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An Introduction to *Biophilia* and the Built Environment

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By Corey Griffin

"Why does a house designed by an architectural individualist for the purposes of a special client appeal so much to the public in general?"[1]

Edgar Kaufmann, Jr.
commenting on Frank Lloyd Wright's Fallingwater

Kaufmann's question is a good one as over 140,000 people visit Fallingwater in remote Western Pennsylvania every year. In a poll of its members in 2000, the American Institute of Architects named Fallingwater "Building of the Century." Despite Fallingwater's structural issues (which a multimillion-dollar renovation has recently fixed) and other problems, this unique building is still regarded by many as the single finest piece of American architecture.

The appeal of Fallingwater may lie in its multiple connections to the natural environment and, consequently, *biophilia*. First defined and described by Harvard biologist Prof. Edward O. Wilson in 1984, biophilia is the study of the human response to the natural environment and the relationship between humans and natural systems, which is, in its simplest form, a sense of place. While there has been a significant amount of study of biophilia and its implications for landscape design, little research or literature exists on biophilia and its connection to the rest of the built environment, particularly architectural design.

Today, the technology and knowledge exists to create a building that touches the earth lightly during both construction and day-to-day operations. However, what has been often neglected by creators of low-impact "green" buildings is the need for spaces to be *habitable*. Occupants of built environments don't want simply to work, play, eat, or sleep in a functional building. They want to be inspired, invigorated, comforted, and reassured by their surroundings. They want spaces that will make them more productive and healthy, and they want spaces in which they love to be—spaces that, as RMI's Amory Lovins puts it, create "delight when entered, pleasure when occupied, and regret when departed."

Over the past two years, RMI's Green Development Services (GDS) has been examining the literature on biophilia and the built environment. In conjunction with Yale University, GDS is now seeking funding for a major multiyear initiative that will collect and disseminate defined and quantified information about "biophilic" design.

"Many of our most cherished buildings and landscapes contain prominent biophilic features only vaguely recognized by occupants and users, although they nonetheless exert powerful effects," said Jenifer Seal of GDS. "What we will be doing is figuring out why these forces occur—both qualitatively *and* quantitatively—so they can then be better promoted, incorporated, and enjoyed in our manmade environments."

"Also, much of the material that has been generated so far is very theoretical in nature and not directly tied to today's real estate development," Seal said. "I hope RMI's contribution will be to make this knowledge more accessible and attractive to the building industry—practical, profitable, and not just for high-end projects. Finding ways to incorporate these concepts into the existing fabric of our already-built environment is important as well."

Biophilia and Our Ancestors

Before discussing the potential connection between biophilia and architecture, the concept of biophilia deserves a deeper explanation. Wilson first described the concept as "the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature."[2] The hypothesis is that this affiliation leads to positive responses in terms of human performance and health—even emotional states.

Connecting to the natural environment.

Photo: Huston Eubank

Introduction to Biophilia

Roger S. Ulrich summarizes this idea best in his essay on biophilia and natural landscapes:

> "The speculation that positive responses to natural landscapes might have a partly genetic basis implies that such responses had adaptive significance during evolution. In other words, if biophilia is represented in the gene pool it is because a predisposition in early humans for biophilic responses to certain natural elements and settings contributed to fitness or chances for survival."[3]

Even before Wilson published *Biophilia* in 1984, British geographer Jay Appleton had applied this hypothesis to landscape design by suggesting that elements of ***prospect*** (an extensive view) and ***refuge*** (being protected from danger) that would have enabled our ancestors to survive can be found in preferred landscapes today. Since Appleton published *The Experience of Landscape* in 1975, many landscape architects and theorists have examined human responses and preferences for certain landscapes. Most notable are the psychologists Rachel and Stephen Kaplan who have written multiple articles on the subject and, in 1998, compiled a book of landscape design elements partially based on biophilic concepts entitled, *With People in Mind*.

Judith Heerwagen (a partner on this RMI research initiative) and Prof. Gordon Orians did some particularly interesting work on landscape prefer-

RMI *in the news*

RMI Helps Make Financial Case for Green Building

RMI has contributed to probably the most impeccable argument ever made for green real estate development. In late 2003, various Institute staffers helped former RMIte **Greg Kats** (see *RMI Solutions* Fall/Winter 2003) assemble a report to California's Sustainable Building Task Force on the costs and benefits of building green.

"This is one impressive report," said RMI's **Jenifer Seal**. "Most people are skeptical about the financial component of green building. Many still carry the belief that green development has to cost significantly more. This report is the first to thoroughly assess and address this misconception."

The report shows that major financial benefits of building green can flow from operational savings after construction—through saved energy costs, saved water costs, saved materials costs, saved waste disposal costs, and saved construction and demolition costs. The report also addresses gains in worker productivity via indoor air quality and natural ventilation and lighting. And it shows that capital cost, if any, is surprisingly modest.

"Integrating 'sustainable' or 'green' building practices into the construction of state buildings is a solid financial investment," states the executive summary. "In the most comprehensive analysis of the financial costs and benefits of green building conducted to date, this report finds that an upfront investment of less than 2 percent of construction costs yields life-cycle savings of over ten times the initial investment. For example, an initial upfront investment of up to $100,000 to incorporate green building features into a $5 million project would result in a savings of at least $1 million over the life of the building, assumed conservatively to be twenty years."

Kats was the principal author for the report, prepared as a result of an August 2000 executive order by **California's then-Governor Gray Davis**, establishing sustainable building as a primary goal for state construction. The report was prepared for more than forty California agencies, including the state's department of finance, which endorsed its conclusions. Although it focuses on California buildings and operations, its data and conclusions are relevant nationally.

Kats is currently writing a chapter about the report for a new book to be published by the Urban Land Institute.

Based in part on the report, the **California Board of Regents** has decided that all future higher education construction in the state will be green—billions of dollars' worth of construction. Kats observes that "The report is already helping public agencies and private institutions make the choice to build green with the confidence that this is the most cost-effective and sensible option."

Contributing authors included Leon Alevantis, Adam Berman, Evan Mills, and Jeff Perlman. Besides Jenifer Seal, RMI's **Bill Browning**, **Bob Wilkinson**, and **Amory Lovins** reviewed the report. It's available at **www.cap-e.com/spotlight/index.cfm?Page=1&NewsID=25770**, along with downloadable PowerPoint slides, assumptions, and some media coverage.

Greater access to natural systems—such as diffuse sunlight and outdoor air through natural ventilation—has been linked to increased productivity in building occupants.

ences. They surveyed people in a variety of cultures and locations around the world to see if there were a preferred image of landscape. What they and others found is that people prefer landscapes that have copses of trees with horizontal canopies, water, elevation changes, distant views, flowers, indications of other people or inhabited structures—all elements that indicate possible food, shelter, and places to explore (or, as Heerwagen and Gordon Orians describe it in *The Biophilia Hypothesis*, "habitability cues, resource availability, shelter and predator protection, hazard cues, wayfinding and movement").[4]

These elements evoke the conditions of our ancestral habitat, the African savanna. Humans frequently replicate savannas in gardens, lawns, parks and other settings. Some argue that this is a purely cultural artifact—the English landscape architect's vision spread by colonialism. On the other hand, we find appealing habitats like the oak savannas of the American Midwest, which came into being through the annual burning of trees by the Indians. In the Algonquian language these savannas are called the "teewahcah," which translates as "the beautiful place."[5]

The natural in-vironment at RMI's super-efficient HQ green-house.

From Landscape to Architecture

While a lot has been written about landscape design and biophilia, Grant Hildebrand, a professor of architectural history at the University of Washington, was the first to make the leap of applying the concept of biophilia to the entire built environment. Using evolutionary theory, Hildebrand argues that in the span of *Homo sapiens*' existence, the era in which humans have constructed habitats for themselves is like a blink of an eye compared to the time spent buildingless in the ancestral habitat of the African savanna. Consequently today, upon "reflecting on the various settings and experiences of our lives, we should be able to find some fairly close matches between characteristics we like and characteristics that would have improved our chances of survival."[6]

Furthermore, these same qualities can and should translate into architecture built over the past few thousand years that humans "like." While Hildebrand says these qualities create architectural pleasure, this study argues that humans find that spaces "that would have improved our chances of survival" make the built environment more habitable. That habitability is the essence of their appeal and why *Homo sapiens* continues to seek these evolutionary design attributes today.

Benefits of a Connection to the Natural Environment

A handful of scientific studies has shown major benefits of a connection to the natural environment—two of which are increased productivity and improved well-being—but the "natural environment" needs a proper explanation.

The natural environment includes the ancestral environment described above as well as such natural systems as the cyclical dynamics of daylight, weather, and temperature, and the annual changes of seasons and the movement of the sun. The natural environment also includes the more traditional definition of nature: ecosystems, trees, flowers, flora and fauna of all types, either inside or out.

Greater access to natural systems—such as diffuse sunlight and outdoor air through natural ventilation—has been linked to increased productivity of building occupants. In a 2001 study, the Heschong Mahone Group showed that "elementary school students in classrooms with the most [diffuse] daylight showed a 21 percent improvement in learning rates compared to students in classrooms with the least daylight."[7] According to a study by Sterling and Sterling (1983), absenteeism rose from 1.3 percent to 4.5 percent when an organization moved from a building with operable windows and natural ventilation to a building with central air and sealed

windows, while the rest of the work environment, including management and furniture arrangements, remained relatively constant.

The clinical benefits of a greater connection to the natural environment include reduced stress, faster recovery time, and decreased use of strong painkillers. In a 1991 study by Terry Hartig and his associates (Mang, and Evans), stressed individuals who took a forty-minute walk in an urban nature area dominated by trees reported improved emotional states and performed better at a proofreading task than equivalently stressed individuals that took a walk in an urban setting without trees. Similarly, M.J. West (1985) discovered that prison inmates with views of nature had fewer health-related stress symptoms, such as digestive complaints and headaches, than prisoners with views of buildings or prison walls. Ulrich (1984) completed the best-known and most thorough study linking views of nature to/with hospital recovery:

> The patients were assigned essentially randomly to rooms that were identical except for window view: one member of each pair overlooked a small stand of deciduous trees; the other had a view of a brown brick wall. Patients with the natural window view had shorter postoperative hospital stays, had fewer negative comments in nurses' notes ("patient is upset," "needs much encouragement"), and tended to have lower scores for minor post-surgical complications such as persistent headache or nausea requiring medication. Moreover, the wall-view patients required many more injec-t[ion]s of potent painkillers, whereas the tree-view patients more frequently received weak oral analgesics such as acetaminophen.[8]

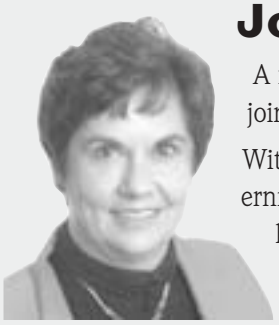
In 1990, Ulrich and Outi Lunde conducted research on the recovery of open-heart surgery patients in Sweden. Their findings suggest that patients with pictures of an open view with water had less postoperative anxiety than control groups or groups exposed to a picture with abstract geometric forms or an enclosed forest scene. While the evidence is still circumstantial, these studies show the possibility that a greater connection between interior spaces and the natural environment could improve health.

Biophilic Design Attributes

Although RMI's work on biophilia is just beginning, a set of design attributes associated with these environments is becoming evident.

RMI *in the news*

Prominent Policy Expert Sue Woolsey Joins RMI Board

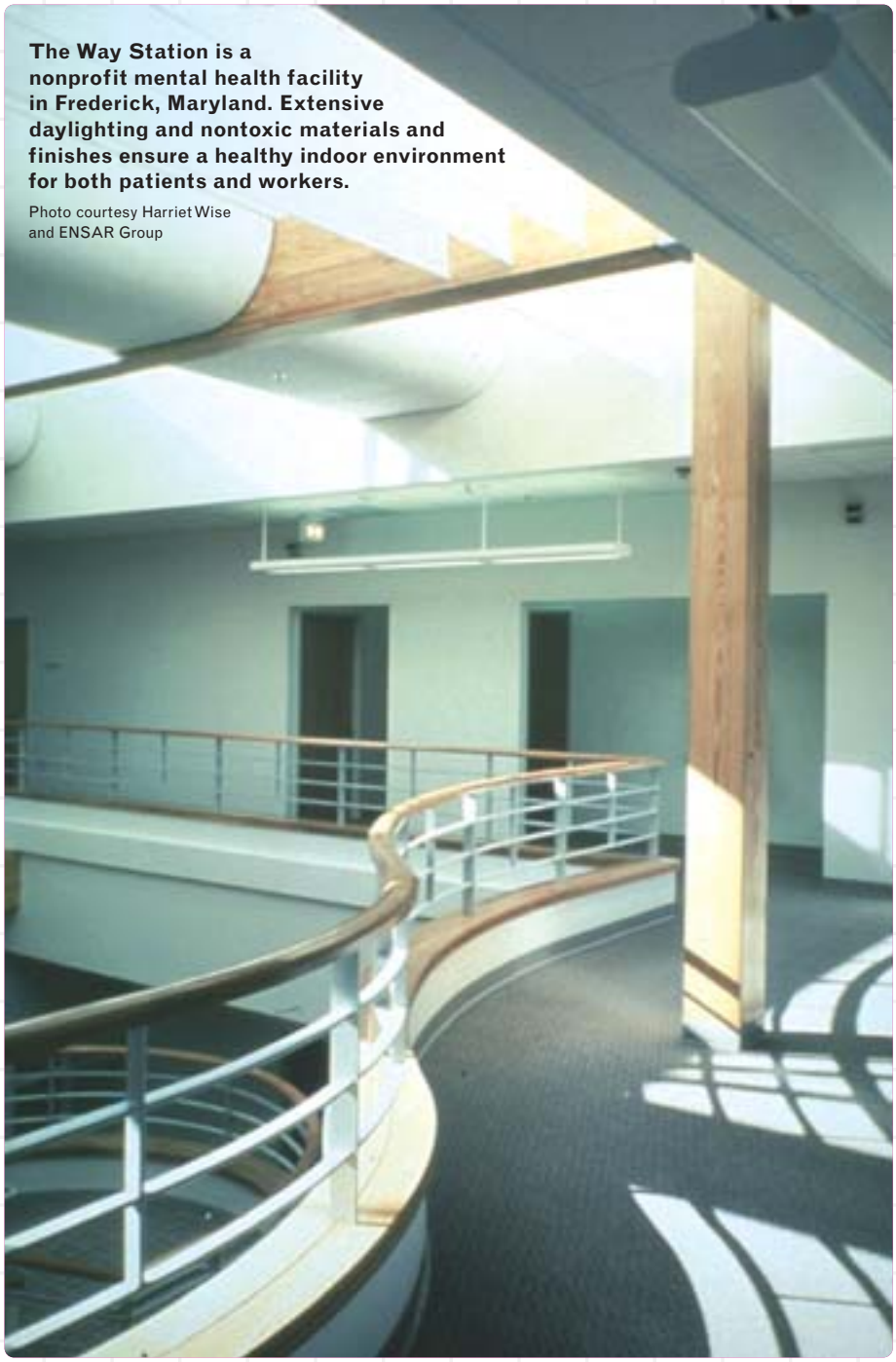


A nationally recognized policy expert and science advocate, Suzanne Woolsey, Ph.D., recently joined RMI's Board of Directors.

With an impressive public service record, Mrs. Woolsey has been active at the intersection of government, the private sector, and the science community for more than three decades. She began her professional career as a policy analyst in the office of Elliott Richardson, then Secretary of Health, Education, and Welfare. In 1977 she became the associate director of the Office of Management and Budget, overseeing 52 percent of the federal budget. In 1980 she joined the editorial board of the *Washington Post*, writing editorials and op-ed pieces on domestic policy issues. At the end of that year she joined Coopers and Lybrand as a consulting partner, managing strategic work with universities and research institutes.

In 1989 Mrs. Woolsey joined The National Academies of Science, Engineering, and Medicine to direct their work in behavioral and social sciences and education. After three years she became the Academies' first chief operating officer, a position she held until May 2000. She then served as the chief communications officer of The National Academies, spearheading a major initiative to improve engagement between the scientific community and the public.

She currently serves on a range of diverse boards, including the boards of the German Marshall Fund of the United States, Van Kampen Mutual Funds, Colorado College, Neurogen Corporation, Intelligent Medical Devices LLC, and the Institute for Defense Analyses. She is also a member of the Council on Foreign Relations. She holds a BA with honors from Stanford in history and psychology, and MA and Ph.D. degrees from Harvard in clinical and social psychology.



The Way Station is a nonprofit mental health facility in Frederick, Maryland. Extensive daylighting and nontoxic materials and finishes ensure a healthy indoor environment for both patients and workers.

Photo courtesy Harriet Wise and ENSAR Group

These biophilic design attributes include:

- the use of dynamic and diffuse daylight,
- the ability to have frequent, spontaneous and repeated contact with nature throughout and between buildings,
- the use of local, natural materials,
- a connection between interior and exterior surfaces,
- natural ventilation,
- a direct physical connection to nature from interior spaces, and
- direct visual access to nature from interior spaces.

Interestingly, some of these amenities provide building occupants with access to natural systems even though they don't have direct contact with them, visually or physically.

Along with a greater connection between the interior and surrounding natural environment, some "successful" projects we've examined so far boast attributes similar to those that would have enhanced our ancestors' chances for survival: access to water, complexity and order, enticement, peril, and the duality of prospect and refuge.

The ultimate goal of RMI's new research initiative is to outline biophilic design attributes and put them into a clear, sensible, organized format so developers, designers, planners, and architects can learn about the importance of a connection to the natural environment in all their building projects. In the near future, this could help more people enjoy the everyday places where they live and work—as much as they enjoy Fallingwater.

Corey Griffin is a former RMI Konheim Fellow. He is currently working on a master's degree in architecture at the University of California at Berkeley.

1 As quoted in Hildebrand, *The Wright Space*, p. 15.

2 Edward O. Wilson, "Biophilia and the Conservation Ethic," p. 31.

3 Roger Ulrich, "Biophilia, Biophobia, and Natural Landscapes," p. 75.

4 Judith H. Heerwagen and Gordon H. Orians, "Humans Habitats and Aesthetics," *The Biophilia Hypothesis*, Island Press, Washington DC, pp. 142–146.

5 Gerald Wilhelm, Conservation Design Forum.

6 Grant Hildebrand, *The Origins of Architectural Pleasure*, p. 10.

7 Lisa Heschong, "Daylighting in Schools," p. 2.

8 Roger Ulrich, "Biophilia, Biophobia, and Natural Landscapes," pp. 106-107.