts are living populations	hardware based

These comparisons suggest the goals of such technology, but it requires creative understanding on the part of the designer to create real places from such organic devices. On a trip with anthropologist Margaret Mead, Todd visited Bali, where they experienced villages which fused practical, artistic, and religious elements in their dealings with the natural world. He realized that the organic constructions he was trying to envision as part of a city were too individually conceived, too much like single buildings, than whole plans that address the complex ways people live. The ecological imperative of thinkers like Todd fails if used to replace architecture, rather than supplement it. The designer's challenge is to combine engineering philosophy with aesthetic and stylistic planning constraints.

Appropriate solutions also involve a certain specific attention to the site at hand. Local knowledge is essential to guarantee ecologically aware designs. Roberto Burle Marx, celebrated Brazilian landscape architect, uses 50,000 species of plants rather than the 12,000 species of the European world. This respect for the great tropical diversity leads to an ecological sensibility:

"People are so uneducated. Nature is always destroyed in the name of progress. Nature is a cycle of life that you must understand in order to take liberties with it in good conscience. The means at our disposal like the great bulldozers, fire, defoliants, can just as well be used for good as for evil but in Brazil they are used to create misery." But this ecology is not extremist: "I don't say that in my gardens I don't plant foreign plants—I do. *But they must fit into our landscape.* It is important that a design is a result of our existing landscape and flora."

In most cases, the traditional division between settlement, agricultural, and forestry land use patterns may be preserved. If care is taken with the existing landscape, its features may be preserved as new development is put on the site. However, in Germany it may be useful to take an over-managed monoculture forest and change it into a mixed stand simply to demonstrate the failings of previously restrictive forest management.

A truly sustainable community will need to be far more integrated than most planning or environmental experiments to date. An inspiring example is Curitiba, Brazil, a city of 1.6 million inhabitants which has made environmental concerns a priority of development. High-rise development is encouraged only in structural axes with central, special lanes for buses. Instead of huge, expensive downtown renewal projects, the city has favored small-scale projects that preserve traditional localities and as much parkland as possible. Separation of trash for recycling by individual families is encouraged by exchanging garbage for food and bus vouchers in the poorer parts of town. Environmental education is instituted at all school levels. As a result of its commitment to providing a high quality of life, the city is a favored site for new industries of local and foreign origin.

It is not design's place to create a religion of appropriate habitation, but that may be happening of its own accord as attention to ecology becomes a fact of our present life, much like attention to progress was earlier on in this century. Ecological thinking must not become too thin and scattered. It is an important aspect of life, but not a self-contained 'new system.' Design can teach both a practical involvement with natural cycles as well as an aesthetic celebration of the range of possible ways to live outward into the natural and social world. It need never hide the individual in a sealed box of his own making. These are the qualitative concerns. Quantitative aspects are discussed in the next section:

V. Life-Cycle Analysis: the Quantification of Environmental Responsibility

The environmental imperative is more than an appeal to a return to more traditional, time-tested aesthetic routes which do not overrun the rich range of natural experiences. We are asking for a consideration of the full life cycle of materials and constructions such that a realistic, sustainable interaction with the natural world is achieved.

With the endorsement of "Life-Cycle Analysis," we are suggesting one of many approaches to environmental impact study, not as any sole criteria, but as one part of the evaluation process. The biggest advantage this method has over other comparable ones is that it encourages optimization: that is, finding a solution, rather than just pointing out the problems. Systems analysis of the entire life-cycle of each part of the built environment is an outgrowth of the modeling pioneered by the *Limits to Growth Report* written at MIT in the early 1970s, applied at a much more specific and smaller scale.

The Society for Environmental Toxicology and Chemistry states that "the life-cycle assessment is an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and material usages and environmental releases, to assess the impact of those energy and material uses and releases on the environment, and to evaluate and implement opportunities to effect environmental improvements. The assessment includes the entire life-cycle of the product, process, or activity, encompassing extracting and processing of raw materials, manufacturing, transportation, and distribution, use/re-use/maintenance, recycling, and final disposal." The following items are from their report, *A Technical Framework for Life-Cycle Assessment*:

There are three phases to the analysis:

•Inventory—The data-based process of quantifying energy and raw material requirements, including air emissions, waterborne effluents, solid waste, and all other releases incurred throughout the life-cycle of the activity.

•*Impact Analysis*—The qualitative and quantitative method to assess environmental loads identified in by inventory, including human and non-human health considerations.

•*Optimization*—A systematic evaluation of the needs and opportunities to reduce these environmental loads throughout the entire life-cycle under scrutiny, using both quantitative and qualitative measures of improvements in design, material use, processing, consumption, and waste management.

The inventory involves these six elements:

•*Raw Materials Acquisition and Energy*. The boundary for the raw material element of the inventory begins with all of the activities needed for the acquisition of a raw material or energy and ends at the first manufacturing stage of refinement.

•*Manufacturing, Processing, and Formulation*. The processing step of the inventory takes feedstocks or raw materials and converts them to final products.

•*Distribution and Transportation*. Transportation is the movement of materials or energy between operations at different locations and can occur at any stage during the life-cycle. Distribution is the transfer of the manufactured product from manufacturer to end user.

•*Use/Re-Use/Maintenance*. This phase occurs after the distribution and before entry into a waste management system.

•*Recycle.* This stage encompasses all activities necessary to take the material out of the waste management phase and return it to the manufacturing phase.

•*Waste Management.* Waste is generated at all phases of the cycle, and refers to any component released to the air, water, or land. Waste must be eliminated or reduced as much as possible.

The impact analysis should consider the following effects:

•*Ecological effects* specific to the process and region of the manufacturing site should be listed in the inventory phase.

•*Site selection* for manufacturing facilities should be examined for all interfaces between human and environmental resources, including population centers, roads, schools and hospitals, and uniquely valued ecosystems.

•*Habitat Alteration* should be examined for each manufacturing site. How many acres will be removed from ecosystems, and how can their intrinsic value be assessed?

•*Community Relations* should be considered in the evaluation of a manufacturer, insuring there is a partnership of concern and action for overall improvement of quality of life.

In terms of optimization, the following goals are included:

• Maintain deposit return systems so that the producer is responsible for buying back products after their useful life.

• Implement environmentally sound and economically competitive manufacturing practices.

• Improve energy and materials efficiency so that environmental responsibility connects with product performance.

• Develop recycling systems which eliminate the concept of waste.

• Product optimization is the goal of life-cycle analysis.

These criteria need to be considered for all manufacturing to be done at the EXPO site as well as the integrity of materials from which the fair will be constructed. If the new structures are a symbol of anything, they should prove the availability of sustainable building practices and materials in the world. Go to the site, analyze all aspects that contribute to the sense of place, and create a living allegory of the realism of these ideas. The design needs to prescribe that the entire process of building, enjoying, and disman-tling/converting of EXPO 2000 seek and respect quality of life at all levels of its creation.

Quality of life needs to be optimized in environmental and social terms. Relation to natural processes and open place in the social fabric can be enjoyed by all. Exploitation should be eliminated throughout the plan for building and execution.

This is a tall order for designers. The challenge for the plan is to imply this, rather than demand or legislate it. Life-cycle analysis is, as this summary of it should indicate, an open concept that needs further development to be a realistic tool of assessment. The Hannover Principles which introduced this document should be seen as part of the way to integrate design concerns into the life-cycle picture. Here are some examples:

• The buildings must be designed to be flexible as their usage changes. In the SoHo section of downtown New York City, the lofts were designed with high-ceilings and tall windows to allow daylight to penetrate deeply before the advent of electric lighting. Originally built as workshops for factories, clothing, and furniture, they are now in great demand as artists' studios, office, and homes. The neighborhood as component of the city is maintained, because building stock has adapted to changing demographic patterns. They never needed to be torn down.

• In terms of liquid waste, land use planners often find it sufficient to have a pipe coming out of their project. They may not think about sewage as part of large scale land use plans. On-site ecologically sustainable solutions include greenhouses, meadows, large open ponds or Todd's "living machines." Areas must be allocated and the topography must be considered.

• Surfaces must be specified in the land use plan to encourage a range of uses. The Hannovermesse has its overflow parking on grass because it is permeable and is not needed all the time. You don't need asphalt for maximum capacity after the world's fair is through. The parking lot might be converted into a park. One needs to determine just how much parking will destroy the landscape. Research the use of gravel or other permeable paving materials as a part of the land use plan *over time*.

• Adverse environmental impact in the life cycle can be compensated for by evaluating the overall energy consumed. If wood is used, trees might be planted somewhere else. There is land use of the site itself, but off-site compensation is also a possibility. A sister city in former East Germany could be chosen as a site for tree planting or water purification to offset the resources used in building the Expo.

The point of these cases is to illustrate that even at the initial scale of site planning and urban design, it is essential to consider the cyclical nature of ecological effects. This will force planners to consider interconnected issues of material, energy, and waste, even at the initial macro level of the project.

Many methodologies have been developed to evaluate a project's performance according to sustainable criteria. One approach is the sustainability matrix, first suggested by Malcolm Wells in his book *Gentle Architecture*, and then revised by Osama Salem in 1990. Although this approach looks ready-made for the process of judging a competition for sustainable design, it is still an example of linear thinking. There is no sense of the interaction between these elements and how they support and affect each other. When "response to culture" and "response to nature" are given a simple rating, it is easy to see the superficiality. Yet in fact, "response to natural ventilation" and "recycling of embodied energy" are just as complex. Design to solve the sustainability problem will be more than the sum of its parts.

This matrix is the simplest system of evaluation which could be used to test a project's quotient of sustainability. However, it is also limited, and unlikely to guarantee the desired results. Instead, we recommend careful study of the historical and philosophical roots of the problems of modernity. If contestants would consider the ideologies and activities that have led up to our present situation, they might offer a deeper design response to the difficult and non-linear criteria of sustainability. We present Salem's version *not* as a procedure which we endorse, but only an example of how the multidimensional goal of sustainability might be quantified:

MATRIX OF SUSTAINABILITY

-100 negative extreme		*positive extreme +100*
	MATERIALS	
imported materials		indigenous materials
high-embodied energy materials		low-embodied energy materials.
non-renewable materials		renewable materials
non-recyclable materials		recyclable materials
toxic materials		non-toxic materials
	LAND USE	
destroys rich soil		protect / creates rich soil
destroys nutrients		creates / adds nutrients
produces no food		produces its own food
destroys wildlife habitat		provides wildlife habitat
uses high-productivity land		uses low-productivity land
	URBAN CONTEXT	
favors high-energy transport		favors low-energy transport
favors polluting transport		favors non-polluting transport
excludes urban agriculture		includes urban agriculture
homogeneous building types		mixed building types
no open space		forever preserved open spaces
destroys human habitat		provides human habitat
no solar and wind access		zoned for solar and wind access
	WATER	
destroys pure water		creates pure water
wastes rainwater		stores and uses rainwater
ignores gray-water use		uses gray-water
wastes run-offs		creates percolation
obtains water far away		obtains water locally
	WASTES	
dumps black-water		recycles black-water
wastes embodied energy		recycles embodied energy
dumps solid waste		recycles solid waste
	AIR	
destroys clean air		creates clean air
pollutes air thermally		avoids thermal pollution
pollutes indoor air		purifies indoor air
	ENERGY	
wastes solar energy		uses solar energy
ignores buildings' thermal inertia		uses buildings' thermal inertia
dumps waste energy		recycles waste energy
wastes wind energy		uses wind energy
wastes biomass		uses biomass
ignores daylighting		uses daylighting
ignores natural ventilation		uses natural ventilation
intensifies microclimate		moderates microclimate
	RESPONSIBILITY	

destroys silence	creates silence
no participatory design	participatory design
needs frequent repair	maintains itself
addictive and enslaving	enlightening and liberating
no response to nature	responsive to nature
no response to change	responsive to change
no response to culture	responsive to culture

adapted from chart developed by Osama Salem in 1990

HISTORICAL AND PHILOSOPHICAL ROOTS

VI. The Evolution of the Industrial Age — What Went Wrong?

Most thinking on the relationship between humanity and nature tends to separate us from our surrounding context by virtue of the constraints in our language. The words we have are "humanity" and "nature" but the problem of sustainability can be solved only by defining who we are, by understanding where we are and how we can enhance and preserve our sense of place. To come to terms with the problem, we will investigate how dual separate concepts have led to the disastrous developments of recent history.

Ecological degradation is nothing unique to modern times. Plato lamented the total deforestation of the Greek isles. Whole Middle Eastern civilizations were brought to ruin after water supplies could not be sustained. The cliff dwellings of Mesa Verde in Colorado were abandoned after a twenty-year drought. Since the industrial revolution, human society has moved further away from a sustainable path. Society wrought by industry is based on principles that discourage human life that nature can tolerate. Some history of recent ideas is necessary to set the stage for sustainability.

Despite misuse by political forces, the social analysis of Karl Marx is still one of the more profound attempts to address these problems. He emphasized how the factory worker makes only pieces of larger objects which he will never have any use for, thus alienating himself from the fruits of his labors. The direction industry pursued in the nineteenth century separated facets of our lives into cogs in a wheel, with each of our actions never cognizant of the whole context. Instead, Marx wished for "production in a human manner," where we share and give of ourselves through the things we design and build. No plan is imposed on another; each creation fulfills itself by connecting each maker to another and to the world as a whole. The failure of these ideas to be realized is testament of the path the modern era chose to follow.

Martin Heidegger placed the roots of our detachment from nature in the moment we began to extract energy from nature, storing it to be consumed at will with no sense of the Earth's cycles. When energy is seen as "standing-reserve," the concept of waste is inherent, because energy is regarded as something there to be used up. The world is no longer something to partake in, but supplied for consumption. This approach has fostered progress as opposed to a way of life which understands the limits of nature and seeks to sustain society within it.

Lewis Mumford made famous the goal of a post-industrial, progressive culture that might respect the value of organic cycles. His categorization of history is pertinent to designers so we will discuss it at greater length here. He puts forth a conception of three great phases in technology, the *eotechnic*, the *paleotechnic*, and the *neotechnic*. The first extends roughly to

1750, the second runs through the industrial revolution until the turn of our century, and the third gathers momentum in the 1920s and 30s, extrapolating promise into generations to follow.

The *eotechnic* is marked by handicraft, agriculture, and the direct embodiment of human extension into the environment through our own labors. By expanding human presence outward, this phase enhances human life by harnessing the immanent natural forces which surround us. Water, wood, and stone are the dominant materials. Tools are manufactured by craftspeople for specific tasks, easily customizable by the user because they are simple enough not to require mass standardization. In this, for Mumford, generally positive time, technology enriched the life of the senses through direct perceptual extensions like the telescope. It was also characterized by developments in urban and garden design, and the artistic depiction of daily existence. We expressed ourselves in nature's terms, and did not focus on the control of our habitat for our own ends.

Why did we move on from it? According to Mumford, the change began in England, somewhat at the fringes of the eotechnic establishment. When the population increased dramatically, the old agricultural order could not be sustained. At about the same time, it became economically feasible to consume energy out of the Earth in the form of coal. The new industry was not based on life enhancement, but on the extraction of a source of power, , fueling transformative inventions like the steam engine and the railroad. Human presence is expanded into nature through machines driven by coal, robbed from the landscape. Life becomes quantified and driven, run by the intertwined materials of iron and carbon. Workers suffer to make these industries grow, and the physical environment is sacrificed as well. It was capital that drove this advance into squalor—so runs Mumford's compelling but somewhat romantic view.

For Mumford this period was not the culmination of human innovation, but a preliminary phase in which human strength is tested against nature, only to learn in the end that life must be upheld once more. This is why he calls the industrial age the *paleotechnic* era, a passing phase in which quality of human life was sacrificed to further the prowess of technology. To transcend it, we should step back from its unique brutality to affirm a higher humanity in a living world.

Pre-World War II optimism renewed faith in technology as a natural force. Human culture would find a way to progress and at the same time follow the guide of life, eschewing destruction of ourselves and the world around us. Mumford names this time of promise the *neotechnic* era, when technology fulfills its original purpose by bringing humanity and the expanded world back together. This is the time of electricity, of social engineering, efficiency, and the birth of instantaneous communication; the period when the machine begins to arc back and affect human essence in more profound ways. Cooperative thought, the functionalist esthetic, and a more balanced, material sense of human personality are some of the effects of mechanization upon the mind. Comprehension of the modern machine makes order accessible to all, no longer the sole privilege of an industrial complex ruled from above.

Mumford is not naïve enough to claim our progression towards the renewal of humanity with the aid of the machine to be an absolute democratic goal. No, even in his steadfast belief that the machine may be inducted into the service of life, nature is never to be wholly independent of human inquiry:
"We may arbitrarily define nature as that part of our experience which is neutral to our desires and interests: but we…have been formed by nature and inescapably are part of the system of nature. Once we have picked and chosen from this realm, as we do in science, the result is a work of art—*our* art: certainly it is no longer in a state of nature."

Mumford implores us to assimilate the mechanical virtues of impersonality, objectivity, and neutrality *before* we can sail towards the edge of the more richly organic, more profoundly human civilization that returns to the virtues of life. What evidence does he give us to support the conclusion that technology has radically changed enough to suggest goals beyond itself? Machinery itself is no longer composed of standardized, identical units which are pieced together. Instead, individual parts are specialized, refined, made more particularly precise to fit into the whole and achieve meaning in the great technical system.

Earlier machinery needed to simplify organic processes to render them in mechanical form. Neotechnic mechanical parts become more complicated individually to mirror complexity in the species and niches of the natural world. The game of machines is no longer like checkers, with teams of identical pieces; but chess, with complexities of moves and regulations. The goal: dissolving the rigid mechanical world picture and redirecting towards an organic understanding, quantifiable only in terms of growth and change.

The shift toward the natural in technology begins when we see machinery not as the towering achievement of an ingenious humanity, but as "lame counterfeits of living organisms." What is an airplane next to an eagle, a radio next to the voice? Our proudest technical achievements only approximate the organic functionalism within nature. By reconsidering the wonder of natural processes, human techniques can be rejuvenated.

But the twentieth century has not reached the utopia Mumford expected. It is with Mumford's illustrations of 'organic' architecture 'harmonizing' humanity and nature that his optimistic and reforming technical vision begins to appear suspect, sixty years later. A photograph of boxlike, concrete single-room dwellings for Swedish workers framed against an evergreen forest is touted as a "handsome and well-integrated human environment, in which the efficiency of neotechnical production can be registered in a higher standard of living and a wider use of leisure." From our vantage point, it looks like a row of mobile homes, parked at the edge of the wilderness, ruining the view and reducing biodiversity. A hydropower station seems as rectilinear and devoid of affinity with nature as any concrete skyscraper glimpsed across a prairie. The scale of the place alone is enough to suggest certain environmental disaster. Yet for Mumford it is a "symbol of a fresh mode of thinking and feeling."

Why do these images appear woefully artificial to us now, if they seemed to herald the clean, purposeful lines of nature in the 1930s? We are no longer able to conceive the relation of these structures to a context, as they and the grids which guide them have expanded so rapidly and easily that the wild has been trampled in their tracks. Two generations have gone by, a Second World War, and advances in technology that threaten to overrun the Earth by their tremendous *triumph.* It is impossible to look at current technology and affirm that it has approached the directions of nature. Yet *nature remains alive as an alternative*, home to a more profoundly human life beyond the horizon of present capacities. Aspiring to nature is striving to be more settled into the world around us.

Mumford re-evaluated technology at the end of his life. Despite all his encouraging 1930s rhetoric, our built environment had failed to earn the quality necessary to really be a part of nature. Design may have claimed to look organic, but it rarely understood its full context enough to avoid harming the natural processes which surround it. Change in social structures, implied by the suburbanization of the city and dependence on the automobiles, served to alienate people from each other and their ecological place.

Early twentieth century attempts to build in line with nature, including Mumford's own, were too dependent on the metaphors of engineering thinking. The idea of efficiency, of minimizing this or maximizing that, reinforces the limitations of mechanistic thinking, which imagines everything we do or experience to be part of a quantifiable system. We need increased

awareness of those aspects of nature and experience which are excluded from such approaches: the unplanned, the fortuitous, the places evolved without any imposed and directing idea. If the concept of efficiency is to be salvaged, it must distinguish itself from expediency: The best solution may not always be the shortest route from point A to point B.

After recognizing the failures of modernism and industrialization, various possible paths emerge. There is the optimistic idea of a ultra-high tech industry, based not on resource exploitation but on electronic notions of work and creation. In the ineffable realm of cyberspace, humanity would metamorphose so as to no longer depend on the physical. There is the Arcadian dream of a return to earlier, local neighborhoods or towns where each inhabitant learns and knows the value of community and inherently limits his or her impact on the globe.

Neither principle of hope confronts the realities of a skyrocketing population using more of our bounded resources all the time. Even if population growth were to level off in the next generation, we still would be in danger of running out of basic necessities unless we curb our consumption patterns and reduce our overall impact on energy flows.

So design thinking to address these issues must be more than aesthetic response or the adoption of eco-rhetoric. Considerations need to enter the design process which were formerly considered alien; left to engineers or environmental auditors. The idea of making human creation part of nature is as old as Aristotle, but the meaning of the goal has changed as we have become more aware of the fragility and interdependence of natural processes. It is hoped that the refinement of the concept of sustainability will guide our civilization without holding it unnecessarily back.

VII. Rights and Responsibility

The history of the concept of "right" shows an expansion of those considered to be worthy of equal moral consideration. It was once common to accept slavery in many societies, and women are just gaining equal rights in political and social matters. Now we speak of extending the concept of right far enough to include animals, plants, and ecosystems, protecting their own fulfillment, independent of our agendas.

This cannot mean staying out of nature's way as much as possible. Increasing world population and the very notion of development preclude this. It simply means accepting nature as something with inherent, intrinsic value, not just as seen from the gaze of human beings. Immanuel Kant thought we should "never use a person only as a means." Contemporary ecophilosopher Arne Naess expands this to state "Never use a living being only as a means." This does not mean that we never incorporate people or living beings into our schemes, but we always respect their value beyond our immediate requirements.

The consequences of this expansion of right into nature are very simple: *Design for the needs of all species and interactions between species, never just for people's needs.* This means: some facets of the design may be of no value to people, only to the rest of nature. A swamp which supports an astounding diversity of life may be more valuable than the pretty, managed marsh. And if we choose to sequester some areas as undisturbed natural habitat, recognize that the setting up of boundaries is itself a human disturbance, and that the effects of this need to be understood.

The use of ecological sustainability as a guiding direction for design can be taken in two different ways, following the two kinds of environmental philosophy known as *social ecology* and *deep ecology*. "Deep ecology" tends to believe the denuding of the Earth will be prevented by a change in mindset and in values, while "social ecology" asserts that the structures of society need to be totally revamped before we can even imagine what improvement might look like. The former finds favor with philosophers, eco-activists, and environmental consultants, who affirm the power of a change in an individual mind to change the world. The latter approach appeals to social planners and activists of the class struggle, those who see people primarily as products of the social systems they are born into. The choice is between articulating a strong idea of what values environmentalism should hold onto, or looking for what reconception of the system of society might prevent ecological devastation from continuing at the present rate.

Deep ecology is well-articulated in the work of philosopher Paul Taylor in his work *Respect for Nature.* His central goal is the establishment of respect for nature as a guiding ethical principle, expanded from the principles of respect for human life. Arne Naess, who coined the term "deep ecology" and has been named its philosophical grandfather, thinks intuition about the intrinsic value of all nature will ground a respectful way of living in and with the natural, non-human world. Taylor demands a rational structure to articulate the bounds of respect for the world outside our own species' goals and dreams. The unifying question according to Taylor two is: "What is the ethical significance of our being members of the Earth's community of life?"

The natural science of ecology may serve to bring into focus the relationships between human beings and other components of the biosphere, but it will never tell us what to do about these relationships. As a natural science, it has difficulty dealing with values in its own terms. To decide how to act is up to us as people, as moral agents. This is where philosophy is meant to help us. Given a new perspective on the situation engendered by ecology, it might now offer suggestions of how to act in response to the scientific vision. Scientists, as much as the rest of us, need to take moral considerations into account even if they are outside the assumed bounds of their profession.

Respect for nature is not the same as love of nature. It is not just affection or care. Respect, says Taylor, is a public and moral commitment. It demands the definition of rules for behavior towards its object. In loving nature you embrace all the uncertainty and tumult of the wild, while admitting its necessity for *your* survival. Respect is a question of treating the other fairly, stipulating specific ethical regulations. These include real, tangible ways to evaluate competing claims for the environment. He analyzed competing interests upon the priority principles of self-defense, proportionality, minimum wrong, and distributive justice. With this emphasis on human and non-human conflicts, Taylor realizes that dissent may be the norm in human contact with the rest of the world. We have to think sometimes for ourselves, sometimes for the rest of nature whom we respect. We cannot always do right.

Deep ecologists tend to take insights from the natural science of ecology and then wonder what changes in human forms of thought will be necessary to appreciate them. Yet this may be too short a step. Perhaps the metaphors from ecology offer more pertinent challenges to the whole manner in which we conceive our communal existence. Rather than assume that nature is good, and reorient our beliefs to reflect this respect, we might take the definitions of life and interconnectedness offered by scientific ecology as preliminary hints for a new way of seeing society. Not immediately a new vision of a *better* society, but a new device for understanding what we have.

This is the view of Niklas Luhmann in his *Ecological Communication.* A social theorist in the German critical tradition, Luhmann is quick to caution against laying too much weight on any

shared moral consensus in our time. There are just too many different kinds of people with different wants and needs, such that real agreement on highest goals and value systems is not very likely. A principle like 'respect for nature' will never mean only one thing to all people. Instead, ecology can offer new methods to take stock of the differences in human activities and situations. It can offer new conceptions of existing society, necessary before any realistic goal may be articulated.

Environmental ethics, according to Luhmann, is most often a rhetoric of anxiety. It gets us worked up and nervous about the end of the Earth, just as we make moral pronouncements that the current course of human progress is wrong. But to what extent are environmental problems moral problems at all? It is not a question of individuals believing the wrong things, but of social systems doing real damage to the world in which we live. Environmental ethics tends to shy away from the revelation of what's wrong with the systems of civilization, taking refuge in uncertain hopes and fears. If you speak only of persons and not of society, you can only hope to change persons, not society. And society is not a person that needs instruction or admonishment.

Luhmann seeks to reconfigure modern society to discover the means to a socially respectful eco-ethic. Why bring in these devices at all? Ecology has excelled at showing the relationships between previously unconnected aspects of the biosphere, and disparate parts of society might be linked in an analogous way. Ethicists too often assume the autonomy of the human and the natural, though society interactively defines the two. Consider the working of social systems upon emerging principles of natural systems, and the relationship may come clear.

Luhmann is intrigued by the concept of *autopoiesis*, or self-direction and renewal, a principle in biology developed by Humberto Maturana and Francisco Varela as a criterion for life. The mechanical systems of cybernetics, invented by the early computer pioneers to suggest how machines might become self-regulating, could not renew or create themselves. Thus cybernetic automata could never quite encompass life. In outlining the qualities of systems that refer to as well as regenerate themselves, these two contemporary biologists are attempting to model the elusive sense of what it means to be alive. In applying autopoiesis to social systems, Luhmann is the latest instance of a long tradition of taking concepts from natural science into social rhetoric. He is often more careful than his predecessors like Herbert Spencer, who drew quick moral conclusions from Darwinism, rather than thoroughly rounding out a theory. For Luhmann social systems remain 'alive' if they continue to communicate, and the links between them make up a vast ecological network of relationships through the net of society. There is an ecology of social structures as much as there is order in a self-referent ecosystem. No part makes sense without communicating to the rest.

Autopoiesis is a code of social existence. Its operative meaning is *to continue to communicate*. When communication fails, the system becomes diseased, falling apart at its wounds. If the course of information goes smoothly, the defined 'life' of social systems functions as an immune system to keep the ecology of society afloat. Polluting a water supply happens when we do not understand the adverse effects of an industry. If we find that the water is rendered unpalatable, we redesign the system to reduce pollution.

Luhmann's concept of ecological communication is a theoretical schema intended to reveal how social systems respond to their contexts, and why we usually fail to see the natural limitations of these organizations. Luhmann develops a very specific and somewhat mechanistic language to explain the way it all fits together. In a style typical of sociology, Luhmann models social reality as a series of codes and programs, connected to each other like some vague machinery, whose invisible cogs reflect nature only as they simplify it. But he does place a limit on these social mechanics: we can never glimpse the whole from within the whole. Inside the whale, Jonah does not know where he is.

As early as 1974, Hans Magnus Enzensberger offered this most succinct critique of the political uses of ecology: "The bourgeoisie can conceive of its own imminent collapse only as the end of the world." What looked like genuine concern for the well-being of the Earth was in fact panic in the wake of the losing battle of the elite against the masses. Political ecologists fail to recognize that the roots of the problems they care for are not overpopulation or pollution, but the unequal distribution of resources and privilege so that the few may consume to excess while the many suffer, their basic needs never met in the first place. That's the basic perspective of social ecology.

The solution implied by the idea of sustainability must take both of these perspectives into account. There needs to be respect for the absolute limits learned from nature which include elimination of the concept of waste and recognition that solar energy is the one overall external renewable source of energy on the Earth. At the same time there needs to be attention to the social inequities that are in part responsible for the manifestations of scarcity and degradation worldwide. In Germany air and water pollution and forest-death from acid rain are the most visible aspects of the eco-crisis, but the world's fair will have to find a way to address these as well as the more distant problems of the developing nations of the world that should be represented as part of the plan in some way.

If there is any doubt that we as designers have some responsibility to these problems, we need only consult the work of German philosopher Hans Jonas in *The Imperative of Responsibility*. Our present world is one dominated by change. The objects in our world do not stay the same. What was constructed ten years ago already seems old. What about it continually demands the new? Do the constructions of our present age display an inherent inadequacy, or are they (by nature) open, in that they exist to set the stage for some other to come? In their realization they seem to imply a future, for they are not complete. A kind of movement is generated. This movement keeps our culture going.

Must we lose ourselves in this movement, or can we somehow guide it? Jonas points out that continuation of any form of our life into the future involves an "imperative of responsibility." This would require the advancement of our ethical agenda beyond immediate, foreseeable effects, to the distant needs and rights of future generations of all kinds of life on Earth, as well as the planet itself. Some Native American peoples are used to looking at least seven generations into the future to assess the value of any particular decision.

He argues that the rapid movement of our lives and society necessitates a new ethical system which would allow us to cast our notions of responsibility far into the future to insure the survival of the Earth an organic system. In addition to the expansion of ethics from humans to natural entities introduced above, this involves ethical expansion into the future of time.

In order to approach both these enlightened points of view—biocentric ethics and long-term ethics—we must identify an already-present striving towards them somewhere in the undefined but accelerating movement that enlivens our society now. Humanity creates—this action is part of our definition. The only thing we do not create is nature. Yet we can perceive and study its creative methods, and thus come to see that our perspectives may point towards the fluxing of nature.

It is only through extending the bounds of our considerations forwards and back in time, from ourselves out to the largest entities we can imagine, that we can hope to establish a connection with nature. The movement which began us through time, still the same movement which *is* us in this present, changing time, propels us to strive in this direction. This is Jonas' responsible imperative. If we do not choose this direction, we will spiral out of control into an escalating change devoid of meaning. If we temper the movement we can spiral asymptotically towards a circle of resonance, oscillating towards a timelessness which has always been there.

The creation of art and design and the discovery of truths in their purest form, involve a claim to some beauty independent of the limitations of context. Beauty of place also has a fundamental value. Added to these are activities that expand our knowledge of the authentic world. Design can teach us about natural processes and increase our awareness of global systems. The revolution in thought implied by sustainability means that in the future, we will not be able to consider human rights without recognizing that they are contained within and limited by the sphere of natural rights. Our prime responsibility is acceptance of our place within these processes, not as the Earth's eternal enemy.

VIII. Humility in Design

Never has a world exposition chosen to celebrate the fact that humanity does not know very much about the world. Yet this is an essential part of our program. Architects have often brought with their work magnanimous pronouncements of how important their creations are as part of a new social vision, but rarely do they step back to realize that the built environment does not change everything. In fact most of the world's best architecture is not designed by any single force, but represents a community solution to a variety of problems which are often better understood by diverse parts of the social fabric, not just the designer or planner.

When we suggest humility, we mean leave space for the design to evolve on its own. Leave room for the many important aspects of life not dictated by design. Leave room for a nature far greater than any notion of "closed-system", "feedback loop", "balanced ecology", "sublime wilderness", or any kind of ideal we may ascribe to it. Ortega y Gasset wrote that the modern man, what he called the "Mass Man", is unable to distinguish between a natural object and an artifact, because we do not need to question technology as we use it. When we get in the train we assume it will take us to our destination. When we type at the computer we assume words will appear on the screen. There is no need to know more about the tools that we use, and most of us do not understand them enough to keep them in good repair.

These are the products of our design, and we cannot think about them too much if we are to use them successfully. We accept them, and go on. It is the same with our artificial ideas of nature. We come up with truisms like balance and interdependence of nature, and then we step back from them, assuming we can exclude ourselves from the equation. Then we imagine nature as somehow contained in our simplistic analyses.

That misses the point. Nature needs to remain more than we can ever know or describe about it. Only a design which encourages the possibility for future discovery will be able to ensure this. One that plans too much will limit its expression to the limited current understanding about humanity in the world. And understanding is always on the move, changing both according to popular fads and the expansion of common knowledge.

It is very difficult to introduce humility into prescriptions about the future, or into any plans that authorize a specific intervention into what exists in the environment. Scientific ecologists are used to saying things like "we simply do not know enough to be sure what course of action is best for the biosphere," but political and philosophical ecologists are quick to say "design with nature! Follow the rules of balance and harmony so essential to the natural world!" One must be careful to mold these imperatives into methods truly usable, not just new dogmas to replace the old.

The evidence is clear from the record of our century: claims to plan all aspects of the environment have failed. Neither previous world's fairs nor suburban sprawls were founded on evil intentions. It's just that their promoters were too sure of their ideology to be able to include questioning in the design process.

Instead we need to recognize the absolute nature of the sustainable goal without claiming to know too much about what to call it. Here, architectural theorist Christopher Alexander's *Timeless Way of Building* may be of help: In this, the first of his many books intended to guide design towards structures respectful of place and purpose, he does not outline any specifics of method, but instead writes poetically of the truth of an integrative kind of beauty which is so impossible to describe: rather than writing of nature or of harmony or of sense of community or space he talks of the "quality without a name" which cannot be talked about, but can always be recognized by those who visit a place that has it. Writing a book about it might seem a fruitless exercise, but Alexander succeeds because he speaks, Zen-like, circling around the subject rather than holding it up for all to examine: "It is a process which brings order out of nothing but ourselves; it cannot be attained, but it will happen of its own accord, if we will only let it."

So design becomes the setting up of spaces which allow the spontaneous and the integrated to occur. Description never dulls experience if enough unplanned space is left around the plan. These ideas of regularity, of systems, of rules of the closed and the open — these are always only limited human creations. The future is not up for grabs in the relative merits of the post-modernists: nature is absolute and stronger than we will ever be. *But we cannot say anything certain about it*.

We hope in vain for the pure and exact, just to discuss it. But waves in the ocean beat rhythmically on the shore, never in the same rhythm. No snowflake is exactly the same. Alexander writes: "The character of nature is no mere poetic metaphor. It is a specific morphological character, a geometric character, which happens to be common to all those things in the world which are not man-made.... Nature is never modular. Nature is full of almost similar units.... We cannot even find two leaves which are the same." Any rule or prescription is thus only an attempt at explaining the ineffable. When the design works in terms of its context and its inhabitation, we can sense this at once. But the sensation is never planned. We love buildings in which we have fallen in love, or where the space looks out to the rest of the world to suggest that the whole has meaning. Despite all our talk here of ecological responsibility, space must be left for wonder and the preservation of not the known, but the unknown.

Two photographs from Christian Norberg-Schultz's *Concept of Dwelling*: On the left, a green, lush Norwegian forest. On the right, a dark wood house with a solid thatched roof. Of course one belongs in the other. There is no jarring contrast, no doubt. This kind of building is not opposed to its landscape, not making such demands on the surroundings so the context dies or is made invisible. Martin Heidegger comes back again, with his most succinct advice for architects: "We dwell in that we build." Building only works when it instills us in the world. Dwelling means to belong to things you don't understand. The house is not a closed system, but one that opens toward the world. Heidegger goes on to speak of "releasement" *Gelassenheit*, a word which he re-invigorates to mean letting go to the Earth so that it will speak through you in your acts and structures. EXPO 2000 does not so much need to bring the world to Hannover as to show that Hannover already opens up toward the world. Visitors should be encouraged to see farther into the essence of their place, not through the imposition of blindly optimistic dreams, but through the beauty of the interconnected nature of our most important problems. We may be unequal to the problems of solving them but know they do exist.

Heidegger points out that buildings should "bring the inhabited landscape close to humanity," rather than imposing humanity onto the landscape. The locally specific, traditional, or vernacular architecture has survived over the centuries because it accomplishes this. Norberg-Schultz speaks of the *Einhaus* of Lower Saxony, the large farmhouses on the North German plains are built of "long ridges surrounded by groups of trees, looking like man-made hills which give structure to the surroundings." They make the landscape readable, but they do not pave it over with their intentions. Adolph Loos wrote in Austria in 1910 of the essentially biological nature of vernacular construction:

"The peasant cuts out the spot on the green grass where the house is to be built and digs out the earth for the foundation walls.... He makes the roof. What kind of roof? One that is beautiful or ugly? He does not know—his aim was to build a house for himself, his family and his livestock and in this he has succeeded. Just as his neighbors and ancestors succeeded. As every animal which allows itself to be led by its instincts, succeeded."

A bit romantic, perhaps. Instinct needs to be combined with the latest in global ecological awareness. But can it be done fast enough to meet the pace of our fleeting, modern world? Kenneth Frampton writes that architecture must deal most poignantly with the present, instead of the past or the future, when it comes to construction: "Building by virtue of its materiality and actuality cannot realize itself in terms of some redeeming future. For all its relative permanence it has no choice—like most instrumental acts—but to exist in its own historical moment. It has as its objective task the non-reductive realization of humanity here and now. Its true object is no longer the idealized projections of the Enlightenment but rather the physical constitution of the necessary attributes of *place*. " The architecture of the EXPO site may build on the vernacular, being local (traditional) and global (eternal/sustainable) at the same time, making ecological concern a reality of today—not a dream of the future or a reinvention of the past.

Among the biggest obstacles to a sustainable and releasing design here is the question of time. Can anything be built quickly that is designed to last, be it a building, a city, a road, or even a poem or a story? Human works which endure are not concocted overnight, changing lead into gold. They need to balance the sudden flash of individual insight with the slow testing of the waters, so by the time they are built, used, and gently aged, no one person or idea can be identified as being solely responsible. Architecture belongs to no one. It expresses the essential anonymity of a species at one with its niche, as both are created together from among the possible choices of symbiotic survival.

At times design must defer to the insights of other disciplines. Town planners often speculate on the behavior of those who live in their model worlds. Who can know how much the built environment influences people, who do not let infrastructure tell them just what to do? Design should leave room for the flexible use of other builders of society. At its best, it can suggest new poetic, aesthetic, and scientific insights, rather than imagine it can provide them all.

It is very difficult for visionary thinking to admit its partiality or incompleteness. Yet it will always be only part of the solution, not the whole. So each detail of the sustainable dream does not need to be included—only the vantage points that direct the rest of us to fill in some of the blanks, and to recognize which parts of the map remain blank. Ideally sustainable development recommends the leveling-off of increases in population and resource consumption. It will finally require a redefinition of values and a commitment from consumers to want and buy less, a pledge from industry to make less, and from builders to build less. This may be the most humble and difficult message to swallow.

IX. Cooperation as Excellence

In this "competition," there will be no single winner. It is our view that the problems proposed for EXPO 2000 cannot be solved by a single planning solution, and probably not by any single designer. What is necessary is a framework by which innovators in different aspects of the problem may be encouraged to participate and build something more profound than the sum of its parts. We must leave room for the evolutionary play that comes from the chance encounter of different ideas. It is the consequence of the principle of humility, and an escape from the tyranny of the plan. Room must be made for diverse responses to the challenge of the vision of sustainability.

A useful historical antecedent may be the Columbian Exposition of 1893 in Chicago, which may be the most influential of previous world's fairs in terms of assessing a present and offering a model for its future. Almost nothing remains of the construction, but the image of the world put forth at the event contrasts starkly with the mainstream of American modernism that replaced it.

The Columbian World Exposition was proposed to commemorate a date nearly as auspicious as the end of the millennium: the four hundredth anniversary of the date of Columbus' supposed discovery of America. The most celebrated designers of the United States were called upon to participate together: Frederick Law Olmstead chose the site on the shores of Lake Michigan. (It was a stretch of unreclaimed marshland which would justify instant protection today, but that was not in the arena of then-contemporary concern.) Working with architect Daniel Burnham, later made famous by his Flatiron Building in New York, an overall plan was devised as a miniature version of the American national landscape, to combine the grid and the garden, linking park and city with wide landscaped boulevards. The idea was not to focus on industrial innovation as in previous fairs, but to present the artistic and cultural ambitions of the nation taking a leading role in the views of the rest of the world.

New York architects Richard Morris Hunt and McKim, Mead, and White contributed buildings. From Boston came Peabody & Stearns, and from Chicago, Louis Sullivan. Sculptor Auguste St.-Gaudens was the chief art consultant, and he commented on the gathering as "the greatest meeting of artists since the fifteenth century." It should be noted that they were only American artists. (Humility was not really a part of the gathering, but it was true that no one person was in charge.)

The durability of the 1893 fair was specifically temporary, not sustainable. The building material was a mixture of jute, cement, and plaster, to emulate alabaster in structures that were meant only to last a summer. (Actually, such temporary intervention might in fact be more sustainable than the dream of creating a whole new city where there is little demand for one.) The style of the construction was an ornate classicism, which Robert Stern sees as an attempt to establish America as a great nation by virtue of a self-proclaimed role as guardian of the classical tradition. Louis Sullivan, however, came to see the classical monumentality of the site as an aberration that set back the solidly American direction of functional modernism by fifty years.

The fair dealt with a myriad of readable symbols in a manner that only a diverse group of co-operative thinkers could accomplish without rendering a vision more personal than accurate. There were allegories of Art, Science, Industry, and Agriculture, along with carnival rides and attractions. Twenty-seven million people visited the exposition in the single summer it was open. That was nearly one-third the population of the United States at the time. The nation was clearly impressed by the monumental classical vision of what a city could be, even though

it did little to alleviate the strained conditions of the Chicago slums which lie, then as now, just a few miles away from the site.

Architecturally, the pictures of the site reveal it as an impressive and unified place, and detailed study of the individual pieces of it reveal an organic sense that only a diverse group of designers could create using a general guiding philosophy. Yet it remains a success of appearance, not permanence. What were its lasting, sustainable effects? Those that worked on the fair were spurred on to be asked to build major, lasting buildings in the same model. The Chicago waterfront parks were expanded, and the subsequent dredging of the Chicago River suggested to Burnham a future for Chicago where it might resemble Paris, with urban center as artwork itself. These designers did not have enough political power to make their vision accepted, but they had better luck refurbishing L'Enfant's plan for Washington, DC, with a series of neo-Federalist buildings that stand unto this day. The Chicago Exposition was like a cardboard model of the real project: it showed what a collaboration of brilliant designers might look like if they were given the encouragement to work together around a common aesthetic vision.

Another important antecedent is the Artists' Pavilion at the Osaka Exposition of 1970. This project was initiated by the organization E.A.T. (Experiments in Art and Technology), founded by engineer Billy Klüwer and artist Robert Rauschenberg in 1966. E.A.T. was founded to provide artists with the technical expertise to realize their ideas with the most up-to-date technology available at the time. The pavilion presented the efforts on behalf of art merged with technology to comment on the possibilities of the future. Klüwer explains how art can address these questions: "Artists are not limited to functionality. They are sensitive to scale. They question assumptions, and assume responsibility for their creations. They make a strong statement with a minimum of means and a single-mindedness of purpose."

The Pavilion at Osaka was commissioned by PepsiCo to highlight the adventurous possibilities of new technologies. Even so, they questioned the dominant mode of futuristic thinking: the Expo demanded that the pavilion be a large geodesic-like dome, in the tradition of monumental world's fair architecture at that time. But the artists and engineers found that too banal, and covered the dome with a constantly rising cloud of mist, cloaking the regularity of the imposed design with an organic, volcanic feel. Inside were mirrors, changing sounds and materials emphasizing the diversity of the world's possible cultures, even telexes allowing visitors to communicate with different parts of the world. There were handheld radios, the walkmans of the past, that could be carried through the exhibit to pick up changing broadcasts from around the inside of the sphere. It was a cooperative effort of many thinkers and designers from all over the world, leading to among the most popular and least expected attractions at the fair.

Still, that Expo was, like most previous ones, based on the premise of the technology of tomorrow. The Hannover EXPO is based on ideas of restraint, awareness, and concern for solving the world's problems, not hiding them behind a wall of promising machines. Yet a similar consortium of artists and technologists should be called upon to address the diversity of problems in a way that no one person could tackle alone.

With EXPO 2000, we propose that the community of designers rally around a common ecological vision, with aesthetic direction open to choice. Cooperative design work may help to diminish the quirks of individual egos, and respond to a complex situation in the complete way only the many can accomplish in contrast to the one.

We would like the *language* of sustainability, a language still undergoing development, to be the framework for the design thinking around this important and momentous project to kick off

the next millennium. What Christopher Alexander says about group process in conceiving a building can easily be extended to a large plan such as this:

"When a group of people try to do something together, they usually fail, because their assumptions are different at every stage. But with a common language, the assumptions should be explicit from the start. Of course they no longer have the medium of a single mind, as an individual person does. But instead, the group uses the site 'out there in front of them' as the medium in which the design takes shape. People walk around, wave their arms, gradually build up a common picture as the plan takes its shape... It is for this reason that the site becomes so much more important for a group. The site speaks to the people—the building forms itself—and people experience it as something received, not created."

For successful cooperation to happen on this project, those involved need to have some agreement that the goal of sustainability is an important one, as well as a commitment to understand the ramifications of their design work well beyond the immediate concept. Ecological integrity of materials, effect upon the overall landscape, role of the project in meeting basic needs of visitors and inhabitants now and in the future, and articulation of the goals of humanity embarking upon the next millennium must all be addressed in a spirit of affirmation and optimistic support.

EXPO 2000 is like an imaginary city which must be built as something real and enduring to prove its point. As author Italo Calvino alludes: "Cities, like dreams, are made of desires and fears. Even if the thread of their discourse is secret, or their rules absurd..., everything conceals something else." The ecologically sustainable vision for Hannover at the edge of the millennium is motivated by the fear of a devastated planet, with a desire to show that we have a real chance to save it and continue the evolution of our species at the same time. There are no easy rules to follow this course, and every choice not only hides another but implies further questions which require consideration. The full exploration of this interwoven net of questions is the sane path towards ecological resolution of the fate of this earth.

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