WILDERNESS AS REENTRANT FORM:
thoughts on the future of electronic art and nature

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"The conception of the form lies in the desire to distinguish.
Granted this desire, we cannot escape the form, although we can see it any way we please."

(G. Spenser-Brown)

I. Current Predicament

The image of grass and weeds asserting themselves through the cracks in concrete walls or asphalt streets has always reminded me of the tenuous audacity of the city dweller. The tenacious presence of such living things is a cautionary delight. We are not the rulers of our biospheric house but merely tenants who have radically transformed the architecture to fit our own decorative expectations. This transformation has been so thorough that we now find ourselves in a coevolutionary dance with Gaian elementals who must decide to either raise the rent or evict us into the deep vacuum of space and its subsequent colonization. But our step into outer space has also been a blessing. For the first time, we have seen the Earth as a whole, with the promise of universal citizenship an admonition to take greater care of home.

This is the predicament that the Deep Ecology movement has specifically articulated: we must define a participatory relationship between contemporary humanity and the greater environmental complexity of the biosphere in a manner that is mutually life-enhancing. This begins with an assumption that the traditional Western philosophical dichotomies between human and nature are no longer tenable. The Romantic regard for nature as source of aesthetic contemplation, as well as the mechanistic view of nature as clockworks merely to support the unique event of the human soul, is insufficient. We are part of dynamic living processes from which we can never extricate ourselves and to which we owe our continued survival.

In the light of the current destructive capacity of civilization and the disequilibrium it has engendered within the biosphere, the obvious human need to reaffirm connection with the non-human world presents an ironic challenge. As we appear to be moving further away from rootedness in a somatic relationship with a biological environment that we have irreversibly altered, the need to define an experiential connection to what we are transforming springs forth in ever-starker relief. The preservation of wilderness is paramount for the

survival of the whole system, including Homo sapiens, and yet our identity as a species demands an essential revisiting of our connectedness to wilderness in ways that seem destructive of it. Eventually, we must confront the seeming contradiction that if the biosphere is going to survive in a manner inclusive of human beings, then human beings must allow more room for the non-human. This realization must include an understanding that we have so altered our environment that `back-to-nature' campaigns will not suffice to solve our problems nor those of the biosphere. Appropriate technologies may soon be necessary, even to help regulate the Gaian atmosphere.

The popular appreciation of wilderness is growing at a dramatic rate. Ideally, along with this experiential relationship to wilderness comes a desire to preserve it. But beyond the obvious issues of destructive human exploitation of our environment is the contradictory challenge that recreational access creates. National parks face this dilemma to the point where human access to the non-human world must be limited if the latter is to survive. If our physical survival is dependent upon the preservation of wilderness, while our psychological health is dependent upon reaffirmation of our connectedness to wilderness in ways that are ultimately destructive, what can constitute viable means through which both criteria can be met?

While recently attending a scientific conference,[1] I heard an interesting statement from the eco-philosopher Arne Naess. Rather than making the usual blanket condemnation of communications technology generally associated with environmentalists, he passionately suggested that the television media could serve as an essential tool for ecological preservation. His argument was based upon the assumption that environmental fragility can no longer tolerate the hordes of nature enthusiasts whose very presence makes their reverence for wilderness problematic. He wondered if the entertainment media consciously could provide a substitute experience of nature as a conservation strategy. In addition to the rather unsettling ethical issues that such a policy raises, there is an interesting possibility worth probing in a deeper fashion: To what extent might the technologies of communication, art and entertainment serve as `prostheses' that would provide us with experiences of wilderness that would not only enrich our human identity but help us to preserve and expand the domain of the non-human world? This question should not be seen as posing a substitute for the direct experience of nature but rather as a means of bringing a deeper experiential understanding of it into our daily lives. There is an apparent inevitability to technological development that will render the ideas discussed in this paper possible in a matter of years. It is essential that we understand both the positive and negative sides of these issues in order to influence responsibly the direction in which these technologies might unfold.

II. Human in Nature - Nature in Human

Political rhetoric concerning the dialectics of exploitation has expanded gradually to an awareness that issues of freedom and dignity, which originated in our anthropocentric ethics, must now include the total fabric of life within which we reside. This issue does not stop at the need for wilderness preservation; it also addresses our desperate need as a species to understand our place in the scheme of the natural world and how this often translates into metaphors of modern alienation. Ultimately, our dilemma is a spiritual one. While I do not believe that we can retrace our steps to some abstract notion of a lost paradise, I also do not think that our predicament is hopeless. What we require are new modes of experience that can help recover those aspects of human integrity that are rooted in a fundamental sense of connectedness with the non-human world.

The historian Morris Berman has argued that our Western world view, based upon the epistemological assumptions of scientific objectivity, is a non-participatory consciousness. Such an epistemology creates an alienated world in which the observer is believed to be separate from what is ob-served. This is a recent event in human history. The vast majority of previous human experience was based in an 'enchantment', where humanity saw itself as an intrinsic part of a world that was alive.[2] Over the thousands of years that made up our human identity as nomadic hunters and gatherers, survival was dependent upon maintaining a reciprocal relationship with a physical environment animated by powerful living forces. All things were understood to be aspects of a dynamic universe populated by myriad intelligences and deities with which humankind had to maintain respectful cooperation. Such an animistic understanding is in stark contrast to the mechanistic perspective that came to dominance over the past four centuries. But dissatisfaction with the vision of the world as grand clockworks, in which man and beast are held to be totally distinct components, now challenges the Cartesian view. This issue of how we see our relationship to other forms of life, and how that view is changing, seems symptomatic of a profound transformation toward a new animistic resurgence in our own times.

Popular culture has encouraged images of animals behaving as human beings to the point where their intrinsic characteristics are lost in an advertising haze of cartoons and stuffed toys. But underlying the trivialities of these images and objects seems to be a hidden need to reach out, and in some way, to comprehend the consciousness of other living things. Our consensus beliefs mostly have become blind to the presence of nature's 'otherness'. This exhaustion can be seen as a saturation of our experience: the destruction of biospheric diversity creates a

vicious circle where our over-hominization of the planet now promises a homogenizing death. While the modern world has nearly severed contact with the non-human, there are reminders buried in the anthropomorphic blur of popular entertainment. Smokey the Bear reminds us of the sacred vulnerability of the non-human world, while Disney's *Fantasia* depicts a world populated by nature spirits reminiscent of archaic lore. We appear to be at a crossroads where the over-humanizing of nature signifies both the end of one world view and the beginning, or rediscovery, of another.

Contemporary science itself has begun to question the traditional assumptions of the mechanistic epistemology. Philosophical scientists have even articulated radical new visions in which a reenchantment of nature is implicit. The synchronicity of the discovery of cybernetics and the growth of ecology as an important science took significant form in the work of Gregory Bateson. He attempted to create a coherent philosophical vision of a new relationship of human society with our physical environment that is based in the reciprocity of the phenomenon of mind in nature.[3]

The philosophical speculations of David Bohm, positing an essential consciousness of all matter in the universe, are grounded in his significant contributions to contemporary physics. His theory of an `implicate order', which lies beneath the seeming paradoxes of quantum mechanics, describes a dimension of infinite depth through which both matter and consciousness find their source and unification.[4]

The thermodynamicist Ilya Prigogine has focused upon the understanding of time as an empirical fact. His work in the area of irreversible thermodynamics and dissipative systems that evolve into greater complexity far from equilibrium suggests a universe akin to a living organism. It is a vision of the universe as a creative source that is self-modifying and full of novelty. In many ways, Prigogine's conclusions represent a synthesis of mechanistic science and the Romantic mysticism from which much of the concept of evolution emerged. Such a philosophical position profoundly blurs the distinctions between life and non-life in a unity that draws humankind closer to nature.[5]

Despite their extreme differences, these current scientific views suggest to me that we are returning to an understanding of our place in nature that is animistic but at a new level of complexity. It is a level that can include technology that is life-enhancing rather than destructive. Our new science can no longer accept the old distinctions between scientific and ethical values, which assumed human separation from, and therefore dominance of, the non-human world. We must accept our role as homeostatic elementals with a responsibility for the participatory custodianship of planetary evolution.

Given our current circumstances, technology can be seen as a logical consequence of a coevolutionary dance. We appear to be engaged in a dynamic scenario in which the biosphere, human culture and the infusion of consciousness into technology are symbiotically transforming into a new pattern of life. It seems no mere coincidence that we are giving birth to 'intelligent' machines at the same time that we are rediscovering the mental complexity of non-human life. Our creation of rudimentary intelligence and 'customized' life forms places us at a hinge where confrontation with a human-made 'other' forces us to reevaluate our overly anthropomorphic perspective. Consistent with this 'new' animism, we are becoming electronic nomads who wander the information pathways of a planetary information environment.

III. Emerging Role of Public Institutions

Despite the popularity of wilderness parks, most people in the United States live a vicarious existence in which their experiential knowledge increasingly is derived from the electronic media. Unfortunately, this kind of experience of the world is heavily diluted and stripped of context. When representing the experiential complexity of nature, the electronic media is often at its most ludicrous. The question of the appropriateness of the entertainment media to provide a substitute experience of nature must therefore be seen in the light of those institutions and events that provide an optimal contextual frame. For instance, although zoological parks are a far cry from wilderness, the recent attempts to emulate natural terrain and environmental conditions are more than a mere ploy for boosting the education of spectators. Zoos have become a major force in the preservation and breeding of endangered species. Attempts at contextual accuracy are a conservation strategy. The same can be true of the increasing commercialization of natural parks. As William G. Conway of the New York Zoological Society has said about the necessity to make natural parks profitable, a maned lion in Kenya is worth nearly 450 times more as a tourist attraction than as a trophy skin.[6]

As many economists predict, tourism may supplant the military/industrial complex as the world's foremost industry by the turn of the century. Museum and theme-park construction is expanding at a rate never before seen, with major activity centered in Europe and Asia. There appears to be a growing sense of responsibility for the role that such public institutions might play as centers linking the preservationist values of traditional museums with the omnipresent global electronic culture. As George F. MacDonald, director of the new Canadian Museum of Civilization, has said: "Museums have a unique place in the formation of an individual's reality and experiential grids. To the young visitor, the displays add scale, real-time sequences and context that is chronically absent

from electronic media."[7] When this statement is juxtaposed with another by the same man, the visionary possibilities become evident:

"Spaces in the new museum, from exhibits to theatres, have been designed for TV production with satellite link-ups that can allow simultaneous and interactive programs between ethnic groups separated by 10,000 miles but participating in the same event (for example, Chinese New Year's in Ottawa, Vancouver, Beijing and Hong Kong, with dancing partners half a world away - a global village in the best McLuhan tradition)."[8]

Despite the obvious competitive pressure to increase profitability, which forces public institutions and parks toward greater commercialization, there appears to be a subconscious activity at work. In the face of current massive social disequilibrium and the accelerating rate of global change (both cultural and environmental), the need to connect to a sense of groundedness in nature or history becomes almost desperate. It is my contention that the hybridized interconnection of public institutions (museums and parks) with the communications technology of the burgeoning electronic culture and information economy represents a major strategic potential for accomplishing what Naess has intuited: the designing of social institutions through which a reconnection with nature can unfold in a mutually life-enhancing manner.

Participatory forms of public recreation, many theme parks for instance, perpetuate a high level of abstraction through fantasy distraction. This is particularly characteristic of 'amusement rides' such as Disneyland's attempts to recreate a tropical rainforest or a historical period. These stand in stark contrast to the somber object fetishism of traditional museums whose role has been to preserve 'real' things of historical or natural value. On the one hand, there is a tendency to sacrifice a sense of connectedness to the real world in order to maximize the viewer's sense of interactivity, and, on the other hand, there is the creation of a sense of separation from real objects in order to protect them. What seems necessary is the creation of a new form of public institution that combines connectedness to the real world with participatory interaction. Perhaps the closest to this ideal has been the hybrid science museum where hands-on exhibits instruct the public about scientific concepts.

Even though the participatory aspect of these institutions is a valuable step toward what I have in mind, my vision is more radical and precise. What I believe we need are places within the urban environment where access to a sense of the mystery of the non-human world can confront us directly --the reentry of wilderness into our civilized lives. While science attempts to understand the natural world by probing deeply into nature's structure, it cannot alone provide us with the necessary experience of nature's mystery and beauty, which is a part of our human heritage. Likewise, the creations of traditional artists provide us

with contemplative or aesthetic interpretations of the natural world, which are themselves highly filtered representations. More appropriate are the contributions of experimental artists investigating new technologies for their interactive potential. What is necessary is the application of skills and knowledge from various disciplines toward the creation of centers dedicated to the experience of the non-human world through as few filters of abstraction (i.e. the personal and cultural biases of artistic representation) as possible .

The necessity of shifting our modes of experience away from passive representation toward interactive experience has become not only one of the essential concerns of education but a central issue for our times. Public schools which have tremendous difficulty competing with television for children's time, serve as contexts for interpersonal socialization rather than as educational institutions. Children now absorb the vast majority of their knowledge of the world from the electronic environment. Since much of this knowledge consists of decontextualized abstractions that are highly redundant, the content of this type of education tends toward its own formal principles: children learn to be citizens of an electronic world that is passive and non-participatory. A challenge for the future is to find a way to reintroduce context and interactivity such that this electronic environment becomes creative and life-enhancing.

Of paramount importance in the design of appropriate institutional contexts is the recognition of telecommunication technologies as powerful tools for connecting the human and non-human worlds. Just as the real-time use of two-way satellite-transmitted video and sound has explored interactivity between groups of people occupying distinct cultures or geographic locations, such technologies can also be used to improve the quality of wilderness representation so that `entertainment' could consist of a greater connectedness to the direct experience of the natural world. The negative side of this application is that it could merely serve as advertising for a global park. The implementation of such ideas must include appropriate safeguards and cautionary measures.

The design of interactive networks linking natural environments and urban institutions, such as museums, zoos and other public spaces, represents a specific application for the development of new and extant technologies. Many of the most creative explorations of this possibility are emerging as cultural phenomena that generally have been subconscious to date. These concepts can be seen in the more general context of experimental artists having moved from the creation of objects to the design of interactive, experiential environments.

IV. Artists as Systems Thinkers

As the emergence of a planetary culture has become apparent, amidst the simultaneous transformation of the industrial age into a world-information economy, one of the essential issues for artists has been the creative use of the major technologies through which ideas find expression in that context. The major technologies of this new planetary culture have been computers, telecommunications and the electronic processing of information in the form of sound and video.

It is interesting that the two predominant systems to utilize these technologies at a global scale are finance and the recorded entertainment industry (i.e. television, movies and music). Both systems are in the business of exchanging patterns of information rather than things, and both are accelerating due to rapid technological innovation.[9]

In the case of the recorded entertainment industry, the innovations often have been the result of work done by artists exploring these technologies outside the context of commercial support. While this industry includes such cultural 'artifacts' as classical music and vintage films, it supports its profitability primarily by creating new information products of diverse cultural and popular interest. Within this system, novelty is an essential factor in the form of fashion. However, fashion is intentionally controlled novelty, not original creativity, and functions as a communication mechanism within this commercial planetary information ecology in a manner that is purposefully constrained by the system's dynamics. Radical discontinuities, such as creative art, are absorbed slowly. Ironically, experimental art functions as a research-and-development resource from which innovation has been selected.

Within this planetary electronic culture, the artist becomes the fabricator of feedback that challenges the ideologies of the status quo. This sets up a dance through which the predominant users of these technologies attempt to filter out feedback that does not immediately confirm their own status and identity. This environment reorganizes to accommodate new information that has lost its threatening status and has been absorbed by the public through 'secondary' channels. Within the commercial entertainment media, novelty is secondhand.

The general public is rarely aware of the activities of radical artists working at the limits of technology and only becomes exposed to their ideas through a distribution network that is generally far removed from the artists and their motivations. Even commercial producers appear to borrow new ideas in a haphazard manner that seems to be unconscious. This is not to say that many experimental artists remain ignorant of this process. To the contrary, some have

humorously suggested that the commercial media should be taxed and the proceeds distributed to artists for research and development.

Given the previous assumption, it is logical to presume that patterns observed in the activities of experimental artists can also predict ideas and technological innovations that will someday play a significant role in the mainstream culture. Ezra Pound referred to such artists as "antennae to the future". It is therefore appropriate to examine those patterns of artistic activity that might support a life-enhancing potential for technological innovation by expanding our interaction with the non-human world.

As the cultural paradigm shifts from languages that are merely descriptive to languages that either imply, or result from, interaction, many artists have been purposefully challenging the nineteenth-century model of the artist as disseminator of knowledge within a non-participatory context of observation. The object fetishism of the commercial art world stands as an anachronistic vestige of an old economy attempting to postpone its demise through the recursive merchandising of cliches. By contrast, the designs for interactivity put forth by many electronic artists imply a new direction --*'artists as systems thinkers'* whose creative imaginations not only enrich the spirit but also provide solutions to real problems. As the earthworks sculptor Robert Smithson said: "Economics, when abstracted from the world, is blind to natural processes. Art can become a resource, that mediates between the ecologist and the industrialist. Ecology and industry are not one-way streets, rather they should be crossroads. Art can provide the needed dialectic between them."[10]

A number of artists stand out for their attempts to articulate the beginnings of such a relationship; they also demonstrate the potential for humanizing our technological environment. In addition, they have focused upon the potential to use these technologies as an expansion of human language into the domain of the non-human. For instance, the video artists Frank Gillette and Bill Viola have created works in which video images are designed according to a syntax intrinsic to the medium. This is in direct contrast to the inability of commercial television to stop perpetuating its worst aspects as an imitator of other mediums. In the work of artists like Gillette and Viola, the intrinsic use of video implies an environmental context and an immediacy that is highly interactive. This becomes explicit in works in which the technology functions not merely as a representational filter through which the `natural' world is seen but also as a means to create a participatory union between the artist, the non-human environment and the viewer.

In Viola's videotape, *I Do Not Know What It Is I Am Like*, the viewer is led on a mythic journey in which linear assumptions of television become deconstructed

into a poetic exploration of the cognitive substrate that links all living things. In the videotape, which is composed almost entirely of images from the non-human world, the camera becomes inquisitor, mirror and channel of light from the autonomous eyes of other sentient beings. We navigate through multifarious worlds of sense data, both familiar in their beauty and alien in their sensuous mystery, toward a profound meditation upon the ecological and spiritual basis of mortality.

To my mind, one of the most comprehensive visions for the potential use of television and video to reconnect humanity to the 'natural' world is found in the work of ecologist / artist Paul Ryan. In his *Ecochannel Design*, he has proposed how a television station could be "dedicated to monitoring the ecology of the Hudson River Basin and developing consensus about how best to live there on a long term basis".[11] The resulting design could be easily implemented or adapted to other natural regions through a cybernetically-based circuit of relations that allowed for self-correction of the human species by eliminating errors in our relationship to specific ecologies.

The extraordinary potential of satellite and telecommunications technologies to radically alter the fabric of human society has been the central focus of the art of Kit Galloway and Sherrie Rabinowitz, who term their collaboration 'Mobile Image'. In addition to their designs for the egalitarian use of existing communications technologies through appropriate systems integration, they have designed a large-scale satellite artwork entitled *Light Transition*. As media philosopher Gene Youngblood has described it,

"Light Transition *addresses the satellite as an instrument for grand-scale observation of planetary transitions. Unique among Mobile Image designs, it is a broadcast event, not a participatory environment. But it's not really about the displayed image; rather it's about extending the observational powers of the witness, whose purview is here conceived in sidereal terms, as containing planetary dynamics otherwise beyond perception. Cameras are positioned at the beach on both coasts, bringing the oceans together in a live split-screen image that is inserted briefly, without comment, every half-hour into the afternoon programming of a satellite superstation. Each transmission builds incrementally upon those previous, disclosing to our gaze those great cyclical patterns of shadow and gravity that mark the aspect and orbit of our planet through its circle of hours -- until at last we behold the sun setting into the Pacific as the moon rises out of the Atlantic, live and in real-time."*[12]

This emphasis upon process and environmental context, which video has stimulated for the visual arts, has been implicit for a long time within the use of sound-generation and recording technologies by both musicians and artists interested in sound as a sculptural medium. The potential for this work to

increase communication between humanity and other living systems is explicit in the work of a number of individuals. For instance, the sculptor Leif Brush has extended his interest in audible sculpture to include the fabrication of a series of "Terrain Instruments: sound orchestration through optical and vibrational sensing of outdoor sculptural configurations and atmospherics".[13] These constructions convert a wide array of environmental phenomena into audible soundworks. More recently he has investigated the coupling of these sounds with electronic imaging and satellite technology:

"I wish to expand my satellite use to include a direct broadcast method where a listener may interact, rather than continue in a receive-only role. I wish to continue pairing experiential sound, structuring in time/space through the national WWV time system and assembling audible constructs both nationally and internationally, from geographically distinct earth areas."[14]

My own work has focused upon using advanced audio technology as a tool to facilitate interaction with other living systems. Through combinations of analog, digital and traditional sound-generating devices, I have designed real-time performance interactions in wilderness spaces where the resulting events are reflective of a larger system of mind, which includes myself and other living systems. I place the emphasis upon understanding the resultant sounds as contextually bound; they are the evidence of purposeful, living systems with attributes of mind. One of the metaphors I have adopted to describe this work is that I am applying current technology toward a rediscovery of 'natural magic'. In this case, it is a marriage of music and electronic technology, which serves to invoke a relationship to nature that is both ancient and contemporary. The most recent example of this mode of thinking is a current project entitled *Sonic Mirror*. Rather than a specific composition, this project is an experiment in systems integration, which continues my previous work in the application of musical structures toward real-time interaction with non-human living systems. Ultimately, it is planned that the project will culminate in a stationary cybernetic sound sculpture capable of processing acoustic data from a specific environment and then communicating transformations of that data back to the environment. The sculpture would eventually function as an autonomous system, structurally coupled to its surrounding environment in a manner that might allow for 'learning' between components.

Further examples of sonic applications for advanced technologies, which imply new potentials for human interaction with the non-human world, are evident in the work of Bill Fontana and Russell Frehling. Recent experiments in the transmission of high-fidelity audio over phone lines to public installations in museums by `sound sculptor' Fontana have shown that real-time access to distant environments is a cogent experience that stimulates public interest.[15]

Likewise, the research done by composer Frehling has shown the appropriateness of the unique knowledge of technological artists for applications in en-vironmental protection.[16] He developed an underwater sound system and library for Japanese fishermen to use in creating a 'sonic fence' to help protect migrating dolphins from fishing lines.

All of these examples are meant to suggest general possibilities, some of which are just beginning to unfold. Public institutions could explore comprehensive programs for similar applications, which would be appropriately designed to enhance our understanding and interaction with the biosphere. A few of the possibilities seem obvious.

The use of communication satellites to link distant locations in real-time could create 'distant touring' of remote wilderness sites through high-resolution video and sound. Museum installations could be designed as a form of environmental theatre that envelopes the viewer in a synaesthetic experience of connection with the non-human world. Selection of different locations around the Earth's surface could be made by individual viewers. These installations could also be placed within large urban centers as public utilities to function as electronic parks for sensory refreshment. Similar satellite transmissions could provide a form of sonic communications exchange for intelligent species such as whales, whose ability to communicate over vast distances has been diminished due to human sound pollution of the Earth's oceans. Such two-way systems might also have applications in the interconnecting of zoos and wild animal parks such that a virtual space of interspecies communications could be engineered for specific purposes. Ultimately, the folding back of these technologies upon the non-human realm may find uses in the grounding of human perception during extraterrestrial exploration. My intuition is that the real-time transmission of biospheric sensory information might prove an essential component in maintaining psychological balance during extended residency in deep space.

Conclusion

This paper has presented a preliminary argument for the appropriate application of audio, video and tele-communications technologies toward the enhancement of our understanding, and interaction with, the non-human biosphere. Any future implementation of these ideas is not intended as a substitute for the direct apprehension of `nature'. Rather, I am suggesting possible uses for extant technologies that might expand our comprehension of these living systems in ways that minimize interference in their life processes. I have attempted to describe how artists working at the leading edge of technological implementation, striving toward a redefinition of the human relationship with

the non-human world, demonstrate a viable direction for institutional applications that can contribute to our general life-enhancement.

Underlying this potential is the current transformation of many of the epistemological assumptions at the core of Western civilization. The issue that confronts us is that the living systems making up the homeostatic complexity of this biosphere are reorganizing as a consequence of human influence. All natural systems will do this, if given sufficient perturbation and disequilibrium. We have been a part of that natural process. The question remains: Will it reorganize in a manner that includes or excludes us from its larger complexity? In our attempts to grapple with this question, we cannot easily abandon the technologies that have contributed to the disequilibrium. I believe we can transform their use into tools to remind us of the larger systemic complexity within which we reside.

Notes:

1. "Physis: To Inhabit the Earth" conference, Florence, October, 1986.

2. Morris Berman, *The Reenchantment of the World, (Ithaca, NY: Cornell University Press, 1981).*

3. Gregory Bateson, *Steps Toward an Ecology of Mind* (New York: Ballantine Books, 1972).

4. David Bohm, *Wholeness and the Implicate Order* (Boston: Routledge & Kegan Paul, 1980).

5. Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature* (New York: Bantam, 1984).

6. John H. Douglas, *Science News* **114**, No. 13 (30 September 1978).

7. George F. MacDonald, *The Future of Museums in the Global Village* (Canadian Museum of Civilization, preprint 1986).

8. MacDonald [7].

9. Stewart Brand, Peter Schwartz and Jay Ogilvy, "The World Information Economy", *Whole Earth Review,* No. 53 (Winter 1986).

10. Nancy Holt, ed., untitled essay, 1971, in *The Writings of Robert Smithson* (New York University Press, 1979).

11. Paul Ryan, "Ecochannel Design", *IS Journal #5* **2**, No.2 (December 1987). See also Paul Ryan, "A Genealogy of Video", *Leonardo* **21**, No. 1, 39-44 (1988).

12. Gene Youngblood, "Virtual Space: the Electronic Environments of Mobile Image", *IS Journal #1* **1**, No.1 (February 1986).

13. Biographical listing for Leif Brush, *New Music America '84* (Hartford CT: Real Art Ways, 1984). See also Leif Brush with Gloria De Filipps Brush, "Monitoring Nature's Sounds with Terrain-Based Constructions", *Leonardo* **17**, No.1, 4-7 (1988).

14. See Ref. [13].

15. Bill Fontana, "The Relocation of Ambient Sound: Urban Sound Sculpture", *Leonardo* **20**, No. 2, 143-147 (1987).

16. This research was supported by grants from Greenpeace, the World Wildlife Fund and the Animal Protection Institute.