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PATTERNS IN THE LANDSCAPE

by

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A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE
MASTER OF ARCHITECTURE

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May 1996
ABSTRACT

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by

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Architecture is a reconciliation between ourselves and the land. Our attitudes toward Nature have traditionally been either deification or desecration, finding the rawest of materials to do as one will—leading form to paralysis or imposition. Nature is inherently discordant; within the chaos are patterns revealing a new type of order. Working with these patterns in the landscape uncovers circuits of relationship, creating mutual acts of amelioration between environment and building. Human action and natural process become one.
ACKNOWLEDGMENTS

I owe a great deal to my advisors for helping me in their own special ways: Charles opened my eyes and always believed in me, Sanford opened my mind and Yung-Ho kept me working.

I would like to thank my mentor Eugene Egger, for giving me my foundation and the tools to grow. I constantly hear your advice in the back of my mind.

Finally and most importantly, I would like to thank my wife, Cyndi. You helped me to stay truthful to what I believe in my heart.
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Preface

The Earth is a cacophony of potential orders. Not only the organic, but the inorganic parts of the world reveal networks of immense complexity. Nature is not an idyllic garden separated from civilization. Human action and natural process are linked inextricably. The environment often has profound effects on traditional cultures and buildings, shaping how people see the world and how they interact with it.

A closer look reveals the pattern of humanity on the land. However, the patterns teach a very important lesson; no one is in control of Nature. Architecture is ultimately a reconciliation of humanity with Nature. By carefully and thoughtfully interacting with the landscape, Architecture can attempt to rejuvenate the Earth.

A new philosophy of nature needs to be developed, bringing thought closer to the reality of nature. The history of environmental thought from Classical Greece to the present is riddled with misguided metaphors. As a result, humanity has attempted to remove from the environment. Preferring to master and control. The new philosophy will restore humanity’s essential relationship to nature.

With a keen eye, the dynamic processes of nature are revealed. Architecture is the process of giving form to the chaos of nature.
Part I: A New Perspective of Nature

When a culture builds, they inevitably mark their perspective of the world, on the land. Two perspectives of Nature have been with humanity from the beginning: the Divine and the Organic. In the last two hundred years another perspective has emerged: the Mechanical. In the divine view, nature is created by an external force: God or the gods. The universe is a perfect, harmonious creation. Everything has its proper place in the sacred order. If Nature is organic, it is a living being in a continuous act of becoming: birth, decay, death, and rebirth. Turbulence, cycles, and flux are the signs of order and reveal the interconnectedness of the Earth. If Nature is a machine, it is rational and predictable. Like a machine, everything in Nature is dissectable into its components. Given enough knowledge and time, the Earth is subdued and controlled.

These three perspectives of nature: the divine, the organic, and the mechanical dominate our thoughts about the environment.\(^1\) Western viewpoints of Nature are often a mix of all three perspectives. Any new vision must reconcile and build upon the beliefs of the past, while offering a more realistic view of Nature.

Nature as Divine

The argument of a divinely created Nature contains some important illusions about the environment. They are illusions deeply embedded in the human psyche. Observing the apparent perfection found in nature, humanity assumed the Earth must be created by a God. The belief in a harmonious environment was used to prove the existence of God. Another important idea is the belief of a purpose in Nature. Many of the ancient civilizations focused on the idea of the perfect world created by the gods as the home for humanity. The result of such an idea was the all important question: What is the purpose of humanity on the Earth?

In the Bible, nature is the design of God out of a "formless void."
Everything is created with definite purpose and place in the universe. "Let there be lights in the expanse of the sky to separate the day from the night, and let them serve as signs to mark seasons and days and years, and let them... give light on the earth."² The idea of human control over the Earth is laid down from the very beginning, "So God created human beings, making them to be like himself... have many children, so that your descendants will live all over the earth and bring it under their control."³

The Book of Genesis is a search for order. It is an attempt to answer one of the most important questions in the history of thought. What is the source of order in the universe? Setting down some of the basic assumptions about the environment, the Bible portrays Nature as inherently harmonious. God's order is fixed and perfect for eternity. Humanity's place is to take care and manage the Divine Architect's creation.

²Genesis 1:14-16
³Genesis 1:26-28
One of the most important moments in the history of the Christian idea of Nature is Adam and Eve's fall from the Garden of Eden. Adam's eating of the apple from the Tree of Knowledge and their banishment from the Garden created disorder in the universe. All the environmental problems are the results of the actions of humanity. A divinely created Nature, free from the meddlings of humanity returns to the orderly perfection of the Garden of Eden. From this perspective, wilderness is good and the city and creations of humanity are evil. It is also the source of the lamenting over earthly existence and desire for the beauty found in the after life. Life is characterized by toil and suffering to atone for the sins of humanity. If this is a world filled with sin and evil everywhere humanity goes, then why should humanity focus on anything but heaven? It is a
source of disengagement from the world. Such withdrawal from the world is a logical extension of the separation of humanity and the rest of creation.

Possibly a more dangerous interpretation of the Fall is the idea that it symbolizes man's existence as one of rebellion against God. "He has used the freedom God has given him for the purpose of ruling over the earthly creation in order to assert his independence from God and to become like God." Humanit y's place is to exhibit power over Nature, reshaping the earth into the perfection once created by God. The marking of the earth evolves into a quest for a return to the Garden; a return to order in the universe. These beliefs will be the foundation for Judeo-Christian beliefs for centuries. Eventually they will be the source of fuel for the mechanistic philosophies of the seventeenth century hoping to control Nature with science and reason. Both philosophies rest on the belief that human action is required for the creation of order.

In contrast to Christian views of Nature deriving from Creation the Greeks found the sources of many ideas in their environmental theories from observation and experience. In their arguments of divine purpose and environmental design, the Greeks laid down the basic positions toward Nature in Western philosophy.

In Greek philosophy, "three kinds of proof are used in demonstrating the existence of divine providence: the proof of physiology, of the cosmic order, and of the earth as a fit environment." From physiology, the Greeks took the idea of everything in nature must have a purposeful creation. Evidence of such a purpose derives from the parts of the body. The eyes, to them, were to show the divine creation. The hands were to give birth to the arts. Standing erect,

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5Glacken, 42.
humanity is superior to the animals standing on four legs and face the ground
instead of the heavens. Superiority of vision on two legs reemphasized the
preferred place of humanity over the "lowly beasts."

The idea of cosmic order was a belief in a perfect god. Proof of the gods
work appears in the design on the earth. To the Greeks, the gods have very
carefully provided for the requirements of humanity. Socrates "points out in
detail the nature of divine foresight: light is provided for man, but night is also
necessary for a period of rest, and if some tasks like sailing, must be done at
night, there are stars to guide us. . . .The gods have made the earth yield food
and they have devised the seasons."7 The ideas show a very superficial
relationship to Nature. Instead of taking a close look at the processes found in
the environment, there is a general tendency to stand in awe at the gods
creation.

Plato's Timaeus shows the universe to be the work of a good,
reasoning, and divine artisan. Plato's god finds himself in a discordant and
chaotic world. Through his Reason, the god imposes order on the cosmos.
The power behind the universe is divine purpose. The beginning of the
Timaeus Plato makes the distinction between Being and Becoming. Being is
the world of rational understanding: the operations of mathematics and logic.
The world of Becoming contains all the things perceived by our senses.
Becoming is too uncertain and transitory for Plato. The physical world is
therefore a secondary reality, and knowledge of it is imprecise. "Whenever,
therefore, the maker of anything keeps his eye on the eternally unchanging and
uses it as his pattern for the form and function of his product the result must be

6Glacken, 42.
7Glacken, 43.
good; whenever he looks to something that has come to be and uses a model
that has come to be, the result is not good." For Plato, the world is beautiful
and perfect; the divine artisan must have created it from an eternal pattern. The
universe is based on logic and mathematics. These assumptions about
Nature, together with the ones derived from Christian thought persisted and
dominated until the time of Darwin, despite the strong critique they received by
other Greek, Roman, and even Christian philosophers.

Nature as Organic

All the Greeks and Romans did not agree on Plato’s divine artisan.
Perhaps the first of the classical philosophers to oppose the divine creation
was Lucretius. He attacked Platonic Creationism on all fronts. “The gods most
certainly never made the world for you and me: it stands too full of flaws.” In
one blow the basis of the Platonic argument cracks. The world is not perfect
and harmonious. Therefore, if the gods creations are perfect the earth cannot
be one of them; in reverse a nonexistent harmony in the world cannot prove the
existence of a divine artisan. Further more in Lucretius, Nature is not based on
universals, reason, logic, or mathematics, but on change. For him, the world of
Becoming is the true source of knowledge. The world is a living body; and like a
body, it is mortal.

Most importantly, Lucretius sees the earth to be an organism. Like the
human body, the environment is constantly changing to meet new conditions.
Both are made up of a variety of systems to manage, change, and sustain life.

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Change is a fundamental characteristic of life, manifested in cycles of birth, life, decay, and death. "All food and increase are repaid in proper part; and since beyond all doubt earth the all-mother is also our common tomb, she gives, but takes away, and grows again."\textsuperscript{10} As an organism, the world constantly evolves.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure2}
\caption{Human Body as Metaphor of the Earth}
\end{figure}

As a theory, \textit{On the Nature of Things} focuses on natural process more than with organic wholes. It will take later writers like Whitehead to expound the ideas of holism. The earth exhibits its organic qualities through natural cycles.

The creation of a "second" nature is a theme within Lucretius. Humanity in the struggle against the environment, recreates Nature. "Surely primal bodies exist in the soil. Plowing the fertile furrow, turning up the earth, we bring

\textsuperscript{10}Lucretius, V, 256-260.
these bodies to the surface. . ."¹¹ Humanity can change the earth to its benefit. The actions of a culture modify their environment. At times, human action reveals the bountiful potential of the earth. At other times, human action leads to failure; the latent cruelty of Nature is unleashed. The earth is not the creation of a divine artisan existing beyond view, but the result of constant interaction between humanity and the forces of Nature.

Lucretius is important for three reasons: he rebutted the basic ideas supporting the idea of a divine Nature, he created a new concept of an organic Nature, and he showed how humanity, as a part of the organic, changes the environment. He displaces the myth of the eternal order of Nature for a belief in constant flux in the environment. The organic viewpoint has been a constant passion underlying western thought about the environment.

Organic theory was revived by the Romantics in the nineteenth century as a response to the rising tide of Mechanistic Theory. There was a shift in the aesthetic perspective from the classical derived from the Greeks and Romans based on symmetry, balance, harmony, and structural order—to the aesthetics of the organic based on change and decay.¹² An important idea of the Romantics is the desire to get rid of the prejudices humanity has held in looking at the environment. They saw Nature with a fresh perspective. This desire is clearly expressed by Henry David Thoreau: "I dream of looking abroad summer and winter, with free gaze. . . to be nature looking into nature with such easy sympathy as the blue-eyed grass looks into the face of the sky."¹³ Like many other Romantic thinkers, Thoreau becomes biocentric.

¹¹Lucretius, I, 210-224.
¹²Botkin, 96-97.
Thoreau and his generation: Emerson, Wordsworth, Goethe, Schelling. They sought to redefine man’s place in the universe. They had a passion for biology and ecology. Such passion shows the pervasive desire to find out where humanity fits in the larger system. Like Lucretius, Thoreau saw humanity as a small part of the organic whole of the universe. Humanity does not live on a dead earth, but within the whole of the universe. Like all organicists, Thoreau saw the earth as a living body: "The earth is not a mere fragment of dead history, stratum upon stratum like the leaves of a book, to be studied by geologists and antiquaries chiefly, but living poetry like the leaves of a tree, which precede flowers and fruit,—not a fossil earth, but a living earth."  

The key concepts of the Romantic view of nature were interdependence, relatedness, and a desire to reestablish the close relationship between humanity and the earth.

Thoreau saw humanity becoming isolated from nature as an unacceptable part of the Industrial Revolution going on around him. "He continually emphasized that the society of nature is as important to the self’s development as is the human variety. Isolated from the natural world, man is like a bird lost from its flock—fractional, naked, like a single thread or raveling from the web to which it belongs." The common belief that humanity is superior to nature is ridiculous. Nature is a dense network of relationships. It is not a hierarchy with humanity on top, but a heterogeneous assemblage within which humanity is embedded.

From Thoreau, to the present, organicism has retained a role as the critic of technology and modern science. He withdrew from society, established

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Worster, 84.
a new religion, condemned technology, and investigated natural processes. Paradoxically, Thoreau set out to destroy the scientific perspective, but found he could not do without it. He set out to become part of nature, but found "once I was part and parcel of Nature; now I am observant of her."\textsuperscript{16}

The critique and eventual redefinition of science is a common theme organic theory. It is a trait shared by Thoreau and Alfred North Whitehead, the most famous proponent of Organism in this century.

In \textit{Science and the Modern World}, Whitehead argues against the mechanistic perspective of nature dominating Western thinking for three centuries. He saw the primary job of philosophy to be a critic of abstractions. To him, all thought is based on abstract concepts, but problems arise when the abstraction goes too far. Sometimes a thinker may abstract too much, removing too many things from their area of focus. Elements of a system are fixed, when actually they are free. Scientific inquiry is a paradox, parts of a system must be fixed to understand, but fixing the parts kills the system. However, Abstraction is necessary for thought. Abstraction allows thought to be concentrated on particular things with clear cut relationships. From such a situation, with a logical mind, a thinker deduces other relationships. Scientific thought confined to abstractions blinds its vision of nature.

Whitehead saw the philosophers of the seventeenth and eighteenth confining scientific thought and philosophy. "It was the age of reason, healthy, manly, upstanding reason; but, of one-eyed reason, deficient in its vision of depth."\textsuperscript{17} The main thinkers of the age: Galileo, Newton, DesCartes, Bacon,

\textsuperscript{16}Worster, 97.
Locke, created a dogma, freezing their perspective of nature. They turned the major assumptions of the age into scientific fact.

Consequently, all nature came to appear "senseless, valueless, purposeless." Such thinking, Whitehead maintained, could well boast of its achievements in positive knowledge and of the technological progress it furthered, but as an account of the world, it is willful blindness.\textsuperscript{18} For him, a new age of science lay ahead. It was to be an age of organicism. Organicism emphasizes process, creativity, indefiniteness, organic unity of the whole universe, and interlocked relatedness of events. By rediscovering the relational depths found in the patterns and processes of the universe, science could regain its sight.

Whitehead believed "a philosophy of nature must contain at least these six notions: change, value, eternal objects, endurance, organism, and interfusion."\textsuperscript{19}

Nature is in a constant process of change and transformation. The mechanists tried to freeze or eradicate changing elements in closed systems. Change is difficult to quantify; mechanists ignored it. However, Whitehead knew change was an integral part of the natural process. The seasons move and transform the landscape. Some aspects of nature are fleeting. They only exist in specific places and at definite moments in time. Change persists. It is a unifying quality of nature across space and time.

For Whitehead, despite change, Nature did have certain "eternal objects." The process of change is eternal. Colors, sounds, scents, geometry are eternally emerging from nature. These qualities allow the observation of

\textsuperscript{18}Worster, 316.
\textsuperscript{19}Whitehead, 88.
nature. Without them, perception is empty. Experience connects these eternal qualities into knowledge about the universe.

Perception shows nature to have value. In Whitehead's terms, value is the intrinsic reality of an event. Value comes out of concrete experience and shows itself to be an end in itself. It is an experience of the realization of nature's potentials, despite inherent spatio-temporal limitations. "One all-pervasive fact, inherent in the very character of what is real is the transition of things, the passage one to another."\(^{20}\) Value shows the qualities of perception and experience are essential to a philosophy of nature, despite the mechanists' attempt to replace them with abstract fact.

Another quality of nature is its endurance. Nature persists. It has the enormous permanence of eternal objects. If change is the figure of nature, then endurance is the background. The qualities of eternal objects: colors, sounds. . . connect experiences across space and time. Endurance establishes patterns of experience and relationship. The spatio-temporal interfusion of events and organisms is effected by the endurance of nature. The permanencies of nature carry tremendous significance in understanding how change affects organisms. In the flux of the environment, endurance allows order to be revealed.

The idea of the organism is central to Whitehead's philosophy. He believed the various parts of nature are interlocked; no part can be abstracted out without altering its own identity and that of the whole. Everything is linked together in a dense network of interactions. This network of interactions is not like a machine, but like a body. Whitehead's vision of organic relatedness

\(^{20}\)Whitehead, 93-94.
evolved out of and enhanced the development of ecology and biology. By restoring the interdependency of the world, Science would teach humanity a new ethic. Western culture would seek cooperation over competition. Whitehead saw organicism restoring morality to science.

Organicism, whether it is lauded by Lucretius, Thoreau, or Whitehead has always been a critique of the static perspective. They all urge nature to be experienced and explained, not by structural symmetries or universal harmonies, but by accepting the dynamism of the world.
Nature as Machine

Mechanistic theory has been a strong influence in the development of modern science. It has shaped science's perspective of nature. In its simplified form, mechanism describes nature as a machine. Nature as a machine must be murdered to be dissected. In its more sophisticated form, mechanism described nature as a system of matter in motion, entirely subject to the laws of physics and chemistry.

The rise of the mechanical world view had four main consequences: acceptance of the new laws of physics, the machine age, a new theological perspective, and a new view of nature.

The ascendance of physics, to the top of the intellectual spectrum, had three influences on science: a materialistic perspective, the method of induction, and a belief in closed systems.

Quantification is the goal of the materialistic perspective. In the age of Galileo and Newton, science focused on measurement, particularly in the "hard" sciences of physics and chemistry. Science looked for measurable elements within observed phenomena and searched for the relations between those measurements. Newton defined the basis of all measurement. His physical laws assume mass to be a common element of all phenomena. Science began to focus on the quantities hidden below the surface of experience instead of the qualities an object may have. Experience was mistrusted; only measurement could give the "Truth."

The method of induction has been rationally justified, Induction reasons general laws can be derived from a particular set of facts or particulars. In order

21Whitehead, 83.
to derive the general law, a metaphysical assumption of the continuity of the universe must be assumed. The limited set of facts must be seen as part of a rational history where the past known characteristics of a “community of occasions” can be extended into the future. “The wider assumption of general laws holding for all cognisable occasions appears a very unsafe addendum to attach to such limited knowledge.”\textsuperscript{22} Induction is necessary for scientific theory, but it rests on shaky philosophical ground.

The ideally isolated system is another essential element of scientific theory. The isolated system is free of “casual contingent dependence” on the rest of the universe. This independence does not have to be total, but only in respect to certain abstract characteristics of the isolated system. Mass, motion, energy, etc. must be conserved within the system and must not be in a relationship with the outside universe. The ideally isolated system or closed system is convenient for science, but in respect to nature is an impossibility. Closed systems exist only in abstraction. The universe is a dynamic, interconnected, network. Everything is connected to everything else.

Materialism, induction, and closed systems are the fundamental assumptions of the epoch. However, they became unquestioned and a burden to philosophy. Philosophy and science focused on a narrow band of phenomena in the universe described by known laws. Whatever did not fit into the accepted scheme of ideas was discarded.

Though the narrowing of the world to the explainable and predictable adversely affected the arts and sciences, it began unimaginable successes in technology. Humanity began to see the possibility of fulfilling the prophecy in

\textsuperscript{22}Whitehead, 44.
the biblical story of the Fall. Technology supplied the means to restore perfection to the world. Science and Reason dominated.

Science became important not for principles, but for results, a storehouse for ideas of utility. The spirit of invention was taken up, most fervently in America. The old World dominated the arts of painting, sculpture, and architecture, but in America the machine would become art and architecture.

Figure 3 Charles Sheeler, Suspended Power, 1939.

In the New World, technology confronted nature. In the words of George Perkins Marsh, in 1847: "America is the first example of the struggle between civilized man and barbarous uncultivated nature. . .the full energies of advanced European civilization, stimulated by its artificial wants and guided by its
accumulated intelligence, were brought to bear on a desert continent... The new machines and technology, when combined with the rising tide of individualism, were a right of democracy.

The railroad, steam engine, telegraph, and other inventions defied the perceived laws of nature. As a result, all morality was stripped from nature and replaced with the morality of the machine. A writer in 1840 remarked:

"We believe the steam engine, upon the land, is to be one of the most valuable agents of the present age, because it is swifter than the greyhound, and powerful as a thousand horses; because it has no passions and no motives; because it is guided by its directors; because it runs and never tires; because it may be applied to so many uses, and expanded to any strength."\(^{24}\)

Machines are superior to nature; they are easier to control.

A variety of theologies developed in mechanistic philosophy. The extreme viewpoint of DesCartes held an atheistic position; arbitrary movement of matter replaced divine control of nature. However, other thinkers like Newton and Linnaeus held onto the belief in a supreme power. Newton, an orthodox Christian, held God as the "crucial motive force behind the Cosmic Machine, the unexplainable source of energy needed to keep its order perfect and regular."\(^{25}\)

Nature's mechanical precision was seen as a gift of God to humanity. The strict order provided a means to "tune" the environment to the needs of


\(^{24}\)Marx, 196.

\(^{25}\)Worster, 41.
civilization. Society’s duty was to turn the raw material of nature into machines for humanity. Built upon divine providence, mechanical morality was an inescapable ethic. "Man's religious duty is to cover the earth with barns, workshops and dwellings, roads and canals." With God on their side, the mechanists set out to control and mold the world.

New science, new technology, new theology, and a new philosophy of nature turned the Machine Age into an orgy of scientific triumph. Eventually, the orgy was exhausted. In fact, the effects of the new technological proficiency began to be seen as the products of a misguided world view. However, out of the mechanistic meanderings came a few positive developments for the relationship between humanity and nature. Belief in the divine myth was overturned. A new science was created: ecology, blending organic metaphors with scientific methods. For much of the twentieth century ecology remained a mechanistic science, but recently it has transformed itself offering a new vision of humanity's place in nature.

The current dilemma is to balance the conflicts between the divine, organic, and mechanistic perspectives. History offers not only important lessons of nature, but also myths holding humanity back. Technology and science have recently moved beyond the older views, offering up fresh philosophies of nature.

\[\text{Worster, 54.}\]
Ecology and a New Perspective

Two events in the twentieth century had profound effects on pushing ecology to the frontlines of scientific investigation: the explosion of the first atomic bombs and the first pictures of the earth from space.

Figure 4 A New Perspective

The atomic bomb proved humanity had the ability to affect the environment in catastrophic proportions. Scientists had put more power into the hands of humanity then could be handled. The mushroom clouds cast a long shadow on the successes of mechanization to dominate nature. What was the morality of science? How could the pace of technology be justified? Why did Reason replace the sacred in the minds of humanity? None of these thoughts were new. They had been raised all along the path of mechanical progress, but now the questions were on the minds of an entire civilization.

The first pictures from space put the earth in a global perspective. For a moment, local squabbles could be forgotten for the awe inspiring qualities of
the blue orb. A global perspective in the popular consciousness benefited the environmental movement. The earth seemed fragile and delicate instead of solid and permanent.

These two events paralleled the rise of a new science equipped to quell human destruction. Ecology emerged as an attempt to reconcile humanity's place on the earth.

At first, Ecology was a "subversive" science, focusing on checking scientific progress and raising awareness of the environment. The task of checking science turned ecology and environmentalism into a pessimistic movement.

The writings of Rachel Carson, Paul Ehrlich, Barry Commoner, and many others sounded the alarm of impending doom. Alarms rang out and continue to ring out with the predicted doom always being avoided. The early history of environmentalism served mainly to raise the ecological consciousness of humanity. Doomsaying focused attention on environmental problems and helped to avoid them; but it spawned a mythology of nature far from the truth.

In many ways, the radical environmentalist perspectives parallel the early Christian perspective: all human action is inherently sinful and harmful to the environment. It is a mythology based on Romanticism and sentimentality not logic. The common environmentalist vision is best expressed by Dave Foreman: "Our environmental problems originate in the hubris of imagining ourselves as the central nervous system or the brain of nature. We're not the brain, we are a cancer on nature."27 Environmental pessimism leaves society

with fear and anger over the problems facing it. Society needs a more optimistic view of humanity’s relationship to nature. Human action can have a positive role in the environment without the desire to be the “brain or central nervous system” of nature. People, technology, and nature can learn to work together to the benefit of everyone.

During the rise of environmentalism, a few thinkers began to lay down a methodology for understanding and relating to the environment. Gregory Bateson argued for the unification of mind and nature. He created ways humanity can create a positive relationship with the environment. James Lovelock defined the Gaia hypothesis, giving scientific evidence for the old idea of an organic, living earth. The ecologist, Daniel Botkin, challenges humanity to rethink some of its most cherished ideas about nature. Dispelling old metaphors about the environment, Botkin’s work shows nature to be dynamic: a “discordant harmony” of disparate systems. Brian Easterbrook, an environmental writer, argues for “eco-realism.” He provides a “platform for reasoned ecological debate. . . making environmental protection clearheaded and rational, and ultimately stronger.”

Gregory Bateson’s writings argue for the unification of mind and nature. Like many scientists and environmentalists he saw the roots to the ecological crisis in the values of Western Civilization. For him, the western tradition in all areas defined and promoted a competition between humanity and the environment. He criticized society’s desire for control of the environment as foolish. His experiences in biology and ecology proved “the creature that wins against its environment destroys itself.” Bateson believed civilization needed

to accept and learn to understand the systematic nature of the world. Humanity is only a part of the larger systems and the part can never control the whole.

Like Whitehead, Bateson focused on the relational quality of the world. In his philosophy, he suggested the biosphere is an "interaction between structure (or form) on the one hand and process (or flux) on the other, or as an interaction between the elements of life to which these two notions (form and flux) refer." His argument created a model of understanding the relationship between structure and process.

Every system has certain fixed points or limits. Those fixed points are the structure of the system. Between the limits there is a gap the structure does not describe. The gap is the world of flux; the domain of freedom in the system.

Structure is a tool of the mind for understanding the flux of events. Flattening and abstracting reality, form is all humanity can know. As Kant said, we can never know the "ding an sich," the thing in itself. Knowing involves looking for the "pattern which connects" separate phenomena. This is done by finding similar relationships within systems, between systems, and about systems. The goal is to find landmarks within the flux.

Bateson's epistemology of flux found its way into ecology. Daniel Botkin dispelled the myth of the "balance of nature" in his work. He believes "wherever we seek to find constancy we discover change..." The old idea of a static landscape, must be abandoned, for such a landscape never existed except in our imagination..." We see a landscape that is always in flux, changing over many scales of time and space."  

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31 Botkin, 62.
Within Bateson’s flux, Daniel Botkin saw the borders between the organic and the inorganic falling away. Life and the environment are one thing, and people, like all life are immersed in nature. When humanity makes changes to nature, ultimately humanity changes.

Unlike ecologists of the past, Botkin sees the potential for technology to play a positive role in the environment. He believes it is not the tools of civilization that are to blame, but the perspectives of nature guiding technology. By combining a concern and understanding of nature with science and technology, humanity can have a positive role in the universe.

To have a positive role, humanity must realize the limits and potentials for action. As the poet, Fredrick Turner said: "There may be limits to technology, but I've seen blackened and polluted sections of England made rich with life. Technology is not necessarily bad, and neither are we."32

The surge of new ideas unifying human action and nature offer hope for the future. With hope and knowledge, humanity learns to read the patterns and processes in nature. Working with the landscape, circuits of relationship are uncovered, creating mutual acts of amelioration between people and the environment. Human action and natural process become one.

32Pollan, 48.
Part II: Working With Nature

By unifying human action and natural process, society can begin to coevolve with nature, instead of battle it. A new understanding of the materiality of nature is essential for architecture. As a reflection of society, architecture has expressed all of the misguided attitudes toward nature. Emulating science, design joined the cult of logic. Whitehead, Bateson, and many other philosophers have shown the ways thinking is intimately connected to the body. For architecture, thinking is always connected to making and interaction with the environment. In many ways, closely connected to the world, architecture is the best source of knowledge. Design is not linear, but works in networks, structures, and interlocked systems.

Architecture must begin with flux. In fact, all beginnings involve flux. However, to have any sense of knowledge, to have any ability to act, the flux must be given a form or structure. The classical mind always had the desire to place the structure on nature. Design modeled nature to fit ideal harmonies and patterns.

Recently, science has shown humanity what it already new intuitively: nature does not reflect an ideal pattern. Nature is relative. Design means looking and listening, not knowing in advance. Architecture needs to see every site as a continual act of becoming. The landscape, earth, buildings, climate... are a history of the site and signs to the future. These qualities express the patterns found in the landscape. They are the qualities determining the order, form, and structure of a situation.

The patterns in the landscape are the "grain" of the environment. It is important to remember the grain is not fixed, it is constantly changing and
flexing to meet new conditions. There are three possible responses to the
patterns. They can be forgotten, followed, or focused.

The first response is foolish.

The second response should be a minimum for all design. Following
the patterns of the environment is a matter of humble respect for nature. It is the
desire to come to a place, create something and leave with the place no worse
than when you arrived. Architecture seeks minimal ruin of the landscape.

However, the best design seeks not just minimal ruin of the landscape,
but something more difficult: a replacement of what was lost with something
that atones for the loss. Use of the earth need not be destructive and
architecture can be an ameliorative act which, in thoughtfulness and
carefulness, counters the destructive effect of construction. The best design
attempts to work with the landscape to give form to the processes of nature.
Natural process can be focused to improve buildings and architecture can
enhance the landscape. Mutual acts of amelioration unify human action and
natural process.

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Nature as Pattern and Process

The biosphere contains multiple events occurring simultaneously. Nature is a self-organizing, dissipative system. It does not exist in a state of perfection, but in a state of continuous process.

Form is immanent in nature. However, all structures are discontinuous and distortive of the actuality of a system. As Gregory Bateson would say: “the map is not the territory, the thing is not the thing named.” Creating forms is necessary to understand the freedoms and rigidities of living systems. Sometimes it is necessary to restrict the movement of some variables to allow others to move smoothly in the mind. Pattern is the temporary restriction of process. Architecture should give form to process.

The shell of the chambered nautilus is a reflection of the animal’s environment. Living only in the outer most chamber of its shell, the nautilus must constantly move forward creating a new chamber, as it grows. The interesting aspect of the nautilus is the growth reflects two rhythms in the universe in its logarithmic spiral: the solar cycle and the lunar cycle. The growing nautilus makes a growth line, in its chamber, every day and creates a new chamber every lunar cycle. Fossils of nautilus shells have been dated to be as old as 420 million years. Over time the number of growth lines has increased. The oldest shells contain 9 growth lines per chamber while the newest contain 30 growth lines per chamber. This suggests the moon used to be a great deal closer to the earth taking only nine days to orbit the earth.

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instead of the thirty it takes today. In the chambered nautilus, the solar system, the earth, and life are linked.\textsuperscript{35}

Figure 5 The Chambered Nautilus

The nautilus is a model for architecture. It is a clock of relativity, recording an intimate relationship to the environment. Centuries of sensitivity mapped the movement of the moon’s orbit away from the earth. Humanity’s creations should have the same unity between object and environment.

In his book, Design with Nature, Ian McHarg developed a methodology for determining land use and urban development from the patterns in the landscape. He illustrated a close relationship between the creation of form in nature and the human creation of form.

\textsuperscript{35}Botkin, 186 - 187.
McHarg saw form as an expression of process and communication. Architects are quite aware of the potential of form to carry meaning, but are generally ignorant of form as the expression of process.

Both human creation and natural creation express processes. To McHarg, form is the expression of all life and does not follow function. "Form follows nothing it is integral with all processes."\(^{36}\)

Most importantly, McHarg developed a method to reflect natural process in urban form. He believed the basic character of the city comes from the site. The goal for planning and design was to recognize and enhance the qualities of the landscape.

In creating a "Comprehensive Land Use Plan for Washington D.C.,” topography, geology, hydrology, slope, soil, landscape, and many other factors defined the potential for development. McHarg's study reveals the implications and patterns immanent in the land and its processes.

Studying and mapping the landscape is the starting point for designing with natural process. McHarg believed responding to nature demonstrated "an elementary level of intelligence and perception" and the goal was to aspire to find ways to affect and enhance nature.

Figure 6 Ian McHarg "Comprehensive Land Use Plan for Washington D.C."
Figure 7 Ian McHarg Comprehensive Land Use Plan for Washington D.C.
Specificity of Place

McHarg's method illustrates an essential aspect of ecological design: specificity of place. Traditional cultures have had an intimate relationship to their environment. Depending on nature for survival, American Indians often changed their environment. Contrary to the common belief of the Indians as gentle stewards of nature, it was common for them to set fires to clear the forest to make travel and hunting easier. Eskimos hunting caribou made careful selections of members of the herd to kill. They left the stronger and older caribou because they helped the herd in winter. The Eskimo's knowledge came from generations of observation in a particular location. When the government intervened in the Eskimo's situation from an objective "scientific perspective", they ordered only the male caribou to be killed. The result was the population of the caribou herds nose dived.37 The stronger experienced males who led the herd through the winter snows were gone. The Eskimos knew how essential the old and strong were to the caribou herds. There is no substitute for local knowledge.

Humanity should not give up on science or the knowledge gained from it. The radical environmentalist advocacy of a return to "pre-technological" times is ridiculous. However, it is essential to use technology with a detailed survey of the local landscape. Modern science and technology can be an effective tool in uncovering potentials in the local environment.

If environmentalism is integrated into the daily lives of people it will be a much more potent force. Then sustainability will be something tangible, instead of the protection of an invisible wilderness. "Ecological design is really

just the unfolding of place through the hearts and minds of the inhabitants. It embraces the realization that needs can be met in the potentialities of the landscape. . .38 It is recognition of the patterns and processes immanent in the landscape. By reading the local environment, the potentialities of the landscape are respected and used to the benefit of humanity and nature.

Dennis Thomson, head of the meteorological department at Penn State, is an expert in local climates. He studies microclimates ranging in size from valleys to a few inches. The real action occurs in microclimates at the “boundary layer.” between different systems. His study enlightens many aspects of the environment normally unnoticed.

Trees absorb solar radiation in their wood and emit it as infrared radiation: the result is a snowless ring at the base of the tree. Thomson shows the site of a planned highway across Bald Eagle Ridge in Pennsylvania. While the planners took into account the vulnerability to snow, ice, and fog, they missed one critical element. The flag trees are a clue that winds on the ridge are strong. In January, he took some measurements of wind speeds up to 70 mph, close to hurricane force. Placing the highway in that microclimate puts lives at risk.39

Thomson does not pepper the environment with sensors, but looks for signs in the environment. The flag trees on the top of the ridge, with no branches near their tops and existing branches pinned down with wind, are an obvious sign of high winds. You do not see flag trees on a USGS map. The highway planners should have immersed themselves in the environment along

38Van der Ryn and Cowan, 65.
39Stuller, Jay. “Climate Is Often a Matter of Inches and a Little Water.” Smithsonian December, 1995. 103. All of the following examples of microclimates are taken from this source.
the route. Then, they would have avoided the dangerous winds on Bald Eagle Ridge.

Climate is very complex. The atmosphere is always changing in response to constant differentials of heat. Differences in heat are caused by the composition of the Earth’s surface. Water, asphalt, grass, buildings, snow, forests, . . . absorb and reflect heat at different rates creating a chaotic pattern of warm and cold air pockets. Warm air rises and cold air sinks creating pressure differences from place to place. These pressure differentials create breezes from the scale of the Gulf of Mexico, to a field in the woods.

Microclimates are critical to agriculture. In Florida, when temperatures fall during certain times in the growing cycle, frost can wipe out entire crops. The potential for frost is influenced by elevation and proximity to water. Because cold air sinks, low elevations create frost pockets. The temperature can be as
much as 25 degrees lower in valleys than the ridges. Not surprisingly, citrus
growers pay close attention to microclimates.

Figure 9 Infrared Image of an Urban Microclimate

Tim Oke, a climatologist at the University of British Columbia, has
studied the abundant microclimates in cities. Tall buildings reduce wind
speed. Pavement for cars, and the materials of buildings absorb heat,
increasing the temperature and creating an "urban heat island."

Probably the most important aspect of microclimates is the ease they
can be altered. While the macroclimate must be endured, the microclimate can
be enhanced. Making roofs out of reflective materials and planting trees can
reduce the "urban heat island." Professor Thomson planned his house with
careful knowledge of its microclimate. South-facing windows let in the winter
sun. Corner windows promote cross-ventilation. The most seductive feature is the placement of the house in a spot where cold air spills down a ridge in the afternoon through the house cooling it on humid summer days. Thomson says: "if we'd located the place ten yards further up the hill, or ten yards lower, we'd miss that band of wind."40

Microclimates reveal the immanence of environmental forces. The city seems to be separate from nature, but it is not. Cities have a close relationship to their environment. It is important for humanity to manage cities as local environments. By seeing the city as nature, planning can work with the patterns of the landscape to benefit both the local and global environment. "Management of nature lies just outside the door, and affects not only ourselves and our neighbors, but also nature in its largest sense."41 Design should reflect the structure of a place.

Revelation of Place

Revealing the spirit of a place is not only a scientific exercise, but also a matter of design. The Japanese garden developed the integration of place and natural process to an art form. Instead of imposing a form upon nature, the Japanese garden is an attempt to "naturalize nature," to take the chaos of nature and give it form. Traditionally in a Western garden, the landscape is rigidly ordered, to allow primacy to the place of humanity in the garden.42 The desire to be god-like drives this vision, to restore order to the cosmos. The Japanese gardener

40Stuiler, 110.
41Botkin, 167.
42Of course there are exceptions to this generalization of Western Gardening: English Gardens, The Romantic Tradition, the gardens of Medieval Monasteries.
allows nature to do the creating. A garden is in constant flux: with the seasons, with the
activities of the gardener, with the weathering of time, . . . The goal is to accept the forces of nature and work with them.

Figure 10 The Order of the Western Garden: Versailles

The Western garden is driven by the objective vision of the plan. Versailles is an expression of absolute control of nature, power of the monarch, the infinity of space.

The Japanese garden is driven by immersion into the environment. A plan of the Katsura Imperial Palace Garden offers little information of the design intentions of the garden.
The secret of the Japanese garden is in the processes taking place within it. Celebrating the elements, to glimpse the raw workings of nature, is the drive of the gardener. In this way, gardening is about the activity of gardening: observing, experiencing, pruning, cutting, living, instead of the finished garden. From the Japanese point of view, the garden is never finished.

"Ask a Japanese gardener the secret of gardening and he will hold up his shears. Pruning, called sentei, allows a more natural and, at the same time, more ideal beauty to emerge. The beauty is there from the first. It is not created, it is merely allowed to express itself...The beautiful garden lives. The gardener merely makes this beautiful garden more visible." In effect, the Japanese garden is the aesthetic example of Bateson's epistemology of form and flux. The gardener slows, focuses, and reveals the flux of the environment.

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to have brief moments of order in the garden. However, it is clear the structuring of nature is done to create moments of silence, to allow fresh perception of nature's sound in other places. The garden is not a search for perfection, but an expression of the uniqueness found in each situation.

Adaptation to changing situations is the essence of the Japanese garden. The use of moss in gardens started as a response to adverse conditions. During the Meiji era (1868 - 1911) economic hardship faced the Kokedera temple. When the temple no longer had money to keep the garden maintained, moss started to grow. Instead of lamenting, the gardeners reflected the situation. They began to work with the moss as an element in the garden. It was shaped pruned and allowed to express its materiality, as if it

Figure 12 Saihoji Temple Moss Garden
were a sacred tree, stone, or pond. The moss garden was born, from the Japanese gardeners talent for observation and play. It is a lesson of the achievements possible when preconceptions of nature are thrown away, in favor of acceptance of the "nature of nature."

Figure 13 Stone shore in the garden of the Sento Gosho Palace

Japanese gardeners select materials to emphasize the quality of a place in the garden. Raked quartz stones shape the tranquillity of a rock garden urging contemplation and meditation. The shape of a rock is selected for its effect on the fallen snow. A rain storm is recorded in holes filled with water, One of the best examples is the shore of the Sento Gosho Palace garden. Smooth, round rocks were hand picked and placed on the shore of a pond. The stones cover the shore and bleed into the pond. The quality of stones reveals the
wetness of the pond. Bleeding the stones into the pond gives expression to the waters edge as it moves up and down with the rainfall. A Japanese garden reveals the joy and palette of nature’s materiality.

The Japanese attitude toward nature is an effort to reveal the essence of nature. Pruning reveals a line nature created, but obscured in its own plenitude. Gardening has nothing to do with style. A gardener strives after the relationship to nature his forebears had. “It is the belief in the identity of man and nature, one which humbles in its insistence upon the transitory nature of the merely human, but which, at the same time, dignifies by its equal insistence that we are all a part of something larger than ourselves.”

Aligning the Japanese attitude to nature, with modern technology gives a potent recipe for uniting natural process and human action. The Japanese already have created a tradition of unity with nature, but it can be done at a larger scale. Instead of confining engagement with nature to the gardens of palaces, the entire city can become a garden for experiencing and working with nature.

Design as Amelioration

Architecture must not only work with nature, but also strive to heal and improve the environment. Through thoughtful and careful action the destructive aspects of building can be atoned and environmental amelioration can happen. Every activity, from the smallest house to the largest city should strive to improve its place. As the architect W. G. Clarke states: “It is worth the effort to build well.”

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*Ito, Iwamiya, and Kamekura, 197.
*Clarke, 5.
Aldo Leopold, one of the founders of modern ecology, began an experiment of environmental reclamation in 1934. He convinced the University of Wisconsin to allow a farmstead to revert back to the prairie it had been. The farm was plowed and seeded with prairie grasses. Leopold believed in the traditional conservationist dogma: if the land was left alone, it would seek natural harmony. For early ecologists, wilderness would reach a climax state if left untouched. For the farm, the climax state was prairie grass.

With the help of the Civilian Conservation Corps, during the depression, Leopold managed the land carefully. They put out fires, weeded out competitors, planted more grass... However, the prairie did not revert back to its “natural harmony.” Prairie plants flourished, but they could not get rid of the weed species. By the mid-forties, Leopold determined a key missing element in his prairie: fire. “Fire made the prairie work. It hatched certain fire-triggered seeds, it eliminated intruding tree saplings, it kept the fire-intolerant urban competitors down. . . When he reintroduced fire into the synthetic plots of the Wisconsin field grass arboretum, the prairie flourished like it had not for centuries. Species that were once sparse started to carpet the plots.”46

Leopold’s experiment was an important step for ecology. It began the dismissal of the myth of natural harmony and verified the role of dynamic change in ecosystems. Healthy environments can resist fires and human interference. Nature loses its health when bottled in false states of perfection and eradicated by ignorance.

In the 1960’s, another experiment of environmental amelioration was begun in Morocco. Wendy Campbell-Purdy planted 2000 trees on 45 acres in

the desert. After six years, her first experiment went so well, she planted 130,000 more trees on a 260 acre dump in Algeria. The result was the creation from scratch of an oasis in the desert: citrus, vegetables, and fields of grain. Campbell-Purdy with experience began to understand the nuances of tree planting. Some trees alter the climate and soil making the place fit for more trees. Other trees, make places and habitats for animals and insects. "Life encourages an environment that encourages more life." 47

The experiments of Leopold and Wendell-Purdy prove human action does not have to be a destructive force in the environment. Aligned together, humanity and nature can be mutually ameliorative.

Subsumption

Ecology and the other sciences have invalidated the 19th Century ideal of utopian planning: proceeding from the top down models controlling individuals, Nature, and the city. Architecture needs to be liberating, allowing order to grow out of disparate situations.

Ecologists have shown ecosystems build from the bottom up: complexity snowballing to create diversity. Another example of "bottom up" organization comes from robotics. The robots produced by Rodney Brooks at M.I.T. illustrate bigger is not better. His experiments developed small robots for planetary exploration. To reduce the cost of transportation into space, they were to be "Fast, Cheap, and Out of Control." 48 Brooks' robots were faster and are more efficient than expensive centrally controlled robots. "Carnegie Mellon's Field Robotics Center created. Ambler weighed two tons, not counting its brain which

47 Kelly, 67.
was so heavy it sat on the ground off to the side. This huge machine toddled in a courtyard, deliberating at each step. It did nothing else. Walking without tripping was enough.\textsuperscript{49} Mapping the terrain and coping with the mountains of calculations turned out to be overwhelming. Robots with the qualities of organisms cannot be centrally controlled.

Figure 14 Rodney Brooks' Robot Genghis

Instead of making a genius knowing so much it is afraid to take a step, Brooks decided to make large numbers of dumb robots working together to create "emergent" properties of mind. His robots are built quickly from off the shelf parts. Reducing the complexity of construction, increases the reliability of the robots and enables 1000's of them to be built faster for the same price as one Ambler. To create complex functions such as walking Brooks used what he calls "subsumption architecture" or bottom-up control. To walk, Brooks robot Genghis lets each leg work as an independent unit with a finite set of

\textsuperscript{49}Kelly, 35.
instructions: "If I am a leg and I am up, put myself down. If I am a leg and I am up swing forward. If I am a leg and I am up, move the other legs back... to create walking then, there just needs to be a sequencing of lifting legs."\textsuperscript{50} The sequencing is the only presence of central control. Therefore, complexity and dynamics walk the edge between control and autonomy.

Another important lesson from Brooks robots are the way they map the environment. Instead of creating a central world model, the robots use the world as its own model. They do not try and sense everything about their environment all at once. They sense what is important at the moment. In this way they can adapt to changing environments over time. As Genghis moves, the leg lifting system dominates until an obstacle is reached. At this point, the robot turns to systems that have been laying dormant or "latent" until the walking program was impeded. Genghis hops, turns, or oscillates its leg to avoid the obstacle.

Architecture's struggle with the environment is the same as those in robotics. Many designers suffer from an objective model of the environment where every aspect must be quantified and "fixed." Such a mechanistic model is the wrong path for architecture. "There is no limit to the number of variables that we can include in the analysis or in the description of the situation... they cannot be expected to constitute a complete description. The crucial task in theory building is to pick the right variables to be included."\textsuperscript{51} Ecologically dynamic architecture and planning will be built up from simple interactions of the environment to complex relationships with the biosphere. At some

\textsuperscript{50}Brooks and Flynn, p.481.
locations one set of relationships will be crucial, while at another set criteria will rule.

If we try to map the entire environment and then act, we will stumble like Ambler. To ameliorate the Earth, the best method is to start with simple environmental interactions and build upward.

Gaia

James Lovelock calls the superorganism of all the Earth’s systems as a whole: Gaia. The Gaia hypothesis has been dismissed by some scientists as unscientific or "Earth worship." However, with the biologist Lynn Margulis, Lovelock sets down a compelling view of our place on earth, not as a conqueror, but as an intelligent species with immense responsibility. What we do to Gaia affects us. With advanced sensing and detection of changes in the environment humanity has begun to understand the immense effect actions have on the Earth. No action or technology can be seen in isolation it affects and influences all other actions.

To our horror, we have found small isolated actions can compound to create the sinister "Butterfly Effects" of global warming and ozone depletion. In James Gleick’s explanation of the Butterfly Effect we build on the scientific principle of interconnectedness begun with Gaia. "In weather, for example, this translates into what is only half-jokingly known as the Butterfly Effect—the notion that a butterfly stirring the air today in Peking can transform storm systems next month in New York."52 If that is the potential effect of one butterfly imagine an entire city such as Houston with a building pattern requiring tons of air-conditioning and consuming far too much of the world’s energy. In the twenty-

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first century, our civilization must begin to understand our dynamic relationship with the environment, not only in the sciences, but also in every area of life. The understanding of our place in the whole of Gaia leads to a new philosophy. It validates the cliché: “think globally, act locally.” Local amelioration follows the law of increasing returns, ultimately healing the planet.
Part III: Ecological Design

Design gives form to process. It is the activity of revealing the structure within the flux of the environment. Architecture needs to be more fundamental and more sophisticated. Current architecture theory offers very little relationship to the fundamental needs and desires of humanity and nature. Buildings must root themselves in the experience and understanding of a place, not to prove a stylistic theory of regionalism or an abstract philosophical concept. Sophisticated architecture adapts to the cyclic processes of the environment. It is more about those processes than about the finished product.

Architectural theory places too much value on surface and style. Creating a tectonic relationship to the environment is a much more meaningful desire for architecture. While most architects pursue the "dogmas of design" a few architects in the twentieth century have worked on the ecological program of architecture. They are the architects blending the fundamental and sophisticated aspects of architecture into a unity with the land.

Frank Lloyd Wright created a comprehensive theory of "organic architecture." He made architecture biological, creating totally integrated buildings. A Wright building is an organism. Alvar Aalto celebrated life with his architecture. His works reveal his obsession with the organic line in the landscape: meandering to find its path. Glenn Murcutt reconciles modern technology with experience of place and culture. Learning from local knowledge, Murcutt creates houses that relate to the land both unique and
traditional ways. The various architects of "Eco-Tech": Renzo Piano, Ken Yeang, Francoise-Helene Jourda and Gilles Perraudin create architectural bodies uniting the biological with the mechanical.

These architects provide a significant part of the tradition of ecological architecture, a tradition marking the "presence of the past"53 in the current architectural situation.

Frank Lloyd Wright

Frank Lloyd Wright believed "The whole must be considered as an integral unit."54 He approached architecture from an organic point of view. Every aspect of a building: plan, section, structure, roof, mechanics worked together for environmental control. Rarely does an element perform a single function; they all work together as an organism in the flux of the environment.

Wright's architecture was "born, not made, consistently growing from within to whatever it becomes. . .it is the first principle of any growth that the thing grown be no mere aggregation. Integration as entity is first essential."55

The section of the Robie House reveals Wright's sensitivity to climatic conditions and his ability to create an integrated solution. Services are concealed within the structure: radiators within the floor, under the windows, or

lights within the ceiling. Cooling is provided by a vented roof and cross ventilation. Ventilation occurs in a variety of ways depending on the wind direction. "Doors, windows may be opened at either end; the entire south glass doors giving onto the balcony, and the rear windows at the western end, overlooking the entrance court, may be opened to exploit not south breezes." 56

Wright extended the eaves to the exact dimension to prevent the summer sun from penetrating the southern windows, while allowing the sun's heat in winter. The house is a totally integrated environmental solution.

Figure 15 Section of Frank Lloyd Wright's Robie House

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Relationship to the site was critical for Wright. The horizontal line of the Midwestern landscape is reflected in the horizontal line of the Prairie House. He saw his buildings growing out of the ground. Architecture “thrusts its roots deep into the soil. . .thus environment and building are one.” This belief found its full expression in the spiral of the Guggenheim Museum emerging from the ground.

![Figure 16 Section of the Guggenheim Museum](image)

Not only did Wright see his buildings relating to the landscape, but also deriving their geometry from patterns found in nature. He advocated the student of architecture should study the differentiation of forms found in nature. In this

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\(^{57}\)Frank, 15.
study, the student should observe the plasticity of trees, altering their forms to various situations. Eventually the architect should incorporate the nature-pattern into their plans. Wright wrote: “design is abstraction of nature elements in purely geometric terms.”⁵⁸ To Wright, architects are not inventors, but revealers of nature’s patterns.

**Alvar Aalto**

Alvar Aalto believed in an architecture of uniformity. After breaking free of the rigid geometries of Classicism in his early work, he became impassioned with the geometry of the organic line. While Classic geometry studies the universal properties of straight lines, grids, and modules, Aalto’s organic lines search for the individual, precise relationship in a situation. The abstraction of classical geometry eradicates tension and imprecision into right angles. Aalto allowed tension to flow through his work and be revealed in obliques and free forms.

One of his first works expressing the organic line is the Paimo Sanitarium. He divided the functions of the hospital into four different wings and freely rotated them in response to the direction the space demanded. As a result, the plan fans out, unifying program with the proper environmental orientation.

Throughout his career, Aalto rejected the dogmas of Modernism, for the clarity of form he saw in the vernacular landscape. In his 1941 essay, "Architecture in Karelia," he describes the Karelian house as: "a way of building that begins with an imperfect embryo...the expanded house can in a way be compared with a biological cell formation. The possibility of a larger more
complete building is always open." 59 The biological character of the traditional Finnish house was not only in plan, but also in the roof form. Aalto praised the ability of roof angles in traditional architecture to freely change angles in constant variation from flat to pitched. The freeform exhibits a closeness to nature for him. Elasticity is an essential quality of architecture for Aalto.

Though architecture seeks its organic origins, form is restricted by "construction and jointing methods". 60 Aalto's form truly is biological in its dance between the order imposed by its materiality and the exploitation of freedom to fit the environment.

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60 Aalto, 83.
Glenn Murcutt

The buildings of Glenn Murcutt are a careful integration of nature, landscape, and culture. Through a series of small rural houses, he developed an ecologically responsive architecture out of modern technology, economic construction, and strict relationship to the landscape. Murcutt’s architecture is ultimately grounded in the idea of place. Each house is specific to its climate, culture, site, . . . Sun-angles, wind patterns, drainage, soil conditions, and ecosystems encompass the devices from which he extracts order into the buildings.

Figure 19 Glenn Murcutt’s Magney House
Murcutt's architecture is compelling in the way it responds in section to the surrounding environment. The roof of the Magney House, like Wright's Robie House, is dimensioned to admit the winter sun, while blocking the hot summer rays. Twin curves drain water to a central gutter to collect precious water in the Australian bush. The concrete slab acts as a heat sink cooling the house in summer and storing the sun's heat in winter. Curving the roof, relates the house to its site on the rolling coastline at Bingie Point.

The Ball-Eastaway House is elevated above a fragile ecosystem in the woodlands north of Sydney. To build on the ground, would have raised the water table, altering the dynamics of the ecosystem. The result would have killed the neighboring yellow bloodwood trees by giving them too much water, rotting their roots. Therefore, the house becomes a narrow insertion in the landscape perched above the sandstone outcropping.

Figure 20 The Ball-Eastaway House
Because the house is in a bush fire prone area, the roof form is curved to keep off leaves. The broad, tapered gutters allow leaves to flow down instead of clogging the drains and setting the roof on fire.

The house is designed to survive in a harsh environment, while preserving the quality of the existing landscape. Environmental sensitivity “that's all I am interested in. Not international standard. I am looking for a standard that is appropriate to its place.”

Renzo Piano

Renzo Piano and the Building Workshop have had a consistent commitment to the pursuit of ecological design. They have approached sustainable architecture from many directions: renovation and rehabilitation of existing buildings, buildings as climatic devices and sensitive responses to the landscape.

Piano's renovation work consists of a great deal of projects: the Schlumberger and Lingotto Factories, the town centers of Otranto, Burano, Genoa, Matera, and Corciano, the Palladio basilica and City Hall, and the Rehabilitation of the moat of the city of Rhodes. All the projects conserve materials and existing structures while rejuvenating city centers, preventing urban sprawl.

Figure 21 Renzo Piano: Rehabilitation of the Moat of the City of Rhodes

Transforming the moat of Rhodes into a two-mile long botanical garden is probably the most ecologically seductive of the reuse projects. The program called for integrating the old town with the new urban elements surrounding it. Shrewdly, Piano responded by revealing the potential of the existing fortifications to produce the microclimates necessary for growing a variety of Mediterranean plants. As the walls vary their position relative to the sun, different climates are produced allowing plants from all over the region to be grown. The project is brilliant in its use of the existing patterns in the landscape for the unification of the town.
Piano's project for the J.M. Tjibaou Cultural Center exemplifies his creation of climatic devices and response to the landscape. His proposal for the center exists in close harmony with nature through a fusion of contemporary technology with traditional responses to the climate and landscape.

The Workshop created a series of “cases” or high-tech huts, containing the functions of the center. Formally, the cases were designed to act as wind-scoops, cooling by funneling the prevailing breeze. However, wind tunnel tests proved the cases were ineffective as scoops and worked better if they were turned away from the prevailing breeze. With their backs to the breeze, the cases act as wind chimneys, sucking the warm air out of the spaces below. They were equipped with a control system to respond to different wind speeds.

Figure 22 The Tjibaou Case
Unfortunately, the plan deteriorated as the project evolved. Originally, the plan would have evoked an image of a traditional South Pacific village, freely dispersing throughout the landscape. Climatically, the village solution could have been justified as the freeform village was generally laid out to allow equal access to cooling breezes, while sensitively responding to the landscape. However, in the final scheme, Piano chose to striate the site in a long band of cases.

Nevertheless, the project stands as a unique synthesis between architecture and nature, innovation and tradition.
The architecture of Ken Yeang, like Renzo Piano, creates a synthesis between nature and technology. In his Bioclimatic Skyscraper projects, he combines sunpath analysis, windflow, landscaping, site constraints, and services into what must be called “architectural organisms”.

Planting and vegetation are integrated into the skyscrapers to create healthy microclimates, by filtering and cooling the air. Combining planting with sun controls, trellises on walls are used as shading devices. The building facade is layered to control the sun and create a transition between the inside and outside. Layering creates a zone where the users can open a window, go
out to a terrace, and have contact with the outside environment, a rare occurrence in most high-rises. The layering of the external wall is varied in response to the orientation of the facade. "In certain conditions, this external wall might also be designed to be environmentally interactive, with parts that move, adjust, and adapt depending on external seasonal conditions."^{52}

A great deal of experimentation has been done with the wind by Yeang. In addition to traditional cross-ventilation strategies, he has also worked on ways of funneling wind through ducts to cool inner spaces or generate power. Service lobbies are placed on the edges of the buildings, instead of the center, to allow for ventilation.

Figure 25 Ken Yeang's Bioclimatic Design Principles

The Menara Mesiniaga Tower incorporates many of Yeang’s Bioclimatic Skyscraper design principles. Planting starts from a berm, at one side of the tower and works its way up the building through trellises and terraces. Windows to the west and east are fitted with external louvers for sun shading. The north and south facades have curtain walls to take advantage of views and ventilation. Service cores are positioned on the sides of the building to allow for ventilation and create relationships to the external environment. The tower is topped with a sun shade covering a terrace and providing a place for the future installation of solar cells.

Ken Yeang’s buildings merge with their climate into a seamless whole of organism and environment.
The work of Jourda/Perraudin began with classic modernist explorations and strict geometries resembling the work of Louis Kahn. More recently, their work has evolved into climatic, organic responses to place. Instead of repeating the lessons of nineteenth century engineering as many of their contemporaries have done, Jourda/Perraudin derive new structural systems from the study of patterns found in nature.
The temporary roof for the underground station at Parilly, emerges from the station below growing into a treelike canopy above the station. The project is successful because it uses the geometry found in nature to create an effective structure.

In addition to the investigation of natural structure, Jourda/Perraudin have searched for a "responsive architecture". They have searched for ways to open up buildings to the environment. The atmospheric roof of the university building at Marne-la-Valle adjusts to the wind, conducts natural light, reveals the changing state of the sky: cloudy or clear, cold or warm. The interaction and interfusion create a vital relationship between inside and out. Instead of a forgotten plane, they have animated the underside of the roof, creating and sculpture of the sky.

Figure 27 Atmospheric Roof at Marne-la-Valle
Jourda/Perraudin create an architecture of being, living architecture on
the threshold of flight and freedom.\textsuperscript{63}

\textbf{Building on the Tradition.}

Throughout history, humanity has been obsessed with the idea of order. Architects especially have imposed order upon the land to control and manage nature. The tradition of ecological design: Wright, Aalto, Piano, Murcutt, Yeang, Jourda, Perraudin, . . . offers a new model for architecture. Ecological design creates a more sensitive order derived from the patterns in the landscape and reflected in the unity, organicism, and flexibility of its buildings. By preferring order immanent in nature to order imposed by humanity, architecture and environment become inseparable.

Part IV: Housing Project for Houston

Too often the study of nature is the study of “wilderness,” far removed from the everyday experience of humanity. A strong desire has been held by many ecological designers to abandon the city and make a fresh start. While it is a courageous decision, Natural patterns are immanent everywhere in the landscape from the desert, to the forest, and to the city. As urban areas spread across the land it is imperative that architects begin to look at the urban environment.

The city and its environment have a close relationship. Design must align building to the city, to the environment, and ultimately to nature.

Figure 28 Site in 1975.
The project to study the revealing of patterns in the landscape and their implication for urban form is a housing development in Houston. Just south of the Medical Center, a block of land has undergone immense transformations. In the seventies, the area was composed of the Shamrock Hotel, a night club, an office building, several apartment buildings, a fraternity house, and a large number of single family homes. Economic forces and human desire have erased all of the buildings except one in a two block area.

![Figure 29 Site in 1995](image)

The site for the project is a long narrow block stretching east to west. Though the buildings are gone the history of the site still remains written in the land. Abandoned foundations are slowly being broken apart by vines and weeds. Sandy gravel where the last three houses were demolished prevents anything from growing. Exotic plants still divide house plots from each other.
Small palm trees still occupy their place where the apartment building's pool used to be. Two of the original driveways remain. A single house sits alone in a barren landscape. Despite the absence of humanity, Live Oaks still line the streets on the western edge of the site. Large Loblolly Pines grow along the street to the south. A grove of Hackberries remains untouched. Three large Willow Oaks sit just south of the remaining house. The landscape is rich with possibilities and implications.

Figure 30 Existing Landscape

A careful inventory was taken of the site. The existing landscape consists of native plants, non-native species planted as ornament, and a variety of saplings and bushes mostly native, that have sprung up since the site has been abandoned.
Due to the proximity of the site to Braes Bayou, the soil is a clay known geologically as Lake Charles Clay. It is very soft, with a high shrink swell capacity. Foundations set in the ground are torn apart under the stress of the
changing soil pressure. Not surprisingly, the neighborhoods surrounding the site have a large number of houses with cracked foundations.

The interaction of soil and landscape is revealed in the presence of the native trees on the site. Live Oaks, Willow Oaks, Hackberries, and Loblolly Pines grow very well in the clay soil. Loamy soil, such as Ozan would have been revealed by the presence of Bald Cypressies, Cottonwoods, and Red Maples.

Weed species such as the Chinese Tallow, an import from the late 1800's, tap the resources of the site and quite often do not survive. In fact, most of the weed species are dying. The tallows grow well, but push the native trees out and destroy the diversity of the site.

The first activity on the site is to remove the weed species and relocate native trees to new locations.

Planting new trees and relocating existing trees was done to improve the microclimate of the site. Landscaping is one of the most powerful climate control devices. Tall trees were planted in bands parallel to the prevailing wind. Working with the existing tall trees, they channel the wind increasing its speed. In addition, the new trees block out low angle east and west sun from the buildings.
Adding shade trees and vine trellises created a pattern of alternating open and shaded areas. This pattern induces convective air flow on the site, by creating pressure differentials. Hot air rises in the open areas: blown away by the prevailing wind. Cool air from the shaded areas sinks and flows into the open, driving the convection currents.

With the induced breezes, the margin between the open and shaded areas becomes the most comfortable region of the site. Buildings become filters to the cool air flowing from the trees.
Figure 34 Tall Trees Channel Prevailing Breezes

Figure 35 New Shade Trees
Another aspect of the building design was derived from research into ventilation. From the beginning, the form of the building was required to allow cross-ventilation. Therefore, long narrow buildings oriented perpendicular to the prevailing wind were preferred. Wind research has shown cross-ventilating buildings do not have to be exactly perpendicular to the wind. Wind tunnel tests proved buildings may rotate up to thirty degrees from perpendicular.

Seeing the buildings fitting in the margin and trying to preserve the existing native trees led to a strategy of "snaking" the buildings through the landscape using the sixty degrees of freedom from the wind studies. Nine two and three story buildings twist their way around trees along the "margin", avoiding sensitive areas, building upon the damaged parts of the site, and incorporating the existing house.
Figure 38 Site Sections
Figure 43 Transverse Section and Model Photographs
Figure 44 Transverse Section and Model Photographs
Figure 45 Computer Model from the North

Figure 46 Computer Model from the East
One of the units was developed to detail. Containing eight units ranging in size from three bedrooms to studio apartments. In addition, the buildings relationship to the landscape is not purely technical. Outdoor areas and windows are placed to connect the inhabitants with the site. The upper floors have the relationship of being in the trees. Users connect to the environment for comfort and meaning.

In section, the building is raised off the ground on concrete piers for two reasons. First, the clay soil does not permit in ground foundations, so the pier foundation is the best option. Second, the site is well within the one hundred year flood plain and the buildings need to be raised at least three feet to be clear of the flood danger.

Tectonically, the building resembles the nearby Hackberry trees. Starting from the concrete piers, the building cantilevers floors off columns until the roof structure spreads out at the top. The roof assists ventilation, protects from the sun and rain. The plan of the roof is cut and angled to avoid adjacent trees and shading by the roof is not necessary and views of the sky are desired. The project is a first step in revealing the order immanent in nature. Landscape, wind, soil, drainage, boundary layers, . . . structured the project, intimately relating building to site. Working with the patterns and processes in nature, architecture ameliorates the landscape.
Works Cited

Works Consulted


