A PHENOMENOLOGICAL INTERPRETATION OF BIOMIMICRY AND ITS POTENTIAL VALUE FOR SUSTAINABLE DESIGN

by

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Abstract

In this thesis, *biomimicry* is defined as imitating or taking inspiration from nature's forms and processes to solve human problems (Benyus, 1997). As the design community realizes the tremendous impact human constructions have on the world, environmental designers look to new approaches like biomimicry to advance sustainable design. Building upon the claim made by biomimicry scientists that a full emulation of nature engages *form*, *ecosystem*, and *process,* this thesis uses a phenomenological approach to interpret human and environmental wholeness. Phenomenology broadens biomimicry's scientific and technical focus on nature and considers how wholeness can be found among form, ecosystem, and process; and between people and environment. The thesis argues that, without a deeper, more responsive connectedness among people, nature, and built environment, any proposal for sustainable design will ultimately be incomplete and thus unsuccessful.

In developing this phenomenological critique, the thesis reinterprets several environmental designs from the perspective of human and environmental wholeness: American architect Eugene Tsui's hypothetical Ultima Tower; South African architect Michael Pearce's Eastgate project in Zimbabwe; the Altamont Pass Wind Energy Development in California; Montana philosopher Gordon Brittan's Windjammer wind turbine; American environmentalist David Orr's Lewis Center at Ohio's Oberlin College; and American architect Christopher Alexander's Eishin campus in Japan. The collective claims developed in this phenomenological critique identify considerations and approaches that move beyond replacement technologies and systems to describe a way of environmental designing and making that is necessary for actualizing a more realistic sustainability in regard to both the natural and human-made worlds.

Keywords: biomimicry, sustainability, green design, phenomenology, built environment

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Dedication

To Melanie and Chloe.

Chapter 1 :
Biomimicry and Sustainable Design

Reducing human impact on the environment becomes more critical as every day passes. The public, along with designers and clients, now realize the tremendous impact our buildings have on the natural and built environment. As sustainable design becomes widely accepted, new approaches, like biomimicry, are advanced to achieve a sustainable future (Benyus, 2008; Burr, 2008; Livingston, 2008; McLennan & Berkebile, 2004). Yet, as sustainable design gains support, an increasing number of critics suggest many current sustainable practices, like LEED, will ultimately be insufficient (Alexander, 2004; Kellert and Heerwagen, 2008; Stefanovic, 2000). Echoing these critics, I argue for a broadened view of the built and natural environment, including qualitative aspects. Suggesting that solutions focused on calculative methods that ignore the complex relationship between people and environment are not adequate for achieving a more realistic sustainability. In short, my thesis asks how a phenomenological approach interprets and broadens biomimicry's focus on nature to include human needs for designing and making the built environment.

In my thesis, biomimicry is defined as imitating or taking inspiration from nature's forms and processes to solve problems for humans (Benyus 1997). Janine Benyus's (1997) *Biomimicry: Innovation Inspired by Nature* provides the foundation for this emerging discipline. Benyus, a biologist, argues for the need to imitate nature to ensure a more sustainable future. She reviews research regarding how we will feed ourselves, harness energy, make things, heal ourselves, store what we learn, and conduct business.

I focus on a qualitative interpretation of biomimicry in regard to its application in environmental design. Benyus does not discuss environmental design in her book; rather, she focuses only on product design, for example, high-strength fabric inspired by spider silk; waterproof adhesives inspired by the mussel's ability to attach to the ocean floor; and high-strength ceramics inspired by abalone shells. Since her book was published, other sources mention these and similar products—for instance, shoe soles inspired by mountain goat hoofs (Katz, 2002); Velcro inspired by cocklebur seed pods (Mueller, 2008); adhesive inspired by gecko toe hairs (Yang, 2008); paint color inspired by butterfly wings (Smith, 2007); selfcleaning paint inspired by lotus leaves (Vartan, 2006); and swimwear inspired by shark skin (Smith, 2007). Though these products have brought attention to biomimicry in the scientific community and general public, one finds a lack of discussion regarding its application in environmental design and the need for additional discussion.

Biomimicry, Environmental Design, and Ecological Design

For the purpose of my thesis, environmental design is defined as design of the physical world shaped and constructed by humans at any scale, whether city, building, or interior. Though specialization within the design professions becomes more common, the sliding scale of environmental design is chosen to not only be more inclusive but as a reminder that all designers play a critical role in shaping the built environment. Biomimicry gained the attention of environmental designers after it was identified as one of the most important principles of sustainability in McLennan and Berkebile's *The Philosophy of Sustainability Design: The Future of Architecture* (2004, p. 43). Since this publication, Benyus has recognized that "the built environment is the most fertile ground for biomimicry" (Livingston, 2008, para 2). Benyus was the closing-event speaker at the 2008 U.S. Green Building Council national Greenbuild conference in Boston (Burr, 2008), and her Biomimicry Guild (founded with Dr. Danya Baumeister) offers services "helping companies and communities find, vet, understand and emulate life's time-tested strategies" ("What Is", 2008, para 1). This guild has now formed an alliance with one of the largest design firms in the world, HOK Architects (Livingston, 2008).

Certainly, nature has regularly inspired designs in the built environment, but as will be pointed out later, most of these examples are grounded in natural form. Although form is an obvious component of nature, Benyus and other scientists working with biomimicry warn that merely mimicking natural form misses the point ("Borrowing," 2007, p. 32; Post, 2007, p. 28). Benyus writes that "a full emulation of nature engages at least three levels of mimicry: form, process, and ecosystem" (Benyus, 2008, p. 40). As will become clear in following chapters, this triad of form, ecosystem, and process is the beginning foundation for the qualitative interpretation of biomimicry presented in this thesis.

In fact, some key contemporary figures have advocated that environmental design be inspired by natural ecosystems and processes as well as natural form. Paulo Soleri (1969) describes his vision for entire cities which is based on habitats for humans centered on what he calls the concept of "miniaturization." Soleri suggests that the morphing of multilevel physical environments and human ecology – what he calls "arcology"—will result in the "the implosion of the flat megalopolis of today into an urban solid of superdense and human vitality" (Soleri, 1969, p. 31). John and Nancy Todd are perhaps among the first to use the term "ecological design" in *Bioshelters, Ocean Arks, City Farming,* which focuses on systems "for human settlement that incorporate principles inherent in the natural world in order to sustain human populations over a long span of time" (Todd, 1984, p. 1), in particular, alternative means for food, energy, and shelter. John Tillman Lyle (1994) uses the term "regenerative design" to identify his approach to ecological design. He describes new systems for energy use, water, and wastewater that are founded on principles of natural processes and ecosystems.

While other thinkers and designers can be identified with biomimicry, the intention is not to provide a comprehensive history of ecological design, but to identify a reoccurring deficiency that exists—namely, a focus on calculative methods and systems that mimic nature to reduce human impact on nature. I would contend, after Kellert and Heerwagen (2008), that without a deeper connection among people, nature, and the built environment, many of the proposed solutions for ecological design and sustainability merely lessen the impact on the environment and "will ultimately be insufficient to achieving the long-term goal of a sustainable, healthy, and well-functioning society" (ibid., p. vii). My central argument is that, without nurturing a caring, long-lasting, and meaningful relationship among people, place, and nature, any sustainable approach, including biomimicry, will merely replace conventional practices and prolong the increasing degradation of the natural and built environment.

This argument is similar to author and professor of architecture Gary Coates' (1981) perspective in *Resettling America: Energy, Ecology, and Community,* considered by many to be a landmark publication and one of the most comprehensive presentations of ecological and sustainable design based on a cooperative human community. Coates suggests that, rather than "continuing to promote a 'Green Revolution' whose time has passed" (ibid., p. 413) and "engaging in a futile attempt to maintain the existing structure of our human habitat with diffuse renewable energy sources" (ibid., p. 32), it is necessary to "to create a symbiosis between nature and culture. To achieve this goal, human culture must come to emulate in its functioning, as far as possible, the dynamic equilibrium characteristics of a mature ecosystem" (ibid., p. 219). From one angle, this thesis is an attempt to continue the many strands of Coates' argument and to describe an approach that is rooted in the human dimension of caring and concern and the need to create human communities in which such care is experienced and enacted in the rituals of everyday life. In this way, we might be able to take "responsibility for reshaping [our] own lives, neighborhoods, and cities" in a built environment that reflects who we want to be (ibid., p. 3).

This emphasis on and inclusion of people is not meant to be a humanistic critique of biomimicry in the vein of Joe Kaplinsky's (2006) *Biomimicry versus Humanism*, which argues that "the idea that there are natural solutions to natural limits is wrong-headed…. the way in which we experience such constraints [of nature] is always mediated by our technological and social systems" (ibid., p. 68). Rather, my intention is to be more encompassing of the complex interrelationships that exist in the built environment and strive for what phenomenological geographer Edward Relph (1981) has called "environmental humility," which involves a genuine caring and concern for the environment that incorporates responsibility and commitment for the natural world, rather than mastery and exploitation. My intention is to avoid the naively anthropocentric humanistic view proposed by Kaplinsky that only furthers the mistakes of a positivist science that places humans apart from nature.

Phenomenology, Hermeneutics, and Biomimicry

Phenomenology can be described as "a way of thinking rigorously and of describing accurately the complex relation between person and world" (Seamon and Mugerauer, 2000, p. 1). At the same time, "phenomenology allows phenomena to be understood as they are without the reduction or distortion so often the result of positivist science or the many styles of structuralism" (ibid, p. 2). Thus, phenomenology's emphasis on the complex relationship between humans and the environment binds them together, avoiding the predominant Western view that humans and environment must be understood apart. Phenomenology identifies and describes the underlying commonalities marking the essential core of "a phenomenon as it has presence and meaning in the concrete lives and experiences of human beings" (Seamon, 2000, p. 159). Particular emphasis is placed on the everyday, taken-for-granted activities and experiences of human beings and their everyday world. It is important to remember these experienced phenomenon are not abstract but begin and end with immediate, concrete experience.

More than perhaps anyone else in this past century, philosopher Martin Heidegger (1890-1976) provided “the instruction for doing a phenomenological and hermeneutic of humanity’s existential situation” in the environmental disciplines (Seamon and Mugeraer, 2000, p. 3). Heidegger explained that “the phenomenological attitude is a respectful stand in face of reality which allows this reality to appear in its own way, undistorted” (Vycinas, 1969, pp. 29). Heidegger believed “that contemporary, technological society has lost a genuine sense of belonging to our natural and built places” and that “ we have come to value material things at the expense of understanding both the relationship between entities and the context within which those entities are comprehended in the first place” (Stefanovic, 2000, p. xvi). My thesis echoes Heidegger’s beliefs regarding our lost sense of belonging and suggests that achieving a more realistic sustainability requires environmental designers to create environments which again instill our sense of belonging.

Along with phenomenology, this thesis adopts a hermeneutic approach. Mugerauer describes hermeneutics as the “theory and practice of interpretation, particularly the interpretation of texts” (1994, p. 4). One key point of hermeneutics is the creator of the text is not typically available to comment and thus, the hermeneutic researcher must find ways to discover meaning through the text itself (Seamon, 2000). This thesis makes use of a hermeneutic approach to study the natural and built environments, which cannot speak for themselves. A hermeneutic interpretation of the built environment not only encompasses physical materials and natural processes but also the symbols and languages through which people gain a sense of environmental belonging (Corner, 1991). As Bortoft suggests, a hermeneutic approach has the ability to reveal the wholeness of the thing studied:

> we do not need the totality of the text in order to understand its meaning. We do not have the totality of the text when we read it, but only one bit after another. But we do not have to store up what is read until it is all collected together, whereupon we suddenly see the meaning all at once in an instant. On the contrary, the meaning of the text is discerned and disclosed with progressive immanence throughout the reading of the text. (Bortoft, 2000, p. 284)

The emphasis on wholes that a hermeneutic approach takes not only avoids the positivist-science view that what is being studied can be dissected and viewed in separate pieces apart from one another, but this approach also allows us to think differently about the wholeness of what is being studied.

Bortoft (2000, p. 284) suggests that the whole of something cannot simply be viewed as the sum of the parts “because there are not parts which are independent of the whole”, and the wholeness cannot be perceived by standing back from it. Instead, the whole is reflected in the parts and is “encountered by going further into the parts instead of by standing back from them” (ibid., p. 284). Drawing on the example of reading text, Bortoft writes, “we can sometimes find that it is just the understanding of a single passage which suddenly illuminates for us the whole meaning of the text” (ibid., p. 285). In this sense, a hermeneutic approach can reveal the wholes and parts of the emerging topic of biomimicry and expand the discussion and language to date. The language surrounding biomimicry is critical because it not only communicates the findings and interpretations, but becomes the final task in shaping understanding that enables the environment to come forward into experience (Mugerauer, 2000).

A hermeneutical and phenomenological approach also avoids a linear-sequential view that a sustainable future can only be reached by implementing a series of replacement technologies and scientific innovations (in other words, parts) to achieve environmental sustainability (in other words, wholeness). Instead, I attempt to uncover the deep-down *ethos* or underlying structures for environmental designers to consider when making decisions about biomimicry’s application in the built environment. This is done by illuminating not only what is explicitly said by writers regarding biomimicry and phenomenology, but also what remains unsaid. In short, I argue as long as designers approach the process of designing and making in the conventional manner, merely replacing current materials and technologies with low-environmental-impact materials and technology, this shift will ultimately be insufficient for reaching a more realistic sustainability. Rather, what is necessary is for environmental designers to develop a way of designing and making which moves us towards Heidegger’s “genuine sense of belonging to our natural and built places” (Stefanovic, 2000, p. xvi).

Organization of the Thesis

To develop the phenomenological-hermeneutic interpretation of biomimicry argued for here, my thesis is organized around the three themes of form, ecosystem, and process—the three levels of nature identified as necessary for a full emulation of nature in biomimicry (Benyus, 2008, p. 40). Phenomenology identifies and interprets the essential underlying connections of form, ecosystem, and process as they relate to people, nature, and the built environment. Each of the three main interpretive chapters discuss one of the three levels as it relates to both conventional and phenomenological views regarding nature, people, and the built environment.

Chapter 2 examines *form*, and begins by reviewing current environmental design styles inspired by natural form and the varying degree in which they demonstrate either image-based engagement or a more grounded interpretation of natural form. The phenomenological view of natural form, grounded in Goethean science, is than discussed. Next, a brief overview of designs grounded in the phenomenological view of natural form demonstrate its application in environmental design. The underlying themes and insight gained from the first part of this chapter are then used to critique two projects inspired by natural form and biomimicry: architect Michael Pearce's Eastgate building in Zimbabwe and architect Eugene Tsui's hypothetical Ultima Tower, both inspired by termite mounds.

Chapter 3 examines *ecosystem*, another of Benyus's three levels of nature. This chapter begins by reviewing the conventional scientific view of ecosystem, contrasted with phenomenological perspectives of the wholeness of nature. Next, phenomenology's way of seeing nature is reviewed as a means to help designers experience the wholeness of nature. Biophilia—the concept that humans need contact with nature—is then used to make a bridge between nature and people. Next, I expand on biophilia to include the phenomenological notion of place and the need for connectedness among people and the built environment. Then, I discuss technology and the role it plays in shaping our relationship with the built environment to identify important considerations regarding the character of ecosystem inspired technology. As in chapter 2, two projects are critiqued—specifically wind energy projects—in regard to claims elicted in the previous sections.

Chapter 4 examines a *process* for designing and making in the natural and built worlds. I begin this examination by describing the lacking sense of wholeness in many conventional design approaches in contrast,with phenomenological approaches. In this closing chapter, architect Christopher Alexander's *process* of designing and making of the Japanese Eishin campus is compared to environmentalist David Orr's *process* of designing and making of Ohio's Oberlin College, Adam Joseph Lewis Center. These processes are critiqued with regard to their potential for creating a sense of belonging and the wholeness exhibited among people, nature, and built environment.

The final chapter begins by extending the discussion of Alexander's work regarding wholeness and the role built environment plays in completing this wholeness. Geographer Edward Relph's notion of "environmental humility" and Heidegger's notion of "appropriation" are than discussed as a means to enlarge Alexander's focus on the built environment. Next, I draw on the writings of community organizer Daniel Kemmis to address considerations for engaging local people in the design and making process. I conclude by describing the potential value a more holistic perspective of biomimcry provides designers engaging nature, people, and place.

There is little doubt that, as biomimicry's application in the built environment gains attention, now is the time to expand and advance discussion of this emerging discipline. Though biomimicry provides inspiration to environmental designers, a phenomenological interpretation of biomimicry's foundation of form, ecosystem, and process can move beyond replacement technology to describe a way of environmental designing and making that is critical for a more complete sustainability.

Chapter 2 :
Beyond Image-based Natural Form

The previous chapter reviewed biomimicry, along with phenomenology and hermeneutics, the two methodologies this thesis uses to interpret and broaden biomimicry's focus on nature to include human needs for environmental design. Chapter 2 discusses *form*, the first of the three themes identified as necessary for a full emulation of nature (Benyus, 2008, p. 40). Natural form has inspired architectural forms from the first vernacular structures to the work of eminent designers, and natural form has always been subject to reinterpretations and applied to the realm of design (Bahamon, Perez, & Campello, 2008, p. 4). Blobitecture (Waters, 2003), evolutionary architecture (Tsui, 1999), and Hungarian organic architecture (Cook, 1996; Makovecz, 2005) represent a few styles within environmental design inspired by natural form. The predominance of natural-form-inspired styles and books suggest this is the most frequent theme through which environmental designers seek inspiration in nature. One potential problem with this formalistic approach is that leaders of biomimicry argue that merely mimicking natural form misses the point ("Borrowing", 2007, p. 32; Post, 2007, p. 28). Instead a full emulation of nature also engages ecosystems and processes (Benyus, 2008, p. 40). This chapter discusses how natural form might be grounded in ecosystem and process and attempts to reveal a wholeness connecting form with ecosystem, process, person, and environment.

In order to distinguish their efforts grounded in natural form from biomimicry, designers should use an appropriate language to describe designs that merely mimic natural form rather than arise authentically from it. As suggested in the previous chapter, an accurate language becomes a central task in shaping understanding and better enables the environment to come forward into experience (Mugerauer, 2000). Using an appropriate and accurate language might also aid the public in distinguishing natural-form-inspired design and authentic biomimicry. *Morphology* is the word natural scientists use to describe form and structure in nature. Morphology can describe topographic features and geology or plants and animals. For this reason, I suggest that designers use the word "biomorphic" (Feurstein, 2000) when describing environmental designs that merely mimic the appearance of natural forms. For example, Herb

Greene's Prairie Chicken house in Norman, Oklahoma (Feuerstein, 2002, p. 119) looks like a prairie chicken and should be considered biomorphism rather than biomimicry because it merely mimics the form of a prairie chicken and does not relate to ecosystems or processes of which the prairie chicken is a part. In other words, by merely mimicking a part of nature (form), this house design ignores the wholeness and connectedness that exists within nature and is better described as biomorphic rather than as biomimicry. Having established the word biomorphic to describe designs grounded in natural form we can describe the contrasting wholeness that form grounded in biomimicry and phenomenology can exhibit.

To begin this hermeneutic interpretation of wholeness the following section reviews the phenomenological notion of authenticity. The argument is made that authentic *use-based* form is the first step in describing the wholeness in nature. Building on the phenomenological foundation of authenticity, the next section discusses the work of the German poet and qualitative scientist Johann Wolfgang von Goethe, a key figure in applying the phenomenological approach to the study of natural form. This review of Goethean phenomenology broadens the conventional view of natural form and identifies an underlying structure serving as a foundation to further ground environmental design more deeply in natural form. As a means to link Goethean form with environmental design, the next section reviews projects grounded in phenomenological natural form—first, Erik Asmussen's buildings at the Rudolf Steiner Seminar in Sweden; and second, John Wilkes' Flowforms first developed in Great Britain. The phenomenological principles elicited from these sections serve to found the basis of a critique of two projects inspired by natural form—South African architect Michael Pearce's Eastgate project in Zimbabwe and American architect Eugene Tsui's Ultima Tower. A phenomenological interpretation of these projects describes, concretely, the wholeness that dwells in authentic form as a means to interpret and broaden the application of biomimicry in environmental design.

Authenticity Interprets Wholeness in Biomimicry

For phenomenologists, authenticity can describe the degree of awareness and condition of integrity in the person-environment relationship (Dovey, 2000; Relph, 1976). Phenomenologists suggest that authentic form is more integral in the person-environment relationship and, that often, authentic form is use-based and inauthentic form is image-based (Bortoft, 2000; Dovey, 2000; Relph, 1976, 1981; Seamon, 2000). These two categories (or "modes of being") arise from Heidegger's readiness-to-hand (*Zuhandenheit*) and presence-at-hand (*Vorhandenheit*). Heidegger argued that *Zuhandenheit* and *Vorhandenheit* represent two distinct modes in which people engage the lived world and result in varying degrees of integrity in the person-environment relationship (Dovey, 2000, p. 36). Readiness-to-hand "is the mode of Being in which we use and actively engage *implements* or form (Dovey, 2000, p. 36). Presence-at-hand, in contrast, "is the condition of an object [or form] that stands in a theoretical visualized relation to the subject; it is not used but rather stands available for our consideration" (ibid., pp. 36-37). In this mode, because the form is not used and only available for consideration, self awareness inserts itself between person and world (Relph, 2000, p. 18). In this sense readiness-to-hand is use- based and more authentic while presence-at-hand is image-based and, in the sense of lived immediacy, less authentic.

Architect Kimberly Dovey (2000) draws on the example of shutters to explain how inauthenticity arises from the misplaced belief that authenticity can be generated through the manipulation or purification of the image of form. Rather, he suggests authentic form arises from everyday, taken-for-granted experiences and use. Dovey (2000, p. 34) uses four different modes of the shutter to illustrate his point. In the first mode, shutters are used for everyday boundary control shutting out light, wind, and creating privacy. In the second mode, shutters still operate, but are no longer used. In the third mode, shutters are fixed and can no longer be open or closed, in the fourth, shutters do not even match the size of the window and merely serve as decoration. A formal analysis of authenticity might interpret the transformation in the shutters as inauthentic when they are fixed to the wall in the third mode. Dovey, however, suggests the transformation occurs between the first and second mode when people no longer engage the shutter in everyday use, even though they can still be operated. Simply put to Dovey, authenticity is use-based, while inauthenticity is image-based.

In addition to drawing a distinction between use-based form and image-based form, phenomenologists suggest authentic use-based form relates to the *context* of surroundings. Drawing again from Heidegger, these thinkers argue that the meaning of a form arises from what it is used *for*, thus the meaning for a shutter is found in its everyday use *for* shutting. In other words, use-based form never has meaning in itself; rather, it is always related to a totality of lived surrounding related to its use (Vycinas, 1969, p. 35). Thus, an authentic person-form relationship is not only use-based, but also relates to a context of surroundings. In this sense, use-based form might reflect the wholeness of its surroundings in one part of design. Drawing on this idea that authentic form has the potential to reveal the wholeness of nature, this thesis argues that authentic form also has the potential to reveal the wholeness in the person-environment relationship. This resulting wholeness has greater potential to connect people and environment, thus instilling a deeper sense of belonging with a more authentic and integral people-environment relationship.

Before moving into the next section's decision of a phenomenology of natural form, it is important to clarify the phenomenological view regarding authenticity in environmental design. This view contends that environmental design rarely demonstrates complete authenticity or inauthenticity, rather varying degrees. As Relph explains, "as a form of existence, authenticity consists of a complete awareness of acceptance of responsibility for your own existence. But in terms of the experience and creation of [environmental designs], authenticity rarely appears in such a pure form" (1976, p. 78). Heidegger suggests that one mode is not more essential than the other but, rather, authenticity is an existential mode and existential knowledge is not opposed or inferior to theoretical knowledge; rather it is prior to theoretical knowledge (Vycinas 1969, p. 34). Yet, as suggested throughout the thesis, it is difficult to maintain objectivity and not judge inauthenticity as it is characterized by the stereotyped, artificial, and dishonest, rather than being direct and genuine (Relph, 1976, p. 80). The final chapter of this thesis studies how a more authentic person-environment relationship is a critical link for actualizing a more realistic approach to sustainability.

Goethean Science and Natural Form

This section reviews Goethean science and its potential for revealing wholeness in natural form. Johann Wolfgang von Goethe (1749-1832) stands out among the first dissidents of modern, positivist science (Orr, 2006, p. 29). One hundred years prior to the first formal phenomenological enterprise laid out by its founder Edmund Husserl, Goethe "devised a qualitative way of seeing and understanding that can rightly be called a phenomenology of the natural world" (Seamon, 2006, p. 54). Goethe described his phenomenological method as *delicate empiricism*—an "effort to understand a thing's meaning through prolonged empathetic looking and seeing grounded in direct experience" (Seamon, 1998, p. 2). Through this delicate empiricism, Goethe identifies the wholeness of what is studied along with parts reflecting the whole.

Goethe's study of light is perhaps the most easily understood example of his ability to move beyond conventional science's study of nature. Goethe began his studies of color in the late 1780s, "skeptical of Newton's color theory (which claimed that colors are contained in colorless light and arise, for example, through refraction in a prism)" (Seamon, 2006, p. 63). Ultimately, Goethe concluded that "color is the reciprocity of darkness and light or, more precisely, that color is the resolution of the tension between darkness and light" (p. 70). Thus, "darkness lightened by light leads to the darker colors of blue, indigo, and violet, while light dimmed by darkness create the lighter colors of yellow, orange, and red" (p. 70). Goethe concluded that "color is the resolution of the tension between darkness and light" (Seamon, 1998, p. 5), describing this reciprocity of darkness and light as the "ur-phenomenon" of color. For Goethe, the "ur-phenomenon" described the foundational situation or deep-down, primal phenomenon that marks the necessary pattern of a thing or relationship (Seamon, 2006).

Goethe's study of color and light indicates how the phenomenological approach of "prolonged empathetic looking and seeing grounded in direct experience" (Seamon, 1998, p. 2) moves beyond the predominant Western view of the natural world as a static entity which can be understood best in parts. In other words, Goethe's study of color and light does not see darkness as a "total, passive absence of light as Newton suggested but, rather an active presence, opposing itself to light and interacting with it" (Seamon, 1998, p. 6).

Goethe's ur-phenomenon regarding the contrast between darkness and light has played a central role in the phenomenological work of ecologist Mark Riegner (1993), who has examined how the form of plants and animals exhibit the polarity of light/dry and dark/moist. One example Riegner uses is the leaf form of bindweed in which the leaf shapes at the base of the plant nearest the darker-moister environment (adjacent to the soil) are simpler, more-rounded, and with fewer serrations (figure 1). Proceeding towards the tip of the plant, nearer the sun and more exposed to the drying air, leaf shape is more complicated with numerous serrations. Riegner discusses how this shift from simpler to more complex leaf form frequently occurs not only with individual plants but that the leaves of an entire ecosystems—e.g., a rainforest—can reflect this polarity of light/dry and dark/moist. Yet again, some plants, like the brittle bush of the Sonoran Desert, change their foliage seasonally with large, soft leaves in the rainy season, and smaller, hair-covered foliage in dry season (ibid., p. 195).

Figure 1. Drawing illustrating the transition from simple rounder leaves at the base (right), to more complex shapes towards the tip (left). Reprinted from "Flowforms" copyright 2003 John Wilkes and used with permission of Floris Books.

Riegner argues that the same relationship exists for animal form. The generally rounder form of mammals like beavers, otters, and marsh rabbits express the dark-moist aquatic environment, while the somewhat more angular forms of the grey squirrel, weasel, and desert rabbit reflect the light-dry terrestrial environment (Riegner, 1993). Riegner suggests that, just as plants exhibit the "roundness and structural simplicity, epitomized in the form of a water droplet" (ibid., p. 200) so do animals, even though some may not at first appear to fit this generalization. For example, the woodchuck inhabits dryer, lighter environments like open woods and fields, yet, its large rounded body is characteristic of aquatic creatures. When, however, one considers the "main life realm" of the woodchuck as burrowing in the soil, one realizes this is the sphere where the quality of water is dominant (ibid., p. 202).

For Riegner this way of understanding natural form not only is an interpretation but, becomes a form of language that describes an environment and its living forms. Thus, natural form serves as one hermeneutical approach for understanding an environment which cannot speak for itself. Furthermore, Goethean interpretation of natural form suggests that environmental designers could learn to understand the connectedness between natural forms and their surroundings. In other words, natural form reflects the environment, and environment reflects natural form. As Riegner writes,

> An animal…does not so much live *in* an environment as the environment is an extension of the animal. Conversely, the animal can be viewed as an extension of the environment. The two are reciprocally united. Thus, the wholeness of a place comes to expression *expansively* in the [whole environment] and *focally* in the parts of the [environment]. (Riegner, 1993, p. 204)

This authentic interconnectedness between organisms and their natural worlds further illustrates that environmental designers cannot consider natural form apart from its context or surroundings. Rather, natural forms should express their environment and surroundings, just as the environment should express its natural forms. As the individuality of an environment comes to expression through its plants and animals, so would it ideally manifest through environmental design. In this way, engaging authentic natural forms which bear the formal signature of a place is one way designers can create environments to express the wholeness dwelling in them.

Environmental Design Inspired by Goethean Form

Goethe's phenomenology of natural form not only influenced the way some natural scientists view nature, but has also influenced environmental designers' engagement of natural form. Rudolf Steiner (1861-1925), an Austrian philosopher, scientist, and educator, was influenced by Goethe's methods and insights. "Steiner argued that, by training one's observational skills and by becoming increasingly aware of one's cognizing activity, the student would be led toward an experience of "the idea within reality" (Riegner and Wilkes, 1998, p. 234). Echoing Heidegger, Steiner believed present environmental design "inclines humanity toward a materialistic worldview and a mechanistic inner life" (Coates, 2000, p. 24). He suggested that countering the negative effects of materialism was the most important task of present and future environmental designs (ibid., p. 23).

Steiner was the first to introduce Geothe's principle of metamorphosis into building (Coates, 2000, p. 25) and inspired the Danish-Swedish architect Erik Asmussen (1913-1998). For Goethe and Steiner, metamorphosis was a process of intensification, enhancement, and heightening by which nature uses the tensions generated by polarities to create metamorphoses of form (Coates, 2000, p. 25). This metamorphosis of form is similar to that described by Riegner in leaves of a plant (figure 1). A plant exhibits a series of expansions and contractions among its leaves and flowers, progressing from the seed (the most contracted), to base leaf of simpler, rounded forms, to the more complex leaves at the tip of the plant, and finally out to the flower. The last expansion occurs in the flower where, after pollination, "there is one last expansion in the swelling of the fruit, which holds within itself the final contraction, the new seed" (ibid., p. 25).

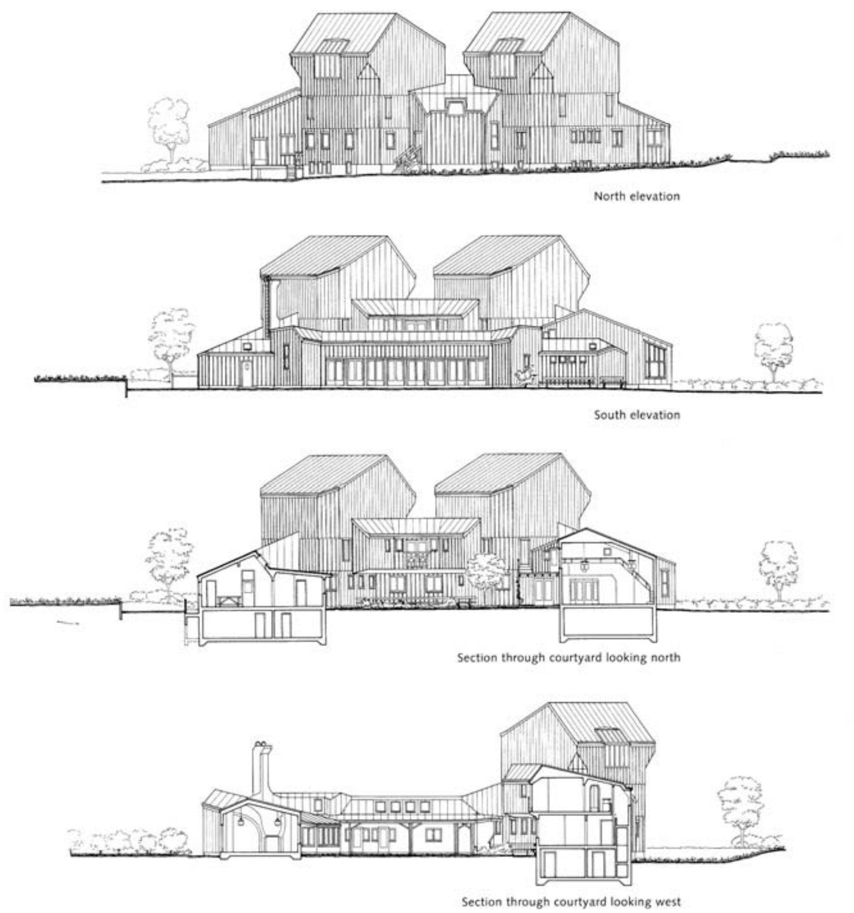

Figure 2. Elevation and section drawings of the Robygge building at the Rudolf Steiner Seminar designed by architect Erik Asmussen according to the Goethean principle of metamorphosis. Drawings copyright 1997 Susanne Siepl-Coates, used with permission.

It appears that Asmussen designed the six buildings clustered at the Rudolf Steiner Seminar according to the principles of this polarity of contraction/expansion and intensification/heightening (Coates, 2000, p. 28). Though the six buildings appear different at first glance, deeper examination reveals that within their circular arrangement they respond to environmental circumstances and serve to express the varied functions and uses of each building (ibid., p. 27). In this way, Asmussen's design expresses the forms and processes of nature and responds to surroundings and bears the signature of the place. Furthermore, the form results from an emphasis on use and function rather than appearance (figure 2). One can argue that, "shifting from an emphasis on buildings as beautiful spatial objects" (Coates, 2000, p. 29) to generate buildings and designs which arise from use and the needs of people, is one step to cultivate a deeper relationship between people and environment. In other words, forms should never primarily be a work of art or image-based; rather, "appropriate form is a form that in harmonizing with a mode of living also serves to lend a deeper harmony" (Casey & Embree, 1990, p. 255). As suggested earlier, instilling this deeper harmony is critical for actualizing sustainability.

John Wilkes' work with Flowforms further describes environmental design that expresses phenomenological form and might have a greater potential for instilling a deeper harmony by revealing the processes of nature. Wilkes, a British sculptor, worked as a research assistant to British mathematician George Adams, cofounder of the Institute for Flow Sciences with German hydrologist Theodor Schwenk (1976). It was "a major aim of the Institute was to study the rhythmic qualities of water and it relation to life and natural forms" (Riegner and Wilkes, 1998, p. 235). This study of the movement of water provides the basis for Wilkes' research. Wilkes wondered if it was "possible to design a sequence of forms through which water could fulfill its potential to manifest an orderly metamorphic process" (ibid., p. 239). Wilkes discovered that:

> at one location in the system,… the dimension of the aperture were such that there was momentary hesitation as water flowed from one section in to the next. Had the aperture been wider, water would have flowed through uninterrupted: if narrower, the upper section would have filled and overflowed. The unanticipated hesitation induced an alternating left and right deviation of flow into the lateral cavities of the channel. With additional experimentation, it was possible to achieve a similar vortical movement in each cavity. The overall movement became a figure eight, or lemniscates, with one side rotating clockwise, the other counterclockwise. (Riegner and Wilkes, 1998, p. 239)

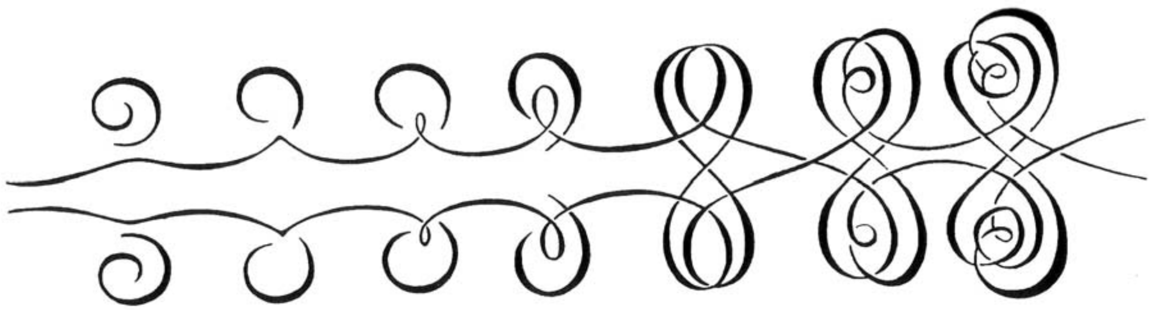

Figure 3. Schematic drawing by Wilkes representing the development of water movement within the cavities of a Flowform from a rotation to the leminiscatory pulse. Reprinted from "Flowforms" copyright 2003 John Wilkes and used with permission of Floris Books.

Additional refinements led to the "Flowform" method and the design of a channel with a series of independent vessels cascading into one other. Early on it was determined water was oxygenated very efficiently in Flowforms. Researchers at Warmonderhof, a Dutch biodynamic agricultural college, compared the water quality of polluted water coming from three different Flowform cascades, versus a traditional step pool (Riegner and Wilkes, 1998, p. 246). Their studies indicated that Flowforms, compared to step pools, supported generative floral and seed, winged-stage species like the midge, and macro fauna like crustaceans and water mites where step pools did not support as many complicated organisms (ibid, pp. 246-247). Flowforms are also used for the treatment of water for indoor plants, for wastewater treatment, and the making of "homeopathic" anthroposophic medicines. One example is provided by a small college community in Jarna, Sweden designed by Erik Asmussen where Flowforms, combined with ponds and filter beds, treat water and serve as the focal point of a community park and wildlife habitat.

Wilkes' ultimate aim (1998) is to "recreate artistically a wide spectrum of qualities and rhythms naturally inherent in water" (p. 248). He suggests that, just as the human organism embodies a rhythmical relationship between pulse and breath of 4 to 1, so too can Flowforms be developed to generate specific relationships between the various rhythms they produce. Rhythms within and between vessels can thus be attuned and harmonized to create a veritable symphony of movement. It is believed that specific combinations of surface relationships and rhythm harmonics may provide specific uses in wastewater treatment, water storage, irrigation, and so forth. Flowforms now appear in numerous projects worldwide, and design professionals like Herbert Dreiseitl (2005) use Flowforms in their environmental designs.

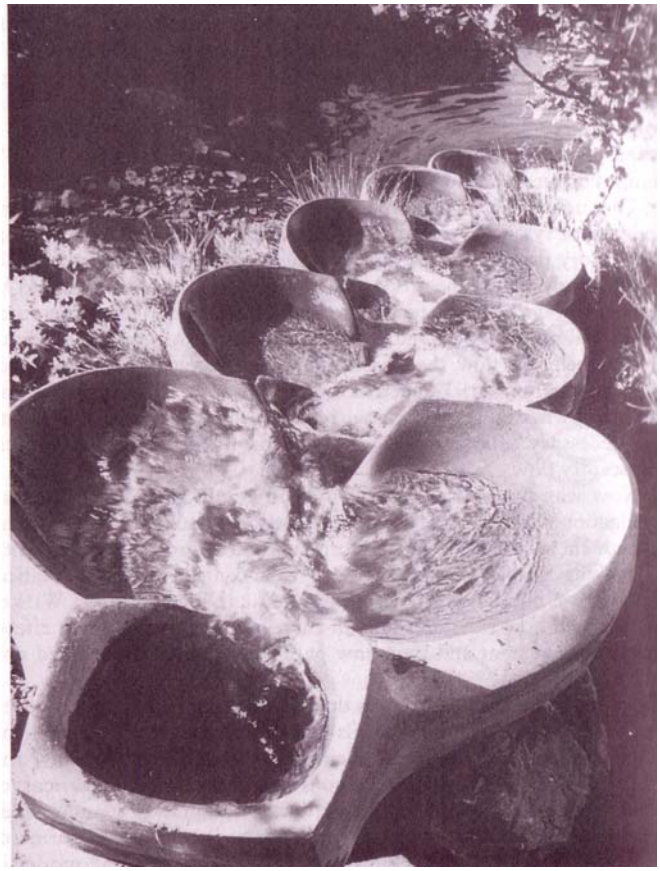

Figure 4. Photograph of Wilkes' Flowform sculpture at Sundet in the Norwegian mountains. Reprinted from "Flowforms" copyright 2003 John Wilkes and used with permission of Floris Books.

Wilkes'and Asmussen's work demonstrates how phenomenological methods might further ground designs inspired by natural form. Even more important, Wilkes' and Asmussen's efforts exhibit how a phenomenology of natural form might help designs move beyond a superficial image-based approach to encourage a deeper connectedness with the natural environment. For example, not only do Flowforms function for regenerating life in polluted water, but they provide a more transparent lens for people to connect with and to understand the regenerative processes of nature. Thus, a phenomenology of natural form helps designers engage creations that bear the signature of places to express the wholeness dwelling in them.

Authenticity in Pearce's Eastgate project and Tsui's Ultima Tower

To develop the phenomenological-hermeneutic interpretation of holistic form argued for in this chapter, I conclude by interpreting the contrasting sense of wholeness which can be found in two environmental designs inspired by natural form. This interpretation is grounded in the argument developed in the three previous sections regarding wholeness in form: first, that natural form should express its surroundings; second, that a lived engagement with natural form goes beyond an image-based encounter and is use-based, emphasizing the everyday needs of people; third, that natural form has the potential to reflect natural processes. Drawing on these three claims, I critique two environmental designs inspired by natural form—first, architect Eugene Tsui's conceptual two-mile-high Ultima Tower (figures 5); second, architect Michael Pearce's Eastgate project located in Harare, Zimbabwe (figures 6-9). These projects are selected because both are inspired by the natural phenomenon of termite mounds, which are found in warmer climates worldwide and reach heights of twenty-three feet with underground networks extending ten feet below the surface (von Frisch, 1974, pp. 123-150). Studying these projects describes, concretely, how a phenomenological approach to natural form can reveal the wholeness dwelling in that form. The central argument is that a more authentic relationship among form, nature, people, and environment has the potential to instill a deeper sense of human and environmental belonging.

It is important to emphasize that Tsui's Ultima Tower (figure 5) is a conceptual project and not yet built. As a result, the design seems to be based on claims and suppositions, rather than well considered facts which can be found in some of his other projects. Tsui proposes a structure height of 10,560 feet (nearly two miles), with a base diameter of 6,000 feet (Tsui, 1999, p. 235). He writes that "the trumpet bell shape [is] modeled after the highest structure created by a creature other than human, the termite's nest structure in Africa" (Tsui, 1999, p. 237). Tsui chooses the termite mound form because "no other shape can dispel loads from top to bottom, is effectively aerodynamic and retains such stability in a tall building" (ibid., p. 237). He proposes such a tall structure "to minimize the 'footprint' of our human-made environments and maximize the sense of openness and close proximity to our natural surroundings" (ibid., p. 236). In other words, the form is selected to achieve a maximum height and reduce the physical footprint of development.

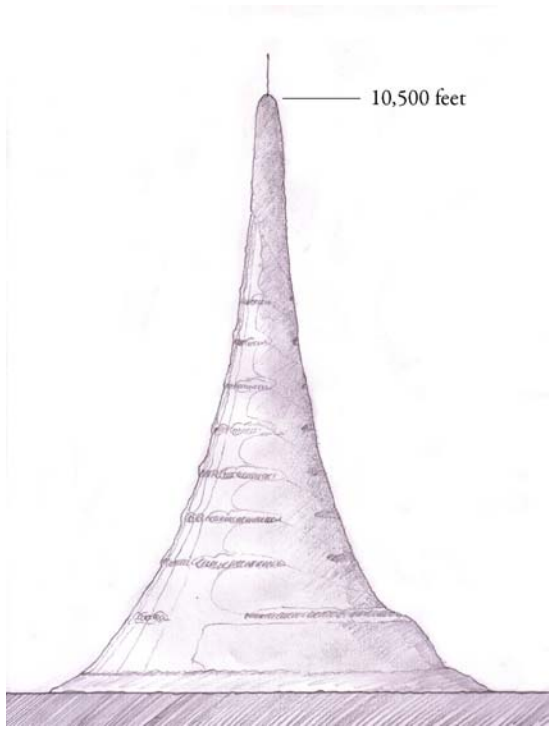

Figure 5. Eugene Tsui's "Two-Mile-High Ultima Tower" redrawn by Lance Klein and based on Tsui, 1999, p. 237.

Figure 6. The mixed-use Eastgate building in downtown Harare, Zimbabwe. Photograph copyright 1997 Michael Pearce Partnership/Aga Khan Trust for Culture, used with permission. Retrieved February 5, 2009 from http://archnet.org/library/images/one-image.jsp?location_id=3167&image_id=36900.

Within the structure, Tsui proposes entire landscaped neighborhood districts with lakes, streams, rivers, hills, and ravines comprising the soil landscape on which residential, office, commercial, retail, and entertainment buildings are built on 120 different levels (Tsui, 2005, para.1). These levels are 100 to 160 feet high, and light is brought into the center of the structure by means of a hollow mirrored core that reflects disperses sunlight (para. 1 & 3). Furthermore, all areas of the structure feature resource-conserving technology such as recycled building materials, composting toilets, and nature-based water-cleansing systems (Tsui, 1999, p.235).

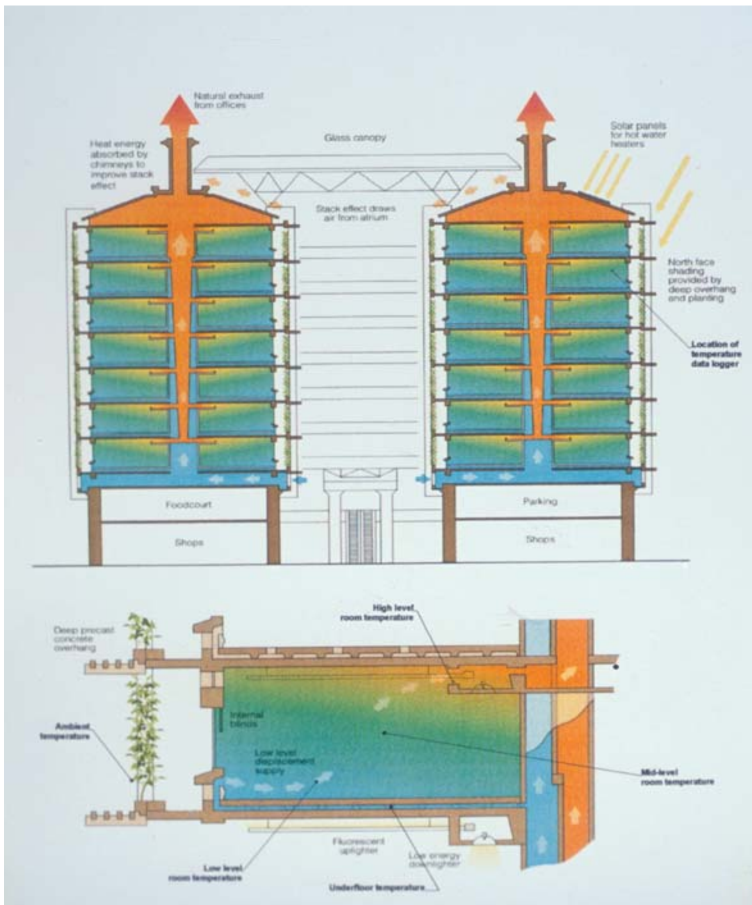

Figure 7. Drawing illustrating the heating and cooling process that Eastgate adapts, drawing cool air from the basement and offices, allowing hot air to escape at the top of the building, a process inspired by the termite mound. Copyright 1997 Michael Pearce Partnership/Aga Khan Trust for Culture, used with permission. Retrieved February 5, 2009 from http://archnet.org/library/images/one-image.jsp?location_id=3167&image_id=36902.

Completed in 1995, the Eastgate project was designed by architect Michael Pearce and engineers Ove Arup Associates. The nine-story mixed-use office and retail building is located in the downtown business district of Harare, Zimbabwe, in southern Africa (see figure 6). Two main cores surround a glass-covered atrium with retail shops on the first and second floors and offices above. Pearce was inspired by the termite mound's ability to maintain a constant 87 degree temperature in a climate that fluctuates between 35 degrees at night and 104 degrees during the day (see figure 7). The process that termites use to achieve this constant temperature is building breeze-catchers at the base of the structure which draw in air, then cool it by pulling it through chambers carved out of the wet mud at the base, while hot air escapes through flues at the top of the mound (Tzonis, Lefaivre, and Stagno, 2001, p. 48).

Comparing the Ultima Tower with an actual termite mound, one finds that the forms are almost identical in appearance. Considering this form in regard to authenticity, we see that the structure is indeed a reductive purification of the termite mound form, suggesting a more inauthentic image-based engagement. According to Tsui, the form is selected because it "is the most stable and aerodynamic shape ever conceived for a tall structure" (Tsui, 2005, para. 1). In other words, achieving a maximum height is the primary reason for mimicking the termite mound form for the Ultima Tower. This begs the question. Why so large a copy?

Authentic Scale in Eastgate and the Ultima Tower

I argue that scale is a critical consideration when translating natural form into authentic lived-space. The most obvious aspect of the Ultima Tower is its mega-scale. Tsui writes that the termite mound form is utilized to achieve a maximum height, specifically 10,560 feet. Similar to Paula Soleri, Tsui claims this mega-scale is important for minimizing urban sprawl and reducing human impact on the earth by building up rather than out. I would argue, however, that Tsui's approach does not create a more authentic relationship between people and place. As Relph (1976) reminds us, authentic places arise out of inhabitants' desires and their involvement in design and building. When considering the Ultima Tower, one is faced with at least two questions: First, how can distinct neighborhoods and districts for thousands of people be created in a structure that can be placed in any densely populated area (Tsui, 1999, p. 235) of the world regardless of climate, context, and people? Second, how can authentic natural systems be recreated within a mile-wide interior lit by a hollowed, mirrored core (Tsui, 1999, p. 238) accessible only by riding several minutes in elevators?

Though the Ultima Tower may provide a smaller footprint for development, I suggest a megastructure approach further separates people from nature and environment. It is not enough to merely have a sense of "close proximity with our natural surroundings" as Tsui proposes (Tsui, 1999, p. 236). Rather, authentic environments arise out of the everyday needs and desires of the people inhabiting them and cannot be created from nothing, in any densely populated area, as Tsui proposes.

I argue that a megastructure approach like the Ultima Tower is not that dissimilar from the functionalist modernist "tower in a park," perhaps best illustrated by Swiss architect Le Corbusier's grandiose plan for a "vertical garden city"—the *Villa Radieuse*, or Radiant City. He wrote of this project that "a pact is sealed with nature, [and] nature is entered in the lease" (Le Corbusier, 1948, p. 52). Tsui echoes the claims of Le Corbusier and other modernists who believed by building up and surrounding towering structures with green spaces, people would be connected with nature, and the city would be more humane. Since the inception of this megastructure approach, numerous thinkers have suggested otherwise (Evenson, 1987; Jacobs, 1961; Mumford, 1962; Newman, 1980; Relph, 1987; Trancik, 1986). These thinkers claim that this visionary, image-based approach, despite its "dazzling clarity, simplicity and harmony" (Jacobs, 1961, p. 23), ignores fundamental and practical needs for its inhabitants and creates a "magnificent dream [that is] … absolute and totalitarian" (Relph, 1987, p. 70). Although it is not as rigidly geometrically as the modernist "tower in the park," I would argue that Tsui's Ultima Tower repeats modernist mistakes by proposing a bold visionary design based on "ambitious utopian plans on a limited set of assumptions about human needs and feelings" (Trancik, 1986, p. 50). Similar to Le Corbusier's designs, the Ultima Tower allows "a certain poetic license…outlining possibilities, simplifying the complexity of urban function for dramatic effect and … leaves unfilled the gap between image and reality" (Evenson, 1987, p. 242). Instead, what is needed is for designers to work at a smaller scale that is incremental and allows for diversity to grow incrementally over time. We examine this notion of incremental, participatory design in chapter 4.

In contrast to Tsui's questionable proposal, I would suggest that the scale and form of the Eastgate project allows for a more authentic relationship between person and place. Examination of this project's form reveals little resemblance to a termite mound. Initially, the building appears like other mid-rise buildings. Yet, a deeper examination reveals that the Eastgate form arises out of the needs of everyday life and is use-based. First, the building form reflects a wholeness of nature by revealing and paralleling natural processes, rather than mimicking static form to achieve a massive height. The linear structure of the office cores allows for two rows of offices surrounding a central atrium. Located between the rows of offices are forty-eight brick funnels connecting to each office (Tzonis et. al., 2001, p. 48). These funnels draw cool air up from the basement and allow hot air to escape from the top of the building, effectively duplicating the heating and cooling process of a termite mound (figure 7). In this sense, Eastgate's form reveals the wholeness of natural processes in its form. The building design reflects a connectedness between form, nature, and people that is not merely a purification of natural form for structural or image-based reasons.

As suggested earlier, another characteristic of authentic form is that it arises from its surroundings, bears the signature of an environment, and is use-based. If we examine how the Ultima Tower relates to its climate, context, and surroundings, we find there is no direct relationship. Tsui writes that the project could be constructed in any densely populated urban environment (Tsui, 1999). Just as Le Corbusier's modernist architecture—first developed for Northern Europe—was adapted and built throughout the world regardless of culture or geography, (Evenson, 1987, p. 248), Tsui's Ultima Tower can be located on any site that can accommodate its 6000-foot-diameter base.

In contrast, the Eastgate project relates to its context and surroundings and is use-based. First, the form accommodates the everyday building uses of working and shopping and fits within the context of the downtown urban fabric, since the structure is at a similar scale to surrounding buildings and provides street-level shopping that is an extension of immediate surrounding uses (figure 8). Second, the building reflects the unique wholeness of its surroundings and could not be replicated in a different city and climate and perform as well or "fit in." For example, Eastgate's construction methods and materials utilize readily local materials and construction skills (Arup, n.d.). Massive masonry and concrete walls (figure 9) serve to reduce solar-heat gain in this hot climate, and the patterns of the masonry are inspired by indigenous architecture of stone walls found in Great Zimbabwe, a city 200 miles southeast of Harare built some 900 years ago (Tzonis et. al., 2001, p. 48). That is not to say Eastgate is more authentic by copying something of the past but instead suggests that the formative process is indigenous because the form emerges out of the needs of everyday life and context of surroundings.

Figure 8. Streel level view of Eastgate, Harare, Zimbabwe, designed by architect Michael Pearce. Photograph copyright 2006 Limbikani Makani, used with permission, retrieved February 3, 2009 from http://www.panoramio.com/photo/2216491.

Because it could be built anywhere of steel, concrete, aluminum, copper, and glass (Tsui, 1999, p. 235), Tsui's design lacks context and relationship to place. Thus, the Ultima Tower is less authentic than Eastgate because it lacks relationship with immediate surroundings and is an image-based purification of the termite mound form for structural reasons ignoring the wholeness of the mound's natural form. Furthermore, the megastructure would likely become another failed "tower in the park" by ignoring complex human needs in favor of a bold visionary statement.

Figure 9. Eastgate's masonry and concrete exterior walls inspired by the 900-year-old walls of Great Zimbabwe. Photograph copyright 1997 Michael Pearce Partnership/Aga Khan Trust for Culture, used with permission. Retrieved February 5, 2009 from http://archnet.org/library/images/one-image.jsp?location_id=3167&image_id=36901.

Authentic Natural Form

The critique of these two projects illustrates, concretely, how natural form might reveal the wholeness of nature and the person-environment relationship. This critique further distinguishes a reductivist *biomorphic* engagement of natural form versus a holistic use-based, *biomimicry* engagement of natural form. Furthermore, *scale* is identified as a critical consideration in drawing upon natural form for use in the built environment. Mugerauer (1994) reminds us that, no matter how seductive natural form can be, what matters is how people experience the scaled-form in lived space. In other words, though natural form may be intriguing and spellbinding in its natural surroundings, when enlarged or downsized to meet human needs, it may no longer represent the wholeness of nature and fail to connect people with the natural world. This counterfeit approach ignores the wholeness of natural form through a purification of natural form for appearance or image-based reasons, and cannot accurately be identified as work arising from biomimicry. Instead, by considering the wholeness of ecosystem and process that has shaped natural form, designers might achieve a more holistic-biomimicry engagement of natural form. This approach would not struggle to freeze form in its purity but instead hold it lightly and *let it be* for what is needed for a holistic person-nature-environment relationship. In this sense, designers might better understand not only the wholeness of nature, but the wholeness in nature, in people, and in the built environment. In the next chapter we further examine the wholeness of nature in terms of *ecosystem*, the second theme to be drawn upon for a full emulation of nature (Benyus, 2008).

Chapter 3 :
Beyond Ecosystem Technology

Building upon the previous chapter's discussion of authentic natural form, this chapter reviews *ecosystem,* the second theme drawn on for a more engaged emulation of nature. As in chapter 2, my aim is to use a phenomenological approach to describe the wholeness among people, nature, and environment. To begin this phenomenological examination, I consider the language surrounding the word "ecosystem."

Conventionally, "ecosystem" arises from the word *ecology,* a word first coined by Ernst Heinrich Haeckel (1834-1919) as *oecology* (Marsh, 1964, p. 122-123). Taken from the Greek root—study of dwelling places—ecology can be defined as the biological science which is concerned with processes and interactions between and among organisms and their environment. Building on this definition, one can define *ecosystems* as distinct, self-sustaining communities of organisms (plants, animals, bacteria, and so forth) within their inorganic environment (nutrients, energy, climate, and so forth) (ibid., p. 125). In this sense, conventional science's definition of ecosystems emphasizes the relationship among *individual* organisms as they relate to a community of organisms within their natural surroundings. Although ecosystem is the term biomimicry scientists use as one of the three levels necessary for a full emulation of nature (Benyus, 2008, p. 40), they emphasize that the real lesson of ecosystems "lies not in the individual adaptations, but in the community's magic" (ibid., p. 37). In this sense, authentic ecosystem biomimicry does not focus on individual parts of the ecosystem but the *wholeness* of an ecosystem. In this opening section, I draw on a phenomenological perspective to further describe this wholeness.

I begin by drawing on architectural and environmental phenomenologist David Seamon's definition of ecology (Seamon, 2006). Seamon points out that ecology is not only a science but can also refer to a world view that emphasizes the study of relationships, interconnections, and environmental wholeness that are different from the sum of their environmental parts (2006, p. 53). This definition draws from Bortoft's examination of authentic wholes mentioned in chapter 1 and also makes use of intellectual historian Donald Worster's "ecological point of view," which Worster defines as "a search for holistic or integrated perception, an emphasis on interdependence and relatedness in nature, and an intense desire to restore man to a place of intimate intercourse with the vast organism that constitutes the earth" (1994, p. 82). In this sense, an ecological point of view describes the wholeness among people, nature, and environment.

In contrast, the science of ecology is more concerned with the relationship of parts (organisms) as they have adapted to the whole (environment). I suggest one problem with this view is that it establishes a linear, static relationship between organism and environment that is not an accurate representation of the wholeness dwelling in nature. As naturalist Paul Krafel suggests, ecosystems do not arise from "survival of the fit," where *fit* describes a relationship in which strongest or best adapted animals survive. Rather, Krafel uses fit to describe the fit between organisms and environment which may change over time, but always survives (1999, p. 26). In this sense, an ecosystem is not a static entity, comprised of individuals. I would suggest that viewing eco(*system)* in this way—as a sum of environment parts—ignores the environmental wholeness dwelling in (*eco)*system. This perspective of an ecosystem as a sum of static parts working together treats the ecosystem as a machine. I suggest that adapting this machine-nature metaphor has resulted in an attitude that focuses on the material parts (organisms) of nature, operating on energy (inorganic environment), that must be conserved to prolong operation of the machine (ecosystem). I draw on philosopher Joseph Grange to explain how this view may be inadequate for achieving sustainability with biomimicry of ecosystems.

Grange (1977) describes such an attitude to nature as *dividend ecology*—"an attitude of fear which worries that if we do not repair the environment, it will eventually be destroyed, and with it, ourselves" (Coates and Seamon, 1993, p. 332). Grange suggests that, although treatment of the environment has improved over the past three decades based on this human-centered attitude, ultimately, it will "fail in saving the environment because it springs from the same selfish impulse which brought on the ecological crisis in the first place" (ibid., p. 332). Instead, dividend ecology needs to be replaced with an attitude that fosters care and concern in relation to organisms, people, places, and environments—what Grange calls *foundational ecology*. This shift in environmental attitude suggested by Grange is supported by some contemporary critics of sustainability (Alexander, 2004; Kellert and Heerwagen, 2008; Stefanovic, 2000).

Grange's differentiation of dividend and foundational ecologies echoes my earlier claim regarding *ecological design*, a term recently adapted by environmental designers (Orr, 2005; Todd, 1984; Van der Ryn and Cowan, 1996). One problem with ecological design identified in chapter 1 is that much of the literature and discussion surrounding it focuses on calculative methods to balance energy and minimize the use of materials. In this sense, ecological design adapts a *dividend* perspective in which design operates as a machine, comprised of material parts, to reduce energy and material usage. I would suggest a more appropriate term for such an approach is *ecosystem technology*. Thus, ecosystem technology is similar to the *biomorphic* term used in chapter 2 to identify a design approach that focuses on a part of nature, ignoring the wholeness dwelling in nature.

In this chapter, I expand this argument and suggest that a phenomenological approach might help designers engage biomimicry of ecosystems. Such an approach, grounded in wholeness, might move beyond an energy or material-based focus—*ecosystem technology*—to develop a more complete biomimicry of ecosystems that recognizes the wholeness among people, nature, and environment. To develop this phenomenological interpretation of ecosystem, I first discuss a phenomenological way of seeing and experiencing nature. Second, I review the concept of *biophilia*—the human need for contact with nature—and draw on the phenomenological notion of place to expand this view to include the human relationship with the built environment. Third, I examine the phenomenological view regarding technology's appropriate role in the lifeworld. Finally, I use these phenomenological principles to develop a critique which examines the varying degree of wholeness which can be found among people, technology, and ecosystem in two works regarding environmental designs—landscape architect Robert Thayer's study of the Altamont Pass Wind Energy Development in California; and Montana philosopher Gordon Brittan's Windjammer wind turbine. A phenomenological critique of these designs points to an ecological wholeness which might exist among people, technology, and ecosystem.

Experiencing Wholeness in Natural Ecosystems

Biomimicry scientists suggest that environmental designers survey the organisms that are on the site (or could have been there in the past) and learn from their embodied wisdom of living in place (Benyus, 2008, p. 40). One problem with this approach is that focusing on the parts of an ecosystem ignores the wholeness of the organisms and the wholeness of the environment. This section presents a phenomenological way of seeing and experiencing nature that is a first step for designers to view organisms, environment, and people as a united, dynamic whole, shaping and being shaped by their lifeworld.

This way of seeing nature is founded in Goethean science, which can be described as an "effort to understand a thing's meaning through prolonged empathetic looking and seeing grounded in direct experience" (Seamon, 1998, p. 2). An early example of Goethean science's influence on developing new technologies grounded in this way of seeing is the work of Austrian naturalist and hydrologist Viktor Schauberger (1885-1958) "who developed a radical new vision of nature, energy, and technology" (Seamon, 1994, p. 6). In a way similar to biomimics, Schauberger believed "the task of technology is not to correct nature, but to imitate it" (Alexandersson, 1990, p. 34). In order to draw inspiration from nature, Schauberger relied not only on empirical testing but on his direct experience as a forest warden and on the direct experience of his family which for generations had cared for their family forest. According to Schauberger, his forebears' experience was built on a deep love of nature and continuous attention: "they relied …upon what they saw with their own eyes and what they felt intuitively" (ibid., p. 19). For Schauberger, this way of seeing might allow him to discover water's "laws and characteristics and the connection between its temperature and its motion" (ibid., p. 19). After several years, his studies convinced him that "water in it natural state shows us how it wishes to flow, and we should follow its wishes" (ibid., p. 35). Schauberger concluded one such phenomenon regarding the motion of water was its cycloid spiral motion or vortex movement.

One direct experience and observation that led to this conclusion arose while observing trout and salmon behavior in the water. On a moonlit spring night while sitting beside a waterfall, he could clearly see trout gathered at the base of the falls. A larger trout appeared from below and begin swimming in a twisting motion back and forth in the undulated water:

> Then…the large trout disappeared in the jet of the waterfall which glistened like falling metal. I saw it fleetingly under a conically-shaped stream of water, dancing in a wildly spinning movement, the reason for which was not clear to me. It then came out of this spinning movement and floated motionlessly upwards. (Alexandersson, 1990, p. 22)

This observation led Schauberger to study this phenomenon further and eventually led to his holistic insights regarding water movement. These insights parallel those of hydrologist Theodor Schwenk (1965), whose phenomenological study of water influenced John Wilkes' Flowforms reviewed in chapter 2.

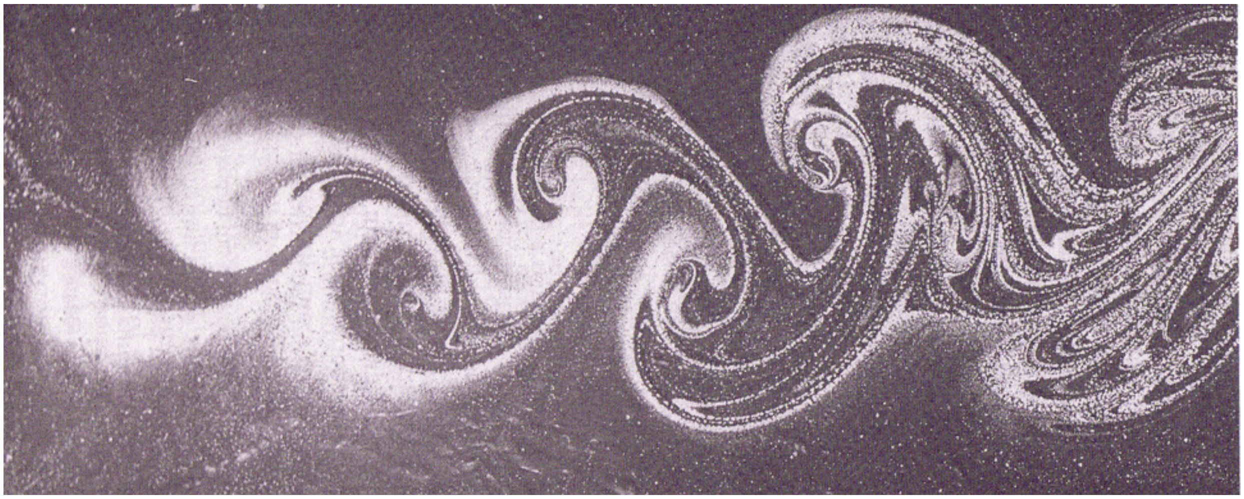

Figure 10. Train of vortices produced when a brush is drawn in a straight line through standing water. Reprinted from "Flowforms" copyright 2003 John Wilkes and used with permission of Floris Books.

Although biomimicry scientist Janine Benyus begins to describe the wholeness of nature when she writes that the real lesson of the ecosystems "lies not in the individual adaptations, but in the community's magic" (Benyus, 2008, p. 37), much of the literature on biomimicry does little to help designers to experience the wholeness of nature. Instead, it focuses on scientists in the field and laboratories probing nature for its secrets often under the lens of a microscope. Seamon explains that, there is nothing wrong with a quantitative science emphasizing features like number, size, and position, giving "attention to the progressive appearance of the natural world in its mathematical aspect, [but] this analytic interpretation is only partial" (2000, p. 71-71).

On the other hand, Benyus (1997) does share a personal experience which could rightly be considered a phenomenological approach to experiencing nature. One afternoon following many weeks of skimming duck weed from the surface of her pond, she sees a leaf moving in the otherwise still water. It then occurs to her that the spring feeding the pond has been choked by erosion from upstream development. She then finds the spring, removes the erosion choking the spring and water flows out of the pond removing the duck week with it. Benyus describes this as an echoing of nature that the preparation for "was a quieting on my part, a silencing of my own cleverness long enough to turn to nature for advice [and the]…the absorbing of secrets in a respectful way" (1997, p. 287). This attentive quieting echoes phenomenological geographer Edward Relph, who writes that "moments of vision or insight cannot be produced to order. It is however, possible for them to be prevented by the sort of studied blindness that imposes feelings, prejudices, and theories on what is seen" (1981, p. 178).

An approach that Krafel (1999, p. 30) suggests is effective in seeing nature with new eyes free of conceptual prejudices involves the avoidance of asking static questions like, "What is the name of that animal," which do not lead to further questions. Instead, his aim is to ask questions like, "What is this animal doing?" "How does this behavior fit?" or "What will this animal do next?" Such questions, he claims, lead to observations that extend beyond the moment, and probe for the *fit* of the individual within the surrounding whole. He adds that, by seeing through the eyes of animals, insects, and other creatures and watching their behavior, "there are thousands of other eyes around me seeing the world from different perspectives" (ibid, p. 32).

Similar to Krafel, naturalist Barry Lopez suggests that the researcher "put aside the bird book, the analytic frame of mind, and compulsion to identify and sit still…the purpose of such attentiveness is to gain intimacy, to rid yourself of assumptions" (Lopez, 1997, p. 25). He suggests that, instead, one should experience the multi-dimensional and multi-sensory qualities of nature. I would add, that this multi-dimensional and multi-sensory experience *lets nature be,* allowing it to reveal the wholeness dwelling in it, rather than conjuring meaning from it or imposing meaning on it. As phenomenological ecologist Mark Riegner writes, "the task of phenomenological ecology is not to discover new facts, but rather permit phenomena to disclose themselves so that new meaning" emerges and those who experience nature are "faced with the challenge of seeing the familiar through new eyes" (1993, p. 212).

In this sense, Riegner, Krafel, and Lopez echo the earlier claims of Benyus and Schauberger that designers gain a fresh perspective on nature through quiet observation of local flora and fauna and let them reveal the wholeness of an ecosystem. This mode of quiet observation can rightly be considered Goethean in that "it move[s] away from a quantitative, analytic approach to the natural world, and emphasize[s], instead, an intimate firsthand encounter between the student and thing studied" (Seamon, 2006, p. 63). I would argue that by adapting a Goethean perspective on nature, designers might begin to experience the wholeness dwelling in an ecosystem, and see the natural world in new ways that would respect the integrity of a wholeness experienced through the eyes of local creatures and plants that can avoid the blindness of analytic, preconceived assumptions. In this way, designers might begin to "crystallize the heart of Goethean seeing: that the mundane, little things of our world can house a miraculous wholeness that we can encounter, understand, and come to care for" (Seamon, 2006, p. 74). It is this attitude of care and concern between people and nature that I examine in more detail in the following section.

Biophilia and Place

Having reviewed the phenomenological perspective regarding the wholeness that can be experienced in nature, I now examine the wholeness that exists between people and nature. I begin this phenomenological interpretation with a brief review of *biophilia*, which is said to biologically link humans and the natural world. I then expand upon this idea with regard to the phenomenological interpretation of place.

Biophilia can be defined as "the idea that humans posses a biological inclination to affiliate with natural systems and processes instrumental in their health and productivity" (Kellert and Heerwagen, 2008, p. viii). This concept was proposed by biologist Edward Wilson, (1984) who wrote that: "to explore and affiliate with life is a deep and complicated process in mental development. To an extent still undervalued…, our existence depends on this propensity; our spirit is woven from it, and hope rises on its currents" (p. 35). Building upon the foundation of biophilia and echoing the claims of Grange (1977) regarding *dividend ecology*, today's critics of current sustainable technology suggest that "the basic deficiency … is a narrow focus on avoiding harmful environmental impacts [which] …fails to address the equally critical needs of diminishing human separation from nature, enhancing positive contact with environmental processes…all basic to human health, productivity, and well-being" (Kellert and Heerwagen, 2008, p. viii).

Other thinkers within the design community have adopted the idea of biophilia and have begun a dialogue regarding its application in environmental design, adopting the term *biophilic design* (Benyus, 2008; Berkibile and Fox, 2008; Heerwagen, 2008; Kellert, 2008; Orr, 2008; Wilson, 2008). Here, I suggest that biomimicry and biophilia are akin to one another in that the design community is eager to engage these nature-focused approaches in sustainable design. Yet, as I have argued they are only partial, and such nature-focused approaches will also be insufficient for achieving sustainability without recognizing the holistic relationship among people, nature, and built environment.

Phenomenological ecology is the term Riegner uses to describe a deep connectedness that exists among people and the natural and built worlds. He defines phenomenological ecology as a descriptive approach that strives to interpret patterns of relationships both within and among natural and human-made environments (1993, p. 211). Riegner writes that "just as the individuality of a landscape comes to expression through it flora and fauna, so may it manifest through the architecture, art, and language of indigenous people" (1993, p. 211-212). He uses the word *place* to identify this holistic setting for people, nature, and built environment.

I suggest that the phenomenological perspective on *place* is particularly valuable in broadening the partial nature-focused perspective of biophilia and better describes the wholeness among nature, people, and built environment. Environmentalist thinker Peter Hay (2002) supports this claim when he writes that, "the most prominent developments of phenomenological insights within environmentalism have occurred in studies of the dynamics of place" (ibid., p. 155). He goes on to emphasize that "most people trying to interpret the nature of 'place', and to relate place to human experience, draw heavily upon phenomenology" (ibid., p. 151).

I draw on Relph's (1976, 1981) phenomenological perspective on place because it is well-suited to examine the deeper connection between people and built environment for a least two reasons. First, it parallels Wilson's (1984) theory of biophilia—but with regard to a whole environment, not merely biological, in that Relph argues that a deep relationship with place is "as necessary, and perhaps as unavoidable, as close relationships with people; without such relationships human existence is bereft of much of its significance" (Relph, 1976, p. 41). Second, Relph's work puts particular emphasis on the role of people in shaping place and their relationship with it. This is in contrast to other place phenomenologists like Norberg-Schulz (1980; 1979), who view place as a physical environment onto itself. As Seamon explains, "Norberg-Schulz…argues that places are essentially what they are because of inherent qualities in site and physical environment" (1982, p. 131). In this sense, for Norberg-Schulz, a place is essentially "what it is"; and human intervention should take account of this fact and only seek to modify place in a way that works harmoniously with it, rather than confronting it with aggression and discord (Hay, 2002, p. 157).

In contrast, Relph's phenomenology of place "stresses the experiential bonds that people establish with place…for Relph it is not a question of place having an essential character: places will be interpreted differently by different people and, hence, will have an infinity of meanings"

(Hay, 2002, p. 157). As Relph (1981) explains "the individual distinctiveness of a place…lies not so much in its exact physical forms and arrangements as in the meanings accorded to it by a community of concerned people, and the continuity of these meanings from generation to generation" (ibid., p. 172). Thus, I suggest that, just as the previous section argued that a phenomenological understanding of the wholeness of nature can be revealed by observing and watching the local flora and fauna, so can quiet observation and phenomenological experience of local people and built environments reveal the wholeness among them and nature.

I argue that Relph's emphasis on people's experience and relationship in shaping place is a critical link when considering the attitude of care and concern I have suggested is necessary for a more complete sustainability. His perspective moves beyond the biological-evolutionary view of biophilia which, to a certain degree, invokes *dividend ecology* in that it establishes the environment in a role that serves as a backdrop for survival. Instead, adopting Relph's perspective allows people the need for a deep connection and bond with place that "imbues it with meanings that transform it from a theatre of fear and struggle to a haven; a positive context for living that evokes affection and a sense of belonging" (Hay, 2002, p. 157). Or, as Seamon contends, place involves a sense of belonging that "enlarges the emotional range of feelings that attach to place to include care, sentiment, concern, warmth, love, and sacredness" (1982, p. 132).

It is this care and concern that this thesis argues is a critical consideration for a more thorough, engaged sustainability. In the next section, I expand on this argument regarding a deeper care and concern towards place and environment with regard to the role technology plays in either eroding or strengthening our relationship with the built environment and nature. This interpretation identifies additional considerations regarding ecosystem technology which might move towards a more holistic, sustainable relationship among people, nature, and built environment.

Fitting Technology

Heidegger and other thinkers believed technology had lost it role as a useful tool and now, instead, dominates modern society and inhibits our sense of belonging, thus inhibiting our ability to form deep connections with place and nature (Relph, 1976; Mugerauer, 1994; Stefanovic, 2000; Thayer, 1994). These thinkers claim that just as an analytical, quantitative approach towards nature ignores its wholeness, so too does a technical, quantitative emphasis towards technology. Instead, it is necessary to rethink the role of technology with regard to the qualitative and phenomenological implications it has in regard to our everyday built environment. As Stefanovic writes, "Heidegger tells us that we can affirm the unavoidable use of technical devices and also deny them the right to dominate us, and so to warp, confuse, and lay waste our nature" (2000, pp. 23-24). In this section, I examine this notion that appropriate technology should be a useful tool that does not dominate our lives, and discuss how designers might involve themselves in a more holistic approach in ecosystem technology that parallels the wholeness exhibited by nature.

I begin this argument by claiming that many current approaches to sustainable design merely replace conventional technology with ecosystem technology will be insufficient for actualizing a more complete sustainability. This result is because merely replacing conventional technology with a "greener" set of standardized technology does not alter the relationship of domination that technology plays in our lives. Drawing on Heidegger, Mugerauer describes how technology works to dominate our current lives, even though:

> We are entering the era of our greatest power and technological mastery over everything, including ourselves, and seem to be able to be at home everywhere on our planet. This is our great paradox: though we more and more are able to do what we will, to most fully control whatever comes within our reach, and to live anywhere as we wish, we also find ourselves alienated from the world and from our own human nature.
> (1994, p. 67)

In this sense, if conventional technology is replaced with low-environmental-impact technology, it may reduce the consumption of materials, energy, and so forth, but such a replacement approach ignores this sense of alienation and technological dominance. As an alternative, it is necessary to think of technology in a new manner which might establish its role as a helpful tool for people, nature, and environment.   Heidegger used the phrase *originary thinking* to describe an approach or idea that moves beyond the past and present to an entirely new perspective that is most relevant for establishing a holistic relationship between the object of contemplation and the taken-for-granted life of people, or *lifeworld* (Mugerauer, 1994, p. 76; Stefanovic, 2000, pp. 23-24). In other words, *originary thinking* regarding biomimicry of ecosystems would seek to find a wholeness among technology, people, nature, and environment that does not currently exist in much of current ecosystem technology. As Mugerauer writes, "we need to try to become open to technology by reflecting on how technology makes a place for us in today's and tomorrow's world" (1994, p. 107).

Using an idea that parallels Grange's *dividend* ecology, Mugerauer suggests that one of the problems with current technology is that things have come to appear as *stock* or *standing reserve* (ibid., p. 108). In this standing-reserve relationship, the resources or commodities that technology provides are experienced as a thing to be ever ready and easily disposed of. In order for this standing reserve to be ever ready, it is necessary for technology to be *modular* so that relevant parts are identical, interchangeable, and easily replaceable (ibid., p. 110-111). Thus, each modular becomes a fixed, predetermined part of a system, and the part has little significance beyond the whole of the system. In this parts-focused relationship, it becomes more important to replace and dispose of modular parts rather than to maintain the greater whole. In other words, when technology becomes overly modular and easily duplicated—for the purpose of making the whole operate more smoothly—not only are the resources and commodities provided by technology treated as a standing reserve. More so, technology is treated as a "stuff" that can be easy disposed of and replaced. I would suggest this replaceable, disposable, care-free attitude towards technology does not exhibit a complete sustainability because the approach does not involve, or instill, a genuine sense of care and concern regarding nature and technology that moves us from an *unbalanced* mode of consumption to a more *balanced* mode of making and using.

Philosopher Albert Borgman uses the words *devices* and *things* to distinguish between these unbalanced and balanced modes (1984, pp. 40-48). For Borgman, *devices* provide ever-ready commodities for human use in a concealed manner that does not engage us beyond an entirely cerebral relationship. In contrast, *things* are inseparable from their context, and our experience with them is always a bodily and social engagement, that is often multi-dimensional in terms of function and use. To illustrate this difference, he contrasts central heaters and wood-burning stoves (ibid., pp. 41-42). A central heater is a *device* which provides the commodity of warmth with little or no demand on our skills or attention; the central heater's use is singular in that all it does is provide warmth. On the other hand, a wood-burning stove is a *thing* in that it requires various skills and attention for not only building and tending the fire but also for gathering the wood. In addition, our engagement with the stove is not merely a singular relationship of warmth. Instead, it gives meaning to our everyday *lifeworld* and responds to the context of surroundings by providing a means of cooking; marking the beginning of day by its lighting; involving a daily tending ritual; providing a central focal point as hearth; and more closely binding us with the rhythm of the seasons (Heschong, 1979; Wylie, 1972; 1964). In short, things engage us in a manner which is at once bodily, social, and contextually responsive. A device like central heat, in contrast, disengages and disburdens us. It makes no demands on skill and has no or little relationship with surroundings or context (Brittan, 2001, p. 174).

In this sense, care-free technology exhibiting the character of a device does not engage us and does little to develop the sense of care and concern that this thesis contends is necessary for a holistic sustainability among people, nature, and environment. Brittan uses three examples to illustrate how devices exhibit a lack of care or concern with people:

> First, many devices, e.g., the pocket calculator, are in principle irreparable; they are designed to be thrown away when they fail. Second, many devices, e.g., the CD sound system, are in principle carefree; they are designed so as not to need repair. Third, many devices, e.g., the jet plane, are in fact so complex that it is not really possible for anyone but a team of experts to go into them. (2001, p. 174)

For Borgman, even if people have the training necessary to care for such complex devices, they are still distinguished from things because devices do little if anything to reveal their contexts or surroundings. He explains that the device "does not itself disclose the skill and character of the inventor and producer; it does not reveal a region and its particular orientation within nature and culture" (Borgman, 1984, p. 48). Thus, relating technology to it context and surroundings moves it away from a care-free, disengaged, device-based relationship toward a thing-based relationship of care.

In this sense, holistic biomimicry of ecosystems moves beyond the care-free *device-based* approach of ecosystem technology towards a *thing-based* approach which engages people more deeply with the technology, and thereby potentially allows a more genuine people-technology relationship. Such a relationship might begin to instill a sense of care and concern for resources and technology that is not based on Grange's *dividend ecology*—i.e., an attitude of fear which further alienates and dominates—but, rather on his *foundational ecology*—i.e., a rich, multi-dimensional engagement of people, nature, and environment in a reciprocal, holistic relationship. Rather than focusing on replacing conventional technology with ecosystem technology, designers must think of technology in an *originary* manner that does not assume conventional approaches but instead allows for new approaches that *let be* what is needed for a holistic person-nature-environment relationship. In this way, ecosystem technology might be better attuned with human needs and seek out a fitting placement which contributes to the wholeness of the built environment, just as each part of nature reveals and contributes to the wholeness of its context and surroundings. Mugerauer writes:

> Restraining our willful plans would allow us to better listen. We could become open to hearing nature's and our own patterns and needs; we could become better attuned to them. Becoming attuned means that we come to follow the same processes and patterns in a newly appropriate manner, since now we not only must cultivate nature but also the technological environment." (Mugerauer, 1994, p. 150)

Contrasting Wholeness in Two Projects

To develop the phenomenological interpretation of holistic ecosystems argued for here, I conclude this chapter by examining the contrasting sense of wholeness which can be found in two sustainable technology projects inspired by an ecosystem perspective. In discussing the wholeness of ecosystem in previous sections, I have emphasized four key points. First, I have argued that an energy-efficiency-focused attitude of dividend ecology treats nature as something to be preserved for our survival, and because of this human centeredness, ignores the wholeness among nature, people, and environment. Second, I have contended that a style of attentive encounter with local inhabitants, including animals and plants, can reveal nature's wholeness in a more multi-dimensional way than an analytical, qualitative assessment. Third, I have claimed that local environments and people often reveal and better understand the wholeness residing in nature and place. Fourth, I have suggested that new approaches for ecosystem technology should instill a sense of care and concern among technology, people, and environment so that there is a lived shift from technology's domination of our lives to a more appropriate role of technology as a useful tool.

Drawing on these four claims, I critique two projects which engage a central part of the natural ecosystem—wind. The projects are the Altamont Pass Wind Energy Development near San Francisco, California and Montana philosopher Gordon G. Brittan Jr.'s development of the "Windjammer" wind turbine. I suggest these two projects exhibit a considerable contrast in degree of engagement among wind, ecosystems, technology, and people. This contrasting awareness of wholeness illustrates, concretely, how a phenomenological approach to natural ecosystems and technology can reveal the wholeness dwelling in those ecosystems. The central argument is that a more holistic relationship between people, place, and ecosystem technology has the potential to instill a deeper sense of human and environmental belonging, and thus a more complete approach to sustainability.

The Two Projects

I begin my critique of the two projects with a brief review of each. The Altamont Pass Wind Energy project (henceforth called Altamont) is located near San Francisco, California, in rolling, treeless grasslands. The Altamont Pass draws steady, high-velocity winds and is considered the most prolific wind site in the state (Thayer and Freeman, 1987, p. 380). The exact number of wind turbines contained within this fifty-square-mile development is unclear (data vary from source to source), but the most common number mentioned is around 6000 wind turbines (Righter, 1996, p. 245; Thayer and Freeman, 1987, p. 380). These wind turbines are large two-or three-blade machines manufactured by various companies around the world, in countries that include Denmark, Germany, Belgium, and the United Kingdom. Nearly all these turbines are large two- and three-blade models, the majority of which (approximately 4000) are 100kW turbines (Righter, 1996, p. 213). To maximize efficiency, towers are laid out in straight lines, most often on the ridges of hills (Righter, 2002, p. 32; Thayer and Freeman, 1987, p. 381).

The Altamont development was constructed in the early 1980s after federal and state tax incentives made wind development lucrative. Early on, the project received public criticism which has continued to the present day; problems cited include noise, wildlife disruption, erosion, and aesthetic degradation (Thayer and Freeman, 1987, p. 381). For the Altamont project, my primary source is California landscape architect Robert Thayer's study of people's experiences and public perceptions of this built project. His study attempts to move beyond perception based on simple image-based characteristics to identify connotative or symbolic perceived meaning of the total wind energy landscape. This symbolic meaning included beliefs, attitudes, and characteristics of the public regarding Altamont (Thayer and Freeman, 1987., p. 198). In this sense, I suggest the study examines a deeper, everyday relationship among people, place, and technology. Thus, the study's findings serve to found a basis for people's relationship with a conventional, efficiency-focused approach regarding an engagement of wind and ecosystems.

Figure 11. Typical turbine and placement at the Altamont Pass Wind Energy Development Altamont, California. Photograph copyright 2007 Daniel Lung, Retrieved March 24, 2009 from http://www.panoramio.com/photo/1351615.

Thayer's study includes a survey of 600 residents, approximately half of whom live within 10 miles directly west and east of Altamont the site, in the cities of Livermore and Tracy, California (ibid., p. 383). The other half of Thayer's sample is selected from a similar landscape of rolling rangeland within equal proximity to San Francisco but which *did not contain* any wind energy development. These two groups were selected "in order to obtain a sample containing a broad cross-section of individuals with respect to their familiarity with large wind development" (ibid, p. 383). In addition, both groups surveyed are located in similar landscapes in order to maintain some similarity with regard to their familiarity and everyday relationship with a rolling, treeless landscape. Each individual was sent identical questionnaires and six color photographs. Participants were asked to rate the photographs along with a rating of overall impressions of wind energy development (ibid., p. 384).

The other project critiqued here is the Windjammer wind turbine, which was initially developed around the same time as Altamont (Righter, 1996, p. 254). This wind-turbine design was first developed for a proposed community wind farm near Livingston, Montana, a community of approximately 5000. Livingston public officials and townspeople began investigating the potential for a wind farm after their town suffered an economic downturn caused by the loss of 300 jobs at its Burlington Northern Railway diesel-engine repair shop (ibid., p. 252). Local investors explored a new type of wind turbine which turned more slowly and featured simpler mechanisms following the failure of conventional 25kW wind turbines. These two- and three-blade machines failed for a variety of reasons. The first five machines, constructed by a Texas-based company, broke down with generator problems and cracks in the fiberglass blades. Eventually, one machine destroyed itself completely, after its hydraulic-brake mechanism failed and blades failed, hurtling over the surrounding land (ibid., p. 254). The next failure occurred with two Danish-made turbines. These machines also proved unreliable, a blade breaking on one machine and the cover for the gearbox, generator, and blade hub falling off the other (ibid., p. 256).

Figure 12. A traditional, unidirectional grist mill in the Lassithi Plain on the island of Crete. Photograph copyright 2008 Paolo Sartori, used with permission. Retrieved April 26, 2009 from http://www.panoramio.com/photo/6859340.

Figure 13. Windjammer turbine being tested in California. Photograph copyright 2002 Gordon G. Brittan Jr. from *Architectural* and *Environmental Phenomenology Newsletter, 13 (2).*

Unlike Altamont's conventional turbine's fiberglass blades mounted on a high tower, Brittan's Windjammer uses triangular sails of cloth similar to those used on thousands of windmills located in Crete's Lassithi Plain (figure 12). These windmills have turned for generations (Brittan, 2001, p. 178; Righter, 1996, p. 254) and even today are used to pump water, though originally they were used for milling grain (Haverson, 1997, p. 806). The Windjammer (figure 13) is much smaller than today's conventional wind turbines, which are typically 80-to100-foot rotors mounted on 100- to 130-foot tall towers (Pasqualetti, Gipe, and Rightner, 2002, p. 8). The first Windjammer prototype was only a height of twenty feet for a 5kW turbine. This model was followed by a seventy-five-foot 105 kW turbine (Rightner, 1996, p. 254). Although

Brittan did not originate the design, he has been involved with development of Windjammer for the past twenty years (Brittan, 2001, p. 184). He explains that, even though larger sizes were developed after the initial twenty-foot model, his development team has returned to the smaller rotor because it "is small enough and simple enough and cheap enough (under $15,000) that almost anyone can install it, unaided" (ibid., p. 184). He describes the machinery of the Windjammer as "exposed and thoroughly accessible, clear and comprehensible." Further, he emphasizes that "the generators, gear boxes, and brakes are situated at ground level and the turbine does not require a crane for either its installation or repair" (ibid., p. 179).

Wholeness Revealed in Indigenous Wind Mills

I have suggested that the Windjammer turbine and the Altamont project illustrate two contrasting approaches regarding the wholeness of ecosystems and wind. Although both projects attempt to achieve a more sustainable future, I would argue that a phenomenological examination regarding the design and approach for these projects illustrates that the Windjammer exhibits a more complete wholeness among wind, ecosystems, and people. I begin this argument with a brief review of the wholeness which can be found dwelling in wind and suggest that, just as local flora and fauna exhibit their surrounding landscape as in Riegner's (1993) phenomenological ecology, local winds exhibit their own unique character. As Brittan explains, "in my part of the country [Montana], the characteristic winds come in the middle of the winter …we call them "chinooks". They are part of our lives, in the same way that the "mistral" is part of the life of the Midi, the "bise" of the Lavaus, or the "foehn" of the Schwarzwald (2001, p. 178). Furthermore, I contend that a review of the history of the windmill illustrates that the individuality and uniqueness of wind is manifested and comes to expression in the individuality and uniqueness of "indigenous windmills."

The first windmills (figure 14) are said to have been developed in the Baluchistan area that borders what is now eastern Iran and western Afghanistan (Harverson, 1997; Kealey, 1987; Reynolds, 1970). These first windmills were certainly in use by the tenth century AD, and possibly made their appearance 300 years earlier (Reynolds, 1970, p. 69). In the Baluchistan region, the predominating wind blows from one direction in the summer from June to September and is referred to as the 120-day wind (Harverson, 1997, p. 796; Kealey, 1987, p. 9-10). As a result of the constant direction and strength of the 120-day wind, the windmills were constructed of sturdy sun-dried mud-brick, a material used in other vernacular buildings in this region. These windmills faced the oncoming wind and were built to catch the wind in only one predominating direction. As a result, they could not be turned to adjust to a change in wind direction, like other later windmills developed in Europe (Harverson, 1997, p. 797). These first windmills used vertical sails placed within a two-story mud-brick structure facing the oncoming wind, which blew through a gap in the upper front wall and emerged through an opening on the opposite side (Kealey, 1987, p. 10). As the wind passed through the structure, it turned the vertical sails made of lightweight reeds mounted to wooden vanes and a mill post that rotated the grindstones below (ibid., p. 10).

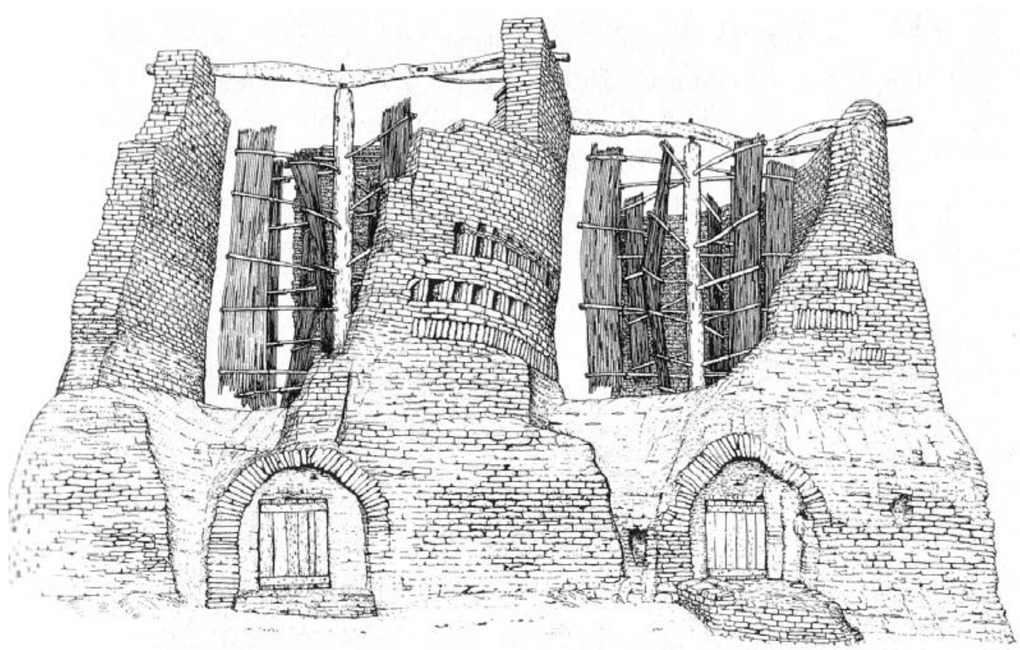

Figure 14. A typical windmill found in the Baluchistan region on the border of Iran and Afghanistan. These first windmills were built of traditional mud brick and faced the predominant 120-day wind. Drawing copyright 1982 Anne and Scott MacGregor from Kealey, 1987, p. 11.

In Europe, windmills first appeared in England sometime before 1137 (Kealey, 1987, p. 2). These structures were referred to as post mills (figure 15) and, although they are pre-dated by the Iranian mills, it is believed that they are a separate, medieval invention (Nash, 1997, p. 790; Reynolds, 1970, p. 69); certainly, differences in design and construction could support this claim. These first post mills were small, timber-framed buildings designed to pivot on a single vertical support (Reynolds, 1970, p. 72). Most often the post mills had four sails attached to the end of a wind shaft, thus taking on the appearance of traditional windmills found throughout Europe today (Nash, 1997, p. 790). Because the wind direction varied throughout the year, these post mills were designed to be rotated and face the oncoming wind by lifting a tail pole extending from the back of the windmill (Reynolds, 1970, p. 74). Over time, more permanent cylindrical wind towers built of locally available stone or brick were developed with only the top cap of the tower rotating with a change in the wind direction. As the post and tower mills spread across Europe and Asia Minor, slight variations were made based on local materials and conditions (Oliver, 1997, pp. 790-807).

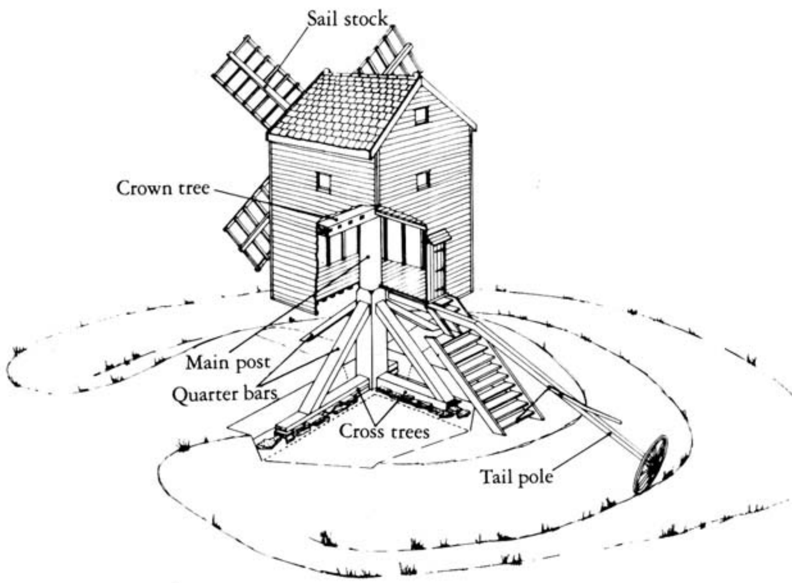

Figure 15. A typical post mill first developed in the 12th century in England. The small wooden structure can be rotated to face the wind. Drawing copyright Robert J. Zeepvat and the Milton Keynes archaeological Unit, Buckinghamshire County Council and used with permission, reprinted from Kealey, 1987, p. 50.

The windmills on the Lassithi Plain of Crete (figure 12)—which the Windjammer is fashioned after—are another example of indigenous windmills. These island windmills rely on triangular cloth sails. Unlike the reed sails or wooden vanes of Persian or European windmills, these cloth sails first were used on windmills in the eastern Mediterranean in late medieval times (Gregory, 1997, p.805). It seems likely that these windmill sails originated from sails used on sailing ships, for which triangular sails or lateen sails are believed to have originated in the Mediterranean around 2000 years ago (Campbell, 1995, p. 8) where they replaced square sails. These triangular-shaped or jib-sail windmills were used to grind grain. Often these grist mills were built of stone and small in scale in a way that was "perfectly adapted to the economy of small-scale subsistence farming on the islands" (Blom, 1997, p. 806). This is a trend that is also found in the Persian mills which were owned by local farmers (Haverson, 1987, p. 797) and in post mills which are believed to have been developed by local farmers because watermills required the permission and water rights of local authorities (Kealey, 1987; Reynolds, 1970).

In regard to wholeness of ecosystems, I suggest that these and other indigenous windmills arose from the local characteristics of the wind and everyday needs of local people. The unidirectional Persian windmills were designed in response the to unidirectional 120-day wind and were built by local farmers of local sun-dried mud-bricks. Similarly, the post mills were adapted to the environmental conditions surrounding them. Thus, these indigenous windmills, though different in external form, exhibit a wholeness among wind, technology, and people. As Brittan explains, "different styles of [windmills] developed in different parts of the world in response to local geological and climatic conditions, to the availability of local materials, to the spiritual and philosophical patterns of the local culture" (2001, p. 176). He suggests that, as a result, these buildings shape and sustain a larger human and environmental context (ibid., p. 176). Or as Heidegger would express the fact, through what they are, they "gather" a world around them.

Beyond Replacement Technology

In contrast, I suggest that conventional two- and three-blade wind turbines, like those used at Altamont, do not "gather" a world around them and have little or no relationship to surroundings or context. These conventional wind turbines are "everywhere and anonymously the same, whether produced in Denmark or Japan, placed in India or Spain, alien objects impressed on a region and in no deeper way connected to it" (Brittan, 2001, p. 176). The standardized wind turbines used at Altamont are, in Heidegger's terms, a form of *standing-reserve* technology which is readily available and selected to provide maximum-quantitative-efficiency. I have argued, however, that such an efficiency-focused approach ignores the wholeness among ecosystems, people, and place. As wind energy historian Robert Rightner asks of the common Danish three-blade turbine, "[it] may be the most efficient, but is it the most harmonious?" (2002, p. 33).

Regional planner, Sylvia White, and other critics, would answer an emphatic no (Brittan, 2001; Gipe, 2002; Rightner, 2002; Schwahn, 2002; Thayer & Freeman, 1987). White suggests that Altamont industrialized the rural landscape; she describes the turbines as "exoskeletal outer-space creations" which changed the once-friendly pastoral scene into an iron forest (Rightner, 2002, pp. 19-20). In agreeing with White, I suggest the standardized appearance and placement of these tall Altamont towers are similar to conventional power plants and other mega-scale technology like high-tension masts of power lines. As German landscape architect Christoph Schwahn explains, speaking of the North Sea marsh lands in Germany, "today, wherever you look…you will see the turning rotors of wind turbines. Because of the repetition of these … wind turbines [they] can be very annoying, contributing to a standardization of the landscape like that caused by industrial agriculture" (2002, p. 142). In this sense, conventional turbines merely replace the dominating technology of conventional industrial power with more of the same, though of a different physical guise.

Echoing Schwahn, White, and other thinkers, Thayer suggests that "intrusion upon the visual landscape is perhaps wind power's principal impediment to widespread diffusion" (1987, p. 397). Yet Thayer's study suggests that the perceived dislike of Altamont is not merely grounded in a visual intrusion based only on aesthetic concerns like "spoiling the landscape." More significantly, this bias is based on a perceived unreliability and disengagement of the technology because the turbines do not always rotate, are expensive to build, and difficult to maintain. Respectively, these concerns ranked first, second, and third among disadvantages listed by Thayer's respondents, followed by the fourth-ranked "spoiling of the landscape" (ibid., p. 391). Drawing on Brittan, Relph, and Borgman, I would suggest that one of the reasons for this perceived unreliability and dislike is that people view these large-scale wind-turbine projects as imposed by outside developers, investors, and utility companies. Even though local people lease or sell the land for the turbines, they are operated and owned by outsiders and large corporations who rarely experience the everyday effects of the projects. Brittan writes: "it is a lesson we in this country have been slow to learn, but those 'on the ground,' who have a sense of the bounds of both tradition and environment, in general make the best land-use decisions" (Brittan, 2001, p. 177). He goes on to suggest that as long as this large-scale outsider approach predominates, "any sense of local connection, and, more importantly, of local responsibility and control" is diminished (ibid., p. 177).

Thayer's (1987) study supports Brittan's claims, namely, that relying on this conventional approach of standardized mega-scale turbines lacks a deeper connection to place and ignores the wholeness of ecosystem. Although Thayer's study points out that the most often identified advantage of the Altamont wind turbines was an alternate energy source which reduced pollution, the study also finds that participants living in close proximity to Altamont, experiencing the project everyday, disliked the development more than people who where unfamiliar with the turbines and rarely experienced the project (Thayer and Freeman, 1987, p. 390). Studies in the Netherlands also "show a tendency for those favoring wind energy to become less supportive once specific projects are proposed and wind's local impacts become more tangible" (Gipe, 2001, p. 176). In other words, the people most familiar with Altamont and affected by its everyday presence in their lives found this large-scale, efficiency-focused approach alienating and dominating, even though they acknowledged that it reduced pollution. Here, as previously argued, I suggest that those most qualified to understand the wholeness of nature and everyday place—local people—support my claim that Altamont's use of conventional wind turbines does little to connect to the local ecosystem or place. In this sense, Altamont's large-scale, efficiency-focused approach is based on a attitude of dividend ecology—a means to conserve energy for our survival—and ignores a more holistic relationship of care and concern regarding this sustainable technology.

In contrast, I argue that the Windjammer's slow-turning sails are more visually pleasing to the eye than the highly technical propeller blades of conventional turbines (Righter, 1996, p. 254; Brittan, 2001, p. 180). More so, the Windjammer's lower height of twenty-five feet is certainly a more human scale than the 150-foot-high conventional wind turbines at the Altamont site. Even more important than these visual qualities is the potential the Windjammer has, through an ecosystem technology, to instill a sense of care and concern that connects local people and places. As mentioned earlier, Brittan has described how the smaller Windjammer can be installed and repaired without cranes, esoteric tools, or specialized engineers. He also described how the simple gearboxes and mechanics of the Windjammer "can be repaired by someone with a rudimentary knowledge of electronics and mechanics, with the sort of tools used to fix farm machinery" (Brittan, 2001, p. 179). In this sense, Brittan's simpler, more visible, and more easily understood Windjammer exhibits a more *thing-like* technology than the *device-like* character of complex, standardized conventional turbines like those at Altamont. It is Brittan's belief that, because the Windjammer is inexpensive and easily maintained and installed without the assistance of outside experts and financing, it will “be more and more possible for owners of small numbers of wind turbines, and of the co-operatives into which I see themselves forming, to put their power on the grid” (Brittan, 2001, p. 180).

Holistic Ecosystem Technology

In this sense, local people might be allowed to shape their built environment in a dynamic, holistic manner, recognizing the individuality of themselves, wind, nature, and place. By adopting this approach people rely on and gather technology as a useful tool, which they care for in their everyday lives and establish a bodily, social, and contextually responsive relationship with technology that does not dominate or alienate. Such an approach aligns with Relph’s perspective regarding the key role which people should play in forming relationships towards *place*—a relationship grounded in an attitude of care and concern. This attitude is what Grange has called *foundational ecology*—a rich, multidimensional engagement of people, nature, and environment in a reciprocal, holistic relationship. This attitude and approach might allow local people the opportunity to engage more deeply with wind technology and other forms of biomimicry for ecosystem technology that move beyond a mere replacement of conventional-dominating technology. That is not say that the Windjammer can and should be applied everywhere, but it does recognize the unique quality of winds and the potential of simple small-scale, technological things to engage nature and people more deeply. In this sense, the Windjammer exemplifies an approach which can be learned from and applied to each unique place and ecosystem. A major issue here, which I address in the last chapter, is how local people can truly understand their place, when so often in today’s world there is a lack of authentic relationship between residents and the locality that is their home.

The critique of Altamont and the Windjammer illustrates, concretely, how authentic biomimicry of ecosystems engages those ecosystems more deeply and reveals wholeness among nature, people, and environment. The critique further distinguishes between a reductivist, efficiency-focused *ecosystem technology* that does not engage natural ecosystems because it is instrument-centered and based on an attitude of dividend ecology for our human preservation from the alternative, which is a holistic engagement with nature recognizing and revealing the necessary interconnectedness among nature, people, and environment. It is this deeper connectedness and attitude of care and concern regarding natural and built environments which I have previously suggested does not exist in much of ecosystem technology. The Windjammer project begins to describe an *originary* approach regarding biomimicry of ecosystems in that this approach engages the unique characteristics and wholeness of the natural ecosystem, while at the same time allowing a deeper, longer lasting relationship among nature, people, and technology.

In contrast, the Altamont project reminds us that no matter how efficient ecosystem technology is in reducing our consumption of natural resources, this instrument-centered approach ignores the deeper interconnections and wholeness of nature and demonstrates how other quantitative, efficiency-focused approaches are only partial. As such, they are insufficient in achieving a complete sustainability. Instead, a more holistic sustainability might replace the dividend attitude of fear and focus on efficiency with a more empathetic attitude that fosters care and concern among people, nature, and environment. In such an originary way of being, one moves away from replacement *ecosystem technology* and toward a *holistic* ecosystem technology. Such a shift in attitude might move our culture away from technology's domination of our lives to a more appropriate role as a useful tool, thus facilitating and constituting a *sustainable lifeworld*.

In the following chapter, I further examine the wholeness among nature, people, and environment with regard to *process*, the third theme to be drawn upon for a full emulation of nature (Benyus, 2008). In this next chapter, I expand upon the phenomenological notion of place and describe how designers might engage local people and environments in a *process* that might instill a more genuine sense of belonging in the natural and built worlds.

Chapter 4 :

Toward a Holistic Process of Designing and Making

In previous chapters, I have considered two of the three themes I use in this thesis to outline a full emulation of nature—*form* and *ecosystem.* I now review natural *processes,* of which examples have already arisen in chapters 1 and 2—for example, the natural heating and cooling of termite mounds in which Pearce's Eastgate project is grounded; the holistic movement of water revealed in Wilkes' and Schauberger's work; and the wholeness of wind as suggested by Brittan's Windjammer. My aim in this chapter is to examine a process for designing and making in the built environment which parallels the holistic formative processes of nature. That is not to say I intend to ignore nature's role in the built environment. Rather, I shift my view from biomimicry of parts of the natural world toward a holistic process for designing and making in the built world. I begin by drawing on a phenomenological perspective to identify the lack of wholeness in conventional design and building approaches. I am interested in better understanding a process for designing and making which instills a deeper relationship among people, nature, and built environments.

Deficiencies of Image-based Designing

Critics of conventional approaches for design suggest that it ignores environmental and human wholeness and needs (Alexander, 1979, 1985; Dovey, 1993; Harries, 1993; Howett, 1993; Jacob, 1961; Kellert and Heerwagen, 2008; Orr, 2001; Newman, 1980; Relph, 1976, 1981). These critics claim that conventional design approaches too often engage in an image-based, stylistic, analytical approach based on mass values and mass style which often ignores the individuality and wholeness of nature, place, and people. Architect Christopher Alexander suggests that the argument which leads to this critical conclusion can be, in essence, biological (1985, p. 33). He contends that in nature the process which produces a holistic fit is:

> the living process of adaptation which is typical in all biological systems, guarantee[ing] that each part is as nearly as possible "just right," appropriate to its local condition, and appropriate in the large, so that it also functions well as part of some larger system than itself." (Alexander, Davis, Martinez, & Corner, 1985, p. 34)

In contrast to this holistic biological process of careful fit, which is grounded in a complex number of variables and a huge number of unique components, standardized-conventional approaches of design are applied at a mass scale. As a result, these standardized-conventional approaches adopt a similar technological scale and character that dominates and alienates contemporary society (Mugerauer, 1994, p. 67). As mentioned earlier, current technology's standardized, mass-scale approach often erodes our everyday relationship with each other, nature, and place and does not instill a deeper relationship based on care and concern for environment (Stefanovic, 2000, pp. 23-24). As philosopher Karsten Harries explains, "the less an individual is bound to a particular place in space and time, the weaker that determination, and the greater the uncertainty about what is to count as natural" (1993, p. 50). He suggests that "one task of architecture is still that of interpreting the world as a meaningful order in which the individual can find his place in the midst of nature and in the midst of a community" (1993, p. 51).

In this section, I draw on these phenomenological claims to identify what I consider to be deficiencies with the conventional approaches of designing and making. My argument is that designers hoping to engage biomimicry to achieve a more complete sustainability must move beyond conventional approaches which merely replace one set of systems and materials with another similar set of "greener" alternatives. I contend that a more complete sustainability adopts the holistic formative processes of nature, and requires rethinking the way in which we approach designing and making our built environment.

I begin this argument by claiming that much of design emphasizes an image-based relationship in both the design process and the resulting built environment. One major problem with such image-focused approaches is that, by ignoring the use-based, or lived experience of the built environment, designers ignore the multi-dimensional, multi-sensory experience of *lifeworld*. Often the first step in the conventional design process is what designers refer to as "site analysis" or "site inventory" (McHarg, 1969). To a certain degree, this is similar to what biomimicry scientists refer to as a "functional survey" of organisms on the site to learn the embodied wisdom of those living in place (Benyus, 2008, p. 40). Yet, as mentioned earlier, such a systematic, analytical approach ignores the wholeness of nature by focusing on parts and imposing our feeling and preconceptions on nature, rather than letting the wholeness reveal itself. Supporting this claim, landscape architect Catherine Howett contends that, although designers are trained to inventory sites for “a wide range of …relevant natural and contextual factors intrinsic to each site… seldom do the designs that emerge make awareness of these complex natural systems accessible to the bodies and psyches of the ordinary people who use these places in the course of their daily lives” (1993, p. 70).

Instead, Howett claims the result is designs that reduce nature and surroundings to image-based, theatrical scenery for visual contemplation. Such an image-based approach avoids a deeper, multi-dimensional, multi-sensory engagement between people and nature. She suggests this approach is founded in “the myth of the designer as heroic genius, in the tradition of those Baroque and Renaissance masters who engineered elaborately contrived landscape features to dazzle the eyes of audiences at courtly festivals” (ibid, p. 72) rather than engaging people and nature in a deeper, everyday relationship based on use, care, and concern.

Echoing Howett’s claims, architect Oscar Newman suggests that conventional design has adopted the character of mass-produced technology and that contemporary design adopted the mass-produced framework, materials, and form of ships, airplanes, and warehouses (1980, p. 291). For Newman, the technological language of exposed concrete and steel does little to address the everyday aspirations of human beings (ibid., p. 314). In this sense, the language of conventional design adopts the alienating and dominating characteristics of technology by ignoring the individuality of people and places and their everyday needs and desires. Newman suggests that the reason designers have adopted this new technological language is that they are taught and expected to keep up with current tastes to gain recognition from fellow designers. He writes: “the [designer] is slave to … his education, his peers, and his critics, and his own revulsion prevents him from even considering the possibility of design for any taste but that currently accepted by his professional peers” (ibid., p. 316). Newman suggests that this desire for recognition is not only founded on current trends and fashions of the profession, but also relates to an emphasis for designers to be innovative and move beyond the current fashion to provide a “sufficiently new twist that will bring him to the attention of his contemporaries” (ibid., p. 317).

Newman’s thinking parallels Relph’s (1976, 1981) claims regarding the lack of place in contemporary society—what he refers to as placelessness. For Relph, it is not that designers are more concerned about professional recognition; rather, he places blame on the scale and approach of mass values and standardized styles at which designs are applied to the built environment. He suggests that such mass-based, conventional designing and making results in a "growing uniformity of landscape and [lessens] diversity of places by encouraging and transmitting general and standardized tastes and fashions" (1976, p. 92). He contends that this approach exemplifies "an intellectual or aesthetic fashion that can be adopted without real involvement" by the designer (ibid., p. 82). This largely disengaged approach to environmental and human needs results in designs where "the individual is unwittingly governed by the 'anonymous they' without reflection or concern" (ibid., p. 81).

In other words, when designers engage conventional styles and fashions, they lack a deeper sense of care and concern for people and environment. In this sense, today's conventional, image-based, mass-scale approach ignores the wholeness and individuality among people and built environment by emphasizing a part of design—usually image—rather than a holistic perspective towards people, nature, and built environment, grounded in a multi-dimensional, multi-sensory lifeworld.

Phenomenological Approaches for Designing and Making

Thinking in a way that parallels the claims of Howett, Newman, and Relph, architect Kimberly Dovey (1993) suggests that the communication between designer and client also relies heavily on imagery. Dovey contends that the major problem with this image-based communication is that it often does not accurately represent the multi-dimensional, multi-sensory lived experience of the built environment. Although sketches and perspectives, ideally, work to compare designer's ideas with the client's and user's desires (ibid, pp. 252-253), Dovey points out that there is often miscommunication and misrepresentation because the designer's drawing and plans do not accurately communicate the lived experience or "lived-space" to the future inhabitants of a built environment.

At least one potential problem with this geometric-imagery is that clients and users may be verbal-oriented and may not have the ability "to make the imaginative leap from the geometric image of a plan into an imaginary lived-space" (ibid, p. 257). Though models and multiple perspectives may be more effective than static plans, sections, and elevations in this respect, "it does not follow that an environment constructed from [models and perspectives] will automatically achieve the experience" that they communicate (ibid., 262). In this sense, when designers engage in a static, image-based approach for design communication, they follow the less authentic, image-based approach of Tsui's formalistic "Ultima Tower." Instead, Dovey claims that approaches grounded in the lived-experience of the space, rather than geometric imagery, better reveal the everyday relationship between people and built environment. Here, I argue that such an approach might instill a more authentic designer-client relationship which arises from immediate context, surroundings, and everyday lived experience versus a relationship founded on the static imagery of geometric space.

Dovey contends that a more effective design-presentation approach would involve marking the proposed locations of buildings and landscape elements on the actual site of the proposed design and engaging clients and users in making adjustments based on this firsthand-environmental experience (ibid., 264). Ideally, the design would not only be laid out on the ground, but "vertical elements must be simulated to give a three-dimensional effect" (ibid., 264). I would argue that such an approach affords the opportunity for designers, clients, and users to to imagine proposed impacts on the environmental context and natural world and is a more authentic approach to achieve a more holistic, multi-dimensional, and multi-sensory experience. Though such an approach does not completely communicate the lived-space of the design and requires an imaginary leap for client and user (ibid., p. 264), I would argue it is a more approachable and instructive approach than looking at plans, elevations, perspectives, and so forth.

Similar to my critique of Eastgate and the Ultima Tower, Dovey suggests that another problem with conventional designing and making is the scale in which it is approached. In contrast to the mega-scale approaches of Tsui and Le Corbusier, Dovey (1993) suggests that working in smaller, incremental steps allows the opportunity to make adjustments during the designing and building process. He calls such small-scale building and adjusting "piecemeal change" (ibid., pp. 264-265). He writes that "strategies for piecemeal change that break down the scale of environmental projects, that reduce the grain size of urban texture, and that limit the size of funding allocations would help to generate conditions necessary for a more successful design process" (ibid., p. 265). In addition, Dovey claims that piecemeal change during the *building* process allows adjustment to be made as the project begins to take shape and is experienced as lived-space. In other words, the first opportunity to experience the lived-space of the project is when the project begins to take shape during construction and thus offers a more effective approach for making adjustments. Conventionally, the downside of piecemeal change during the designing and building processes is that these changes often cost the client money because they require additional work by the designer and builder (ibid., p. 265), an issue I address later in the final section of this chapter.

Another potential problem with conventional approaches of building is the lack of integration between designer and builder (ibid., pp. 253-254). Conventionally, designers work with the client and users to understand the desired end of the project and, then, designers provide their plans, sections, and details to the builder for construction of the project. Yet often, “the builder has no access to sketch plans or to an understanding of the lived-experience that is the desired end of the process” (ibid., p. 253). Dovey suggests the problem here is that “the builder inhabits the lived-space of the building site on a daily basis during construction, separated from the proposed lived-experience, yet most in touch with its emergence” (ibid., p. 253-254). In this sense, a more integral relationship among designer, builder, and client, where all are more deeply involved in the building and designing processes, affords the opportunity for refinements in the built environment. I contend that such an approach is more responsive to the lived-space of the emerging project in contrast to a linear, top-down approach where there are a series of disconnects between design, client, and builder.

A Practical Example

Naturalist Paul Krafel (1999, pp. 144-152) provides one real-world example illustrating a more integral, incremental approach in designing and making that suggests how Dovey’s integrated, incremental process of design and building might provide a more holistic approach for dealing with natural and built worlds. After Krafel observes six-foot deep gullies eroded in an overgrazed field near the school where he teaches, he decides to work toward healing this damaged site. At first adopting a larger-scale, manipulative approach, Krafel starts by working in the larger main channels, assuming this would have the greatest impact on stopping erosion (ibid., p. 145). His first efforts involved building dams in the larger channels which required that the dams “had to be to tall enough to force the water to flow around it onto a new path rather than over it [and that] the dam had to be thick enough to hold back the torrent that it opposed” (ibid., p. 145). This method required much digging and required removing large amounts of healthy plants in the sod clumps to form the large dam, a result that led to even more damage to the overgrazed field. At first this larger-scale, pre-determined approach seemed effective because the dams held and diverted the water to a new path, lessening the erosion. However, when larger storms arrive the dams wash out.

After these large-scale dams failed, Krafel begins working with “the smaller channels near the top of the drainage, where run-off was just beginning to converge its power.…there, in channels a few inches wide, [his] dams survived” (ibid., p. 145). Though initially discouraged because he felt he would lessen his impact by working on these smaller-scale channels, he eventually realized that working at this smaller scale afforded him an opportunity to refine his approach. He began to build small diversions using small channels, then quietly observing and adjusting his approach. Furthermore, Krafel worked while it rained so he could readily observe the flowing water and the effect of his efforts. Thus, his incremental approach becomes more responsive and grounded in a designing and making resulting from the specific conditions of the flowing water, plants, and soil of each of the individual channels.

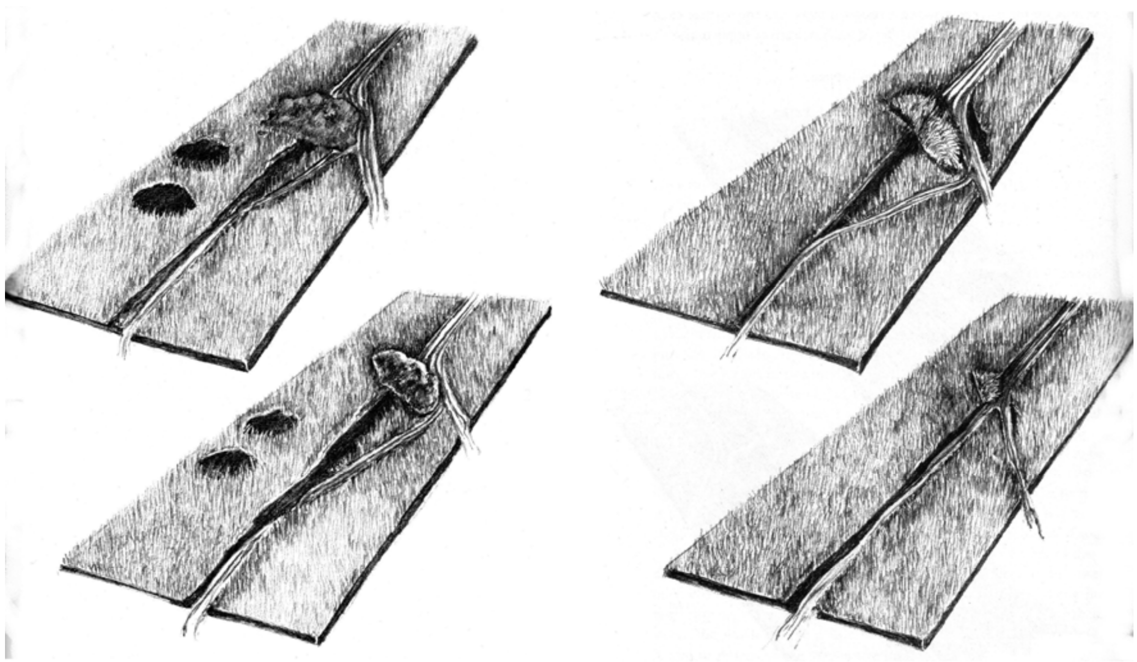

Figure 16. Drawings illustrating Krafel's responsive process that resulted in a more effective approach for reducing soil erosion. His first attempt is illustrated on the upper left and his final effort is shown on the lower right. Reprinted from “Seeing Nature” copyright 1999 Paul Krafel, used with permission of Chelsea Green Publishing (www.chelseagreen.com).

Through this process of incremental, responsive designing and making he learned that, instead of building dams large enough to completely stop the water—which caused more turbulence and more quickly eroded the dam—it was more effective to divert a portion of the water into a new, non-eroded, path. This approach required less energy, and the process of building the divergences grew easier as his approaches became more precise and responsive to the needs of the field. He describes this incremental, responsive approach:

> I began the work with an awkward design, random actions, and assumptions of limited possibilities. I did some work and the results altered the way I did the work next time. Practice initiated a spiral of learning between the fields and myself. My structures evolved from opposing the flow of water to turning and leading the water onto new paths. These structures fit better within the flow of water and accomplished more with less effort. Because of the wisdom evolving within the design, I could now make more divergences with the same amount of energy and time. (Krafel, 1999, p. 148)

Over time, as a result of his efforts, Krafel observed a healing of the overgrazed field as plants began to grow in the eroded channels, thus creating habitat for animals and insects. These newly established flora and fauna helped to further protect the soil and allowed water to soak into the soil, "which raised the water table and nourished more plants" further healing the damaged field (ibid., p. 152). Thus, Krafel's small-scale, incremental, responsive designing and making began a positive shift in healing the landscape, which allowed local plants, insects, and animals to further the process of healing based on their specific needs and natural processes of the environment. In this sense, Krafel's approach which worked directly in the *lifeworld* of his design in incremental-responsive steps, allowed him to slowly gain wisdom while designing and making. As a result of this gathered wisdom, his designing and building required less work, used fewer resources, and was more effective for instigating a healing shift in the environment, which was further enhanced by the local organisms of the field.

Although his approach is in response to the natural world, I would claim such an approach can be expanded into the built environment, working with local people, the clients, builders, and users in the built environment. Thus, Krafel's approach is similar to Dovey's suggestions for a more integral, incremental designing and making which engages the designer, builder, user, and client in a lived experience in the environment of the proposed design. Although seemingly less effective at first, this small-scale, incremental approach over time might prove to be more effective and appropriate. In this sense, it illustrates a method which can describe a more holistic, biological-generative process responsive to the local environment and inhabitants. This process is more adaptive to their unique needs and unique signature of their environment, and engages them more deeply in the process. If applied to the built environment this approach points towards a more holistic process that is responsive to the wholeness among people, nature, and built environment.

An Indigenous Example

As suggested earlier in my discussion of indigenous windmills, various thinkers contend that indigenous architecture bears the unique signature of people and place in contrast to much of conventional modernist designing and building, which arises from mass values and mass style (Alexander, 1979, 1985, 2003; Benyus, 2008; Brittan, 2001; Kellert and Heerwagen, 2008; Mugerauer, 1994; Orr, 2006; Relph, 1976, 1981; Riegner, 1993; Rudofsky, 1964; Stefanovic, 2000; Seamon, 1985, 2000). Biomimicry scientist Janine Benyus describes an example involving Hispanic settlers in the San Luis Valley of Colorado that gained knowledge from the burrowing ground squirrel which inhabited the valley. She writes that "new to the mountain climate, the settlers did not know how thick to make their adobe walls to buffer winter and summer temperatures. To this day, adobe walls in the valley are built as thick as the average depth of the squirrel's bedroom chamber" (Benyus, 2008, p. 28).

Benyus's example indicates how regularly indigenous builders were closely involved in the process of designing and making their environment, thus adopting, in a lifeworld context, Dovey (1993) and Krafel's (1999) more integral, responsive approach for designing and making. As a means to extend on Krafel's example into the built environment, I draw on Canadian architect Ronald Walkey's (1993) study of the process of designing and making of indigenous houses in northern Greece. Though this approach relied on outside builders I would argue that the process recognizes the wholeness among people, nature, and built environment—what Walkey refers to as a "lesson in continuity" between people and place.

For Walkey (1993), local inhabitants often find indigenous buildings and environments sustaining not only because of their image-based, "picturesque" quality but also because of a deeper place experience that "connects to something that allows us to inhabit and to see ourselves there" (ibid., p. 129). This deeper, personal experience is in contrast to the image-based "monotony and machine-like repetition" of conventional design that is often abstract and alienates (ibid., pp. 129-130). Walkey suggests two reasons why the buildings of northern Greece, western Turkey, and the adjoining Balkans exhibit an engaging, cohesive quality: first, that the designs respond to the local conditions, climate, and limited resources and, second, the indigenous designs respond to the distinct regional cultures of Greek, Vlach, Turk, Bulgar, and Jew.

Walkey contends that an important reason for the cohesive nature of these buildings—despite the varied social and environmental conditions—is the process by which they were conceived and built. This process allowed for a "single housing form for a pluralistic and diverse culture" (ibid., p. 130), a form which was "robust enough to have survived through five centuries and fluid enough to suit radically different terrains [and] to support local custom" (ibid., p. 132). He suggests the formal qualities and building process was similar for both grand houses and humble houses (ibid., p. 131), which "were not the product of trained architects nor were they built by residents as part of a layman's vernacular. Rather, these dwellings were the product of an extensive network of 'design-build' teams" (ibid., p. 155) descended from the builder's guilds of the Ottoman Empire (ibid., p. 137). Often times these teams lived in remote villages and were led by a master who oversaw a group of ten to twenty builders. Leaving their villages following spring carnival, these building teams traveled to other villages to build houses. No drawings were used, instead, only a brief description regarding payment and the number of rooms, special doors, and fireplaces was provided (ibid., p. 138). Completing only one or two houses during the building season, these teams worked closely with their clients to build the particular house they wanted (ibid., p. 138).

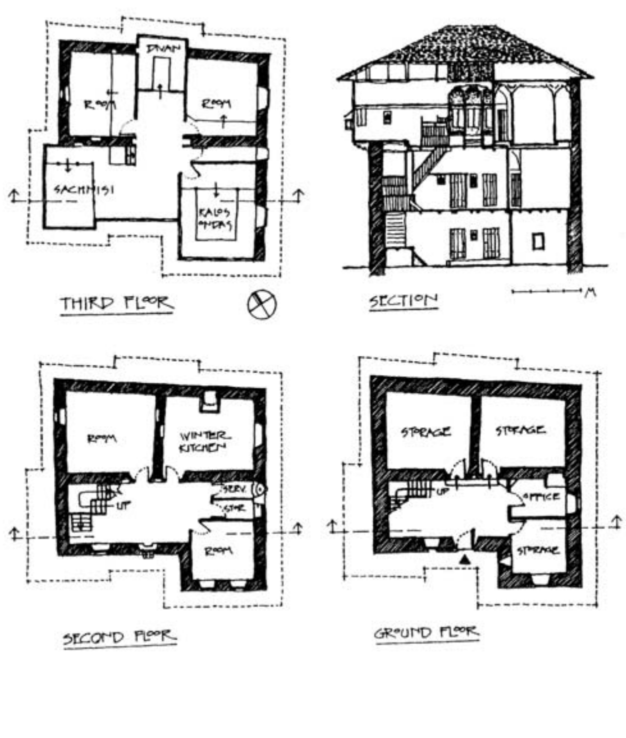

Figure 17. Plans and section of a typical dwelling in northern Greece designed and built by the builder's guild. Drawing copyright 1993 Ronald Walkey, used with permission.

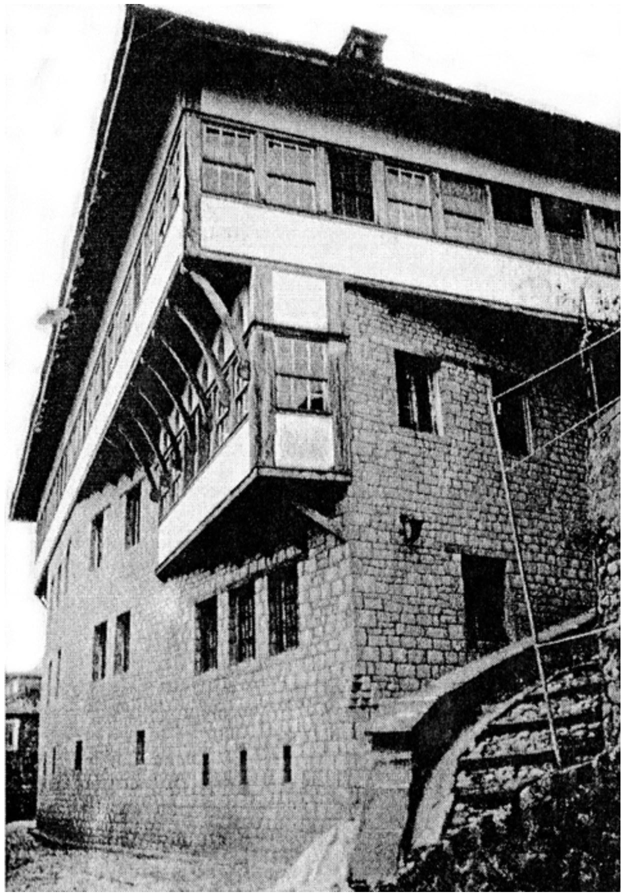

Figure 18. A typical indigenous home in northern Greece built and designed with the builder's guild approach. Drawing copyright 1993 Ronald Walkey, used with permission.

Walkey suggests that these builders' guilds relied on a well-defined set of rules and qualities for a house—what he refers to as an *iconic house* (ibid., p. 145). I would suggest that these qualities were not simply image-based or prescriptive qualities, but rather use-based and incorporated deeper symbolic qualities which could be adapted to the scale of the house, the uniqueness of the site, and the specific desires of the client. As he explains, "there was no loss of essential features despite the myriad of interpretations…. once the central quality had informed a particular building part, it would be … [felt] to builders and clients alike that a particular quality had been achieved" (ibid., p. 146). In this sense, the builder's guild relied on an incremental approach that was responsive to the needs of the client who observed the lived experience of the building as it progressed. Thus, clients and builders worked as Dovey suggests in a more integral-incremental process that is centered around the lived experience of the proposed building.

I would argue that this approach for designing and making these indigenous, iconic houses begins to move toward a way of making that is “flexible enough, and at such a deep level that it could not only adapt to site and client, but to sub-culture as well” (ibid., p. 155). I suggest that similar, more integral, incremental approaches for designing and making the built environment today are necessary to respond to the wholeness and individuality of people and nature. Such processes might move us beyond an image-based design approach that alienates, ignores, and destroys this wholeness. In this sense, the builder’s guild approach is a more phenomenological approach that, together with Krafel’s example, poses the possibility of a more holistic process of designing and making.

A Critique of Two Projects

In discussing a more holistic process for designing and making, I have emphasized three key points. First, I have argued that much conventional design ignores the individuality and uniqueness of people and environment and instead emphasizes an image-based approach founded on mass styles and fashions. Second, I have contended that a phenomenological approach to design would move beyond an image-based approach to emphasize the importance of lived-space in design. Third, I have suggested that a more integral, incremental approach would facilitate designs that are more responsive to the wholeness of people and environment. Drawing on these three claims, I critique two campus projects which attempt to achieve a more sustainable future: First, American environmentalist David Orr’s description of designing and building the Adam Joseph Lewis Center, an environmental education center at Ohio’s Oberlin College; and second, American architect Christopher Alexander’s designing and building of the New Eishin Campus near Tokyo, Japan.

The Adam Joseph Lewis Center (henceforth Lewis Center) was built to house the Environmental Studies program at Oberlin College in northern Ohio. This 13,500-square-foot complex includes a two-story building with classrooms and offices connected to a smaller structure housing an auditorium (Truppin, 1999, p. 110). The building was completed in 2000 and has since received numerous sustainable-design awards (Orr, 2003). The project was created by several well-known figures in the sustainable design movement, including lead architect William McDonough, landscape architect John Lyle, energy expert Amory Lovins, and ecological designer John Todd (Orr, 2003).

My primary source for this project is David Orr, who is an environmentalist and Chair of the Environmental Studies program at Oberlin College. Orr explains that the planning for the project “started in fall 1992 with a year-long class at Oberlin organized to examine the possibilities for creating an environmental studies center that would provide offices, classrooms, and working areas for students and faculty in the program” (Orr, 2006, p. 65). Meeting once a week, the class invited various architects and designers to speak “about life-cycle costs of materials and buildings…buildings as ecological systems” (ibid., p. 67). Initially, the class considered renovating an existing building: over time the students realized “that no suitable old building was available for renovation… [and they, however,] quickly moved on to the job of designing a new one.” At the end of the first year, the students had developed a “preprogram” of goals, objectives, building standards, and possible building sites for the new facility (ibid., p. 66).

After the completion of the student’s preprogram, Orr claims that he made a number of “decisions that shaped the design process” (ibid., p. 69). First, “the programming phase would be open to the students, faculty, and the wider community” (ibid., p. 69). Second, the building would serve as an “example of the highest possible standards of ecological architecture” (ibid). Third, he engaged “a team of designers including energy experts, ecological engineers, landscape architects, and a contractor” (ibid.). During this programming phase, Orr relied on landscape architect John Lyle to conduct a series of design charrettes in the dining room of the Oberlin Seminary (ibid., p. 70) where, “typical of design charrettes, sheets of paper went up on the walls to document and organize the flow of ideas” (ibid., p. 70).

Out of this charrette process, participants agreed on three basic program principles which included: first, “aim for a building and landscape that would cause no ugliness, human or ecological;” second, “aim to reconnect a mostly urban clientele with soils, trees, animals, landscapes, energy systems, water, and solar technology;” and third, “develop and apply new analytic tools … [too] better appraise building performance and its full costs” (ibid., p. 72). From these three principles, objectives were identified and another preprogram was developed to include “the kinds of public and private spaces, the numbers of offices and classrooms, and the standards for the project” (ibid., p. 75-76). Once this program was established, a lead architect was selected and the design team began refining the program and advancing the design process (ibid., p. 76). Over time, the design team completed the necessary drawings which they provided to the contractor to construct the project.

Following the conclusion of these early programming phases and the selection of McDonough + Partners as lead architect the design process appears to have moved away from the more integral, responsive programming phase and reverted to a conventional approach for designing and making. Orr explains that the building site was not chosen according to any campus master plan but, instead, was "selected because the site was available and unobstructed, and it competed with no other proposed uses" (ibid., p. 80). He also explains that, although participants had expressed a desire for a building that felt "warmer…[and] more sensually appealing," eventually, the architectural result was a "harder-edged, more contemporary style" selected "to meet codes…, avoid unnecessary controversy, and expedite design" (ibid., p. 81). Orr describes the resulting design as a "combination of greenery, curves, straight lines, and angles" (Orr, 2006, p. 83). In this sense, the building's design team adopted an image-based, standardized style of design, which, to a certain degree, ignores the desires of the students and faculty along with the uniqueness of the campus and surroundings.

Figure 19. The Adam Joseph Lewis Center for Environmental Studies at Oberlin College in Ohio. Copyright 2009 Oberlin College, used with permission.

In addition, the technology that the Lewis Center adopts is conventional, even though Orr had assembled a multi-disciplinary team of to reduce the project's environmental impacts. I would suggest this team adopted a standardized, replacement approach toward technology rather than engaging a more holistic ecosystem technology. As Orr explains, "we chose to use available (off-the-shelf) technology combined with state-of-the-art design" (2006., p. 81). In addition, "project engineers and college officials favored a more conventional and presumably risk-free application of heating, cooling, and ventilation" (ibid., p. 82). The result, he admits, is that "building controls [are] highly centralized, hence less subject to management by its occupants" (ibid., p. 82). Though the building uses sustainable technologies like solar photovoltaic electric panels, green materials, and a "Living Machine" to purify wastewater, post-occupancy studies have shown that the building "is using twice as much energy as projected" (Bailey, 2002, p. 14). One Oberlin physics professor claims that the building uses about 125,000 BTUs per square foot, while conventional Oberlin classrooms use 130,000 BTUs. Orr responds that, compared to other new academic buildings constructed at the same time, energy use in the Lewis Center is quite low" (Orr, 2006, p. 91).

Regardless of the actual energy used, I would suggest that at least one reason for the higher-than-projected energy use is the less integral, conventional process for designing and building that appears to undermine the clients' desire for a more sustainable-energy building. Orr refers to this less responsive approach when he writes that, "the architect failed to see that in the final construction documents the mechanical engineers had upgraded an electric boiler from emergency backup to primary heat source" (2003, p. 42). He also explains that other issues intervened when energy efficiency had to be weighed against education and aesthetics and that the "the college prolonged the design process for nearly three years, which did not help morale on the design team and, in turn, diminished the quality of the final building design" (Orr, 2006, p. 91).

Although the earlier programming design phase of the Lewis Center allowed for a more integral, responsive approach involving students, faculty, and designers. I would argue that McDonough + Partner's reliance on a conventional designing and building process resulted in a less sustainable approach that merely replaced one standardized technology with another less-environmental-impact set of standardized technology. This less sustainable approach not only lacks a deeper connection with surroundings, people, and place but also reduces the environmental efficiency of the building. In this sense, the building design exhibits a conventional design approach which adopts standardized technology, design, and building conceptions instead of supporting a process which is more integral, responsive, and holistic.

A Pattern Language Process

I now examine architect Christopher Alexander's process for the Eishin campus (figure 20-23) in Japan. The new Eishin campus is a combined high school and four-year college for approximately 2000 students. Located west of Tokyo, in Iruma, Japan, the campus will eventually include a total of thirty-five buildings placed on a twenty-two acre site (Alexander, 2009), so far twenty buildings have been completed. Alexander worked as the chief architect for his California-based Center for Environmental Structure (CES), which included a team of architects and engineers. The process began in 1981 when Alexander was contacted by the managing director of the school, Hisae Hosoi, who selected Alexander and CES "because of its reputation for employing user participation in the design process, which would be instrumental in activating the political processes within the school towards defining a new identity, institutionally as well as physically" (Fiksdahl King, 1993, p. 82). In other words, Hosoi selected Alexander and CES to assist his faculty and staff in facilitating a process for shaping their vision and mission of the institution, not merely to provide physical design.

To a certain degree, this early phase is similar to the preprogramming and programming phases of Orr's Lewis Center project. I would argue, however, that the CES process incorporates a more holistic approach. I begin this argument by briefly reviewing the programming process for the Lewis Center, for which the initial program was developed by a small group of students. Next a design charrette was conducted to identify three principles and a number of objectives which became a part of the program. Orr (2006, p. 75) presents the following as the "building program":

- Maximize daylight
- Use energy and materials efficiently
- Use sunlight for electrical power
- Export electricity—"as a goal to strive for"
- Purify wastewater on site, that is, drinking water in drinking water out
- Eliminate the use of toxic materials in paints, fabrics, and materials
- Use recycled materials in office and classroom furniture
- Promote biological diversity

- Use certified wood and other materials
- Design the building to evolve or "learn"
- Design the building and landscape as an educational laboratory
- Use the building as a model to develop a college environmental policy
- Monitor performance

The program also listed "the kinds of public and private spaces, the numbers of offices and classrooms, and the standards for the project" (Orr, 2006, p. 75-76). These lists of objectives, principles, number of rooms, and so forth were then provided to the design team to produce the final design. I would suggest this conventional approach exhibits a prescriptive-quantitative "listing," that as the project proceeds, reduces user participation in favor of a more top-down method controlled by the design team.

I would contend that the pattern language expands this conventional process and exhibits a more responsive, adaptive, and descriptive method in contrast to the more top-down, static, and prescriptive Lewis Center program. For Alexander, this programming phase was a preparatory phase which is often labeled "creating the pattern language" (Fiksdahl King, 1993, p. 52), an effort that is described as an open process: "Open in the sense of continually providing for interaction with the various realms of 'reality', as well as 'open' in the sense of providing for continual dialogue and discussion between the various participants in the process" (ibid., p. 50). Patterns are "based on interviews and observations, as well as other kind of investigation" (ibid., p. 84), and they are established for different levels of scales and conceived "as 'operators' on the given reality. This is the proposition that provides the grounds for 'design' as an extraverted process, and thereby the possibility of collective participation…" (ibid., p. 26).

Ingrid Fiksdahl King, a CES architect on the Eishin project, claims that this continual, extraverted-collective process allowed "the various levels of patterns to coincide with levels of social organization [of the school], and where the process would carry through in the 'gradually emerging form' of actual building" (ibid., p. 26). She explains that the pattern language process for the Eishin campus "consisted of trying to bring out archetypal configurations from the community at hand, as well as identifying major and minor functional problems… [and the] invention of building types and configurations that represent 'wholes'" (ibid., p. 84). Fiksdahl King describes this wholeness as allowing "typical behaviors and events to come together in a new gestalt through the physical form so that the overall situation becomes positive and energetic" (ibid., p. 84). The following excerpt for the Eishin campus's pattern language illustrates this emphasis on wholeness, and typical behaviors and everyday activities:

> The homerooms are arranged in a series of smaller buildings along a wide street-like yard. All the homerooms have easy access to ground and there is plenty of space for the students to run and play in the home base street as well as in the fields beyond. (Fiksdahl King, 1993, p. 86)

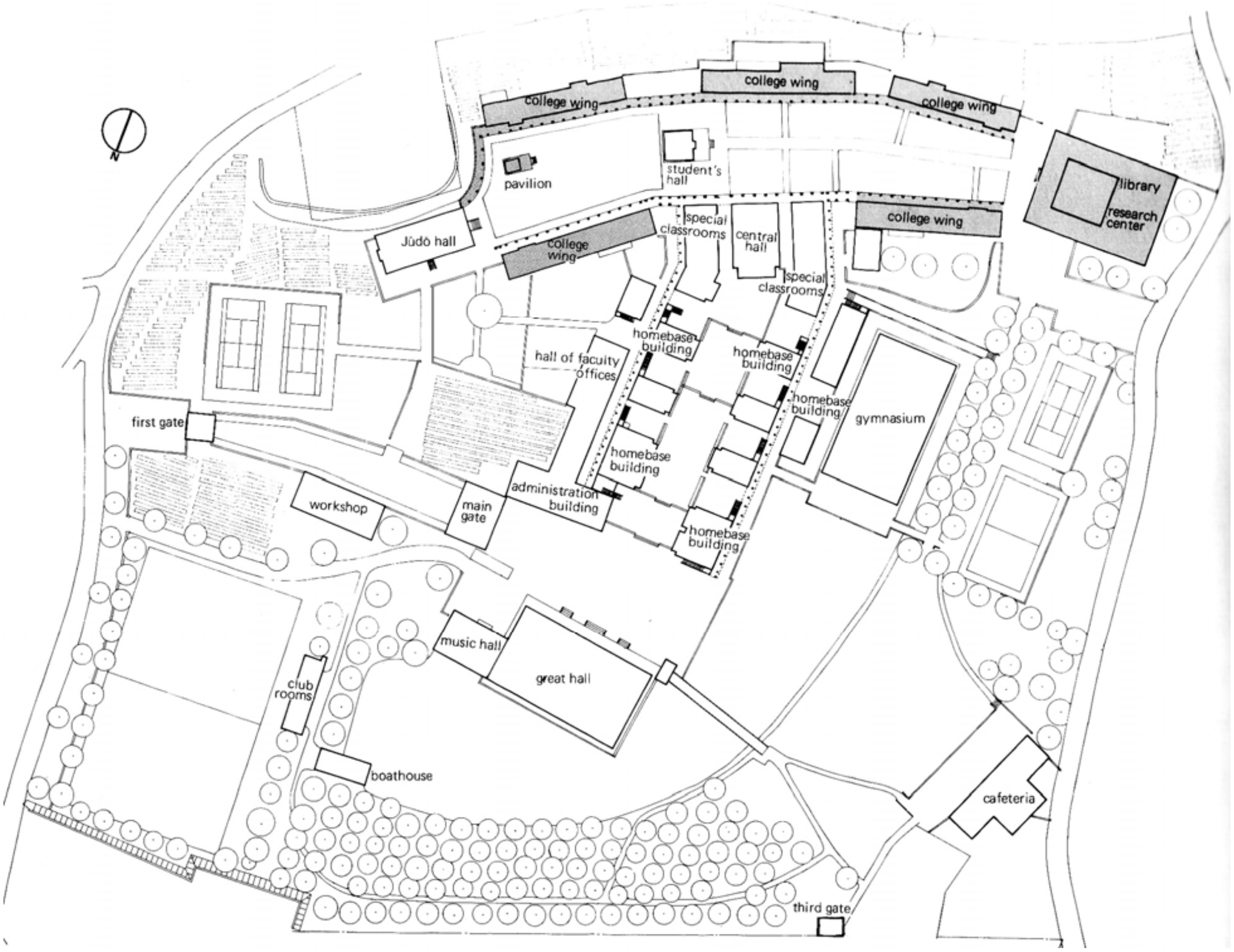

Figure 20. Site plan of the New Eishin campus located in Iruma, Japan, designed by Christopher Alexander and the Center for Environmental Structure. Copyright 1985 Center for Environmental Structure, used with permission.

In this sense, the continual dialogue and discussion of the pattern-language process is adaptive and flexible, thus moving beyond a conventional sequential, quantitative listing that reduces user participation as the project proceeds. In other words, the pattern-language approach aims at a more adaptive-participatory process that emphasizes incremental or "gradually emerging design" in response to the desires of the client and users. For Alexander, these patterns are adaptive and descriptive, like language, in the sense they can be combined in an “invariant configuration that exhibits a great deal of flexibility and expressiveness in the individual instance” (ibid., p. 18). I would also contend that the pattern language of the Eishin campus places an emphasis on everyday campus uses and personal interactions and thus is more responsive to the needs and desires of users and their lived-space that the built environment all play a major role in shaping.

Designing and Building the Eishin Campus

Once the pattern language for the project is developed, it “sets the stage for designing in the reality of experienced space through the proposition of making the inventions first, and then doing the ‘final’ design through lay-out procedures on the site” (ibid., p. 40). In contrast to a representation-drawing mode of conventional design, the design process on the Eishin campus “in large part takes place on the actual site, staking out full scale visualization, and sometimes also working directly with earth moving equipment” (ibid., p. 53-56). Alexander claims that as the designers, faculty, and students staked out the buildings and site elements of the campus they had “the sensation of building the real thing, bit by bit. Emotionally, you feel as if you are literally creating the actual physical school itself” (Alexander, 1985, p. 18), a feeling that Hosoi said he also shared during this process (Landy, 1990). Alexander calls this “the overwhelming reality of the site” (Fiksdahl King, 1993, p. 58), which is a “physically exhilarating” experience where “you enjoy the fresh air, the rain, the sun, the wind. You have the real bushes and plants and trees. You are dealing with a living thing, in the most real way possible” (Alexander, 1985, p. 18). Clearly, he is describing here a process that is multi-dimensional, multi-sensory, and engaging the lived-space of the project.

Paralleling this daily-on-site, full-scale design process was extensive model building at a variety of scales. These crude, cardboard models “sketched” out and documented the collective knowledge and user input gathered during the daily field staking and flagging (Freiman, 1991, p. 103); these models are “moved around, demolished, [and] adjusted” (Fiksdahl King, 1993, p. 56). At the same time, patterns, field staking, and models were developed, adapted, and adjusted from interaction with site and client, so were building systems and material palette. Fiksdahl King explains that, “primarily…it is the physical reality of the specific site, with its sensual and tactile qualities, that provides the reference for the choice of materials and the design of the building systems” (1993, p. 60).

Figure 21. On-site staking and flagging design process to determine the approach towards the main gate from the first gate on the Eishin campus. Photograph copyright 1985 Center for Environmental Structure, used with permission.

To best experience the reality of these systems and materials, full-scale mock-ups of details, wall sections, and segments of entire buildings were developed to inform the modeling, field staking, and pattern descriptions (ibid., p. 58). A ten-foot-by-fourteen-foot mockup was built on site and served as a "proportional profile of the complex mix of concrete, wood, stone, and plaster in predominant hues of black, white, green, and gray that best suited the compound's physical and emotional landscape, and the light's odd mixture of softness and harshness" (Freiman, 1991, p. 103). Alexander (1985) suggests that, in this more integral, full-scale process, "each building arises, in a natural way, from the specific conditions of its location…from the cooperation and layout of the people who are going to use it" (ibid., p. 18). He also claims that the design incrementally "gets its physical character, its actual material substance, from a process of thinking how to make it" (ibid., p. 18) and "only after the entire design is completed in this way" are drawings made (Fiksdahl King, 1993, p. 56). In this sense, the process used for designing the Eishin campus moves beyond a representational drawing mode and engages designers, clients, and users to participate and experience the potential lived-space of the project in a more integral, incremental, and responsive design process.

This more holistic process for design is extended into the building process. In their environmental design practice, Alexander and CES not only develop the pattern language and designs for a building system, but they also serve as the construction manager or general contractor during the building process, which is decentralized in the sense that several small crews work in parallel, giving each individual building and element of the site considerable care and attention (ibid., p. 62). The reason for adopting this approach is that the building process is considered the final stage in the design process where one begins to experience the lived-space of the project, in the way Dovey suggested. Alexander claims that the building process is the final synthesis and "requires presence in space, minute adjustments, and finally has to occur in the stuff of the fabric" (ibid., p. 36). This more integral process was used for completing the site-work portion of the Eishin campus. As Alexander explains, "we ran the job. We arranged the work. We worked directly with the subcontractors and the craftsmen. We paid the subcontractors directly, by sending the bills to the school, with our seal on them" (Alexander, 1985, p. 20).

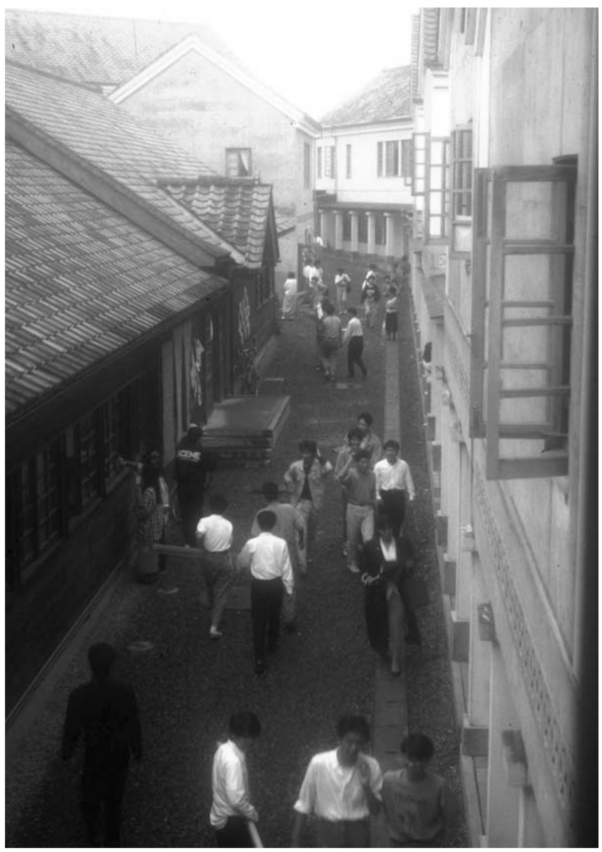

Figure 22. Students gathering in a street on the Eishin campus. Photograph copyright 2009 Center for Environmental Structure, used with permission. Retrieved April 15, 2009 from http://www.livingneighborhoods.org/pics/eishin/eishin-pedestrian-street.jpg.

Though the CES team was able to adopt this deeply-integral role as the construction manager for the civil and site construction portions of the Eishin campus, they were not as deeply involved during the construction of the buildings. The primary reason for this appears to be the short time frame for construction—only eight months for the first phase (Alexander, 2009, p. 19). Despite a reduced role in the building process, CES still did “on-site checking, day by day” and the large Japanese construction company “was responsive to our requests” within limits (Alexander, 1985, p. 34). Though Alexander at times refers to the experience of working with a large construction company as a “battle,” he acknowledges that “what we achieved… has succeeded in great degree because of the help of Fujita, not in spite of them” (ibid., p. 34).

Figure 23. Homeroom buildings adjacent to the lake on the Eishin campus. Photograph copyright 2009 Center for Environmental Structure, used with permission. Retrieved April 15, 2009 from http://www.livingneighborhoods.org/pics/eishin/waters-edge.jpg.

Though the construction process for the Eishin campus was less integral and responsive than the pattern language and design process, Alexander, students, and the client still feel the resulting built environment was a success. Hosoi explains in a letter to Alexander that “we’ve succeeded at last…confirmed by the actual result after experiencing many painful and serious situations we’ve got over together” (Alexander, 1985, p. 20). This success is more than merely completing the project but successfully achieving a more holistic relationship with the natural and human environments. Hosoi intimates this wholeness when he writes that “ten ducks have started swimming in the lake very gracefully…it shows how deeply they appreciate and enjoy this lake" (ibid., p. 20). I would suggest that the Eishin campus achieves a certain wholeness and deeper relationship among people, nature, and environment that moves beyond standardized, alienating designs and styles. As one student explains, "all my life before I came to this place, I felt that I was living behind bars. When I came to the school, it was the first time in my life I felt that I was free" (Alexander, 2009, p. 6).

A Holistic Process

I would contend that this deeper, holistic relationship is the result of Alexander's more biological, generative-adaptive process and that this approach supports an authentic biomimicry of natural processes that are not merely an analogy of biological relationships and forms but, instead, offers a clear example of an originary process for conceiving, designing, and building that achieves the complexity, plurality, interconnectedness, and wholeness of nature. In this sense, Alexander's process moves beyond McDonough's superficial "building as a tree" analogy for the Lewis Center which merely relies on a conventional-replacement approach. I draw this conclusion for a number of reasons.

In making this claim more fully, I first argue that Alexander facilitated a responsive-participatory process in shaping a campus vision grounded in the wishes and values of client, staff, designers, and builders and that this more integral process unfolded, not only in the early stages (as in the Lewis Center) but continued through the Eishin School's entire design and building process. Second, I contend that Alexander's pattern-language process engages a multi-dimensional, multi-sensory description of everyday, use-based relationships among nature, people, and the built environment (in contrast to a conventional program listing principles, objectives, number of rooms, and so forth as was used in the Lewis Center). Third, I argue that these patterns are descriptive enough and at the same time adaptive enough to allow participants to understand and experience the physical form of the campus in the staking and flagging process on the actual Eishin campus site. This effort moves beyond a representational-drawing mode toward a lived experience of the space whereby participants not only gain a more accurate experience of lived-space but also directly experience the resulting effects on the site's natural world, thus fostering a more authentic engagement with nature. Fourth, I claim that these on-site experiences were supported by modeling at a variety of scales, including full-scale mock ups, thus extending the lived-space experience on site to a lived experience of the building systems and materials. This approach is in contrast to a conventional process where representational drawings and perspectives are the primary tool for communication. Fifth, I suggest that building systems and materials were selected on the basis of the unique qualities of the site, including soils, plants, and light (in contrast to the harder-edged, contemporary style of the Lewis Center). Finally, I believe that, as much as possible, Alexander continued this responsive-integral approach into the building process, making final selections for color, detailing, and materials in the lived-space of the buildings and site construction.

In short, I argue that the more integral, responsive process of designing and making illustrated by the Eishin campus demonstrates, concretely, how authentic biomimicry of a biological adaptive process might engage people, nature, and built environment in a more holistic relationship. This approach is considerably different from that of the Lewis Center effort where one standardized technology is replaced by another standardized technology that does not really achieve a more sustainable end. This reduced sustainability was the result of a disconnected, piecemeal process which to a certain degree ignored the individuality and uniqueness of people and surroundings in favor of conventional mass styles and fashions.

My critique of the Lewis Center and Eishin Campus points toward an originary mode of environmental design which provides a more complete sustainability by facilitating a deeper connectedness among people, nature, and the built environment. The central argument is that a more holistic process moves beyond conventional methods to rethink standard approaches for environmental design. I argue that rethinking conventional designing and building is necessary for achieving a more holistic relationship among people, nature, and environment. This deeper connectedness has the potential to instill a deeper sense of human and environmental belonging. Alexander's approach offers an originary process where designers, clients, and the public follow "one overriding rule: every increment of construction must be made in such a way as to heal….,'heal' in the original sense of 'to make whole' (Mehaffy, 2008, p. 63).

Chapter 5 :

Environmental Belonging and Sustainability

Christopher Alexander's process for designing and building is considered by many thinkers as the clearest example of a holistic, phenomenological approach in contemporary design (Alexander, 2002-2005; Fisher, 1986; Ingrid-King, 1993; Mehaffy, 2007; Seamon, 2004). This claim is made partly because Alexander's approach emphasizes a wholeness among people, place, and nature that is similar to the wholeness that much of premodern-vernacular architecture exhibits (Alexander, 1979, 1984, 2003; Benyus, 2008; Brittan, 2001; Kellert and Heerwagen, 2008; Mugerauer, 1994; Orr, 2006; Relph, 1976, 1981; Riegner, 1993; Rudofsky, 1964; Stefanovic, 2000; Seamon & Mugerauer, 2000; Seamon, 2000).

In this final chapter, I expand my discussion regarding Alexander's research on wholeness for two reasons: first, to assist the reader in better understanding the contributions of Alexander's work for advancing biomimicry; and, second, as a means to discuss the role of the built environment for instilling Heidegger's *genuine sense of belonging* and the value this environmental belonging might have for sustainability. Making reference to Heidegger, architectural journalist Thomas Fisher suggests that Alexander's approach avoids the positivism of modern and post-modern architecture that has "blinded us to what it means to 'be' in this world—to feel at one with a community and at home in the environment" (Fisher, 1986, p. 102). In other words, Alexander's work is largely devoted to instilling a genuine sense of belonging which moves beyond conventional approaches.

It could be rightly said that Alexander's entire professional career has been devoted to developing a process for the creation of wholeness in the built environment. Even before doctoral studies in architecture at Harvard in the late 50s, Alexander was a physics student at Cambridge, England, where his studies focused on the relation of parts to wholes (Mehaffy, 2007). His research and writings on wholeness—which parallels and has influenced research in biological and computer sciences—is the most extensive and perhaps radical in planning and design (ibid., p. 46). Similar to Bortoft's (1996,2000) studies of the wholeness of nature, Alexander believes that "one cannot look at a part of the whole without looking at its relation to the whole, and the complex influences of its location within the field" (ibid., p. 46). Mehaffy explains that "at the core of [Alexander's] work is the recognition that good design is not a matter of elements working properly in an additive atomic systems, but rather of regions of space amplifying one another in a larger totality" (ibid., p. 46). A key focus in this argument is that "overlap and redundancy," though subtle and seemingly accidental in nature and vernacular architecture, are "essential attributes…occurring in very particular ways" (ibid., p. 42).

Alexander claims that the qualities of overlap and redundancy have been ignored in most modernist design. This is in contrast to the "apparently humble structures of vernacular architecture [which] were in fact extremely robust and capable of producing exceedingly complex results" (ibid., p. 44). Alexander suggests that robustness and complexity in pre-modern design resulted from deeply rooted "interactions between humans and their environment" (ibid., p. 44). Mehaffy explains that "taking his cue from nature, Alexander studied the processes of morphogenesis in biology and other natural phenomena, and the characteristic geometries that resulted" (ibid., p 45). In other words, Alexander believes that morphogenesis in nature was automatically and unself-consciously adopted by earlier cultures because of their deep connectedness with the natural world. In this sense, their creations engaged a process of morphology as a phenomena of nature and this way of understanding and making can rightly be considered as authentic biomimicry.

Building on this foundation, Alexander studied the geometry of nature and vernacular architecture for over thirty-five years, working phenomenologically rather than reductively to distill morphological geometries into several properties; a few examples are strong centers, gradients, and deep interlock (ibid., p. 45). In this research, Alexander also made the observation that each of these properties "has a corresponding kind of transformation that gives rise to it" (ibid., p. 45) or what Alexander refers to most recently as a "wholeness-extending transformation" (Alexander, 2007). Though it may seem that Alexander has simplified and reduced wholeness to a quantitative listing of properties, it is important to note that the descriptions of these properties of nature and processes are presented in a four-volume masterwork written over thirty years and entitled the *Nature of Order* (Alexander, 2002-2005).

In this work, Alexander stresses that adopting a holistic perspective has important implications with regard to the qualitative experience of value in the built environment, which for Alexander "is a sharable phenomenon, and discussible one" that is intrinsically and innately understood by all humans and other creatures. As Mehaffy (2007) explains, "when it comes to [all] living organisms, and apparently, when it comes to the built environment, value is rooted in the structure of things" (ibid., p. 47). In short, Alexander seeks to develop a process which as much as possible mimics the generative-wholeness of nature. Furthermore, he suggests that, by adapting this process for designing and building the human-made world, one can foster a healing and fulfilling quality, similar to the natural world's role in biophilia.

Alexander believes that much of modernist design lacks this healing quality which he argues is a shared and intrinsic value among humans. As a result, much design today lacks feeling and the appreciation of wholeness that forms our own existence: "to put it bluntly [because of the character of contemporary design], *we do not know who we are*. We can hardly act without floundering morally or emotionally" (Alexander, 2007, p. 11). Thus, in *Nature of Order* he continually explores the way "that we sentient, feeling creatures interact with our surroundings, and…the way that interaction leads us to understand ourselves and the nature of our lives, and ultimately even to understand, in part, the nature of our souls" (ibid., p. 12). He refers to the physical, geometric aspects of our surroundings that engage us in this deeper, interactive, fulfilling relationship as "living structures." He explains that "the appearance of living structures in things—large or small—is also correlated with the fact that these things induce deep feeling and a quality of connectedness in those who are in the presence of these things" (ibid., p. 13).

He suggests that this "living structure" is almost always present in nature and explains why nature always exhibits a special kind of harmony, beauty, and wholeness. Therefore, "we must conclude that there are particular kinds of process occurring in nature that, repeatedly and without effort, make things beautiful" (Alexander, 2007, p. 14). For Alexander, this process is called an "unfolding," which is a holistic and sequential process that "governs the coherent quality of end-product configurations" in the built environment. Only "this kind of process places appropriate emphasis on the well-being of the whole" (ibid., p. 15). He claims that the "core quality of an environment that is *unfolded* through *wholeness-extending transformations* is its deep relatedness to human beings in a way that may be called 'belonging'" (ibid., p. 15). He contends that this "belonging" is "related to people's inner feeling" and is by no means trivial in the sense that structures created in this process "by their nature…nourish the land and the people and give rise to a great depth of substance that provides genuine support for human beings and the Earth" (ibid., p. 15). In short, Alexander contends that adapting this holistic process results in an environment that "will be sustainable as a whole" in a way that is "deeper and more comprehensive…than the partial technological sustainability that has become fashionable in recent years" (ibid., p. 15).

Environmental Humility

In a way similar to Alexander's claims regarding the interrelated beauty and wholeness of nature and vernacular architecture, Relph suggests that unique places "share in the fact of having been made by more or less committed individuals, and they therefore always reflect in some measure human abilities and concerns similar to one's own" (Relph, 1981, p. 174). Relph calls such lived commitment to place and nature "environmental humility," and in this section I review this concept to further describe a relationship that might exist between humans and environment that is reciprocal and healing. Such a relationship, I contend, has direct implications for a more complete sustainability.

Relph's notion of environmental *humility* draws on the Latin roots of *humus* and *humanus* to preserve and stress their shared meanings for both Earth (*humus*) and human (*humanus*), emphasizing "the original sense of human-beings as earth-bound" in the sense that we are earth-born and sooner of later return to the earth. In addition to highlighting the inseparable physical connectedness between human and earth, Relph emphasizes human responsibility and the fact we are linked to the earth in the sense that "it is impossible to pretend that we are only a part of nature like ants or ostriches" (ibid., p. 163). Yet, at the same time, he explains that, as humans, we are "nevertheless only one being among many" and are not masters of all we survey" (ibid., p. 187). Instead, after Heidegger, he suggests that human beings have a "profound responsibility for the guardianship and protection of all things" (ibid., p. 164).

For Relph, this responsibility and guardianship is not based on mastery, domination, or technical manipulation. Rather, it is founded in Heidegger's notion of appropriation. Relph writes that the essence of appropriation is "the taking over of some being by allowing oneself to be taken over by it" (1981, p. 187). This means that "as we open ourselves to the world, the things and places lend meaning to our sense of identity" (Dovey, 2000, p. 37). In other words, not only can we care and learn from nature and the built environment; just as importantly, we gain knowledge and an enriched sense of well being. Relph explains that environmental humility "is an appeal for guardianship, for taking care of things merely because they exist, for tending and protecting them. In this there is neither mastery nor subservience, but there is responsibility and commitment" (Relph, 1981, p. 187). I would argue that this attitude of letting things be as they exist and adopting a deeper responsibility based on tending and commitment is needed for a more sustainable approach.

Heidegger (1977) uses the example of a cabinet maker to elucidate the character of an approach to the world grounded in care and concern. He explains that "the learning of a cabinet-maker's apprentice is not mere practice, not the accumulation of knowledge about the things he is likely to make." Instead, to become a true cabinet-maker, the apprentice "makes himself answer and respond above all to the different kinds of wood and to the shapes slumbering with the wood" (Relph, 1981, p. 188). In other words, designing and building are not merely the application of accumulated knowledge and skills but requires a quieting of one's own preconceptions and letting things be so that, as much as possible, what might be done has an opening whereby it might reveal itself. This *letting be* is not complete passivity but implies that we engage nature, environment, and people in a "tending" that is revealed by them. Such an approach is similar to Krafel's (1999) tending of the eroded fields, where at first he failed because he believed the larger his efforts, the larger the resulting impact. After these first unsuccessful attempts, however, his continual tending to the eroded channels slowly reveals an approach that requires much less effort yet has much greater impact.

I would contend that, to adopt such an approach, designers must put aside their *individualism* and "the belief that personal growth, freedom, and gratification take priority" (Relph, 1981, p. 170). Such an attitude is "merely a counterpart to highly-trained technicians and administrators" (ibid., p. 170). Instead, the design aim must be a deep appreciation for the *individuality* of both natural and built environments as well as people and the acknowledgement that "there is no part of environment, whether human or natural, which is worthless;" therefore everything we do is "ethical and has ethical consequences" (ibid., 194). I would contend that environmental designers—beyond their desires for innovation and artistry—have a deeper responsibility to nature, people, and built environments that, if ignored erodes the possibility for achieving a more complete sustainability.

Relph contends that only by working incrementally and finding the means to direct events and circumstances gently and appropriately, can we encourage the "making and maintenance of places by the people who understand them and live in them" (ibid., p. 191). In this sense, I would argue that Relph's idea of environmental humility and Heidegger's notion of appropriation enlarges Alexander's claim that humans gain a sense of belonging by merely viewing or experiencing the visual qualities of the "living structures." Instead, Relph suggests that the actions of tending and shaping our environment are innately and intrinsically shared by all humans. In other words, not only can designers lead a process for designing and making in the built environment which produces a final result that exhibits an image-based wholeness; rather, it is the process itself and the ongoing tending and adapting of these environments which must also occur to optimize this wholeness. I would therefore contend that Relph's environmental humility and Heidegger's notion of appropriation extends Alexander's design process beyond an emphasis on producing image-based objects of beauty.

This being said, even Relph acknowledges the contributions of Alexander's work. Relph writes: "Alexander has shown that it is possible to conceive of a way of making and tending" whereby one might create "once again places with all the qualities of these inherited and admirable landscapes which we have otherwise forgotten how to build" (Relph, 1981, p. 205). In short, only by developing "a compassionate intelligence which respects things and persons as they are" (ibid., p. 209), can designers acknowledge the role that appropriation can have in an environmental belonging that fosters a more complete care and concern for the environment. This deeper care and concern for built and natural worlds is prerequisite for moving beyond approaches emphasizing low-impact technology for purposes of conserving nature for our survival. Though these technology-based approaches may reduce human environmental impact, they may likely become another stop-gap response that merely prolongs environmental degradation by ignoring a more complete sustainability. In this sense, these approaches are partial, incomplete, and thus insufficient for achieving a sustainable lifeworld. Instead, conventional approaches of designing and making grounded in replacement technology must be rethought and transformed into an originary designing and making that instills an everyday, use-based relationship of *appropriation* with our natural and built worlds. Only then can we shift from conventional approaches toward a holistic approach that heals ourselves, our places, and our damaged natural world.

Sensitizing the Local

One potential weakness of this more holistic approach to environmental design is how local people can truly understand their place, when so often in today's world there is lack of authentic relationship between residents and the locality that is their home. Former Montana state legislator and mayor of Missoula, Daniel Kemmis, addresses this concern when he writes that “even here in Missoula, a modest city of some sixty thousand people, any dream of achieving some comprehensive sense of wholeness in the city at large…would leave me or any of my neighbors in despair” (1995, p. 13). I would argue, however, that Kemmis’writings on place and community making (Kemmis, 1993, 1995) in fact point towards a more holistic approach for involving people in healing and revealing the wholeness dwelling in their places—what I have called “sensitizing the local”—and that an important effort for designers is to facilitate and allow for this process. Only then can designers elucidate the necessary wholeness which may have been lost and begin healing people, nature, and place.

Kemmis writes that “one mark of a good politician is knowing when to let the world work, and when to work on the world” (ibid., p. 177). Here I would claim he is describing an approach that lets things be so they might have an opening to reveal what might be done. He explains that it is necessary to acknowledge that local residents and their community’s desires are organic and need to organize themselves in their own terms, though he also acknowledges that living and working within a diverse community is challenging and requires a special way of relating to one another. Kemmis believes that when one recognizes that a community shapes and organizes “itself entrepreneurially, ceaselessly risking and experimenting,” one learns to work with [other members of that community] and to see opportunities to share risk-taking with the community (ibid., p. 177). He suggests that it is everyday interaction, concern, and tending that is the true meaning of *civility*, citizenship, and civilization. Kemmis contends that communities acquire “an organic life force of their own” and that this *civility* “broadens beyond a pure survival mechanism…and like the biological instinct for life, which is not always content for survival, the life instinct of the city turns its energy to the pursuit and realization of opportunities…thrive and prosper” (ibid., p. 191). Here, Kemmis clearly adopts the language of nature to describe a more holistic-positive relationship among people and place.

I would contend that Kemmis’ civility enlarges Relph’s and Heidegger’s people-environment relationship and describes a deeper, more reciprocal relationship of appropriation that can exist among people-in-place. In other words, when locals are cooperatively engaged with one another, their efforts not only produce a physical wholeness in the built environment but this cooperative process is part of that wholeness. By involving themselves in a common situation, they assume responsibility and accept a role of tending and care for the environment and each other that enriches their sense of individual and collective well being. Kemmis claims that citizens themselves are the best leaders and that, when they become more practiced at working together with the wholeness of environment at heart, it is precisely this wholeness that is revealed and given their attention (ibid., p. 194). He explains that in this way the community "continues to be present in—and to pursue its own interest through—the nurture and practice of civility" (ibid., p. 194). In this sense, I would claim that such a process fosters a reciprocal, holistic relationship of healing and belonging.

According to Kemmis, it is not only important for citizens to be leaders but for power to be dispersed among as many individuals and groups as possible. He claims that people cannot simply rely on community leaders to take charge; this mode of governance only results in others feeling ignored or alienated, which can end "in a wide range of personally and socially destructive behaviors" which undermine the healing and wholeness-making process (ibid., p. 203). Instead, a more successful effort would be to "share the burdens and the satisfactions of citizenship more broadly" (ibid., p. 203). As a result, more people feel "more whole by becoming more engaged, and the city itself more robust as a result" (ibid., p. 203). He argues that only working incrementally, with as many people as possible, allows "the small acts of kindness, of hope, of cooperation by which people sustain and nurture the fundamental goodness of their communities… [and] truly feel at home" (ibid., p. xviii). A potential problem with this approach is that "unfortunately today, community involvement too often becomes special-interest groups fighting for power" (Seamon, 2004, p. 126). Kemmis claims, however, that in his experience, locals often take responsibility in these situations and begin to mediate outspoken extremists and find common ground on opposing views as means to complete the wholeness within community (Kemmis, 1995, p.188-191).

Here, I would contend that Kemmis' implicit phenomenological perspective provides a concrete example for designers to engage locals in a process which reveals the wholeness dwelling in places. By sensitizing locals to their places and each other, designers' efforts are directed to healing the lacking sense of wholeness. This process of sensitizing not only serves to engage locals in a process of tending, caring, and appropriation for their environment, as described by Relph, Heidegger, and Alexander. I would contend that it also points toward a deeper connectedness and relationship of appropriation among individuals and a larger community of people. In this sense, as Seamon suggests, Kemmis "provides an extended picture of what is necessary, in terms of getting different parties to discuss and compromise, if the…wholeness and healing" of Alexander's process is to be carried out and supported by locals (2004, p. 133).

I would contend that by adopting Kemmis' approach, designers engage locals in a process of civility where power is broadly dispersed among participants who accept responsibility as a means to complete the wholeness within the community. In this process, designers "sensitize" locals and let them be, allowing them an opening to reveal what can be done to heal the lacking sense of wholeness among them and their places. By adopting this holistic process, designers' efforts do not simply preserve nature for our survival, but their efforts heal people and places. This cooperative process is similar to that which exists so deeply in the interconnectedness and wholeness of nature and points toward an approach that can begin to restore our environments as a positive-fulfilling force in our everyday lives.

Sensitizing the Designer Toward a Holistic Perspective

The major aim of this thesis has been to develop a phenomenological interpretation of biomimicry and its potential value for sustainable design. I have argued that this holistic perspective is a necessary supplement to a nature-focused perspective like biomimicry. I believe that the arguments and claims I have outlined point towards important considerations for designers when engaging nature. These claims emphasize the conceptual and applied wholeness dwelling in nature and the problems which arise when this wholeness is ignored. In this final section, I address challenges surrounding this holistic approach. I do this not to undermine my arguments, but to fulfill the true meaning of phenomenological critique and describe things critically yet fairly.

One of the obstacles for designers that choose to engage this more holistic process is the demands they face at nearly every step of the process. It is not easy to experience the wholeness of nature and to understand the complex relationships that exist within it. Nor is it easy to engage the wholeness which can be found in the built environment or to facilitate a collective seeing and understanding as to what can be done to complete the wholeness that might be lacking. To a certain degree, these demands arise from working in reverse of the established system for conventional designing and building which relies on designers to envision;

contractors to construct; specialized consultants to provide specialized knowledge; clients more often concerned in maximizing profits than in addressing user needs, and so forth. Such a wide range of participants and obstacles can lead to cynicism.

Alexander describes this difficult situation as a *battle* between opposing systems. He claims that this is not merely a battle in the worlds of designing and building but in a much larger societal and existential sense. He claims that the battle describes a deeper struggle between political and social life in contemporary culture that arises in the process of providing physical form to our society (Alexander et. al., 1985; Alexander, 2009). In other words, Alexander sees his work as not merely a process in designing and making which heals the connection between people and place. More so, he sees his efforts as a way to heal the growing degradation of earth and society. In this sense, "this is a huge matter…[that is] fundamental to the history" of our future (Alexander et. al., 1985, p. 35). Perhaps this is why Alexander has devoted much of his professional life to countering these conventional approaches. Many thinkers suggest that he possesses a singular passion that is unmatched for restoring peoples' rightful role in designing and making their environments, but such passion and insight is difficult for most other designers to master. A key question, then, is how does the larger design community engage in such demanding efforts?

I draw on Krafel to elucidate one possible direction. I believe Krafel would suggest that an approach viewed as the complete paradigm shift that Alexander advocates is likely to achieve large resistance. Krafel writes: "attempts at large changes create large resisting forces" (Krafel, 1999, p. 179). In contrast, he suggests "that small changes can relentlessly accumulate into significance…[and that] each tiny choice is a tiny source of power" for change (ibid). He refers to such small changes as shifting balances or upward spirals. Describing this in his repair efforts with the eroded fields, he writes: "I no longer saw myself confronting and halting erosion single-handedly. [Instead, I] see my work as that of shifting balances—little balances—wherever I encountered the opportunity. Whenever a balance shifts, an enemy will become an ally to help me with the work" (ibid., p. 152). By adopting this perspective, Krafel explains that "a shift in relative balances causes sequences of cause-and-effect to tilt to the other direction. Downward spirals of erosion reverse direction and become upward spirals of growth" (ibid.). In this sense, I would claim Krafel is describing an approach which is more phenomenological and less imposing than Alexander's.

Such an approach lets things be and allows them to reveal what might be done as opposed to confronting what appears to be a series of obstacles which must be altered or manipulated. I would contend that, if we are to move towards a more complete sustainability, the need is not only replacement of our current piecemeal knowledge with a "greener" contextual knowledge, nor is it a complete paradigm shift, which would most likely be met with much resistance so that the power of the shift is dispersed and any sense of wholeness lost. Instead, we must look at each small individual choice as an opportunity to make a small-scale shift in relative balances, transforming downward spirals into upward spirals. This phenomenological attitude might allow us to see the wholeness that is reflected in each of these choices so that a healing might happen among people, place, and nature. If we do not attempt or trust this approach, we accept by default that it is only human cleverness and intelligence that can draw the necessary solutions from nature for our needs. This anthropocentric attitude merely replaces one positivist view with another. This approach is not authentic biomimicry but simply "green."

Authentic biomimicry must acknowledge the deep and profound role we each play in being on earth and being with each other. Conventional sustainability approaches may be necessary to shift balances in energy consumption and reduce our environment impact, but I believe that this standard approach does not acknowledge a deeper shift in the ways we design and make our places—a shift that is essential if we hope to engage and strengthen the intricate and interrelatedness between human beings and the natural and built worlds.

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