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# Technology and Nature: Connections within Biophilic Design

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## Abstract

The biophilia hypothesis, posited by sociobiologist Edward O. Wilson, presents the existence of an innate human-nature connection which is based on societal behavior. This hypothesis is also supported by artists of the environmental movement, starting in the1970s and continuing today. This art historical observation and analysis is the core of this study. Environmentally conscious artists have created land based installation art and design experiments intended to reconnect the public to the natural world, the biophilia in human behavior. Artists such as Hans Haacke created simplified gallery spaces to exemplify their natural relationships and Vaughn Bell facilitates spaces within galleries where human and plant experiences are mutually beneficial, through a shift in the viewer's perspective. Alan Sonfist installed gardens of indigenous plants that memorialize the identity of New York's pre-colonial ecosystems, while contemporary artist Mark Dion's greenhouse installation, "Neukom Vivarium" facilitates educational memorial spaces where that natural world is accessible within urban environments. This mode of making is also mimicked by the Earthship architecture of Mike Reynolds and breathing and living "Pulse Dome" home designs by Don Zanfagna. Likewise, these interests continue into home furniture, with Amy Youngs' plant and organic waste based furniture designs maintained by human participation, allowing for positive human-to-plant interactions.

## 1. Introduction

Artists of the 1970s and their successors into the twenty-first century have come to realize that there is a necessity to embrace the natural world and inspire the public with nature's sustainable and beautifully simplistic qualities. Artists and designers became concerned with the ramifications of unmanaged progress and ecological degradation, where the former is often valued at the cost of the latter. Edward Wilson, a sociobiologist, developed the "biophilia" hypothesis as an attempt to reconnect the general public to nature, and reveal the genetic and behavioral origins for biophilia. Wilson defined biophilia as "humans' innate tendency to focus on living things, as opposed to the inanimate."[1] This thesis applies the biophilia hypothesis to the artists of the 1970s and 2000s who explore this desire to reconnect the public and domestic spheres with the natural world.

Biophilia literally means "love of life," but its application to design creates a dialogue between materials, intention, and utility within the framework of urban and domestic installation concepts and designs. Wilson's theory has been applied to biology and social science, specifically through the 1993 "Biophilia Hypothesis" publication. Evolutionary perspectives of landscape aesthetic analysis have revealed specific behavioral responses in viewers of landscape paintings. Psychological researchers were informed of how resource availability, appearance of shelter and protection, hazard cues, and the ability to move and migrate triggered positive responses in observers.[2] Further hypotheses support the environmental impacts of biophilic human behavior and how genetic predispositions toward biophilia emerge in certain populations versus others.[3] Wilson supported this hypothesis and presented the belief that when children and adults are in regular contact with other organisms, biophilia may be instilled through experience.[4] Genetic predispositions for biophilia are created through experience over many generations. This conclusion has lead

researchers to believe that interactions with the environment can influence the individual to love, nurture, and identify with nature in a more biophilic way.

Artists sought to reconnect the public to their natural surroundings, as to alter the public's perceptions of natural spaces. Many art works from the 1960s to 70s consisted of site-specific installations in galleries and urban landscapes. Contemporary designers and installation artists have developed domestic and public installation works that created familiar biophilic spaces inspired by the ecological relationships present in the natural world. Artists and designers have reintroduced the natural world to the domestic and urban spheres of contemporary experience.

Hans Haacke and Vaughn Bell are two examples of artists merging natural and manmade spaces with the result of manifesting biophilia in the visitors. The visitor was an observer within Haacke's work, but a participant within Bell's, though both used Plexiglas and living matter to create enclosed installations within the gallery. The previous examples showed biophilia introduced through the gallery, but 1970s Land Artist Alan Sonfist and 2000s installation artist Mark Dion brought nature and the manmade urban environment together within public outdoor spaces. Sonfist created a public garden not meant for human entertainment, but as a memorial to the original ecology of New York State. The public was placed as an observer in Sonfist's installation, but Dion's work brought a fallen hemlock, state tree of Washington, into a public sculpture park. Dion's installation used electricity-dependent technology which maintained an artificial replica of a temperate rainforest. This installation served as an educational medium demonstrating how complex ecological systems are, as well as how much energy is needed to replace ecological systems naturally in place.

The most direct approach to reintroducing biophilia into the manmade environment was created within the home, as practiced by 1970s architect Mike Reynolds, his futurist contemporary Don Zanfagna, and 21st century installation artist Amy Youngs. Reynolds and Zanfagna were both experimental in their architectural designs of homes, the first in his use of recycled materials and systems thinking and the second in his conceptual living homes. Both methods used natural materials as a functional addition to a home, but Reynolds' were successfully constructed and innovated over forty years' time while Zanfagna's were never achieved. Amy Youngs created furniture installations designed for the home, and extended biophilic design principles from architecture to the objects which fill a home. Youngs, Reynolds, and Zanfagna found different methods of allowing individuals to experience a biophilic environment within conventionally inorganic manmade spaces.

The evolution of philosophical intention from simply unveiling and reconnecting to nature during the modern period into artworks designed to facilitate symbiotic interactions with nature in the 21st century — reveals how biophilia in installation art work has transformed from its origins in the environmental movement to today. These artists allow for a fresh perspective based in natural systems, in relation to anthropogenically altered environments. Biophilic design has the potential to be a conversation between humans and nature, one method of demonstrating how necessary biodiversity is. Philosophical parameters of the environmental movement are thoroughly contextualized within books and popular publications released during the 1970s Energy Crisis. One example, the 1973 publication" Small is Beautiful," captures the global scale of environmentalists' concerns. E. F. Schumacher explains the complexity of social, economic, cultural, and methodology issues which inform humanity's destruction of the environment. Resource scarcity, cultural definitions of progress and innovation, and ecological health are the connections between the 1970s environmental movement and 21st century environmental artists. Biophilic design works within the intersection of human effects on nature and the human participants themselves.

## 2. Sustainability, Philosophy, and Biophilic Spaces

Sustainability requires the individual to recognize the diversity of a community's needs and to refine what is necessary and most beneficial in the moment, as to maintain a viable future. The most popular philosophy connected to environmentalism and sustainability is "deep ecology." Decreases in human expansion are intrinsic to ecological philosophy, which sees sustainability as incompatible with current modes of human expansion. Science and the arts must merge in order to meet human needs. The umbrella of sustainability, which takes the needs and habits of nature into account, is directly related to biophilia.[5] Deep ecology philosophy developed from the debate over nature's value, encouraging self-realization and realization of biocentric equality "where humans are connected to other life forces and that all species have the intrinsic right to exist."[6] "Self-realization" in relation to the personal needs and wants of the individual are addressed. The individual has opportunities to seek a lifetime of education, enacting compassion, active community participation, and emotional fulfillment.

By doing so, the self-realized individual has the time and resources to actively affect those in need, human and non-human. This perspective equates the needs of humans with those of nature, which is abstractly accurate, with the

exception of biology and behavior. Humanist arguments for the intrinsic value of nature lie in the failings of deep ecology, which depends on universalism and the existence of indistinguishable needs among anthropogenic and non-anthropogenic entities. Deep ecology philosophy equates all needs without equitable differences.

Arguments for nature, utilized by environmentalists and sustainability advocates, attempt to categorize nature in light of the ways mankind seeks to create value within itself, either through self-sacrifice, universalism, or expanding the ego to encompass all living entities. Methods of seeking meaning from nature: protecting and valuing nature because it is so separate and valuable to humanity is a form of biophilia.[7] The issue that presents is the assumption that humanity is an outsider from the biodiversity and ecological systems of nature, but creates the opportunity to disconnect from nature. Biophilia is believed to a part of the DNA and genetic code of humanity's psyche and behavior, so biophilic behavior must be triggered by the individual's environment.[8] If biophilia is the core of humanity's connect and stewardship of the environment, then the opportunity to reconnect and restore Earth's ecology lies in manmade spaces which include natural materials and systems thinking.

All of these approaches deny the diversity of existence, the need for individuality, and chaos.[9] Technology is a tool by which we manipulate our experiences of nature; our ability to control it is simply an illusion. The tendency of human behavior and space to include natural symbols or plants represents the tendency of civilization to adopt facets of nature that is personally related to. The inclusion of natural symbols or phenomena represents the biophilia theory, which relates the organizing principles of humanity to the presence of nature. The design adaptation of such biophilic thinking and cultural practice is the foundation of this analysis, which sees systems thinking and use of natural material as a connection among the all the works, 1970s to 200s. Systems thinking in the context described by Rosenthal, a studio art educator and education theorist provides an explanation for how environmental artists and designers are able to contextualize the emotional effects a biophilic design may have on the viewer's experience. [10]

"To understand the lessons of ecosystems and apply them to our human communities, we need to learn the principles of ecology, the 'language of nature'… The principles of ecology are, if you wish, the patterns of life… Patterns of life are networks that are regulated by feedback loops. Feedback allows a system to engage certain functions, to learn from mistakes, and thus to sustain itself."

To grow and self-realize over a lifetime is directly related to "learn[ing] from mistakes" and accepting the interrelated nature of humanity. The identity of a plant, landscape, or climate is not static but is instead organic, chaotic, and dependent on a multiplicity of biodiversity, adaptation, and change.[11] In order to generalize the mechanisms and systems of nature, various other roles and factors which nature depends/functions upon/with must be removed and ignored.[12]Waste does not exist within a natural system, human constructed or organically produced. Nature consists solely of the ingredients necessary for the design of a harmonious relationship, if allowed to thrive and evolve through feedback loops between living and nonliving entities. This truth can act as a blueprint for design and aesthetic choices within an artwork, allowing viewers to experience nature is a familiar setting. Experiences with nature in a familiar setting allow biophilia to be influenced within the individual. As hypothesized by Wilson and other contributors to the "Biophilia Hypothesis," the environment of an individual directly influences their expression of biophilia, and motivations to be stewards of the Earth.[13] A cultural and philosophical shift must occur: away from institutionally controlling, defining, and generalizing nature, and towards a respectful acknowledgement and embrace of the chaos, diversity, roles, and basic social livelihoods maintained within ecosystems, human or otherwise.[14]

Such a transition must begin with reintroducing the natural world and its qualities to everyday urban, suburban, and domestic life, which philosophically and literally happened within the 1970s art and design movements. The technology used must be redesigned, in order to prevent further pollution and human illness. This can be accomplished; by seeing natural motions and mechanisms as the context and model for technology and design, we return to nature the agency and independent qualities which intrinsically give it worth, outside of human control.[15] Biophilia, as described by Edward Wilson and other scholars within *Biophilia Hypothesis*, is present throughout human cultures, in some more than others. This disproportionate expression of biophilia in some cultures versus others is explained as being due to the amount of non-human organisms in direct contact and interaction with individuals.[16]

Rationalism, dominated by the need to control and predict nature through instrumentalist and materialist value systems, has motivated the industrialization, urbanization, and globalization of human society. A disconnect between modern society and the natural world has occurred to some extent due to manmade space being devoid of natural materials, living non-human organisms, and a divorce from the natural and union with the inanimate and controllable. Decisions to use and not coordinate with nature are validated by dichotomies of progress and wilderness, civilized and primitive, logical and emotional, among other dualistic ideologies.[17] Val Plumwood highlights the failures of traditional arguments for nature, and unveils the issues within mankind's ability to understand itself, and in turn, project this understanding onto nature. Such philosophy is dissected and discussed by Plumwood, a feminist philosopher. Her analysis reveals that conflicts between ecological scholars, seeking to "create" value for nature.

Nature is objectified and used as a symbol of human experience in Western visual art and architecture, ignoring the existence of diversity and feedback loops of form and function that are intrinsic to natural systems. Non-human entities, and humans associated with nature, become progressively more expendable for production and progress of Western elitism, as a result of an objective relationship between humanity and nature. This behavior has been reinforced through landscape and still life paintings, the sublime experience, linear perspective,[18] and the use of instrumentalist and humanist language[19] to give purpose and meaning to the natural world for human emotional and physical needs. The environment, within such a philosophical and cultural context is given no agency or independent identity beyond instrumental uses for civilization and industrialization. Artists of the 1970s began to embrace the environmental movement, returning to the roots of what constitutes biophilia in society, and to reintroduce the general public to natural world so separated from the public and private spheres of daily life.

## 3. Impactful Events, Environmental Movement, and 1970s Publications

The book *Silent Spring* by Rachel Carson, published in 1962, the 1974 Energy Crisis, and the 1973 publication *Small is Beautiful* by E.F. Schumacher inspired environmental artists of the 1970s and 80s.A philosophical shift occurred in discussions of environmental worth, the roles humans play in the natural world, the affects industrial progress has had on the health of ecology, and how artists, architects, and designers began to reevaluate the ways humans participate in the natural world. Living materials in visual art and architecture allow the viewer to have an experiential relationship, both physically and emotionally, with plants which are highlighted as being directly affected by human intervention.

The 1970s experienced an information revolution in terms of how much the public knew of environmental repercussions, and *Silent Spring* was the ignition of those revelations. Rachel Carson was a biologist, and did extensive research and interviews concerning the habitat and population effects of chemical spraying on wild life. Carson's work connected degradation of habitat and species populations to the health of human communities. Her book was highly criticized, but it did bring about a temporary depletion in chemical spraying of herbicides and pesticides in the United States. That spraying and habitat destruction has instead been moved overseas, under the disguise of development, aid, and reconstruction.

Those revelations extended beyond habitat and species losses, and included resource scarcity during the 1974 Energy Crisis, which was caused by politics, not scarcity. The public was hit by sky rocketing gas prices, energy outages, and changes in energy consumptive lifestyles.[20] Artists and designers began to seek out alternatives to industrial construct methods, and contemplative reflection of the roles humans play in changing the natural world. Artists primarily created dialogue focuses on how the natural environment dominates human civilization, how at mercy progress is to the state of nature, and that the best technology is reminiscent of natural systems and relationships.

The environmental art movements of the 1970s were a reaction to the 1963 publication of *Silent Spring* by Rachel Carson and the 1974 Energy Crisis. The book and event respectively highlight the scarcity of resources, and the human actions involved in reducing the availability of clean air, water, soil, food, and homes. E.F. Schumacher's book *Small Is Beautiful: Economics as if People Mattered* published in 1973 [21] inspired designers and scholars to think differently on the ramifications of technological growth, as well as reacquaint themselves with ecologically oriented design and aesthetic choices.[22] The Energy Crisis was the result of OPEC and oil export embargoes on a global scale; it revealed a need for alternative energy sources and more efficient conservation efforts.[23] The artistic community reacted to the apparent scarcity of resources and the need to shift how people relate to the environment.

Environmental art has philosophically evolved- artists and architects are discussing conflicts that remain between human civilization, design, and technology in the 21st century. Contemporary artists and architects are seeking ways to create reciprocal dialogue between urban dwellers and the natural world that is isolated from their day-to-day lives. Technology and nature must inspire one another in order to coexist, informing how creators are approaching their use of materials, composition, and location.

Artists and designers reacted to these realizations, as exemplified by the installations of Hans Haacke and Alan Sonfist, as well as designs by Mike Reynolds and Don Zanfagna. All four create a dialogue between natural forces and artistic manipulation introducing viewers and participants to experiences that change how they perceive their effect on their immediate surroundings. The successors of those same goals are contemporary 21st century installation artists concerned with reshaping the assumptions urban dwellers have of the wilderness and what an integrated ecological system means in an urban environment, as well as the private domestic sphere.

However, design methods and materials must be sustainable. By definition, sustainability is the "ability to meet the needs of the present without compromising the ability of future generations to meet their needs."[24] Sustainability

brings various needs into an equitable conversation and allows for adaptability in design. The needs of nature and those of man differ, however they can both benefit from technology. Sustainable technology can be inspired by natural materials, local topography, and living plants. The new criterion, sustainability, is an issue being addressed by contemporary artists working in the 2000s, an issue scarcely addressed during the 1970s, with Reynolds and Zanfagna as exceptions. Cycles and functions of ecology create a blue print for sustainable design. Designers can apply biophilia to the urban and domestic spheres. Biophilic design involves formally and functionally mimicking/integrating the movements of water, energy, nutrients, and ecological life cycles. This relationship between natural mechanisms, and the ways they may be adapted into urban areas and homes has emerged during the 21st century.

Installation artists and architects are adapting advanced technology and scientific observations to inform the ways that materials, form, and utility may be combined with in a micro-climate, as to be enjoyed by plants and humans alike. The site-specific nature of installation works of 1970s, such as Haacke's minimalist cube in the gallery space, Sonfists' urban garden installation, and Reynold's use of local materials and climate to adapt his home designs inform how diverse the modes of environmental art were during that time. Political, locational, and domestic issues where addressed through the viewers' assumptions of certain space and how those assumptions warp and effect their relationship to them. Those spaces were altered by the inclusion of natural or organic phenomena and materials.[25]

## 4. Biophilia in the Public Gallery Space

The work of Hans Haacke and Vaughn Bell revealed the adaptability of organic materials within an inorganic space. Their work also created dialogue concerning social assumptions/implications that can be made within a composition, both outdoor and indoor. Haacke began working during the late 1960s, the beginning of the land art and minimalist movements. Vaughn Bell is a contemporary artist who worked in the 2000s, where she specialized in participatory installation art works. Both artists use Plexiglas, but with different effects on the viewer and relationship to the gallery. As per the dialogue created by the publications of *Silent Spring*, *Small is Beautiful*, and the 1974 Energy Crisis, Haacke and Bell focus on the affects humans have on constructing and manipulating the nature world, and how their perceptions are created by institutions and hierarchies veiled from the public's eye.

Figure 1. Hans Haacke, "Condensation Cube," installation sculpture, 1963-1965, clear Plexiglas and distilled water 12"x12"x12"
http://www.stedelijk.nl/en/artwork/92089-kondensationswurfel-condensation-cube

Hans Haacke's installation *Condensation Cube* (Fig. 1) from 1963 to 1965 contains the elements which feed weather, climate, heat, water, and wind movements. Water, space, temperature, and mass are connected within the *Condensation Cube*. The complexity of these connections of temperature, mass, and water allows the Minimalist composition and style of the sculpture to be balanced by an organic and changing interior. Condensation forms and settles depending on the temperature of the room. Cool and warm temperatures create different weights in pressure and affect the form of water, transforming it from vapor to droplets. The relationship between temperature and climate act as a miniature system of heat changes and reveal the simple conditions necessary to affect fluxuations of

temperature and climate.[26] Gallery visitors are the temperature and mass necessary to alter the art piece, activation its condensation ability/function.

Haacke's work is minimalist and site specific to the gallery space, where the parameters of temperature changes, inhabitants, and location are organized and static. The Plexiglas cube presents the gallery space itself— cold, sterile, and lifeless. Visitors bring in life and experiences that create value and exposure for the artwork, just as they affect the state of water enclosed in the *Condensation Cube*. This conversation between effects of the gallery visitor, the static nature of the gallery space, and how human participants manipulate the space's identity creates a frame work for site-specific gallery installations. *Condensation Cube* ceases to function when taken outside of the gallery.

Biophilia relates to this system of indirect heating and cooling as to exclude active heaters or fans, dependent on fossil fuels. Biophilia is incorporated into Haacke's work by allowing visitors to reevaluate assumptions of a sterile space, seemingly devoid of living materials or anything natural. Reactions among temperatures and materials behave symbiotically and slowly, in the gallery as well as the climate of Earth. The Plexiglas and water are similar to the aesthetic of a greenhouse, where moisture is used to maintain heat levels and move water throughout the entire structure.

A biophilic environment is created through example, between larger presumptions of the gallery and then the gallery brought down to scale within Plexiglas. Low-tech ideas relate to sustainable ideas, where a minimum of materials are used and energy conservation are combined to meet the goals of climate control without high energy technology, but rather, passive systems that function independently.[27] The movement of water within *Condensation Cube* is due to changes in temperature and mass within the gallery, while the gallery itself experiences similar changes, but regulated by climate monitoring technology (Fig. 1). Hans Haacke created gallery installations which "focused on spatial determinates as mapped out by random or natural motions", allowing the viewer to see a display of systems working with living things. [28] Vaughn Bell and Haacke connect in their philosophy of connecting natural phenomenon and human participants, but in very different ways. Haacke articulates the connection between his installations and biophilia through a quote.[29]

"…make something which experiences, reacts to its environment, changes, is nonstable…make something sensitive to light and temperature changes that is subject to air currents and depends, in its function, on the forces of gravity…articulate something natural."

Vaughn Bell's work from 2012 expresses this relationship by placing the bust of the viewer into a micro-climate, where the unique diversity of Pacific Northwestern plant life is magnified (Fig.2). Bell's work *Metropolis* is a Plexiglas structure filled with natural fauna water installation suspended above the ground. Its orientation above the floor causes the viewer to enter the constructed environment as a visitor, but at eye level, as if the viewer is another animal in the wild, walking along the forest's floor (Fig. 2). *Metropolis* interrupts the assumptions of the natural separate from urban spaces, making the plant life a facet of such cosmopolitan connotations. The installation is easily three feet tall, leaving an abundance of growing space for the ferns and temperate plant life native to the immediate region, Seattle.

Figure 2. Vaughn Bell, Metropolis,
acrylic, aluminum, hardware and rigging, soil, water, native plants and mosses of the Pacific Northwest forests, footstools installation at Seattle Center as part of the Next Fifty, 2012, Commissioned by the Seattle Center Foundation http://www.vaughnbell.net/metropolis/index.html

Bell's work *Metropolis* was funded by the Natural Resources Defense Council and was an expanded version of an earlier work called *Village Green* from 2008, where the Plexiglas boxes where isolated terrariums where visitors would individually view plant life and foliage at eye level.[30] *Metropolis* is a combined version of the previous work, and is a literal interpretation of a collection of buildings: an urban metropolis of large several buildings. *Metropolis* also included a limited collection of portable biomes encased in plastic, and visitor could adopt one, with the stipulation that they sign a contract and promise to care and be stewards for the biomes.[31] Her work combines assumptions of wild landscapes, connotations associated with what an urban space versus a natural space are described as, and that visitors are complicit in the care or destruction of the living natural environment by being a part of the urban environment.

Vaughn Bell uses Plexiglas is her work, but as a representation of larger architecture, as to create dialogue between a home, and the needs a home serves for its inhabitants, inviting exhibition visitors to visit the home of plants, within the gallery. Where Haacke used the Plexiglas cube to represent a sterile environment containing organic relationships, Bell literally fills Plexiglas with plant life and invites the viewer to experience the organic chaos together. Haacke's work is observer based, while Bell's is participatory.

Bell's work seeks to merge the urban setting with the wild natural landscape by titling her work *Metropolis*, reminding the viewer's memory of a busy urban setting. The shape of the Plexiglas exterior is reminiscent of the shape created by a group of buildings, bringing the familiar form of a metropolis into the viewers' mind's eye. Tapered and flat Plexiglas structures retain the temperature, humidity, and nutrients of the fauna and soil with in the *Metropolis*. The structure envelopes the participant's head, muffling the sounds around them, and brings rich smells of the earth directly to the nose.

Every sense is stimulated; potentially even taste, if a person were so bold as to take a bite of fauna from the *Metropolis*. As its name implies, the "Metropolis" is implied through the skyline reminiscent Plexiglas form, but also by the diversity present among the fauna, creating a clever twist on the idea of an urban setting, full of many types of people from different origins (Fig.2). This direct exposure to nature within the gallery is dramatically different from Haacke's approach. Haacke sought to educate visitors of greater relationships present within the gallery space, by example and observation. Bell brings the viewer literally into her installation, and creating a separate an entirely separate space within the gallery. By participating in the *Metropolis,* visitors are placed within a biophilic space, where they can enjoy the experience together, with the option of bringing a piece of the exhibition home with them.

The ecological diversity present among the plant life also connects to the immediate landscape, Seattle, Washington, the home of America's temperate rainforest, and constantly in danger due to pollution and urban development. It can also be implied that the plants will grow to fill the negative space within the Plexiglas, overwhelming the space, and creating a rich and exciting experience for future visitors. The *Metropolis* suggested by Bell includes a diverse plant population, visited by humans, but not altered by their participation. *Metropolis* is site specific to the region of plants from which the fauna originated from, but also in its intentional contrast with the gallery space. Contemporary installation works create site-specific connections through context and region, and not necessarily through the immediate physical location.

Art history scholar Miwon Kwon describes these goals as having experienced a shift from the 1970s to the 21st century, where the installation issues and goals of artists and conceptual designers become more transient from the limitations set upon traditional site-specific installation works. Site-specific works become concerned with "phenomenological, social/institutional, and discursive" schemas of art and design making.[32] Kwon implies that the experience of the installation and the relationship the viewer shares with the artwork are more significant in contemporary art than the static locational stipulations of the site-specific in modern art works.

## 5. Biophilia in the Urban Public Spaces

Alan Sonfist conveys that reconciliation of human and nature within environmental art by adapting to the immediate climate of New York and providing individuals with a medium through which to experience nature at work, a garden. Sonfist's work *Time Landscape,* constructed and maintained from 1965 to 1978, and ongoing today, is an outdoor instillation that brings human intervention into a  to positive light, where native plants and the biodiversity of New York is restored to its pre-colonial state (Fig. 3). The installation space is left too wild for trails, parks, or paths to facilitate human-nature interaction. [33] Sonfist's land art installation is 45 feet by 200ft and is full of grasses, Virginia creeper, goldenrod, birch, cedar, red oak, white oak, elm, sassafras, dogwood, sumac, and other botanicals native to the region (Fig.3). *Time Landscape* was criticized by locals and environmentalists for being idealist and selective of

certain biodiversity in the region, however the artist's response was that he was attempting to bring attention the ecological issue at hand, not to choose a side or isolate an aspect as more important than another. [34]

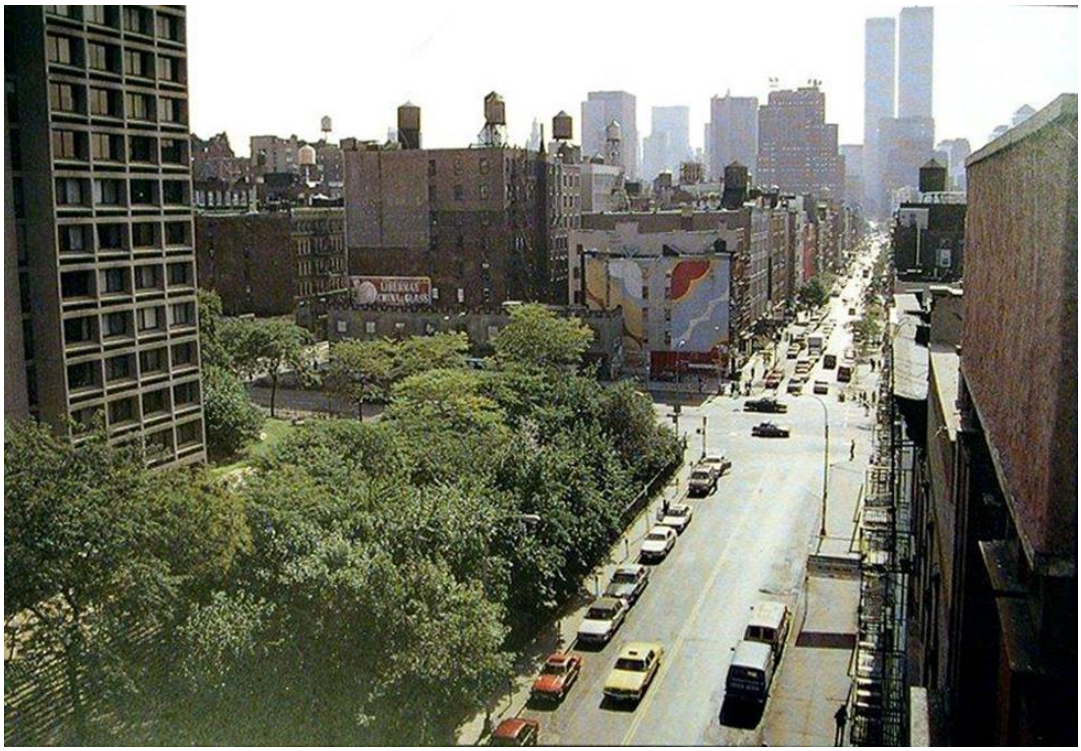

Figure 3, Alan Sonfist, Greenwich Village Time-Landscape, 1978 and ongoing, 45' x 200'
grasses, Virginia creeper, goldenrod, birch, cedar, red oak, white oak, elm, sassafras, dogwood, sumac, and other botanicals http://avant-guardians.com/sonfist1/as_pop11.html

Critics questioned the community benefits of such a wild installation park within the center of an urban setting. Plant life was left to grow unabated and with little regard for human visitors. Sonfist's approach is dramatically different from Dion's in this way, but reveals the breadth of approaches available to connected society to the wilderness and plant life surrounding them. Disconnect between experience and comfort creates tension and discontent among New York citizens unable to interact comfortably with the *Time Landscape*, revealing the contrast between their lifestyles and the patterns of nature. This conflict of human enjoyment and wild spaces highlights the importance of biophilia is academia and aesthetic analysis. The urban manmade landscape of New York is so dominated by inorganic order and control that a space devoid of those characteristics is questioned. By installing a ecological memorial to New York's past Sonfist is able to bridge the divide between landscapes that reject biophilia and a space that creates opportunities for biophilic experiences.

Sonfist stated that *Time Landscape* work is a part of the heritage of New York, and without it, important elements of local identity would be lost.[35] The use of local ecology as a living memorial to the local landscape is a site specific and unique element of environmental art of the 1970s and 80s. Work by Alan Sonfist during the 1960s and 70s expresses the efforts of visual artists to represent the personality, value, and diversity of nature. There is a place for such discussion, and much of it is integral to the success or failure of sustainable goals. Those arguments dictate the intentions of technology and the desired outcomes laid into place by artists, architects, and designers. The societal recognition of humanities' collective responsibility to maintain the health of Earth's diverse natural systems is integral. Respect and stewardship must not be for human dominance and expansion, but because Earth has inherent rights, knowledge, and wisdom.

Figure 4. Mark Dion, *Neukom Vivarium* 2006, installed in Seattle's Olympic Sculpture Park, Specifically designed greenhouse-shed with green tinted windows and forest simulating lighting, tiled planter, 60 ft. long fallen Hemlock tree and plants of temperate rainforest, climate regulators, and scientific tools used to extract the tree and attached wildlife http://archinect.com/blogs/gallery/104645536/2/life-support-the-neukom-vivarium

*Time Landscape* highlighted the existence of different terrains, which organically evolve over time, as to illustrate the individuality of biodiversity, the unique characteristics of specific regions, and how the human community responds, regardless of its original state. Land artist Alan Sonfist relates to the contemporary installation artist Mark Dion through his use of location; the location allows visitors an opportunity to experience the wild past of the region. The experience of visitors can also be connected to Mark Dion's educational *Neukom Vivarium* public urban park installation from 2006. Mark Dion's public installation *Neukom Vivarium* (Fig.4) completed in 2006 blends local plant life, a fallen Hemlock trees, within an urban setting. By collaborating with local architects, Dion utilizes the aesthetics of living nature to affect the aesthetics of a space, maintained by high-tech mechanisms.

Technology provides new methods for visual artist's to create conversations related to humans' involvements in natural systems, as well as reveal the complex necessities of life that nature maintains with ease. *Neukom Vivarium* has green glazed windows that mimic the leafy canopy present in a temperate rainforest; temperature control technology maintains the environment suited to the Northwestern Pacific climate, from which the Hemlock was taken. Shades automatically move in and out of place, depending on available sunlight. Plants, insects, and other small organisms are categorized, logged, and preserved for visitors, but their active roles within the temperate forest ecosystem have been eliminated. Tiles eulogize the lives of insects, small animals, and plant life removed from the tree as a part of the permanent tomb which holds the tree, its foliage, and the nutrient rich soil beneath it. The space is sterile, outside of the plant/tree basin, letting the visitors observe an organized presentation of the tools used by the scientists involved in categorizing the various organic living and nonliving variables connected to the tree's ecological community. Biophilia and participation are made accessible by Dion's installation, but the objectifying role adopted by the sciences translates into a sterile and detached environment.

Mark Dion places himself as scientist-artist who is objective in his use of objects, but subjective in aesthetics and presentation. The greenhouse that houses the Hemlock tree creates an immersive environment where visitors are given every opportunity to comfortably interact with nature, but at the cost of the tree's unique role within the forest. As if it were a caged animal, the tree is put on display and removed from nature for the viewer's comfort, creating a warped interpretation of nature and sterilized version of a biophilic space. Insects and small organisms would have been more thoroughly characterized and celebrated by the educational materials if biophilia were holistically incorporated with the installation. In addition, the technology of the *Neukom Vivarium* would be maintained by renewable energy sources if it were truly environmentally conscious.

The installation's distance from the origin of the Hemlock tree; the mechanized processes of nature are maintained by technology run by fossil fuels. The plant life and organisms recorded by the biologists and other professionals of the project do not highlight the ecological roles played by every categorized organism, only their existence. The installation is meant to be educational, yet the remainder of the sculpture park is devoid of such intensions, creating a

significant disconnect between the goals of the industrial sponsors of the project, and the outcome of *Neukom Vivarium.* Dion's work reveals conflicts inherent in plant life-human hybrid technology. Plant life involved can be harmed, objectified, and isolated due to the parameters of the man-made space, and objectives of the project.

Dion's *Neukom Vivarium* removes a massive Hemlock tree from the temperate forest from which it originates, confines it within a space, and removes the tree from is role within an ecosystem. *Neukom Vivarium* allows visitors to experience its beauty, separated from its role in nature as to educate humans of its functions, but without its original context. The identity and role of the tree is generalized, but specifically catered to in the design of the greenhouse-shed climate technology.

## 6. Biophilia in the Domestic Sphere

Mike Reynolds's work during the 1970s reveals how a home may be integrated into the immediate environment. Environmentally inspired technology relates to- conservation of energy through sun light absorption, solar heating, southern-oriented placement of windows, and mimicking climates specific to the plants housed within, as well as adapting to exterior conditions. The inclusion of living materials in a greenhouse directly informs the aesthetic aspects of the architecture, as to create a micro-climate. Approaching architecture as an extension of living systems creates sustainable technology designed with ecological needs and functions in mind.

Nature is traditionally separated from man-made spaces in Western construction and design, and used as a background to architecture.[36] Western architecture is inspired by domination over nature.[37] According to Vincent Scully, an historian of architecture, Greek architecture sought to represent the human presence within the landscape. The other approach described by Scully is that architecture can be inspired by local terrain through use of materials and the design of the building, as is the case of pueblos in Taos, New Mexico.[38] Mike Reynolds' work is the inspired by the organically driven designs of the Taos pueblos (Fig.5).

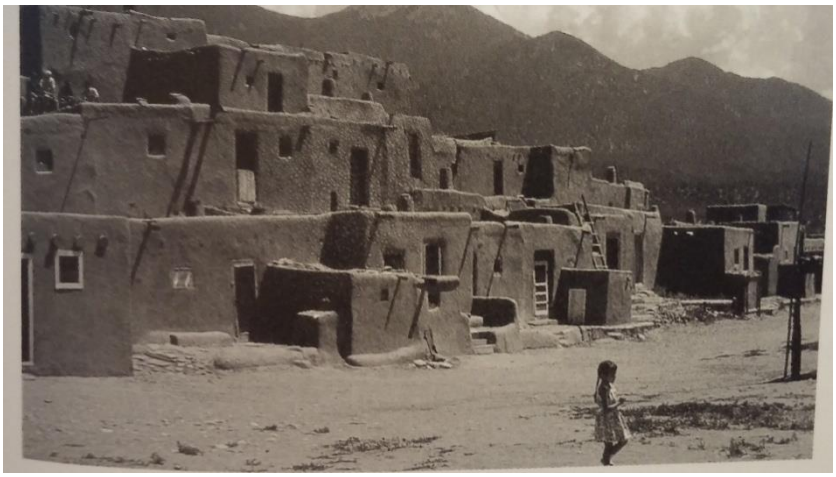

Figure 5. Taos, New Mexico pueblo and mountains, Scully, Vincent, and Neil Levine. "Architecture: The Natural and the Manmade." In *Modern Architecture and Other Essays*, 285.

The square buildings, windows, and lintels exposed beyond the roof's edge of the pueblos reveal structural decisions made by the original architects. Taos pueblos are square and deceptively stagnant in their appearance. The square corners and planes create areas of shade versus direct sunlight, at various times of the day. This interplay of surface area and angles create a way for the adobe to capture and release heat, maintaining an internal temperature and refuge from the heat. Adobe can be damaged and settles overtime, requiring repairs and additions throughout its lifecycle, keeping it sturdy and stable. Since the individual dwellings are stacked up each other, heat and cool air are loss less frequently, retaining a consistent micro-climate and unifying the well-being of all residents. Beyond utilitarian purposes, the stacked appearance mimics the desert landscape, as well as provides protection from unwanted visitors. Reynolds has designed terraced Earthship versions of this stacked approach, allowing its benefits to effect 20$^{th}$ and 21$^{st}$ century home owners in arid dry places.[39]

Adobe brick is a naturally occurring and abundant resource, reactive to temperature and moisture, and highly durable. Red mud, clay, and plant fibers are used to create passively cooling and heating interior climates of architecture. The local terrain of New Mexico is hot and conventionally uninviting, which is perfect for the construction of the pueblos. The buildings are stacked atop of one another and resemble the mountains that create the local terrain. Entrances are raised and must be reached by ladder, for protection, but also further connect the inhabitants to the natural setting, where great lengths must be made to cross the desert. The Earthship represents another aspect of the sweltering desert climate. The material necessary for adobe brick (which acts as the exterior insulation) naturally occurs and is abundant in New Mexico. The immediate climate and what it has to offer can be seen within the design, architectural, and functional elements of the Earthship, as inspired by the Taos pueblos.

Figure 6. Mike Reynolds, architect, 1975, *Earthships Biotecture*, EXPERIMENTAL HOUSE COMPLETED NEAR TAOS, NEW MEXICO USING EMPTY STEEL BEER AND SOFT DRINK CANS - NARA - 556623" by David Hiser, 1937-, Photographer (NARA record: 3651517) - U.S. National Archives and Records Administration.

The exception to this mimicry of local terrain within the Earthship (Fig.6) exists within the inclusion of a solar greenhouse, glass bottle mosaics, solar panels, and rubber tire foundations. Grey water and rain are collected on the roof, held behind the home, and its utility needs are maintained through filters that clean shower and toilet water for further use. The greenhouse hall space serves as a filter of water, regulator of heat, and a unifying space to the entire home. Round rooms radiate from the greenhouse room/hall way. Its interior can get damp and materials must be chosen to maintain a balance of the hot arid exterior and its humid inner climate. Reynolds believes the Earthship systems are based on the systems within a tree, which regulate similar states of climate and temperature through bark, trunk, leaves, branches, and roots.[40]

Mike Reynolds, creator of the Earthship (Fig. 6), uses site specific materials and immerses inhabitants within a manmade ecosystem which collects and filters rain water, grows plants in an integrated greenhouse at the center of the home, and passively cools and heats the home due to the use of local clay and discarded bottles and tires, and is south and southwest orientation as to best absorb light. Reynolds' design brings attention to the diversity of ecological and human needs within one united space.[41] Micro climates are created due to the use of plants. Their ability to absorb radiation, heat, and moisture allow them to reduce the temperature of a space significantly.[42] Nature is the model and the context for construction, mechanisms, and materials, as described by John T. Lyle, an architect and author on the design team for the Center for Regenerative Studies in California, USA.[43] Human needs are mirrored in nature and can be adapted by sustainable design through the use of the biophilic design.[44] Environmental art of the 1970s focuses on the scale of nature, its ability to dwarf the viewer and the bridges humans make in order to interact with the landscape.

The Earthship is an example of such a bridge between human lives and natural systems, as well as an experiment in sustainable living. Reynolds's work highlights the unique qualities of New Mexico, through his use of local materials and form through architecture. The Earthship was originally conceived when Reynolds saw the ways industrial methods of construction were causing more harm than good to both humans and nature.[45] His first design was made from beer cans, strung together to make cube shaped bricks. He later called it the "Thumb House" and completed it in

1972. The beer can bricks work the way adobe bricks function within an adobe home: creating a breathable barrier between the inhabitants and outdoors, this regulates interior temperatures and is easily found and constructed. Adobe is massive and heavy, but the foundations are accessible and malleable. In order to use is properly, one must also understand how the formed materials function.[46] Adobe is much more insulating, abundant, durable, and protective than aluminum cans. Reynolds's more current experiments involve adobe, concrete, tires, and tests on systems that may be installed as to reduce the need for energy consumptive appliances.

Earthship is an interaction of materials, human manipulation, and time, which allows for natural phenomena to affect the structure. Settling, hardening, and natural chemical reactions occur throughout the design. Often human manipulation is seen as negative, which is the case when it is done at the cost of human and ecological health. Earthships bridge that gap between the manmade and the natural, allowing humans to be mutually beneficial participants with natural systems. Environmental artists also relay that message: that nature and humans are interdependent and react to one another, in positive and negative ways. Materials play a central role in the passive interactions of heat, water, and plants within the greenhouse.

The relationships present within the Earthship inform how Reynolds is being considered a biophilic architect by this study. He manages to create an entire home that is maintained by ecological systems, constructed with natural or local materials, and inspired by the immediate landscape. The Earthship could be considered a Land Art domestic space installation. Human needs are literally installed into the landscape, bringing biophilia into every aspect of the home, and allowing inhabitants to experience nature in every corner of their home and at every moment of their day.


Figure 7. Don Zanfagna, *Pulse Dome no.8*, concept design, c. 1970, sketch and collage on notebook paper. ZanFagna, Don, and Mark Sloan. *Pulse Dome Project: Art & Design by Don ZanFagna : A Project of the Halsey Institute of Contemporary Art at the College of Charleston*.

The futurist thinker, designer, and educator Don Zanfagna worked consistently from the 1950s and 60s through the 80s and early 1990s, until he became more interested in his work as a teacher.[47] The *Pulse Dome* concept has never been successfully constructed (Fig. 7) but was developed during his time as a working artist of the 1970s. The year Zanfagna's work was found and organized into an exhibition in 2012, art students at Clemson University replicated the instructions and designs present in his notes and journals to attempt a living *Pulse Dome.* It quickly collapsed, but his ideas were ahead of his time, allowing artists and scholars today an opportunity to revisit Zanfagna's concepts.

The *Pulse Dome* is an architectural concept where the structure and construction of a home is grown from living material, maintained by the living inhabitants' waste and breath, and compositionally inspired by fluidity and the photosynthesizing abilities of plants. There are many versions of the idea, but its design is highly integrated in the immediate landscape, creating a site specific element to its construction. This site specific element was a trademark of the 1970s environmental and installation art movements, where the parameters of the location informs every decision made by the artist. The location marks the lack of control the viewer has over the wild open space, but the

water, heat, and natural filters illustrate the ability of human technology to adopt the rules of the environment.[48] Reynold's technique stems from the legacy of "earth-man" art forms, which seek to bridge the divide between civilization and ecology, through location and materials. [49]

Relational feedback loops, which include a complementary mimicry of form and function, as in the Taos pueblos, connect architecture and human needs with natural actions and reactions. Functional mechanisms blend the qualities which humans and nature share.[50] Earthships bring together the goals of environmental art and revitalize it through to the 21th century; architecture that integrates sustainability and adobe style mud structures. [51] Zanfagna's *Pulse Dome* was designed to be a mixture of living foam and photosynthesizing membranes maintained by the inhabitant's waste and breathe. The structure was meant to be a futuristic model of homes that were completely integrated into the landscape and needs of humanity. Zanfagna's conceptual home was meant to create a completely biophilic space for human inhabitance, fueled by healthy plant life.

Figure 8. Amy Youngs, *Digestive Table*, 2006, Live Red Wiggler composting worms, sowbugs, food scraps, shredded paper, landscaping fabric, polyethylene, security camera, LCD screen, infrared filters, live houseplants and FSC (Forest Stewardship Council Certified) oak plywood, stained with a mixture of boiled red cabbage and worm compost tea. http://hypernatural.com/digestive.html

Amy Youngs' work is a successful celebration of the biophilic design- low tech technology (the cone, tube, and chair mechanical system), the inclusion of a structured and enclosed micro-climate (among worms, plants, and nutrient/water circulation), and a space where plants and humans mutually benefit from casual every day interactions (rocking in a chair and plant growth over time). Her work also creates a method of reducing trash and reintroduces waste into a closed ecosystem. *Digestive Table* is an interactive furniture design with built in composting and waste management capabilities (Fig. 8). These capabilities are achieved by combining a breathable cone bag, composting worms, and common everyday domestic trash, with the needs of every indoor gardener: how to compost inside?

The author has attempted to compost indoors several times, but to no success due to space and the odor of the decomposing waste. As an urban dweller, the author has taken on the topic of this thesis as to merge the desires of sustainable lifestyle with the obstacles that often prevent such a lifestyle. Amy Youngs is a designer, installation artist, and architect seeking to combine low-tech solutions with the pace of nature, as to create solutions for urban communities short of space and resources. The funneling mechanisms of a cone shape, combined with a breathable material, and composting worms remove the obstacles of indoor composting, while also creating a comfortable dining table for one or two.

*Digestive Table* reintroduces the participant to the living ecosystem thriving inside of the cone shaped compost bag bellow. That union is achieved through the implementation of a small camera and LED screen which projects the composting actions of the worms, waste, and materials. While the viewer observes the screen, their understanding of *Digestive Table* expands, reveling a complex, yet simple and automatic, relationship among insects, soil, nutrient density, and the regenerative cycles of ecological communities. Philosophically, the ecological systems and their organic and inorganic agents of change are given an active and meaningful role at the dinner table, in the home, and potentially throughout sustainability culture. Independent, symbiotic, and diverse mechanisms of nature, which are often generalized, become specific, personal, and celebrated by *Digestive Table.* Biophilia in Young's work is made mobile, diverse, and adaptable to the needs of domestic spaces within urban places, where space and land are limited.

Figure 9. Amy Youngs, *Machine for Living Interdependently*, 2012
coffee grounds and veggie scraps from our kitchen, old newspapers and shredded junk mail from our offices, and carbon dioxide from our breath; rocking chair, metal cones attached to piping, moss plants, vining plants, succulents, and worms http://hypernatural.com/machineforliving.html

sAmy Youngs doesn't stop there; her 2012 *Machine for Living Independently* takes the biophilic design successes of her 2006 design and transcends its role in the kitchen and dining room, placing her installation within the realm of home decor. The tube connecting the structure to the chair allows motion to pump the compost tea to the top, where vining and sun loving plants are oriented. Each level of the sculpture highlights the independent characteristics and needs of various plants, as to celebrate their individuality, but also to equitably address their roles within a feedback loop. Nutrients must be filtered and absorbed by plants at the top and bottom, as to balance their concentration and allow the plants to receive exactly what they require to function and thrive. From bellow the cones appear to be a cascade of silver water drops. Gravity guides the pumped nutrients and water from the top to the bottom (Fig. 9). The cone shaped planters funnel and filter as they descend, pushing nutrients down as they're used and excreted. Beyond the beauty of the plants, they also serve as an air filter, temperature regulator, and sink for organic waste produced by the home. The domestic sphere becomes a space that is actively alleviating the waste of a family and contributing to the beautification of the interior.

*Digestive Table's* cone shape is replicated in a twisting spiral surrounding a unifying and utilitarian pipe connected to a rocking chair within Youngs' *Machine for Living Independently*. Every form, motion, plant, and orientation from top-to-bottom is significant and necessary. The lowest cone holds moisture loving moss, where compost and organic

waste are placed. As the worms break down the organic materials, a nutrient rich compost tea collects, and is then circulated throughout the spiraling form by the motion of a human participant rocking in a chair. The gallery installation includes a rug to highlight how domestically oriented the design is (Fig. 9).

## 7. Conclusion

Biophilia is the behavioral base for humanity's love of the animate and alive. Biophilic space may be created through land art, site specific art works, and architecture of the home. From the 1970s to the 21st century artists and designers have transitioned in their attempts to reconnect the public to the nature, activating their biophilic tendencies. Gallery spaces, urban gardens, the home, and furniture have become the spaces of conversation where biophilia is attempted by artists and designers. Regardless of their location, biophilic spaces have the ability to create conservationist and environmentally conscious culture, starting with one space at a time. It is with this objective in mind that the author seeks to apply the previous manifestations of biophilia to new original designs that can allow urban dwellers opportunities to garden and celebrate nature in their homes. Biophilia is a cultural, biological, behavioral, aesthetic, and psychological challenge of the 21st century; either climate change will teach humanity a lesson, or the knowledge already at hand will be reinvested in.

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