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Reinterpreting Sustainable Architecture: The Place of Technology

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This paper examines the relationships between diverse technical design strategies and competing conceptions of ecological place making. It highlights the conceptual challenges involved in defining what we mean by calling a building "green" and outlines a social constructivist perspective on the development of sustainable architecture. The paper identifies six alternative logics of ecological design which have their roots in competing conceptions of environmentalism, and explores the ways in which each logic prefigures technological strategies and alternative visions of sustainable places. Finally, the paper discusses the implications of the contested nature of ecological design for architectural education, practice, and research.

Introduction

Susan Maxman has suggested that "sustainable architecture isn't a prescription. Its an approach, an attitude. It shouldn't really even have a label. It should just be *architecture*."[1] However, beyond this de facto professional embrace of "green" design, making sense of environmental innovation in architecture tends to be a confusing business. Glancing through the myriad of articles, reports, and books on the subject of green or sustainable buildings, we find a bewildering array of contrasting building types, employing a great variety of different technologies and design approaches, each justified by a highly diverse set of interpretations of what a sustainable place might represent. As Cook and Golton put it, "the designation 'green' is extremely wide ranging, encompassing many viewpoints and open to broad interpretation," with sustainable architecture embodying an "essentially contestable concept."[2]

Constructing Consensus

While it is widely recognized that sustainability is a contested concept, much of the contemporary debate on sustainable architecture tends to sidestep the issue. Either competing environmental strategies are grouped within a single, homogenous categorization of green design with little or no reference to their distinctiveness, or the existence of a multiplicity of design approaches is identified as a significant barrier to solving what are considered to be self-evident problems such as global warming. Seen this way, sustainable buildings are assumed to merely represent differently configured technical structures, with particular pathways of technological innovation viewed as objectively preferable to others. Reflecting the "technocist supremacy" that dominates most environmental research programs, this perspective tends to ignore the essentially social questions implicated in the practice of sustainable architecture.[3] Typical are suggestions that if we are to achieve sustainable buildings then architecture should become more "objective," and that "until a consensus is attained, the ability of the architectural community to adopt a coherent environmental strategy, across all building types and styles of development, will remain elusive."[4] Such "environmental realism" is founded on the notion that "rational science can and will provide the understanding of the environment and the assessment of those measures which are necessary to rectify environmental bads."[5] Further implicit in this model of consensus is a "process of standardisation," which means that "particular local conditions" and competing "forms of local knowledge" tend to be ignored.[6]

Reinterpreting Sustainable Architecture

We suggest that a more appropriate way to understand this strategic diversity lies in abandoning the search for a true or incontestable definition of sustainable buildings, and instead treating the concept in a "relative rather than an absolute sense" as a "means of raising awareness of all the issues that can be considered."[7] In this we follow John Hannigan in suggesting that society's willingness to recognize and solve environmental problems depends more upon the way these claims are presented by a limited number of people than upon the severity of the threats they pose.[8] That is, the concept of a green building is a social construct. This is not to say that the range of environmental innovations are not valid—socially, commercially, or technically—in their own terms. The aim of this analysis is not to "discredit environmental claims but rather to understand how they are created, legitimated, and contested."[9] The premise is, then, that individuals, groups, and institutions embody widely differing perceptions of what environmental innovation is about.[10] Each of these actors may share a commitment to sustainable design but are likely to differ greatly in their "interpretation of the causes of, and hence the solution to, unsustainability."[11] This is a highly contested process. Design and development actors possess varying degress of power to implement their environmental visions. By treating these competing views as environmental discourses that take material form in the shape of buildings, we can recognize the tension between alternative environmental beliefs and strategies. Thus, by adopting an interpretative framework, and by "exploring the notion of discourse, we highlight the social production of space, place, and the environment. We challenge the assumption that environment is merely a physical entity and resist the categorisation of it only in scientific terms."[12]

Journal of Architectural Education, pp. 140–148

Table 1 The six competing logics of sustainable architecture

Logic	Image of Space	Source of Environmental Knowledge	Building Image	Technologies	Idealized Concept of Place
Eco-technic	global context macrophysical	technorational scientific	commercial modern future oriented	integrated energy efficient high-tech intelligent	Integration of global environmental concerns into conventional building design strategies. Urban vision of the compact and dense city.
Eco-centric	fragile microbiotic	systemic ecology metaphysical holism	polluter parasitic consumer	autonomous renewable recycled intermediate	Harmony with nature through decentralized, autonomous buildings with limited ecological footprints. Ensuring the stability, integrity, and "flourishing" of local and global biodiversity.
Eco-aesthetic	alienating anthropocentric	sensual postmodern science	iconic architectural New Age	pragmatic new nonlinear organic	Universally reconstructed in the light of new ecological knowledge and transforming our consciousness of nature.
Eco-cultural	cultural context regional	phenomenology cultural ecology	authentic harmonious typological	local low-tech commonplace vernacular	Learning to "dwell" through buildings adapted to local and bioregional physical and cultural characteristics.
Eco-medical	polluted hazardous	medical clinical ecology	healthy living caring	passive nontoxic natural tactile	A natural and tactile environment which ensures the health, well-being, and quality of life for individuals.
Eco-social	social context hierarchical	sociology social ecology	democratic home individual	flexible participatory appropriate locally managed	Reconciliation of individual and community in socially cohesive manner through decentralized "organic," nonhierarchical, and participatory communities.

The Competing Logics of Sustainable Architecture

Our analysis is based upon studies of completed buildings and an extensive literature review of books, articles, and reports covering issues related to sustainable, environmental, ecological, or green buildings. Careful analysis of the resulting search resulted in a typology of six environmental logics, which are illustrated in Table 1.[13] Here, we define *logic*, following Hajer, as "a specific ensemble of ideas, concepts and categorisations that are produced, reproduced and transformed in a particular set of practices through which meaning is given to social and physical realities."[14] These logics are not meant to be in any way exclusive, or frozen in time or space. As Benton and Short suggest, "Discourses are never static and rarely stable."[15] That is, through the design process of any particular development, logics may collide, merge, or coinhabit debate about form, design, and specification. The main point is that the "environmental problematique is hardly ever discussed in its full complexity." Rather, each "environmental logic tends to be dominated by specific emblems: issues that dominate the perception of the ecological dilemma."[16] Each of the logics highlight the ways in which the green building debate is framed differently depending upon competing constructions of the environmental problem and alternative concepts of what might constitute a sustainable place. These contrasting environmental discourses "mobilise biases in and out of the environmental debate," thereby shaping the subsequent design strategy.[17] In particular, each logic is underpinned by a disparate concept of the space through which environmental benefits and detriments flow and are represented; differing sources of environmental knowledge though which we come to experience and understand the environment; and distinct images of buildings in relation to the environments they inhabit. In exploring these interpretative frameworks, we illustrate how each logic prefigures technological choice within a broad design strategy premised by a specific form of environmental place making. As we highlighted above, we present these logics as separate but not autonomous. In practice, logics may merge or simply be absent as exemplified by analysis of any individual building (which we must leave for another paper). Rather than focus on the particular, our aim here is to unpack the general metalogics that frame our thinking about sustainable architecture.

The Ecotechnic Logic—Buildings and the Global Place

The ecotechnic logic is based on a technorational, policy-oriented discourse which represents a belief in incremental, technoeconomic

change and that science and technology can provide the solutions to environmental problems. As Cook and Golton put it, "technocentrics recognize the existence of environmental problems and want to solve them through management of the environment" putting their trust in "objective analysis and a rational scientific method."[18] In the field of environmental policy, these ideas have been expressed in terms of ecological modernization, which "indicates the possibility of overcoming the environmental crisis without leaving the path of modernisation."[19] The assumption is that existing institutions can internalize and respond to ecological concerns and what is required is an integrative approach in which science, technology, and management take account of the environmental impacts of development.

A key feature of the ecological modernization paradigm is its globalizing viewpoint, which situates sustainability within a context that is distant in terms of space and time. Concerns are mainly for the universal, global environmental problems of climate change, global warming, ozone layer depletion, and transnational pollution issues such as acid rain. It is a view that the real environmental dangers are those of a "global physical crisis that threatens survival."[20] What is required is the formation of an international political consensus around the need for centralized national and global action. There is an emphasis on the concept of futurity, as suggested by the Brundtland definition of sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."[21] We therefore have an ethical responsibility to distant humanity or future generations in maintaining both the stability and resource richness of the globe. The role and context of sustainable buildings becomes prioritized in terms of global action and local reaction.

In practice, these ideas are characterized by a consensual, top-down view of environmental and technological change in which a "progressive process of innovation mitigates the adverse effects of development."[22] The source of environmental problems stems from past practices not taking sufficient account of environmental concerns, and what is required is the "development, inauguration and diffusion of new technologies that are more intelligent than the older ones and that benefit the environment," and under the assumption that "the only possible way out of the ecological crisis is by going further into industrialisation."[23] This approach therefore, while borrowing much of its symbolic language from ecology, places its optimism and faith in the potential and possibilities of technological development as a panacea for our environmental ills.

In the case of building design, the emblematic issue is efficiency and, in line with global concerns, energy efficiency is prioritized. The negative environmental impacts of buildings are assumed to be the result of a variety of inefficient practices implicit within the process of building production. The resulting design strategy is adaptive but based on recognizably modern, usually high-technology buildings that attempt to maximize the efficiency of building in spatial, construction, and energy terms. This approach is perhaps best epitomized by the High-Tech school, led by British architects such as Norman Foster, Richard Rogers, Nicholas Grimshaw, and Michael Hopkins and including the work of Italian architect Renzo Piano, Thomas Herzog in Germany, and the bioclimatic skyscrapers of Ken Yeang in Malaysia.[24] Here, an emphasis on the environmental efficiency of development has stimulated a whole range of technological innovations in building fabric and servicing systems: translucent insulation, new types of glass and solar shading, intelligent facades, double-skin walls and roofs, and photovoltaics. Energy-efficient lighting, passive solar design and daylighting, the use of natural and mixed-mode ventilation, more efficient air conditioning and comfort cooling, combined with sophisticated energy management systems are all part of the High-Tech approach. The rhetoric of the ecotechnic approach tends to be overwhelmingly quantitative, success is expressed in the numerical reduction of building energy consumption, material-embodied energy, waste and resource-use reduction, and in concepts such as life-cycle flexibility and cost-benefit analysis.

The Eco-centric Logic—Buildings and the Place of Nature

In sharp contrast to the eco-technic logic with its emphasis on incremental technical change and an optimism in the adaptability of institutions to accommodate environmental demands, the eco-centric logic is founded on a need for a radical reconfiguration of values. According to Victor Papenak the "beneficial connection between economics and ecology has been systematically misrepresented by industrial and governmental apologists."[25] Here the assumption is that "the challenge of sustainable design is too big, too complex, and too uncertain to deal with as a technical problem, or even as an exercise in institutional design."[26] The eco-centric logic stems from a particular view of nature generated through the natural scientific paradigm of systemic ecology. As a framework of analysis, it emphasizes both the epistemological holism implicit in ecology and the metaphysical reality of ecological wholes. It is a discourse that stresses the dynamic interaction between the living and nonliving as a community of interdependent parts suggested by the notion of "Gaia."[27] Ecocentric discourse combines the science of ecology with an eco-centric or bio-centric ethical framework that extends moral considerations beyond anthropocentric concerns to encompass nonliving objects and ecological systems. This is ex-

pressed by Aldo Leopold's "land ethic," which portrays the earth not as a commodity to be bought and sold but rather as a community of which humans are an integral part.[28] Human responsibilities to the environment are conceived as stewardship, a kind of management ethic dictated by the biophysical constraints and limits that come not from human needs but from within nature itself. Exceeding these limits, it is argued, will have catastrophic results, with nothing less than planetary survival at stake.

This rhetoric generates a viewpoint in which nature becomes viewed as fragile and where natural equilibrium is easily disrupted. Sustainability therefore requires immediate and full precautionary protection of ecosystems and natural capital; an absolute response needing "a radical approach to rethinking building design and production."[29] The role of sustainable architecture is not simply the improvement of environmental performance, as this approach "belongs to an instrumental paradigm that is in itself complicit in our environmental problems."[30] Here, what is required is not only the development of more efficient technologies but a wider questioning of what constitutes sufficient technology; it is the latter which must define the boundaries of the former.[31] The ecocentric image of the built environment emphasizes its negative environmental impacts; in the case of buildings, the perception is that they are an unnatural form of "pure consumption" interrupting the natural cycles of nature.[32] In this sense: "Each building is an act against nature; it directly makes some proportion of the earth's surface organically sterile by covering it over, rendering that area incapable of producing those natural resources that require the interaction between soil, sun and water. As a result in ecological terms, a building is a parasite."[33] The essential mission of sustainable architecture becomes that of noninterference with nature, the ultimate measure of sustainability is the flourishing of ecosystems, and the fundamental question is whether to build at all. Where building is essential, the aim is to radically reduce the "ecological footprint" of buildings.[34] Approaches to building tend to draw directly on analogies with ecological systems as efficient, living, closed, cyclical processes, which oppose the linear, inefficient, open systems of conventional buildings. The holistic design strategies that result tend to revolve around small-scale and decentralized techniques utilizing low and intermediate technologies. There is an emphasis on reducing, or severing dependency on centralized infrastructure services of water, energy, and waste as in the autonomous house designs of architects like Brenda and Robert Vale in the UK.[35] In terms of building materials, preference is for renewable, natural materials such as earth, timber, and straw combined with a reduction of the use of virgin building materials through reuse and recycling. This approach is epitomized by Mike Reynold's work on domestic "Earthships" in New Mexico, where self-sufficient homes are made from used tires, bottles, and other waste materials, filled and plastered with earth.[36]

The Eco-aesthetic Logic—Buildings and the New Age Place

The eco-aesthetic logic shifts the debate about sustainable architecture beyond the efficient use of resources and the reduction of ecological footprints. Here the role of sustainable architecture is metaphorical and, as an iconic expression of societal values, it should act to inspire and convey an increasing identification with nature and the nonhuman world, what is required is a "new language in the building arts."[37] The eco-aesthetic logic draws on what might be termed a new concept discourse, which emphasizes spirituality in social and environmental relations and contains a strong New Age dimension. New Ageism takes an evolutionary view of world history, and "is bound together by a belief that the world is undergoing a transformation or shift in consciousness which will usher in a new mode of being."[38] As a theory of social change, it represents an idealist vision of a global universal consciousness, which begins with individual reflexivity and ecological awareness and which will eventually lead to the establishment of "whole new civilisations and cultures."[39] The starting point for change derives from a "convergence of views inherent in Eastern philosophies [and] postmodern science."[40] This new postmodern paradigm "is a new world view that is illuminated by what are called the new sciences of complexity, which includes Complexity Theory itself, Chaos Science, self-organising systems, and non-linear dynamics."[41] The eco-aesthetic logic places an emphasis on individual creativity and a liberated imagination combined with a romantic view of nature that rejects Western rationalism, modernism, and materialism; the assumption is that "the salvation of this human world lies nowhere else than in the human heart."[42] The solution to the environmental crisis requires a shift from utilitarian values to a view in which aesthetic and sensual values play a prominent role. According to John Passmore: "A more sensuous society could never have endured the desolate towns, the dreary and dirty houses, the uniquely ugly chapels, the slag heaps, the filthy rivers, the junk yards which constitute the "scenery" of the post industrial west . . . Only if men can first learn to look sensuously at the world will they learn to care for it."[43]

The emblematic issue in building design is how to represent the epoch shift of the new millennium and the transition to a holistic, ecological worldview or zeitgeist. This invokes an ethical responsibility in beginning to redefine culture itself, and in creating a new universal architectural iconography that has transformative value in altering our consciousness of nature. The role of green

buildings is to break free from strictly formalist interpretations of architecture, which are representative of a humanist culture with an anthropocentric attitude to nature, and "the entire direction in design suggests the development of a new paradigm in the building arts that [is] based on ecological models."[44] The rhetoric of this logic prioritizes appropriate architectural form above physical performance, expressed in Charles Jencks's assertion that "good ecological building may mean bad expressive architecture."[45] Instead it is "essential to cultivate a tradition of sensuous, creative Green Architecture," one that "delights in the ecological paradigm for its philosophy of holism, its style and the way in which it illuminates the complexity paradigm."[46] This new architectural language will be made possible by the new technologies of the information age—namely, advances in structural engineering, the ability to build curved forms through the use of computer modeling, automated production and new materials that offer the possibility to move beyond conventional notions of space and functional norms to create new forms that celebrate the environmental message. A move back towards organicism, expressionism, the chaotic, and the nonlinear is the "aesthetic . . . growing out of this new world view; a language of building and design close to nature, of twists and folds and undulations; of crystalline forms and fractured planes."[47] Jencks suggests that the beginning of this new movement can be witnessed in the "organi-tech" architecture of Frank Gehry, Santiago Calatrava, and Future Systems; in the "cosmic" forms of Japanese architects such as Arato Isosaki; and in the artistic fusion of landscape and architecture in the work of SITE.[48]

The Eco-cultural Logic—Buildings and the Authentic Place

The eco-cultural logic emphasizes a fundamental reorientation of values to engage with both environmental and cultural concerns. Here, it is not the development of a new universal culture which is promoted, but rather the preservation of a diversity of existing cultures. The emblematic issue is authenticity and the notion that truly sustainable buildings need to more fully relate to the concept of locality and place. The emphasis on place, or genius loci, is intended to counteract the deficiencies of abstract modernist space and is a reaction against the globalism of the International Style. Our ethical responsibilities are to resist the phenomena of universalization prevalent in modern culture, as, according to Frampton, "sustaining any kind of authentic culture in the future will depend ultimately on our capacity to generate vital forms of regional culture."[49] Arne Naess argues that we should "aim to conserve the richness and diversity of life on earth—and that includes human cultural diversity."[50] This requires a further step from ecologically sustainable development to long-range "ecosophical" development: "Any model of ecologically sustainable development must contain answers, however tentative, as to how to avoid contributing to thoughtless destruction of cultures, and to the dissemination of the belief in a glorious, meaningless life."[51]

The eco-cultural logic draws inspiration from a phenomenological account of the environment and revives Heideggers concept of dwelling with an emphasis on reinhabiting or relearning a sense of place. This unique sense of identity evolves subjectively from within nature and there is a concern for the continuity of meaning between tradition and the individual combined with the cultivation of an ecological consciousness. It implies both the development of a sense of being indigenous to a place and a responsibility for protecting landscape and ecosystems from disturbance. The approach stresses decentralization and is concerned with the characteristics of regions or bioregions, which are conceived as the basic geographical unit of a small-scale ecological society. Here a bioregion is defined by a combination of natural, biological, and ecological characteristics and by a cultural context, it is both a bounded physical terrain and a "terrain of consciousness."[52] Sustainability means living within the constraints and possibilities imposed by these characteristics, and as a design strategy, bioregionalism draws inspiration from indigenous and vernacular building approaches. These traditional building forms are seen as indicative of the way in which rooted cultures have naturally evolved appropriate lifestyles adapted to their particular physical environment.

Within this logic it is suggested that sustainable architectural approaches should move away from universal and technologically based design methodologies as these often fail to coincide with the cultural values of a particular place or people. According to Ujam and Stevenson this means "refuting the concern of certain 'Green' architects with 'Green' but culturally unsustainable technical fixes situated within existing building typologies. Adding insulation made from synthetic materials or 'Arabic-wind' towers as objects to an office block does not integrate a 'green' solution in terms of cultural considerations and sustainable design."[53] Contemporary architecture should therefore "recognize very deeply structured personal responses to particular places" if it is to be sustainable.[54] The eco-cultural logic emphasizes both the preservation and conservation of the variety of built cultural archetypes that already exist, combined with a concern for cultural continuity expressed through the transformation and reuse of traditional construction techniques, building typologies, and settlement patterns, each with a history of local evolution and use. This emphasis on the peculiarities of place, the use of local materials, and an appropriate formal response to climatic and microclimatic conditions is perhaps best expressed in the

regionalist approaches of architects like Glenn Murcutt in Australia, Charles Correa in India, Geoffrey Bawa in Sri Lanka, and Hassan Fathy in Egypt.

The Eco-medical Logic—Buildings and the Healthy Place

The eco-medical logic shifts debates about sustainability from concerns about appropriate form and the wider cultural context of design towards a humanist and social concern for the sustaining of individual health. It is generated through a medical discourse that tends to relate "the health of the individual to an increasingly important condition: a healthy environment."[55] A new relationship of human beings to the environment has been legitimated through an understanding that the health of individuals is conditioned by the external environment. "By linking health to issues such as the quality of air, water and urban space, medicine has helped to make the environment an important concern."[56] This logic utilizes a medical rhetoric to focus attention on the adverse impacts of the built environment and the causes of stress that engender health problems, both physical and psychological. Medical discourse has highlighted the environmental hazards that are associated with mechanization and that accompany the "risk society."[57] Here the application of technology is not considered to be a risk-free operation, and importantly, this discourse has served to highlight that reducing the technological intensity of buildings (or society) does not necessarily "lead to a shrinking well-being: on the contrary even a growth in well-being can be imagined."[58]

In the case of buildings, the eco-medical logic tends to focus a critical attention on the interior of buildings, where the concept of sick buildings is a familiar emblematic issue applied to both working and domestic environments.[59] As David Pearson suggests, "the majority of urban built environments are poorly designed and managed, and the constant exposure to them produces stress and illness—the symptoms of 'sick building syndrome' being part of a far wider malaise."[60] Here The role of buildings as a technological barrier to a hostile natural world has been transformed; instead, we have a new image of buildings themselves as potentially dangerous environments in which individuals are put at daily risk from a variety of hazards.[61] Our health is literally threatened by the technologies that were created to protect it. In the case of the work environment, critics utilizing this logic tend to identify the technological intensity of large modern buildings, combined with a separation from nature and a lack of individual control over our immediate surroundings, as the root cause of the problem. Many people spend their lives in anonymous, universal environments which are artificially lit, mechanically ventilated, and effectively cut off from the outside world. This isolation from nature is being increasingly challenged by building occupiers, who now desire more control over their internal environments. As a result, new design principles of "environmental diversity are emerging," which envisage spaces that maintain, in the occupant, a sense of dynamics of the natural climate, of the proper condition of mankind."[62]

The promotion of naturally conditioned environments extends to the choice of materials, and the ecomedical logic draws on the disciplines of clinical ecology and environmental medicine where chemical pollution from synthetic building materials is seen as a key issue.[63] Architects such as Christopher Day have further extended these concerns to spiritual well-being, suggesting the importance of lifestyle as a complex whole.[64] What is required is "healing environments," ones in which we feel "balanced, relaxed and at one with the world," an architecture that can "honour the senses."[65] These ideals are embodied in the concept of *Baubiologie* (building biology), where the concepts of health and ecology are interwoven, and the aim is to "design buildings that meet our physical, biological, and spiritual needs. Their fabric, services, colour and scent must interact harmoniously with us and the environment . . . to maintain a healthy, 'living' indoor climate."[66] This approach has inspired the buildings of Peter Schmid in the Netherlands, Floyd Stein in Denmark, the Gaia group in Norway, and the practice of Elbe and Sambeth in Germany. Baubiologie promotes the use of natural and tactile materials and traditional building methods utilizing organic treatments and finishes, natural light and ventilation, and the use of color to promote health.

The Eco-social Logic—Buildings and the Community Place

The eco-social logic extends the social agenda of sustainability beyond a concern for the individual to encompass a political discourse that suggests that the root cause of the ecological crisis stems from wider social factors. It addresses the emblematic issue of democracy as the key to an ecological society. It is only through a model of community that is created to serve common needs and goals, where humans experience true freedom and individual self-realization, that they will be able to live in harmony with the natural world. According to Murray Bookchin: "The ecological principle of unity in diversity grades into a richly mediated social principle," implicit in the term "social ecology."[67] Social ecologists believe that "human domination and degradation of nature arises out of social patterns of domination and hierarchy, patterns of social life in which some humans exercise control or domination over others."[68] Environmental and ecological destruction is therefore best understood as a form of human domination, and the more hierarchical and oppressive the nature of a society, the more likely that it will abuse and dominate the environment.

The ecological society can therefore only attain "its truth, its self actualization, in the form of richly articulated, mutualistic networks of people based on community."[69] This approach proposes the decentralization of industrial society into smaller, highly self-sufficient, and communal units, working with "intermediate technologies that are based on an understanding of the laws of ecology."[70] The aim is the creation of healthy, self-reliant societies that exercise local control, take responsibility for their environment, operate a local economy based on minimal levels of material goods and the maximum use of human resources. This logic suggests the creation of buildings that embody and express the notion of a social and ecological community in which democratic values such as full participation and freedom are the norm. It promotes the notion of building as home and seeks to challenge the feelings of alienation attached to many examples of modern architecture. It is exemplified by Dick Russell's suggestion that "we need a building metaphor that somehow encapsulates the idea of co-operative community, of a responsibility toward the earth and each other that we have abandoned."[71] Here, ethical concerns stem from the creation of buildings that have the potential to help us forge a sense of individual and collective identity. The design approach aims to express the organic formation of society with links to the natural locality within which communities are developed; and through these links, we will become more aware of our impact on the environment. The strategy deriving from this logic is as much social as technical and aesthetic, and it highlights the political issue of democratic control over technology and expertise. There is a concern for the use of "appropriate technologies," which according to Pepper, "are democratic [because] unlike high technology they can be owned, understood, maintained and used by individuals . . . not just a minority of 'expert' men."[72] This contrasts with the black-box anonymity of many complex building technologies, and here, the vision of building is one of an enabling, transparent, participatory process that is adapted to, and grounded within, particular local ecological conditions. Contemporary architectural approaches range from the participatory design processes utilized by Lucien Kroll in Belgium and Ralph Erskine in the U.K. to the self-build projects of Peter Hubner in Germany and a number of architects working with the Segal method in the U.K.[73] The aim throughout is to construct appropriate, flexible, and participatory buildings that serve the needs of occupiers without impacting on the environment unnecessarily by using renewable natural, recycled, and wherever possible, local materials. The vision of independent ecocommunities is more fully realized in a number of alternative communities throughout the world including the Findhorn Community in Scotland, Christiana Free City in Denmark, and Arcosanti in Arizona.

Conclusions: Reconstructing Sustainable Architecture

In highlighting the contested nature of debates around sustainable architecture, our analysis raises significant questions about the positivistic scientific assumption underpinning the search for a consensual definition of sustainable architectural practice. We suggest that design debates and practice constitute sites of conflicting interpretations through which an often complex set of actors participate in a continuous process of defining and redefining the nature of the environmental problem itself. Debates about sustainable architecture are shaped by different social interests, based on different interpretations of the problem, and characterized by quite different pathways towards a range of sustainable futures. These competing environmental debates are not the result of uncertainty, but are due to the existence of "*contradictory certainties:* Severely divergent and mutually irreconcilable sets of convictions both about the environmental problems we face and the solutions that are available to us."[74] The analytical framework of social constructivist theory developed here and elsewhere usefully demonstrates the contingent and contextual nature of technological innovation and building design, and highlights the arguably most fundamental issue (understandably marginalized in the debate about consensus)—that the environment is a contested terrain, and that implicit within alternative technological strategies are distinct philosophies of environmental place making.[75] Environmental concerns are both time and space specific and are governed by a specific modeling of nature, this same "logic can be applied to technology and to sustainable architecture. In other words there is 'interpretative flexibility' attached to any artefact: It might be designed in another way."[76] This perspective points towards a multidirectional analytical model that recognizes how certain technological development pathways fade away, while others are "economically reinforced as members of a society come to share a set of meanings or benefits" attached to them.[77]

Adopting a social constructivist perspective has critical implications for architectural practice, education, and research. Rather than searching for a singular optimal technological pathway, it is vital that we learn to recognize and listen to the number of voices striving to frame the debate and the visions they express of alternative environmental places. The search for consensus that has hitherto characterized sustainable design and policy making should be translated into the search for an enlarged context in which a more heterogeneous coalition of practices can be developed. In this sense, rather than viewing sustainable design practice as the "implementation of a plan for action, it should be viewed as an on-going transformational process in which different actor interests and struggles are located."[78]

In an educational context, there is an opportunity to encourage greater reflectivity in architectural students by challenging the search for a true or incontestable, consensual definition of green buildings. If the future direction and success of sustainable architecture strategies relies on the abilities of architects to act as moral citizens by engaging in an open process of negotiation, criticism and debate, then it is vital that students are encouraged to become more sensitive to the range of possible logics of innovation that may surface in design practice. This means searching for critical methods for understanding technological innovation that transcend both instrumental and deterministic interpretations and that can begin to open "the discourse of technology to future designers in the hopes of engendering a more humane and multivocal world."[79] Multiple opinions and perspectives are not only valid but highly desirable. Further, once a diversity of possible approaches have been exposed "they might lead to a more reflective attitude towards certain environmental constructs and perhaps even the formulation of alternative scenarios."[80]

Finally, we cannot ignore the ways in which particular logics of environmental innovation take root in commercial development practices. This means accepting that architecture is dependant on the contingent and dynamic strategies of those development actors with the power to implement their chosen design strategy. An important contribution of social constructivist analysis may lie in its ability to demonstrate how the power relations among competing development interests frame technological decision making and subsequent design strategies. An analysis of the changing power relationships structuring this process suggests an important future direction in research.[81] Such research may help to identify those societal actors with most influence over decision making and enable practitioners and students to recognize their own position and role in the provision of more sustainable lifestyles. However, this may only be possible if, according to Hajer, "ecological politics could shed its prevailing techno-corporatist format and create open structures to determine what sort of nature and society we really want."[82] In recognizing the socially contested nature of environmental design, we might begin to engage in a very different dialogue about sustainable architecture.

Notes

1. Susan Maxman,"Shaking the Rafters," *Earthwatch* (July/Aug. 1993): 11.

2. Sara J. Cook and Bryn L. Golton, "Sustainable Development: Concepts and Practice in the Built Environment," *Sustainable Construction* CIB TG 16, (Nov. 1994): 677–685.

3. Graham Woodgate and Michael Redclift, "From a 'Sociology of Nature' to Environmental Sociology," *Environmental Values* 7 (1998): 2–24.

4. John Brennan, "Green Architecture: Style over Content," *Architectural Design* 67/1-2 (1997): 23–25.

5. Phil Macnaghton and John Urry, *Contested Natures* (London: Sage, 1998), p. 1.

6. Ibid., p. 9.

7. Cook and Golton, "Sustainable Development," p. 684.

8. John Hannigan, *Environmental Sociology: A Social Constructivist Perspective* (London: Routledge, 1995).

9. Hannigan, *Environmental Sociology,* p. 3.

10. See Marteen Hajer, *The Politics of Environmental Discourse* (Oxford: Oxford University Press, 1995), pp. 12-13, where the author suggests that, "the present hegemony of the idea of sustainable development in environmental discourse should not be seen as the product of a linear, progressive, and value-free process of convincing actors of the importance of the Green case. It is much more a struggle between various unconventional political coalitions, each made up of such actors as scientists, politicians, activists, or organisations representing such actors, but also having links with specific television channels, journals and newspapers, or even celebrities."

11. Steve Hatfield Dodds, "Pathways and Paradigms for Sustaining Human Communities," *Open House International* 24/1 (1999): 6–16.

12. Lisa Benton and John Short, *Environmental Discourse and Practice* (Oxford: Blackwell, 1999), p. 2. We share Benton and Short's definition of environmental discourses as "explanations of the world around us. They are deep structures which pattern thought, belief and practices, and allow us to understand why human-environmental relationships take the forms they do."

13. This analysis derives partly from an earlier analysis that interprets each logic in terms of their competing ethical perspectives. See Simon Guy and Graham Farmer, "Contested Constructions: The Competing Logics of Green Buildings and Ethics," in Warwick Fox, ed., *The Ethics of the Built Environment* (London: Routledge, 2000). We would like to acknowledge the contribution of Suzie Osborn to the literature review.

14. Hajer, *The Politics of Environmental Discourse,* p. 44.

15. Benton and Short, *Environmental Discourse and Practice,* p. 2

16. Hajer, *The Politics of Environmental Discourse*, pp. 19–20.

17. Ibid., p. 20.

18. Cook and Golton, "Sustainable Development," p. 677.

19. Gert Spaargaren and Arthur P.J. Mol, "Sociology, Environment and Modernity: Ecological Modernisation as a Theory of Social Change," *Society and Natural Resources* 5 (1992): 323–344.

20. Hajer, *Environmental Discourse,* p. 14.

21. This definition of sustainability stems from the World Commission on Environment and Development (WCED). See *Our Common Future* (New York: Oxford University Press, 1987), p. 42.

22. Andrew Blowers, "Environmental Policy: Ecological Modernisation or the Risk Society?," *Urban Studies* 34/5–6 (1996): 853.

23. Spaargaren and Mol, "Sociology, Environment and Modernity," p. 335.

24. See Catherine Slessor, *Eco-Tech: Sustainable Architecture and High Technology* (London: Thames and Hudson, 1997).

25. Victor Papenak, *The Green Imperative: Ecology and Ethics in Design and Architecture* (London: Thames and Hudson, 1995), p. 46.

26. Hatfied Dodds, "Pathways and Paradigms," p. 7.

27. See James Lovelock, *The Ages of Gaia: A Biography of Our Living Earth*, (Oxford: Oxford University Press, 1989).

28. Aldo Leopold, *A Sand County Almanack* (New York: Oxford University Press, 1949), pp. 223–224.

29. John Farmer, *Green Shift: Towards a Green Sensibilty in Architecture* (Oxford. WWF, 1996), p. 172.

30. William Braham, "Correalism and Equipoise: Observations on the Sustainable," *Architectural Research Quarterley* 3/1 (1999): 57–63.

31. Wolfgang Sachs, "Sustainable Development and the Crisis of Nature: On the Political Anatomy of an Oxymoron," in Franck Fischer and Maarten Hajer, eds., *Living With Nature: Environmental Politics as Cultural Discourse* (Oxford: Oxford University Press, 1999), pp. 23–41.

32. William Rees and Mathis Wackernagel, *Our Ecological Footprint: Reducing Human Impact on the Earth* (Canada: New Society Publishers, 1996).

33. Steve Curwell and Ian Cooper, "The implications of urban sustainability," *Building Research and Information* 26/1 (1998):17–27.

34. For a full explanation of the theory of ecological footprints see Rees and Wackernagel, *Our Ecological Footprint,* pp. 7–30.

35. See Brenda Vale, *The Autonomous House: Design and Planning for Self Sufficiency* (London: Thames and Hudson, 1975).

36. See Sumita Sinha, "Down to Earth Buildings," *Architectural Design* 67 (1997): 90–93.

37. James Wines, "The architecture of ecology," *The Amicus Journal* (Summer 1993): 23.

38. See Richard Storm, *In Search of Heaven on Earth: A History of the New Age* (London: Bloomsbury Press, 1991).

39. David Pepper, *Modern Environmentalism: An Introduction* (London: Routledge, 1996), p. 27.

40. Ibid., p. 296.

41. Charles Jencks, *The Architecture of the Jumping Universe: How Complexity Science is Changing Architecture and Culture* (London: Academy Editions, 1995), p. 9.

42. Peter Russell, *The Awakening Earth: The Global Brain* (London: Arkana, 1991), p. 226.

43. John Passmore, *Man's Responsibility for Nature* (New York: Scribner's, 1974), p.189.

44. James Wines, "Passages: The Fusion of Architecture and Landscape in the Recent Work of SITE," *Architectural Design* 67 (1997): 32–37.

45. Jencks, *The Architecture of the Jumping Universe,* p. 94.

46. Ibid., pp. 94–96.

47. Ibid., p. 9.

48. Ibid., pp. 96–136.

49. Kenneth Frampton, *Modern Architecture: A Critical History* (London: Thames and Hudson, 1985), p. 317.

50. Arne Naess, "Deep Ecology and Ultimate Premises," *The Ecologist* 18/4-5 (1988): 128–131.

51. Arne Naess, "Sustainable Development and the Deep Ecology Movement," Proceedings of the European Consortium for Political Research Conference, *The Politics of Sustainable Development in the European Union*, University of Crete (1994): 1.

52. Roger Talbot, "Alternative Future or Future Shock," *Alt'ing*, Mar. 1996): 10–14.

53. Faozi Ujam and Fionn Stevenson, "Structuring Sustainability," *Alt'ing*, Mar. 1996): 45–49.

54. Ibid., p. 49.

55. Isabelle Lanthier and Lawrence Olivier, "The Construction of Environmental Awareness," in Eric Darier, ed., *Discourses of the Environment* (Oxford: Blackwell, 1999), p. 65.

56. Ibid., p. 76.

57. Ulrich Beck, "From Industrial Society to the Risk Society: Questions of Survival, Social Structure and Ecological Enlightenment," *Theory, Culture and Society* 9 (1992): 97–123.

58. Sachs, "Sustainable Development and the Crisis of Nature," p. 40.

59. Sick building syndrome is a term used to describe a set of commonly occurring symptoms that affect people at their place of work, usually in office type environments. These include headaches, fatigue, irritation to the eyes, nose, and skin, a dry throat, and nausea.

60. David Pearson, "Making Sense of Architecture," *The Architectural Review* No. 1136 (Oct. 1991): 68–69.

61. See Simon Guy and Elizabeth Shove, "From Shelter to Machine: Remodeling Buildings for a Changing Environment," *Proceedings of the World Conference of Sociology,* Biederfeld, Germany (July 1994).

62. Dean Hawkes, *The Environmental Tradition: Studies in the Architecture of the Environment* (London: E&Fn Spon, 1996), p. 17.

63. See for example, Alfred Zamm and Robert Gannon, *Why Your House May Endanger Your Health* (New York: Simon and Schuster, 1980) and Debra Lynn Dadd, *The Non-Toxic Home* (Los Angeles: Jeremy P Tarcher, 1986).

64. See Christopher Day, *Places of the Soul: Architecture and Environmental Design as a Healing Art* (London: Thorsons, 1995).

65. Pearson, "Making Sense of Architecture," pp. 68–69.

66. David Pearson, *The Natural House Book* (London: Conran Octopus, 1991), p. 26.

67. Murray Bookchin, *The Modern Crisis* (Philadelphia: New Society Publishers, 1986), p. 59.

68. Joseph R. Des Jardins, *Environmental Ethics: An Introduction to Environmental Philosophy* (Belmont: Wadsworth, 1993) p. 240.

69. Bookchin, *The Modern Crisis,* p. 59.

70. Hajer, *The Politics of Environmental Discourse*, p. 85.

71. Dick Russell, "Ecologically Sound Architecture Gains Ground," *The Amicus Journal* Summer 1993): 14–17.

72. Pepper, *Modern Enviromentalism: An Introduction,* p. 36.

73. The Segal method is a self-build timber-frame construction system developed by architect Walter Segal. For an introduction see Charlotte Ellis, "Walter's Way," *The Architectural Review* 1081 (Mar. 1987): 77–85.

74. Hannigan, *Environmental Sociology,* p. 30.

75. On the contingent and contextual nature of technological innovation and building design, see Steven A. Moore, "Technology and the Politics of Sustainability at Blueprint Demonstration Farm," *Journal of Architectural Education,* 51/1 (1997): 23–31. For arguments that the environment is a contested terrain, see, for example, Simon Guy and Simon Marvin, "Understanding Sustainable Cities: Competing Urban Futures," *European Urban and Regional Studies* 6/3 (1999): 268–275.

76. Moore, *Technology and the Politics of Sustainability*, p. 25.

77. Ibid., p. 25.

78. Norman Long and Ann Long, *Battlefields of Knowledge The Interlocking of Theory and Practice in Social Research and Development* (London: Routledge, 1992), p. 9.

79. Barbara L. Allen, "Rethinking Architectural Technology: History, Theory, and Practice," *Journal of Architectural Education*, 51/1(1997): 2–4.

80. Maarten Hajer, "Ecological Modernisation," in Scott Lash, Bronislaw Szerszynski, and Brianne Wynne, eds., *Risk, Environment and Modernity: Towards a New Ecology* (London: Sage, 1996), p. 258.

81. Simon Guy, "Developing Alternatives: Energy, Offices and the Environment," *International Journal of Urban and Regional Research,* 22/2 (1998): 264–82.

82. Hajer, *Environmental Discourse,* p. 294.