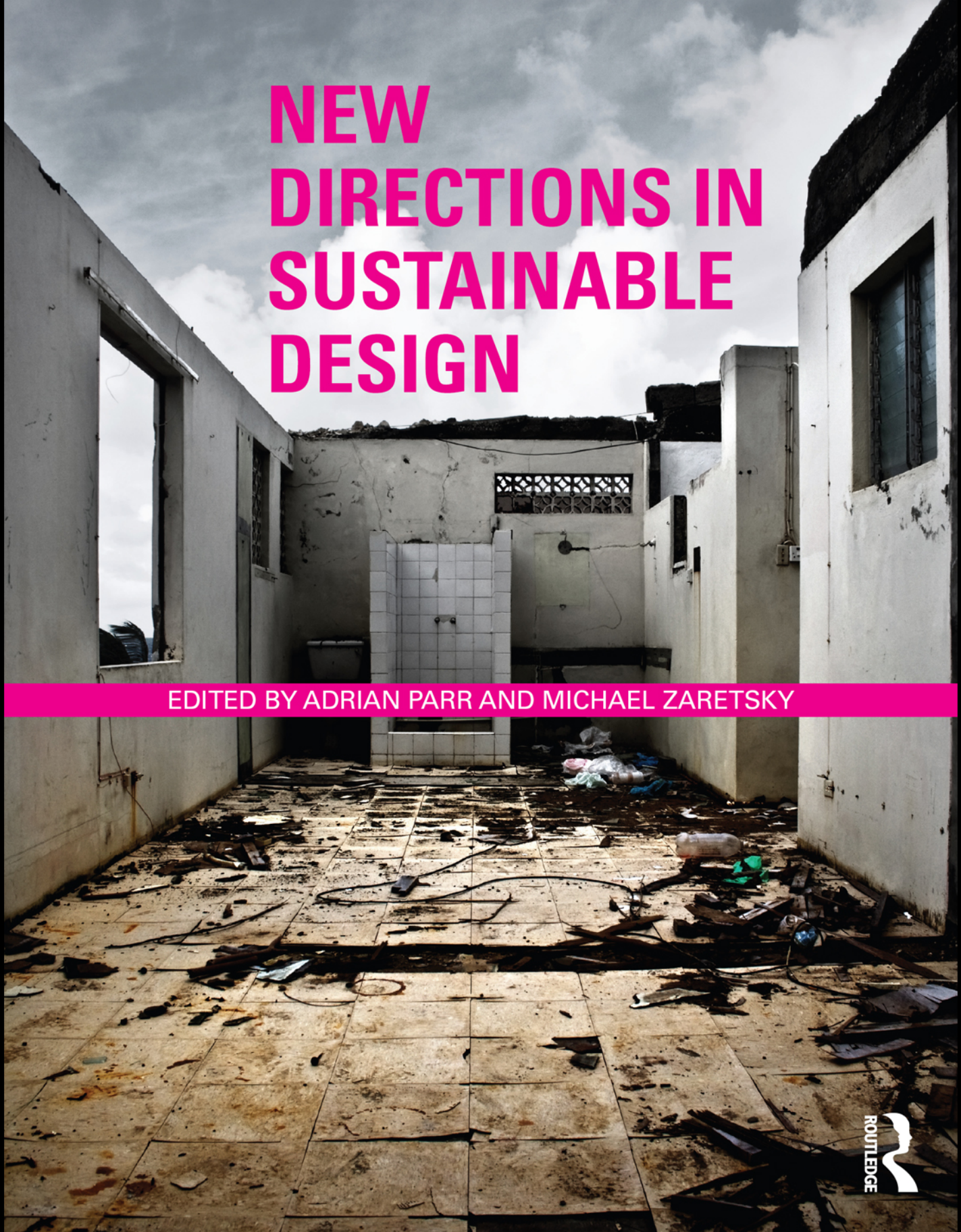
NEW
DIRECTIONS IN
SUSTAINABLE
DESIGN
EDITED BY ADRIAN PARR AND MICHAEL ZARETSKY
ROUTLEDGE

# New Directions in Sustainable Design

# New Directions in Sustainable Design

*Edited by Adrian Parr and Michael Zaretsky*

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# Contributors

**Durganand Balsavar** (Nandan) co-founded ARTES-Human Settlements Development Collaborative (www.artesindia.com) with Aneela Rao. After graduating in architecture from CEPT, Ahmedabad and ETH, Zurich, he apprenticed in Paris and worked with Dr. B. V. Doshi. Balsavar has been a member of several international design juries and writes for Indian national dailies on ecology and architecture. Based in Chennai-India, ARTES has been engaged in urban and rural development, housing, educational institutions, and disaster mitigation. The post-tsunami projects by the Tata group, designed by ARTES, received mention by the United Nations Development Programme (UNDP) for its best practices.

**Jeffrey A. Bell** is Professor of Philosophy and Fay Warren Reimers Distinguished Professor in the Humanities at Southeastern Louisiana University. He is the author of numerous articles and books relating to the work of Deleuze, including *Philosophy at the Edge of Chaos: Gilles Deleuze and the Philosophy of Difference* (University of Toronto Press, 2006), *Deleuze's Hume: Philosophy, Culture and the Scottish Enlightenment* (Edinburgh University Press, 2009), and editor, with Claire Colebrook, of *Deleuze and History* (Edinburgh University Press, 2009).

**Marshall Brown** is an Assistant Professor at the Illinois Institute of Technology College of Architecture as well as the founding director of the Yards Development Workshop, an independent design group dedicated to responsible development of the MTA Vanderbilt Rail Yards (a.k.a. Atlantic Yards) in Brooklyn, New York. On the basis of this work he was one of the contributors to the exhibition publication of *Block By Block, Jane Jacobs and the Future of New York* (Princeton Architectural Press, 2007).

**Claire Colebrook** is Professor of English at The Pennsylvania State University. She is the author of *New Literary Histories* (St. Martin's Press, 1997), *Ethics and Representation* (Edinburgh University Press, 2000), *Gilles Deleuze* (Routledge, 2001), *Irony in the Work of Philosophy* (University of Nebraska Press, 2007), *Gender* (Palgrave Macmillan, 2004), and *Deleuze: A Guide for the Perplexed* (Continuum, 2006).

**Teddy Cruz** was born in Guatemala City. After earning the Rome Prize in Architecture and obtaining an MDesS-1997 at the Harvard GSD, he established his practice in San Diego, California in 2000. He has been recognized internationally for his urban research of the Tijuana–San Diego border, and in collaboration with community-based non-profit organizations such as Casa Familiar, for his work on housing and its relationship to an urban policy more inclusive of social and cultural programs for the city. In 2004/2005 he was the first recipient of the James Stirling

Memorial Lecture On The City Prize, by the Canadian Center of Architecture and the London School of Economics, and in 2010 he has been selected to represent the United States at the Venice Biennial of Architecture. He is currently an Associate Professor of Public Culture and Urbanism in the Visual Arts Department at the University of California, San Diego.

**Roland Faber** is Kilsby Family/John B. Cobb Jr. Professor of Process Studies at the Claremont School of Theology and Professor of Religion and Philosophy at the Claremont Graduate University, Co-Director of the Center for Process Studies and Executive Director of the Whitehead Research Project (founded 2007). His fields of research and publication are Poststructuralism; Process Thought and Process Theology; Comparative Philosophy of Religion; Interreligious Discourse; Cosmology, Theology and Spirituality of the Renaissance; and Mysticism. He is the author of *God as Poet of the World: Exploring Process Theologies* (Westminster John Knox Press, 2008) and co-editor with Andrea Stephenson, *Secrets of Becoming: Negotiating Whitehead, Deleuze, and Butler* (Fordham University Press, 2010).

**Thomas Fisher** is a Professor and Dean of the College of Design at the University of Minnesota. Educated at Cornell University in architecture and Case Western Reserve University in intellectual history, he previously served as the editorial director of *Progressive Architecture* magazine. He has lectured or juried at over 40 different schools of architecture and 60 professional societies, and has published 35 book chapters and over 250 articles in various magazines and journals. His books include *In the Scheme of Things: Alternative Thinking on the Practice of Architecture* (University of Minnesota Press, 2006); *Salmela Architect* (University of Minnesota Press, 2005); *Lake/Flato: Buildings & Landscapes* (Rockport Publishers, 2005); and *Architectural Design and Ethics: Tools for Survival* (Architectural Press, 2008).

**Peter Head**, OBE, FREng, FRSA, Director of ARUP, is a champion for developing global practice which demonstrates that the way we invest public and private money in the built environment could be made more effective if the public and private sector adopted sustainable development principles. He is a civil and structural engineer who has become a recognized world leader in major bridges (he received an OBE for successfully delivering the Second Severn Crossing as Government Agent), advanced composite technology, and sustainable development in cities. He has won many awards for his work including the Award of Merit of IABSE, the Royal Academy of Engineering's Silver Medal, and the Prince Philip Award for Polymers in the Service of Mankind. He was cited by *Time* magazine in 2008 as one of 30 global eco-heroes and is one of CNN's Principal Voices.

**Christof Jantzen**, AIA, LEED AP, is principal of Behnisch Architekten, an architecture and planning firm with offices in Stuttgart and Munich, Germany, as well as Los Angeles and Boston. Recognized for his award-winning green architecture, including the LEED-Platinum Genzyme Center, Jantzen is I-CARES Professor at the International Center for Advanced Renewable Energy on Sustainability at Washington University, St. Louis. He has also taught design at University of Stuttgart, SCI-Arc, Cal Poly Pomona, and USC, and has lectured at MIT, Rural Design Studio, and Cornell University.

**Janet Laurence** is an Australian artist who is best known for her site-specific installations whose work is included in several major international and national public,

corporate, and private collections. Her public commissions include: *The Tomb of the Unknown Soldier* (Australian War Memorial), *Edge of the Trees* (Museum of Sydney), award-winning windows for the Central Synagogue Sydney, *In the Shadow* (2000 Sydney Olympic Games), *Australian War Memorial* (Hyde Park, London), the *Waterveil* (CH2 Building, Melbourne), and she has created permanent installations for the Echigo-Tsumi Art Triennal in Japan. She has been awarded the Churchill Fellowship, the Rockerfeller Foundation Residency, and was the subject of John Beard's award-winning entry for the Archibald Prize.

**Graham Livesey** is the Associate Dean (Academic – Architecture) and Associate Professor in the Faculty of Environmental Design at the University of Calgary, where he has taught design, architectural history, and urban design since 1991. He is an expert advisor on architecture to *The Canadian Encyclopedia*, editorial advisor to the journal *Architecture and Ideas*, and member of the editorial board of the *Journal of Architectural Education*. He is the author of the book *Passages: Explorations of the Contemporary City* (University of Calgary Press, 2004).

**Amory B. Lovins** is a physicist, Chairman and Chief Scientist of Rocky Mountain Institute (www.rmi.org) and Chairman Emeritus of Fiberforge Corporation (www.fiberforge.com). Published in 29 books and hundreds of papers, his wide-ranging innovations in energy, security, environment, and development have been recognized by the Blue Planet, Volvo, Onassis, Nissan, Shingo, and Mitchell Prizes, MacArthur and Ashoka Fellowships, the Benjamin Franklin and Happold Medals, 11 honorary doctorates, honorary membership of the American Institute of Architects, Fellowship of the Royal Society of Arts, Foreign Membership of the Royal Swedish Academy of Engineering Sciences, and the Heinz, Lindbergh, Right Livelihood, National Design, and World Technology Awards. He advises governments and major firms worldwide on advanced energy and resource efficiency, has briefed 20 heads of state, and has led the technical redesign of more than $30 billion worth of industrial facilities in 29 sectors to achieve very large energy savings at typically lower capital cost. His latest academic chair was as a 2007 Visiting Professor in Stanford University's School of Engineering. In 2009, *Time* named him one of the 100 most influential people in the world, and *Foreign Policy*, one of the 100 top global thinkers.

**Stephen Luoni** is Director of the University of Arkansas Community Design Center (UACDC) where he is the Steven L. Anderson Chair in Architecture and Urban Studies. His design and research have won more than 70 design awards, including Progressive Architecture Awards, American Institute of Architects Honors Awards, a Charter Award from the Congress for the New Urbanism, and American Society of Landscape Architecture Awards, all for planning and urban design. His work at UACDC specializes in interdisciplinary public works projects combining landscape, urban, and architectural design. His work has been published in *Oz*, *Architectural Record*, *Landscape Architecture*, *Progressive Architecture*, *Architect*, *Places*, *L'Architecture d'Aujourd'hui*, *Progressive Planning*, and *Public Art Review*.

**Shannon May** is a U.C. Berkeley-trained anthropologist with substantial experience researching and implementing plans for the economic transformation of poor and rural communities in developing countries, as well as uncovering the underlying drivers of success and failure of local and international community development

initiatives. She has conducted fieldwork throughout China and in Sub-Saharan Africa. Her dissertation on the convergence of ecological and market rationalities in a project to "modernize" rural China, titled *Practices of Ecological Citizenship: Global Dreams for a Chinese Village* will be released in 2010. She is currently working in Nairobi, Kenya, where she is the co-founder of a sustainable design solution to improve education in developing countries: franchise-like, high-quality, low-cost, private primary schools serving impoverished families in informal settlements.

**Kiel Moe** is Assistant Professor of Architecture at Northeastern University's School of Architecture. He has a design/build practice for small, research-driven projects and contracts for other architects on the design of integrated material and energy systems for larger projects. His books include *Integrated Design in Contemporary Architecture* (Princeton Architectural Press, 2008) and *Thermally Active Surfaces in Architecture* (Princeton Architectural Press, 2010). He is a Fellow of the American Academy in Rome.

**Adrian Parr** is an Associate Professor in the Department of Women's, Gender and Sexuality Studies and the School of Architecture and Interior Design at the University of Cincinnati, and a Distinguished Fellow at iCinema, the University of New South Wales. She is the author of *Hijacking Sustainability* (MIT Press, 2009) and *Deleuze and Memorial Culture* (Edinburgh University Press, 2008), editor of *The Deleuze Dictionary* (Columbia University Press, 2005), and co-editor with Ian Buchanan of *Deleuze and the Contemporary World* (Edinburgh University Press, 2006).

**Nick Seemann** is a director of Constructive Dialogue Architects, a firm based in Sydney, Australia, that was established to develop buildings that support community development initiatives and organizations involved in the delivery of social services. His postgraduate research was carried out under the supervision of Howard Davis at the University of Oregon, and developed an approach to architecture as a tool of community development.

**Nancy B. Solomon**, AIA, is an architect and journalist. She has published numerous articles on architecture and is editor of *Architecture: Celebrating the Past, Designing the Future: Commemorating the 150th Anniversary of the American Institute of Architects* (Visual Reference Publications, 2008).

**Carl S. Sterner** is a designer at William McDonough + Partners and a LEED Accredited Professional. He received a Master of Architecture from the University of Cincinnati, where he earned a Citation for Outstanding Research for his thesis, *A Sustainable Pattern Language.* He has previously published in *The Journal of Green Building* and presented papers at regional and national conferences. His research and design interests revolve around a critical investigation of sustainability – the social, cultural, and economic conditions necessary to create an ecologically viable (and ultimately more livable, just, and equitable) society.

**Kenneth Surin** was born in Malaya (subsequently 'Malaysia') and completed his schooling in Britain, obtaining a PhD in Philosophy and Theology from the University of Birmingham in 1977. He is currently Professor of Literature, with a joint appointment in the Department of Religion and an adjunct appointment in the German Studies PhD Program at Duke University. He has also been Director of Duke's Center for European Studies, and is currently Chair of the Program in

Literature. He is the author of *Freedom Not Yet: Liberation and the Next World Order* (Duke University Press, 2009) as well as other books and chapters.

**Michael Zaretsky** is an Architect, LEED AP and Assistant Professor at the University of Cincinnati School of Architecture and Interior Design. His practice, research, and teaching engage with issues of public-interest design, humanitarian design, and a holistic approach to sustainable design. He is the author of *Precedents in Zero-Energy Design: Architecture and Passive Design in the 2007 Solar Decathlon* (Routledge, 2009). He is Chair of the Roche Health Center Design Committee and is presently leading the design of a zero-energy health center for Roche Village in rural Tanzania.

# Foreword

## The Adulthood of the Species

*Thomas Fisher*

The Native American Ojibway think of human beings as infants, dependent upon and responsible for the care of Mother Earth, relying, as children do parents, on other species, who can live quite well without us.[1] That idea underscores the hubris of humans putting ourselves at the peak of the pyramid of life, and the childishness of our exploitation and willful extinction of so many of the other species upon which we depend. In addition, it clarifies the challenge we face: will we, as the children of this planet, grow up and learn to respect each other and our elders, as the Ojibway call other animals and plants, or will we, like tragically reckless youth, destroy what we most need in order to survive?

Our survival as a species seems so remote a possibility that we rarely raise it, even as we have set in motion what scientists now call the "sixth extinction," in which, because of our fragmentation of habitat, pollution of water, and alteration of the atmosphere, we will likely see the loss of as many as half of the species currently alive over the next 40 years.[2] And yet we remain among the most vulnerable of them all. Human societies have never been more globally interconnected and technologically efficient, and less resilient, as Carl Sterner calls it here: less able to handle, physically and psychologically, the disruptive changes we will likely face as we encounter planetary tipping points in the decades ahead.

We can guess where some of those tipping points might lie: prolonged droughts we cannot prevent, widespread crop failures we cannot stop, or perhaps global pandemics for which we have no cure. Whatever the circumstances, they will force our species to grow up fast. Like adults, we will have to set aside the petty politics and short-sighted economics that preoccupy nations as the world burns, as if jobs mattered more than the planet. We will have to live within our ecological footprint, which will require a dramatic reduction in the energy and resources that human beings now so childishly overconsume. And we will have to rouse ourselves from our technologically induced stupor long enough to acknowledge the immaturity of our relationship with the planet and with each other.

All of which makes a book like this not just important, but urgent. The authors, from a number of disciplines, offer insights into what the maturation of our species might look like. It will demand, as Teddy Cruz, Michael Zaretsky, Durganand Balsavar, Shannon May, and Kenneth Surin each articulate in this book, that we explore John Rawls's idea of our living behind a "veil of ignorance," and that no one really benefits unless everyone benefits to some extent from our actions, not just other humans, but other species as well.[3] The sustainability of the human species depends, fundamentally, on the justness of human society, and contrary arguments that attempt to elevate greed or pleasure as worthy ends show just how juvenile humanity has allowed itself to remain for far too long.

Our maturation as a species will also require that we see the connections among things often kept separate and thought of as distinct. Various authors here make that point, whether it involves Stephen Luoni's integration of social, ecological, and economic measures of development; Carl Sterner's complex-systems approach to resilience; Graham Livesey's application of landscape ecology theory to the contemporary city; Jeffrey Bell's focus on the dynamic material relations that underlie our new political reality; or Claire Colebrook's attention to the way in which concepts have their own ecology of connections. Such essays show how an adult analysis of our situation resists the temptation to reduce the world to established categories, fixed identities, or defined territories, even as it embraces the dynamic complexity, heterogeneity, and non-linearity that characterizes healthy ecosystems.

With the development of our species will come the recognition of what makes childhood truly valuable, not the envy and selfishness around which we have built so much of our current economy and society, but instead the creativity, imagination, and openness to new experiences and to the construction of new identities that makes "the child . . . father to the man," as Gerard Manley Hopkins put it. You see it here in the creative work of Behnisch Architekten or Janet Laurence. And you read it in Adrian Parr's inventive argument that aesthetics may offer a better way of moving people toward political action and change; in Roland Faber's insightful observation that we need new systems of cultural symbolism to reflect the multiplicity of our sustainable future; in Nick Seemann's "constructive dialogue approach" to the design of supportive housing and community projects; in Marshall Brown's imaginative microscopic history of a particular redevelopment site; and in Kiel Moe's important connection between the way the body heats and cools itself at its surface and the way buildings might do so.

No one likes to be called childish, least of all the childish adults who deny climate change even exists. For that reason, the maturing of the human species to the point where we can inhabit the planet with the same equality and equanimity as the other species with whom we share it will take real parenting skill. We may need to use some reverse psychology, not using the word sustainability, for example, in order to hasten people's acceptance of it. And we may need to accept that bottom-up peer pressure will be more effective than top-down rules and regulations, which no one in the teenage of humanity will want to follow.

Throughout it all, we will need to keep in mind the question that Gilles Deleuze and Félix Guattari so aptly asked: "Why do men fight for their servitude as stubbornly as though it were their salvation?"[4] Revealing the servitude that lies at the heart of humanity's unsustainable practices and exposing the almost Orwellian misuse of terms like freedom and happiness in our current political culture remains

one of the most important tasks of those who, in books such as this, have begun to construct a new reality: the adulthood of the species.

## Notes

1 Basil Johnston, *The Manitous: The Spiritual World of the Ojibway* (New York: HarperCollins, 1995).
2 Richard Leakey and Roger Lewin, *The Sixth Extinction: Patterns of Life and the Future of Humankind* (New York: Anchor Books, 1995).
3 John Rawls, *A Theory of Justice* (Cambridge MA: Harvard University Press, 1971).
4 Gilles Deleuze and Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia*, trans. Robert Hurley, Mark Seem, and Helen R. Lane (Minneapolis: University of Minnesota Press, 1983).

# Acknowledgments

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Part I

# Principles

Chapter 1

# Letter to the Profession of Architecture

*Teddy Cruz*

During my participation at the last Venice Architecture Biennale, in the fall of 2008, as I walked through the main exhibition inside the Arsenale, I thought of the huge divide between the architectures of excess that were displayed there and the economic precariousness of the world outside. It was unsettling to witness some of the most "cutting-edge" architectural practices present themselves as silent props for free market economic and political systems that were so wildly floundering that September. In my mind, this contrast magnified the powerlessness of our profession against the context of the world's most pressing socio-political and economic realities. Yet as this fatalistic idea invaded my thoughts, what resonated most with me as I left the exhibition was how this unprecedented moment of crisis could actually become an opportunity to anticipate and rethink the institution of architecture, practice, and research.

A sense of pessimistic optimism drives this period as we confront the double meaning of the crisis: on one hand, the need to expose the unprecedented conflict inscribed across the economy, the environment, and the social and political value systems of a globalized world; and on the other, how to make this very conflict the operational device to redefine our normative idea of the institution of architecture, inspiring expanded models of practice and research.

## Making Different Arrangements?

There is an overwhelming perception around us that this moment calls for fundamental change; but what does this really mean? Climate change, for example, tends to be seen solely as an environmental crisis, when in reality we must confront it as a cultural crisis. Across all these crises, the need for institutions of urban development to redefine themselves while generating a different type of interface with the public must generate new ways of thinking and acting beyond ideological polarities and reductive problem-solving.

It is saddening to see how even the progressive agenda of the Obama Administration has so far been defined by conventional thinking when referring to issues of urbanization, that the main idea behind producing new jobs is simply to buy more cars, or that "investing" in public and transportation infrastructure manifests itself solely as fixing bridges or building more roads.

I recently attended a presentation by James Kunstler, the author of *Geography of Nowhere*.[1] He recounted his travels across the U.S. describing how, in unprecedented ways, different audiences across the country were clamoring for solutions. He then suggested that he approached this sense of urgency with skepticism, feeling that the solutions being sought were only to maintain a status quo and did not fundamentally rethink (everyday) practices.

## Foresight Across Divided Agendas

But as I dwell on these questions in the context of the frustrating status quo even in this era of "change," I cannot avoid thinking about how the debate continues to be polarized between the politics of the Right and the Left. I would like to speculate on three current and problematic foresights across the following divided agendas in the architectural spectrum:

1. A project of apolitical formalism, made of hyper-aesthetics for the sake of aesthetics, continues to press the notion of the avant-garde as an autonomous project, "needing" a *critical distance* from the institutions to operate critically in the research of experimental form (instead, I would argue that it is a project of *radical proximity* that can produce new aesthetic categories, problematizing the relationship of the social, the political, and the formal).
2. The cheap politics of architectural identity, packaged as a stylistic neoconservatism, sponsored by New Urbanism's aspiration for a homogeneous middle class protected by picket fences and Victorian porches. The Truman Show/Homeland Security of urbanism continues to hijack the debate away from the real concrete issues that plague urbanization efforts: the de-funding of social and public infrastructure and the economic gap dividing enclaves of the mega-wealthy from the poverty surrounding them (I would argue that what is needed here is a committed reinvestment in research, a creative triangulation across new interpretations of density, social, and environmental networks; and an urban pedagogy that will allow us to rethink the meaning of infrastructure and "ownership").
3. A project of social justice in architecture, as expressed in the most benign efforts such as Architecture for Humanity, which continues to polarize the meaning of aesthetics and design, and ultimately contributes to the widening gap between social and formal systems. In this context, emergency relief efforts are always biased toward fixing short-term problems, not communities in the long term (again I would argue that a reversal of thinking must introduce the idea that architects, besides being designers of buildings, can be designers of political processes, economic models, and collaborations across institutions and jurisdictions. Ultimately this kind of social justice implies a politics of aesthetics).

I am not trying to argue here for a foresight that searches for the middle ground across these divided agendas. Rather I advance a need for a critical re-contextualizing of our different approaches and procedures. Ultimately, it does not matter whether urban development is wrapped by the latest morphogenetic skin, pseudo neoclassical prop, or LEED-certified photovoltaic panels, if all these approaches continue to camouflage the most pressing problems of urbanization today. Without altering the exclusionary policies constructing the socio-economic and political ground of our society, our profession will continue to be subordinated to the visionless environments defined by the bottom-line urbanism of the developer's spreadsheet and the neo-conservative politics and economics of a hyper-individualistic society premised upon a principle of ownership. No advances in urban planning can be made without redefining what we mean by infrastructure, density, mixed use, and affordability. No meaningful advances in housing design can be made without advances in housing policy and economy. As architects, we can be responsible for imagining counter-spatial procedures, political, and economic structures that can produce new modes of sociability and public culture.

## Note

1 James Kunstler, *Geography of Nowhere* (New York: The Free Press, 1994).

Chapter 2

# Art, Politics, and Climate Change

*Adrian Parr*

As the people roared and the delegates of prosperous nations unflinchingly dragged their heels upon reaching a binding agreement at the United Nations Climate Change Conference in Copenhagen 2009, leaders of low-income countries garnered together in solidarity to protest the self-interested opportunism threatening to turn the results of the talks into lukewarm tokenistic gestures. The stark divide between the developed and developing world was also exposed as outdated and simplistic, especially as many began pointing the finger at the Chinese for weakening the final accord. What will it take to produce lasting change? How many more hurricanes, droughts, melting ice-caps, species extinction, greenhouse gas emissions, rises in sea level, and so on does it take for a global commons to start acting as one?

The earth's climate would have to be one of the longest standing examples of the public commons we have left in a world that has become increasingly fine-tuned to the sound of neoliberal privatization, competition, individualism, and the mythic belief in the freedom of choice. And if neoliberalism is the melody, the beat accompanying this is the paranoid throb of extensive security and surveillance mechanisms that work hard to keep the rowdy multitude in check. As the Danish prepared to host leaders from all around the world, they were also spending approximately $122 million on securing the nation's capital. Reassigning forces from across the country, Copenhagen had a provisional force of 6,500 police poised and eager to protect the city and the delegates from demonstrators. In the Valby District, three dozen cages that could hold up to 350 anticipated troublemakers were erected in an abandoned beer warehouse. In addition, steel fences on concrete barricades closed off the center from the rest of the city and the general public. Delegates, officials, and other pre-approved individuals were maneuvered through a series of security checkpoints before they eventually entered the center where negotiations would take place. It is important to get a good, clear picture of the competing principles emerging from this scene: freedom and constraint, diplomacy

and anxiety, and independence and interdependency. And as I will discuss momentarily, art is particularly well positioned to affectively bring these differences into relation with one another in ways that can change how we position ourselves within the larger social field that characterizes the growing discourse around environmental degradation and the concomitant problem of sustainable living.

Changes in climate are symptomatic of an absence of political clarity over the way in which the public commons clashes with privatization. While in the lead-up to the climate talks in Copenhagen the political stage was set for constructive dialogue over how to halt global warming, there still remained a fundamental unquestioned presumption that would prove to be one of the most difficult hurdles the talks would encounter. Given that climate change will provide a direct threat to the human species, in the lead-up to the talks it was assumed that the urgency of this situation would be enough to bring into existence a global commons. The belief was that when the human species is existentially threatened it will act in its own best self-interest and this would motivate the world's leaders to exercise their practical intelligence and skills at diplomacy to achieve a meaningful consensus. Obviously the presumption was wrong. Self-interest does not seamlessly translate into the collective good. Furthermore, this logic is predicated upon a neoliberal viewpoint; it is no different to the view that believes social services ought to be left up to the market to solve. So in light of this, no matter how much money prosperous nations might have ended up throwing in the direction of poorer nations to offset the disproportionately negative effects they would experience as a result of climate change, without a system in place that can verify a nation's emissions or a legally binding agreement that holds countries accountable to their agreed emissions targets, the $3.6 billion from the U.S. or the $10.6 billion from the European Union (to name a few examples) in climate funds for the poor are no better than the remuneration packages being handed out to workers worldwide during the current global economic downturn. Both continue to pander to the self-interests of protectionist economic policies and the greed of corporate risk-taking. To put it differently, for the people of the Maldives to receive climate funds might even seem cruelly humorous because what's the point if their islands end up at the bottom of the Indian Ocean?

The outcome of the Copenhagen climate talks was exasperating to say the least. What began as a historical opportunity ended up being a glib nod to change, if not because the urgency of the problem quickly ossified as competing national and economic interests splintered any possibility of activating the collective dimension of the global commons. And it was in this context that artists rallied alongside the demonstrators in a desperate attempt to activate the collective imaginary. Mark Coreth's *Ice Bear Project,* a life-size ice sculpture of a polar bear sponsored by the World Wildlife Fund, dripped away in downtown Copenhagen. The polar bear has certainly become the symbol of the negative impact human activities are having on the environment and other than human species. People could touch the sculpture and in doing so their bodily warmth would contribute to its further deterioration – an accessible way to demonstrate how life as a whole is an interactive transformative system of change. What remained was a bronze monument of the polar bear's skeleton. Other art in and around Copenhagen at the time included the *CO2 Cube* by The Millennium Project, a 3-D sculpture whose size reflected the amount of space that one ton of carbon takes up, this being the average amount

of $CO_2$ that a person from the industrialized world emits on a monthly basis. Or there was Fred George's nine-foot *Solar Peace Sculpture* made out of solar panels, along with an installation by Wiktor Szostalo and Agnieszka Gradzik titled the *The Tree Hugger Project*, consisting of a line of human beings made out of biomass waiting to hug a tree; an obvious comment on the disappearance of old growth forests.

All these works were an interesting addition to the live bodies demonstrating throughout the streets of Copenhagen but I remain unconvinced by how effective they are in producing change. The kind of change that I am referring to here is not literal; it doesn't mean changing the direction of the negotiations that were going on behind closed doors in the way that the demonstrators hoped. That sort of change happens at the level of policy and law. What I am thinking of is how art can prompt change at the level of sense, sensation, feeling, and imagination to better prepare us for the difficult task of transforming how we behave and perceive our connection to one another and other than human species. There is something didactic about the artworks just described. They fail to activate the problem of power and the different ways in which power combines with desire to creatively inform processes of change.

There is a stark difference between art in the service of imagining possibilities and art activating our potential to re-imagine what currently exists. The latter, as French philosopher Jacques Rancière has noted in *The Politics of Aesthetics* (2006), is tantamount to disturbing the distribution of the sensible. He explains:

> I call the distribution of the sensible the system of self-evident facts of sense perception that simultaneously discloses the existence of something in common and the delimitations that define the respective parts and positions within it. A distribution of the sensible therefore establishes at one and the same time something common that is shared and exclusive parts. This apportionment of parts and positions is based on a distribution of spaces, times, and forms of activity that determines the very manner in which something in common lends itself to participation and in what way various individuals have a part in this distribution.[1]

Rancière therefore presupposes that there always exists a political aesthetic community. The commons, as Rancière conceives it, arises out of a distribution of perceptual coordinates – what is sayable, visible, and audible. Through the distribution of the sensible, a community is constituted via a process of inclusion and exclusion, and those who take part in the community do so from their allocated social positions and functions.

Following Rancière the politics of art in the age of climate change would assume that there are fundamental divisions already in operation between what is visible and invisible, audible and inaudible, sayable and unsayable. The political condition of art struggles to visualize, give a voice to, and render audible those who remain excluded from the dominant organizational system of knowledge, law, and social position. The power of Rancière's thinking comes from his original description of how this system of inclusion and exclusion operates. He explains that this takes place by way of a distribution of the sensible. In this respect, art can be a mode of political subjectivization. That is, when art redistributes the coordinates

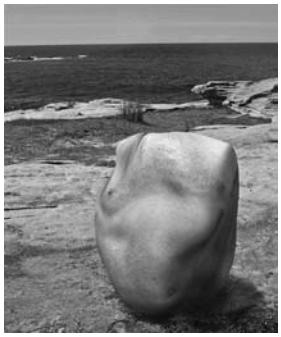
of how the sensible is distributed it can transform the hierarchical system of social and epistemological organization.[2]

For Rancière artistic practices have a special strength, since they are "'ways of doing and making' that intervene in the general distribution of ways of doing and making as well as in the relationships they maintain to modes of being and forms of visibility."[3] And so we return once more to the issue of art in the age of climate change and the future of a sustainable way of life. Sustainability, in the way that I am using the term, uses a historical frame of reference to combine care for other than human species with social justice concerns as a way of invoking the emancipatory potential of the future. It entails not only the sharing of power, an idea which implies that finite entities of power are shared with other finite entities or subjects, but an affective understanding of power that emphasizes the temporal and dynamic character of shared encounters. By tapping into how desire and power connect, art can optimistically prompt us to re-imagine our connection to one another and to the environments in which we live.

One example of this would be the *Fleshstones* series from 2003 by Australian artist Julie Rrap. She presents the implication of individual bodies in a larger landscape of life – water, foliage, earth, sand, stone, wind, moisture, light, and shadow. We come to sense the flexibility and sensuality of stone.

In addition, Rrap poses us with the question of supplementarity: Does the human body supplement the environment, or vice versa? The question itself begins the redistribution of the sensible, disturbing the coordinates that strictly define and situate the human body in opposition to nature. *Fleshstones* subjectivizes the interconnected system of creative implication and complication between humans and the environment, changing the aesthetic coordinates of both. By referencing the history of art, for example, Rrap intervenes in aesthetic divisions that tend to epitomize the work of English sculptor Henry Moore.

Moore's valorization of the open-air experience defined aesthetics in opposition to the image and in particular images produced using the technologies common for art in the age of mechanical reproduction, as Walter Benjamin coined it. Moore's abstract and often reclining human forms might be situated outdoors in an effort to allow light and air to circulate through them, and yet there remains a strong smell of patriarchal aesthetics at work here.[4] His direct carving technique, that shapes and cuts into the stone, chiseling out the human form through a display of manly strength (a common image of Moore at work handed down to us in photographs), has been brought under scrutiny by Jane Beckett and Fiona Russell. They contend that this sort of "determined individuality and authorship" that Moore displayed carries "associations with the virtues of craftsmanship and a notion of honest labour, concepts all tied to masculine subjectivity."[5] Added to this was Moore's overtly masculinist appraisal of art; for example, he is cited as blaming Donatello's bronze *David* for "sapp(ing) the manhood out of western sculpture."[6]



**2.1**
Julie Rrap, *Coogee Paul,* 2003, from the series *Fleshstones*. Digital print, 150 × 126cm. Courtesy of the artist and Roslyn Oxley9 Gallery, Sydney.

As the ecofeminist Karren J. Warren once argued, those selfsame structures of male domination disenfranchising and oppressing the lives of individual women also underpin the destruction of nature.[7] Her basic conclusion is that environmental degradation is a problem of patriarchy, and without connecting issues such as resource depletion, extinction, pollution, and the historical oppression of women through the exercise of patriarchal values and structures, we cannot hope to seriously address environmental problems. Women in the Green movement, she

says, are not interested in replacing male domination with female domination; rather they are aspiring to transform the patriarchal model of power – exerting power *over* others – with a model of cooperation – sharing power *with* others, all in an effort to produce social, cultural, and political change.

When we transpose these ideas using Rancière's logic, we begin to get a sense of how patriarchal systems of knowledge inform the distribution of the sensible throughout the social field by the very way in which we have come to conquer other than human species. We visualize the landscape in oppositional terms – form versus matter – as our built environment has come to be defined by phallic skyscrapers made out of concrete and steel, while the ground beneath our feet is now an impermeable stream of asphalt that causes significant rises in temperature during the summer months for which we have come to rely upon air-conditioning units to cool our bodies down. We silence other than human species canceling out the birdsong beneath the drone of traffic. We erase the traces of animal suffering out of the battery farm eggs and chickens we consume, and are instead presented with a nice, clean, neatly packaged carton of eggs with a cartoon rendition of the happy chicken, an image that taps into our nostalgic memories of the local farmer and non-commercialized agricultural production. For ecofeminists this kind of distribution of the sensible is inherently patriarchal.

And so we return to Moore once again, to the manicured landscapes that provided the artist with a backdrop more than a context. Supplementing the perceptual coordinates that divide human from nature, the natural from the artificial, and abstraction from the messiness of the material world, Rrap turns the clarity of these divisions on their head. She leaves us feeling awkward in our own bodies and she seduces us with the tensions she sets in play between form and matter, mind and body, masculinity and femininity. She makes the formal purity of modernism and the supposed clarity of abstraction tremble with her dimpled and at times slightly bruised male bodies that also provide the crevices and hollows for the landscapes in which they appear. In Rrap's imaginary hybrids, bodily creases are places where darkness resides and moisture collects. She teases the patriarchal logic informing the modernist vision of the body in opposition to the environment by summoning forth a dissensus over the supposed transparency of the opposition in play.

With Rrap, the hard, masculine body might appear in stone, yet through their affective combination a new corporeal landscape is galvanized such that human and nature, male and female, hard and soft, form and matter resist signification. The *Fleshstones* are male bodies that have struck a conversation with the messiness and disorderly forces of nature in the raw – John connects the smooth sands of Pearl Beach with the wild waves of the ocean; Paul's belly is poised on the moss-covered rock along the shores of Coogee Beach; and Richard is morphed inside the dark, damp corners of an unknown cliff face (an image that also harkens back to Gustave Courbet's *The Source* [1868]). Rrap uses history and affection to unsettle the patriarchal distribution of the sensible that aspires to transcend materiality and voyeuristically position the female body as the object of the male gaze.

So let us now revisit our opening problem: wherein lies the political potential of art in the era of climate change? Now more than ever we need to figure out how to come up with innovative responses to the problems surrounding anthropocentric changes in climate and the consistent failure of the international community to

**2.2**
Julie Rrap, *Richard Cliff*, 2003, from the series *Fleshstones*. Digital print, 132 × 126cm. Courtesy of the artist and Roslyn Oxley9 Gallery, Sydney.

agree upon binding solutions to these changes.[8] Art is especially well placed to sharpen our thinking on the issue of climate change because it can present our everyday lives and habitual ideas in unfamiliar ways, reconfiguring our routine perceptions and ways of comprehending and making sense of the world.

Art can tease our comfort zones by stimulating our senses anew, such as in Ruri's *Glass Rain* (1984) when the beautiful becomes perilous. Ruri presents the viewer with a collection of razor-sharp slabs of glass suspended from the ceiling. She combines attraction with resistance, splendor with fear and anxiety, to successfully entice the viewer into the space despite the danger lurking there. In her *Acqua Silence* (2002) she presents us with a forest of screens, documenting the movement and sounds of gushing water; these qualities contrapuntally collaborate with the pace and noise of city traffic. With *Acqua Silence* we enter a liminal space of mystery situated in between the natural and the cultural.

Art subtly tampers and tinkers with familiarity, it prompts us to experience and imagine new ways of framing the ordinary, such as when in *Unspeakable Happiness II* (2003), Chu Yun hung a series of brightly colored flags around the façade of the museum (Ullens Center for Contemporary Art, Beijing) and throughout the city, fine-tuning the landscape with an element of surprise. As the tiny flags rapidly flapped, the rhythms and colorful patterns that these produced punctuated the solidity of the built environment.

Art can arise out of an act of care, such as when Chu Yun covered the walls of the dimly lit rental rooms of poor migrant workers with colorful paper (*The Light of Rented Rooms 2002*). Yun explains:

> It is difficult to separate my works from the external environment. It is not a question of specific events or questions; rather, it has to do with how disparate external environments can elicit different emotional responses from us. To me, artistic creation is aimed at understanding these physical responses and adjustments. This is the sole relationship between us and the external world.[9]

Following on from here, the proposition is that activating the global commons will not just happen once we become more open to sharing a variety of different viewpoints, approaches, and experiences; it also involves being able to play with various combinations of these differences with a view to carving out innovative directions that will constructively move us forward. It is here where art can optimistically prompt us to sensitize us anew, inviting us to reconfigure our connection to one another and other than human species without privileging one category, social function, or position over another as the agent of historical change.

In this context the connection between art and politics is far from didactic. It does not communicate a political program. It does not attempt to find a hidden universal truth that is then transmitted to the public, an approach that presumes a position of mastery as Rancière so astutely notes. The politics of art activates the very potential of transformation when it "reconstruct(s) the conceptual network that makes it possible to conceive of a statement that causes a painting or a piece of music to make an impression, that causes reality to appear transformable or inalterable."[10]

Art can tickle our imagination, making us laugh, cringe, or twitch at the obvious. Art guides us through an alternative way of looking and sensing the world;

it doesn't give us a finite political agenda, ideological position, or opinion. For some of us, art invites us to question our beliefs and the assumptions we hold dear; namely the widely held idea that freedom equates with individual choice. The conceptual clarity that the visual arts can prompt along with the affective potential to move us in ways we never imagined is a very powerful combination. It can awaken our inherent feelings of care and empathy, all the while arousing a sense of fury and outrage toward the continued deadlock over taking action in response to climate change.

Art can facilitate wonder, surprise, bewilderment, and intensity. It can arouse our passions just when we thought we were feeling indifferent. It can excite our senses and catch us unawares so that we need to stop and do a double take. This is art in undiluted, concrete, and direct form, yet it still somehow remains intangible and slightly unintelligible. The political potential of art involves the way in which it can agitate the standardization of feeling, sense, sensation, and perception, creating an opening through which the excluded speak for themselves. This opening constitutes the site of the political.

## Notes

1 Jacques Rancière, *The Politics of Aesthetics: The Distribution of the Sensible*, trans. Gabriel Rockhill (London: Continuum, 2006), 12.
2 As Rancière clearly states in the Foreword to *The Politics of Aesthetics*, he is "concerned with aesthetic acts as configurations of experience that create new modes of sense perception and induce novel forms of political subjectivity." Ibid., 9.
3 Ibid., 13.
4 Following the analysis of how an aesthetic political field is created through a distribution of the sensible, I am less convinced than Robert Burstow is that Moore's open-air aesthetic implies a socialist anti-capitalist stance. See "Henry Moore's 'Open Air Sculpture': A modern, reforming aesthetic of sunlight and air," in *Henry Moore: Critical Essays*, ed. Jane Beckett and Fiona Russell (Aldershot: Ashgate, 2003), 143–172.
5 Jane Beckett and Fiona Russell, "Introduction," in ibid., 3.
6 Cited in Jason Edwards, "*A Portrait of the Artist as a Young Aesthete*: Alfred Gilbert's *Perseus Arming* (1882), and the question of 'Aesthetic' sculpture in late Victorian Britain," in *Sculpture and the Pursuit of a Modern Ideal in Britain, c.1883–1930*, ed. David Getsy (Aldershot: Ashgate, 2004), 11.
7 Karren J. Warren, *Ecofeminist Philosophy: A Western Perspective on What It Is and Why It Matters* (Lanham, MD: Rowman and Littlefield, 2000).
8 *Rethink: Contemporary Art and Climate Change*. Senior curator Marianne Torp. http://www.rethinkclimate.org/. Accessed January 3, 2010.
9 Chu Yun, Interview with Caroline Elgh, Bonnierskonsthall, http://www.bonnierskonsthall.se/en/Exhibitions/Exhibitions/Sprout-from-White-Nights/Chu-Yun/. Accessed January 12, 2010.
10 Rancière, *The Politics of Aesthetics*, 50.

Chapter 3

# Interview with Janet Laurence on Public Art and Ecology

January 2010

*Adrian Parr*

**In a lot of your work, a few examples being *The System of Nature* or *In the Shadow*, you seem to take a holistic systems view of nature. Would you like to comment more on this?**

I believe we are inseparable from the world around us. We are not finite entities, we are porous beings and this impacts upon our connection to the world in which we live. We breathe in the world and we affect the world. I believe it is necessary to look at nature as a web, one in which humans, animals, and plants are ecologically interconnected (an ecosystem does not depend upon us for its survival; it might even thrive if there were fewer human beings).

**3.1**
Janet Laurence, *In the Shadow*, 2000, Olympic Park, Sydney, Australia. Materials: fog, Casuarina forest, bullrushes, resin, wands with stainless steel bases (height 2–9m), text (numbers indicate water chemistry monitoring). Courtesy of the artist and Arc One Gallery, Melbourne.

One of the main ecological undercurrents in my work is to help the viewer sense their interdependency with other life forms and systems. I attempt to create spaces of perception that can immerse us within the lifeworld. I understand these spaces as elemental and fugitive. Through a language of veiling, transparency, and translucency I set out to create enmeshed environments that express ephemerality. I am interested in how spaces can be slowed down, the pace and rhythm of porosity and fluidity and how these processes inform environments. I prefer not to think in terms of boundaries; rather membranes.

**How do you understand sustainability and does it inform the way you work as an artist?**

I think an old Lao proverb is an appropriate way for me to respond to this question: "When the river dries up, the ants eat the fish. When the river flows, the fish eat the ants." For me sustainability concerns a way of being in the world; one that is tuned into the organic systematicity of the Earth. The Earth cannot be reduced to mere matter, it is not simply a resource for us to endlessly consume and exploit. The systematicity of the Earth is a source of ecological understanding. What I mean is that ecological understanding is future-oriented and cyclical, as opposed to linear and chronological. My work might not directly represent this but I try to express this through the spatial, temporal, and visual languages that I use. Apart from using organic and recycled materials it has to do with the way I combine elements, how these combinations point to complex connections, and a deep sense of interconnection.

An example would be the glass foyer wall I completed for the CH2 building in Melbourne. This is a building that expresses ecological complexity throughout its design. My work, *Waterveil* (2006), is a space that expresses and reveals the transformation and purification of water. It actually echoes the black water treatment occurring within the building, a process that usually remains unseen. The work utilizes the double-story height of the window to enhance the vertical sensation of fluids spilling over the glass membranes, which consist of overlapping glass panels that have the chemical symbols of what is removed through the black water treatment inscribed on them. Across a variety of levels this work deals with interconnectedness; for instance, it can be viewed from within and outside of the building, the process of the work is cyclical, and the form of the work is creative change.

**3.2**
Janet Laurence, *Waterveil*, 2006. Council House 2 (CH2) Building, Melbourne City Council, Australia. Glass layered wall 6000 × 5000mm. Courtesy of the artist and Arc One Gallery, Melbourne.

**Do you directly or indirectly address climate change and the problems associated with climate change – species extinction, pollution, waste, collapse of ecosystems, and so on – in your work?**

I directly address the problems associated with climate change; specifically issues such as species extinction, the collapse of ecosystems, and the loss of habitats; all of which I see as stemming from humanity's non-holistic view of the world. The problem is that we have lost the ability to share the world with other life forms. In *Birdsong* (2007), which was shown at Object Gallery, a circular space that was once a chapel, I suspended at face height 700 birds from The Australian Museum collection. They were all lying on their backs on a transparent double ring in the

**3.3**
Janet Laurence, *Elixir*, 2003. Materials: wooden traditional house, glass panel screenprinted with poured paint and plants and fluids, blown-glass vials, plant extracts steeped in shochu, laboratory glass. Permanent installation for Echigo-Tsumari Art triennial, Japan. Courtesy of the artist and Arc One Gallery, Melbourne.

center of the space. The viewer walked around a vast array of different species, 70 percent of whom have lost their habitat and are now threatened with extinction.

Climate change politics seems to focus on the needs of human beings first and it tends to strive to maintain current standards of living. As such the loss of habitats for other species does not figure in the dominant discourse of climate change ethics. I have a problem with this. In my work I aspire to articulate this more lateral dimension of the climate change talks.

In another series of works, *The Selva Veil Series* (2005), that was the outcome of a residency where I spent time in the jungle of Chiapas, Mexico, I recorded the future ghosting of the forest that is currently under threat of extinction. It is being felled in order to grow crops for the Indian people. However, the land would be owned by large corporations, who would then develop and profit from it. This would leave the Indians worse off than they were before. They would basically lose their autonomy. I see this as an example of how the socio-political issues of sustainability are being abused. Global companies focus on short-term economic gain and in the process not only introduce measures that will economically disadvantage the indigenous inhabitants but also destroy the environment that provides a habitat for other plants and animals to thrive.

In the mountains of Japan, near Nagata, I made a work called *Elixir* (2003); in a small, restored, traditional storage house. I transformed the interior of the dark wooden house into a light-reflecting glass laboratory. As a space it felt like both an old apothecary and botanical museum (albeit in miniature form). This is a permanent site-specific artwork that forms part of the "necklace" of art, architecture, and landscape projects transforming and regenerating a traditional, mountainous, rice-farming community into a dynamic community that is viable in the present, one where art helps bring to life a vibrant and lively connection between the forests and the traditional wooden villages. I feel this is a successful example of how issues of sustainability in the context of art can be put to work in an effort to embrace a different politics of climate change.

**Given the important role which nature plays in your work, how important is it for you to be able to exhibit outside the confines of a gallery space?**

I exhibit within more institutionalized settings such as museums, as well as outdoors and at other venues that are not typically associated with the art world. Ironically, the role of nature in my work can be represented and amplified within the confines of a gallery. This is because the gallery context enables me to focus more directly upon the natural, to create an experience that engages as art. In contrast, when art is placed outside the gallery, within the scale and atmosphere of landscape architecture and generally the world around us, it often becomes harder to read. What I am suggesting is that I am strategic in how I create visibility for my work. The benefit of the gallery comes from how it frames and brings the art into focus. However, I believe it is also important for art to be experienced outside the gallery, in the public sphere; where there is a more diverse audience. This is not to forget that in the public realm art also has the potential to more directly address and amplify its relationship to a place/site and invite readings of these relationships that may otherwise go unarticulated.

**Your work also focuses on the corporeal dimension of memory and the process of remembering, and here I am thinking of the *Australian War Memorial* at Hyde Park Corner in London that you completed with architects Tonkin Zulaikha Greer. How can art activate the productive relationship between memory and place?**

I think art has a powerful possibility to connect us to place and to the memory of a site, as well as having the potential to evoke a creative memory within the viewer. I see art as having the possibility to affect a person's sense of rhythm, to prompt a kind of "slowing" of perception and affect. A type of thickening that can entice one *into* the work rather than merely looking *at* it. This slowed process allows for an initial perceptual experience that is bodily; it is a haptic awareness that happens through the combined materiality that makes up the work and the processes of perception, memory – an effect that the viewer undergoes. I'm interested in how this complex material and creative memory process comes into play. The *Australian War Memorial* engages with memory through a process of textual layering. This consists of weaving names of places with names of birthplaces and places of death. The familiar battle names are worn away as they are brought into relationship with the thousands of birthplaces of those who were killed.

I am especially interested in how memorials tap into the way that art retrieves, reveals, and holds memories. With memorials there is of course the added question of how memorialization functions in the contemporary world, one that suffers from amnesia, and where there is so little opportunity for reflection. In so many works I have attempted to form reflective spaces of memory, and many of my projects carry a multiplicity of functions: regenerative, memorialization, and museumification. *The Tomb of the Unknown Soldier* (1993) in the Hall of Memory in The War Memorial Museum Canberra and the *Australian War Memorial* (2003) in London are certainly memorials and destination sites where a space is formed for the viewer to enter and experience the materiality of the work, and so too is *Edge of the Trees* (1995) at the Museum of Sydney which actively engages the memory

**3.4**
Janet Laurence and Tonkin Zulaikha Greer Architects, *Australian War Memorial*, 2003, Hyde Park, London. Courtesy of the artist and Arc One Gallery, Melbourne.

of the site. Meanwhile, I think of my *Stilled Lives* (2000) project at the Melbourne Museum as also being a memorial; it is a memorial to all the forgotten species.

**Your work on memory and place poses some interesting connections to the problem of environmental degradation – as you present a sense of place, you also present feelings of impermanence and transformation. Would you like to comment further on these connections?**

I was able to really explore this possibility in an artwork called *In the Shadow* (2000), a permanent work that actually transformed an industrial polluted space into a healthy, thriving ecological system again. The idea was that art could tangibly transform the toxicity of the site as well as re-frame the restored environment as a work of art in and of itself. My artworks regularly deal with the organic world of transformation and impermanence.

I am interested in the healing and regenerative potential of art. At present for the Biennale of Sydney I'm working on a new work called *Waiting: A Medicinal Garden for Ailing Plants* (2010) and, as in the earlier works *Cellular Gardens* (2005) and *Heartshock* (2008), it will show medical life support systems caring and nurturing plants back to life; this being a metaphor for regenerating and healing the environment.

**As a contemporary artist do you think art can act as a catalyst for change in how we relate to the environment and other than human species? And why?**

I think it is important to bring this content into art, and for art to be able to be perceived as a catalyst. So many artists have been real forecasters with their work, but because of the place of contemporary art in our society this is often not recognized and valued. On the whole society is only able to recognize this in retrospect as it looks back on the history of art.

Artists often work closely with researchers, scientists, and other experts. They are able to bring to a broad audience issues and facts otherwise invisible throughout public space. In this way they often indirectly educate their audiences in innovative, playful, poetic, or surprising ways.

**As a woman, would you say that you bring a feminist perspective to your practice?**

I think that the sensibility in my work has developed from my awareness early on in my career that a woman artist does not occupy a neat position within the linear "progression" of art history; she has occupied a place outside of this linear narrative. I find that this "outside" space that women have had in the history of art is potentially beneficial. I used to talk in terms of taking a sidestep outside of art history and of course this is what happened with postmodernism: all these other views and stories came seeping into the mainstream narrative, disrupting it and producing new positions and experiences from which to make art.

My interest in alchemy came about through this search, which was also simultaneously about taking a holistic stance. It enabled a freedom in my work and an empathy with nature, which was out of step with the dominant concerns of the art world at the time. This outside position provided me with a source of inspiration through which I could begin an ecological way of thinking and making art. In fact the whole Western historical position has seen nature as separate and subordinate to "Man." Historically both women and nature have been positioned as Others.

**Do you think the abusive relationship we have had toward the environment and other than human species is a result of a cultural attitude, one that is an extension of a gendered system of oppression?**

To a certain extent I think it is, both a cultural and gendered system of oppression. There seems to be something in man as a species that views development and progress in terms of moving beyond what is necessary and as a way to take control of the environment and other than human species. Whether this has always been a purely male pursuit, I'm not sure. But it seems apparent that this is the case for Western civilization as we know it.

**Over the years you have collaborated a lot with architects. In your experience have you found the design world to be receptive to the way you work and approach issues such as ecosystem vitality and animal rights?**

I have found the design world to be receptive of my work; it may sometimes be for its spatiality, materiality, and overall aesthetic. Some are less interested in the specific content in the work: my ecological and animal liberation concerns. Ironically enough though, some comment on the fact that they like the "eco look" of my work, which I think is problematic insofar as it reduces both the art and its ecological sensibility to a style or passing fad. That said, architects are certainly now all working with environmental principles; this is really determining so much of the design we live with now.

**Do you think art can be ecologically friendly?**

Yes, I do think art can be ecologically friendly; however, it still needs to engage us as art, and somehow transcend everyday didactic language, otherwise it becomes like other forms of documentation, or information. As an artist working with environmental degradation and the suffering of other than human species it is sometimes hard to find this balance.

**This interview will appear in an anthology titled *New Directions in Sustainable Design*. From the point of view of an artist what do you think some new directions in sustainable design might be? Are they currently in practice, and, if not, why do you think that is?**

New directions are very much in existence and there are so many collaborative workshops now that are exchanging ideas over the role of intelligent design, new technologies, how to use recycled materials, how to practice design in ways that amplify our own ecological being; I have noticed that now climate change engineers are being used in many projects.

I think there is a great amount of will among designers worldwide to work with principles of sustainability. This is resulting in such a fertility of ideas and solutions. I suspect the real obstacles now lie with governments and policies that remain conservative, and which are caught up with business-as-usual economic politics that really inhibits the will to change driving many innovative projects.

**Do you think the recent climate talks in Copenhagen went far enough?**

Sadly, I don't think they went far enough at all; it was a missed opportunity. It simply exposed the fact that for most of the developed world climate change is an issue of how to maintain current living standards and economic growth, which of course is an absolute contradiction. What is required is a complete paradigm shift. This is the only way we will alter our relationship to the environment.

Chapter 4

# The Brunel Lecture[1]

*Peter Head*

In recent decades it has dawned on many of us that there can be no viable future for humanity without a healthy planet. Earth, water and air support the existence of an immensely complex living system, powered by the sun. We are part of this web of life and within a few generations we have used up most of the earth's stored fossil fuel resources. Their transfer from the earth to the atmosphere is significantly altering its composition. From our ever-expanding urban centers, our tentacles now spread across the world. Our globalizing economic system is destabilizing the planet's life-support systems – the very systems that support us, and the future of our children. The Intergovernmental Panel on Climate Change (IPCC) says that there is now a 50 percent probability of a 5-degree Celsius rise in the earth's temperature by the end of the century, which would be the end of civilization as we know it.

In this paper I will attempt to provide some innovative answers to the following important questions:

- Can we move towards a sustainable way of living with up to nine billion people and create what is being called the Ecological Age?
- What policies and investments are needed in low- , middle- and high-income countries?
- What is the role of the engineer in leading this transition to an Ecological Age?

I will start by examining the problems we are facing and I will highlight the opportunities for change. I will spend a little time on this because the seriousness of the problems are still not well understood. Then I will use a specially designed framework to show what we can do over the next fifty years, particularly in North America, and then draw some firm conclusions about policies, changes, investments and the role of the engineer.

## Background

The earth is a closed system. It receives energy from the sun and exports only energy into space. Down on the ground, photosynthesis in plants converts the sun's energy into carbon material, which over the course of human history has provided us with our primary source of energy and has also been the root of our food supply chain.

The Industrial Revolution moved civilization from the Agricultural Age to the Industrial Age and into an urban resource-dependent lifestyle. At this time there were voices of concern, such as the economist Thomas Malthus (1766–1834) who argued that population increases would at some point overwhelm our ability to feed ourselves. Many of these predictions have proved to be wrong owing to our extraordinary ability to increase food productivity, but production is now totally dependent on fossil fuels to make fertilizers. The population is now seven times greater than when Malthus made his prediction.

We civil engineers are proud of our profession's contribution to the rapid development of the economy during the Industrial Revolution. We stand on the shoulders of the great engineers like Brunel and Roebling who created so much of the infrastructure that has supported economic growth and the move to city living.

Industrial development and urbanization have continued unabated. Civil engineers have been at the heart of the design and delivery of the essential infrastructure for energy, water, waste, communications, transport and flood protection. Energy consumption is central to our model of human development, and in designing and building these systems we have created the hard wiring of a non-renewable fossil fuel resource-consuming society.

In 1998, the World Wildlife Fund (WWF) began to publish a biennial *Planet Report*. The 2006 *Planet Report* showed that we are now living in severe ecological overshoot. We are now consuming 25 percent more resources than the planet can replace and are drawing down the stock of natural capital that supports our lives. In 1990 we had an average of 7.91 hectares of land to support everyone's life on the planet, but in 2005, with population growth and the loss of productive land due to pollution, we only had 2.02 hectares. In Britain and the US we are living as if this hasn't happened and we are using 6 to 10 hectares on average each – three to five planets' worth of resources.

The key metric, in response to this situation, is the "ecological footprint" of the population of each country. This is the area of earth surface required to support the population's lifestyle with water, energy, food, resources and waste absorption.


**4.1**
Our Shrinking Earth. Image property of Arup and from The Brunel Lecture by Peter Head.

China's president, Hu Jintao, in his speech at the Seventeenth Party Congress in October 2007, referred for the first time to "moving China towards an ecological civilization". He described this as "using resources more efficiently, using renewable energy, and living in harmony with nature". China has realized that their industrial development model is rapidly becoming uneconomic owing to environmental pollution, health costs and rising raw material costs.

This paper addresses this journey into the Ecological Age. For China this means a transition from an Agricultural to an Ecological Age; however, in the US it involves transitioning from an Industrial to an Ecological Age. This paper uses the knowledge gained from Arup's drivers for change research and Arup's project work all over the world. It shows how we could make the transition. Let us have a quick look at the economics of this transition.

## Economics

With the current economic model we use non-renewable resources and throw them away, polluting and destroying the fragile eco-system that supports life. We have now realized that our global economy has become so big that the impact of the loss of the eco-system at each growth increment may cost us more than it is worth. Hence, growth may be uneconomic and we may have to begin the search for an optimal scale in which marginal costs equal marginal benefits.

The critical task is to take human development forward with much fewer non-renewable resources and an economic model where growth comes from the efficiency in using renewable resources. By valuing eco-system services we can start to repair the damage we have done.

The long-term objective is to reach a sustainable lifestyle that uses renewable resources and the energy from the sun. We need to find a soft transition over the longest possible period, so that we can use fossil fuels and nuclear power as long as resources are available but with much less environmental pollution. To achieve this we need vision and some clear objectives. The objectives I have chosen to use are:

- $CO_2$ reduction of 80 percent from 1990 levels by 2050 in developed countries with a worldwide 50 percent reduction. This was agreed at the G8 meeting in Japan (2008) in line with IPCC recommendations to stabilize the earth's temperature.
- A transition of Ecological Footprint to the 2050 global earthshare of 1.44 hectares in all countries.
- Raising overall well-being in every country in line with the Human Development Index millennium development goals.[2]

A key question is whether we can take these steps without damaging our short-term economic performance. Let us consider this from a low-income country perspective first and then come back to the US.

For example, Africa could combine this new economic thinking with the use and development of technology utilizing their own renewable resources, without the need for the wasteful steps that the high-income world has gone through.

A critical priority for Africa will be to incorporate adaptation to climate change in their development model. I will give some examples later.

In high-income countries like the US we need to retrofit. Most detailed carbon emissions reduction studies (e.g. Stern and McKinsey) say the costs are within our means and will not hurt economic growth.[3] For example, the McKinsey report says that here in the US you can reduce greenhouse gas emissions by one-third to a half by 2030 at manageable costs to the economy, and this is now informing economic plans.

We are actually so wasteful that there are many opportunities for rapid improvement. Each problem we have created in our development model tends to be addressed by another fossil fuel-dependent fix. Therefore, we have ended up creating an abundance of interdependent resource-consuming technologies. In what Arup calls the "virtuous cycles of benefit," we have found that were we to solve this problem, the social, economic and environmental benefits could be surprisingly large.

The stacking of problems has led to a complexity of infrastructure with high maintenance costs. More than rigid complexity, smart, responsive simplicity is much more effective at lowering life-cycle costs. For example, in a compact mixed-use development, people can easily go to work, school, shops and leisure facilities by walking, cycling or public transport. The residents save money, travel creates less pollution from car exhausts, which in turn leads to better health that lowers social care costs, and all this creates a more desirable place and a higher return for the developer. On 1 October 2008 Governor Schwarzenegger held a press conference to sign Bill SB375. This bill will provide up to $20 billion for infrastructure that will combat greenhouse gas emissions – he understands that planning and engineering infrastructures are crucial to making the changes we need.

The most liveable urban areas in the world, such as Vancouver, Canada, are already providing infrastructure that supports the reduction of greenhouse gas emissions. They have one-tenth of the freeways of a typical North American city and they also don't have the burden of the high maintenance costs that come with such infrastructure. Walking and cycling are preferred means of travel and Vancouver has high-quality public transport for longer journeys.

It should be noted that the space required for moving people in buses and on cycles is significantly less than for cars, and far fewer parking spaces are needed. So reducing car use in city centers frees up valuable land for housing, parks and offices; not to mention that the land that comes from closing roads may be used to fund public transport.

In the current industrial urban model, power comes from inefficient centralized power stations outside urban areas that belch out pollutants, products are consumed and thrown to waste in landfills, fossil fuel-based fertilizers are used to grow food and large, noisy freeways cut through city areas with hard landscape and fast water run-off. In contrast, the new model for the Ecological Age would be a place where communities and food production are protected from flooding; where water and waste are reused locally; where people can walk, cycle and use public transport; and where everything runs on renewables. But before that, let us look at the fundamental problems we face in the world and start with energy consumption and supply.

## Cities

In our current industrial development model, energy consumption grows proportionately to gross domestic product (GDP). Consumption eventually levels off as manufacturing is offshored to low- and middle-income countries. The differences in energy consumption now between the US and Europe, with the US consuming more, is largely the result of car use in lower density sprawling urban US centers. The Ecological Age model that China is currently pursuing aims to flatten energy growth by 20 percent. They intend to do this by using the eco-city urbanization model, which entails building high-speed rail lines and moving to energy efficient manufacturing.

Competition for land in most urban areas is driving up the cost-of-land component of house prices and inequalities are widening.

"People move to the cities not because they *will* be better off but because they *expect* to be better off."[4] A high proportion of people in urban areas live in slums. Many people who move to cities find it hard to integrate and survive. Their dire financial situation and lack of affordable housing, exacerbated by rising fuel and food costs, is often leading to homelessness and slum housing. And the forecast for the world's slum population is not good. According to the UN State of the World Cities Report 2006/2007, slum populations are expected to rise to 1.4 billion by 2020, with Africa being most affected.

The Ecological Footprint can be dramatically impacted by changes in urban density levels and how people live. As such, the approach to city living needs to radically change to a much more efficient use of land. While food and goods are things consumers can influence, urban density, mix of uses and fuel choice are largely the domain of planning decisions. One of the main reasons why I moved from civil engineering to planning was because I realized good urban design and planning are key to human beings living within the carrying capacity of the earth.

As I mentioned earlier, urban density is important for reducing transport energy demand. An average US urban dweller uses about twenty-four times more energy annually in private transport than a Chinese urban resident. There is a sweet spot of urban density of 35–100 people/hectare where public transport is viable and where there is plenty of room for urban parks and gardens. So choosing the right density for retrofitting and new building is really important.


**4.2**
Arup Algae building. Image property of Arup and from The Brunel Lecture by Peter Head.

## Resource Efficiency: Food, Water, Energy and Raw Materials

### *Food*

As population grows and the negative impacts of climate change impacts increase, the area of productive land is reduced. The floods in Burma and India show how vulnerable food producing areas are. In addition, the deterioration of soil quality and overgrazing are reducing the productivity on what land we have left, forcing us to use more chemical fertilizers and fossil fuels. Yet we still cannot meet demand, and the amount of food per person is dropping for the first time.

The imbalance between supply and demand is now driving up food prices. Consumption is outstripping production, and food stocks normally reserved for future use are now being used. This situation is worsening as land previously used for food production is being increasingly used to grow bio fuels, and fossil fuel prices increase.

As wealth increases, people eat more – particularly high footprint foods like meat. Meat needs significantly more land and water than crops. On the brighter side, productivity of land for vegetables and fruit can be improved using new low-energy processes of building and balancing soil fertility, and this can be assisted by closing the resource loops between urban living and rural food production (which I will come back to) and demands engineering solutions.

### *Water*

Freshwater resources are fundamental to agriculture, food production and human development. "If present trends continue, 1.8 billion people will be living in countries or regions with absolute water scarcity by 2025, and two-thirds of the world population could be subject to water stress."[5] The US has a serious proportion of this problem.

Water scarcity is caused primarily by abstracting too much, wasting what we have, polluting our water sources and deforestation. In Las Vegas the public sector is facing up to these really pressing questions. The serious drought problems in the US are occurring in areas being targeted for population growth and radical solutions will be necessary.

Major opportunities include: use much less water, treat and recycle urban wastewater and use drip-feed systems for agriculture, as well as collecting and storing rainwater and using it as grey water for secondary uses. The increasing frequency of wild fires linked to climate change is also becoming a major threat across the country.

### *Energy*

If current trends continue the world's primary energy demand will more than double by 2030; almost half of that will be accounted for by energy demand in India and China alone if the changes I outlined above are not implemented. Prices are rising quickly. Coal consumption is rising faster than oil and gas consumption,

with global demand forecast to jump 70 percent between 2005 and 2030. Coal-powered stations are being built all over the world despite the threat of emissions caps because coal is now the cheapest and most plentiful fossil fuel we have left and could last beyond oil and gas. Carbon capture and storage plus new coal gasification technologies offer the opportunity to reduce emissions from coal power stations. More on that later.

Nuclear power and gas power will have a continued important role to play in the energy supply mix. There are limits to sources of raw material supply here too and prices of raw materials will inevitably rise.

In the case of oil the prospects for the future are not good; the science strongly suggests that supply will not be able keep up with demand. We are currently using more than we are discovering and the controversial concept of "peak oil" has emerged. We are passing the peak of oil reserves and oil price has increased fourfold in seven years. Oil price does not just impact upon our transport costs but directly impacts upon food and goods prices. Energy from renewable sources such as solar, wind, tides and waves are underused and comparatively expensive, but they are becoming more viable as oil prices increase.

There is much more solar energy available in the desert regions of the world than we are currently generating from fossil fuels. According to the 2006 United Nations Environment Report, an area of 640,000 square kilometres could provide the world with all of its electricity needs (the Sahara is more than nine million square kilometres in size). We have to be willing to build the infrastructure needed to transfer desert power to our urban centers. This has begun in California where there has been a single contract for 900mw of concentrated solar collector power. There is great potential for solar and wind power in the southwest of the US. There is no doubt that a large percentage of US electrical power can come from renewable energy.

### *Raw Materials*

Raw material consumption is rising fast and the extraction of minerals comes at an environmental price, with mining stripping more of the earth's surface each year than natural erosion. At a typical bauxite mine, ten tons of waste rock and three tons of toxic mud are generated to produce just one ton of aluminum. Meanwhile, some of the largest metal mines in the world are in the buildings, products and infrastructure of existing urban centers, and these can be refashioned to the needs of an Ecological Age.

## Climate Change

More and more people live in coastal areas and they have increasing exposure to floods and cyclones. In many areas droughts and floods are affecting food production and prices, while higher summer temperatures in urban centers are creating dangerous conditions for the young, elderly and infirm. Many of the nations and regions most at risk from the impacts of climate change are low- and middle-income nations that have contributed very little to greenhouse gases.

These nations are not the best equipped with the skills and resources to combat climate change impacts or to mitigate their occurrence. Floods are not the only problem. Ozone and heat impacts are problematic as well with rapidly rising numbers of deaths. This is all going to get much worse.

Additionally, we are all painfully aware of the human and financial costs of the increased intensity of hurricanes caused by warming, and this is a real worry.

We have a huge responsibility to act now to reduce our emissions and ecological footprint. In making these changes we need to ensure that strategies and investments to protect vulnerable communities are put in place.

Adaptation and mitigation need to be implemented together. A priority is infrastructure for water and flood management, recognizing increased storm intensity and sea level rise. We can also plan urban areas to take advantage of natural cooling by building green roofs and parks, and greening streets.

## *Biomimicry*

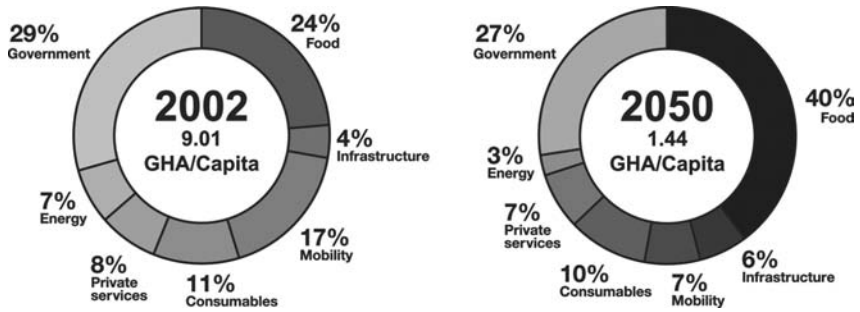
All of this points to finding a way to live more harmoniously with the natural world, and so how do we get there quickly? Janine Benyus in her brilliant book *Biomimicry* sets out ten principles that can guide us.[6]

1. Diversify and cooperate.
2. Use waste as a resource.
3. Gather and use energy efficiently.
4. Optimize not maximize.
5. Use materials sparingly.
6. Clean up, don't pollute.
7. Do not draw down resources.
8. Remain in balance with the biosphere.
9. Run on information.
10. Use local resources.

These are the principles that successful organisms adopt, and we do none of them. I will use these principles as a route map to show how the way we live can be transformed to reach our goals, often working in partnership with optimized natural organisms such as bacteria and algae.

Starting with high-income countries, they have the opportunity to develop in a way that improves quality of life and creates jobs and opportunities within an emerging resource-efficient ecological economy. It is critical to stabilize inflation and provide a secure supply of basic needs. The model I have used for them is to assess emissions, footprint and development index, following the long-term lessons from urban centers like London and San Francisco and their climate change action plans. The idea is to use retrofitting to help move these cities from the Industrial Age model to the Ecological Age, and I will use biomimicry thinking to show how this can be done.

San Francisco's current ecological footprint is between four and five planets and this is largely a result of it being a high car-use city. With a target of 1.44 hectares per person in 2050, the reduction in footprint needed is around 84 percent.




**4.3**
Ecological footprint of San Francisco, 2002 and 2050. Image property of Arup and from The Brunel Lecture by Peter Head.

Admittedly this is extremely challenging. This is similar to the reduction in carbon emissions target of 80 percent, so all resource impacts need to be reduced in similar proportions, that is, all except for food (this would be an overstretch).

Let us start by considering how the principles of biomimicry can be put to work to reach a footprint of 1.44 hectares per person by 2050, starting with "using materials sparingly", "using waste as a resource" and "not drawing down non-renewables". As this is a global issue I will consider low- and high-income countries together.

We need to reduce non-renewable resource consumption. The way to do this is to reuse much of the existing products in their current form and, if this is not possible, to either remanufacture them back into a new product or recycle them into usable feedstock. Studies in the UK have shown that to get to one-planet living, all products will need to come from 80 to 100 percent sustainable sourcing and this will require regulated quality labels to show the impact of the product life cycle. Manufacturers will need to be clustered using industrial symbiosis principles, which means sharing resources and having integrated supply chain management. It has been estimated in the UK that this can lead to a 75 percent overall reduction in the ecological footprint of products. Products can be taken back by manufacturers and remanufactured or reused.

So, let us collect up all these ideas and see how a typical US city suburb could be retrofitted to meet 80 percent emissions reduction from 1990 levels towards which Barack Obama aspires. Let us start in the street and then move to the neighborhood.


**4.4**
Arup future suburban garden home image. Image property of Arup and from The Brunel Lecture by Peter Head.

The introduction of dedicated cycle lanes and public transport would free up garage space for more bedrooms and a higher density of people. Solar energy, wind collectors and natural ventilation chimneys that could replace air-conditioning could be introduced, as could the greening of hard standings to cool down the area, shade the buildings and slow water run-off. Land can be used for urban agriculture, and local shops and markets opened up to sell local produce. Water can be collected and stored for irrigation, which will also reduce run-off speeds. With new technology, enough solar energy could be collected to make houses energy-positive. Increased numbers of people and more of those people being around during the day, as they work locally, will help community cohesion and family support for young children. There will be space in houses for elderly parents to live locally at lower cost and be able to support their grandchildren. Large cars will disappear from streets and be replaced by public transport and cycle facilities with walking pavements. Smaller electric cars will be available through car clubs – charged up ready to go, greatly reducing car ownership costs. Infrastructure investment could be used to put in underground waste collection and the narrowing and refashioning of local streets. Trees will be planted to cool pavements and lower heat island effects. Maintenance costs of roads will be lowered. Public transport will come down most streets and the whole landscape will be changed to be more intimate and attractive, with more biodiversity.

In the city region a grid of public transport services and communication systems which link higher density mixed-use developments within the suburb could be introduced – a smart growth strategy. These can then be connected to intercity high-speed rail and light rail intercity region systems. As a result, green corridors can be built through the region for walking and cycling, and food can be grown locally. In addition, community heat and power schemes can provide lower cost efficient energy services including energy from waste.

All of this illustrates diverse and cooperative solutions, which will help to make city communities more robust, self-sufficient and have lower living costs. There will be other benefits from cleaner air, lower healthcare costs and lower flood risks, which can be factored in. In addition, the more efficient use of land will be important to enable more land to be released for development to help finance change.

On gathering and using energy, the retrofit scenario I have described involves a combination of demand reduction, supply side efficiency and a progressive


**4.5**
Arup future of US suburb image. Image property of Arup and from The Brunel Lecture by Peter Head.

transition to more renewables; and it is one that the San Francisco climate change plan anticipates.

Reducing transport energy use and emissions is a key challenge. A substantial reduction in petrol and diesel use in private vehicles in urban areas will be necessary, partly incentivized by the health benefits of improved air quality and lower running costs. Battery and hydrogen fuel cell-powered vehicles for cars, vans, lorries and buses will be part of the mix with hydrogen sourced from natural gas or other sources. Car clubs will enable people to borrow vehicles when they need them but public transport should become the preferred form of travel. Urban electric metro systems are seven times more energy efficient than the average car with 1.5 occupants. Energy consumed in goods distribution in urban areas can be reduced by 70 percent with the use of consolidation centers around the city perimeter, which are accessed by intercity rail and road links. Deliveries can then be made from these centers with zero-emission vehicles.

A key to lower energy use in intercity travel is investment in a high-speed rail passenger network (eventually running on renewable energy), as well as building bus and car-share priority lanes on motorways, having improved information and traffic management systems and, of course, improved vehicle and fuel technology.

We now have a viable high-speed rail network in Europe, and we know that rail is a more attractive option *where available* than regional air travel for distances up to 600km. Therefore, building high-speed rail lines through international airports as well as major city centers will reduce regional air travel.

What about bio-fuels? European policy-makers are now reviewing their bio-fuel targets amid growing concerns of their social and environmental impacts and high footprint. Second-generation bio-fuels from waste agriculture such as rice husks, stalks of grain crops and $CO_2$ absorbing algae are much more sustainable with lower footprint. When first-generation footprint targets are introduced, I think bio-fuels will reduce in attraction.

In addition, a program for improving the efficiency of power stations is currently under way and this, combined with the introduction of decentralized heat/cooling and power facilities in urban areas, is an attractive model. Combined heat and power (CHP) plants can run on gas or waste materials and biomass from local sources. They can be combined with the use of ground source heat pumps to serve a large area. It is estimated that 50 percent of the reduction in emissions from energy supply could come from this approach.

Looking beyond the short-term targets for renewables, a promising commercial solution is a largely renewable power grid that would run on a combination of concentrated solar power, wind power and waste. Hydrogen derived from renewable energy sources could also provide part of the transport energy supply and also act as a storage medium for renewable energy. This would require new supply infrastructure such as that already being put into Shanghai with fuelling stations around the city.

An early and quick way to accelerate ecological footprint reduction is to provide information to customers in a form in which they can optimize their daily lives to be as efficient and comfortable as possible. For example, optimized real-time journey planning for public transport, in which someone could ask to go to a point in a city within a given time and be given a plan based on where buses and trains would be in real time, would transform safety and ease of public transport use.

## Retrofitting Cities

Some of the ways in which higher rise urban centers could be retrofitted include:

- New communication services would enable people to choose a much more sustainable, low footprint lifestyle. For example, real-time travel information would provide journey plans over a personal PDA, which can be checked on arrival at bus or tram stops.
- We now know that cities of the future will be ones where we can live a cooler, higher quality of life in harmony with the natural world with greening, food production on roofs and energy collection.
- On pollution, there is a virtuous cycle between using waste as a resource and not polluting the air, water and soil. Health costs would go down and bio-diversity and carbon sinks go up. European legislation has been effective in driving change but the one area that is lagging behind is in the recycling of sewage and wastewater. If we do this, solid waste would be digested in anaerobic digesters to provide energy and compost, and water would be recycled for use to grow food.
- In addition, fitting water capture and grey water recycling systems into homes would save 30 percent of household potable water consumption. It would also reduce storm water run-off, as would green roofs, making this another virtuous cycle.
- Retrofitting of buildings to reduce energy demand and increasingly to turn them into power plants to collect energy on the façade and roof will become the norm.

One issue that has to be addressed quickly is the reduction of carbon emissions at coal power stations. Carbon capture and storage is one option that is being developed, with underground storage being the preferred option. However, finding the storage at the scale needed is difficult, and carbon dioxide has to go through an expensive and energy-intensive liquefaction process. A more sustainable option, which is still in the early stages of development, is to close the carbon cycle in a shortened integrated carbon cycle (SICC). In this, carbon dioxide is cleaned and separated from the flue gas and passed through a collection of bio-reactors in which


**4.6**
Arup building with green passive façade. Image property of Arup and from The Brunel Lecture by Peter Head.

light, nutrients and seawater allow different algae types to grow quickly and absorb the carbon, releasing oxygen and in some cases hydrogen. Small pilot plants have been created at the Massachusetts Institute of Technology to demonstrate the viability. The different algae may then be sold – one type used as a fuel for energy production in anaerobic digesters in local urban centers, another as a pharmaceutical product, another for oil production, and the hydrogen from the other bio-reactor can be used for transport. In this process the by-product has a value, so we believe it has a good possibility of having a commercial future compared with underground storage.

## Low- and Middle-income Countries

The evidence base for the transition in developing countries comes from the eco-city plans in China and the lessons learned from brilliant developments in Curitiba and Bogota. In the case of low- or middle-income countries the key issue is how they can directly move from an Agricultural to an Ecological Age, and leapfrog the Industrial Age. Here are some initial thoughts:

- Urban developments can be designed as a collection of villages, each being a compact mixed-use development with density of over fifty dwellings per hectare.
- Developments can have green spaces, green roofs, trees in streets and high bio-diversity reflecting the local ecology.
- Cultural history can be reflected through public spaces and architecture.
- A critical priority will be flood protection for people, infrastructure and also protection of food production land. This can be built into the fabric of the city and combined with the water management system.
- Walking, cycling and public transport running on renewable energy can be the primary means of getting around with local stops for everyone. Goods can be delivered with green vehicles too. Quiet, clean vehicles can mean quiet places to relax in the city.
- Social services such as hospitals and schools can be located so that they are accessible within the community.


**4.7**
Arup future slum image. Image property of Arup and from The Brunel Lecture by Peter Head.

- Where there is no existing electricity grid, use of local renewable energy supplies from solar, wind and waste biomass are very cost-effective for electricity, heating and cooling. Waste can be used in future construction.
- Large-scale natural renewable energy sources locally can be used as well.
- Buildings can be designed to use very little primary energy and can be integrated with the food production systems in the city.

All in all, these models show that cities can enable people to live a modern lifestyle within environmental limits.

## Policy

Now let us look briefly at policies that will drive the changes listed above. There are three aspects of change to be addressed as we move to an ecological model of economics:

1. natural capital is increasingly valued as the global economy reaches an optimal scale;
2. a fair distribution of resources is encouraged;
3. efficiency is driven by the market in a way that reduces overall non-renewable resource consumption.

Policy is clearly needed at a variety of scales – global, national and regional, with the global being the most difficult.[7] Political and technical leadership at a national and local level has been shown to be absolutely critical for moving sustainable development forward. The first step anywhere should be the establishment of a clear, sustainable development framework with long-term objectives for social, environmental and economic performance. High-quality planning and design can then begin using modelling tools, such as Integrated Resource Modelling, to plan the infrastructure and land-use changes necessary to deliver the outcomes. The next stage is to establish the partnership and funding arrangements for delivery and this is where engineers come in.

There is clear evidence that first movers in this transition all over the world are gaining benefit both at a regional economic level and at a business level, and so there is every reason to start now.

The C40 Clinton Climate Initiative is an example of a global partnership to move urban centers in higher income countries in the direction set out in this paper. They are creating global buying clubs to provide huge orders for new technologies.

Financing solutions will require long-term infrastructure partnerships between public and private sectors and community groups and Non-Governmental Organizations (NGOs) with funding partly coming from pension funds like the public building retrofit programs now starting in US cities to reduce energy demand.

We are only at the start of this journey and so learning, research feedback and capacity building are essential. Arup is supporting the creation of a network of research institutes to help move this process forward. Initially there are four: Thames Gateway, UK; Dongtan, China; Cape Town, South Africa; Melbourne,

Australia. Each institute has outreach partnerships in the research community of each country. We are currently discussing a Melbourne partnership with the West Coast city of San Francisco in the US.

## Closing Remarks

Let us return to those key questions. Yes, it looks as if there is a way of living a modern, attractive lifestyle within environmental limits in 2050. A range of critical infrastructure investments is needed with these limits and, with a comprehensive change to manufacturing resource efficiency, the target of 80 percent carbon emissions reduction could also be achieved. I have set out a policy framework and delivery methodology to help drive this forward with land-use planning being essential before engineers can start delivery.

Engineers have global experience and are adept at multidisciplinary team working, which will be so essential for success. We can design and deliver these new integrated infrastructure systems but the task is huge. We will need to train and motivate more young people to join this challenge and be the Brunels of the twenty-first century.

I have shown a first glimpse of a way forward and what I hope is a credible vision of the future. That said, it is only a modest start for a long journey. I hope that presenting this paper around the world will enable the global community of engineers to come together to understand what we need to do and inspire young people to join us in this challenge. Without doubt this is the greatest challenge humankind has ever faced.

Thank you.

## Notes

1 Lecture is from a series presented at cities around the world. http://www.resilient-futures.com/brunel-lecture-series. Accessed April 20, 2010.
2 UNESCO Millennium Development Goals. http://www.unesco.org/education/tlsf/TLSF/theme_a/mod02/uncom02t03.htm. Accessed March 30, 2010.
3 See Stern Review, "Stern Review: The Economics of Climate Change". http://siteresources.worldbank.org/INTINDONESIA/Resources/226271-1170911056314/3428109-1174614780539/SternReviewEng.pdf; and McKinsey and Company, "Reducing US Greenhouse Gas Emissions: How Much at What Cost?" http://www.mckinsey.com/clientservice/ccsi/pdf/Greenhouse_Gas_Emissions_Executive_Summary.pdf.
4 Anna Tibaijuka, Executive Director of UN Habitat, quoted in http://news.bbc.co.uk/1/hi/5078654.stm. Accessed May 1, 2010.
5 Committee on Earth Observation Satellites (CEOS). *CEOS EO Handbook*. http://www.eohandbook.com/eohb2009/casestudy_water.html. Accessed March 30, 2010.
6 Janine Benyus, *Biomimicry: Innovation Inspired by Nature* (New York: Perennial, 2002).
7 The global models I describe are in sympathy with the Contract and Convergence proposal by Aubrey Meyer for carbon, and the Shrink and Share proposal by the WWF for Ecological Footprint.

Part II

# Ecologies

Chapter 5

# Ecological Modernism and the Making of a New Working Class

*Shannon May*

Looking at any master plan it is immediately apparent that its function is to mark the spatial relationship between buildings and corridors, civilization and nature. What is less obvious at first glance is that a master plan is always also a reification of political philosophy. The relationship between buildings, between edifice and environment is the material manifestation of a desired relationship between persons, and between humanity and nature. A master plan is no less than the transformation of an abstract idea into a concrete structure. To make an analogy after Georg Hegel, if philosophy is its time comprehended in thought, architecture is its time constructed in things.

In this chapter I outline the tenets of William McDonough's ecological thought in order to give background for the intentions and consequences of the Master Plan for Huangbaiyu: an internationally lauded plan for ecological urbanization in the twenty-first century. Once so obscure that it was not even listed on Liaoning provincial maps as late as 2006, environmentalists and journalists across the globe have heralded Huangbaiyu as a critical place in the fight to stem global climate change.[1] Leading environmental commentator Elizabeth Economy has called the project "perhaps the most ambitious multinational effort to help redirect China on to a new development path."[2] The extent of McDonough and his partners in the China-US Center for Sustainable Development's[3] ambitions for the Huangbaiyu project are clear when he announces that it is a "sustainable rural village that the government hopes will serve as a prototype for improving the lives of 800 million rural Chinese."[4]

When speaking of the need for ecological design, McDonough often repeats his maxim that "design is the first signal of intention." This chapter probes McDonough's designs to make apparent the underlying economic and sociological signals embedded in the seemingly innocuous ecological designs of the Huangbaiyu Master Plan. I begin by following McDonough's arguments for the need for a "next industrial revolution." It will become clear that while McDonough is calling for a

revolution in the common sense of upheaval, his sensibility is the same as all the industrial modernists that came before him, except for a slight modification that changes very little in the philosophy and practices of those earlier industrialists. This is likely why he is the most popular of all the early twenty-first-century sustainability gurus: he sustains more than he changes.

While nature was once something to be harnessed for the use of humanity, for McDonough nature is to be used as a barometer of humanity's viability. As such, I call McDonough an ecological modernist. After presenting McDonough's case for design as the necessary salve to humanity's peril and placing it within the context of the modernist sensibility, I present his Master Plan for Huangbaiyu, the grounds upon which it is to be built, and the radical, rationalized social and economic relations it promises to bring into being in the name of ecology.

## The Case for Design

In their essay "The Meaning of Sustainability," William McDonough + Partners and David Rothenberg establish the imperative of design to intervene in the present existence of civilization, and transform it.

> Examples of sustainability are not hard to cull from the *history* of world cultures. . . . Typically, there is no design or designer that guides the inhabitation of the place. But this is rarely true anymore. The interactions between people and nature have grown so complex, the rate and scale of change so overwhelming. . . . Design has become crucial to our future – and to achieve any measure of sustainability we are in need of designs that strike a balance between the local and the global, traditional settlements and the emerging planetary culture.[5]

With "the rate and scale of change so overwhelming" it is no longer possible for "small-scale" solutions that "do little or no damage to their surrounding habitat."[6] With the environment now conceived of as the planetary ecosystem, it is no longer possible for human beings as individuals and spatially localized communities *to know* how to live sustainably. That time is relegated to history. The present, they imply, imperils the future. Someone – the designer – must come forward who can mediate between the needs of "traditional settlements," those places comprising edifices that individuals, families, and communities build for themselves, and the planet.

McDonough's indictment of the present is encapsulated in the title of his 2002 book written with his long-term collaborator Michael Braungart: *Cradle-to-Cradle*. Subtitled "Remaking the way we make things," it is a manifesto calling for a new way of thinking about existence, and a charter for how to bring their utopian vision into reality. The present is conceived as a cradle-to-grave existence, in which not only the detritus of consumptive living is being thrown "away" and which pollutes our soils and waters, but the very products we produce in pursuit of increasing our quality of life are causing our cells to mutate, and filling our lungs with metallic dust. They write that the scientific advances of the Industrial Revolution are sending us, and the planet, to our graves. Salvation from this

catastrophe will come from "the *next* industrial revolution," which seeks to create a sustainable future by eradicating the practices of the past and its inherited patterns in the present.

In this context, it should not be surprising that the Master Plan for Huangbaiyu builds a new settlement from scratch instead of renovating existing structures. McDonough's ecologically modernist approach led him and his team to ignore all but a limited set of topographical and water conditions in the valleys of Huangbaiyu because it was precisely the existing forms of energy, land use, household type, and community that he was seeking to change. Self-organized sustainable communities could no longer be found or looked for – they were *history*. Like other utopian revolutions, the conditions of the present must be negated to bring a rationally planned, sustainable world into being.

## The Designers of Ecological Modernism

A central argument of *Cradle-to-Cradle* is that government cannot be entrusted with safeguarding public interest; this role must be left to unregulated industry enlightened by design. Unlike many other environmentalists who seek to make humanity act on "inconvenient truth[s]" through a combination of government regulation and consumer behavior change,[7] McDonough and Braungart turn to commerce as the key to their revolution. Building on the thought of Jane Jacobs's *Systems of Survival*, they summarize:

> The guardian is government, the agency whose primary purpose is to preserve and protect the public. . . . Commerce, on the other hand, is the day-to-day, instant exchange of value. . . . Any hybrid . . . [is] "monstrous." Money, the tool of commerce, will corrupt the guardian. Regulation, the tool of the guardian, will slow down commerce.[8]

Moreover, "a regulation," they write, "is a signal of design failure."[9] If regulations are the only tool of government (McDonough and Braungart's implied claim), and regulations are a signal of design failure, then the only solution to planetary crisis is through commerce, well-designed. Through this argument McDonough and Braungart collapse the authority of the modernist mandate to plan and develop the world as coming from the state *and* the expert[10] into *only* the expert – and not just any expert, but the designer. With his foretold catastrophe of planetary devastation upon us, the means of enacting his utopian critique is another unregulated industrial revolution, led by himself.

This attitude toward development is unabashedly modernist, with an ecological twist. There are seven aspects of the modernist sensibility that set it apart from other perspectives on how to engage and enact civilization. First, modernists argue that the contemporary organization of society and practices of daily life are not how life *should* be lived. Second, modernists establish an alternative form of human life that should be brought into being. Third, they hold that the complexity of human activity and organization can be known; abstractions of human behavior can be created that make it possible to alter civilization to achieve their desired goal. The future can be modeled, and the model instantiated. Fourth, they hold that the

instrument of intervention will have the effect expected. Fifth, a desperate urgency pervades the sensibility, affecting its perspective on both time and space: the project to replace the past with the present must be done with both speed and scale. Sixth, modernists' critique is not textual, but physical. They do not write; they build. Seventh, the environment is either seen as harboring resources that must be liberated and managed for humanity's use, or ignored as a mere background upon which humanity creates civilization. In short, the modernist sensibility is one that it is both critical and utopian, it lays claim to both omniscience and omnipotence, and it acts swiftly with universal ambitions focused purely on the progress of human civilization.[11]

McDonough shares all aspects of this sensibility but the last. Rather than taking the environment as the background of human development, he takes it as the foreground. This inversion changes little of the modernist sensibility, however. In fact, it heightens all the other aspects of it. With the indictment of the present based upon fears of planetary devastation, the future functions as a threat of a terrible unknown – even death and extinction – if contemporary social forms and economic relationships are not radically altered. The will to act with speed and scale to alter the actions putting the ecosystem of the Earth at risk resounds as a biological imperative.

With the threat to the "good life" framed in ecological terms, it becomes politically impossible to deny the need to alter the present in the name of humanity's future. To do so echoes against this ecological frame with reckless selfishness, resounding as a desire to preserve the status quo at the expense of the species. With the threat of extinction held up as the result of inaction, what I call ecological modernism may be modernism's most powerful and pervasive form. It is James Ferguson's "anti-politics machine" *par excellence*.[12]

McDonough exemplifies this sensibility when he effuses one of his stock stories about himself. I first heard him relate the story at a welcome reception for his partners in the Huangbaiyu project on May 18, 2005. Introducing himself, McDonough said: "At the end of my *Newsweek* interview,[13] the reporter turned to me and said 'I finally get how you do your work. You speak about the future in the present tense.'"

With a slip of tense, the reality of the world disappears and is replaced by the presence of the future. In this language of utopian dreams there is no inheritance of that which is disparaged. It is as if the past and its present never existed; there is only the future. Architectural drawings and master plans strengthen the power of this mythic slip, as buildings, neighborhoods and cities appear on flat pages upon which the future rises, and the complex social and economic inheritances of the present are impossible to represent.

## Local Environments, Universal Knowledge

If modernism strives for universal solutions, how can that be reconciled with McDonough's insistence on the local criterion of sustainability? While there seems to be a contradiction between McDonough's emphasis on scale and his arguments for the importance of locality, it is critical to remember that for McDonough the local is always in reference to the environment, not to people. When he designs, as

he likes to say, he looks at the landscape as if he were a bird, to see what a bird would want in the habitat.[14] He has taken the defining technological object of the modernists – the airplane, conquering distance with speed, embracing change – and replaced it with a biological one. While the switch from airplane to bird may seem significant, it has no effect on the perspective from which knowledge is acquired and plans drawn. It preserves a spatial gaze that is incompatible with the perspective of a person standing on the ground. Produced through a "redistribution of space," McDonough's bird-gaze can claim to be "scientific" – objective, rational, universal – precisely because it denies the particular and the personal.[15]

This metaphorical displacement reinforces ecological modernism's authoritarian tendencies: since birds cannot speak, there is no need to hold open meetings to elicit their concerns. Since it is the current lives and livelihoods of the people that are portrayed as destroying the planet, why would a sustainable designer look to them for insight? What then would the human-built world look like if McDonough built it? What signals does it send for the future of millions of lives of rural Chinese for whom he sees his work as a prototype?

## A Master Plan

Despite intending to create "a higher quality of life for the villagers and to exemplify a more hopeful future for the children," there is no discussion of villagers or children at all in the Huangbaiyu Master Plan. There is no mention of existing household structure, spatial patterns of sociality, relationships between geography and kinship networks. There is no survey of existing types of labor and their earning power; no discussion of land tenure and its relationship to household income. There is no discussion of existing energy life cycles. The focus of the Master Plan is on architectural form and expert-led systematic urban planning. It is implicit in the Plan that building an eco-city in the countryside will improve the lives of its residents and bring a more hopeful future for the children. Deeper entanglements with local conditions were not seen as necessary.

I use the term "city" intentionally. The transformation that the Master Plan performs in Huangbaiyu is more than an environmentally conscious upgrade of rural housing. Its ecological goals are achieved through a radical transformation in family and community organization. It is the blueprint of a developmental regime that unifies seemingly disparate concerns – global climate change, denigration of "peasants," and the aesthetics of modernity – into an instrument of environmental, economic, and social transformation. A desire to reduce carbon emissions causes a shift away from the responsibility to provide for one's own survival needs to an infrastructure of shared resource distribution.

This transformation entails another: a shift away from small-scale ownership of household production to the wage labor of market production – to a life that is at greater mercy to forces that are beyond one's control, but where there is guarantee of convenience and promise of affluence. New economic dependencies increase insecurity for households as they are brought into physically structured interdependency with each other, the nation, and the planet. A new sociality is reflected in neighborhood parks and a town center, where people can congregate and converse, and thereby be transformed from "isolated" private individuals

into a community. To save the planet from peril, "the effectiveness and elegance of natural systems" are taken as the foundational principles for the design of Huangbaiyu, and the specific historical phenomena of urban structures and market relationships are naturalized as biologically necessary.

## Building Community

Echoing the concept of sustainable development that emerged from the Brundtland Commission,[16] McDonough writes in the Master Plan that the goal of his "Cradle-to-Cradle village" "is to provide a higher quality of life for the villagers and to exemplify a more hopeful future for the children."[17] While much of this more hopeful future is to be made possible through the use of specific materials and energy sources, there are two facets of the Plan that call for a reorganization of spatial order: centralization of human habitat to "optimize the use of the valuable productive land"[18] and to improve quality of life "through increased community, convenience and comfort."[19] Both of these objectives lay the framework for a radical reorganization of self and society, household and economy.

Community is a key conceptual lens of the Master Plan. The Huangbaiyu project began in September 2002 as a commitment between McDonough, US Co-Chair of the China-US Center for Sustainable Development, and his China counterpart, Co-Chair Deng Nan to develop a "sustainable community" in China's countryside. Within five months Huangbaiyu was selected as the site where a "scalable model for the revitalization and sustainable development of China's rural communities" would be built.[20] The implication is that life in rural China is both collapsing and unsustainable, although no description of the lives or livelihoods of families whose lives are so described is given. Having described them as "rural" was synonymous with degeneration; the Master Plan proffers no other explanation.

The following commentary of Peng Sizhen, the CUCSD affiliate from China's Agenda 21, is typical of the perspective of McDonough and his partners in the Huangbaiyu plan. Looking out over the construction site of Phase One and south to Dry Riverbed, Peng narrativized what we were seeing.

> They [the houses, the people] are scattered like kernels of grain. There is no order to it. It is chaotic. When they are collected together through the Plan, when there is a comprehensive plan, then it will be better. Their lives will be better together. There will be parks and a lake. Then it will be a sustainable community.[21]

In *The Hannover Principles*, McDonough and Braungart's precursor to *Cradle-to-Cradle*, McDonough argued for the importance of an "identifiable center" to a "successful community":

> The original city was based on the intermingling of people from different social classes and the cultural value of chance meetings in the streets with a past. Can such a traditional way of life be simulated? A successful community needs a *locus mundi* where an identifiable

> center for human interaction and interchange is scaled to social and cultural demographics. There needs to be a "well point" where unplanned communication can occur.[22]

Over the course of my fieldwork in and around Huangbaiyu, distinct but interrelated descriptive themes about the lack of community in Huangbaiyu repeatedly came up in planning meetings for the project, and in explanatory conversations. Intertwined together they form a specific vision of the desirable social order. Community is conflated with the creation of rationally ordered, centralized housing and formal public spaces that facilitate chance and casual encounters between persons.

First, there is the consistent assertion that since the houses in Huangbaiyu were scattered, the lives lived in them were isolated. (That it was not the houses that were scattered but the hamlets were never recognized; see Figure 5.2.) There could be no community – no sociality – among people who were physically separated in this way. Second, there is an aestheticization of community as a place that is ordered according to a legible comprehensive plan, and the hamlets in Huangbaiyu are not (to many urban Chinese and American eyes). Third, current household provision of subsistence goods is seen as prohibiting community formation. Echoing Emile Durkheim's logic in admiring the strength of "organic solidarity,"[23] to be part of a community, a household must be reliant on shared infrastructure, and Huangbaiyu has none. Fourth, there could be no community – no friendship – without public spaces, and there is none. A community, as such, is something that can be encountered in open space, and as a stranger.

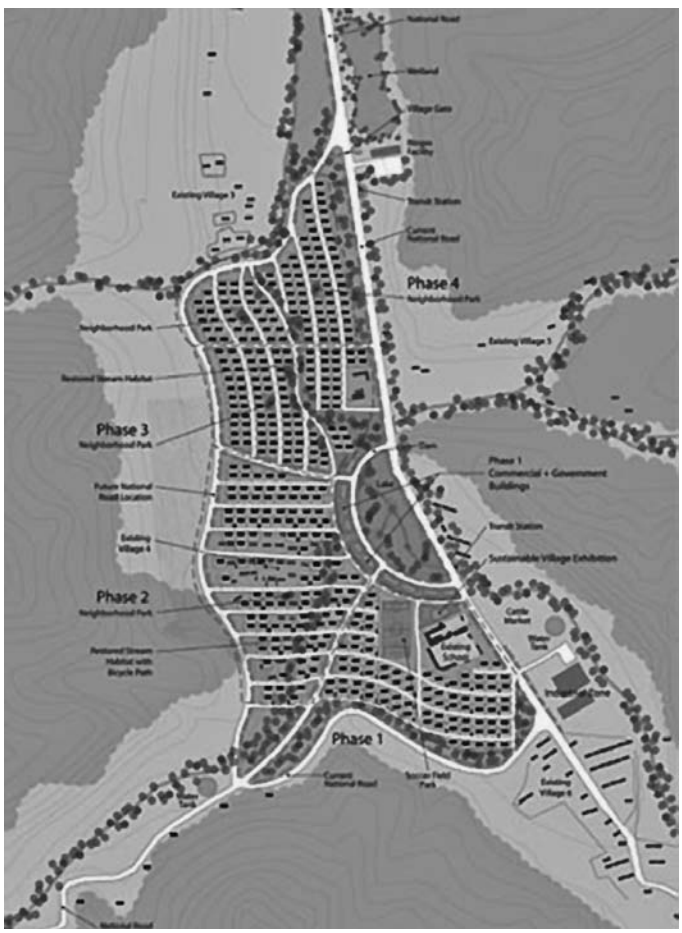
Taken together, these four articulations make community synonymous with the organization of physical structures that bring the private dwelling of persons into close proximity with shared services, and encourage them to enact a public life that is observable and open to engagement by others. Community is conceived of as a public series of flows: water, gas, and people.

In the perspective that guided the Master Plan's approach to building a community, the term "building" was always taken literally. Specific physical and spatial relationships are necessary for happiness, friendship, and reciprocity – community – to be possible. Significantly, none of the team drawing or implementing the designs to build a sustainable community for rural China in Huangbaiyu lived in rural China, or in Huangbaiyu. Their perceptions of community are based on urban spatial forms. In each conception of community, there is a conflation of "community" as a network of people connected through reciprocal personal relationships with "community" as a specific form of built space, marked by centralization, shared public infrastructure, and constructed public spaces.

From this perspective, community becomes not a concept but a material form; not something created by personal activity but by impersonal structure. It is this conflation that makes it possible to see the existing hamlets of Huangbaiyu as lacking community, and to provide the solution through construction – to build a community through material structures that did not exist before.

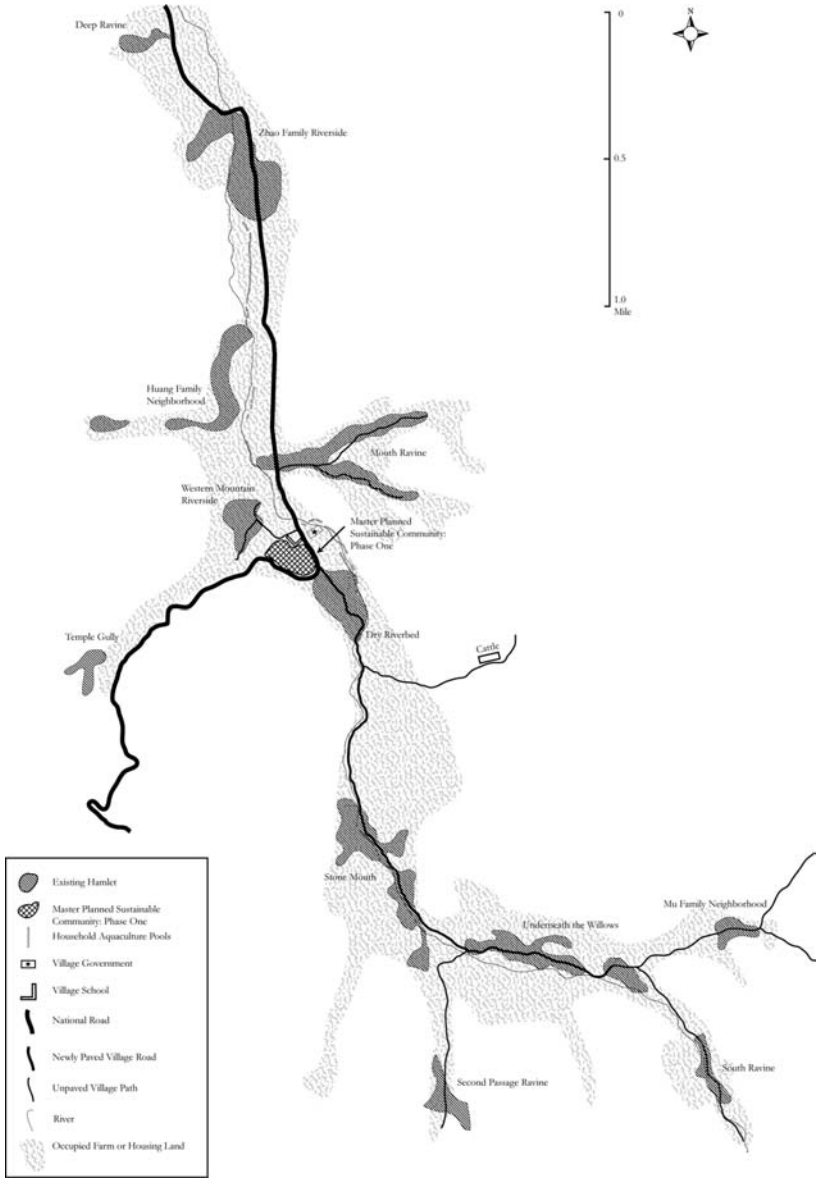
## Designs for Sustainable Living

The "community design" begins with the benefits of consolidation and centralization of the settlements, and the advantages and services that such a social environment brings to the quality of life of its residents. While the north–south axis spanning the existing hamlets in these valleys stretches 4.5 miles, the model prototype reduces it to little more than half a mile. This proximity, the Master Plan states, will ensure that "every house will be within walking distance of the employment center, the central public park, and the school." All interior streets feed like spokes into the hub of the new town: a semicircle of commercial and government buildings that face a central great park and lake (see Figure 5.1). The new "recreational lake" stands at the existing juncture of two streams, serving as a "centerpiece of the new public park." This is the new town's *locus mundi* – the legible "well point" where individuals come together and in that space become visible as a community. It is envisioned that "village administrative offices, community center, health clinic, post office, bank, convenience retail, restaurants, day care, senior center, and farm market" will all be built here to serve the needs of the residents.




**5.1**
The Master Plan diagram for Huangbaiyu. The greatest North–South distance is approximately 0.5 miles. Existing hamlets are listed as villages, and denoted by their communist-era production team number. For example, Huang Family Neighborhood is listed as Existing Village 3. © 2003, 2004 William McDonough + Partners.

**5.2**
The Hamlets of Huangbaiyu




Anticipating the town's future "affluence," the majority of houses have an automobile garage, but no parking is provided anywhere else in town. While the spatial organization of the Master Plan for the prototype town has been set, McDonough suggests that more expansive villas could be built in the valley to the southwest (Temple Gully, see Figure 5.2).

A central focus of the Plan is on the role of settlement consolidation in making shared infrastructure economically viable. "Closed cradle-to-cradle cycles [will result] in cleaner water, cleaner air, and a healthier population." Water will be supplied through a closed community system with the reuse of "grey water" before it

is discharged. The biogas facility is the linchpin of the model's ecological aspirations: "Using biogas in lieu of coal will transfer the village's predominant reliance on fossil fuels to a reliance on fuel generated from a rapidly renewable organic material, positively affecting the community's carbon balance."[24]

Consolidation also allows the design "to optimize use of the valuable productive land, while enhancing habitat and honoring the natural setting of the site." While the phrase "valuable productive land" is not explained within the text of the Master Plan, statements at project meetings and official documents regularly announced that "valuable productive land" meant land used for commercial cropping. With land a finite resource, to increase land for cropping, other land uses would have to be eliminated and space reconfigured. All non-farming land uses were classified as "wasteland," legitimizing their appropriation and transformation through the Master Plan.

Similar to how the people who lived in these valleys were thought to be "scattered," their use of the lands leased to them by the state was seen as inefficient and environmentally degrading. Scattered people require more roads and paths to walk between them, on land that could have produced tall stalks of maize instead of dirt trampled under people's feet. The irregular spaces in between houses were seen as the problem of each family having built their own house, only thinking of their own needs and preferences rather than adhering to a rational system that would create an order that would optimize benefits for all. Land enclosed within a courtyard was similarly classified as wasteland, and the result of ill-informed practices. Following his edict that waste should be literally turned into food, McDonough's prototype for a sustainable community is determined to bring perceived piecemeal, inefficient use of natural (and national) resources – be that energy, land, or people – into a rationalized master plan.

## Mediating Excrement, Forming Organic Solidarity

While denser settlements make provision of shared infrastructure more economical by lowering the cost of laying pipes, decreasing loss in energy across distance, it is not necessary that the unit through which ecological impact is measured is the town or city. It could just as well be the house. McDonough's discussion of the ecological features of house construction does not require a certain proximity or other spatial relationship between houses, just the use of either straw bales or BASF's expanded polystyrene for insulation, and the use of recycled bricks or Vermeer's system for manufacturing compressed earth blocks.[25]

Efficient systems of water use and recycling can be implemented at the household level, from rainwater collection to gray water reuse. It is not the use of public infrastructure that makes the reuse of kitchen and laundry water for toilets possible, but the routing of pipes *within* the house. The recycling of animal and agricultural waste into gas for cooking may also be done on a household basis, if the fodder available is proportionate to the gas needed. At the household level, it is easier to estimate and then ensure the ratios needed, although it does require that every household, if it is to produce enough gas for their cooking and heating needs, raise enough livestock to produce sufficient excrement for their energy usage. Unlike water, in which ecologically minded usage only requires reconfigurations of piping,

household-based biogas energy requires a particular form of household production: the raising of large, sedentary livestock, which must provide a means of income in addition to their energy contributions to economically justify the expenditure of the land, feed, and water used to keep them.

City-distributed biogas, on the other hand, transfers the labor burden of each household to a single, shared facility, freeing up labor hours in exchange for paying a fee for services provided. In China, this shift from household production to distributed services is what delineates the rural from the urban, the country from the city. Rather than each household bearing the responsibility for providing their own water and gas, public infrastructure serves as the city's circulatory system, supplying the necessities of biological life so that urban labor power is freed up to circulate within the capital market (see Table 5.1).

This binding yet libratory tie of the person to a distributed public is the distinction of urbanity in China: urban residents receive their sustenance through the pipes and wires managed by government; rural residents are on their own. The urban–rural divide should therefore no longer be thought of simply as a divide between types of economic activity, or the remains of historical geographic divisions. To be rural is to be responsible for the provision of one's own biological needs: shelter, heat, water, and food. To be urban is to be managed and measured through circuits of consumption. The critical distinction is the provision of public infrastructure.

Simply thinking of communal infrastructure as creating the opportunity for employment through freed-up labor hours is misleading, however. It *requires* it. The delivery of water and energy to one's home comes with a bill. How is that bill to be paid? From the wages earned by the labor that the infrastructure services made possible. Just as household biogas provision requires a specific form of household production, based upon assumptions of land use and the profitability of raising sedentary cattle or pigs, a city-based biogas system requires a system of market production.

There is more to market production than waged labor. The interconnectivity that market production requires has long been argued to be of moral as well as economic benefit. Social theorists of various political inclinations have written of the transition from household production to market production as one that is integral to the development of humankind, privileging it above a life in which a person provides all of his own needs within his household. Karl Marx argued that "[t]he contrast between town and country begins with the transition from barbarism to civilization, from the tribal regime to the state, from the individual locality to the nation, and recurs in all history of the world until our own days."[26] Influenced by Charles Darwin's work on the evolution of species and the benefit of ecological niches to species survival, Durkheim wrote that such self-sufficiency is "a state of detachment and indeterminateness [that] is somewhat anti-social"[27] and that it is not only "a law of history"[28] but a "law govern[ing] biological development"[29] that such a "horde"[30] of independent and detached persons be transformed into a state of organic solidarity through the division of labor. Such evolutionary biological sentiments are encapsulated within the everyday language of historical time used to authorize the necessity for intervention in some people's lives: securing progress, development, and eradicating their antithesis, namely backwardness.

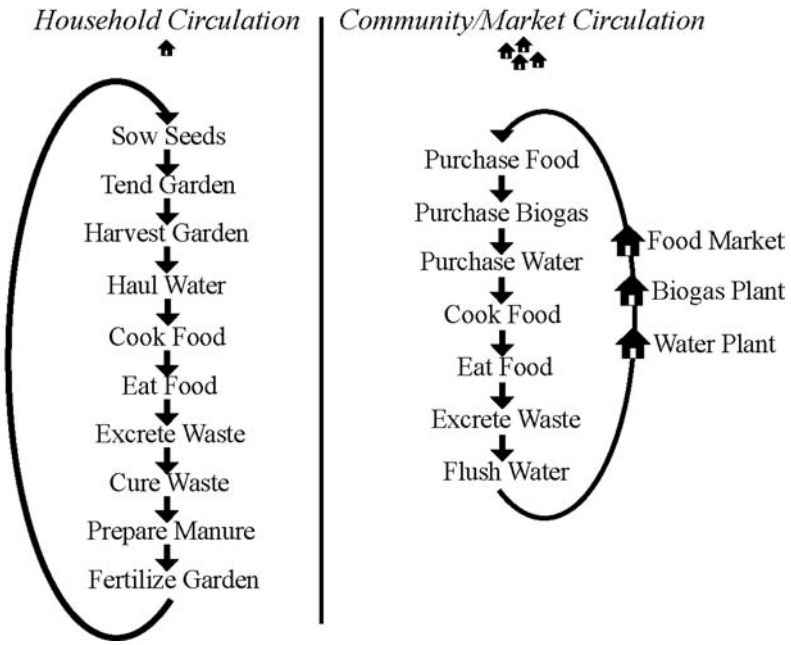
A circulatory system that accelerates the elimination of wastes and delivers water and fuel is as important to the existence of the social body as the structures

that facilitate the division of labor. It also makes the metaphor of the social body more literal. With the advent of public infrastructure, the bodily necessities of individuals are mediated through a circulatory system that ties their ability to receive nourishment or eliminate waste to each other. While it is the Master Plan that is bringing these changes to Huangbaiyu in the twenty-first century, changes in economic relations made the circulation of energy, water, and waste necessary in parts of Europe at the end of the eighteenth century. The new economic modes at that time and place, Michel Foucault wrote,

> made it necessary to ensure the circulation of effects of power through progressively finer channels, gaining access to individuals themselves, to their bodies, their gestures and all their daily actions. By such means power, even when faced with ruling a multiplicity of men, could be as efficacious as if it were being exercised over a single one.[31]

While Foucault is speaking of channels in a figurative sense here, reading channels literally, as the pipes that connect all the spaces of urban inhabitance, illuminates the effective power of such banal structures as plumbing to dictate the conditions of everyday life.

The sewage system also takes what was a private natural resource, or in McDonough's terms, a biological nutrient, and moves the prerogative of its use from the household to the "public." What was a household-based, closed-loop cycle becomes a cycle that mediates between the household and the "community," private and public (see Figure 5.3). That mediation not only structures a need for division of labor, but as the circulation of excrement is externalized from the household, central governance of the everyday functions of life becomes possible. Cycles of nutrients are also cycles of power, and money.




**5.3**
Excrement–nutrient cycles in systems of household and community/market circulation

## Naturalizing a New Chinese Working Class

In seeking to build a "sustainable community" out of "isolated," "scattered," "self-reliant" households, the Master Plan for Huangbaiyu reverses the temporal relationship between public infrastructure and market production. In Huangbaiyu, the biogas infrastructure *establishes* a density of living that would make the forms of household production that had sustained most families in these valleys untenable. What was earned by the work of one's own hands and so required no cash outlay must now be paid for with money. Of course, the various partners of the CUCSD often heralded the importance of the biogas plant in freeing up "wasted" time so that people could use their labor time more productively, always meaning for a wage.

What the biogas plant actually does is increase the cost of living, so that if a family wants to maintain the lifestyle they had before the "sustainable community" they must earn more money than they did before in an organization of space that effectively dispossesses them from their means of household production through reduction or elimination of all land uses that are not for commercial crops, despite the average household earning only 23 percent of their annual net income from maize. The designers of the Master Plan were aware that their rendering of the model eco-city would reduce the land used for subsistence food gardens, and leave no space for the various forms of animal husbandry that occur in the existing hamlets. Corrals for goats were classed as "wasteland" even though households with herds earn 49.5 percent of their annual net income from their cashmere, and pools in the watershed for aquaculture were deemed too polluting to be allowed for the households that earn 85 percent of their income from the sale of trout, despite lack of any testing.[32] Nature as an aesthetic rather than a working resource is to be highlighted and integrated throughout this "sustainable community." The designers did not consider this a problem, however, since the point of the exercise was to create an ecological town where the residents would be gainfully employed in "restorative commerce" conceived of as part of McDonough's next *industrial* revolution.

Writing for the United Nation's Environmental Program, McDonough and Braungart make explicit that "the promise of cradle-to-cradle design" for Huangbaiyu is a transformation from smallholder agriculture to commercial industry. "The people of Huangbaiyu will be steadily employed in a variety of local enterprises, from sustainable forestry to farming to working in the biogas facility or a wood products plant. The enduring cycles of nature, it is hoped, will generate a wide spectrum of community wealth."[33] They do include "farming" as a local enterprise, but the consolidation of the hamlets and elimination of the "wasteland" that households used for animal husbandry and gardens turns being a farmer from a viable means of supporting a family to an assured path to poverty.

The use of the term "employed" in conjunction with farming is significant in that it tacitly acknowledges China's national interest in rural settlement centralization: the consolidation of household farms into corporate agriculture holdings. Self-employed smallholders are transformed into wage laborers on land that was once their own from which to profit. As Dai Xiaolong, McDonough's local partner, told a reporter from the Ministry of Construction, "We are in the process of diligently exploring high-efficiency agriculture and intensive agriculture, planting high-added-value cereal and grain crops and industrial cash crops, then we will raise the productivity through combined-holdings agriculture."[34] This path to

development involves transferring the use value of lands from households and communal holdings to a commercial venture. In each case it is the farmers who will become the workers, rather than the farmers who will retain equity.

In order to improve quality of life, the lands that households could invest in and profit from were to be transferred to industrial interests. In the transition to wage labor, the smallholder gives up the poverty of a bad season and the wealth of a good one for wage consistency. Both the risk of profit and loss is transferred to the industry. While this might seem an equitable trade, it should be considered that after a bad year the farmer still has his land and his herd from which to seek profit in the next, and even when these businesses collapse, he can rely on his land as insurance for subsistence food. When the industry collapses he loses his job, and realizes that the security he had was false – it was still dependent on the rise and fall of prices. It is just that the upside is denied him, and the downside is amortized over a longer length of time than when he employed his own labor time. When the downside comes he is fired, and is left with nothing to ensure his subsistence.

It would be impossible for families to afford to live in the "sustainable community" without becoming part of China's working class. As the Director of Benxi City Coordinating Council for the project, Xie Baoxing, told me, the directive of the project was to change the rural mode of life in order to lead to a new mode of production: "We must transform the countryside, we must transform the farming way of life. By turning to manufacturing their incomes will rise. Huangbaiyu sustainable development village is an experiment for the nation."[35] With rising incomes, the majority of China's population could finally be transformed from producers to consumers.

Justified by an ecological paradigm, the Master Plan for Huangbaiyu naturalizes the radical transformation of economic and social relationships. The tenets of the Master Plan that are framed as ecological are in fact geared toward the structuring of a particular form of industrial economy – naturalized as "the necessary minimum requirements for a living organism." The consolidation of settlements, conversion of "wasteland" into "productive" land, and an integrated waste and energy system all organize space and material substance in such a way as to force a transformation from household production to market production, from "isolation" to "community," from "countryside" to "civilization."

**Table 5.1** Available sources of household income in existing hamlets and under the Master Plan

| ***Hamlets*** | ***Master Plan*** |
|---|---|
| Smallholder agriculture/equity | Smallholder agriculture/wage labor |
| Trout | — |
| Goats | — |
| Silkworms | — |
| Vegetable gardens | — |
| Subsistence livestock (pigs/cattle) | — |
| Commercial grain | Commercial grain |
| Wage labor | Wage labor |
| Contract labor | Contract labor |
| Day labor | Day labor |

## Conclusion

Through the work of the designers' hands, disorder is ordered, irrationality is rationalized, waste is made productive, and the irregular is regularized. Through the Master Plan's introduction of successive methods of mediation – circulatory systems of waste and labor – hamlets in rural valleys are transformed into an industrial town. It is a utopia where the economic relationships of commodity production and distribution are perceived as the natural filaments with which to tie a community together, where science and technology allows for increasing control over both the individual body and the social body. McDonough's ecological modernist perspective enables him to believe that his intervention is not an intervention at all, but simply a restoration of "natural systems," and naturalizes market production and urban governance as the only non-pathological forms of human existence.

If, as McDonough believes, design is the first signal of intention, then the designs for Huangbaiyu are a disturbing sign that the dangers of modernism – its love affair with unabashed industrialization and urbanization, along with its authoritarian and de-contextualized practices – have returned to the forefront of design, shielded by an ecological cloak. If sustainable design is not to become a scheme – intentional or not – for the transfer of economic value from smallholder farmers into the hands of industry and the inconsiderate destruction of existing communities in the name of ecological preservation, we must begin to look beneath the surface of claims of ecological necessity and recognize that every master plan and development project is always at heart a plan of governance and resource (re-)distribution.

## Notes

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13 See Anne Underwood, "Designing the Future," *Newsweek*, May 16, 2005.
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22 WM + P with Rothenberg (2003), 42.
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24 Extrapolating from a 10 percent randomized household survey of Huangbaiyu residents conducted by the author in August to October 2006, 0 percent of households used coal; by specific inquiry into the issue in 2005, only four households used coal (irregularly), or 1 percent. The assumption of coal use is emblematic of the designers' lack of specific research on the practices of local residents, and reliance on national or regional data.
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Chapter 6

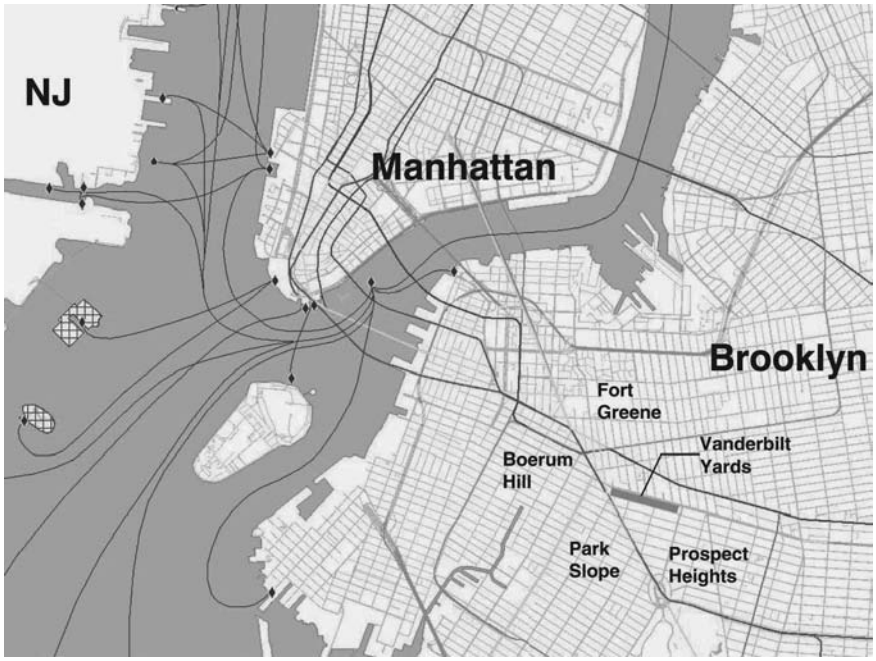
# Back to the Garden

## The Ecological Evolution of the Atlantic Yards

*Marshall Brown*

In the cultural epicenter of Brooklyn, New York there is an eight-acre swathe of fallow land. It lies twenty feet below the sidewalk, is filled with railroad tracks, and for many years it was invisible to the people who lived and worked nearby. This land is now commonly known as the Atlantic Yards – officially the MTA Vanderbilt Rail Yard – and is currently dedicated to the occasional storage and servicing of commuter trains from the Long Island Railroad. The Atlantic Yards brand was a gift from the New York City developer Bruce Ratner, head of Forest City Ratner Companies (FCR). In 2004 the Yards suddenly became the site of a bitter public battle between FCR and local residents. FCR had hired the architect Frank Gehry to design an 8.5-million-square-foot master plan containing sixteen skyscrapers and a basketball arena. The project was announced to great fanfare and with the support of many important politicians, including Mayor Michael Bloomberg, former Governor George Pataki, and the Brooklyn Borough President Marty Markowitz. The Atlantic Yards was a classic 1950s-style urban renewal scheme, but repackaged within the kind of architectural glamor that became standard in New York during the height of the recent real estate boom. The project boundaries included not only the rail yards, but three adjacent city blocks and their intervening streets. Upon the unveiling of the Ratner/Gehry scheme it was announced that any owners within the project boundary would be offered money for their property. Along with the offer came the threat that those who refused to sell would eventually be evicted by the state authorities through the use of eminent domain.[1]

The Yards serve the Atlantic Terminal, one of New York's largest transit hubs, and occupy the intersection of two of Brooklyn's busiest boulevards – Atlantic and Flatbush Avenues. Prospect Heights and Park Slope are neighborhoods to the south, and Fort Greene is the neighborhood to the north (Figure 6.1). Each of them has become increasingly affluent in the past two decades. Park Slope is known as the place where upper-middle-class New Yorkers retreat to start families. Fort Greene is home to the Brooklyn Academy of Music which attracts performers and visitors




**6.1**
The MTA Vanderbilt Yards location map

from around the world. Prospect Heights, the official neighborhood of the Yards, has had a less clear identity, since it forms a literal crossroads between the others. Thus the Yards lie in the center of Brooklyn's infrastructural and cultural core, so the typical challenges of doing smart development have come with particularly high stakes.

The Atlantic Yards is a unique environment with a complex history and a potentially promising future. Over time, this landscape has both flourished and languished at the hands of its human inhabitants. From pastoral beginnings, through the industrial era, and up until the present, the site has gone through drastic evolution in both use and occupation. Its future development represents a unique opportunity to advance the very meaning of development, at a time when so many people have become interested in the question of what environmentalism means for urbanism. It may be that we are in a period where the weight of concern in urban development may shift away from short-term monetary gains to broader concerns of how urban environments can be physically improved and culturally enriched over the long term; that is, sustainably.

However, in the battle over the Yards, the meaning of sustainability, which is often elusive, has taken several very concrete forms. First there are matters of pure survival, on both sides of the issue. The threat of property takings meant that many homeowners and renters would be forced to move. Many businesses would be forced to move as well, or even close down altogether. On the other side, the advocacy organizations BUILD (Brooklyn United for Innovative Local Development) and ACORN Housing (Association of Community Organizations for Reform Now) assumed the responsibility for representing the alleged interests of poor, working-class, and mostly black residents of the neighborhood. They argued that the FCR project was badly needed to provide jobs and affordable housing for

their constituencies, who suffer from gross unemployment and had not reaped the benefits of recent gentrification in Brooklyn. In addition, as the battle between these sides has been waged in the courts over six years, sustainability has also begun to mean the stamina of the competing parties. Opposition to the project became an official full-time job for Daniel Goldstein, the spokesman for Develop Don't Destroy Brooklyn (DDDB) and lead plaintiff in the eminent domain case. Goldstein has been the sole remaining occupant of his condominium building for five years, after the other owners sold their units to FCR under threat of eventual eviction. At the same time, FCR has seen sharp drops in its stock value due to the decline in the real estate market as legal delays have kept it from moving forward on the project. Furthermore, in 2009 the project suffered an enormous setback as Frank Gehry finally departed after reported cost overruns and several revisions. As is often the case in large-scale urban developments, the first version of any project is rarely built, and projects can take many years, if not decades, to reach even partial completion.

Thus the Atlantic Yards might teach us how sustainable urbanism can hold as much or more meaning for process as it does for building technologies or form. In order for projects to be implemented they must survive complex public negotiations and protests, along with shifts in political and economic cycles. Wary of these challenges, developers often simply build them into the cost of the project rather than rethinking the root causes. Rather than engaging a broad range of stakeholders directly, FCR handpicked its supporters and assembled its political alliances before the project was publicly announced. Facing such financial, political, and architectural force, many or most of those who might have opposed the project quickly fell silent or sold their property and moved away. Bruce Ratner, head of FCR, was known to be a politically well-connected and shrewd businessman, and therefore it was assumed, especially by him and his allies, that the project was a "done deal." However, there were a few that chose to fight Mr. Ratner, and they have fought much harder than anyone might have anticipated. On the political side, resistance was led by New York City Council Member 35th district Letitia James. A lifetime resident of Brooklyn, she had been elected to her first term in November, 2003. Being a rookie council member, the deal for the Atlantic Yards had already been sealed by the time James had taken office. It is not evident that FCR ever attempted to gain her support, but her generally populist political tendencies suggest that she may have fought the project regardless of any such efforts. Resident opposition first formed in DDDB. As mentioned earlier, Daniel Goldstein, along with fourteen others, has been the lead plaintiff in the eminent domain lawsuit against FCR. Although it began as a small opposition group, DDDB has become part of a large coalition formed around opposition to the project. As is the case in so many development projects, those who had been excluded from the private negotiations, residents and politicians alike, felt threatened and determined they had no choice but to fight. This kind of confrontation has become a standard part of the urban development process, but is it necessarily so?

In collaboration with Council member James,[2] I founded the Yards Development Workshop in February, 2004. Our goal was simple: to provide an alternative model of development that would turn the Yards into a place that could be environmentally, culturally, and economically productive over the long term. We did not seek to criticize the FCR proposal, but instead sought to shift the public conversation away from superficial concerns to a more substantive conversation

about the future of the Yards and what development there could mean for its surrounding neighborhoods. We also constructed the Workshop as an open-source network that could engage a broad constituency and allow the inclusion of a wide range of voices and intelligences. Unlike typical participatory planning processes that seek consensus through a design-by-committee approach, we have engaged a diverse field of constituents with divergent and often competing agendas through a series of public seminars that have yielded readymade ideas and information. From that knowledge base, we have sampled key concepts and issues for incorporation into any eventual design proposal. We did not set out (at first) to design an alternative plan, but rather to provide information and a method of communication to all those who had an interest in the site, even those in favor of the FCR proposal. In retrospect, we may have been attempting a more ecological urbanism. This would mean a design process that constructs more effective relationships between developers, design professionals, residents, and politicians, thus allowing them to collaborate more positively on the improvement of their urban environments. A more ecological urbanism would also exchange short-term gains for broad, long-term goals that aspire to a higher level of positive productivity than our current system of real estate-driven development.

At the time of writing, this particular war of attrition between major development and neighborhood activists was being waged to a stalemate. While the lawsuits have plodded through the courts, FCR has wasted no time demolishing buildings around the site and has even removed one of the streets bridging over the Yards ( Figure 6.2). At least one building of architectural significance, the Ward

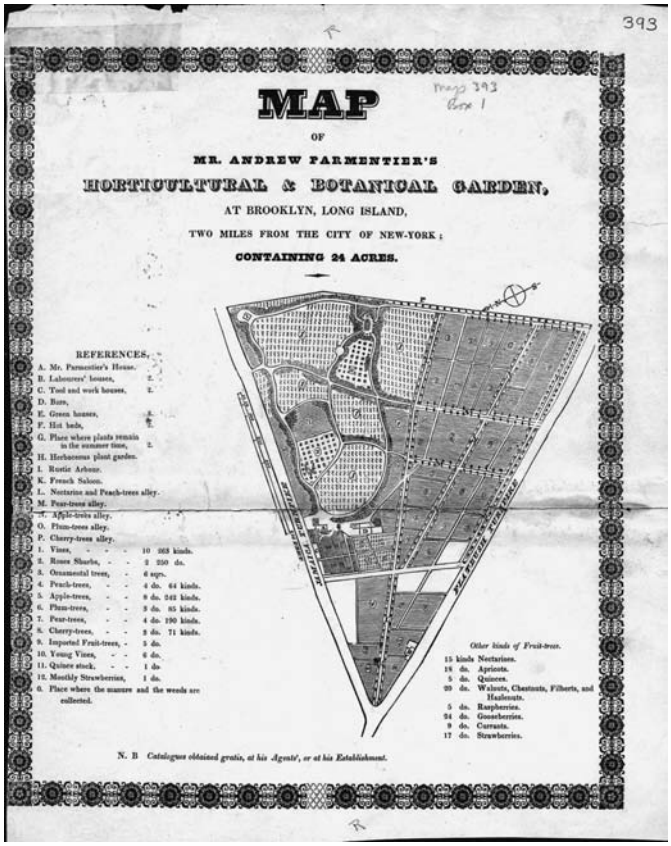

**6.2**
Developer's blight at the Yards – the closure of Carlton Avenue

Bakery Building, has fallen victim to the demolitions, and the Yards are now surrounded by fences, vacant lots, and the assorted detritus of stalled construction. The phenomenon commonly known as *developer's blight* has firmly set in at the Atlantic Yards. In plant ecosystems, blight refers to the browning and death of plant tissues resulting from contagious and infectious disease. In urban ecosystems, the definition of blight is less clear. Blight is a purportedly technical, but actually quite subjective designation that is applied to conditions of extreme deterioration in urban ecosystems. Despite its lack of clarity, blight is often a determining factor for whether entire neighborhoods live or die, particularly in cases where eminent domain takings are at stake. Blight is also a slur: a scarlet letter used to condemn neighborhoods suffering from the ills of disinvestment and neglect. Finally, blight is a weapon used by politicians and developers to disgrace neighborhoods to the point where they can be demolished, rebuilt, and then sold back, often at a higher price. In debates over blight, it is impossible to objectively define the difference between a historic district and a slum, or the difference between a ruin and that which is just ruined.

One of the tragic ironies of the battle over the Atlantic Yards is that FCR has sought the eminent domain takings based on designating the project area as blighted, but their demolitions within the area over the past six years have done more to create those conditions than anything else. Given the current state of the neighborhood, it is difficult to imagine that it was once an Eden of sorts, but from 1825 to 1830, the site did in fact form the northern edge of Andre Parmentier's Horticultural and Botanical Garden. Parmentier, often considered to be America's first landscape architect, emigrated to the United States in 1824. In Henry R. Stiles's *History of the City of Brooklyn*, this brief account is given:

> Stopping a while in New York City, he was finally induced by his passion for botanical pursuits, to devote himself to gardening on a scale heretofore almost unknown in this section. Refusing the superintendence of the once famous Botanical Garden of New York, which was urgently pressed upon him . . . he selected and purchased in Brooklyn, this tract of twenty-five acres, lying between the Jamaica and Flatbush roads, on the 4th of October, 1825, for the sum of $4000. Although beautifully and advantageously located, the surface of these grounds was a bed of rocks, some of which were used in enclosing the garden with a wall. In a brief time, Mr. Parmentier erected a dwelling and garden house, and stocked the land with a great variety of trees and plants, useful and ornamental, indigenous and exotic. The garden soon grew into importance and developed beauties, which attracted large numbers of visitors, from all quarters.
>
> In this garden the *Morus Multicaulis* [Chinese Mulberry] plant was first introduced into America by Mr. Parmentier, whose enthusiastic devotion to floral pursuits promised brilliantly for his own interests, as well as for the public benefit.[3]

The original map of Parmentier's garden (Figure 6.3) shows it firmly nestled between the old Jamaica and Flatbush Turnpikes. The Jamaica Turnpike eventually became Atlantic Avenue, while the Flatbush Turnpike ran east of the current




**6.3**
Map of Parmentier's Horticultural and Botanical Garden. Courtesy of Brooklyn Historical Society.

Flatbush Avenue. Twenty-four acres in area, the garden contained a diverse inventory of plants for sale, especially fruit trees ranging from apples and pears to gooseberries and currants. Besides the orchards and fields, Parmentier's garden also contained his home, workers' housing, green houses, a "rustic arbor," and "French saloon." The formality of the layout with long pedestrian alleys among the trees suggests that the garden was not only a landscape of production, but also a landscape for pleasure and enjoyment, a place that was at the same time economically, environmentally, and culturally productive.

Land grant records show that immediately following Parmentier's early death in 1830, the land was subdivided and sold off to various other owners.[4] Stiles described how Parmentier's garden came to its untimely end:

> But, to the great regret of all who knew him, and who sympathized with his hopes and aspirations, he was cut off by death, on the 27th of November, 1830, after a brief illness. His estimable widow, who is still living in this city, strove hard to continue his business, but failing in her endeavors, in consequence of the death of her only son, was finally obliged to dispose of the trees and plants, and the grounds, once occupied by their attractive garden, were cut up into building lots and streets.[5]

By 1869, the present-day block structure was formed and much of the land was subdivided into smaller plots, establishing the pattern of development that currently exists in Prospect Heights.[6] Another notable addition was the installation of a new rail line along Atlantic Avenue. The construction of the Atlantic Avenue line from the East River to Jamaica along Atlantic Avenue was begun in 1832 and the Long Island Railroad (LIRR) was incorporated. By the 1850s the trains had caused much distress within the surrounding neighborhoods, due to the incredible noise and pollution that early steam engines produced. As Henry Stiles wrote, "The use of steam . . . on Atlantic street, was considered a great drawback to the prosperity of that thoroughfare, and after years of agitation steam was finally got rid of, and the Long Island rail road driven from Brooklyn, and removed to its present terminus at Hunters Point."[7] In 1859 the Brooklyn Central Railroad Company was subsequently established to take control of the Brooklyn and Jamaica Railroad, and began a horse-drawn streetcar service along Atlantic Avenue shortly thereafter, while the old tunnel was closed. However, after a short while it was realized that Brooklyn had lost a great infrastructural resource with the removal of its steam service and that it had been effectively disconnected from the rest of Long Island. In 1877 lines were reintroduced along Flatbush Avenue and the steam service resumed, run by the LIRR. Significant changes came with the electrification of trains in the early 1900s. This was the moment when the MTA Vanderbilt Rail Yard was created. A tunnel was built from the Flatbush Terminal to East New York, and the Vanderbilt Yards were built as part of this massive infrastructural transformation, creating a large open tear in the urban fabric.[8] All steam traffic to the area was discontinued in 1905. To this day, Long Island Railroad commuter trains continue to arrive at what is now called the Atlantic Terminal, which lies directly across the road from the Yards. Looking back on this history, the birth and evolution of rail infrastructure have had tremendous impact upon the neighborhoods surrounding the Yards. It is also clear that the relationship has been extremely ambivalent over time. While the connection to rail has given the site value as a primary gateway to the rest of Long Island, the technological and spatial realities of such a massive infrastructure have also brought some problems along with it: air and noise pollution, physical danger, and not least of all, nearly 200 years of almost continuous construction along Atlantic Avenue.

The next significant chapter in the evolution of the Yards unfolded in the 1950s when it became the proposed site for a new Dodgers baseball stadium. It was first reported in the *New York Times* in August, 1955 and put forth by then Brooklyn Borough President John Cashmore, who was reported as saying, "the survey would be to study traffic congestion, slum clearance, relocation of the Long Island Rail Road's terminal and of the Fort Greene meat market."[9] The proposal for the new Dodgers stadium was in response to Dodgers' owner Walter O'Malley's desire for a new, more modern facility. Interestingly, O'Malley was a real estate developer by profession, similar to Bruce Ratner, the mastermind of the current Atlantic Yards Proposal.

Yet it was the infamous Robert Moses,[10] of all people, who was a leading critic of O'Malley's and Cashmore's plan to move the Dodgers to the Atlantic Terminal. O'Malley wanted the city to use its authority to seize the land necessary for the project, and Moses objected, asserting that eminent domain could not be used to support such a private enterprise. Nonetheless, a $100,000 study was

commissioned to research the feasibility of the project. After years of near misses and disappointments, the Brooklyn Dodgers had won the World Series in 1955, and it would be an understatement to say that the threat of their departure from Brooklyn was a major public controversy. The plan that was developed and presented in July, 1956 included not only the new baseball stadium, but also several other improvements for the surrounding area. The proposed location for the stadium, as outlined in the plan by the consulting engineers Clarke and Rapuano, was not the site of the LIRR terminal, as had been originally proposed. The stadium had instead been drawn in on the south side of Flatbush Avenue in Park Slope, while the Terminal site was then designated as a redevelopment area for housing and commercial buildings. The LIRR station was to be moved across Atlantic Avenue to the site of the Yards with a new subway concourse constructed at the intersections of Fourth Avenue and Flatbush with direct access to the new stadium. The *New York Times* reported that there was a "'difference of opinion' between Construction Coordinator Robert Moses and the consultant engineers as to where the sports stadium should be built."[11] The article continues:

> Mr. Moses, Mr. Cashmore said, favored the site of the existing Fort Greene Meat Market and the present terminal of the Long Island Rail Road at Hanson Place-Fort Greene Place-Atlantic Avenue-Flatbush Avenue . . . The Borough President said Mr. Moses was supported in his ideas by Walter O'Malley, president of the Dodgers, and by officials of the Long Island Rail Road. Mr. Cashmore said he favored the recommended site.[12]

Moses revealed his true ambivalence to the stadium plan later that year when, as Chairman of the Mayor's Committee on Slum Clearance, he was quoted as saying,

> Let us assume for the sake of argument . . . that the athletic center is not practical. Supposing the engineers say there is not enough revenue and you can't sell the bonds. I don't say they will. I don't know. Then we will put a Title I project there. The rest of the improvements can go through. We can use the land for a housing project – a taxpaying project.[13]

The "Title I" that Moses was referring to was Title I of the federal Housing Act of 1949 which he used as a tool for many of his most infamous projects to purchase "blighted" properties and resell them at reduced cost to developers. Two-thirds of the write-down on the properties would be covered by a subsidy from the federal government.

In retrospect, Moses was either announcing or ushering in the next evolutionary phase of the Yards – the era of urban renewal. Last-minute attempts were made by Mayor Wagner and even by Nelson Rockefeller, who offered to purchase the Atlantic Terminal site and build the stadium himself. But eventually the Dodgers deal collapsed and they moved to Los Angeles in 1958. In many ways, the Dodgers fiasco set the stage for the current battle over the Yards. Many of the same challenges have arisen again, especially the debate over whether professional sports facilities should qualify for public subsidy. In addition, the supposedly unhealed

psychic wound resulting from the Dodgers' departure has been used as one of the major alibis for building the new arena and bringing the Nets basketball team to Brooklyn.

After the Dodgers' departure, a decade passed with little productive action around the Yards until the Atlantic Terminal Urban Renewal Area (ATURA) was created in 1968. The *New York Times* provided a fairly grim description of the state of the neighborhood at that time:

> A family living in two-and-a-half small rooms in a crumbling brownstone that rivals the worst of Brownsville or Bedford-Stuyvesant for dilapidation . . . Rows of two-and-three-story buildings in the Fort Greene section, built during the Civil War and long since converted into meat processing plants. The pavement smells of rancid fat on a warm day and the meat cutting continues through the night . . . Three blocks of open railroad tracks alongside Atlantic Avenue and an abandoned railroad loading platform, where vagrants, addicts, and drunks sleep and prostitutes congregate even during the day.[14]

The renewal plan called for "2400 new low and middle income housing units . . . removal of the blighting Fort Greene Meat Market, a 14-acre site for the City University's new Baruch College, two new parks and community facilities such as day-care centers."[15] Some hard social and political lessons had already been learned from earlier urban renewal projects in New York, and the ATURA plan was intended to provide mechanisms for private citizens to have more input into the redevelopment process. Subsequently, the Fort Greene Non-Profit Improvement Corporation (FGNPIC) was named the sponsoring agent for the housing. The organization was largely composed of residents from the area who had organized and been given control of the development area by Mayor John V. Lindsay. The FGNPIC eventually succeeded in completing three twelve-story co-op apartment buildings along Atlantic Avenue which, though impressive, was just a portion of the number of units they had originally been charged with. The units were made affordable by using what would have been the typical developer's profit to make the down payments for the original residents, some of whom still live there today. In a sense, the FGNPIC has served as an inspiration, if not a model, for our current efforts with the Yards Workshop.

Overall, the ATURA development was slow in its realization, stalled primarily by the inability to find a new home for the Fort Greene meat market. The meat market was eventually demolished in 1976, according to a study by the Center for Urban Pedagogy on the history of ATURA.[16] The Baruch College component of the project, though it stayed in play until around 1977, eventually fell away owing to internal resistance and New York's extreme fiscal crisis during that period.

By 1985 new attention was being focused on Brooklyn as an alternative location for speculative development. That was the year when Rose Associates, a large local development firm, announced its intention to construct a major mixed-use development within the ATURA. At the time it was the largest such development to have ever been attempted in Brooklyn.[17] The rise in rents for office space in Manhattan was producing development pressure that suddenly made locations in Brooklyn seem more appealing than they had ever been before. Coincidentally,

Forest City Enterprises, the Cleveland-based development company of which Forest City Ratner is a part, had recently announced its intention to build a large office development in downtown Brooklyn called *Metrotech*. Unlike Metrotech, which was built and completed, the Rose Associates proposal ran into litigation from local residents who attacked the project on the basis that the environmental impact statement for the project was inadequate and had failed to properly estimate the figures for increased traffic in the Fort Greene neighborhood. Rose eventually backed away from the project and transferred the development rights to Forest City Ratner, thus marking the beginning of Ratner's involvement with the ATURA.

In December, 1993, FCR began construction on the Atlantic Center Mall, a two-story big box structure that was the first major commercial component to be completed within the ATURA. The mall was not built over the LIRR terminal, but rather directly east of it, on an L-shaped site with one edge along Fort Greene Place and another along Atlantic Avenue. The development has long been criticized for the way that it turned its back on the First Atlantic Terminal housing project, by closing off South Elliott Place at its southern end and not providing any entrances on the eastern face of the project, adjacent to the housing. Since its opening, the Atlantic Center has had a difficult time holding anchor tenants. A 2004 critique in the *New York Times* read,

> The Atlantic Center mall is not like other malls. Instead of open, multi-level atriums . . . there are vast expanses of nothingness and dead corridors leading, it seems, to nowhere. In place of furnished common areas . . . there are broad stretches of shiny institutional floor tile and walls left bare save a hodgepodge of clown-colored signs advertising stores that no longer exist.[18]

According to Ratner himself, "The isolation of stores and lack of gathering locations inside the building was intentional . . . driven by the needs of skittish national retailers and the notion that urban malls had failed because they became magnets for loitering teenagers who frightened the shoppers away."[19] Despite the questionable quality of that first project, Bruce Ratner got another chance to prove himself with the Atlantic Terminal, which was built directly over the LIRR terminal and completed in 2003. The development comprises a large indoor retail complex with an office tower above and the newly refurbished transit station below. The Atlantic Terminal development together with its slightly older sibling the Atlantic Center and the Metrotech office complex just up Flatbush Avenue solidified FCR's foothold as the prime large-scale developer in downtown Brooklyn.

But the last and single biggest piece in the ATURA puzzle was still the MTA Vanderbilt Rail Yard that stretches for half a mile and spreads across eight acres directly in front of the housing and retail complexes that it had taken so long to complete. In the two decades since FCR had begun its work in downtown Brooklyn, the economy and culture of the area had changed: The neighborhoods around the Yards, especially Fort Greene and Prospect Heights, had undergone a fairly radical transformation in nature and perception. Once considered dangerous and undesirable, they had become neighborhoods of choice for New Yorkers of all persuasions. As Manhattan became increasingly less affordable in the 1990s, greater numbers of young professionals, middle-class, and wealthy people began to move to the

neighborhoods surrounding the Yards. The demographics of the area were changing rapidly, along with the culture of the neighborhoods. Most importantly, Brooklyn was no longer being thought of simply as a subordinate borough to Manhattan. If taken as an independent city, Brooklyn would be the fourth largest in the United States, and this sleeping giant was finally developing its own culture, identity, and economy. Brooklyn was booming. So even though FCR had already developed a massive presence, its 2003 Atlantic Yards Proposal came as a sudden shock to many who had either taken the recent flowering for granted or gotten too used to the site of the empty rail yards lying directly at their feet. The truth was, in fact, that the forces of big development had been increasing pace for over a decade, and it was only a matter of time before the subject of the Yards came up again.

The last major Yards proposal for Baruch College had been dead for almost twenty years, and never had any particularly strong political or financial support. The FCR Atlantic Yards Proposal of 2003 was a different case, however, and to many it seemed as though it was a *fait accompli* from the start: a massive transformation to the local ecology, the results of which were impossible to anticipate. In their current state, the Yards already form a gulf between the neighborhoods of Prospect Heights, Fort Greene, and Park Slope which is difficult for pedestrians to cross. Street closures and superblocks in the Ratner/Gehry master plan seemed to exacerbate the problem by closing several streets and creating private open spaces through which the public may or may not have free access. In addition, there were significant questions of how increased automobile traffic from the basketball arena would affect the already congested Flatbush/Atlantic intersection. Asthma rates in the area were already above normal levels, and the project was seen as potentially adding to the poor air quality of the area without any improvements to the current mass transit infrastructure. Finally, there were concerns about the construction itself, which could continue for the next decade or more. So from the point of view of many in or near the project area, the Atlantic Yards development seemed to be a potential environmental disaster. Despite the apparent drawbacks of the project, Herbert Muschamp, the former *New York Times* architecture critic, was a cheerleader of the Ratner/Gehry proposal from the start. In an article titled "Courtside Seats to an Urban Garden," Muschamp wrote:

> A Garden of Eden grows in Brooklyn. This one will have its own basketball team. Also, an arena surrounded by office towers; apartment buildings and shops; excellent public transportation; and, above all, a terrific skyline, with six acres of new parkland at its feet. Almost everything the well-equipped urban paradise must have, in fact.[20]

Facing the political and media support that had already gathered in support of the FCR project, we formed the Yards Development Workshop in order to address the site from an alternative standpoint. Not knowing at the time all that we know now about the history and development of the site, we realized from the outset that the established discussion in the media was entirely superficial. FCR's emphasis had been on bringing Frank Gehry and basketball to Brooklyn, which made for spectacular iconography, but provided little understanding about the spatial or environmental implications of their proposal. Thus we designed the Workshop to fill the vacuum of real knowledge that had surrounded the project. At our first public

studio in March, 2004, we brought designers and local stakeholders together for debate and discussion, with the dual purpose of shifting and broadening the public discussion about the Yards (Figure 6.4). Our goal was to subvert the simplistic debates on professional sports or architectural aesthetics with a deeper discussion about the spatial, environmental, programmatic, social, and economic future of the site. We did not realize it at first, but we had begun a discussion about the ecological future of the Yards and its surrounding neighborhoods. The FCR slogan for their project had been "Housing, Jobs and Hoops." Our strategy was to elevate the conversation beyond these slogans. Instead of housing, we challenged people to think about homes, which meant considering how affordable ownership could be extended to more people over the longer term. Instead of jobs we shifted the conversation to careers, which meant that schools, education, and space for new local businesses had to become part of the project. And instead of hoops we looked at how recreation and physical health could become an integral part of the project in the form of public space networks and athletic facilities. In the past six years, these concepts have spread among a network of individuals and organizations who have dedicated themselves to supporting that future with *Principles for Responsible Community Development on the Vanderbilt Rail Yards*, a document that was built around concepts that arose from the Yards Development Workshop.[21]

**6.4**
Debate at the first Yards development workshop in Fort Greene, March 2004

In our current capitalist society, the "anti-development" position has been rendered politically ineffective. However, conventional approaches to urban development tend to be based on the idea of limitless growth, which we now know produces other kinds of problems. In the face of this contradiction, perhaps we must redefine development with a focus on quality rather than the constant emphasis on sheer quantity. A broader definition and understanding of development as more than real estate finance taking shape in bricks and mortar would bring it much closer to current and growing concerns over the health and quality of urban environments. By the time this chapter is published the future of the Yards will most likely not be any clearer. Even if the lawsuits have been resolved in Bruce Ratner's favor, the current economic crisis has severely limited the feasibility of his Atlantic Yards project. At most, the basketball arena is likely to be the only piece of the original proposal to survive. At the same time, even if the lawsuits are resolved in favor of the local residents, FCR has still managed to acquire a great deal of property around the Yards, so all of their fates will no doubt be intertwined for the foreseeable future. Collaboration between all sides has been the major obstacle until now. However, collaboration is undoubtedly the path toward overcoming the current stalemate and moving toward a new period of ecological development: something closer to Parmentier's Garden, where human interactions with the land could once again be an altogether culturally, economically, and environmentally productive enterprise.

## Acknowledgment

Special thanks from the author to Kim Soss at the IIT Graham Resource Center for indispensable assistance in researching this chapter.

## Notes

1 Eminent domain is the power of governments to take private property for public uses with just compensation.
2 Anna Dietzsch, architect, and Alexander Felson, landscape architect, eventually joined me as full collaborators on the project. Ronald Shiffman and Tom Angotti, planners, have served as advisors.
3 Henry R. Stiles, *A History of the City of Brooklyn II* (Brooklyn, NY: Subscription, 1867), 173.
4 The land grant records for New York City blocks 1118–1121 and 2001 correspond to the MTA Vanderbilt Rail Yards which are held in the research library at the Brooklyn Historical Society. The staff and collections of the library were indispensable in the researching of this chapter.
5 Stiles, (1867), 173.
6 Matthew Dripps, *Map of the City of Brooklyn* (New York: M. Dripps, 1869).
7 Henry R. Stiles, *A History of the City of Brooklyn III* (Brooklyn, NY: Subscription, 1867), 570.
8 Hugo Ullitz, *Atlas of the Borough of Brooklyn, City of New York* (Brooklyn, NY: E. Belcher Hyde, 1903–1911).
9 "Dodgers May Get Assist From City," *New York Times*, August 25, 1955.
10 See Robert Caro, *The Power Broker: Robert Moses and the Fall of New York* (New York: Vintage Books, 1974) for more on Moses' history.
11 Charles G. Bennett, "Big Dodger Stadium Outlined to Mayor," *New York Times*, July 25, 1956.
12 Ibid.
13 "Housing Favored If Sport Site Fails," *New York Times*, December 24, 1956.
14 "Renewal Raises Brooklyn Hopes," *New York Times*, June 24, 1968.
15 Ibid.
16 Rosten Woo, Eric Schuldenfrei, and Marisa Yiu, "ATURA Movie," Center for Urban Pedagogy. http://www.anothercupdevelopment.org/resources/atura.mov. Accessed February 26, 2010.
17 Alan S. Oser, "Brooklyn Launches Its Biggest Office-Building Effort," *New York Times*, January 27, 1985. http://www.nytimes.com/1985/01/27/realestate/brooklyn-launches-its-biggest-office-building-effort.html?scp=1&sq=oser+jan+27+1985&st=nyt. Accessed February 26, 2010.
18 Diane Cardwell, "Different by Design, Soon to Be Less So; Rethinking Atlantic Center With the Customer in Mind," *New York Times*, May 26, 2004. http://www.nytimes.com/2004/05/26/nyregion/different-design-soon-be-less-so-rethinking-atlantic-center-with-customer-mind.html?scp=3&sq=different%20by%20design&st=cse. Accessed February 26, 2010.
19 Ibid.
20 Herbert Muschamp, "Courtside Seats to an Urban Garden," *New York Times*, December 11, 2003. http://www.nytimes.com/2003/12/11/nyregion/courtside-seats-to-an-urban-garden.html?scp=1&sq=courtside%20seats%20to%20an%20urban%20garden&st=cse. Accessed February 26, 2010.
21 *Principles for Responsible Community Development on the Vanderbilt Rail Yards* may be found at http://dddb.net/documents/communityplans/principles.pdf.

Chapter 7

# Building Recombinant Ecologies

## Triangulating Policy, Models, and Design in Urban Infrastructure

*Stephen Luoni*

> The temperature and rainfall are no longer to be entirely the work of some separate, uncivilizable force, but instead in part a product of our habits, our economies, our ways of life . . . The world outdoors will mean much the same thing as the world indoors, the hill the same thing as the house.
>
> (Bill McKibben, *The End of Nature*)[1]

The greatest ongoing challenge to the planning and the design disciplines is design within human-dominated ecosystems. Since our environment is no longer "naturally" determined – that is, independent of human technology – the design of cities will have to address ecosystem interface and management. In order to achieve both a lower energy future, and to sustain life-supporting biogeochemical processes produced by natural systems, design will be tasked with the delivery of ecological services beyond the conventional programs that generally motivate project development. This entails an expansion in current design thinking, conventionally focused on the production of discrete projects rather than the integral design of community processes and places. The specialization of work in urban design, landscape architecture, architecture, civil engineering, and environmental planning has institutionalized a mutual exclusivity between cities and natural systems, though this outlook is waning. A new consciousness, galvanized by the end of nature as a separate category, compels design vocabularies dedicated to *context production* – the formation of topological structures or design patterns that define a project through its network of relations. Recombinant design patterns provide new programming approaches to core environmental problems in context-production, collectively yielding an *ecology of the city*.

Before further examination of recombinant thinking in design proposals by the University of Arkansas Community Design Center (UACDC), a turn to ecology as a conceptual framework is useful for exploring these new planning synergies. In

recollecting the modern origins of ecology, philosopher Frederic Migayrou challenges our reductive understanding of ecology as simply landscape or ecosystem. He reminds us that ecology is essentially a science of habitation based on ever-increasing exchange and connectivity. Ecology, conceived by nineteenth-century scientific materialists to describe the relationship between organisms and their environment, derives from the Greek *oikos*, or house. "*Oikos* defines the notion of the habitat as a constitutive interrelationship, a directly contextual value . . . and is concerned with the form and occupation of places."[2] Habitat, as a constructive process commonly undertaken by living matter through overlapping webs of relations and resources, does not distinguish between nature and the city. Interestingly enough, ecology and economy, the latter meaning household management, share the same root in *oikos* and its implications for a continuous system of exchange. Indeed, Migayrou argues:

> Ecology as a science is based on the negation of all things natural. It makes nature into a constituent element of an interrelationship with urban production. This marks the end of nature as an indeterminate field on its own. Now it has to be translated in terms of resources and their exploitation, and ecology – the infinite expansion of the *oikos* – confines it within finite borders.[3]

Habitat possesses an inclination toward infinite expansion. For Migayrou this defines the structural "principle of mutability" driving *oikos* and the production of context. Nature and urbanism are submitted to the same endless system of exchanges in a "continuous environment with no hope of exteriority."[4] The planetary urbanization of the environment through socio-environmental transactions that produce cities, climate change, genetic modification, resource extraction, agriculture, continental-scaled hydrological engineering, etc., defies the ideology of self-sufficient form in the discrete design project. Conversely, environmentalists, a group traditionally hostile to the city, must now account for the production of human habitat in their modeling, and engage design epistemology in the true ecological work required to address the challenges of a human-dominated biosphere. Despite its Malthusian current within an agrarian and primitivist ideology, ecology offers more than an analytic and landscape preservation framework. Its topological tools manifest a robust yet underused vocabulary for shaping sustainable possibilities in a habitat already configured through a continuum of nature and city. Adaptive management, emergence, feedback, recombination, and diversification, all of which drive a habitat's principle of mutability, expand design's disciplinary capacity to engage ecology's transactional economy. Pushed to a higher order of practice, design then is submitted to the following test. As nature's technologies create "conditions conducive to life . . . where every action – breathing and breeding, feeding and dying – helps to build soil, clean water, filter air, and cycle nutrients,"[5] we ask through the words of *Biomimicry* author Janine Benyus: "Does this action create conditions conducive to life?"[6]

## Building Recombinant Ecologies

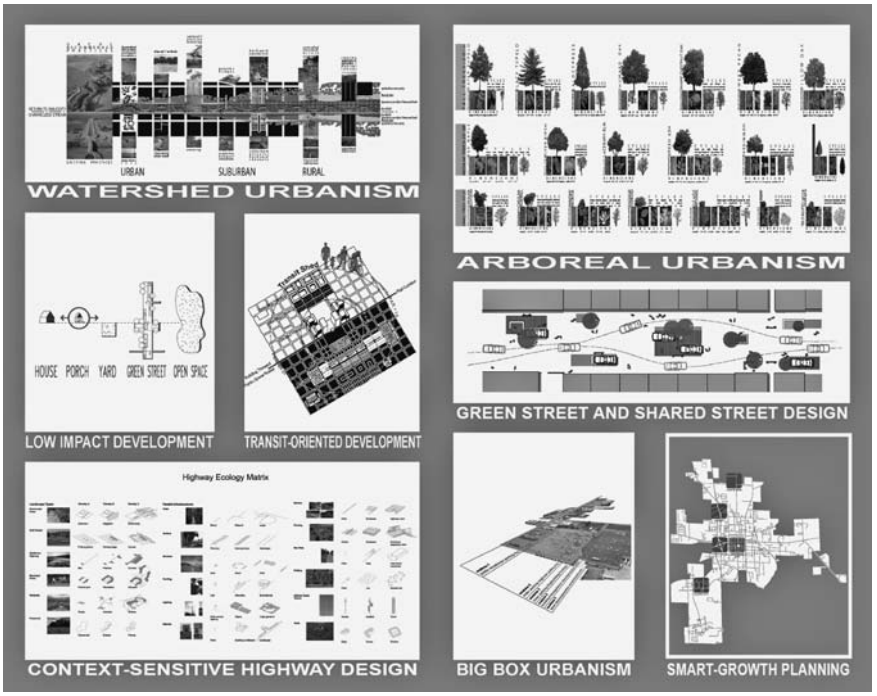
The accelerated urbanization of the planet entails novel management challenges prompting evolutionary design solutions. Recombinant design integrates metrics from ecology, engineering, architecture, urban design, and social policy into design patterns not possible in their respective parent disciplines. Much like recombination in the biological sciences where the concept originated, genetic material, either through evolution or engineering, is transplanted from one species to another, creating new cross-over structures with performative qualities absent in the originating organisms. Likewise, design's disciplinary capacity is thickened by the absorption of another's tools (metadisciplinary), enabling co-evolutionary planning approaches solicitous of feedback with the social and environmental energies of a local context.

Recombinant processes expand upon design culture's traditional tools in the diagram, master plan, or *parti*, which consolidate design thinking toward a fixed product shape, composition, or type, based primarily on geometric principles. Solving for fixed properties in discrete products is insufficient for engaging the properties of network intelligence motivating design patterns in context production. Instead, author Keller Easterling, looking outside of celebrated design pedigrees, finds instructive development logics in the "organizational expressions of spatial arrangements" exemplified in infrastructure, airports, offices, and other service economy complexes. Such spatial arrangements are "calibrated according to protocols for timing and interactivity, privileging not the formal, morphological attributes of building, but rather a repertoire of operatives affected by time, patterns of connectivity, and changing protocols of multiple components . . . with powerful spatial consequences."[7] Recombinant design embraces this economy in organizational expression to reconcile the preservation of nature's ecosystem services with infrastructural challenges involving energy use, clean water, waste management, and the movement of material and people. But unlike Easterling's "non-place" examples and their functionalist ideology, recombinant thinking engages anthropological discussions of equity, identity, scale, and livability.

UACDC is developing a repertoire of place-building design patterns in watershed urbanism, transit-oriented development, green street and shared street design, big box urbanism, low impact development, arboreal urbanism, context sensitive highway design, and smart growth planning (an urban agriculture model, important for compressing urban food supply chains while improving access to nutrition has yet to be developed). Through algorithmic logics and what architect Christopher Alexander calls "relational complexes," these recombinant models negotiate conflicting forces in recursive environmental problems. Recombinant design investigates the modularity of the environment, emphasizing infrastructural components' interface with one another. Concerned with protocols of sequencing and interactivity among multiple systems, these recombinant models triangulate policy, administration, and design through various development tools involving ecotone, matrix, transect, map, and table to sort and sequence environmental resources. Regardless of project circumstances, these topological structures constitute general palettes and organizations for retrofitting settlement patterns to deliver both urban and ecological services.

UACDC's mission is to advance creative development in Arkansas through education, research, and design solutions that enhance the physical environment.

**7.1**
UACDC place-building design models. Image property of UACDC.




As an outreach center of the Fay Jones School of Architecture, UACDC is developing a repertoire of recombinant design methodologies applicable to community development issues in Arkansas with currency beyond the state. UACDC design solutions introduce a triple bottom line, integrating social and environmental measures with economic development. UACDC works multilaterally with clients, collaborators, and government agencies to build learning networks that facilitate creative development, triangulating development in policy, best management practices, and design. Recombinant development embeds ecological metrics into otherwise obdurate or stubbornly entrenched planning conventions governing land-use policy and infrastructure.

Four out of the eight recombinant design patterns described below focus on organizational approaches to community problem types. They are related to UACDC's proposals for a low impact development in an affordable housing neighborhood, a shared street network within a residential development, a watershed regeneration project for a university campus, and the center's advocacy for a regional light rail system. Even though all directly address livability concerns, not all necessarily reduce energy usage, but, as author David Owens states in his case for the necessity of the city as the only choice for living sustainably:

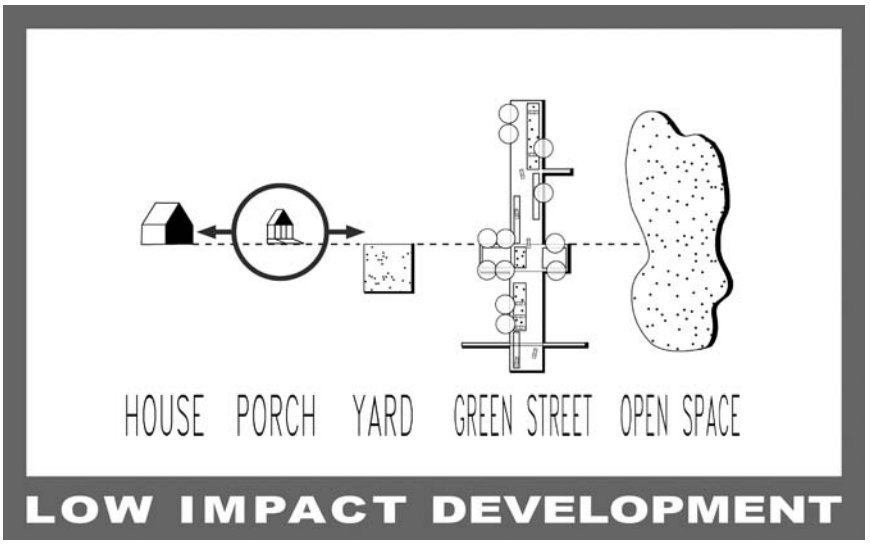
> in a dense city the truly important environmental issues are less likely to be things like the carbon footprints of apartment buildings than they are to be the old-fashioned quality-of-life concerns like education, culture, crime, street noise, bad smells, resources for the elderly, and the availability of recreational facilities – all of which affect the willingness of people to live in efficient urban cores.[8]

More than a matter of product eco-efficiency that simply calculates BTUs consumed, these models pose steps toward a development ecology in which cities become productive metabolic tools, answering Benyus' challenge to "create conditions conducive to life."

## Low Impact Development: Parks, Not Pipes

The first hour of urban stormwater runoff generally has a pollution index greater than that of raw sewage.[9] The U.S. Environmental Protection Agency (EPA) estimates that more than 10 trillion gallons of untreated stormwater enters our surface waters each year, mostly from nonpoint (diffuse) sources due to urban and agricultural development. Nonpoint sources were principal pollution contributors to 76 percent of lakes and 65 percent of streams classified as environmentally impaired.[10] Pollutant loads in urban hydrology contain hydrocarbons from gasoline, motor oil, and heavy metals, as well as fertilizers and pesticides from lawns, which are consolidated and channeled by stormwater runoff from impervious surfaces, eventually ending up in our streams. Sadly, the EPA's Index of Watershed Indicators shows that only 16 percent of the nation's watersheds exhibit good water quality.[11] However, like all organic systems, watersheds possess a resilient capacity for self-correction once volatile agents are neutralized.

Low Impact Development (LID) metabolizes nonpoint source pollution from urban stormwater runoff, remediating its deleterious impacts on soil quality and general watershed health. LID is an ecological stormwater management approach modeled after nature: manage rainfall locally through a vegetated treatment network that keeps water on the site. The goal of LID is to sustain a site's predevelopment hydrologic regime by using techniques that infiltrate, filter, store, and evaporate stormwater runoff close to its source. Opposite the conventional pipe-and-pond conveyance infrastructure that channels runoff through pipes, catchment

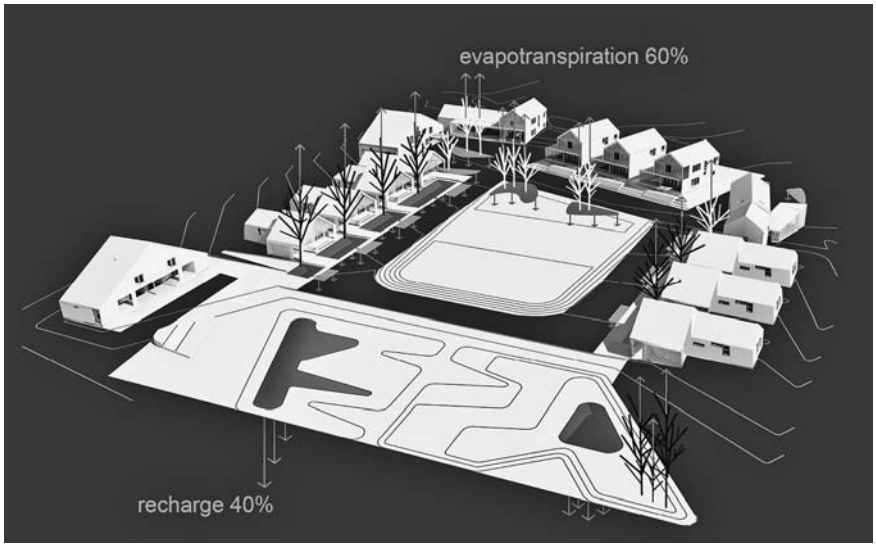



**7.2**
"Low Impact Development" place-building design model. Image property of UACDC.

basins, and curbs and gutters to a single point, LID remediates polluted runoff through distributed treatment landscapes. These treatment landscapes function through a contiguous network of sediment filters, tree box filters, rainwater gardens, bioswales, infiltration basins, and wet meadows to enhance water quality. LID treatment networks are designed to function within the biological *carrying capacity* of the site's landscape to treat and redistribute stormwater runoff through infiltration or evapotranspiration. Conventional civil engineering's plumbing offers no ecological services beyond detention and storage, essentially transferring water pollution elsewhere. Indeed, most of the developed world's answer to waste and pollution has been to move it around. LID manages water quality through feedback and self-organizing processes in designed landscapes, presenting a place-bound technology embedded in local climate, soil, plant, and animal communities.

Habitat Trails is a seventeen-unit affordable neighborhood on a five-acre site in Rogers, the first LID project in Arkansas. Project planning began with an integrated Green Neighborhood Transect to overcome the specialization of work that organizes market-oriented development. Subdivision is an apt term for the role that fragmented market interests play in bureaucratizing development patterns, from financiers and investors to developers, designers and engineers, residents and property owners' associations, insurers, and municipal government entitlement (permitting) processes. Each interest in the real estate commodity chain is rewarded for minimizing its time, liability, and investment, leaving little possibility for implementing sustainable and holistic development patterns. However, a full-service non-profit housing provider like our client, Habitat for Humanity, administrates, finances, builds, and co-manages the neighborhood with property owners. Since housing services can be integrated throughout the project's life cycle, the five primary components of residential context production – house, porch, yard, street, and open space – are configured as a contiguous landscape to ecologically manage stormwater runoff. LID represents a triple bottom line solution not yet likely in mainstream business models.

The project's horizontal infrastructure was built without pipes, catchment basins, and curbs and gutters, cutting street costs from $400 to $250 per linear foot. An entire family of LID facilities – typically deployed as autonomous BMPs (best management practices) on individual lots – is networked to optimize ecological services through redundant, diverse, and distributed configurations. Collaborating with the fire and public works departments, the requirement for a thirty-foot paved street width was reduced to an eighteen-foot asphalt throughway with nine-foot pervious parking surfaces of alternating crushed brick and grass paver bands, and an additional two-foot grass paver band to enable emergency vehicle access. The street right-of-way is designed to function like a sponge, slowing, spreading, and soaking water in a treatment process that cycles runoff through grade and subgrade infiltration trenches for removing sediment. Adjacent tree-lined bioswale corridors in front yards treat runoff through microbial activity in the root zone of wetland plant communities, replacing the energy-intensive industrialized turf lawn. Connected side yard bioswales convey roof runoff, while a neighborhood wet meadow with indigenous wildflowers and grasses provides aquifer recharge and 100-year storm event retention. Autocourts and driveways of crushed brick infiltrate stormwater runoff while minimizing impervious surfaces. The latter was a significant project goal, since indicators show "that when impervious area in a




**7.3**
Habitat Trails hydrological solution. Image property of UACDC.

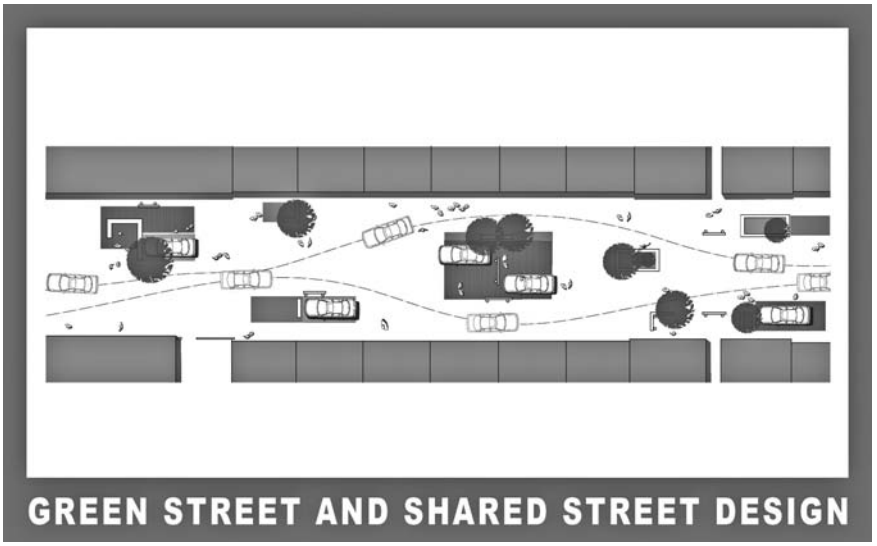
watershed reaches 10 percent, stream ecosystems begin to show evidence of degradation, and coverage more than 30 percent is associated with severe, practically irreversible degradation."[12] Far from being a decorative medium, landscape constitutes a soft infrastructure through which important habitat services pass.

Since the building industry has essentially optimized cost discipline in housing unit construction, the next frontier of affordability lies in the infrastructure. Unfortunately, LID, as a non-conforming water management system, is illegal in most places. While Habitat Trails had to secure nearly thirty zoning variances for implementation, the project now demonstrates a superior track record in mitigating urban runoff compared to surrounding development. Demonstration is the first step in changing established code and financing obstacles. Notwithstanding the reasonable critique against concentrating a single market grade of housing, higher amenity neighborhood landscapes, which are safer and greener, should allow low-income property owners to sustain equity appreciation in their investments, which is usually not the case in this market class. Perhaps, the social entrepreneurialism of the non-profit world will mainstream LID templates for all housing market grades.

## Green Street and Shared Street Design: Botanizing the Street

"In traffic, we struggle to stay human."[13] Although streets constitute a majority of the total public space in urbanized areas and 25 percent of their surface areas, they are now designed and managed as isolated technical matters, impairing social life. Since the early twentieth-century professionalization of the American traffic engineer (many of whom shared a background in railroading), traffic movement has become the sole objective of street design. Before their centralized administration by governments and engineers, streets were locally built, designed, and maintained by abutters who valued the myriad social exchanges in play, meeting,

**7.4**
"Green Street and Shared Street Design" place-building design model. Image property of UACDC.




commerce, assembly, and relaxation enacted in vital public spaces.[14] With the displacement of an abutter ecology by a new commuter culture, street design became universally bound to "levels of service" based solely on maximizing vehicular throughput per lane per hour. But the negative externalities from automobile-dominated streets have been huge. Just in terms of safety, the U.S. experienced over 37,000 traffic fatalities and close to 2.5 million injuries last year alone, according to the National Highway Traffic Safety Administration. In this erasure of the social world by a traffic world, *Traffic* author Tom Vanderbilt chronicles this "struggle to stay human." Last year in the U.S. more than 4,300 pedestrians were killed (76,000 in the past fifteen years), most, as Vanderbilt emphasizes, "while legally crossing in the crosswalks."[15] Currently an unrecognized health problem, "by 2020 the World Health Organization predicts, road fatalities will be the world's third-leading cause of death."[16]

Green streets, shared streets, and context sensitive highway design are place-building models for recovering the street's non-traffic functions to enhance livability within neighborhood settings. Shared streets are the most radical in their recombination of multiple functions, producing new frameworks for social life that resemble gardens more than traffic corridors. Also known as home zones in England, and living streets throughout Europe and Japan, the shared street or Dutch *woonerf* (meaning "residential yard") was pioneered in the Netherlands more than thirty years ago by Hans Monderman. Shared streets encompass the entire right-of-way from building front to building front. Streets are designed as urban rooms that extend the living and commercial activities of abutting buildings, calming traffic through the presence or even the potential of social activity without the use of traffic control devices and signals. The latter simply assigns driver priority but does not communicate risk or impart safety. In the shared street, legal priority is shifted to the pedestrian, compelling cyclists and motorists alike to behave as pedestrians. Shared space is designed for a maximum speed of 17mph, the threshold at which motorists and pedestrians lose communicative eye contact. Absent abutters'

territorial claim to the street, motorists will rationally optimize the speed for which a street is designed regardless of posted limits and engineering devices intended to control behavior. This supports Monderman's contention that: "If you want motorists to behave as if they are in a village, then build a village."[17] Shared streets then are shaped to elicit the type of social behavior desired from motorists.

Shared space principles defy almost every accepted tenet in traffic engineering, the latter privileging a smooth and frictionless corridor. In questioning what causes motorists to slow down, traffic-calming authority David Engwicht points to three factors abhorred by traffic engineers: intrigue, uncertainty, and humor.[18] "Uncertainty, like intrigue, keeps us engaged with our immediate surroundings."[19] As more permissive transportation environments, shared space eliminates barriers that separate traffic modes – raised curbs and sidewalks, traffic signals, material demarcations, and wide, straight, driving lanes – to create one continuous landscaped living surface akin to a plaza. Contrast this design criterion with the lexicon populating the ironically named "Green Book," *A Policy on Geometric Design of Highways and Streets,* the bible of highway and street design produced by the American Association of State Highway and Transportation Officials. Here, trees are referred to as FHOs – fixed and hazardous objects – while sidewalks are termed "auto recovery zones," not good news for pedestrians. Indeed, pedestrians as annoyances in traffic modeling are referred to as "impedances" and "interferences."[20] Nonetheless, a safety paradox exists, since shared streets have a superior record of safety compared to conventional streets offering similar levels of service.[21] As it turns out, the universal application of highway standards and mode separation to local streets led to greater speed and inattentiveness, absolving drivers from behaving socially. Thus smarter street design signatures that substitute social self-organization for command-and-control authority are needed to reclaim the range of life-conducive services once imparted in these important public spaces.

Porchscapes is a forty-three-unit LID affordable neighborhood development in Fayetteville, Arkansas that employs shared street geometries as multi-purpose

**7.5**
Aerial view of Porchscapes neighborhood. Image property of UACDC.

**7.6**
Aerial view of South Shared Street Plaza. Image property of UACDC.

landscapes to organize a small-lot development. Shared streets incorporate stormwater treatment gardens while providing a neighborhood open space system with amenities otherwise developed in private yards. Designed as shaded garden rooms to extend the modest living space of dwelling units, shared street plazas contain playgrounds, pocket parks, lounging lawns, and rainwater gardens. Plazas are ringed on three sides by large, screened porch rooms built to the street edge, which place "eyes on the street" and instill a sense of security. Picking up on this well-understood relation between design and safety, Engwicht observes that: "Traffic in residential streets is governed to a large extent, by the degree to which residents have psychologically retreated from their street."[22] Two-way traffic is split and recoupled along skinny traffic throughways around pedestrian assembly spaces, enhancing the intimacy of plazas. Traffic calming is supported by throughway geometries with slight jogs and meanders in the automobile's passage, even along the neighborhood's 1,400-foot-long main street. Street geometries and their optical compression of road widths force traffic transactions to be socially negotiated rather than ceded as by-right entitlements to motorists.

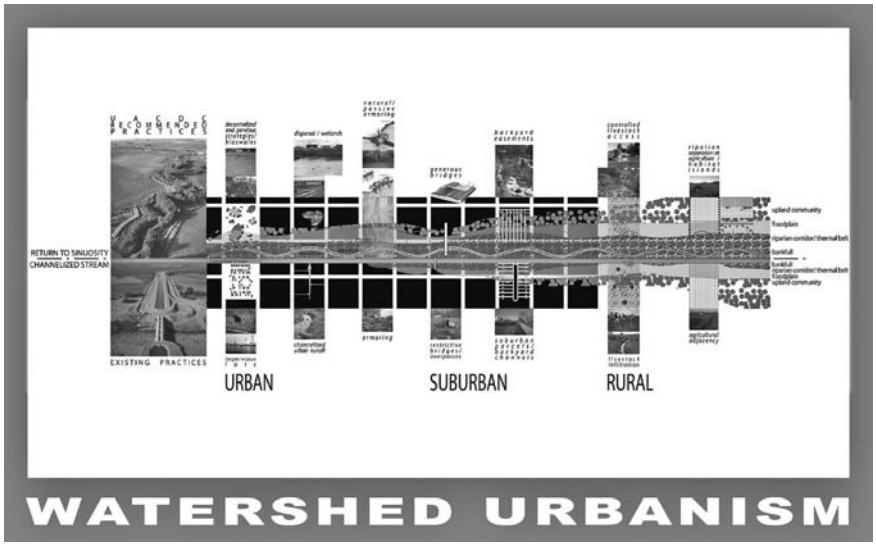
The groundwork of this shared space network forms a mosaic of pervious, patterned, and sculpted surfaces dedicated to creating a sense of place. Surfaces of crushed brick, stamped and colored asphalt, concrete grass pavers, rubber sidewalks and play surfaces, wetland plants, colorful bar-coded crosswalks, and manicured turf patches are programmed to serve varying needs. The street as a graphic medium signals to the motorist an ecology of uses, while inviting pedestrian spontaneity and sociability. Part of a LID network, the street is an ecological asset, conveying, infiltrating, and treating stormwater runoff through a diverse xeriscape that enlivens the street with color, texture, and floristic structure. Shared streets are safer, greener, cooler (reducing heat island effect), and sponsor greater flexibility in accommodating multiple parking solutions than conventional streets. Most importantly, the shared street does not eliminate the car or isolate traffic as a mobility solution, but rather offers a recombinant approach for bundling multiple services while creating novel living environments.

## Watershed Urbanism: Rewilding Riparian Fabrics to Shape the City

While water is the medium through which most life-supporting activities occur, planners never knew what to do with it since its fluvial dynamic hinders development potential. When urban streams and their wetlands were not drained, diverted,

or piped underground, they were channelized as conveyance for waste removal and freight transport. Riparian (stream) systems were managed for their logistical worth absent any ecological value, resulting in chronic environmental impairment or "urban stream syndrome." The consequences of this development-centric legacy still linger as 50 percent of the nation's rivers and streams, 66 percent of its lakes, reservoirs, and ponds, 64 percent of its bays and estuaries, and 82 percent of its ocean and near coastal waters are classified as environmentally impaired by the EPA, meaning that they do not meet water quality standards supportive of drinking, swimming, or fishing.[23] But beyond the single matter of water quality, we have come to understand through a growing ecological consciousness that a healthy riparian system delivers seventeen comprehensive ecological services whose value can no longer remain outside human systems of development. Impaired water bodies fail to deliver the following comprehensive life-supporting services outlined by ecological economist Robert Costanza: gas regulation (carbon sequestration), climate regulation, disturbance regulation, water regulation (flood control), water supply, erosion control, soil formation, nutrient cycling, waste treatment, pollination, biological control, refugia (habitat), food production, raw material, genetic resources, recreation, and cultural value.[24] Ecological functioning in riparian habitat is directly tied to a normative geomorphological structure governing stream and sediment flows, and nutrient exchange – or stream metabolism.

Based on ecological science, Watershed Urbanism proposes a "rewilding" of riparian corridors to restore lost ecological functioning while forming well-amenitized urban networks of linear parks, neighborhood open spaces, and pedestrian facilities. Alongside street and block fabrics, healthy riparian fabrics can play a constitutive role in structuring productive biological exchange and energy flow within the city. The important components of a riparian system, whether it is a first order headwater stream or an eleventh order stream like the Mississippi River, include a floodplain, riparian banks, and the stream channel. Floodplains, like all wetland ecologies, are the most productive in biomass production, efficient nutrient



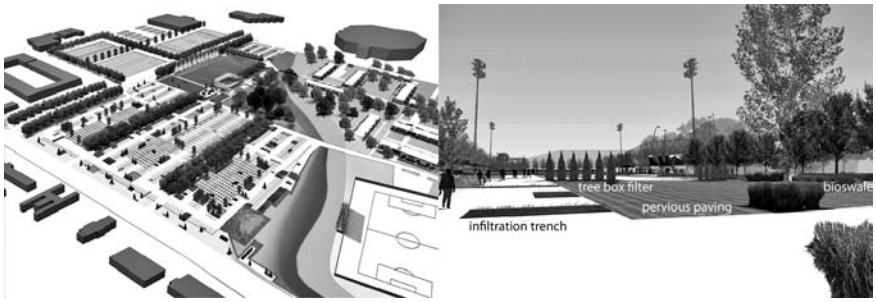

**7.7**
"Watershed Urbanism" place-building design model. Image property of UACDC.

cycling, and energy flow behind rainforests.[25] Yet floodplains are typically the first riparian component sacrificed in urban development since their area can be extensive. As a rule of thumb, floodplains are ten to thirty times the stream channel width, so a mile-wide stream like the Mississippi River may have a floodplain of up to thirty miles in width. Floodplain reclamation restores valuable ecological services related to flood storage (lessening property damage), disturbance regulation, and increased habitat of 100 to 1,000 times as many species as the stream. Quick-growing wetland plant communities, tolerant of periodic inundations, generate deep root structures and attract anaerobic microbial activity ideal for phytoremediating polluted urban water. Besides providing extensive urban water treatment basins (contrary to conventional understanding, wetlands are one of the cleanest water sources), floodplains are nutrient-rich food banks and excellent genetic reservoirs. Floodplains with their pulsing hydroperiods continually process new layers of decomposed matter through productive micro-organism communities, creating fecund soils ideal for urban agriculture.

Riparian banks are important ecotones regulating sediment inputs from upland plant communities into the stream. In urban areas they are often denuded of vegetation, if not altogether armored with hard surfaces, making unavailable valuable carbon sequestration services. Yet riparian banks require facultative vegetation to control sedimentation, provide shade, and regulate shallow water temperatures necessary for important land-water enzymatic exchange and aquatic life affected by wide temperature variations. Reflecting water's natural helical flow, healthy stream channels generally create sinuous corridors of alternating erosional and depositional zones, which moderate water and sediment flows. Likewise, normative stream hydraulics repeats a riffle-pool-glide algorithm in its longitudinal section, which oxygenates the system. Urban stream syndrome expresses degradation due to breakdowns in these relationships, ultimately overwhelming the system's carrying capacity. Channelized streams based on conventional civil engineering fail to recognize the intelligence in ecosystem self-organization and unwittingly remove ecological functioning and its inherent capacity for self-correction.

Campus Hydroscapes is a 2,000-foot riparian corridor improvement proposal for College Branch stream on the University of Arkansas campus. Due to unmanaged growth, College Branch exhibits the classic impairments of urban stream syndrome – flashflooding, eroded stream banks, elevated nutrient and contaminant levels, excessive sedimentation, high temperatures, and loss of aquatic wildlife. Peak runoff loading from new roads, buildings, parking lots, and athletic facilities far exceeds the stream's carrying capacity, and threatens the integrity of highway and campus infrastructure. The plan proposes holistic stream remediation as an armature for collateral campus transportation, housing, and recreation solutions. Existing parking for more than 1,400 cars is maintained and accompanied by new intermodal campus transportation facilities, and a visitor/ecological interpretive center. A proposed boulevard with "green" parking lots, floodplain parks, and recreational components double as wayfinding elements in this new campus gateway. The approach employs ecological principles governing healthy riparian systems rather than hard engineering solutions, which exacerbate both urban and ecosystem dysfunction.

Three watershed planning options, offering progressive levels of ecological services, serve as a planning platform to accommodate varying budgets and




**7.8**
Views of Hydrological Pixelation Solution Scheme. Image property of UACDC.

institutional will. One solution may be implemented incrementally, or all three may be successively phased toward a climax solution. Each approach restores floodplain retention along the stream while adding individual stormwater management facilities. The Hydrology Pixelation approach, involving incremental investments, distributes stormwater facilities across the site, minimizing alterations to existing land uses. The automobile parking landscape functions as a treatment sieve, recharging groundwater through localized rainwater gardens. A new floodplain with flow attenuation mounds provides collateral recreation and ecological programs in the expanded stream corridor.

The Riparian Bands approach stratifies land uses, minimizing hard-surface parking within new pervious surface landscapes. This is the most efficient treatment configuration as automobiles sit within rainwater catchment gardens. This green parking lot is designed for a fifty-year flood, and supports expanded treatment functions, ensuring high-quality water discharge. A new floodplain park offers an expanded treatment buffer while sponsoring associated educational, recreational, and ecological functions.

The Total Marsh planning approach maximizes stormwater treatment services through a constructed wetland in place of surface parking while separating floodwater retention. Facilities for parking, a visitor center, and classrooms are removed from the expanded riparian corridor and stacked along the new boulevard, hovering over the marsh. The urban marsh also serves as a unique campus gateway feature, a fitting wayfinding element for the flagship university of the "Natural State."

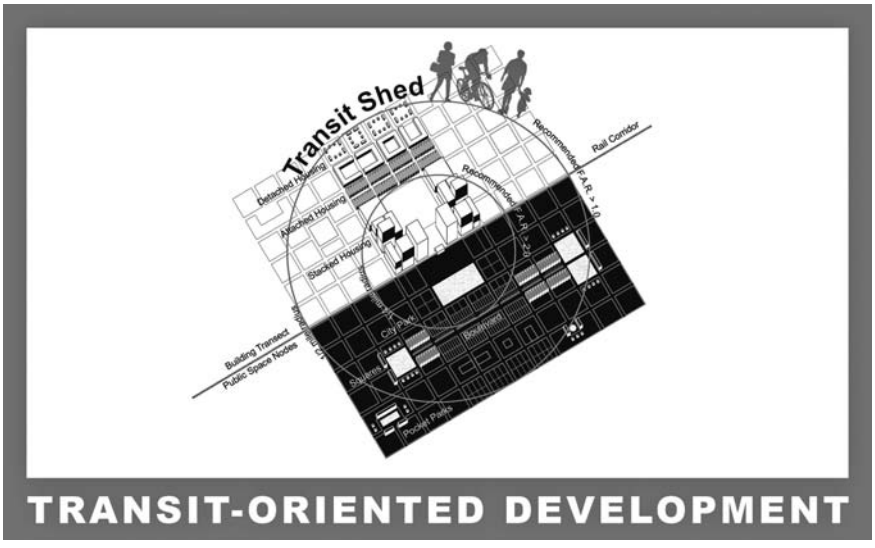
## Transit-oriented Development: Socially Optimizing the Transportation Network

Man now rivals nature in the movement of material, including geological, marine, and glacial forces.[26] Transportation of goods and people has radicalized our ecological footprint, exerting unprecedented stresses on the earth's ecosystems. Transportation and its consequent land-use patterns determine the nature of our cities, how we live, and ultimately our capacity to achieve sustainability. With modern transportation systems' over-reliance on the automobile, mobility has been privileged over access – speed and distance over convenience, equity, and choice in transit mode. But this has been the case since the underwriting of transit companies by suburban real estate developers in the latter 1800s, tying transportation economics to land development distant from the city. Ever since,

"short-haul inner-city customers effectively subsidized longer haul suburban customers."[27] This is true today as gasoline and vehicle taxes pay for 25 percent[28] of the costs to maintain highways whereas the average ticket on an inner-city commuter rail pays for 30 percent of the costs to maintain rail systems.[29] Historically all transportation systems are revenue-losing operations, so the pertinent question concerns the collateral benefits (as well as negative externalities) and best uses attending each transit investment.

Light rail is the most efficient motorized transit mode by all measures: economic, social, and environmental. In *Train Time: Railroads and the Imminent Reshaping of the United States Landscape,* environmental historian John Stilgoe observes that: "Whether or not they know it, millions of Americans live in an economy waiting for the train."[30] Stilgoe chronicles the nationwide resurgence of an intercity passenger rail service and its role in stimulating the resuscitation of walkable urban neighborhoods. Unlike other motorized transportation modes – airplane, bus, or automobile – only a fixed guideway system (i.e., light rail, streetcar, and trolley) prompts the market to build walkable mixed-use neighborhoods. Rail transit not only optimizes a region's transportation efficiency, it generates downtown revitalization, lowers a region's land and energy consumption footprint, and facilitates neighborhood-based commerce beyond the suburban big box retail center. A transportation system that includes rail provides more transit options, increasing access for transit-challenged populations while reducing congestion and individual transportation costs. As Stilgoe observes, railroads *concentrate* populations, functioning most efficiently as peak-demand transportation systems. Automobiles and buses as transportation modes *distribute* populations, and do not create this constellation of economic and social benefits.[31]

Inner-city light rail needs a minimum concentration of twelve dwelling units per acre within a half-mile radius of transit stops to achieve feasibility[32] (three times the average suburban density of four units per acre). Rail feasibility also requires concentrations of employment centers, commerce, and other non-residential land




**7.9**
"Transit-oriented Development" place-building design model. Image property of UACDC.

uses within the half-mile pedestrian shed of transit stops to create ridership. Transit-oriented development captures a premium market value due to the prospect of being readily connected to the region. Many people will elect to walk rather than drive within a half-mile radius if the environment rewards them with vital streets, pedestrian amenities, and a concentrated mix of land uses. Population concentration is a key determinant of species health and resiliency, and humans are no different. In drawing the connection between habitat characteristics and population stability, planner Randolph Hester reminds us of the forgotten Allee effect developed in the ecological sciences to study aggregation and its thresholds of diminishing returns:

> In some cases, most notably among plants, there is value in spreading out to reduce competition for sunlight and food. Sometimes this is true for animals, but concentrated density and the accompanying "intra-specific protocooperation" frequently are more critical. In short, Allee found that for some social animals undercrowding is as detrimental as overcrowding. For those species, resilience depends on a relatively high density of population in a small concentrated space.[33]

While agreement on ideal concentration levels fluctuates according to livability conditions and carrying capacities of cities, we are coming to understand that rail and walkability – that is, better neighborhoods – are symbiotic solutions, more so than a total transit solution confined to the question of mode split between rail and bus. Sustainable transit requires pedestrian and cycling solutions at either end. Most cities, including small towns, were historically well served by comprehensive rail systems (receiving same-day parcel and twice-daily mail service, beating the contemporary standards of FedEx) decades before the advent of buses. Since the mid-century erasure of inner-city rail by a consortium of highway, auto industry, and petroleum interests,[34] the multiple livability benefits from concentration have become more apparent in hindsight. We now experience increased health costs due to lifestyle diseases from loss of physical activity in daily routines, increased air pollution from automobiles (with costs that exceed $10 billion annually[35]), ecosystem destruction caused by land consumption at a multiple growth rate of population growth, not to mention the immeasurable erosion of social capital among the many other costs of sprawl. A wave of intermodal transit projects is underway nationwide, accelerating the uncoupling of land consumption from wealth production, restructuring prosperity's ties toward smarter energy use and urban development.

*Visioning Rail Transit in Northwest Arkansas: Lifestyles and Ecologies*[36] is a study advocating political and grassroots support for the construction of a light rail system. Northwest Arkansas (NWA), a region of small towns, was not only once crisscrossed by rail, but a product of passenger rail development in the latter 1800s. One trunk line remains. This underused rail corridor with some local freight shipping connects three of the region's historic downtowns and its primary employment centers. Two-thirds of the population still lives within one mile of the corridor. The proposal calls for resuscitation of the line as a light rail facility in this region of 400,000 people expected to grow to over one million by 2050. NWA is the nation's twenty-sixth fastest-growing region, home to a public land-grant university, and three Fortune 500 companies – Wal-Mart, Tyson Foods, and J.B. Hunt Transport

**7.10**
Before and after: light rail transit in Springdale, Arkansas. Image property of UACDC.

Services – all strong logistics companies whose growth and ballooning vendor support communities ensure the region's expansion. More than 8 percent of the region's population alone is employed at Wal-Mart's corporate headquarters. However, due to its lack of strong planning traditions, NWA's growth is sprawling, based on the promise of future expressway expansions. *Visioning Rail Transit* proposes incentivizing a portion of this new growth toward transit-oriented development patterns.

The project envisions community development possibilities around rail transit, suggesting that NWA could be a smart growth model if it progressively shaped its expansion rather than chased it retroactively. While not limited to simply creating greater efficiencies in transportation networks, the study addresses collateral lifestyle possibilities and multiplier benefits – what is known as "transit leverage"[37] – through the consideration of four planning scenarios. What if choices in transit mode beyond the car were provided in NWA? What if rail revived the amenity-rich environments of historic NWA downtowns? What if local commerce were integrated into the development of NWA neighborhoods? What if NWA directed its growth to become a model region for sustainability by lowering its energy footprint, and weaving ecological services into its cities? *Visioning Rail Transit* retools NWA from a collection of autonomous cities, in unproductive competition with one another for cultural and economic resources, to a well-connected metropolitan region cooperating as one fundamental economic unit. The study's smart growth platform addresses emerging challenges in housing affordability and new immigrant populations who are prompting a spatial resorting of the region along class and racial lines. Most of all, the study embeds transportation planning into community development to build and maintain a sense of place, which is ultimately tied to human scale and exchange.

## Conclusion

The development of technological systems, including cities, co-evolves with equally determining social forces. Recombinant design requires attention to the development of new disciplinary and social formations – learning networks – to enact design solutions seeking a network intelligence. Such intelligence, based upon the switching among heterogeneous components where one variable is expressed as a function of another, counters the fixity of prevailing command-and-control management in contemporary infrastructure. Command-and-control development

of roads, water bodies, transit, and housing maximizes energies through single variables framed by the mindsets of specialized labor groups. How will such socio-technical organization, including design, "come to terms with the structural mutation of the law of *oikos*?"[38]

Each of the four planning initiatives required a robust stakeholder network of non-profit organizations, government agencies, foundations, and for-profit professionals representing varying interests. Since these vested constituencies understood the benefits in recombinant approaches, why are their respective projects difficult and even impossible to implement? Science and technology studies expert Anique Hommels offers a framework for analyzing the complex reasons driving obduracy in the physical environment, particularly in the constraining role of social frames and managerial mindsets:

> When certain ways of thinking have been built up around an artifact, it becomes difficult to ignore them, let alone change them. Implicit in these approaches is the assumption that, because certain ways of thinking are narrow in focus or difficult to adapt, the technology involved will become obdurate or will have limited flexibility. This means that obduracy, instead of being caused by material factors alone [i.e., expense, power, special interests, permanence], is the result of interactions between social groups – interactions that are constrained by specific ways of thinking.[39]

In overcoming hardened networks of practice it is insufficient for design to work through a formal consciousness alone. Design culture's effectiveness will be measured by the degree to which disciplinary tools are thickened by research, public policy intelligence, and a new epistemology of engagement in shaping territory. The stakes are significant as the status of sustainability is a question of resource productivity and its spatial arrangements, intrinsically a matter of design.

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Chapter 8

# Patchworks, Ecologies, and the Contemporary City

*Graham Livesey*

Cities comprise numerous interlocking and overlapping ecologies; they are also located within larger ecological systems, including surrounding agricultural lands. Today, cities are rampant consumers of resources and producers of waste, contributing significantly to current global environmental challenges such as climate change. Historically, urban centers have been locations for all kinds of innovation, and have depended upon extensive support networks of goods, people, and information.[1] The networks that cities draw upon have always been very broad; however, most of these are pre-determined linear systems such as distribution and communications systems (roads, shipping routes, aqueducts, waste removal networks). As cities struggle to become more sustainable, and to use their creative and productive capacities in more effective ways, they will need to become better interconnected and more multi-functional, and they will need to engender more effective flows outside of established channels; in other words, cities will need to become better functioning ecologies. There is no doubt that in order to address these challenges, urban areas must change the ways in which they operate, by developing renewable energy sources, becoming denser, reducing consumption, eliminating waste, restoring ecosystems, and generally managing themselves in a more environmentally appropriate manner.[2] Today, many cities are seriously addressing these issues; however, as Herbert Girardet points out, they are more achievable in small and mid-sized centers than in large contemporary mega-cities where the complexity factor is higher. [3] Instead of reiterating the well-known ideas suggested above, this chapter will examine some of the broad issues of sustainability and the structure of the contemporary city by looking at theories of landscape ecology developed by Richard T.T. Forman and others.

Landscape ecology has emerged as an independent field of study during the past several decades, drawing from disciplines such as ecology, geography, biology, zoology, forestry, and landscape architecture. The analytical techniques developed in landscape ecology initially addressed the "single elements of the network, such

as patches and nodes, buffer areas, corridors and linkages; or with the dynamics of the network, such as movements, flows, migration, dispersal, fragmentation and connectivity."[4] This rather crude approach has since evolved into integrated and comprehensive frameworks for ecological analysis, which have typically been employed in examining the performance, or ecological effectiveness, of non-urban environments. Nevertheless, landscape ecology provides powerful theories and techniques for studying the ecological behavior of contemporary cities.[5] In their seminal book, *Landscape Ecology*, Forman and Michel Godron present a structural method for analyzing ecologies by focusing on "patch," "corridor," and "matrix" structures, these being the basic spatial types employed in landscape ecology.

Patches are defined surfaces and areas that differ from their surroundings; however, they vary widely in their defining characteristics. As a defined piece of land, a patch has a distinctive composition and spatial quality and is produced typically by an intervention in a landscape, either natural or from human action.[6] Several types of patches are identified by Forman and Godron. The "disturbance patch" is created by localized disruption in a landscape; an example of this would be damage caused by a storm in an urban forest or a clear-cut patch caused by logging. The "remnant patch" is the inverse of a disturbance patch; it occurs where a piece of a previous landscape survives. The "environmental resource patch" tends to be an anomalous patch in a landscape, or a repeating patchy condition in a more general landscape; these are often a multitude of stable patches in a system that provides nutrients and other resources. The "introduced" or "planted" patch, such as those found extensively in agricultural and urban landscapes, is the typical result of human activity. Agricultural landscapes made up of fields of differing crops, and urban landscapes made up of blocks of land determined by function are examples of highly "patchy" landscapes caused by introduced activities. Finally, the "ephemeral" patch, or those caused by temporary social interactions, or changes in the environment, is another factor in landscape dynamics. Normally, the human habitation of a landscape results in a general patchwork system. Within a patchwork system there are many factors that determine the diversity and healthiness of an individual patch. In particular the types of boundaries or edges, the size and shape of a patch, and the larger landscape matrix are vital functional characteristics of a patch; further factors such as composition, age, heterogeneity, and type are also vital to the way in which patches and landscapes operate. Each of these determines the function of a patch, and also how it interacts with adjacent land and an overall system, such as that found in human settlements.

A second basic typology, identified by Forman and Godron, is the corridor. Corridors both connect and divide landscapes, and are found in landscapes that are most affected by human intervention. Like patches, they fall into various types: disturbance corridors, remnant corridors, environmental resource corridors, planted corridors, and regenerated corridors. As Forman and Godron stress, the nature of a corridor depends upon its width, its continuity, nodes or intersections, curvilinearity, connectivity, and other factors.[7] Like a patchwork system, a corridor system, or network, has a functional effectiveness based on the structure of the system. A mesh of corridor elements creates a network, in which the mesh size and the types of nodes (intersections) define the functioning of the system. A corridor can either be a linear strip removed from a surrounding landscape (such as a road through a forest), or a remnant (such as a strip of surviving forest in an agricultural landscape),

or it can be a planted condition. In agricultural landscapes, a common corridor typology is the hedgerow or shelterbelt, which modulates wind and energy flows, and can support a diverse range of plant and animal life. As the width of a corridor increases, so does the diversity and complexity of its ecology; this is termed "width effect."[8] The four functions of corridors are: (1) to act as a habitat for various species; (2) to be a conduit for movement; (3) to be a barrier or filter between areas; and (4) to be "a source of environmental or biotic effects on the surrounding matrix."[9] The corridor typology plays a dominant role in defining both the structure and functioning of cities, particularly as conduits of movement, such as those found in street systems, and as barriers between adjacent parcels of land.

Third, Forman and Godron identify the existence of a matrix as where one type of landscape element (forest, agricultural fields, urban development, etc.) covers more than half of a landscape, although other factors, such as connectivity, may come into play.[10] The matrix is the most extensive spatial system, and, where present, has the greatest influence on the ecology of a landscape. A landscape matrix has a variety of characteristics, which typically influence connectivity and resistance across a landscape; these determine ecological flows of elements such as energy, water, waste, and organisms.[11] In an urban or suburban landscape, the matrix may largely comprise a network system of corridors and a heterogeneous patchwork of varying landscape types.

When it comes to examining the productivity of a given landscape, or ecosystem, landscape ecologists measure in terms of Net Ecosystem Productivity (NEP), or a measure of the overall activities of producers, consumers, and decomposers in a system. An effective system is "dynamically stable" over time, such that while there is continual transformation the overall system does not become unbalanced, or aspects of the system dominate disproportionately to others.[12] In landscape ecology the functioning of a complex landscape is determined by the interactions of patches, corridors, and matrices as spatial and structural elements. Landscapes can transform quickly, as in the case of a natural disaster, or slowly, as in the case of a forest. The stability of a landscape is dependent on many factors, including resistances in the system, and the ability to recover from change; blockages, porosities, adjacencies, and shape are some of the factors examined in determining a landscape's health and efficiency. Over time, landscapes tend to oscillate between stable and unstable conditions, but ultimately move toward a dynamic stability, or an ecological balance.[13]

The continuous transformation of a landscape by urbanization results in new ecologies. The ecological productivity of a landscape depends upon the integrated interconnectedness of all the elements in a system. In cities, many aspects of a complex urban ecology are engineered, not allowing for the integration of flows. In order to become more ecologically sustainable, cities must begin to induce flows across their entireties; in other words, across patch, corridor, and matrix systems. An example of this is the standard handling of stormwater runoff in many urban environments in which rainwater is channeled into storm sewers, which lead into rivers and oceans, bypassing a wealth of ecological opportunities. Typically, cities segregate urban elements physically and functionally. In a preliminary way, we can suggest that cities need to become more multi-functional and spatially dynamic, or the patches that tend to comprise a city (city blocks, parks, recreational facilities, malls, office parks, transportation complexes, institutions) need to be

better interconnected to be more sustainable. In theory, this means that the impact of requirements for resources and energy, and the production of waste, could be mitigated at the local level, by creating environments that are better integrated with local ecological systems.

## Patchwork Systems

Human settlement typically leads to widespread disturbance in a landscape. This usually results in the replacement of indigenous, or local, ecologies by new, or imported, ecologies; these are often invasive, or not well suited to the specifics of indigenous ecologies. Furthermore, the complex ecologies that existed prior to human settlement, or exist in adjacent untouched areas, are usually replaced by the relatively simple ecologies created by humans. Cities comprise a wide range of flows; these include materials, information, energy, organisms, nutrients, water, and so on. These are propelled in many ways, from wind to mechanized transportation, and may be contained or dispersed, guided, or randomly distributed. Historically, cities have been subject to highly channelized flows, which means they are often ecologically unproductive, in that flows are highly controlled, usually prevented from integrating into broad ecologies. Cities are also aggregated landscapes that comprise a high density of patches and corridor systems that have generally evolved over time. Inner cities tend to be patchy and rigid environments with a high degree of uniformity in the composition of individual parcels (patches) of land. The density of street systems in urban environments means that urban blocks are highly segregated from each other; in other words, corridor systems, while comprising communication and distribution networks, also act as boundaries.

Inner cities are dominated by buildings and hard landscapes that make transformation difficult. Forman and Godron note that suburban landscapes are more diverse, with relatively fewer corridor or matrix elements, where "patchiness" is at a maximum and vegetation diversity is relatively high.[14] Most contemporary cities combine both urban and suburban landscapes which possess high degrees of patchiness; however, suburban landscapes possess more opportunities as a result of their lower building densities and significant amounts of green space. Therefore, patchwork systems largely defined by transportation networks effectively become the background matrix for the contemporary city. The low or negative ecological productivity in contemporary cities results from a lack of connectivity across very patchy landscapes, where networks of corridor systems and sharp edges prevent cross-flows. We would suggest that suburbia possesses a higher ecological potential due to the broader range of patch types and relative openness of the fabric. This phenomenon is reinforced by Brenda Case Scheer, who categorizes urban landscape typologies as "static," "elastic," or "campus."[15] The static typology generally reflects inner-city block systems. The elastic tissue is generally associated with unplanned and unstable suburban environments, resulting in indeterminate, or "virtually unseen and under-theorized"[16] spaces. The campus typology belongs to planned developments such as airports, apartment developments, and institutions, and is a typology situated between static and elastic tissues. Here, the elastic and campus typologies, ironically the least urban or the least subjected to the subdivision of land, likely hold the greatest ecological potential.

Patches vary widely in their inherent characteristics and can form matrices or mosaics where the overall system is a patchwork of defined parcels of land. Cities, as complex ecologies or landscapes, are in constant flux, and are therefore also subject to the various periodicities of daily, seasonal, and annual change. Heterogeneity, diversity, flexibility, flow, and evolution within a landscape are key indicators of ecological functioning. Often the activities of people have the greatest influence on inter-landscape flows, in particular the consumption of energy and non-renewable resources, and the resulting emissions and waste produced, and the effects these have on ecologies. Urbanization has always been about the human management of landscapes, often with little or no understanding of the many and various impacts settlement can have on ecologies, the structure of a given landscape or the elements present, the nature of the flows within the landscape, and changes over time. Ultimately, cities will become more sustainable if the ecological flows across elements in an urban landscape are able to be made more effective, where the management of resources and wastes can be handled in a more integrated, or functionally complex, manner. Examining in detail the landscape ecology of a city, particularly the operation of patch and corridor systems, is one method for understanding the ecological complexities of urban environments and their associated territories. As highly patchy environments, contemporary cities, aspiring to be more sustainable, will need to work with the interrelationship between patches. In his book, *Land Mosaics: The Ecology of Landscapes and Regions*, Forman argues that working at the regional level is the best way of achieving a sustainable system. He writes:

> A large area in equilibrium that contains many patches in various successional stages has been called a *shifting mosaic*. Although the total area remains in a steady state, over time patches in different places appear and disappear. In addition to considering shifting mosaic change, *patch dynamics* focuses on the event or agent causing a patch, and the species changes within it over time. A near-instantaneous disturbance typically is followed by a successional sequence. Each patch exhibits directionality, proceeding from initiation toward "climax." The balance between the rate of initiation of patches by disturbance, and the rate of succession within them, determines both the rate and direction of change of the whole mosaic. Hence, the mosaic may be degrading or aggrading, slowly or rapidly, or may be in steady state.[17]

This introduces the concept of "patch dynamics" which is used in landscape ecology as a means for understanding the functioning of landscapes. In highly patchy environments, such as cities, a patchwork system is established which creates a continuously reorganizing matrix or mosaic. It is evident that in urban and suburban environments patch and corridor systems are fully interrelated, or one defines the other. While a given patch in a larger urban system is provided its location in a larger corridor network, and is serviced by that network, the interrelationship between the two tends to be rigid and mechanical. The functioning of the overall system depends upon the composition of individual patches, the structure of boundaries (often corridors), and the patterns of flows operating within and across the landscape. Large patches support a more diverse ecology than do small

ones; however, a sequence or mosaic of small patches can operate in a similar manner to a single large patch. Patches come in many shapes and sizes, and are caused by a wide range of factors. These include: (1) compact patch shapes, such as a square, conserve energy, whereas patches with convoluted edges enhance interconnections (or flows) with adjacent ecologies; (2) patches function better when they are interconnected with other patches, or they have permeable edges; (3) the relative size of patches and the length of edges (or boundaries) determine how resistant a landscape is to the flow of species, energy, and material. Typically, the edges of a patch support a different ecosystem than its interior. The functioning of a specific patch depends also on its location in an overall system, its immediate adjacencies, and its local context. Therefore, a variety of scales, and the overall aspects of the background matrix, influence the behavior of a specific patch. Within a landscape particularly dominated by patches, configurations emerge as flows are established across a system and can take on various patterns.

A patchwork system is a continuously shifting set of alliances, forces, degradations, and aggradations. For example, several patches could form an alignment, or a larger patch. This is similar to the effects created by a patchwork quilt, where patches of cloth sewn together join to make shapes and patterns. Each piece in a patchwork quilt has its own place and characteristics, and can exist as a defined area in a larger system, or can blend into larger patterns. As Forman and others imply, there are numerous factors both internal and external to a landscape, particularly a patchwork system that can initiate transformations or structural organizations. These can be abetted by human and non-human agents, or can emerge from the system as a whole. For example, individual patches, within a larger patchwork structure, can act as countervailing conditions, or they can be a disease-like force that invades, exploits, reverses, or implodes a larger system; this corresponds with the notion of disturbance or planted patches identified by Forman and Godron. A system that appears stable, or has been stable for a long time, can suddenly collapse or transform. In the contemporary patchwork city, one that is seeking to move toward a continuous space, where ecological flows can be fully integrated, and the pattern of the patchwork will be the determining factor, the size, shape, location, edge conditions, and composition of patches in the larger landscape will be crucial to understanding a system that is dynamically stable. This suggests that patterns within an urban patchwork system would be determined by ecological factors.

Therefore, a city, as a system comprising primarily patches and corridors, can consist of specific patches or corridors (for example, a park or street), or as a patchwork system of interacting elements that are constantly realigning themselves as edges open and close. A given patch within the overall structure of a city contains a particular set of organisms, elements, and spaces that are coded according to systems of use and administration. Depending on the interactions within the patch and its interrelation with a larger system of patches, a given patch will either stand alone from larger systems or be active in shifting patterns of performance within the greater patchwork. If a patch is disconnected and mono-functional, as is so often the case in urban environments, then the ecological potential, or its ability to interconnect, is low. In order for a patch to operate effectively in a larger ecological matrix, the edges must be porous, or a re-functioning of the territory or patch must occur. This is consistent with landscape ecology, which notes that the operations

of a patch, and a patchwork, are determined by many factors including size, shape, diversity, and edge conditions. The breaking down of edges in cities is vital to ecological functionality, as is the creation of movements of flow outside, or against, organized corridors or channels. In the contemporary city, if the background matrix becomes a functioning patchwork with the ability to continuously reorganize itself, then it will begin to behave like a continuous space system with a potential for a high degree of flow of materials, organisms, energy, and waste. Beyond the patch, and patchwork system, is the functioning of the edges or boundaries within a given system. In cities, corridors function as both channels for movement, distribution, and communication, and act as barriers between adjacent parcels of land.

As noted above, cities, which are highly patchy, are often prevented from supporting fluid ecological flows by their extensive corridor networks. One strategy for activating a patchwork system is to selectively reduce or modify the edges in the system; this includes transportation networks, property divisions, zoning regimes, and infrastructure systems. In effect this has been the case in contemporary suburban subdivisions, where there has been a departure from the evenly applied street grid often found in inner cities. Like all complex organizations, cities are subjected to continuous processes of transformation that can modify edges and activate patchworks; these include forces of expansion, collapse, shape changing, and migration, to name a few. These processes of change can modify or divide an existing landscape, through the introduction of holes or cuts, or through fragmentation and decline. Other forces can result in an increased breakdown of a landscape, or the reduction in size or outright loss of elements. As highly patchy landscapes, cities are also highly fragmented. Many landscapes, particularly urban and suburban, have been subjected to radical fragmentation, which leads to habitat loss, isolation, and ecological breakdown. Ultimately, patch size, connectivity, and boundary length are determining factors in defining the spatial composition of a landscape.[18] Urban landscapes, as artificial landscapes, once established, transform relatively slowly. Ultimately, cities comprise many types of patch ecologies ranging from small patches of green space, parking lots, buildings, to large urban parks.

With the extensive use of corridor systems and divisions (property lines, zoning, infrastructure) in urban environments, the result is inordinate lengths of edges. Forman writes: "in sustainability issues, humans are edge species . . . by carving up the land and increasing edges enormously, we eliminate the key values of large patches, thus degrading our landscapes."[19] In other words, when humans settle a landscape they create an infinitude of abrupt and precise edge conditions between landscape elements (blocks, streets, parks, fields, etc.). The porosity of edges between landscape elements and the structure of the boundaries or edges (sharp, blurred, or overlapping) are critical to the overall functioning and interconnectedness of a landscape. The boundary between elements determines the amount of flow between adjacent patches of land. The more complicated the boundary, the greater the likelihood of complex interchange.[20] In every ecosystem, there is a direct relationship between the structure of a landscape and the way flows operate within it. More homogeneous landscapes tend to support more continuous flows due to the relative lack of interruptions, whereas flows within landscapes with a multitude of boundaries will depend on the permeability of the boundaries. Edges are influenced by a wide variety of activities; they are habitats in and of themselves, and ecologically different from the adjacent ecologies, as edges often contain a high

degree of diversity. Microclimatic conditions, influenced by sun, precipitation, and wind, are very different in edge conditions from the interior environment of a patch. Through their actions, humans have an enormous impact on the creation and maintenance of edges in a landscape; whether rural, suburban, or urban, humans tend to aggressively maintain edges in the environments they create; these edges are often barriers to ecological flows. The control of the movements and flows across edges or boundaries is determined by flows of wind and water, or by locomotion (animal, human, and machine), as all edges are filters that contain some degree of permeability.[21] Ecologists, in determining the effectiveness of a landscape, examine the resistance to flows inherent to that landscape. According to Forman, landscape resistance is described:

> as the effect of structural characteristics of a landscape impeding the flow of objects (species, energy, and material). Since boundaries separating spatial elements are locations where objects usually accelerate or slow down, it has been suggested that that *boundary-crossing frequency*, i.e., the number of boundaries per unit length of route, is a useful measure of resistance.[22]

Resistance is a way of understanding flows in a system and where flows move in an integrated manner, or where they are blocked by impervious barriers.

Cities typically have high degrees of both heterogeneity and homogeneity, and are subject to many sharp, and often impermeable, boundaries that prevent flows outside of pre-determined channels. This leads to flows that are "saltatory," or subject to interruptions. This concentrates on how connected and smooth flows are, and how they interact with a landscape. However, saltatory flows also involve more interactions between a landscape and flow of elements.[23] In natural landscapes edges tend to be curvilinear and complex, comprising soft concave or convex surfaces, with a high degree of inter-digitation or interaction, and, therefore, flows across the boundary. In landscapes significantly modified by human intervention, boundaries tend to be hard, straight, and sharp, hindering flows of organisms, energy, materials, and so on.[24] Therefore, ecological flows across a landscape are a function of the patches, and corridors, but also the types of edges. The soft edge between two ecologies creates a blended condition, or "ecotone," which acts as an inter-system; this occurs extensively in natural landscapes as a transition between ecosystems. In contemporary cities, with their hard edges, the functional separation of urban elements (patches, corridors, infrastructure, etc.) is reinforced by zoning and planning regimes, and is enhanced by the widespread use of the "buffer":

> The concept of a buffer, as an area that lessens or cushions the effect of one area on another, is common in land-use discussions. It relates to the juxtaposition of two areas with incompatible interactions. A buffer separating two areas is sometimes proposed to minimize negative interactions, or to reduce steep gradients in an edge. The buffer may repel, or may absorb, those flows. These are the same two functions accomplished by the many ways of sculpting and managing boundaries.[25]

The buffer technique used in many contemporary cities functionally separates urban elements, and has a theoretical similarity to an ecotone; however, it typically does not perform the same role, acting more like an independent element, rather than a thick edge or boundary. In fact, the use of functional city zoning is designed to prevent flows between pieces of land. The softening of buffer systems in contemporary cities is another way in which cross-flows could be encouraged.

As noted above, the types of edges, particularly within a patchwork or matrix system, are crucial. The edge or boundary between landscape elements acts in five interconnected ways: habitat, filter, conduit, source, and sink. This indicates that edges can either be simple or complex in the way they interact with a larger system. Edges, or boundary conditions, depending on width, composition, and adjacent patches can enhance or prevent flows, and can also act as a spatial order that supports an ecosystem as a part of the management of resources, wastes, and organisms. An edge, on its composition, can be a location for organisms that occupy the inter-zone between ecosystems, a barrier, an open condition that facilitates free movement, and/or a location that generates or stores materials, energy, nutrients, and so on. The differentials in permeability caused by varying edge conditions within a patchwork, or matrix, determine the degree and types of flow.[26] These characteristics are very similar to the way in which corridors function, as defined above. There is a direct interrelationship between the composition of edges and the functioning of a particular patch; edges have different characteristics and thicknesses based on the size and shape of a patch, orientation and climate, the relative age of elements in the system, the activity of organisms, the overall composition of the patch, and the structure of various adjacencies. Edges and boundaries can advance and retreat over time depending on the forces at play, although human-created and maintained boundaries in landscapes are typically quite stable.[27]

## Interconnectivity in Urban Ecologies

The urbanite tends to live in a system that is relatively stable. However, cities are continuously subjected to forces that belong to material, social, and ecological flows, and are also effected by a wide range of structures, intensities, political and bureaucratic regimes, weather patterns, geological forces, natural disasters, infestations, and so on. Herein lies the potential for urban and suburban environments to be rendered more ecologically connected, by allowing cities to accommodate the flows of energy, materials, information, and social systems more effectively. In other words, the entire field of operations can be activated rather than being reliant on independent networks that are poorly interconnected and unable to provide for the functioning of a total urban system. The patches of land that comprise suburban and urban environments can be reworked, as currently they tend to be inert or have a negative impact. The boundaries that define most urban patches are infrastructure systems that directionally channel flows, but tend to be significant barriers to cross-flows. The high degree of edges and boundaries in urban landscapes runs counter to the development of effective urban ecologies. There are forces within and outside a system that coalesce to create a new alignment, arrangement, or configuration.

In order to improve the connectivity across patchy landscapes, the patchwork needs to become activated, or a shifting system of patterns and changing arrangements must occur. The networks of corridor systems that define urban patchworks provide an important function in cities; however, these also function as edges and boundaries. In other words, corridor systems should also be read as edges; this would describe them as more complex urban structures. The ability for a patchwork to become active depends upon the structure of the edges between individual pieces and the structure of patches in play. To make patch and corridor landscapes of suburbs and cities more connected, the corridors must function as a system acting as part of a distribution network, but also as a system of permeable edges allowing for cross-flows, habitats, and sources/sinks. While both suburban and urban landscapes tend to be highly patchy, the suburb supports a functioning patchwork system more readily. The inner city is more resistant owing to the relative impermeability of the patches and the high preponderance of rigid corridor networks. Unfortunately, urban patches tend to be inert; as they are functionally determined, and precisely bounded, they tend to exist as disconnected islands; they are the result of urban decision-making, in particular the zoning of urban space. In order to generate flow and interconnectivity, the plethora of edges that subdivide cities must be softened. Every patch in a city has the potential to direct movement or flow.

Typically some human intervention in a landscape increases the heterogeneity of the landscape; however, too much disturbance leads to a homogenization of the ecology of landscape. Both suburban and urban patchworks tend to be ecologically homogeneous or mono-cultural, often comprising imported or invasive species and/or typologies, with sharply defined boundaries that allow for little cross-migration or species interaction. Cities are functions of numerous types of flows, mainly along pre-determined routes and channels: the road, the freeway, the flight path, the telephone cable, the sewer line, and so on. The control of flows has existed throughout the history of urbanization. Social structures have always operated through and against pre-determined conduits, and electronic technologies are also able to operate in more diffuse ways. The emergence of cross-flows, triggered by the reorganization of cities, will require the changing of boundaries, the harnessing of forces, and the operations of certain agents (such as urban governments, communities, and design professionals). As we expand the applicability of the powerful concepts of landscape ecology (and patch dynamics) to contemporary cities, we embrace the notion that urban structures are singular (in that they embrace spatial, temporal, social, affective, and material qualities) and infinitely complex. If we consider a city as a very complex set of interlocking ecologies, we can further understand cities as a constellation of systems, spaces, elements, actions, affects, bodies, languages, structures, and codes. Cities encompass a multiplicity of forces that can modify the ecological and spatial structures that are continuously at play. Currently, the heavy reliance on organized channels of movement, functional zoning, and property ownership prevents the ecological harmonization of contemporary cities. The creation of greater interconnectivity through more complex boundaries is a necessary step to move cities toward sustainability; fully integrated landscapes of patches and corridors will make contemporary cities more ecologically effective.

## Notes

1 See Jane Jacobs, *The Economy of Cities* (New York: Random House, 1969), 3–48.
2 See David Orr, "Architecture, Ecological Design, and Human Ecology," in Kim Tanzer and Rafael Longorio, eds, *The Green Braid: Towards an Architecture of Ecology, Economy, and Equity* (London: Routledge, 2007), 15–33.
3 Herbert Girardet, *Creating Sustainable Cities* (Devon: Green Books, 1999), 61–62.
4 Rob H.G. Jongman and Gloria Pungetti, eds, *Ecological Networks and Greenways: Concept, Design, Implementation* (Cambridge: Cambridge University Press, 2004), 5.
5 See, for example, Brian McGrath and Victoria Marshall, eds, *Designing Patch Dynamics* (New York: GSAPP/Columbia University, 2007). See also Stan Allen, *Practice: Architecture, Technique and Representation* (London: Routledge, 2009), 159–191.
6 See Richard T.T. Forman and Michel Godron, *Landscape Ecology* (New York: John Wiley & Sons, 1986), 83–120.
7 Ibid., 124–127.
8 Ibid., 146.
9 Ibid., 397–398.
10 Ibid., 161.
11 Ibid., 404–411.
12 See Douglas G. Sprugel, "Natural Disturbance and Ecosystem Energetics," in S.T.A. Pickett and P.S. White, eds, *The Ecology of Natural Disturbance and Patch Dynamics* (Orlando, FL: Academic Press, 1985), 344–351.
13 Forman and Godron, *Landscape Ecology*, 431–435, 449.
14 Ibid., 302–303.
15 See Brenda Case Scheer, "The Anatomy of Sprawl," *Places* 14, 2 (2001): 28–37.
16 Albert Pope, *Ladders* (New York: Princeton Architectural Press, 1996), 5.
17 Richard T.T. Forman, *Land Mosaics: The Ecology of Landscapes and Regions* (Cambridge: Cambridge University Press, 1995), 44; emphasis in original.
18 Ibid., 407–412, 426–428.
19 Ibid., 81.
20 Forman and Godron, *Landscape Ecology*, 177.
21 Forman, *Land Mosaics*, 100.
22 Ibid., 279; emphasis in original.
23 Forman and Godron, *Landscape Ecology*, 357–361.
24 Forman, *Land Mosaics*, 83.
25 Ibid., 292.
26 Ibid., 96.
27 Ibid., 104–111.

Part III

# Resiliences

Chapter 9

# Design from the Ground Up

## Risks and Opportunities in Humanitarian Design

*Michael Zaretsky*

There is a growing body of designers who want to save the world. There has been a recent proliferation of "common-good" design/build, "public-interest" or "humanitarian" design projects, and community or "participatory" design projects coming out of universities, firms, and organizations around the world. There is recognition that some needs of communities stricken by poverty, environmental, climatic, and political crises can be addressed by design practitioners, educators, and students. Designers are working collaboratively with disciplines in the social and physical sciences, as well as the arts, to produce buildings and places that provide much-needed solutions to the necessity for shelter, housing, and development.

Many universities worldwide, as well as non-profit organizations, such as Architecture for Humanity and DesignCorps, and Community Design Centers at local and institutional levels, have provided support, funding, energy, sweat-equity, and inspiration for the development of these projects. These projects offer an unparalleled opportunity to capture the energy and inspiration of design education combined with the practice, research, teaching, and service interests of these institutions for development that has the potential to benefit communities in need both in the short and long term. However, if these projects are developed without sensitivity, they also have the potential to risk damaging communities in a multiplicity of ways. This chapter explores some of the risks and opportunities that arise when designers develop projects for communities in need that are located in cultures other than their own. The basis of this chapter is the Roche Health Center, an ongoing project in rural Tanzania that represents the focus of my research and teaching since 2008.

## Opportunities in Humanitarian Design

### *Design Equity*

As many have noted, design services are predominantly for those who can afford them, while basic design could often improve the quality of life for those in need. There are numerous examples of communities that have benefited from humanitarian design and construction throughout the world. There is no question that while the apparent product may be a new building, the lasting impressions of these interactions are social and cultural. Design students working with the Rural Studio Design/Build projects in Alabama have written at length about the relationships that developed between the students and the families and communities with whom they worked.[1] When this work occurs overseas with a positive result, the impacts can improve negative perceptions about the United States.

### *Student Energy and Inspiration*

Any students who have had the opportunity to tangibly experience the potential that they hold within their skill set to positively impact upon a community are forever changed. Students within architecture and design programs spend thousands of hours devoted to their design development in the design studio, which is at the core of most design curricula. This is an untapped resource that can be directed toward real projects for real clients producing proposals that can make a difference for a community in need. In my experience as a professor for dozens of architecture design studios, students always work much more thoroughly, diligently, creatively, and responsibly when they know that their work has the potential to benefit a community. There is a rigor and passion for a project that emerges when students begin to realize that their design decisions will have lasting impacts for these communities.

### *Faculty Research Agenda*

I left full-time architectural practice and entered academia to have a greater opportunity to positively impact upon the world. There are few professions where one has the opportunity to devote one's energy, knowledge, and experience to self-directed research and the dissemination of knowledge. In the sciences, research is commonly done toward a goal that will benefit the world at large (medicine, pharmacy, engineering, etc.). However, in the discipline of design, research is a recent phenomenon and its role is still being debated. Practicing architects rarely turn to the architecture academy for research. This is markedly different from medicine and engineering and other sciences where the research occurs within the university and is often the basis for what is practiced in the profession. The requirement that faculty of design engage in research to achieve tenure represents an untapped potential to further the disciplines of design while benefitting communities in need.

## *Collaboration and Interdisciplinary Activity*

Humanitarian design projects inevitably require collaboration and interdisciplinary activity. There is no question that architecture practice and academia in the twenty-first century recognize the need for greater levels of collaboration to achieve success. Academic design studios are the ideal laboratory for learning the necessary skills to succeed in these contexts. The onus falls upon the professors to also stretch beyond their comfort zone to interact with other disciplines and provide effective management, coordination, and leadership for these studies to succeed. But those educated in this model are more fully prepared for practice in the contemporary design disciplines.

## *Research-based Design*

The budget and schedule limitations of most architecture projects would not permit substantial amounts of time for dedicated research; it is extremely rare for an architecture budget to include research and development. In the project we have been leading in rural Tanzania, students, faculty, and consultants have spent eighteen months of research on a project whose total budget is less than half a million dollars (the cost of a single family home in many U.S. neighborhoods). In humanitarian design projects, most people working on these projects are working without getting a wage. As a result, the focus is purely on the successful development of the project for all constituents as well as for all students involved. Not-for-profit projects exist because people feel a need to do something positive. Given that there is not financial gain for those involved, it is typically a desire to help others that drives people to pursue this type of work. Yet, the positive results are so undeniable that some design and engineering firms now require their employees to donate a percentage of their time toward humanitarian work. For the Roche Health Center project, Arup Engineers donated their engineering expertise on thermal, structural, and constructive issues through numerous meetings and video conferences.

For the health center, we have had the luxury of spending many months on this research. I was recently asked, "What would you do if you only had six months or six weeks to do this?"[2] Outside of academia, it is rare for a project of this scale to have significant research. Within, we have the opportunity to disseminate the lessons learned to students, faculty, and other projects. This type of research must benefit more than a single project or community.This research has been approached systematically so that it can be effectively disseminated and deployed by others doing similar work within this region or beyond. For this project, the Tanzanian government is considering using this project as a prototype for rural healthcare in Tanzania. However, if replicated without the initial research, it would be as ineffective as the colonial buildings introduced by the British.

In addition to the individual project, we are producing a manual that provides basic research that is relevant to all regions in Tanzania as well as a series of unique conditions that need to be addressed individually in each project. Additionally, there will be a system of master-plan scale relationships and construction techniques proposed that can be adjusted based on regional specificity.[3]

### *Benefit the Lives of Others*

For the Roche Health Center project, over 200 individuals – students, faculty, and consultants – have participated in the development of a project that will directly benefit the lives of approximately 25,000 villagers in the region. This project is also being considered by the Tanzanian government as a potential precedent for future healthcare facilities in rural regions. Beyond those in Tanzania, every person who works on this project leaves with a personal understanding of his or her potential to positively impact upon the world.

## Risks in Humanitarian Design

Most students whom I have encountered in design school have an innate desire to help others. When a community is in need of shelter, any offer of assistance is appreciated. Yet, it is critical to first consider the sociological, political, and technological impacts of introducing a construction process or product that is foreign to a community. These projects are inspiring for the students, educators, and practitioners involved, but first the community needs to answer the question, "What is needed first?" Although we can imagine how helpful a new building will be, that may not be the first priority.

With any project that is built outside of one's own cultural context, there are numerous short-term and long-term risks that must be considered. Design can occur through informed research, through trial and error, or through imperialism and arrogance. An informed design methodology is critical before beginning any humanitarian project for a community in need as there are significant risks inherent in a project of this type. We need only look to the long-term impacts of colonial architecture in regions such as East Africa. The English brought traditional masonry buildings that may have performed well in their homeland to fundamentally different climatic, technological, social, and cultural conditions. The damage of these regionally inappropriate buildings extends well beyond the initial construction; it is common for these communities to continue to emulate these building types even after the colonial period is over.

Any activity that occurs in a foreign land, however altruistic it may seem, may have unintended results. There is a long history of colonization occurring under the auspices of benefiting those in need. As Edward Said discusses in his seminal lecture "Culture and Imperialism," the creation of an empire and resulting imperialism can be achieved through "force, by political collaboration, economic, social or cultural dependence."[4] It is specifically the unintended impacts of economic, social, or cultural dependence that are potential unintended results of humanitarian projects.

According to Said, "imperialism" refers to the practice, the theory, and the attitudes of a dominating metropolitan center that rules a distant territory while "colonialism," which is almost always a consequence of imperialism, is the implanting of settlements on distant territory.[5]

For example, the United Republic of Tanzania has been free of its colonial inhabitation since 1961,yet there are numerous examples of buildings that resemble the colonial English structures being built today, though typically of unreinforced masonry. These buildings are being built in a region with significant seismic activity

and a climate that is architecturally mediated much more successfully by indigenous construction (mud huts with thatch roofs) than by unreinforced masonry buildings with leaking metal roofs and structurally unsound wooden trusses.

Paul Pholeros, Australian Architect and Director of Healthabitat, has discussed his initial visits to impoverished aboriginal communities in the 1970s. Although he assumed that he and his students would be providing housing, what was actually needed was plumbing. Instead of producing design solutions, Pholeros led the development of a process to assess basic needs within existing housing and train architecture students to carefully test house plumbing and electrical installations, allowing immediate fix work to occur, which was a much more urgent and effective utilization of resources for a community in need.[6]

Pholeros is wary of spending too much time assessing the situation. He quotes Dr. Fred Hollows (an eye doctor known for his work with aboriginal people) who said "No survey without service."[7] According to Pholeros, this means, "there is no point telling people their eyes or house, etc. are faulty and ticking a box if you have no means to help . . . then and there."[8] There is no quicker way to lose the support of a community than to spend time on research without providing any results. Pholeros urges those doing work for communities in need to never leave without doing "something" that will benefit that community.

Additional risks may occur when constructing projects abroad in which technologies are introduced that are not safe, viable, or sustainable in the region. An accepted technology can create technological dependency on something that may not be reproducible or may take work away from members of the community. In addition, for any technology introduced, the question of long-term maintenance and repair must be considered.

## Theoretical Approaches to Humanitarian Design

What role does any individual or group play when designing anything for a community in a fundamentally different context across the world? This question can provide a sense of humility but must not disable productivity. Ironically, in our experience in Tanzania, before we were involved, a Tanzanian architecture firm produced a design proposal that was completely unresponsive to the site, climate, culture, or the specific needs of the villagers. We later learned that the design they proposed had already been built on a completely unrelated site in Kenya.

The responsibilities of a designer include assessing the needs of the client, the program, and developing a project that addresses the environmental conditions at the site. For the health center project, the site is a rural area in East Africa hours from a modern city, for a tribal community in a region with no power, water, or sanitation. The additional challenges imposed by this type of project create an increased need to produce meaningful and appropriate designs that are based on appropriate research as well as relevant theoretical perspectives for approaching the design process.

Amos Rapoport provides a methodology for effective design for developing countries based on four theoretical issues:[9]

(1) [D]esign is not a free, capricious, "artistic" or "creative" activity based on whims, guesses or designers' likes or preferences. It is

rather a responsible attempt to help provide settings appropriate for specific groups of people . . . Conceivably, a designer might design an environment which he intensely disliked personally if it were appropriate and desirable for the group in question.

(2) The purpose of theory is to set goals and objectives and to provide criteria for making the choices among alternatives that are involved in design. The purpose of such criteria is to guide the answer to the question: what should be done and why (rather than how it should be done). The latter question deals with implementation, with the various constraining and enabling variables such as economics, politics, structure, materials, site conditions and the like.

(3) . . . [G]eneralisations [the basis of theory] can only be made with confidence on the basis of sufficient evidence.

(4) Such evidence, in order to be sufficiently broad, must include:

    (a) all historical periods, not merely the present or the immediate past;
    (b) all cultural traditions, not merely the Western tradition;
    (c) all forms of design, including preliterate, vernacular, popular, etc., not merely the high-style tradition.[10]

Although many designers may feel they are already incorporating cultural sensitivity into their work, a theoretical approach such as the one provided by Rapoport offers an explicit and clear methodology that can benefit all parties involved in humanitarian projects.

## *Reactions to Aid to Africa*

Recently there has been an abundance of negative literature describing Western assistance in Africa. One noted author is Dambisa Moyo, an Oxford and Harvard-trained economist from Zambia, who wrote *Dead Aid: Why Aid is not Working and How There is a Better Way for Africa*, in which the case is made that Western aid to Africa has actually been harmful. She makes a clear case that assistance of over $1 trillion over the past fifty years in Africa has actually stunted African development.[11]

One significant reason for the failure of aid to sustainably benefit Africa is what she describes as the "micro–macro paradox" – "a short-term efficacious intervention may have few discernible, sustainable long-term benefits. Worse still, it can unintentionally undermine whatever fragile chance for sustainable development may already be in play."[12] Moyo provides the example of a mosquito net-maker who manufactures around 500 nets per week with ten employees, each of whom supports approximately fifteen relatives. The business is successful, but they cannot produce enough nets to combat the malaria-carrying mosquito. Then "(e)nter vociferous Hollywood movie star who rallies the masses, and goads Western governments to collect and send 100,000 mosquito nets to the region, at a cost of a million dollars. The nets arrive, the nets are distributed, and a 'good' deed is done."[13] However, the mosquito net-maker is now out of business and the

employees can no longer support their families. Furthermore, she reminds us, the nets will likely be torn and need replacement in five years. Who will replace them?

One of the greatest threats of aid is corruption, which is endemic throughout the African continent. Aid fuels corruption and greater dependence on aid. These issues must be considered when providing assistance to communities in need.

## *Appropriate Technology*

> Appropriate technology is defined as any object, process, ideas, or practice that enhances human fulfillment through satisfaction of human needs. A technology is deemed to be appropriate when it is compatible with local, cultural, and economic conditions (i.e., the human, material, and cultural resources of the economy), and utilizes locally available materials and energy resources, with tools and processes maintained and operationally controlled by the local population. Technology is considered thus "appropriate" to the extent that it is consistent with the cultural, social, economic, and political institutions of the society in which it is used.[14]

One writer on appropriate technology, Francis Vanek, describes two distinct categories of design to be considered for any projects in low-income areas – "hard" and "soft" design.[15]

> In hard design, a device is broken down into component parts, which are precisely defined in terms of their dimensions and materials. The device requires that each component be fabricated to these standards in order for the device to function. Take the example of an automobile: An engine piston having the wrong circumference or not having a smooth surface could prevent the entire vehicle from moving, even if all other components are built "according to spec."
>
> Appropriate technologies are more often built along the lines of "soft design," in which the design concept is subject to modification in the field so as to better use available materials and knowhow. Certain materials or skills may not be available so the design must allow for this flexibility.[16]

Vanek suggests three questions that must guide any technological implementation:

1. What will the effect of this project/technology be on this individual community?
2. Is it compatible with the local situation and needs?
3. Are there hidden disbenefits that were not obvious at first glance?[17]

To effectively answer these questions, it is critical to have ongoing on-site interactions with the community. Often this occurs by working with local non-profit partners who have working knowledge of the culture of a given community.

## Case Study: Village Life Outreach Roche Health Center

Village Life Outreach Project (VLOP) is a non-profit organization whose focus involves providing health and educational improvement measures to the people of the Rorya District of Tanzania, East Africa. This is a region in which there is one doctor for every 50,000 people.[18] In these efforts, VLOP aims to not simply provide hand-outs, but rather to provide "hand-ups" – that is, to empower local villagers to address the issues that affect their communities. The issues that VLOP addresses are in the realms of health, education, and life.[19] By illuminating and joining the struggle against poverty in Africa, VLOP hopes to also strengthen the local community by promoting ideas of humanitarianism, service, and social responsibility.[20]

### *The VLOP Approach to Design*

> "Village leaders identify their own needs," the doctor explains. "Then we strategize with them on how to solve those problems together. This buy-in solidifies the idea that they are going to do their part. It's a 'hand up rather than a hand out' mentality."[21]

According to VLOP President and founder Dr. Chris Lewis, "Three key concepts guide [the VLOP] mission: an emphasis on preventive health care, long-term solutions that villagers can sustain by themselves and village partnerships throughout all stages of any project."[22] These partnerships have led to village-based committees for water, health, and education. Speaking about the water committees, Lewis states: "The program is totally sustainable." He continues: "We don't have to infuse any funds. Instead, each village organized a water committee that goes to other villages to teach people how to build these filters. The last time we gave money to the water committees was to buy each of them two bicycles so they could travel to the other villages."[23]

There is no regularly available source of clean water for the villagers. Most water is collected from ground sources that are often shared with livestock. Many of the health issues are a result of this lack of clean water for drinking and sanitation. As a result, water filtration and disinfection were recognized as critical elements of the work of the VLOP Life Committee.

Each year since 2004, VLOP outreach "brigades" bring twenty to thirty self-funded students, faculty, and practitioners of medicine, nursing, engineering, architecture, and education to the region to treat acute illnesses in temporary field clinics and to address issues of infrastructure and education. They typically offer medical assistance to approximately 1,000 villagers with each trip. However, this is

**9.1**
Roche Health Center site, Tanzania. Photograph by Emily Roush, 2009.

the only healthcare available for the majority of the villagers. The long-term goals of VLOP involve the development of permanent healthcare in the region, run by the community with the support of the national Tanzanian government.

## *Partnerships*

It is essential for any group working in a culture other than its own to develop a long-term relationship within the community. The complexity of humanitarian design projects require first-hand knowledge of the community, culture, and region in which the project is occurring. VLOP coordinates regularly with its sister non-profit organization based in the region, the Shirati Health, Education and Development Foundation (SHED). Local partnerships are also tremendous resources for funding and research. In addition, VLOP has an ongoing collaboration with the University of Cincinnati and student groups such as Engineers Without Borders (EWB) as well as other local and national affiliations.

## *Roche Health Center*

In spring 2008, VLOP began the development of a health center in the Rorya District of northern Tanzania at a location that would serve approximately 25,000 villagers. The Roche community provided a twenty-one-acre building site, though there was no existing power generation, clean water sources or infrastructure for sanitation or waste – all of which would be critical for the health center. Initially, VLOP hired a commercial architecture firm based in the largest city in Tanzania, Dar es Salaam. This firm provided a set of drawings without ever visiting the site or speaking with the villagers. The drawings had no topographic contours or site relationships incorporated and it was assumed that power, water, and sanitation would somehow be available.

Based on a sense that this design methodology was not consistent with VLOP's approach to sustainability, VLOP sought additional input from someone involved in sustainable development. A group from the University of Cincinnati School of Architecture and Interior Design was asked to assess the design proposal and we immediately realized that it was not in any way consistent with the needs of VLOP or the community with which they were working in Tanzania.

Thus began a collaboration with the faculty and students from the University of Cincinnati College of Design, Architecture, Art and Planning (DAAP) and the College of Engineering, with assistance from Arup Engineers in Chicago, Los Angeles, and San Francisco and engineers from the Environmental Protection Agency in Cincinnati, researching and designing for the short-term and long-term needs of this community with regard to health, education, and sustainability.

Through extensive research spanning culture, history, politics, environment, climate, and construction, the initial goal of designing a health center expanded into the development of a community center, an educational center for health, sanitation, and construction, and housing for medical personnel. Before any building design could occur, there had to be a fully implementable plan for water collection, storage, filtration, and distribution, for power collection and distribution, and for sanitation.

## Beginning With Research

Within the design discipline "research" takes many forms. For the Roche Health Center project qualitative assessment of socio-cultural conditions, cultural relationships to construction, investigations of "meaning" in architecture, and other criteria have been investigated through data collection and analysis, precedent analysis, programmatic analysis, formal and spatial investigations, and interviews. Quantitative research has included demographic and healthcare data, climate and environmental analysis, passive design strategies, water usage and collection assessment, electrical usage assessment, and renewable energy potential.

**9.2**
University of Cincinnati student surveying Roche Health Center site

### *Qualitative Research*

Part of the initial challenge in a non-profit project abroad is to clarify the breadth of constituents who are involved in and impacted by the project. Who are you designing for? Who can make decisions? For this, one needs firsthand knowledge. But when there is no budget for travel, one must find alternative ways to gain meaningful firsthand knowledge of a place. Soon after I became involved with this project, a VLOP Brigade left for Tanzania. Before they left we created a series of interview questions and research requests, and members of VLOP conducted thirty hours of interviews with local villagers, village leaders, doctors, and nurses. A research assistant summarized these videos and they have remained integral to our research.

In October 2008, I traveled to Kenya and Tanzania with VLOP for two weeks of extensive on-site research including several interviews with local villagers, meetings with local architects, builders, fabricators, material suppliers, community leaders, and medical personnel. We were based in the town of Shirati and from there we traveled to the villages with whom VLOP works, including Roche Village, where the health center site is located. There are no maps of the region, much less a survey of the twenty-one-acre site. A civil engineering student from our university completed the first survey of the site with the assistance of several villagers.

There are two types of construction evident in this region. The indigenous construction is built of round or rectangular mud and dung huts with sisal stick and rope for structure and thatched roofs made of local grasses. In terms of daylight, ventilation, flexibility, and constructability, these perform well. Cooking and bathing occur outside the huts. These buildings have a limited lifespan of between five and seven years before needing to be reconstructed as a result of the impact of the heavy rains in the two annual rainy seasons. We considered using this as a model for the health center, though interviews with the local community clarified that this type of building was not perceived as an appropriate model for institutional buildings.

Through interviews we learned that, following marriage, most men in this region are expected to begin construction of a more permanent, masonry building, built of wood-fired brick with a wood truss roof structure supporting a corrugated metal sheet roof (often galvanized). They are clearly derivatives of the colonial buildings that were introduced by the English using materials such as CMU (concrete masonry units) that were imported. Although the English are long gone, these buildings still represent the highest standard of construction. The community buildings all tended to be of this construction type. However, many of them were

**9.3**
Crumbled church wall in Nyambogo, Tanzania. Photograph from Village Life Outreach.

**9.4**
Example of typical existing brick and example of ISSB brick. Photograph on top from Village Life Outreach. Photograph on bottom by Emily Roush, 2009.

in significant disrepair and there were several where walls had fallen down and nearly everyone had a roof that was unable to keep out water. The local transformation from reinforced CMU construction to unreinforced brittle bricks becomes a liability in a region with significant seismic activity and monsoon-like rains.

## *Asking and Listening*

While in Roche meeting with the Roche Village Council, we asked the Council if there were any stories or myths that we should be aware of as we designed the health center. Through translation, the Village Leader, Alfred, told us the story of the Kamegata people, a subset of the Luo tribe, the predominant tribe in this region. According to our understanding of the story, Alfred is the great-great-grandson of the original King of the Kamegata clan. This group had been located in Sudan until about four generations ago when the King decided that they needed to settle in a more fertile land. A committee was sent in search of their new home and it was discovered in northern Tanzania. Soon after settling in the new location, a group of foreigners attempted to take the land from the community. The community was able to fend off the foreigners and protect the land. The land on which they settled is the site of the health center which the community has donated to VLOP and the local sister organization, SHED.

**9.5**
Roche Village Council Leader describing the Roche Health Center site

Before the King died, he told his people that the next group of foreigners who came to the site should be welcomed by the community and that these foreigners would be critical for the future development of the Kamegata clan. Alfred informed us that to this community the members of VLOP represent that group. This is why they have donated their most precious piece of land for the health center.

Hearing the story only reinforced the responsibility that I, and everyone working on this project, feel toward this community, but it also highlighted the importance of asking the right questions. VLOP had been shown the health center site nearly two years earlier and this was the first time that they learned of its tremendous importance for the community.

I carried a portable Global Positioning System (GPS) as Alfred walked me around the perimeter of the health center site. I also traced the perimeter as I walked the site with two other members of the village. Though there were no apparent signposts, the GPS data showed that all three traced nearly the exact same steps. They clearly knew the site well.

## *Quantitative Research*

Collecting quantitative research about a rural village in Tanzania from abroad is challenging. In addition to having no map or site contours, we were unable to locate any weather station in the vicinity of the site and had to therefore widen our search for climate data to include Tanzanian and Kenyan cities with similar altitudes. From the climatic data we were able to develop strategies to achieve thermal comfort in all the buildings. However, we later realized that our assumed levels of comfort were based on American standards of comfort while the community in Roche had a noticeably altered comfort zone. When asked about the apparent thermal comfort of the villagers, Dr. Lewis said, "I've never seen anyone uncomfortably warm inside, even when we [VLOP members] are sweating."[24]

The collected quantitative data had to be assessed, analyzed, and critiqued. We began by researching construction, design, and building performance. For on-site research we used basic tools: tape measure, compass, infrared thermometer, illuminance meter and portable weather station for measuring and testing temperature, humidity, wind direction, and speed and surface temperatures. We took temperature, humidity, and wind measurements throughout the buildings and the region. We measured and documented dimensions of several schools, clinics, and houses and took thousands of photographs.

We worked with several engineers to parse this information into meaningful design strategies for the master plan and the individual buildings. We utilized a variety of software for climatic analysis and energy modeling.

While software modeling has been helpful, we find hands-on data collection much more useful and accurate. We found no digital information about precipitation in this area but luckily discovered that one of the doctors involved with SHED had been keeping track of precipitation for over a decade. This provided extremely critical data for our environmental analysis.

As the complexity of the health center project has unfolded, a series of specialized committees was organized to distinguish between the core building design issues being addressed in the studio and the infrastructural issues being

addressed by students, faculty, and practitioners of engineering. These include a Roche Health Center Infrastructure Committee, a water subcommittee, a power subcommittee, and a ventilation committee that is undertaking a computational fluid dynamics analysis of the project.

We have identified specific conditions that need testing for verification. We have built mock-ups of specific construction conditions including producing bricks with a brick press and pouring an inline concrete column. As a result of the acoustic conditions in the typical roof condition, we recognized the need to reduce the sound transmission through the roof. We built four variations of the roof construction, created a continuous flow of water, and measured the acoustic transfer through the variations.

We have developed a collection of precedents that provide comparisons and examples of projects with a similar architectural program, climate, materials, and construction types. These include projects throughout Africa as well as those in similar climates throughout the world.

All this research has been critical in our project development. We have developed hypotheses based on our analyses but we realize that we will only know what works once the buildings are constructed and can be assessed and monitored. We will be installing data loggers throughout the buildings produced in the first phase of construction. These data will inform the remainder of the construction.

## Research Outcomes

The outcome of the initial research was a set of design intentions for the Roche Health Center.

### *A Model for Rural Healthcare*

According to the 2006 *World Health Report*, Tanzania has one of the lowest rates of doctors to population (1:50,000). Nearly 45 percent of the Tanzanian population have a probability of not surviving past the age of 40.[25] Maternal deaths are on the rise and at least 30 percent of the population is malnourished.[26] The Roche Health Center will provide healthcare for 25,000 villagers who currently have no healthcare centers available within several hours' walk.

The Tanzanian government is committed to addressing the need for healthcare and is encouraging the development of healthcare centers throughout the country. Our intention is to provide a model that could easily be adjusted to work in conditions throughout Tanzania.

### *Education and Consistent Assessment*

A new healthcare facility will address acute medical needs, but providing areas for health education locally will lead to a decreased need for healthcare for the whole population. This includes education on and distribution of mosquito nets, water filtration, sanitation, cooking for health, and many other areas. At every opportunity, health education will be integrated into the project.

There are training facilities throughout the Roche Health Center for a variety of medical training situations. There are spaces for local medical personnel to train local villagers in healthcare and sanitation as well as for healthcare training from the medical personnel visiting from other locations. Spaces are designed throughout the facility to effectively facilitate medical teaching, testing, and learning.

Within the Roche Health Center and medical housing technologically appropriate examples of water retention, water recycling, water filtration, and waste facilities are all utilized, shown and exemplified throughout. These are implementable teaching tools for the local community.

## *Roche Community Hub*

Throughout societies worldwide, communities develop areas where people can congregate and interact socially. Roche Village and surrounding villages have no "center" where the community comes to interact. Early in the design process it became clear that the new Roche Health Center would become the community center for this region. The design proposal evolved to include plans for community, educational, and commercial spaces of different scales engaging the main road. These are organized as a series of layers from the road to deep within the site, with increasing levels of privacy.

As is typically found in vernacular buildings in temperate climates, many of the activities of daily life in this region occur outside. This includes cooking on open fires or in fire pits and eating in covered shelters called *bondas*. Schools and medical clinics throughout the region are typically organized courtyard spaces. As a result, outdoor spaces and *bondas* play a central part in the organization of the project.

## *Design for All*

According to the Tanzanian *Guideline Standards for Health Facilities*, any health center must provide appropriate housing for doctors and nurses.[27] The facilities must be sufficiently desirable to draw medical professionals to the medical schools in the Tanzanian cities of Dar Es Salaam and Mwanza. However, the health center must also support the patients and their families, the staff, visiting medical personnel, as well as the whole community.

The master plan includes distinct zones for doctors' and nurses' housing, as well as for their families, and includes a facility proposed for visiting medical outreach staff, such as VLOP. There is a designated area within the clinic complex for the families of patients who typically provide food and laundry facilities for the patients. In addition, there are specific areas for men, women, children, pregnant women, and new mothers within the health center.

## *Infrastructure*

Given that there is no source for clean water, no source for power, and no source for clean sanitation, a thorough, phased proposal for infrastructure has begun.

According to public-private partnership agreements with them, the Tanzanian government will begin providing infrastructure once the health facility is constructed and permitted. However, there is no guarantee that this will occur at any point in the near future. Therefore, a full infrastructure plan is included in the master plan.

Technologies for power generation and storage, water collection, storage, and filtration, and waste collection must be made available with the consideration of health, safety, and collective knowledge of the community. All infrastructural design choices are intended to provide the highest quality resources to the community with the lowest environmental impact and a minimal need for maintenance.

In addition to digging a well to provide much needed water, every roof will act as a water collector. Water will be stored for long-term use before being transported to elevated storage. From there it will be dispersed to individual buildings where it will be filtered and heated as needed. Potable water will be brought to a central location: a water house. From this point, it will be delivered manually to each building as needed. This assures quality assurance and security of this vulnerable resource.

Renewable energy will be the predominant source of power generation, although energy needs will be kept to a minimum by utilizing passive solar principles to provide buildings that need no mechanical cooling or heating. Energy for lighting, pumping water, medical equipment, and appliances will be provided by photovoltaic panels with back-up generators.

Sanitation is a complex issue culturally. The typical pit latrine used in the region is perceived as being a viable option because the unlined pits rarely fill up. The waste is unfortunately leeching into the soil and potentially into the groundwater and aquifer. A more ecologically sound lined pit will have to be cleaned out and there are no companies providing this service. The most ecologically appropriate solution is a composting toilet, although there is a cultural stigma

**9.6**
Roche villager showing ISSB brick. Photograph by Emily Roush, 2009.

attached with any toilet that has to be cleaned out. As a result, we are going to attempt to slowly integrate composting toilets and work with the community to assess whether this stigma can be adjusted through education.

## *Design from the Ground Up*

All construction on this site has been envisioned as a series of teaching tools for effective and appropriate contemporary construction for Roche Village and throughout the region. The contemporary kiln-fired mud brick construction has significant negative environmental impacts, is not structurally sound, and leads to significant waste and deforestation. Future construction must exemplify more effective solutions that address these issues of environmental impact, durability, and stability. Yet, all new construction must be proposed to incorporate available materials, available construction knowledge, and appropriate environmental performance.

The construction of the health center is designed to be clearly legible and replicable in order to inspire technology transfer. The buildings become models for teaching new construction methods and for local expression through craftsmanship. By bringing local materials and crafts into a new construction methodology and encouraging interaction throughout the site, the health center will be a nucleus of innovation and inspiration for the community of Roche. Construction classes will be available for all villagers through the community education center.

## *Community Buy-in*

The health center must be welcomed and embraced by the people of Roche and the surrounding regions. The proposal for the Roche Health Center design came from a clear understanding of the programmatic, cultural, social, and aesthetic desires of the community that will be using the facilities. However, we recognize that we cannot completely understand what a building form means to this community. We have continually shown progress designs to our local partner SHED as well as to the Roche Village community. The response has been positive, but it is critical that the health center is fully accepted and "belongs" to the village. We will incorporate the drawings, paintings, and crafts of the people of Roche throughout the Roche Health Center.

## *Flexibility and a Systems Approach*

Regardless of what we design, it will not be exactly what is built. What we intend to provide to the community is a set of proposals and relationships that they can incorporate and adjust for their own needs. We are proposing a construction and spatial system that can adjust to the residential scale of the housing or the institutional scale of the medical complex. The spatial organization maximizes available daylight and ventilation as well as circulation into and through the spaces. These spaces can be organized in a multiplicity of different sizes and organizations depending on the users' needs.

**9.7**
Digital rendering of proposed Roche Health Center entry

For the construction systems, we are proposing three material options based on distances to material availability: that which is only available in Roche and Shirati (within 20km), that which is available in the nearest city with hardware stores, Tarime (40km), or from the nearest major metropolis, Mwanza (200km). Based on availability and budget, they can choose which system to utilize for construction.

## *Expansion, Phasing, and Re-assessment*

The health center design will incorporate simple, replicable buildings in a legible relationship to each other, surrounding clearly defined outdoor spaces. The site program proposal contains the medical clinic, housing for the medical personnel, dormitories for visitors and patients' families, a canteen that services the clinic and the community, as well as a place for communal and educational activities. The adjacent areas of these buildings provide ample outdoor space for interaction among all visitors and users of the facilities. The organization is designed to provide a clear system for expansion.

Phase one construction is intended to produce one clinic building and one doctors' house. The construction will bring to light questions and solutions. These will be documented, studied, and assessed before any additional building occurs. The goal is that the project will evolve as the specificity of needs and knowledge increases. At every scale of the project, flexibility of use, of technology, and of construction is incorporated into the design to allow the users to interact with and adjust the design of the buildings.

Measuring success for a project such as this is challenging. We hope to find that the Roche Village community will improve upon the systems for design and construction in the health center as the project evolves. We hope to find that they are replacing the seismically unstable kiln-fired brick construction with safer, more durable construction. And, we hope to find that the health center is effectively serving the community for health, life, and education.

## Notes

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17 Ibid., 9.
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Chapter 10

# Constructive Dialogue

## Community Building as a Tool of Social Change

*Nick Seemann*

In 1998, Sthir Basti,[1] a squatter community located in open fields on the edge of Kathmandu, faced several challenges. The children lacked access to education. They were located on land they did not own and feared eviction. They had a limited sense of being part of a community, measured in terms of people within the settlement knowing each other. They had low incomes with few financial resources beyond subsistence living.

By 2005 the area resembled any other suburb of Kathmandu. The city had grown to encompass the settlement, there was an increase in wealth, a functioning school, water pumps, and strong participation in community life evident in an active network of women's savings groups. Individual action might have generated wealth for specific families, but the settlement-wide change was the result of community development initiatives, which had been supported by the process of constructing the school. Sustaining communities such as Sthir Basti, helping them grow and developing their capacity to address challenges as a community, is central to addressing the global environmental problems we all now face.

Sustainable practice requires massive social change. Communities provide the basic unit of social change. This chapter gives two examples of community-based projects (one in Nepal and one in Australia) that explicitly implement strategies for focusing on environmental impact and resource conservation. It explores the role of an architect working with communities to address both social and environmental issues, and presents an approach for doing so.

Problems relating to over-reliance on fossil fuel-generated energy, energy wastage, water scarcity, and forest depletion are now well documented, as is the impact that building design has on these issues. Never in the history of architecture has a new idea entered the marketplace as quickly and thoroughly as sustainability. Most architects and clients say they want this. The question is whether all this has any real meaning without serious community involvement and "buy-in."

Intellectual discourse and government policy continue to concentrate on operational issues, regulatory processes, and the technical knowledge of building

professionals, yet these alone cannot create a shift in how we build or address environmental issues. The shift required is social. Communities provide a forum for exploring issues, developing responses, and realizing decisions. While individuals are often unprepared to make the sacrifices required by a lifestyle that has a lower environmental impact, community initiatives provide a base for that change. Community construction projects mobilize people around a shared resource and lead to direct action. This is enabled by the investment that a community has in the building in which they will live.

In recent work Constructive Dialogue Architects[2] has developed a church that has a low environmental impact through extensive use of daylight, passive solar design, and cross-ventilation, in lieu of reliance on artificial lighting and air conditioning. These were achieved through building siting and orientation, with rooms opening up to interconnected gardens that step down a sloping site. However, the building will only retain its low impact through the manner in which it is used, such as the church community's commitment not to retrofit high-energy heating and cooling systems. The success of the building is thus reliant on the knowledge and skills developed and retained by the community during the design process.

The approach presented in this chapter has been developed by Constructive Dialogue Architects over the past decade. It incorporates the participant-observer methodologies of social researchers such as Paul Atkinson[3] and the pattern languages of Christopher Alexander.[4] Two projects are used as case studies to illustrate the approach. The first is the Nepalese community school mentioned above, through which the methodology was initially developed. The second case study describes work on the redevelopment of a homeless men's facility in Australia. Both projects have been chosen due to their focus on the process of social change and their small size, making it easier to examine them in detail.

## Nepalese Community School Building

In 1999, as part of postgraduate research,[5] I was involved as an architect working with Lumanti, a local non-government organization that supported community development programs in Nepal. Along with Lumanti, I assisted a local community of approximately 170 households, living on land they did not own, to construct a school. The work followed other community development programs supported by Lumanti, including the establishment of women's savings groups.[6] Lumanti staff saw the construction of the school as an opportunity for the community to work on a shared asset that would necessitate further cooperation, require an increased commitment by individuals to the community's organizational development, and provide an additional resource to the community. A series of themes were developed out of the research with implications for how architectural practice can support community development. These themes include design languages, community development, and relating to existing situations.

The term "design language" is used to describe a set of concepts through which people discuss the planning of a building project, such as functional requirements, building form, materials, and relationships between spaces. In this project familiarity with the concept of a "pakka school" encouraged the participation of community members. The following excerpt from field notes describes a

preliminary planning meeting organized by Prashant, one of the people within the community driving the project:

> The meeting was held on mats in a dusty yard under the bamboo frame of a previous school building. Men sat at the front, women in their own group at the back. Some people sat under the verandahs in front of homes around the edge of the yard. Prashant sat at a table with a representative of the municipal department that would provide teachers and introduced the project. He explained to the gathering: "The earlier bamboo school was a failure. We ran out of resources and did not finish it. Then it fell apart. For this school we will provide labor and foundations. Lumanti must provide everything else to finish four rooms. And it must be pakka (solid)."
>
> Everyone knew what sort of building he was speaking about, one with a raised floor on a brick podium to keep it above the flood level, solid white-painted walls, timber-framed windows along one side and a metal roof with no insulation. He provided a drawing to support his concept of a "government school."

This excerpt demonstrates the value placed on a "pakka school" as a known product. It was a building type defined by Davis[7] as a repeated configuration of space that reflects relationships and values that are commonly understood and shared within a culture. This became an important concept for working with the community, as it was a recognizable form and a clear goal. Community members expressed a distinction between accepting "katcha" (temporary or makeshift) construction in their own homes and the pakka construction they expected in a community building. The particular choice of type also supported one of Prashant's primary objectives, namely the registration of a recognizable government school on the site, which he believed would reduce the likelihood of eviction.

The second theme is "community development." One of the project's primary focuses was social supports and outcomes. Lumanti hoped that the school planning process would strengthen the women's savings groups. Asta was the head of the first women's savings group in the community. Her dissatisfaction with the school planning and construction is outlined in the following excerpt from field notes:

> "Akash said the windows are okay, but they are not. The pillars are crooked and the walls are not straight." Sirish backed her up: "the room is not good, because the roof is not symmetrical over the space. We were part of decision making, after which the men still did what they wanted."
>
> During a discussion about the windows, Asta had pushed for the need for more light and openness for fresh air. She had supported my suggestions of more windows and a series of openings made by leaving out bricks from the wall. The men had agreed, but had not followed this through.
>
> "I no longer make suggestions, because no one listens even though I raised Rs 12,000 [The women's savings groups collected

> money from community members to make a contribution to the school construction required by Lumanti]. If I knew how to make a wall, I'd do it myself. I want a good school to improve the children's play area, raising them out of mud, even paving the yard and adding a gate to prevent garbage."
>
> I suggested that we could arrange brick-laying lessons. Asta was excited. She was certain that Sirish, Purnima and Sarala would get involved. They would show something to the lazy men. And if they did it, "the building would be beautiful."

A series of issues can be identified in this excerpt. First, the savings groups were an important existing social structure. They brought people together, provided a discussion forum, and helped them develop financial resources. Second, the groups helped bring about change within the community. Even though the women were excluded from the initial planning, through the control of funds they gained an ongoing say in community matters with representation in the community's leadership group. Third, the women had a different aim in the construction of the school: creating a good place for their children to learn. Ultimately the aims of both Prashant and Asta could be fulfilled, but it was important to define those aims as part of the planning process.

The savings groups supported what Friedmann[8] describes as "bases" or community needs. Relevant bases to this work were social organization, financial resources, defensible space, information, and construction skills. The community as a whole gained from the strengthening of various bases, more than they would have benefited from being given a completed building, irrespective of the qualities of that building. The approach left control in the hands of the community members, encouraged the participation of women, and encouraged them to learn from incidents and develop systems to avoid replicating patterns of undesirable decision-making.

The final theme is "relating to existing situations" as the foundation of bigger work. Each stage of the work focused on small changes to existing social and environmental structures, rather than the introduction of new designs or large-scale replanning. The experience of completing the first room of the school provided the foundation for further work being carried out with increasing independence. Six months after the completion of the first room, classes were still being held and the women continued to maintain the building, repair damage, and plan further initiatives. Six years later they had completed the construction of two further classrooms, toilets, and a water pump, as well as paving the courtyard.

The incremental change to a familiar environment enabled the community to focus on specific, smaller issues, rather than being overwhelmed by the enormity of a larger project. It also gave those involved time to critique each completed stage of work prior to planning the next stage. The community members were thus able to retain control over the development of each stage and manage the product, rather than relying on a benefactor. Retaining elements of an environment that function well is crucial to sustainable outcomes; it conserves both human energy and resources that can then be directed where they are needed most.

The primary outcome of the work on the school was social: the community's ability to address various challenges. Yet, both the planning and construction

process was primarily focused on the development of the physical environment. The architect's role was to help facilitate that planning process, direct the discussion toward environmental impact, and help identify options. The social research methodology enabled me to develop an understanding of issues relevant to community members, formulate a process for discussing issues, and evaluate the success of each part of the project. The methodology helped in the identification of what Gergen describes as "social knowledge,"[9] or common understandings of the environmental issues to be addressed.

One community member noted that Lumanti's and my role had "made the school possible, not due to funding support, but by stimulating conversation on the work and keeping it going. There are always lots of arguments that make a project as large as the school difficult." Unfortunately, rather than seeing these problems as an opportunity to reflect on issues, they often become excuses for removing power from the end users of a building and concentrating it in the hands of a few decision-makers who control funds.

## Homeless Men's Facility in Australia

Foster House is a homeless men's facility in Sydney run by the Salvation Army. Constructive Dialogue Architects were engaged to work on renovations to the building at a time when the management team for the facility were considering a major shift in their approach to service delivery. Therefore, as with the work in Nepal, the architecture was intentionally supporting other social agendas. The process included participant-observer research studies, auditing of the building to establish strengths of the initial configuration, the development of a shared design language with the management team, incremental change to adjust the existing environment, and workshops that explored the implications of significant design decisions.

The primary agenda presented by the management team was a change in approach that they defined as a shift from provision of accommodation to case management. According to the staff of Foster House, there has been a change in the profile of people coming to the service over the past twenty years. Previously it had been 50- to 60-year-old alcoholics; now the average age is approximately 39. In addition, the issues have become more complex. In Sydney people are often homeless owing to social issues beyond the lack of access to appropriate accommodation. Service records indicate that 80 percent of clients have mental health issues, and 74 percent have drug and alcohol issues. Prior to the commencement of work on the project, the main focus of the service was to give people a bed. The team now wanted to focus on personal change. In the terminology of the manager, this required "challenging people to shift towards more stable lifestyles and helping provide a pathway." The management team were also extending their own capacity to explore issues as a group, rather than utilizing a top-down, instruction-based decision-making process.

The work on the building involved three distinct construction projects, starting with the establishment of the detox unit, followed by changes to the entry and office areas, and finally the reconfiguring of the intoxicated persons unit (IPU). These were carried out sequentially over a five-year period from simplest to most

complex. Each change reflected the management team's development of the case management approach.

Initially Constructive Dialogue staff spent time within the facility observing what happened at different times of the day and holding workshops to explore the implications of the case management approach. The project team (architects and management) developed a set of design ideas as a shared *design language* that could be translated into specific changes to the building. This developed the "pattern languages" of Alexander by articulating the brief as a series of ideas, with reliance on diagrams.[10] Separate diagrams were used to illustrate each design idea and this facilitated the input of the management team by giving the concepts that had been discussed an intelligible form and thus encouraging further refinement.

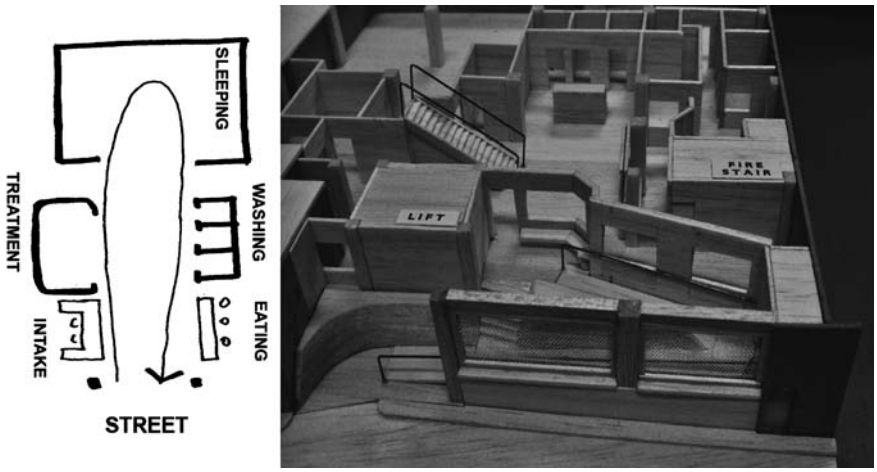
The feedback from the management team was that this process was both valuable and familiar. It allowed the staff to explore concepts beyond their experience, training, and knowledge and had similarities to their own case management work in which the objective is informed decision-making.

The case management approach required three social issues to be addressed: a welcoming entry; a recognizable pathway; and a safe environment for small group conversations. Each issue is outlined below with the text of the associated design ideas that were formulated with the management team and specific building work that they prompted. Many of the design ideas crossed over several social issues, but have been grouped with the main issue with which they were associated.

The first issue regarding "a welcoming entry" had implications for the whole process of arrival. Most of the residents did not arrive in a jovial mood, whether due to the harshness of street life, mental health issues, medication, or other reasons. Prior to the commencement of the first renovation project the management team had established a "Socks and Jocks" program. The men coming to the facility had already been given access to second-hand clothes; this program provided each person entering the building with new socks, new jocks (underwear), and a sweet milky drink. Despite initial skepticism from some staff, the program had reduced some of the aggression, and it resulted in improved relations between staff and residents and also helped improve sleep.

The project team recognized that the environment in which people arrived was important to social outcomes. It needed to demonstrate respect for those arriving and distinguish the facility's appearance from correctional facilities, hospitals, and other institutions that were familiar to many of the residents. The institutional appearance of these places is characterized by plastic surfaces, harsh light, and glass barriers. This appearance encourages an expectation of aggression that is often fulfilled, with each person either becoming submissive or having to "fight against the system" to retain any self-determination. Furthermore, as the facility was located in a suburb that has become gentrified, staff felt the need to maintain a positive non-slum-like appearance from the street for better neighbor relations.

This led to two key design ideas: "A process for supporting clients moving through the service" and "A clear gateway."




**10.1**
Diagram of Design Idea (a process for supporting clients moving through the service). Photograph depicts realization of Design Idea in a model showing space configuration.

**DESIGN IDEA: A process for supporting clients moving through the service**

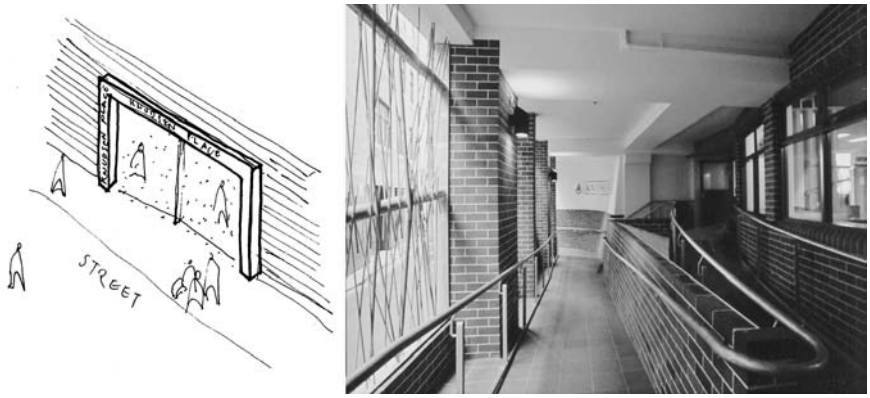
*The design needs to reflect a process of intake and support. Clients enter off the street to an initial point of intake. They can then access a range of services including food, a shower, new clothes and treatment, before moving through to a place where they can sleep. Upon leaving, clients can again access the services.*

This idea was literally translated into a transition path past the services within the IPU from the street to the bedrooms. The model in Figure 10.1 shows the different parts of the IPU and the direct translation of the path into the space: a ramp leading to a foyer, services surrounding the foyer, and dormitories beyond.

**DESIGN IDEA: A clear gateway**

*"You are either in or you're out." If a resident is within the facility there are rules which they need to follow. The gateway point establishes where that rule-governed space begins. It is also important to staff that they can control the entry point. If a resident is asked to leave the building, they should not be able to sit around an entry from which staff cannot remove them.*

Previously the IPU was a dark, unpleasant space with little room for interactions outside of the dormitory and little visual connection to the street or other parts of the building. Due to its location on the lowest level of the building, opening into a rear lane, it needed to be opened up as much as possible to daylight. The metal screen in Figure 10.2 shows the fence that was created as a clear boundary to the building, but allowed in a lot more light to the IPU foyer. The zone of the ramp and the fence itself formed the required barrier. The design of the fence as intersecting rods was developed to create an interesting façade from the street that looked less institutional.




**10.2**
Diagram of Design Idea (a clear gateway). Photograph depicts realization of Design Idea in entry ramp.

The second issue of "a recognizable pathway" was fundamental to the new approach and was formulated as a continuum of care that provided clear steps from the street to a more stable life. Not everyone came in at the same point. However, many initially entered the IPU, where the average length of stay at the unit is only a few hours. This was also the only part of the facility that an intoxicated person could enter. The second step was a medicated detox unit, introduced as part of the new service model that was used to remove physical addiction over a ten-day period. The third step was short-term crisis accommodation on the site for up to three months. A final step prior to leaving the service was community housing in which the residents were supported for up to two years in shared apartments around the city for which the Salvation Army was landlord.

The project team recognized that visible links between the different parts of the facility would support an awareness among residents that the continuum existed. Furthermore, each part of the building should be connected to a shared space: a central atrium. This led to the following design idea.

> **DESIGN IDEA: Connecting stair: integration with the Foster House community**
>
> *It is easy for the IPU to become a distinct dungeon, hidden way from Foster House. The form of the stair and the space around it should help to connect levels and maintain a sense of a connected building. This shows clients that they are part of a larger place. This can be achieved by openness of the space around a stair allowing vision between levels, acoustic connections and even the form of the stair extending out to the level above. The stair needs to maintain some form of barrier that allows for the movement between levels to be prevented when this is required.*

The building was renovated in 1996 through major interventions, including the establishment of an atrium in the center of the building which linked four storeys. However, this atrium did not extend down to the IPU, which consequently felt like a dark, disconnected cave to residents and staff. The atrium created an important social hub as it was a thoroughfare for people moving through the building, somewhere to smoke, and the primary social gathering space.


**10.3**
Diagram of Design Idea (connecting stair). Photograph depicts realization of Design Idea through changes to the stair.

The initial work on the detox (the first project) focused on the relationship that the unit would have to the atrium. Conversations with management resulted in the location being changed. A gathering space for the detox was set up next to the atrium with dedicated internal and external areas for people from the detox. Similarly, work in the final stage linked the IPU to the atrium by reconfiguring a stair (see Figure 10.3). The stair was originally a "dog-leg" stair with a mid landing, surrounded by a glass screen to prevent any sound from traveling between floors. This reinforced a perceived separation from the building as a whole. The work involved cutting the stair in half and welding it into a straight flight, creating a lot of space around the stair and allowing people in the IPU to see the atrium. This was not originally seen by facility staff as having any significance, but was later assessed by them to have transformed the space.

The third issue of "a safe environment for small group conversations" between staff and residents as well as within the staff community was critical to the success of case management that is often built on short informal interactions. To support conversations, more opportunities for people to engage were required, such as places to have a hot meal, somewhere to sit and chat. However, while glass barriers and cages present an impediment to counseling, staff were concerned about their own safety. Many of the harder drugs that are used by people coming to the facility can lead to violence and psychotic episodes. These issues made Foster House a challenging and tiring place for staff. There was a strong need to support them in ways that would help reduce that stress and keep them out of physically exposed situations. The interactions between staff and residents would only be successful if the environment helped make all those involved feel comfortable. We also observed the tendency for the residents to be more comfortable sitting in corners away from large social gatherings. This was consistent with street life that often involved sleeping in alcoves around doors as safer than more exposed sites.

The above led to two key design ideas: "Boundaries and staff–client engagement" and "The Fishing Pond."

**DESIGN IDEA: Boundaries and staff–client engagement**

*The client group have an impaired ability to understand and acknowledge social boundaries. Yet the types of boundaries between staff and clients are fundamental for the facility to work effectively. Boundaries need to provide an obvious physical separation, but allow for easy visibility and*


**10.4**
Diagram of Design Idea (boundaries and staff–client engagement). Photograph depicts realization of Design Idea in reception desk and interview booth design.

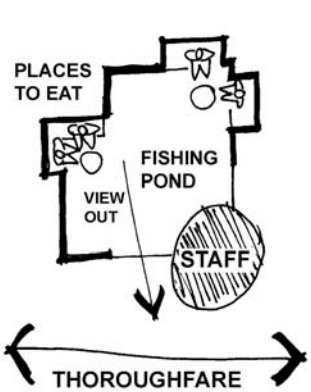
*conversation. These can include a tall or wide reception desk, wide interview desks or a barn door. A barrier can also become a focus of social interaction.*

Throughout the building, joinery items were designed with proportions that provided safety for staff, while not presenting a physical barrier at face height. This is illustrated in the photo of the reception desk and an interview booth beyond divided off from the foyer by a cardboard cylinder screen (Figure 10.4). The screen was robust and provided some privacy, while allowing staff to see and hear what was happening. The design of the reception, entry, and counseling booth provided a safe place for staff and clients that would remove barriers to conversation. However, the design also provided clear physical boundaries as physical impediments to attack, good lines of sight between staff members to enhance their ability to support one another in crisis situations, adequate space to reduce tension, and clear retreat paths for both staff and clients. The materials used were chosen to be robust, but also warm, natural finishes to reduce the sense of institutional space.

**DESIGN IDEA: The Fishing Pond – loitering encouraged: food as a focal space for engagement**

*Foster House staff aim to engage with homeless men and offer options for them to move to more stable lifestyles. To assist informal chats, there needs to be an alcove or side space in which the men can eat, wait, or relax. This space provides an environment in which staff can engage proactively with clients. It is a space that is more likely to be used by clients after they have slept and should be out of the thoroughfare to avoid too much interaction between those arriving and leaving the service. Food needs to be prepared in a kitchen that is only accessible to staff.*

Figure 10.5 shows a series of booths that were designed to be a continuous landscape of seats to provide space for residents, while always presenting a spot for a staff member to sit and have a conversation. The built-in design was chosen by the staff as it would be easier to maintain, look neat, prevent items from being




**10.5**
Diagram of Design Idea (The Fishing Pond). Photograph depicts realization of Design Idea in sitting booths.

hidden, and house no free-standing furniture that might be thrown around the room.

The outcome of the three projects at Foster House was that the agenda of the management team was realized and they became more aware of the impact of the space that they were using. The management team also gained ownership of the work in that they took responsibility for the impact of the adjusted environment. The design had become an exploratory process working through ideas with the client.

## Further Steps

Howard Davis provides a model of building cultures as "the coordinated system of knowledge, rules and procedures that is shared by people who participate in the building activity that determines the form buildings and cities take."[11] Social processes are central to whether or not architecture can shift to a sustainable paradigm. The operational knowledge alone is insufficient.

This chapter has explored an architectural approach directed toward community development, grounded in the belief that communities are the basic unit of social change, and that their structure intrinsically contains the supports required to address the challenges such a shift of lifestyle presents. Those supports include a community's ability to bring together differing perspectives and ideas in order to consider issues, the greater impact of a group decision over that of individuals, the sharing of resources, and peer support to act on specific decisions.

The examples used in this chapter have focused on social outcomes with implicit environmental implications. The approach has also been used to more explicitly address sustainability outcomes. One example is work currently in preliminary planning stages on an Integrated Child and Family Center. The development of the brief as a set of design ideas has brought together a management team with different professional orientations – early childhood learning and family services. It has addressed both social issues (teaching and community services methodologies) and the management team's sustainability agenda. As a learning center located in a part of the city that is challenged socially and economically, their aim is to both

realize and demonstrate how to reduce environmental impact. If this is achieved, the children and parents who will form a community of users will experience what is required to maintain good environmental practice through use of the center. Ongoing commitment and awareness by building users will be required for the project to be successful.

The case studies described in this chapter provide specific examples of one professional approach. However, there are generic elements to this approach that can be adapted differently to other projects. Those elements are listed below.

1. Clear definition of objectives and roles: The extent to which an architect or any other professional can realize a social agenda is limited by the terms of an engagement and the parameters set on a specific assignment by the client. Therefore, agreement and commitment from the commencement of a project regarding aims and the decision-making process are important. This includes identifying priorities, decisions that are important to the community, and issues to be left to professionals with limited consultation. At the outset of a project clients often present a closed brief in which they have answered the questions they have chosen to pose. A challenge to the architect is how to best open up that conversation. Helping clarify goals and refining organizational strategies is part of the community-building process and may require the use of non-traditional professional skills such as scenario planning.[12]
2. Capacity-building focus: While the example from Nepal demonstrates work in a context in which communities are strong, in Australia community structures are less clear. An architectural project cannot build communities that are non-existent, but the stakeholders (such as a management committee, work team, or residential group) can be brought together around a project. The processes discussed work best in collaboration with existing community-building initiatives, whether coordinated by distinct organizations or by individuals within a community. The capacity being built might also relate to specific skills, such as the training of indigenous tradespeople to service their own communities in the work of Healthabitat in remote Australia.[13]
3. Small workshops: All the initiatives described relied on a series of small group workshops. These are also critical to the social outcomes being realized. Depending on project size and complexity, workshops might be limited to meetings with a single project team or a range of meetings for groups with distinct concerns. The workshops need to be oriented toward resolving specific decisions with demonstrable outcomes. In the Foster House projects these were highly valued by clients, as they acquired skills outside of their training and experience. The process became a self-perpetuating motivator as, once some decisions were realized, enthusiasm grew for the group to confront the next issues.
4. Shared language: The projects discussed follow an approach to the development of project design briefs based on the methodology of Alexander. However, different methodologies can be equally successful, such as the narrative approach of Peter Hübner.[14] Whatever form the language takes, it needs to allow the representation of social relationships and provide a clear direction to design work.

5. Following a sequence: For people to gain a sense of ownership of a project, the workshops need to be convened throughout the project period. At different stages workshops need to be framed differently. This includes establishing overall aims at the start of the project, developing the language during brief development, considering specific design issues raised by the architect through the design, reviewing the outcomes through construction, and preparing for operation and maintenance once a stage of work is complete. These sequences also allow larger, generic issues to be reduced in size and complexity to a series of distinct and specific issues.
6. Building on what exists: Retaining what works in a building ensures sustainable practice by avoiding wastage of resources and energy, both physical and social. In the Foster House project, the original plan of the management team had been to move the dormitories. However, through the course of the project they realized that the location of the dormitories was not a problem. Therefore, their location was retained, while the rest of the spaces were reconfigured around them. By assessing the existing environment with a community, a project team draws on users' knowledge of the strengths and weaknesses of the place in which they live. It has the further benefit that community participants work from a position of familiarity.
7. Underlying social research: The projects described relied on social research techniques that define a participant role for architects. They become part of the group for the duration of the project, rather than a detached individual creating something independently to be handed over at the completion of the process. Participant–observer methodologies have been heavily documented as they apply to ethnographic research by people such as Atkinson and Margot Ely.[15] The aim in this context is to help the professional understand an existing context better, identify issues that the group will need to consider, and recognize values that might be expressed through action (consciously or unconsciously), rather than identified in discussion.

Together, these elements create an approach that inspires a community to be reflective and empowered to make considered choices, whether or not they choose to lessen their impact on the environment. This is the realization of Paolo Friere's approach toward community development as a shared process of exploration that brings together the community and the professional for the period of the engagement.[16] However, many of the elements described above are often absent from architectural practice. Without them architecture becomes a marketing exercise that seeks to sell the vision of an individual professional to the end users. The resulting imposed solutions are often resented by community workers and other building users, and impede the potential for a well-designed space to contribute to positive human relationships and environmental outcomes.

The issues which a community face will inevitably change. There are many examples of frustrated professionals returning to childcare centers that are not being used in the way for which they were designed, air conditioning being retrofitted to buildings designed for low energy usage and poor additions that compromise ventilation, passive solar design, or the function of buildings. Beyond creating a pristine "green" building, the aim needs to be broader, to assist people in developing more sustainable lifestyles relevant to the specific context of the

project. This will allow for ongoing actions that reinforce the aims of any project and leave those involved with clearer ideas of what can be achieved in the future through initiatives with which they are involved.

To that end, the best criterion for judging the success of community architecture comes once the construction work is complete and can be measured in terms of community development. This includes the community's sense of ownership of the end-product and the skills developed by the various stakeholders involved in the process. Sustainable building requires groups and individuals to develop an ability and commitment to continue to find challenges, reflect upon them, develop new responses, and carry through their solutions.

## Notes

1 All names used in this chapter associated with the Nepalese community have been changed to protect the privacy of those represented.
2 The author is a director of Constructive Dialogue Architects, a Sydney-based firm established to develop buildings that support community development initiatives and organizations involved in the delivery of social services.
3 Paul Atkinson, *The Ethnographic Imagination: Textual Constructions of Reality* (New York: Routledge, 1990).
4 Christopher Alexander, Sara Ishikawa, and Murray Silverstein, *The Pattern Language* (New York: Oxford University Press, 1977).
5 The research was a participant-observer study involving multiple weekly visits for a twelve-month period to the community described in this chapter, titled "Mapping The Mandala: An Approach to Community-based Architecture in Kathmandu, Nepal" (M.Arch.-diss., University of Oregon, 2000).
6 For further discussion of women's savings groups as a community development tool in Asia see the work of the Asian Coalition for Housing Rights at www.achr.net and the Grameen Bank at www.grameen-info.org.
7 Howard Davis, *The Culture of Building* (New York: Oxford University Press, 1999), 132.
8 John Friedmann, *Empowerment: The Politics of Alternative Development* (Cambridge: Blackwell, 1992).
9 Kenneth Gergen, *Towards Transformation in Social Knowledge* (London: Sage, 1994).
10 Alexander's "pattern language" patterns are presented as universal solutions to problems repeated "in the environment." The approach presented in this chapter develops Alexander's work by recognizing that ideas are necessarily subjective, constantly evolving, shared by a particular group, and oriented to a specific project only.
11 Davis, *The Culture of Building*, 5.
12 The application of scenario planning to architecture is discussed in Stewart Brand, *How Buildings Learn: What Happens after they're Built* (New York: Viking, 1994), ch. 11.
13 Paul Pholeros, Stephan Rainow, and Paul Torzillo, *Housing for Health: Towards a Healthy Living Environment for Aboriginal Australia* (Sydney: Healthabitat, 1993).
14 Peter Blundell Jones, *Peter Hübner: Building as a Social Process* (Stuttgart: Edition Axel Menges, 2007).
15 Margot Ely, with Margret Anzul, Teri Friedman, Diane Garner, and Ann McCormack, *Doing Qualitative Research: Circles Within Circles* (London: The Farmer Press, 1991).
16 Paolo Friere, *Pedagogy of the Oppressed* (London: Shed & Ward, 1972).

Chapter 11

# Interview with Durganand Balsavar (Nandan)

## Director-Principal Architect of ARTES-Human Settlements Development Collaborative, Chennai, India

January 2010

*Adrian Parr*

**What does sustainable development mean to you? And, how do you understand the connection between disaster mitigation and sustainable development?**

Development, as we experience it, is sustainable when it responds to human needs for a better quality of life, while protecting the environment we live in. Philosophically speaking, sustainable development recognizes society's responsibility to conserve the environment "for futurity." We do not subscribe to the conventional view that destroying natural environs is inevitable in the face of growing urban needs. However, the challenge lies in discovering an innovative balance between ecological sustainability, livelihood, and a creative freedom of expression.

We are aware that the natural environment faces tangible threats, such as deforestation, coastal erosion, sea level rise, topsoil erosion, air and water pollution, destruction of biodiversity with the extinction of animal and plant species and depletion of fossil fuels. This destruction ostensibly appears to be driven by narrow economic considerations and callous vested interests. Fortunately, there is growing awareness of the link between indiscriminate frenetic development and the adverse impact of climate change, resulting in frequent large-scale natural disasters. Disaster mitigation and sustainable development are hence inextricably linked.[1]

In this context, development is sustainable when communities participate in the process of shaping and building their own environments and conserving non-renewable natural resources. Over the centuries indigenous communities have had a symbiotic relationship and reverence for Nature, that modern societies can well emulate and learn from. These traditional cultures were aware of the catastrophic

consequences of destroying forests, the fragile coastal ecology, and depleting natural resources. These practices are invariably put to test during the rebuilding process in the aftermath of natural calamities, be it earthquakes, cyclones, tsunamis, or flooding.

Conventional practices of planning are inadequate to address these complex issues. They demand a paradigmatic shift with innovative community-based approaches, synthesizing disaster mitigation with mainstream development. The immediate challenge for Southeast Asia lies in addressing basic needs of urban development, infrastructure, affordable housing, transport, conserving energy resources, education, and healthcare in the context of a fast-growing population.

Studies indicate that environment-conscious development could reduce pollution and ameliorate trends in global warming. Reforestation could stabilize rain patterns to a considerable extent. Thus sustainable development could not only slow down the prospect of climate change but also minimize the incidence of natural disasters in the long term.

**How is the rebuilding of communities a problem of sustainable design? And how does ARTES approach the process of rebuilding?**

In the event of a disaster, needless to say, the community is most affected. Facilitating communities to be self-reliant during the rebuilding stage is essential for any sustainable development. The corner-stone of rehabilitation is one in which community leaders, women, elderly, and children evolve their own ecological future, facilitated (if required) by governments, architects, non-governmental organizations (NGOs), and other organizations.

Our experience revealed that proactive communities are more resilient and accountable; they are better prepared to collectively respond to adversity and are less dependent on external agencies for assistance. These conditions promote an awareness of the need to conserve local ecosystems.

Since the trauma of having survived a cataclysmic event can momentarily weaken a community's resilience, the ARTES design team begins by reinforcing community decision-making rather than hastily imposing decisions. Facilitating communities to be self-reliant enhances the sustainability of the rebuilding effort because it encourages the community to work together.[2]

As catalysts, facilitating the disaster risk-reduction process, ARTES collaborated with the community and initiated an assessment of vulnerability, training, and capacity-building in environmental conservation and appropriate green building practices, coastal zone management, effective networking of marginalized communities, affordable technology transfers, disseminated alternative energy-efficient technologies, and formulated ecological settlement planning guidelines.

**ARTES takes a catalytic approach to rebuilding communities that have been devastated as a result of natural disasters. Could you describe what you mean by "catalytic design" and how it works?**

Indigenous communities, most often, are acutely aware of their own needs and familiar with their environment, its resources, and terrain. They are also valuable

repositories of ancient traditional knowledge. In such a context, our premise is that development is sustainable, when communities actively participate in the process of rebuilding their own environments. Thus, while working with communities during the post-tsunami rebuilding process (2005–2008) in Nagapatinam, a catalytic participatory approach was evolved.

In this context, the architects reinforced traditional knowledge and equipped the affected community with appropriate skills in alternative construction technologies, design, and settlement planning through capacity-building programs. The program recognized and assimilated indigenous skills, locally available materials, technologies, and cultural practices rather than indiscriminately imposing alien solutions on the community.

By collaborating with the architects, the community designed its own dwellings and settlements with a better understanding of the issues involved. The new skill base opened up new avenues for alternative livelihoods.

Significantly, such an approach ensures continuity of traditional practices and knowledge even as it explores possibilities to upgrade construction and design standards in response to the disaster. Through an interactive discussion with engineers, architects, sociologists, anthropologists, and economists, the community identified its specific response to the rebuilding process. The process thus is suggestive rather than prescriptive.

To reiterate, a catalytic process is one in which communities take their own decisions and assimilate skills for long-term resilience, facilitated by an appropriate capacity-building program that enriches the traditional systems.

In promoting equity and building confidence between the architects and the community, several responses to relief, rehabilitation, and rebuilding efforts gradually unfolded. In addition, discussions around the broader issue of disaster mitigation helped the architects better understand the relationship with the community.

**Often the rebuilding of communities struck by natural disasters is treated simply as an exercise in engineering. Do you think this is appropriate?**

At times, rebuilding in the wake of disasters is treated as engineering exercises, and this approach tends to overlook socio-economic factors. Deploying local materials, and respecting indigenous technology and cultural practices is critical. It is in this context that a catalytic community-based construction process (as described above) creates a greater sense of belonging and pride in the community.

The following anecdote would probably provide a better idea on the difference between treating rebuilding merely as an engineering exercise versus recognizing the cultural, ecological, and socio-economic concerns as well.

During a presentation to the state government, organized by the United Nations Development Programme (UNDP), we reiterated the need to understand the rebuilding process in its larger context.[3] Through a complex dialogue between community and state, along with several NGOs, guidelines were refined. The premise was to upgrade indigenous technologies in remote rural areas to meet safety standards of earthquake- and tsunami-resistant structures, rather than abruptly imposing foreign technologies and engineering solutions. This synthesis between time-tested traditional construction practices and modern alternative

technologies led to the evolution of innovative approaches. With an active dialogue between state authorities and several reputed structural engineers, new building codes were evolved articulating the structural requirements for buildings in the coastal regions to ensure public safety and health.

For example, the codes required the introduction of three "ring beams," one at the level of the basement tying the foundations, another as a continuous lintel band around the building, and the third ring beam at the slab level. This simple structural introduction enhanced the indigenous technologies to fulfill building codes for earthquake- and tsunami-resistant buildings.

The alternative engineering approach, in the absence of an awareness of its social implications, was to import technology from earthquake-ravaged Japanese regions. This would have had disastrous socio-economic consequences in the remote villages of South India. It would not only have increased the cost of construction, but also rendered time-tested traditional technologies and building skills obsolete. The indigenous communities would have also become perpetually dependent on highly skilled contractors to meet their simple needs of constructing their own homes.

The Nagapatinam project ensured that the rebuilding process was holistic, taking into account the creation of alternative skills, upgrading traditional skills, and sustainable ecological design, thereby reinforcing indigenous cultures.

**How does ARTES engage the community in the design and rebuilding process?**

The first stage focuses on assimilating the traditional knowledge of the community and assessing the methodology to enhance its existing skill base to respond to the disaster.

In a project near Sirkali, the community built their own homes, facilitated by the architects and engineers. Qualified engineers provided training to the community in the construction practices that they aspired to learn. The community

**11.1**
ARTES mason training program in [re]bar bending. Photograph by Durganand Balsavar in Nagapatinam district during the ARTES tsunami rehabilitation project, 2005.

was also trained by the architects in alternative technologies, for instance, the construction of walls using rat-trap bond; this kind of construction was introduced by Laurie Baker, an architect involved in affordable housing projects in South India (1960).[4] By hollowing out a cavity in the twenty-three-centimeter thick wall this allowed for better insulation in response to heat. It also reduced costs by almost 20 percent, while enabling the electrical and plumbing services to be placed in the cavity. The construction technique was an ecological intervention since it considerably reduced the consumption of bricks. The dwellings were not plastered and acquired a humane scale.

Extensive training was also provided in carpentry, casting concrete slabs, shuttering, electrical, and plumbing services. Not only did it provide the community with the opportunity to build their own homes but also empowered them with new skills. While more than 300 dwellings were built as part of this project over a period of two years, almost 10,000 dwellings were constructed through the ARTES capacity-building program.[5]

**How does the work of ARTES conserve the natural ecology of a given region?**

Given the scarcity of resources in Southeast Asia, most of our work depends on a rudimentary approach to conserving natural ecologies. We assimilate many of the ancient traditional knowledge systems and practices from a region. Each region has a unique bio-system that needs to be respected and enriched. Human intervention in settlement building is often a dilemmatic process as it contains the risk of disturbing or destroying these ecosystems that have emerged over centuries. Rebuilding valuable biodiversity can take over a hundred years or more perhaps, while it may take a fraction of that time to destroy them for short-term economic gains.

For example, it came as no surprise to the Nagapatinam community that nations across the world recognized that destroying biodiversity induces climate change, which consequently results in an increase in the frequency and intensity of natural disasters. The community was experiencing first hand how climate change was adversely affecting their daily living patterns. They witnessed how rising sea levels are eroding the coastline, sea-wave intensity is increasing, fish species are dying off, and cyclone and rainfall patterns are becoming erratic. To clarify these issues, the architects began by translating the United Nations International Strategy for Disaster Reduction (UNISDR-2009) into the ancient Tamil dialect (the local language). The time and effort invested in these measures allowed for a more meaningful dialogue between the village and the architects during the capacity-building phase.

Certain tenets were diligently followed during rebuilding. For instance, settlement layouts were decided with a view to conserving all the existing trees, natural slopes, and natural resources of the site. The dwellings were thus accommodated and constructed between trees. The settlement pattern was thus organic with the trees providing shade for community gathering spaces, similar to the existing traditional settlements. The designs were in response to local climatic conditions to ensure the interior remained cool throughout the day.

During the reconstruction of the Tata Housing Project in Nagapatinam, the epicenter of the tsunami devastation, particular attention was given to protect the existing sand-dunes and coastal vegetation. The project recycled wastewater,

**11.2**
ARTES designed rural housing (Nagapatinam tsunami rehabilitation housing supported by ADER-ISED-ISCOS and Fondation de France). Photograph by Durganand Balsavar, 2006.

which was used to cultivate a coastal bio-shield of dense vegetation, as a protection from cyclones and future tsunamis. The Tata group also supplied solar lamps for street lighting in the remote villages.

The symbiotic relationship between the natural landscape and the built environment remained a guiding factor in both the design and reconstruction processes.

**How do issues such as gender equity figure in the design and rebuilding process?**

Early on during the rehabilitation process, the significant contribution of women in the coastal community had been recognized. Along with the architects, in discussion with the community, Aneela Rao, a researcher at ARTES, formulated a creative participatory planning process. The community decided to involve women and men equally in the decision-making process and women took over the design discussions of the dwelling. The concept of the house was based on traditional practices. With an acute awareness of terrain, the women participated in locating houses on high land or with high plinths to prevent possible flooding. Existing trees acted as cyclonic buffers.

The design of the dwelling, evolved by the women in the community in collaboration with the architects, consisted of two rooms each of about ten square meters in area and a *thinnai* (front verandah) containing the kitchen. The *thinnai* had a sloping roof made of locally available country wood frames and terracotta tiles. As suggested by the community, several alternative designs were produced by the women, which were chosen after an intensive series of discussions. The Institute for Social and Economic Development – Chennai (ISED), along with ARTES

architects, facilitated this process based on guidelines formulated by ARTES and the community.

Aneela endeavored to collaborate and transform the focus from conventional roles of women (cooking, nurturing children, looking after the house, etc.) to participating in decision-making as well, such as designing dwelling typologies of the settlement. The process also identified women's capacities in natural resource management (e.g. solar technologies, rainwater harvesting, caring for indigenous plants, dwelling design, and project management skills). Over the next few years, the objective is to appreciate traditional and gender-related nuances in connection with natural resources, and from here to create appropriate responses to ecological degradation.

There were several other related benefits, like management on construction sites headed by women that led to better building quality standards. With new conditions, women learnt to use bicycles, thereby increasing their mobility and entrepreneurial skills. Consequently, ARTES received support from CII-Rolls Royce, UK to design a primary school in remote Pazhayar district of Tamilnadu to ensure the education of the girls.

**Do you see a role for architects in the construction of temporary shelters in the immediate aftermath of a disaster, or is this something that you think is best left to aid organizations and the government?**

Contrary to conventional perceptions, in our experience, architects do have a role in the construction of temporary shelters in the immediate aftermath of a disaster. The construction of these shelters is a collaborative effort involving aid agencies, government, architects, engineers, the community, and, in many situations, paramilitary forces as well.

The role of temporary shelters and the sensitivity required in their design and construction have often been overlooked. It is a common misconception during relief operations that permanent housing would be ready in a matter of four to five months. This phase is more complex than assumed. Rebuilding has to deal with the identification of appropriate land, community aspirations, financial resources, new government regulations that evolve in response to the disaster, the process of identifying community members (conventionally referred to as "beneficiaries"), and ensuring an equitable process. Given these complexities, rebuilding entire settlements and their infrastructure can take between two and five years.

Thus "temporary" shelters have to withstand longer durations than presently envisaged. Having intervened in earlier disaster mitigation processes, we realized that these shelters could not be anonymous barracks or tents, whatever the circumstances. They had to be designed like a village settlement albeit in a record time of fifteen to twenty days.

In Nagapatinam, the community was keen to participate in building the temporary shelters, though they lacked the basic skills. Thus, we formulated a capacity-building program and established the design criteria, assisted by qualified engineers, government personnel, and paramilitary forces.

During this stage, issues of privacy, hygiene, sanitation standards, safety, children, needs of the elderly, daily routines, cooking requirements, storage of valuables, clothes, and other assets were discussed in considerable detail.

Based on these discussions, plans were drawn up. Although temporary, the shelters were designed like a village, with gathering spaces and streets incorporating the trees on the site into the design. In the absence of reliable data, intensive mapping of the damaged sites and the neighboring settlements was carried out to study the dwelling typologies, way of life, record locally available materials, and indigenous construction technologies.[6] Our work in the construction of temporary shelters has provided valuable insights for the design and building of the permanent settlements. All in all, the "catalytic disaster mitigation" process ARTES uses actively recognizes that in the wake of disaster relief, rehabilitation, and rebuilding need to be addressed in tandem.

## Notes

1 *The Hyogo Framework of Action: Building the Resilience of Nations and Communities to Disasters* (2005–15) recommends the integration of disaster risk reduction (DRR) considerations into development assistance frameworks.
2 Akhila Krishnamurthy, "Simply Chennai, Design: Architecture," *India Today*, New Delhi, August 20, 2007: 22.
3 William Curtis, *Balkrishna Doshi, An Architecture for India* (Ahmedabad: Mapin Publishing, 1988).
4 Gautam Bhatia, *Laurie Baker, Life, Works and Writings* (New Delhi: Penguin Books, 1994).
5 ARTES was supported by the Tata Relief Committee and M. S. Swaminathan Research Foundation during the capacity-building process. The rebuilding and construction of dwellings near Sirkali was in collaboration with ADER-ISCOS, a French and Italian NGO respectively. The social coordination was supported by Fondation de France and ISED, a local NGO. A preliminary thirty days construction skill program by ARTES was in collaboration with COSTFORD, Abhilasha, and the Orissa Development Techno Forum.
6 Durganand Balsavar, *Managing the "Transition" – Construction and Maintenance of Temporary Shelters in Post-disaster Context* (Chennai: Dhan Foundation-OXFAM-Novib, 2007).

Chapter 12

# The Politics of the Southeast Asian Smog Crises

## A Classic Case of Rentier Capitalism at Work?

*Kenneth Surin*

From August until the end of November 1997, with a short break from October 7–11 and another during the first week of November, many parts of Southeast Asia were covered by massive smog. The smog extended 2,000 miles from east to west at its peak points, and affected at least 100 million people. Satellite photographs showed that peat fires, occurring between 6 and 60 feet below ground, ranged over 2.5 million acres, and were likely to burn for years, releasing significant amounts of carbon dioxide into the atmosphere.[1] Since then, the Southeast Asian smog has almost become an annual event, as big plantation owners and small slash-and-burn farmers in Indonesia and Malaysia ignore government bans and use the dry season to clear forests and grasslands for planting when the monsoon rains arrive. As I write, at the beginning of October 2009, smog shrouds an area of Southeast Asia extending from peninsular Malaysia and Singapore, most of Indonesia, to Brunei at its northernmost point.[2] In this chapter I will focus on the smog of 1997, since the failures of government policy and leadership evident then largely remain to this day – although the ASEAN Agreement on Transboundary Haze Pollution was passed in 2002, Southeast Asian governments, and the Indonesian government in particular, have been largely ineffective in implementing the ASEAN Agreement.

The brief description of the 1997 smog given above provides only the merest inkling of what the (then) head of the World Wildlife Fund, Claude Martin, called "a planetary disaster."[3] The smog, made up of soot and ash particles and wood smoke containing lead, sulfur, creosote, nitrogen dioxide, carbon monoxide, as well as acetaldehyde and formaldehyde and other carcinogenic compounds, was estimated to have had effects on human health that would not be known for at least thirty years.[4] Reports indicated that twenty million people in Indonesia alone had serious smog-related respiratory ailments, and birds were reported by the *Far*

*Eastern Economic Review* to have dropped dead from the sky in the Philippines, and in Malaysia weeks without sunshine caused leaves from non-deciduous trees to fall in the manner of an autumn in the temperate zones. In one of the worst affected areas, Kuching, the capital of Sarawak, a state of emergency had to be declared on September 19 when for days visibility was limited to around twenty yards and the air-pollution index reached 839 (500 being the level deemed by the World Health Organization to be extremely dangerous for human health).[5] A level of 200–300 is said by experts to be the equivalent of smoking twenty cigarettes a day. In Thailand, nine provinces had air-pollution levels twice the legal safety limit.[6] Indonesia declared itself a disaster zone. Deaths were attributed to the smog: on September 26, 1997, a Garuda Airlines Airbus crashed in poor visibility a few miles from Medan airport in Sumatra, killing all 234 people on board; there were supertanker collisions in the heavily congested Straits of Malacca that lies between Sumatra and peninsular Malaysia, with twenty-eight deaths in one instance and a huge oil-spill in another; and 462 people were reported by Antara, Indonesia's official news agency, to have died of starvation and cholera in remote villages in the province of Irian Jaya.[7]

Southeast Asia is one of the world's most species-rich areas. In 1994, Indonesia, while occupying a mere 1.3 percent of the earth's surface, contained about 10 percent of the world's flowering species, 12 percent of its mammalian species, 17 percent of its avian species, and 25 percent of its fish species; and in Sarawak, the Royal Geographical Society identified on a twenty-five-acre sample plot nearly 800 tree species, more than twenty times the number of native species in the whole of Britain.[8] A number of these species, especially the plant varieties, were thought to be endangered by several decades of deforestation prior to the fires and smog, and it can safely be surmised that the repeated occurrences of the fires and accompanying smog have damaged both breeding grounds and important links in the food chain.[9]

The immediate and short-term economic costs of the 1997 smog, although not precisely quantifiable, were substantial.[10] Fifty thousand firefighters, including Indonesian military personnel, and contingents and equipment from thirteen other countries, had to be deployed. Production was lost due to factory and office closures. Airports, including a dozen in Indonesia, had to be shut down for substantial periods and flights canceled. Schools had to be closed. Tourism was badly affected, and foreign business personnel, after being advised by their embassies, left the region in large numbers.[11]

So much for a general picture of what has occurred as a result of the 1997 smog and its more immediately devastating consequences. Two features of the initial response to it in Southeast Asia are noteworthy. The first was the concerted finger-pointing in the direction of Indonesia. This was justified to the extent that the extensive fires, which produced the 1997 smog, were located in Indonesian territory and seemingly in no other Southeast Asian country. The question of culpability, however, is considerably more complex and ramified, as will emerge shortly. The second notable aspect of the disaster was the Indonesian government's wholly disingenuous attempt to depict itself as the victim of happenstance, of a "natural disaster," in the words of then President Suharto and his ministers.[12]

## A "Natural Disaster" or an Ongoing Disaster Begging to Happen?

Large areas of Indonesia have been devastated by similar fires over the course of decades. In 1983, the wildfires that destroyed 3.2 million hectares in Kalimantan were the largest recorded in human history; and from May to October 1994, fires burned an area of 5.11 million hectares, and led to protests from Malaysia and Singapore.[13] The region also saw significant episodes of smog pollution in 2000, 2001, 2002, 2005, 2006 (involving the worst forest burning since 1997), and 2009. Although no one disputes that the wildfires have been exacerbated by droughts attributable to the El Niño effect, it is also undeniably the case that they were started advertently (as were the catastrophic fires of 1983 and 1994). As was the case with the previous fires, the responsibility for causing the 1997 smog was quickly placed by governments and media alike on shifting slash-and-burn cultivators. It soon became evident that the forest fires were also started by large commercial plantations using a quick and easy way of clearing logged-over areas to make room for lucrative crops such as palm oil and rubber. In 1997 the then Indonesian Forestry Minister Djamaludin Suryohadikusomo named 176 companies, including a number of rubber and palm oil plantations, as violators of the 1995 ban on the use of burning as a means of clear-felling.[14]

Any confidence in the Indonesian government's willingness to take measures against the offending companies in the fires of the past few decades has to be tempered by the fact that it has a risible record when it comes to enforcing its own environmental laws and regulations, which are waived if they are thought to hinder top-priority development schemes. A case in point is the free-trade zone on Batan Island in Western Indonesia, which, given its proximity to Malaysia and Singapore, is seen by the Indonesian government as a way of promoting three-way trade between those countries and this part of Indonesia. To woo potential investors, the Indonesian government announced that existing environmental regulations would not apply to Batan Island, including anti-pollution laws and the environmental impact analyses that (since 1986) are required by law to be applied to all development schemes in Indonesia.[15]

In addition, President Suharto's regime practiced a form of crony capitalism which allowed favored individuals to hold huge concessions in the forestry and timber sectors, and to be above the law when it came to running their enterprises, as indicated by several known cases, in particular the dropping of a $5 million fine levied in July 1991 on the Barito Pacific Group for numerous violations of the timber operation laws. Barito's president, Prajogo Pangestu, used his influence with Suharto to have the case dropped.[16] P.G. Barito was also in the news in 1993, when it tried to raise $200 million in a new share flotation, and revealed in a pre-flotation presentation that the State Pension Fund (Taspen) had invested around $177 million of Civil Service pension money in Barito. This occasioned surprise, because the head of Taspen had appeared before a government commission inquiring into the operations of the pension fund a few weeks earlier, and failed then to report this substantial investment of government funds in one of the country's biggest logging companies.[17] Another instance of the government's willingness to break its own laws was the egregious breach of the constitution made by Suharto when he returned Indonesia's first broadcasting law to Parliament for amendment, even

though it had already been made law by the national legislature, because he did not like provisions within it that ostensibly restricted the operations of private television stations: his daughter Siti Hardijanti Rukmana, son Bambang Trihatmodjo and Bambang's wife Halimah had substantial holdings in four of Indonesia's five private television channels.[18]

Any declaration by the Suharto government that it would penalize those who broke its forest-clearing laws evoked immediate skepticism, not only because of individual cases such as the ones just mentioned, but also because the perceived need to clear forest land in the cheapest and most expeditious way possible (i.e., by burning logged-over forest areas) was fueled precisely by the government's own agricultural development policies. Government plans under Suharto set a production target for palm oil of 7.2 million tons by 2000, with the plantation area given over to palm oil production more than doubling to 5.5 million hectares. The fifth Five-Year Plan (1989–1994) had already called for the creation of 1.5 million hectares of new plantation space. This government-sponsored scaling-up of land earmarked for plantation growth was accompanied by a scaling-down of its projections for the replanting of logged-over forest areas with fast-growth trees intended to meet the (then) growing demand for plywood, pulp, and paper: the replanting scheme (Human tanamam industri) had projected for 2.3 million hectares to be replanted by 2000, but already by 1994 the Forestry Ministry had revised this figure downward by nearly one-third to 800,000 hectares. The government's environmentally sustaining (if properly conceived and managed!) replanting scheme had clearly yielded priority to its plantation-growth counterpart. It is not difficult to see why. Demand for Indonesian processed wood products had fallen just as the worldwide demand for palm oil and the products derived from it had increased. Global consumption of palm oil and its ancillary products grew by 32 percent between 1991 and 1996, providing Indonesia with exports worth more than $1 billion in 1996. The prospects for plywood by contrast declined during that period, and the Indonesian Ministry of Forestry encouraged a shift from plywood to fiber board manufacturing in response to the former's declining market: plywood exports fell by 3 percent in the first half of 1996, and Mark Poffenberger says that plywood prices fell by 32 percent in the first nine months of 1994 and Indonesian exports dropped by 9 percent during the same period (with P.G. Barito holding over five million hectares of forest concessions experiencing a 36 percent fall in profits (to $33 million) in the first half of 1994).[19]

The other significant factor driving plantation growth in Indonesia was the government's resettlement scheme, which moved people from highly populated Java to the Outer Islands. The *Far Eastern Economic Review* reported that thirty-five companies developed plantations in tandem with the government's resettlement scheme.[20] It would take more than a few expressions and gestures of contrition, produced in any case to deflect criticism from vexed neighbors, to undo a fraction (if that) of the effects of the systematic deforestation that had taken place with Suharto's not so tacit collusion since the mid-1960s. It is not difficult to see why.[21]

The 1946 Constitution gave the Indonesian government exclusive property rights to its natural forests, though provision was made for the transfer of these rights to private individuals or for lease as concessions for a twenty- to twenty-five-year period.[22] The upshot was a large-scale deforestation due primarily to

commercial logging, shifting cultivation, and population resettlement schemes, so that between 1950 and 1985 thirty-nine million hectares of forest were lost – an average of 1.1 million hectares per year.[23] This tells only part of the story, because other institutional factors had to combine with these patterns of forest utilization in order to make possible the very substantial (some would say calamitous) depredation and degradation of the country's silvicultural resources that had taken place under Suharto's New Order. Dauvergne, Gillis, Repetto, and his associates Poffenberger, MacAndrews, and Barbier et al., provide compellingly detailed accounts of the institutional framework, both national and supranational, that made massive deforestation virtually unavoidable in Indonesia.[24] These include dilatory and haphazard enforcement of the lease arrangements; inconsistencies in the land laws themselves; problems with the terms of the timber concession agreements (many of which put already resentful local people in competition with the logging companies when it came to harvesting timber); endemic corruption that allowed an already flawed and inefficient system of regulation to be circumvented even more easily; illegal felling that went virtually unchecked; conflicts and rivalries between the six government departments responsible for the oversight of different areas of forest management and utilization; advances in tools and machinery for tree-felling; the almost complete lack of any kind of environmentalist sensibility on the part of officialdom and the logging companies; inefficient and wasteful processing operations; extremely poor management of forest resources caused primarily by the government's policy of levying a flat-rate per item tax on trees felled, which encouraged loggers to harvest only the best (and most profitable) trees in each stand, and to lay waste the surrounding forest floor and nearby trees considered too small or inferior in quality; and the policies of the World Bank, the Asian Development Bank, and the International Monetary Fund, all of which financed resettlement schemes, dam and road construction without attending to the environmental implications of these schemes.[25]

The Indonesian government's ramshackle system of revenue collection also created problems. Malcolm Gillis estimated that between 1979 and 1982 alone the government lost over $545 million in potential rents (or $136 million annually) that were not collected due to administrative oversight or inefficiency.[26] But it is not only revenue that is forgone when forests are depleted in this way. A poorly run forestry sector is also a drain on what some ecological economists call "natural capital," and Robert Repetto has argued that Indonesia's very impressive annual average growth-rate from the early 1970s to the mid-1980s would be halved if it was adjusted to include the depreciation of forests, soils, and petroleum.[27]

The published accounts mentioned here also make it clear that it is not timber production in itself that has contributed to the destruction of Indonesia's rainforests.[28] As was pointed out above, an equally decisive impetus to deforestation has come from encroachments of forest land, driven by Indonesian central government resettlement schemes, to convert such land to agricultural (and especially plantation) use.[29] Forests that have already been harvested for timber aid this process by being both easier to penetrate (because the logging companies have to create a minimal infrastructure to make the removal of timber possible) and to clear (by the favored method of setting fire to what's left of the thinned-out forest). This is probably the main reason why the government's log export ban of 1985 (replaced by export taxes in 1992 with the same effect) was not able to slow down

the overall rate of forest destruction, though it had admittedly reduced the rate of log extraction per se (in 1990 log production was still only at the 1973 rate, having surpassed the 1980 level only in 1987).[30]

What transpired with regard to Indonesia's environment simply confirms the commonplace – not least because it has been shown to be true over and over again all over the world and not just in Indonesia – that environmental resources are perforce also economic in character, and hence are irreducibly political in nature. A great deal may certainly be said about each of these, and in the case of Suharto's government, by 1997 enough was known about its economic, political, and environmental practices and policies for one to be able to say with a fair degree of confidence that the 1997 smog disaster was something begging to happen. It may also be said that it is probably true today (2009), as it was in 1997, 1994, and 1983, that, whether "natural" or not, a disaster of this kind and magnitude is even now begging to occur again. If several Indonesian environmental organizations are to be believed, the government conveniently overlooked breaches of the regulations it made in response to the smog of 1994 once international attention died down, and the fires burning in 1997 would not have occurred if these regulations had been adequately enforced at that time. Equally, it may be assumed that the fires causing the 2009 smog occurred because of a similar laxity with regard to enforcement.[31]

## Indonesia's Responsibility Alone? Forestry Policies Elsewhere in Southeast Asia

Indonesia came under considerable international scrutiny for its handling of the 1997 smog crisis and for its failure to prevent the forest burnings that caused it. Suharto, used to being courted and flattered by foreign governments for creating a successful economy in his thirty-one years in power (an admiration that evidently discounted the physical liquidation of hundreds of thousands of Indonesian communists in the mid-1960s and the genocidal policies carried out in East Timor, as well as the systematic violation of the human rights and civil liberties of many of Indonesia's citizens throughout that time), apologized twice publicly for the 1997 smog and announced that he wanted the guilty plantation-owners to be tracked-down by the military if necessary (this turned out to be a hollow publicity gesture).[32]

Indonesia's immediate neighbors, Malaysia and Singapore, held Indonesia responsible for the 1997 smog, but at the same time seemed not to want to controvert too emphatically Suharto's declaration that Indonesia and its neighbors were the victims of a "natural disaster."[33] This leniency prevailed even in 2009, a pattern that is in essential continuity with the Indonesian government's responses to the 1997 smog and its succeeding episodes. The ASEAN nations have a policy of non-interference in the "domestic affairs" of member nations, and this provides a convenient alibi for environmental inaction on the part of neighboring countries who make reasons for not wanting their own environmental policies to be scrutinized by the other members of ASEAN. Thus, Reuters reports that the Indonesian government did not respond to offers of assistance from other ASEAN nations in efforts to deal with the 2009 smog.[34]

There are interesting possible reasons for this seeming desire on the part of the governments of Malaysia and Singapore to be lenient with Indonesia and to

downplay the effects of the repeated smogs, reasons deriving in large part from a shared animus against environmental protection and a common desire to promote capitalist accumulation at just about any cost (the two of course dovetail quite nicely), but the more immediate reasons are not difficult to find. The *Far Eastern Economic Review* reported[35] that the Indonesian government has been informed by "industry sources" that eighteen Malaysian and five Singaporean companies involved in joint ventures are responsible for starting some of the fires, and it is also known that forty Indonesian companies with land-cultivation licenses have Malaysian joint-venture partners.[36] In addition, Singapore was in 1996 the third largest foreign investor in Indonesia, with investments there totaling $1.99 billion; in 1993 its investments in Indonesia totaled $1.46 billion, and exceeded the combined total for the United States and Japan ($445 million and $836 million respectively).[37] Both Singapore and Malaysia have for the past decade been driven by rising labor costs and shortages at home to redirect investment to other countries with cheaper and more plentiful supplies of labor, and Indonesia, along with Vietnam and China, all with relatively large rural populations providing ample pools of cheap labor for new industries to draw on, satisfies this requirement particularly well among East Asian economies.[38] Given the significant involvement of Malaysia and Singapore in the Indonesia economy, and the participation of some of their companies in the forest burnings, it is hardly surprising that they have not been more forthright in condemning Indonesia for creating conditions that made the several smog episodes almost inevitable once drought conditions started to prevail.

However, another consideration has to be borne in mind here, namely that the governments of Malaysia, Thailand, and the Philippines also have reputations of their own for environmental despoliation, with deforestation being particularly significant (Thailand and the Philippines are virtually logged-out). They are therefore in no position (should they even be possessed of the desire to do so) to occupy any kind of moral high ground in their responses to the Indonesian government's handling of the several smog crises. The issues involved here are complex, to say the least, and with the possible exception of a few small and already developed Northern European states, no country can claim to have anything like an excellent record when it comes to environmental protection, at least not one that it can take unqualified credit for or hold out to others as a suitable model of well-regulated development, pollution control, limitation of forest clearing, stewardship of land and water resources, adequate disposal and treatment of toxic and hazardous materials, and so on. I shall come back to this in the concluding section, which deals, albeit briefly, with the question of national and international policies for sustainable development.

Despite some important differences between the two countries, several of the problems associated with Indonesian deforestation have some parallel in Malaysia's timber industry. These include corruption and nepotism involving politicians and officials at all levels; a badly administered concession-system which leads to revenue loss;[39] a land-tenure system with a built-in propensity to create conflicts between those who live in the forests and who depend on them for a livelihood and the logging companies;[40] a cumbersome and unmanageable subcontracting system that awards logging licenses to groups with little or no felling experience; poor supervision of logging operations; illegal felling; unregulated shifting cultivation

accompanied by rural poverty; a sensibility among politicians and administrators not attuned to any ecological considerations, with the result that timber is treated as a non renewable asset to be "mined" like tin or copper;[41] and inadequate oversight of the administrative procedures for exporting timber products leading to significant tax revenue losses for the government.[42] The result of all this is that West Malaysia (i.e., Sabah and Sarawak) is now completely logged-out, while peninsular (or West) Malaysia was logged-out three decades ago,[43] and the ruinous rates of extraction in the West Malaysian states made it inevitable that the East Malaysian states followed suit in the relatively near future. What has happened in regard to timber and timber production is merely a reflection of a more general disposition toward the environment on the part of officialdom in Malaysia, one which manifests itself in several different ways: "cronyism" and corruption that result in the non-enforcement of existing (and sometimes not very onerous because avowedly "business-friendly") environmental regulations; an economic nationalism that encourages the pursuit of "development" at any cost; and the fact that parts of Malaysia are now so polluted that no Malaysian leader can criticize another country for its derelictions with regard to the environment without being insincere or hypocritical. The wholesale depletion of forest reserves is not the only problem. Soil erosion, often caused by deforestation, is fairly prevalent; as too are river and water pollution (caused by toxic effluents from rubber and palm oil processing, and excavated soil from tin-mining operations, which flows into rivers to cause silting); as well as the inadequate handling of toxic waste leading to spillages; along with the excessive use of pesticides (a legacy of the so-called Green Revolution); and of course continued air pollution.[44]

The forest fires in 1983 and 1994, also associated with the El Niño effect, were larger than the 1997 fires, but still did not cause a smog episode that was as severe as the 1997 event. In seeking a possible explanation for this, it is hard to avoid the realization that pollution levels in Malaysian cities have gone up for several decades, as indeed has been the case with nearly every major Southeast Asian city. Even before the 1997 smog crisis, the World Health Organization's figures for average pollution levels between 1980 and 1984 placed four Southeast Asian cities – Jakarta, Bangkok, Kuala Lumpur, and Manila – among the twenty worst in the world for high particulate levels, and WHO data for the same years for sulfur dioxide levels show three cities – Manila, Kuala Lumpur, and Bangkok – in the top fifty for sulfur dioxide emissions.[45] The Malaysian government is directly responsible for some of the country's air pollution problems. The *Far Eastern Economic Review* reported that proposed "clean air" legislation was vetoed in cabinet in 1994 on the grounds that the implementation of this legislation would drive up industrial costs.[46] But this episode is merely symptomatic, and Malaysia, like Indonesia, has always shown itself to be more than willing to bypass its own environmental legislation if it threatens to stand in the way of development projects.

Perhaps the best-known recent example of this, since it has attracted international attention, has been the controversial Bakun Dam project in Sarawak, the centerpiece of which is a $6 billion, 2,400-megawatt dam, the second largest in the world, that would flood an area of 70,000 hectares and create a lake the size of Singapore, displacing 10,000 Sarawakians in the process.[47] The electricity generated by the dam, expected to be fully operational by 2011, is to be sent to peninsular Malaysia by giant cables stretched across the bed of the South China

Sea. Malaysia, like Indonesia, has laws that require an environmental impact assessment to be made of all development projects. The reports provided by such assessments have to be made public before the Department of the Environment approves them. In the case of the Bakun Dam, in March 1995 the Minister of the Environment waived the public disclosure clause contained in Malaysia's environmental impact legislation, at least where projects in Sarawak were concerned, including of course the Bakun Dam project. In addition, the waiver was backdated to September 1994, when the Sarawak state assembly had passed its own environmental laws, which of course no longer required the environmental impact reports to be made public.[48] Of the four assessments pertaining to the Bakun project, three were approved by the state's Natural Resource and Environmental Board, which was chaired by the Chief Minister, Abdul Taib Mahmud (approval for the fourth was being awaited at the time of the *Far Eastern Economic Review* story). Several groups of Sarawakians affected by the dam's construction took the government to the Malaysian High Court, and during the hearings were able to show that two of the Chief Minister's sons each held 1 percent of the equity of Ekran, the firm given the contract for building the dam (interestingly enough, 43 percent of Ekran's equity was held by proxy companies in 1993, making it impossible to identify many of its remaining shareholders). The High Court judge, James Foong, found against the government, a quite unexpected verdict for the Sarawakian plaintiffs opposed to the dam's construction. The Malaysian judiciary has a reputation for being highly respectful of the government's wishes, and the dam project had been enthusiastically taken up by the then Prime Minister, Mahathir Mohammad.

Two aspects of this case call for comment. The first is that the Sarawak Chief Minister, Abdul Taib Mahmud, also had control of logging concessions said to be worth around $3 billion (10 billion Malaysian ringgit).[49] The second is that the Bakun Dam project has attracted charges of impropriety right from the beginning. A detailed analysis of its planning and financing provided by E.T. Gomez and K.S. Jomo indicates that the $5–$6 billion contract for the dam's construction had been awarded without tender to Ekran, which is controlled by the Sarawakian Chinese timber magnate Ting Pek Khiing, who, according to Gomez and Jomo, is "closely associated with Sarawak Chief Minister Abdul Taib Mahmud, economic adviser Daim Zainuddin and Prime Minister Mahathir."[50] This is just one example of the operation of a "clientalist" system of rule and administration that makes institutionalized venality a pervasive feature of government, and which enables the Malaysian government to ride roughshod (like its Indonesian counterpart) over its own environmental laws. Many other instances of corruption and "clientalist" capitalism resulting in environmental depredation may be found in the literature dealing with government–business relationships in Malaysia – indeed, Mahathir Mohammed was not ashamed to say to a meeting of the *Asian Society Forum* in 1991 that "democracy, human rights, ecology, union rights, are but obstacles that advanced countries try to put on the road of their future competitors."[51]

I have not said anything so far about the attitude of governments to environmental issues and concerns in Thailand and the Philippines, two other ASEAN countries affected by the smog episodes, though not as badly as Malaysia and Singapore. Deforestation has been a significant problem in both of these countries for decades, but is hardly remediable now that Thailand and the Philippines are

almost completely logged-out. However, other forms of environmental despoliation remain in both countries. In Thailand, with its burgeoning export-oriented agribusiness sector, major problems exist over dam construction, river pollution caused by salt farming, motorway development, and the wholesale destruction of mangroves (primarily to make way for shrimp farms).[52] Environmental problems are also common in the Philippines. Deforestation, accompanied by land erosion, is prevalent, as are government-sponsored mining (the Philippines is among the largest producers of gold, copper, and nickel in the world) and electricity projects, often undertaken without regard for the wishes of the people who live there.[53] Rivers have been polluted by the excessive use of agricultural chemicals. Plantations, some of which are owned by major American companies such as Dole, are literally bulldozed into existence, with creeks being filled in, so that soil loss again becomes a major problem. Commercial prawn farms (80 percent of the prawns being exported to Japan) consume large quantities of potable water, which has had to be rationed in several areas. The Philippines has lost 70 percent of all its coral reefs. Severe air pollution affects Manila, with over 50 percent of the vehicles there believed to be in breach of exhaust-emission regulations, and Manila Bay is a soup of raw sewage and poisonous chemicals dumped into it by the hundreds of industries that encircle it.[54] The Philippines has environmental laws modeled on those of California, which are among the strictest in the industrialized world, but enforcement is lax and haphazard: corruption is all-subordinating, and its practitioners include multinational corporations, who realize that they have to do business "the Philippine way" if they are to get anywhere in that country.[55]

Environmental despoliation in Southeast Asian countries, therefore, is widespread, structural (in that it seems to be intrinsic to the forms of rent capturing favored by prevailing modes of capitalist accumulation), and, given the entrenched character of these modes of accumulation, is not likely to cease in the immediate future. The oligarchic and clientelist appropriation of rent-yielding natural resources seems almost without exception to be the order of the day in the newly industrialized ASEAN countries, and it takes place with strong governmental connivance.[56] Responsibility for the several Southeast Asian smog episodes may be the Indonesian government's alone if the matter is viewed in purely legal terms. Yet, given the interconnectedness of the region's economies, the overall similarity of land- and forestry-use policies (which are closely integrated in the case of some activities, as when Sarawak's timber is taken to Kalimantan to be processed in Indonesian sawmills or when excessive logging takes place in Malaysia's Kelantan state to meet timber needs in nearby Thailand), and the manifest failure of governments in the region to take basic measures to protect an already vulnerable environment, as well as the smog-induced misery being experienced throughout Southeast Asia on an almost annual basis, it would be futile for Indonesia's ASEAN neighbors to comfort themselves with the belief that the blame for such disasters lies with Indonesia alone. More than ever it is clear that the only solution to the question of how Southeast Asian forests (and other natural resources) are to be used in sustainable ways is going to have to be one that encompasses the whole region.

The auguries for effective government action in Southeast Asia are not good. Transparency International's 2009 Corruption Perception Index surveyed 180 countries, and ranked the smog-affected Southeast Asian countries as follows: Singapore 3rd, Brunei 39th, Malaysia 56th, Thailand 84th, Indonesia 111th, and

the Philippines 139th.[57] With the exception of Singapore, all the above-mentioned Southeast Asian countries are wedded to a form of capitalism in which rent-seeking plays a major role. Rent-seeking elements within the ruling elite, or having access to that elite, do not have a productive function within the economy, but with a monopoly on "rights" to natural resources, financial assets, licensing arrangements, and so on, are able to amass considerable wealth from deals or "opportunities" made available by the possession of such "rights" (witness the prosperity of the children of Suharto and Mahathir documented above). One does not have to be a Marxist to acknowledge that such rent-seeking – undertaken on a prodigious scale more often than not in countries where corruption is simply a part of "doing business" – makes little or no contribution to actual economic production. Rent-seekers in these economies garner wealth from their role as gatekeepers able to cash in on their (monopolistically secured and guaranteed) ability to enable access to the resources needed for economic production.[58] Rent-seeking is difficult to eliminate. Change invariably has to begin at the level of government, and since rent-seekers owe their leverage to the government in the first place, thanks to the enabling machinations of a crony-system, the impetus for change is unlikely to come from within the government. If the Philippines and Indonesia were able to get rid of Marcos and Suharto respectively, the decisive factor in their overthrow was the decision of the United States to withdraw its support for these dictators, whose services as staunch anti-communists became dispensable as the threat represented by communism started to fade from the mid-1980s onward.

Change will come only when an entire system of capitalist accumulation in the region is transformed decisively. . . . But that is another story.

## Notes

1 On the extent of the 1997 peat fires, see the *Guardian*, September 27, 1997.
2 See Luke Hunt, "Fires Spread Thick Haze Across Much of Southeast Asia," *Voice of America News*, at http://www.voanews.com/english/2009-10-01-voa19.cfm. Accessed October 3, 2009.
3 *Guardian*, September 27, 1997.
4 *The Economist*, September 27, 1997.
5 For the pollution level in Kuching, see the *Manchester Guardian Weekly*, September 28, 1997.
6 *Guardian*, September 27, 1997.
7 For the Antara News Agency Report, see *The Indonesia Times*, October 17, 1997. It quoted officials as saying that 90,000 of Irian Jaya's population of 500,000 faced serious food shortages, and that efforts to air-drop food supplies were hampered by the smog.
8 For Indonesia, see Hal Hill, *The Indonesian Economy Since 1966* (Cambridge: Cambridge University Press, 1996), 144, citing the World Bank Report of 1994; and for Sarawak (and Malaysia generally), see K.S. Jomo, "Malaysian Forests, Japanese Wood: Japan's Role in Malaysia's Deforestation," in K.S. Jomo (ed.), *Japan and Malaysian Development* (London: Routledge, 1994), 182–210, esp. 182. This is true worldwide of the tropical moist forests, which although they constitute only 6 percent of the world's area, contain more than 50 percent of its species.
9 The removal of rain forests and the resulting destruction of habitats has certainly been going on for some time all over the world. Humans are among the animals affected in this way – in Brazil alone eighty-seven tribes became extinct between 1900 and 1957,

and Robert S. Aiken and Colin H. Leigh say that a "similar fate probably awaits the Penan of Sarawak [in West Malaysia], where logging is polluting rivers, depleting game, and rapidly encroaching on remaining ancestral lands." See their *Vanishing Rain Forests: The Ecological Transition in Malaysia* (Oxford: Oxford University Press, 1992), 13.

10 *The Indonesia Times* of October 15, 1997 quoted Emmy Hafild of Walhi, Indonesia's leading environmental-protection group, as saying that 1.7 hectares were under fire, causing damage then estimated at $1.8 billion.

11 The *Straits Times* (Singapore) of November 22, 1997 reported that tourism for the previous month had declined by 17.6 percent.

12 For the Indonesian government's claim that the smog is a "natural" and not some other kind of disaster, see the *Guardian*, September 24, 1997, where the Minister of Welfare, Azwar Anas, was quoted as saying: "We're not late in anticipating the problem. It's a natural disaster no one could have prevented." The *Far Eastern Economic Review*, October 22, 1997, 43, reports President Suharto as making the same claim in a speech to a meeting of the Association of Southeast Asian Nations (ASEAN). A useful account of the failure of Southeast Asian governments to implement already existing agreements and laws is to be found in Alan Collins, *Security and Southeast Asia: Domestic, Regional, and Global Issues* (Boulder, CO: Lynne Rienner Publishers, 2003), 141–145, who describes this implementation as "nonchalant."

13 See J. Mayer, "Impacts of the East Kalimantan Forest Fires of 1982–1983 on Village Life, Forest Use, and Land Use", in Christine Padoch and Nancy Lee Peluso (eds), *Borneo in Transition: People, Forests, Conservation, and Development* (Oxford: Oxford University Press, 1996), 197–218.

14 See *The Economist*, September 27, 1997; *Asiaweek*, October 17, 1997; and the *Far Eastern Economic Review*, October 2, 1997, 28–29, the latter stating that the blame for starting the 1997 fires lay not so much with the shifting cultivators but with the big plantations themselves.

15 Colin MacAndrews, "Politics of the Environment in Indonesia," *Asian Survey*, 34 (1994), 376, discusses the Batan Island case, using a report in the leading Indonesian newsweekly *Tempo* on November 28,1992, p. 42.

16 This case involving Prajogo Pangestu is mentioned in A. MacIntyre, "Power, Prosperity, and Patrimonialism," in Andrew MacIntyre (ed.), *Business and Government in Industrialising Asia* (Ithaca, NY, and London: Cornell University Press, 1994), 244–267.

17 Ibid., 379.

18 For Suharto's rejection of the legislation on private television, see the *Far Eastern Economic Review*, September 4, 1997, 24, which said that the Suharto family holdings represent "a considerable stake in an industry that now generates $1 billion in advertising revenue annually." The six Suharto children acquired immense fortunes during their father's dictatorship – "booty" would not be an inappropriate term – as beneficiaries of a system which required foreign companies investing in Indonesia to obtain licenses from the government and to form joint ventures with local firms and investors. The Suharto family, and cronies like "Bob" Hasan, had a virtual monopoly on these licenses, and state banks were required to give Suharto's four sons and two daughters interest-free loans to facilitate ventures in which they are involved. The *Far Eastern Economic Review*, September 5, 1996, 56–58, estimated that the Suharto offspring were worth, as individuals, a total of $6.35 billion, though the assets they controlled were almost certainly much higher if their ancillary business enterprises (sometimes undertaken by proxies drawn from the extended family) were taken into account.

19 See *Far Eastern Economic Review*, October 2, 1997, for the palm oil figures given in this paragraph.

20 *Far Eastern Economic Review*, October 2, 1997, 28.

21 For the next few paragraphs I am indebted to the conspectus of the Indonesian

government's forestry policies provided by Malcolm Gillis in his "Indonesia: Public Policies, Resource Management, and the Tropical Forest," in M. Gillis and R. Repetto (eds), *Public Policies and the Misuse of Forest Resources* (Cambridge: Cambridge University Press, 1988) 43–113.

22 The granting of concessions was an important form of patronage disbursed by the Suharto family circle. The extensive and hugely lucrative ties of this circle with the military (which to this day owns and operates its own businesses) and the Chinese business community are discussed in detail in Richard Robison, *Indonesia: The Rise of Capital* (Sydney: Allen & Unwin, 1986).

23 The Indonesian government's resettlement program moved about a million families from Java to the Outer Islands by 1997, 80 percent of them on land that had been deforested, some of the time for presumably just this purpose.

24 P. Dauvergne, "The Politics of Deforestation in Indonesia," *Pacific Affairs*, 66 (1993–1994), 497–517; Gillis and Repetto, *Public Policies and the Misuse of Forest Resources*; R. Repetto et al., *The Forest for the Trees?: Government Policies and the Misuse of Forest Resources* (Washington, DC: World Resources Institute, 1988); M. Poffenberger, "Rethinking Indonesian Forest Policy: Beyond the Timber Barons," *Asian Survey*, 37 (1996), 453–469; C. MacAndrews, "Politics of the Environment in Indonesia," *Asian Survey*, 34 (1994), 369–380; and E.B. Barbier et al., "The Linkages Between the Timber Trade and Tropical Deforestation – Indonesia," *The World Economy*, 18 (1995), 411–442.

25 Japan and the World Bank are donors who have paid little heed to the environmental effects of their subventions to the Indonesian government.

26 Gillis, "Indonesia: Public Policies," 84ff.

27 Robert Repetto, "Economic Incentives for Sustainable Production," in Gunter Schramm and Jeremy Warford (eds), *Environmental Management and Economic Development* (Baltimore, MD: Johns Hopkins University Press, 1989), 69–86; R. Repetto, "Government Policy, Economics, and the Forest Sector," in ibid., 93–110; and R. Repetto et al., *Wasting Assets: Natural Resources in the National Income Accounts* (Washington, DC: World Resources Institute, 1989).

28 See especially E.B. Barbier, "The Environmental Effects of Trade in the Forestry Sector," in *The Environmental Effects of Trade* (Paris: OECD, 1994), 94.

29 Mayer, "Impacts of the East Kalimantan Forest Fires of 1982–1983," 210, indicates that the blame for the wildfires on that occasion lay not so much with indigenous swidden cultivators, but with commercial loggers and pioneer settlers brought to the region by the Indonesian government's resettlement program.

30 There are other reasons why the export restriction policy was successful in slowing down the overall rate of deforestation. The introduction of the policy in 1985 coincided with a boom in the production of processed timber (not affected by the new policy, which of course only applied to log extraction for export). The outputs of plywood and sawn timber rose by 800 percent and 500 percent respectively during 1980 and 1991 and more than offset any reductions made in log harvesting that may have been caused by the ban on raw timber exports. For these, see Hal Hill (ed.), *Indonesia's New Order: The Dynamics of Socio-Economic Transformation* (Honolulu: University of Honolulu Press, 1994), 145.

31 Joan Hardjono's splendid overview of Indonesian environmental policy, even though it is fifteen years old, makes it obvious why such pessimism is justified. See J. Hardjono, "Resource Utilisation and the Environment," in ibid., 179–215. Bapedal, Indonesia's Environmental Impact Management Agency, has been successful only in dealing with industrial pollution in urban areas. Bapedal has made no headway in dealing with other forms of environmental despoliation: these fall under the jurisdiction of other government agencies, who are only allowed to function in an "advisory" capacity when it comes to monitoring the effects of their policies on the environment.

32 For an informative assessment of Indonesian policy on East Timor, see Benedict Anderson,

"East Timor and Indonesia: Some Implications," in Peter Carey and G. Carter Bentley (eds), *East Timor at the Crossroads: The Forging of a Nation* (Honolulu: University of Hawaii Press, 1995), 137–147.

33 Malaysians were not impressed by their government's handling of the 1997 smog crisis. According to a poll conducted by the national daily, *The Star*, 93 percent of those interviewed believed that the government was not doing enough to deal with the haze. See the Malaysian news magazine *Aliran Monthly*, 17 (1997), 4.

34 Reuters, "Indonesia Tight-lipped as SE Asia Braces for Worsening Haze," at http://www.google.com/search?hl=en&client=firefox-a&rls=org.mozilla:en-US:official&hs=UOx&q=southeast+asian+smog+and+haze+2009&start=10&sa=N. Accessed November 12, 2009.

35 *Far Eastern Economic Review*, October 2, 1997, 28.

36 *Manchester Guardian Weekly*, September 28, 1997.

37 See the *Straits Times* (Singapore), October 15, 1997, for the 1996 figures, and R. Edwards and M. Skully (eds), *ASEAN Business, Trade and Development* (London: Butterworth-Heinemann, 1996), 63, for the 1993 figures.

38 Hal Hill cites an unpublished 1993 paper by C.G. Manning which says that the minimum wage in Jakarta was less than 50 percent of that of Bangkok, less than 25 percent of that of Malaysia, and less than that of Manila, though it probably exceeded those in Vietnam and China. See his *Indonesian Economy*, 282 n. 26.

39 As is the case in Indonesia, the concessions in Malaysia are given out by the state governments to friends and families of those in power.

40 As pointed out before, in Malaysia this problem is compounded by the fact that it is the individual state governments, and not the federal government, that award concessions. One result is the complete lack of consistency in the awarding of concessions; another is the occurrence of frequent conflicts between the federal government and the individual states (in particular the West Malaysian states of Sabah and Sarawak) over the disposal of timber-revenues and the managing of forests. Published reports of the granting of concessions as political favors in Malaysia started appearing as early as two decades ago. See *Far Eastern Economic Review*, December 2, 1997, 48.

41 The most immediate consequence of this is that no efforts at reforestation are made in Malaysian Sarawak and only a paltry reforestation program exists in Malaysian Sabah. On this, see Gillis, "Malaysia: Public Policies," 115–164.

42 K.S. Jomo, citing surveys of logging practices in Malaysia, finds rates of tree damage that are very similar to those in Indonesia: "in Malaysia, extraction of only 10 per cent of the trees in a specific area resulted in an additional 55 per cent being damaged or destroyed in the process." See his "Malaysian Forests, Japanese Wood," 194.

43 Ibid.

44 There is an overview of Malaysia's environmental problems in Mark A. McDowell, "Development and the Environment in ASEAN," *Pacific Affairs*, 62 (1989), 307–329.

45 For these figures, see Alan J. Krupnick, "Urban Air Pollution in Developing Countries," in Partha Dasgupta and Karl-goran Mäler (eds), *The Environment and Emerging Development Issues* (Oxford: Oxford University Press, 2001), 425–469, esp. figs 16.2 and 16.3.

46 *Far Eastern Economic Review*, October 2, 1997.

47 It is now widely accepted that hydroelectric power facilities are relatively short-lived because sedimentation, associated with soil erosion, reduces the storage capacities of the dams. On this, see Norman Myers, "The Environmental Basis of Sustainable Development," in Schramm and Warford (eds), *Environmental Management and Economic Development* (Cambridge: Cambridge University Press, 1999), 57–68, esp. 61.

48 For this account, see *Far Eastern Economic Review*, July 4, 1996, 71.

49 On Abdul Taib Mahmud's holdings in timber industry, see Jomo, "Malaysian Forests, Japanese Wood," 201.

50 E.T. Gomez and K.S. Jomo, *Malaysia's Political Economy: Politics, Patronage and Profits* (Cambridge: Cambridge University Press, 1997), 110. Needless to say, the site had to be cleared of trees before it is submerged, and Gomez and Jomo cite reports from the *Asian Wall Street Journal* (March 10, 1994), *Far Eastern Economic Review* (February 2, 1994), and *Malaysian Business* (March 16, 1994) to show that revenue from the ensuing timber harvest would amount to just under $1 billion (2 billion ringgit) in the first few years of the project. Furthermore, on completion, receipts from the sale of electricity generated by the dam were expected to amount to over $1 billion (3.5 billion ringgit) annually.

51 Quoted in Alain Lipietz, "Enclosing the Global Commons: Global Environmental Negotiations in a North-South Conflictual Approach," in Vinit Bhaskar and Andrew Glyn (eds), *The North, the South and the Environment* (New York: Palgrave Macmillan, 1995), 131. In 1986, Mahathir specifically named the Environmental Protection Society of Malaysia as an enemy of the state, and environmentalists were among the 106 people detained in late 1987 under Malaysia's Internal Security Act (which provides for detention without trial). On this, see James V. Jesudason, "The Syncretic State and the Structuring of Oppositional Politics in Malaysia", in Garry Rodan (ed.), *Political Oppositions in Industrialising Asia* (London: Routledge, 1996), 128–160. It should be noted that Mahathir's three sons sat on the boards of 213 companies between them: Mirzan was a director of ninety-eight companies, Mukhriz sixty-seven, and Mokhzani forty-eight. See *Aliran Monthly* 17 (1997), 19.

52 Thailand, Bangladesh, Cameroon, Chad, India, Niger, Vietnam have lost over 80 percent of their freshwater wetlands, according to R.K. Turner *et al.*, "Wetland Valuation: Three Case Studies," in C. Perrings et al. (eds), *Biodiversity Less: Economic and Ecological Issues* (Cambridge: Cambridge University Press, 1997), 131.

53 The island of Mindanao has become the site of many government projects, including a geothermal energy development that is destroying trees and causing soil erosion. The island, home of a Muslim secessionist movement, was neglected for decades by the Christian-dominated central government, but it is now considered important because it will constitute the Philippine section of a newly created sub-regional growth triangle called the East ASEAN Growth Area (EAGA), encompassing Mindanao-Sulu in the Philippines, Brunei, three provinces of eastern Indonesia, and the Malaysian territories of Sabah, Sarawak, and Labuan. On this see M. Turner, "Subregional Economic Zones, Politics and Development: The Philippine Involvement in the East ASEAN Growth Area (EAGA)," *Pacific Review*, 8 (1995), 637–648. Illegal logging is rampant in the Philippines. M.A. McDowell, "Development and the Environment in ASEAN," *Pacific Affairs*, 62 (1989), 307–329, at 313, says "that in October 1986, Philippine Minister of Natural Resources E. Macheda estimated that 50% of the Philippine Wood Products Association were engaged in log smuggling, and one-third in illegal logging."

54 See Robin Broad with John Cavanaugh, *Plundering Paradise: The Struggle for the Environment in the Philippines* (Berkeley, CA: University of California Press, 1993), 21.

55 See Kunio Yoshihara, *The Nation and Economic Growth: The Philippines and Thailand* (Oxford: Oxford University Press South East Asia, 1994), for one of the many accounts of Philippine corruption, which entangled American companies as well.

56 Singapore has not been mentioned so far. As a small island with no hinterland it lacks natural resources that can be exploited in the rent-capturing style favored by its ASEAN neighbors.

57 For the 2009 Index, see http://www.transparency.org/policy_research/surveys_indices/cpi/2009/cpi_2009_table. Accessed November 17, 2009.

58 For useful elaboration on this notion see Robert Pollin, "Resurrection of the Rentier," *New Left Review*, 46 (July–August 2007), 140–153.

Chapter 13

# Designing Resilience

## Sustainable Design from a Complex Systems Perspective

*Carl S. Sterner*

What allows some systems to weather change, adapt, and survive over the long term, while others experience catastrophic failure and collapse? The question is central to sustainability. It is also a question of system behavior – in this case, behavior of the complex social-ecological system. An understanding of complex systems and the related field of network theory can help designers navigate the dense terrain of sustainability, and has the potential to inform the design of the multitudinous systems that comprise the built environment, from energy and transportation systems to communities and cities.

Specifically, Complex Adaptive Systems (CAS) theory – emphasis on *adaptive* – is an emerging discipline that studies the way systems self-organize, learn, and change proactively. CAS theory is intentionally interdisciplinary, built upon findings from a range of disciplines, from economics to ecology, and therefore is broadly applicable.[1]

A central concept in CAS theory is *resilience* – the ability of a system to absorb disturbance and adapt to change without passing a threshold into a qualitatively different state.[2] CAS scholars suggest that thinking sustainably necessarily entails resilience thinking. Indeed, the term resilience has begun to appear in the designer's lexicon. The Resilience Alliance, an interdisciplinary research organization devoted to the study of social-ecological systems, has initiated a program focused on "urban resilience." Planners Peter Newman and Timothy Beatley write about "resilience cities" and organizations such as ResilientCity have begun to apply the concept of resilience to urban design.[3]

How might the concept of resilience – and the complex systems theory that necessarily underlies a robust understanding of resilience – begin to affect architectural practice and the built environment? This chapter explores the application of resilience to design via a review of three case studies in urban design. Complex systems theory is, however, rapidly evolving, and the aim of this chapter is primarily to forge a connection between theory and design – to present some implications

of complexity theory and to envision the possibilities created by this understanding – rather than to provide definitive answers or suggest an optimal organization of particular systems.

## Overview of Complex Systems

A complex system is a network of components that can produce unexpected behaviors owing to nonlinear interactions.[4] Rather than maintaining equilibrium, a complex system is characterized by the existence of many "alternative stable states" in which the system can exist and between which it can shift, sometimes abruptly, as critical thresholds are crossed.[5] These states – also called "regimes" or "basins of attraction" – can be conceptualized as depressions in the topography of a system. A marble representing the present system state tends to settle in these depressions, but can be jarred by disruptions into an alternate state.[6] The topography itself shifts over time, defined by many variables that change at many different scales, both physical and temporal. Interactions of fast and slow variables may produce both slow and sudden shifts that can fundamentally alter the landscape.[7]

The dynamic and nonlinear nature of complex systems challenges conventional models of sustainable development. Many of these models assume that nature would be "in balance" were it not for the disruptive effects of human activity. They therefore seek to reduce throughput to a "sustainable" level – equal to a presumed constant rate of regeneration. But ecosystem change and thresholds can be crossed with very little warning; as a result, attempted applications of the "sustainable yield" approach (e.g., in fisheries) have often proven brittle over the long term.[8]

Yet despite their complexity and unpredictability, many natural systems are able to adapt and change gracefully – they are, in a word, *resilient*. Resilience has two dimensions: *passive* and *active* resilience. Passive resilience is the ability of a system to absorb shock and remain in one regime. Active resilience is the ability to *adapt* to change.[9] The latter acknowledges the capacity of many systems – human societies included – to learn and reorganize. It is this aspect of resilience that has led a number of CAS theorists to a focus on the social processes and institutions that influence adaptive capacity.

While the roots of resilience are numerous, a relatively small number of factors appear consistently throughout the literature: diversity, redundancy, flexibility, and an optimal network structure.[10] These factors form the backbone of this chapter.

### *Diversity*

Perhaps the most important factor in determining resilience is *diversity*. Heterogeneous components limit the likelihood that a disruption will damage all components. Diversity is equally important for adaptive capacity, essentially providing a menu of options or alternative pathways in the face of change.[11] *Dispersion* is essentially geographic diversity – heterogeneous spatial distribution of components.[12]

## *Redundancy*

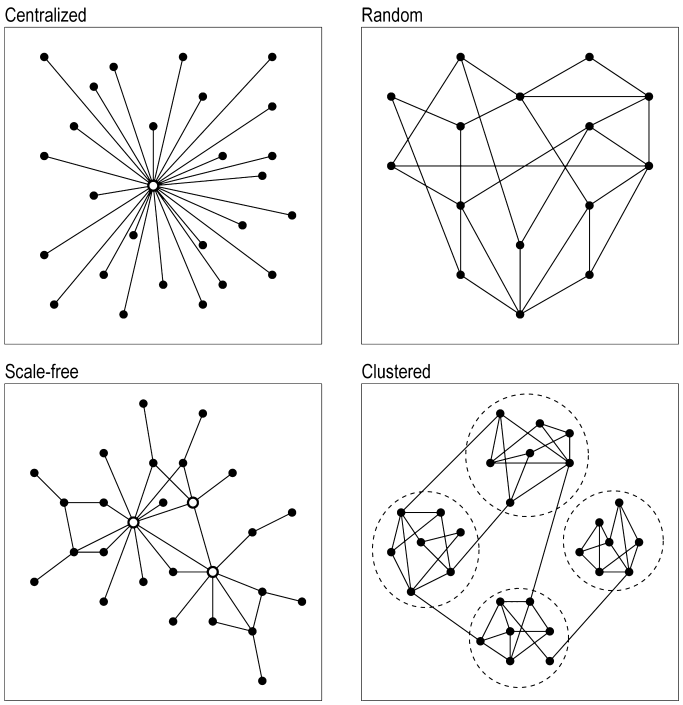
Redundancy occurs when two components are an "exact match" – that is, they have identical attributes in every respect.[13] *Functional redundancy* (actually another type of diversity) is when heterogeneous components achieve the same function.[14] The latter is particularly important to resilience, allowing system functions to continue even if a disruption harms an entire class of components.

## *Flexibility*

Flexibility is the ability of an individual component to adapt or perform alternative functions when necessary. For instance, a boiler that can accept a variety of fuels is flexible, and less susceptible to failure should conditions change.[15]

## *Optimal Network Structure*

While diversity, redundancy, and flexibility are characteristics of the components of a network, optimal structure is a function of how these components are connected.[16] This is the domain of network theory – an emerging discipline that studies, among other things, the structure and topology of networks. A number of scholars have recently put network theory to work, utilizing it to study everything from food chains to the Internet.[17]




**13.1**
Archetypal centralized, random, scale-free, and clustered networks. Centralized graph adapted from P. Baran, *On Distributed Communications: Introduction to Distributed Communications Networks* (Santa Monica, CA: The Rand Corporation, 1964); random and scale-free graphs adapted from A.-L. Barabási and Z.N. Oltvai, "Network Biology: Understanding the Cell's Functional Organization," *Nature Reviews Genetics* 5 (February 2004): 101–113; clustered graph adapted from R.K. Pan and S. Sinha, "Modular Networks with Hierarchical Organization: The Dynamical Implications of Complex Structure," *Pramana* 71, 2 (August 2008): 331–340.

**Table 13.1.** Characteristics of archetypal networks

| | ***Centralized*** | ***Random*** | ***Scale-free*** | ***Clustered*** |
|---|---|---|---|---|
| Vulnerability to random failure | Robust | Relatively robust; threshold | Robust | Varies |
| Vulnerability to targeted attack | Extremely vulnerable | Robust | Vulnerable | Varies |
| Rate of flow | Rapid | Slow | Rapid | Varies; flow can be controlled |
| Degree of separation | Low; "small-world" effect | High | Low; "small-world" effect | Varies |

A network is a loose concept; its assemblage of nodes and links can represent everything from individuals connected by relationships to cities connected by highways. These connections, or links, form a structure over which quantities flow – information, influence, electricity, traffic. Networks may be seen as the skeleton of complex systems, offering a way to study the practical effects of network structure on certain aspects of performance – for example, a network's robustness to various kinds of failure.[18] One way to begin to understand the significance of network structure is to look at archetypal networks. Briefly considered below are four archetypes: centralized, random, scale-free, and clustered networks (Figure 13.1 and Table 13.1).

## Centralized

A centralized network is characterized by a single node to which all other nodes are attached. While they rarely occur in nature, they provide a useful heuristic device for understanding the behavior of other networks, many of which display a degree of centrality. A centralized network is remarkably robust against the random failure of a node or link: probability favors the destruction of a minor node over the central hub; however, the network is extremely vulnerable to the disruption of its hub.[19]

## Random

In network theory parlance, a node's "degree" is the number of links it has; a "degree distribution" plots the degree of each node in a network. The degree distribution of a random graph follows a bell curve – each node has roughly the same number of links. Random failure in this network is not a gradual process: removing a few nodes has little impact; the network remains intact. But if the number of nodes removed crosses a certain critical threshold, the network suddenly fragments.[20] The network is highly robust against targeted attack, as there are no critical hubs. The rate of flow across a random network is relatively slow: the path between any two nodes tends to be rather large, likely passing through several other nodes before reaching its destination.[21] Whether this is considered a benefit

or liability depends on what is flowing through the network (i.e., information vs. a virus), as well as the network's intended purpose.

### Scale-free

A "scale-free" network is characterized by a degree distribution that follows a power-law: most nodes have a small number of links, but a few nodes are extremely well connected.[22] These hubs tie the network together and create a "small-world effect" – unlike the random network, the path between any two nodes is short.[23] As a result, the rate of flow across a scale-free network is incredibly rapid.[24] This network is robust to the random removal of nodes – indeed, a significant fraction of nodes can be removed without the network falling apart. However, the network is highly vulnerable to attack: removing hubs quickly fragments the network.[25]

### Clustered

A clustered network exhibits what is known as "intermediate modularity." An entirely modular system would consist of disconnected clusters of nodes; intermediate modularity implies a degree of overlap, or nodes that are linked to more than one cluster. Unlike random and scale-free networks, which are defined by their degree distributions, a clustered network varies; indeed, a network may be both clustered and scale-free.[26] Depending upon its degree distribution, clustered can also begin to approximate the qualities of these other archetypes.

How might the characteristics of resilient systems and network archetypes be applied to design? The following case studies begin to answer this question. The master plan of Greensburg, Kansas, the proposed redevelopment of Lloyd Crossing in Portland, Oregon, and the proposed development of North Innisfil in Ontario, Canada, were all designed with high sustainability aspirations. While they were not designed with the idea of "resilience" in mind, they nevertheless illuminate the concept of resilient design, as well as the complexities that accompany such an approach. Each case study focuses on specific aspects of the designs that are relevant to this discussion, and are not intended to be comprehensive reviews.

## Greensburg

On May 4, 2007, the town of Greensburg, Kansas, an agricultural community of approximately 1,400 residents, was decimated by a tornado that destroyed 90 percent of the city. Greensburg decided not simply to rebuild, but to become a model sustainable community.[27] The community invested in a series of long-term comprehensive community planning efforts, beginning with the "Long-Term Community Recovery Plan," led by the Federal Emergency Management Agency, (FEMA) and followed by the "Greensburg Sustainable Comprehensive Plan," led by BNIM Architects.[28] In addition, the National Renewable Energy Laboratory (NREL) prepared numerous energy-related studies and recommendations for

Greensburg, many of which were adopted or incorporated into the "Comprehensive Plan."[29] In part owing to NREL's enthusiastic participation, Greensburg's energy system is of particular note – designed to meet all of the city's energy needs with local renewable sources.

The novelty of Greensburg's new energy system may be seen most clearly in contrast to what came before. Prior to the tornado, Greensburg's energy system was relatively traditional: its electricity came primarily from distant coal-fired power plants, transferred to the city via a primary arterial transmission line. The city acted as a municipal utility, purchasing power for its residents through a state agency. In addition, the city owned five dual-fuel (natural gas and diesel) generators, which were run intermittently to supply extra energy during peak periods or during power outages.[30]

Amory Lovins first described the inherent brittleness of such a system in his 1977 *Soft Energy Paths*, and has subsequently elaborated on this thesis in numerous works, including a 1981 report for FEMA, co-authored with L. Hunter Lovins. The arguments advanced in this report are rooted in the idea of resilience, and rely in part upon the work of C.S. Holling, a central figure in CAS theory. Aside from the community-scale backup (which will be discussed later), the energy system described above conflicts with the factors that support resilience in nearly every instance. It is not particularly diverse: electricity production is dominated by a few large power plants that rely upon the same source of fuel. There is little redundancy. And it is not particularly flexible: large-scale power plants are capital-intensive, requiring large investments in both the plant itself and its supporting infrastructure, and thus requiring long lead times. The system therefore cannot respond rapidly to changing conditions.[31]

The structure of this system is difficult to assess. The physical network – the power plants, transmission lines, and substations that make up the electric grid – is complex; and while it has been the subject of a number of recent studies from a network theory perspective, the results are still preliminary. Several scholars have suggested that the electric grid exhibits a scale-free topology, displaying a degree of centrality: hubs (whether power plants, substations, or other infrastructure) with greater-than-average links.[32]

In a system designed to facilitate the flow of electricity, a scale-free topology makes sense: such a network is densely interconnected, with each node never far from a hub. However, this same quality also facilitates the flow of disturbances, which can spread quickly through a scale-free network.[33] Albert-László Barabási notes that a particular type of disturbance, a *cascading failure*, is "a natural consequence of connectedness and interdependency."[34] A cascading failure occurs when the failure of one node shifts loads or responsibilities to neighboring nodes; if the loads are too great then these nodes, too, will fail. Such failures have been responsible for a number of major blackouts.[35] Greensburg's backup system served as insurance against complete failure. Indeed, these backup generators anticipated many of the characteristics that would define Greensburg's new energy system: diversity, redundancy, flexibility, and modularity.

The new system, based largely upon NREL's reports and recommendations, focuses on providing for Greensburg's energy needs with local renewable sources via both community-scale and distributed generation. The centerpiece of Greensburg's system is a new wind farm about five miles outside of town.

Greensburg's wind resources are among the best in the country, and the ten turbines are expected to generate 12.5MW of electricity – four times what the city is expected to consume. The remainder will be sold back to the Kansas Power Pool. When the wind is not blowing, Greensburg can pull power from the grid. Kansas Power Pool has guaranteed that this energy, too, will be renewable, generated by a number of sources, including wind and hydropower.[36] The new energy system also includes distributed generation. Individual homeowners and businesses are encouraged to install small-scale wind turbines and photovoltaic panels for electricity production, geothermal ground-source heat pumps for heating and cooling, and biomass plants for cogeneration of electricity and heat in larger scale applications.[37]

This new system exhibits many characteristics of a resilient system. First, there is a great diversity of energy sources – from local solar and wind to more distant hydropower – that enhances the system's ability to function under a wide variety of conditions and withstand many kinds of disturbance. Second, there is redundancy – both literal redundancy (exactly similar wind turbines and photovoltaic panels) and functional redundancy (multiple systems generating energy). There is redundancy at multiple scales, from small, distributed panels to large regional sources; and these systems are distributed throughout the landscape, providing insurance against a localized disruption (like a tornado). The system is also flexible: the small scale of the individual components means that they are easy to replace, do not require huge capital investments, and may be reconfigured if necessary. Together, small scale and simplicity allow a degree of self-organization: the system can adapt to changing conditions through the accumulated actions of individuals and neighborhoods, as they tweak and adjust the components over time, responding intelligently to local changes. The system requires little central planning and coordination, aside from the right mix of policies to make distributed generation practicable in the first place.[38]

The distributed nature of this system begins to suggest a network structure dominated by semi-autonomous clusters (towns like Greensburg) connected via multi-directional links – a marked departure from a unidirectional network dominated by central plants. The rate of flow across a clustered network depends upon its degree of distribution, but the existence of clusters may provide the opportunity to regulate flow in a way that is not possible in the globally interconnected scale-free model.[39] The clustered architecture is, in one sense, a compromise solution that seeks to retain the benefits of interconnection while maintaining a degree of internal stability and autonomy; a structure that may enhance robustness and reduce the impact of perturbations.[40]

Intermediate modularity provides the additional benefit of enabling local adaptation: cities and communities can match their energy systems and policies to their particular social and environmental context, and can adjust these systems in response to changing needs and conditions. Indeed, Greensburg specifically set out to create a system that afforded them such control: that was reliable, easy to operate and maintain, and offered "flexibility to the community to determine its energy sources."[41] While such goals are social and institutional rather than strictly ecological, they are nevertheless enabled by the design and structure of the technical system. Communities and small towns can effectively manage small-scale technologies such as solar, wind, and biomass,[42] suggesting that network structure and topology may have important social implications.

According to network theorists Colleen Webb and Örjan Bodin, "Numerous studies in social science agree that power is bound up with centrality, although the connection is not completely straightforward."[43] Amory Lovins postulates that centralized energy systems tend to centralize power and control by virtue of their large scale; their need for massive capital investment; their technical complexity, which requires experts and specialists; and their vulnerability to a range of disturbances, which require heightened security and control.[44] The design and deployment of such systems tend to involve large companies and governments – which alone have the necessary capacity to execute such projects – and are typically far removed from local decision-making and oversight. This analysis is reminiscent of the work of anthropologist Vernon Scarborough, who makes similar connections between large-scale construction projects, social stratification, and brittleness in the context of ancient water management systems.[45] Scarborough also suggests that these social patterns are manifest in settlement patterns, with greater hierarchy corresponding to larger, more centralized cities. While far from conclusive, such correlations are suggestive of an overlap between technical and social systems, and may provide a framework for integrating social criteria – equity, self-determination, the distribution of wealth and power – into the design and analysis of technical systems.

The ability for a community such as Greensburg to adjust their energy system to meet site-specific and/or changing conditions indicates *active* resilience at work: the capacity to learn, adapt, and change proactively. Thus the design of the built environment affects not only passive resilience by providing a system that can withstand disturbance, but also active resilience by constraining or expanding the range of local control. In other words, there appears to be a correlation between the structure of technical systems, local decision-making capability, and resilience.[46]

## Lloyd Crossing

Lloyd Crossing is an urban infill and redevelopment plan for a site within the Lloyd District of Portland, Oregon, an urban neighborhood consisting predominantly of two- to five-story buildings with some surface parking lots. The design was completed in 2004 by an interdisciplinary design team led by Mithun Architects + Designers + Planners. Their innovative approach compared proposed designs to predevelopment conditions, looking to restore natural ecosystems and a number of the services they provide. The emphasis on regenerating habitat is of particular interest – especially in an urban site with few remnants of natural ecology.

The approach to creating habitat in Lloyd Crossing, while framed in terms of site-scale metrics such as increased tree cover, improved stormwater infiltration, and carbon sequestration, is steeped in the language of landscape ecology. The aim of the plan is to create a series of small-scale habitat patches and corridors, and to establish connectivity with significant adjacent habitat along the Willamette River.[47] The goal was to restore some degree of the ecosystem that existed on the site prior to human development: a mixed conifer forest that supported a wide variety of species – beaver, otter, bear, turtle, salmon, and more – and provided important ecosystem services such as groundwater recharge and carbon sequestration.[48] The design proposes two acres of natural habitat, which sprouts among dense urban

development in the form of parks and natural areas. These distributed patches are linked via a network of green streets, pocket parks, and green roofs. A major habitat corridor (another two acres) links these patches to habitat along the Willamette River.[49] The corridor is created by converting a length of avenue to native landscape. Together, this habitat network is expected to provide avian, invertebrate, and limited aquatic habitats for a number of native species.[50]

Webb and Bodin suggest that network theory may be used to describe ecosystems and landscapes.[51] A landscape can be viewed as a network of supportive habitat patches linked by corridors. The focus of landscape networks is typically *connectedness* – specifically a measure called the "minimum spanning tree," which measures "the shortest path through the network that connects all of the nodes together,"[52] allowing species to disperse across the landscape. Small "stepping-stone" patches can play a vital role despite their size by tying a network together and, by extension, maintaining the minimum spanning tree that may be required to support certain populations.[53]

Issues of landscape connectivity are large-scale issues that transgress the boundaries of a single site or even a single neighborhood. The Lloyd Crossing plan acknowledges this implicitly when it proposes several off-site interventions: stream restoration along parts of the Willamette River, and restoration of fifty acres of restored mixed conifer habitat.[54] These achievements are significant and represent an important direction in urban design. However, complex systems theory suggests that the approach to ecology should not be piecemeal, but rather that the scale of planning and design should be matched to the spatial, temporal, or functional scale of the system in question.[55] Noted complex system theorists Graeme Cumming, David Cumming, and Charles Redman argue that scale mismatches between ecological systems and the social processes and institutions designed to manage them often lead to mismanagement and loss of resilience.[56] This reveals a significant conflict between the traditional design process – in which the design assignment is limited at the outset to a particular site – and the approach suggested by complex systems theory – in which the scale of an intervention is matched with the scale of the system it is designed to manage.

However, even the best designs are part of a complex system, and thus do not always yield intended results: learning and adaptation are necessary. The Lloyd Crossing plan acknowledges this, too, when it notes that the habitat plan should be implemented in phases, and with careful monitoring – implying that the plan must remain flexible.[57] Such flexibility is rooted in the *adaptive capacity* of social institutions, in this case of the developers and local administrators. Indeed, a central focus of CAS theory is the social and institutional conditions that support adaptive capacity. Jon Norberg and colleagues argue that the ability for social institutions to learn and adapt relies upon a *diversity* of potential practices, and the *flexibility* to change practices when necessary.[58] They propose that diversity originates from the interaction between local adaptation to varied conditions on the one hand, and exchange of information and the introduction of novelty on the other. The first condition suggests localization (or a modular network); the second suggests connectedness and flow between nodes. A balance of these requirements suggests a degree of intermediate modularity in the structure of the institutions.[59] In social systems, this balance requires that local groups be granted some degree of autonomy to craft policies, and also implies that policies themselves allow some degree

of flexibility and diversity of approaches. It also requires the occasional injection of variation and fresh ideas – electing new leaders to office, for instance, or exchanging information with other locales.[60]

In contemporary practice, however, exchanging information and ideas is rarely a problem; rather, the challenge is facilitating local adaptation. This challenge is particularly acute in the world of sustainable design, where simple lists of commonly accepted best practices are often substituted for place-specific analysis and context-driven responses. The practical effects of these best practices, while well intentioned, may be to limit the diversity of ideas and practices.[61]

Mithun's approach to Lloyd Crossing was based upon a detailed understanding of the site and interdisciplinary collaboration. A complex systems perspective suggests that these design processes, rather than the specific ingredients of the design, are the critical factors for resilience.

## North Innisfil

The concept plan for North Innisfil (Figure 13.2) was completed in 2009 by an interdisciplinary design team led by William McDonough + Partners. The proposed community is located on the western shore of Lake Simcoe, north of Innisfil in Ontario, Canada. William McDonough + Partners' approach was explicitly systems-based, conceptualizing the existing landscape and the proposed design as a series of overlapping systems: hydrology, energy, material recovery, landscape ecology, and community.[62] Three aspects of this design are relevant to our discussion. First, the energy system provides an opportunity to discuss the role of efficiency in complex systems. Second, its carefully considered material flows reveal how seemingly separate networks are tied together. Finally, the community plan – a compelling diagram of clustered "villages" – suggests a connection between urban form and social and economic order.


**13.2**
Concept plan for North Innisfil. Courtesy of William McDonough + Partners.

## *Energy: Resilience vs. Efficiency*

Like Greensburg, North Innisfil's energy system combines distributed and community-scale generation based upon an array of locally available renewable sources. Designed in collaboration with engineering firm Arup, the system features a community-scale combined heat and power (CHP) biomass plant that produces both electric and thermal energy. The latter is distributed to surrounding buildings to meet their heating and cooling needs. Distributed energy sources include solar thermal (for domestic hot water) and photovoltaic panels (which meet an anticipated 15 percent of electrical demand).[63]

Given the argument advanced in the Greensburg case study – that small-scale distributed sources greatly enhanced resilience – why include *any* larger scale, more centralized energy sources? The answer is clear: the CHP offers dramatic gains in energy efficiency. This is in part due to its ability to utilize "waste" heat from electricity production to heat and cool buildings, but it is also due to inherent efficiencies that come from size. A single plant can reduce process losses and can operate at a steadier load than many individual units, thereby running closer to optimal efficiency for a greater percentage of the time.[64]

Resilience would appear to favor infinitely fine-grained systems, with so many redundant, diverse, and flexible units that any single failure is negligible. Yet this is clearly impractical, and would also be incredibly costly and inefficient: the production, maintenance, and connection of so many components would require substantial investment of time and resources. In addition, many of these components would not operate under normal conditions: diversity requires an array of solutions adapted to many conditions. Norberg and Cumming observe that many components in a diverse system "may be relatively inefficient or even unnecessary."[65] The very conditions that make a system resilient – diversity, redundancy, and flexibility – can also make it more costly and less efficient.

Given stable conditions, systems select out inefficient components. This optimization tends to eliminate diversity in favor of the solutions that work *most of the time*; and eliminates those components that underperform for those that perform well *in a specific situation*. Market forces are one mechanism of optimization – they tend to select in favor of short-term profitability, optimizing systems for efficiency and low cost.[66] The resultant systems tend to be brittle and inflexible, and are prone to spectacular failure should conditions change.[67] Yet the opposite extreme – designing for resilience alone – could be costly and inefficient.

In a recent paper, network theorists Raj Kumar Pan and Sitabhra Sinha attempt to understand the constraints that lead to the formation of real-world systems. They suggest that networks evolve in response to cost, efficiency, and stability, as well as additional factors not yet identified.[68] Optimizing certain of these criteria favors certain types of networks – for example, optimizing cost and efficiency favors a centralized network: fewer resources are required to maintain the system, and direct connections enhance flow. The sacrifice, however, is stability. Pan and Sinha argue that a clustered network structure balances all three criteria, forming an exquisite compromise between efficiency and resilience, and that this balance helps to explain the ubiquity of clustered networks in human and natural systems.[69]

The idea of balance is clearly important: systems must fulfill a number of constraints, and they cannot all be optimized. The preponderance of various types

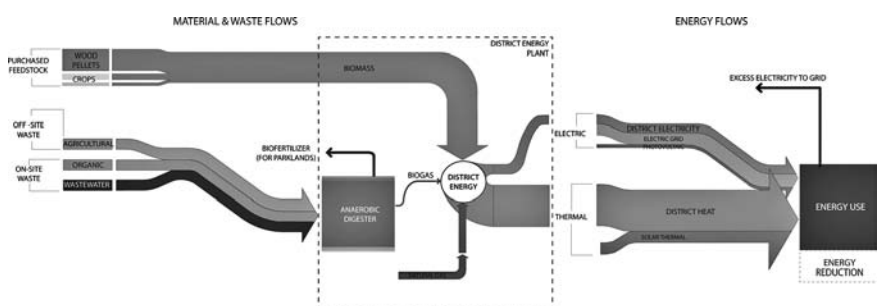
of clustered networks in nature suggests that these represent such a balance. The point, however, is not to arbitrarily favor a particular type of network; rather, the point is that the optimal network structure is determined by the particular constraints of the system in question. In the case of North Innisfil, the available resources (agricultural wastes are readily available for biomass plants), the make-up of energy needs (dominated by thermal loads), and the desire for energy efficiency and cost-effective design, contributed to a design that balances these criteria and still exhibits a number of properties of a resilient system.

## *Material Recovery: Overlapping Systems*

In the spirit of William McDonough and Michael Braungart's "cradle-to-cradle" philosophy,[70] the North Innisfil plan reconceptualizes "waste management" as "material recovery," with the aim of transforming what is normally considered waste into a community asset.[71] Organic wastes – including household waste, wasterwater, and off-site agricultural wastes – are routed to a community-scale anaerobic digestor. The organic matter is broken down in an oxygen-free environment, producing rich biofertilizer and biogas (an additional fuel for the CHP plant). As shown in Figure 13.3, material and energy are not discrete systems; rather, they come together to form a larger system, linked by the hub of the district energy plant.

Similar overlap occurs between North Innisfil's systems of landscape ecology and stormwater management. Stormwater treatment was a primary focus of the design. The treatment system consists of a distributed network of rain gardens, bioswales, and wet ponds which is woven into the landscape and seamlessly integrated with the site's hydrology, heritage landscapes, and new public green spaces. This inherently resilient water treatment infrastructure could be expanded to include wastewater from the digestor, which would create a link between the energy-wastewater network and the habitat-hydrology-recreation network.

Additional networks could easily be overlayed – public open spaces, village centers, transportation – that share common links and thus begin to form a single interconnected network. This is not accidental: the designers approached the project with a systems perspective, interested in mimicking the "elegant interdependence" of the natural world, in which most components have multiple functions.[72] The design of North Innisfil, like an ecosystem or a food web, is a system of overlapping and interlocking networks.




**13.3**
North Innisfil's interconnected material and energy systems. Courtesy of William McDonough + Partners.

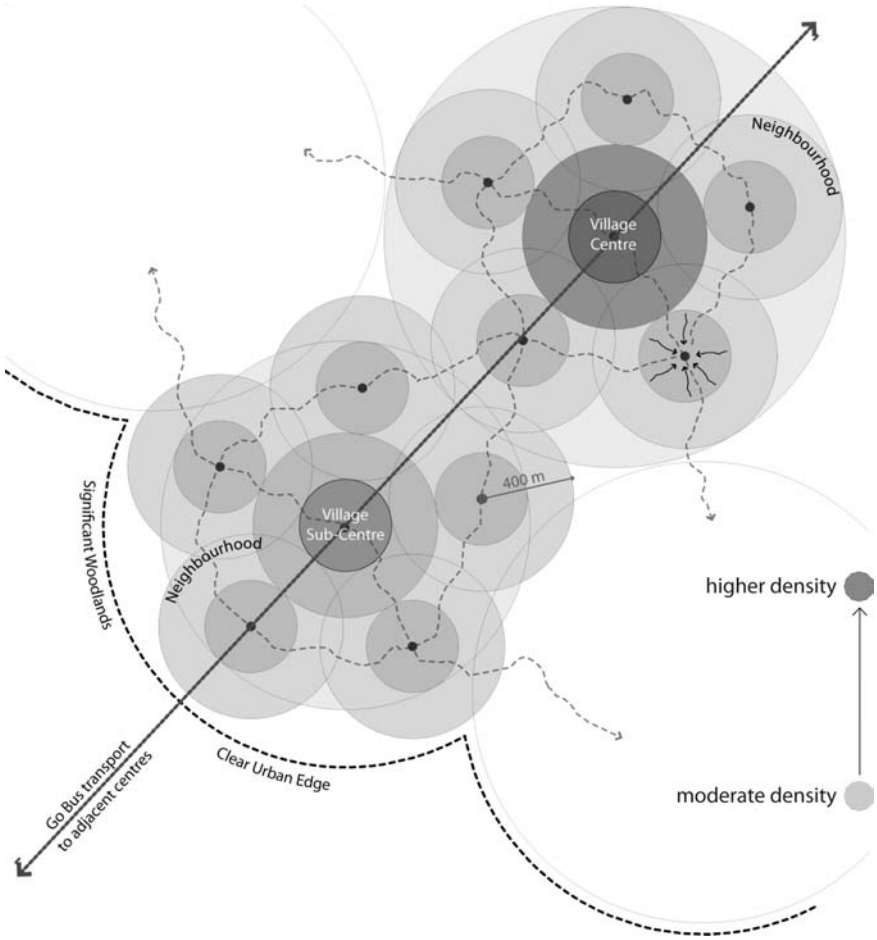
In reality, this complexity is not unique to North Innisfil. Most systems cannot be assessed as independent entities, neatly separated from their surroundings and interrogated objectively. Complex systems theory was developed in part to explain behaviors that a reductionist approach could not.[73] As the designers of North Innisfil acknowledge, terms like "hydrology" and "energy" are heuristic devices (or "conceptual filters") that are useful for thinking about particular aspects of a larger, integrated whole.[74]

This larger, tightly woven system is difficult to evaluate. What does its network structure look like? How might it be optimized? How might the ideas of diversity, redundancy, and flexibility be applied at a larger scale? It is in this arena that network theory and complex systems offer an entirely new approach to design. Novel metrics could be developed based upon this approach – degree distribution, centrality, and robustness to various types of failure. These could add a level of understanding that goes beyond efficiency and throughput, and may help designers determine the optimal network structure of a given system, and the right balance between efficiency and resilience. The design of North Innisfil represents a step in this direction: William McDonough + Partners' design process consciously takes into account the specificities of context, the overlap of systems, and cross-scale interactions from building to region.[75] Yet a conscious focus on network theory may extend this thinking even further in order to create even more resilient designs.

## *Community Design: Modularity and Social Considerations*

One of the defining features of the North Innisfil plan is its network of compact, walkable neighborhoods bunched like grapes around distinct "village centers," linked together by roads and bike paths that navigate the wetlands, forests, and hedgerows (Figure 13.4). The organization is immediately suggestive of a clustered network structure – a form somehow tied up in the very concept of *community*. There seems to be some correspondence between the clustered urban form and the organization of the social networks it is designed to support. The nested clusters suggest localized place-based social networks – manifest in pocket parks and neighborhoods centers, where one could imagine seeing familiar faces, establishing and maintaining social connections.

The analysis of Lloyd Crossing revealed localization as a mechanism for maintaining diversity and resilience in social institutions. Resilience seems inherently bound up in localization: its preference for the diverse, redundant, and flexible leads to a focus on the small scale and locally adapted. These ideas may be applied to economies as well as to energy systems. Indeed, the concept of localization appears to be gaining traction as a social movement with strong economic overtones. Rob Hopkins, co-founder of the Transition Network – an organization dedicated to local, community-focused responses to climate change and peak oil – emphasizes in a recent essay the importance of local production and small-scale businesses in building resilience and reducing local dependence on an energy-intensive global economy. Localization, Hopkins argues, increases local autonomy, tightens feedback loops, and provides numerous social benefits.[76] The design of North Innisfil, with its several small neighborhood centers and area for local agriculture, is compatible with such ideas, giving form and geometry to these economic concepts.




**13.4**
The concept diagram for North Innisfil, showing neighborhoods clustered around village centers. Courtesy of William McDonough + Partners.

Yet characterizing clustered networks simply as "localized" is inaccurate: complex systems thinking subverts such simple generalities. Pan and Sinha note that a particular type of clustered network – the hierarchically clustered network – is ubiquitous in real-world systems.[77] This hierarchy reveals larger scales of organization and some degree of centrality. Such hierarchically clustered networks can approximate the degree distribution of a scale-free network, with its dense interconnection, rapid flow, and "small-world" effect.[78] As noted previously, a critical aspect of resilience is matching the scale of a plan or policy with the scale of the system it addresses. Larger scale systems require larger scale policies and plans, suggesting larger scale bodies to carry them out. The authors of *Panarchy* suggest that nested hierarchies are critical to adaptive cycles in complex systems.[79] This network structure appears to represent a balance between a completely local, autonomous network and a highly centralized, globally interconnected one, although it is, as yet, unclear precisely what factors are being balanced.[80]

A hierarchically clustered network structure is visible in North Innisfil's plan: neighborhoods are clustered around larger "village sub-centers," which are themselves clustered around a larger "center" (Figure 13.4). This hierarchical

organization supports (and was in part generated by) the town's transportation systems, designed in collaboration with Poulos + Chung Limited. Each neighborhood is designed to be walkable, within a five to ten minute walk of a village center. Village centers are linked to one another by roads and bicycle paths, and are served by a local bus system. A regional rail station is accessible by both bus and bicycle. The hierarchy of the urban plan supports this hierarchy of transportation options and provides a high level of mobility. Thus the structure of this network balances local community identity and autonomy with high connectivity with the wider world.

The congruence of these diverse and varied systems suggests that there is some correspondence between resilience and a clustered network structure – and, moreover, that there is some relationship between the structure of built and technological systems and the structure of social and economic systems. While the nascent nature of network theory and complex systems theory makes it difficult to draw any conclusions from this overlap, it reveals great potential for this perspective to bring together the social and technical aspects of systems and to influence design in many different ways, namely process, organization, form, and metrics for evaluation.

## Conclusions

Complex systems pervade our world – both the natural and the built environments – and are prone to nonlinear, unexpected behaviors. In the face of this uncertainty (as well as the additional uncertainty created by climate change, globalization, and so on) the concept of *resilience* provides an important conceptual framework for designers to navigate – or even celebrate – this complexity. Resilience extends traditional notions of sustainability by looking at those processes and characteristics that make a system sustainable over the long term. Many of these characteristics may be applied to the built environment in order to create systems, communities, and cities that are resilient and sustainable.

Many of the ideas presented here are merely suggestive: the vague outlines of something deeper, based upon a rapidly emerging body of work. Indeed, many of the ideas raise important ethical questions that have not been addressed here. Rather than suggest a particular trajectory or correct approach, this analysis has insisted on context-based approaches that balance local requirements, and has revealed the role of complex systems theory in understanding that balance. The complex systems approach has great potential to tie together social and ecological considerations of sustainability, to contribute to our understanding of the rich interconnections between physical systems and their myriad social and economic implications, and to suggest new patterns for development based upon an evolving understanding of a complex world.

## Notes

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9 This terminology is borrowed from Amory B. Lovins and L. Hunter Lovins, *Energy Policies for Resilience and National Security*, report prepared for the Federal Emergency Management Agency (October 1981), 136.
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11 Norberg and Cumming, *Complexity Theory*, 9–10.
12 Lovins and Lovins, *Energy Policies*, 145.
13 Norberg et al., "Diversity and Resilience," 47.
14 Ibid., 48.
15 This definition is drawn largely from Lovins and Lovins, *Energy Policies*, 149.
16 Webb and Bodin, "A Network Perspective," 85.
17 See Barabási, *Linked*, for a variety of applications.
18 Norberg and Cumming, *Complexity Theory*, xiv, 81. See also Barabási, *Linked*. Robustness has a specific meaning in network theory: it is the capacity of a network to withstand the removal of components (nodes or links) without becoming fragmented into smaller pieces. It is not the same as resilience, but may contribute to resilience.
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33 Barabási, *Linked*, 135; Norberg and Cumming, *Complexity Theory*, 82.
34 Barabási, *Linked*, 211.
35 Ibid., 119–120.
36 Billman, *Rebuilding Greensburg*, 35.
37 Ibid., 12, 36–42.
38 For a description of these policies, see Billman, *Rebuilding Greensburg*, 36.
39 Ibid., 86.
40 Webb and Bodin, "A Network Perspective," 96, 102; Norberg and Cumming, *Complexity Theory*, 83; Raj Kumar Pan and Sitabhra Sinha, "Modular Networks with Hierarchical Organization: The Dynamical Implications of Complex Structure," *Pramana* 71, 2 (August 2008): 331–340.
41 Billman, *Rebuilding Greensburg*, 31.
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60 Norberg et al., "Diversity and Resilience," 64, 67.

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66 Because social and environmental costs and benefits are largely external to economic transactions, the "economic efficiency" achieved by the market is often markedly different from the "engineering efficiency" advocated by practitioners of sustainable design. For an excellent discussion of these different types of efficiency, see Amory B. Lovins, "Energy Efficiency: A Taxonomic Overview," in *Encyclopedia of Energy*, vol. 2 (San Diego, CA: Elsevier, 2004).
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72 Ibid.
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77 Pan and Sinha, "Modular Networks."
78 Barabási and Oltvai, "Network Biology."
79 Holling et al., "Theory of Adaptive Change"; Holling and Gunderson, "Resilience and Adaptive Cycles."
80 Pan and Sinha, "Modular Networks."

Part IV

# Techniques

Chapter 14

# Technique Is the Architecture of Sustainability

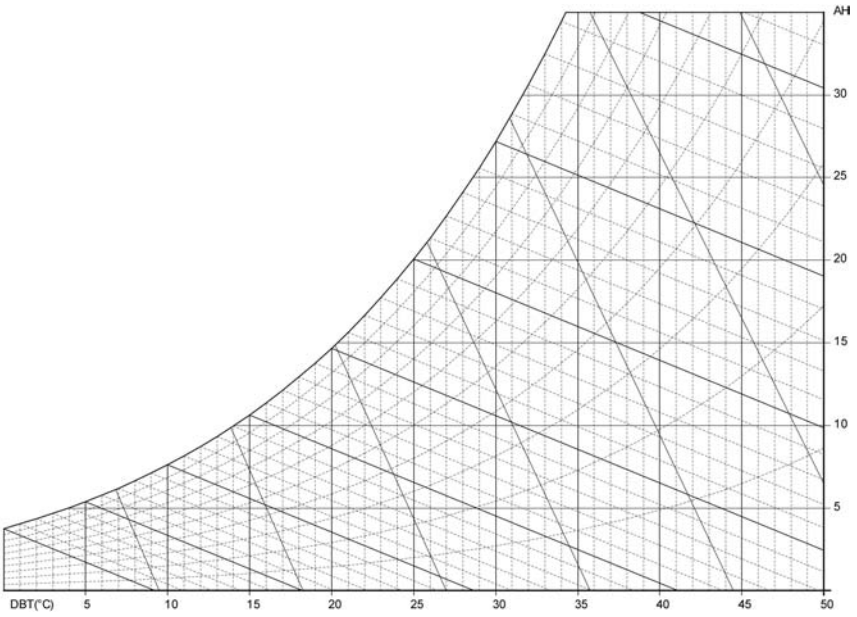
*Kiel Moe*

> We can hold in our minds the enormous benefits of a technological society, but we cannot so easily hold the ways it may have deprived us, because technique is ourselves.[1]

Any technology is fraught with historical contingencies and legitimizations that characterize its origins, development, and use. The lack of broad theoretical and historical understanding of technical practices in architecture frequently forces the hand of the architect. As momentum builds for sustainable practices in and outside of architecture, it is critical that architecture question its own assumptions about technology and sustainability as well as the techniques we deploy to practice and achieve it.

Before we know what to do, how to practice sustainably, we must know more about what we already do because technique is ourselves; we become our techniques. This chapter presents a narrative about a particular technique that is based on a relatively unconsidered – and unsustainable – assumption of our built environments: that air is a suitable medium for heating and cooling buildings. Few building systems or techniques in architecture acquired more ubiquity in the twentieth century than air-conditioning. Ultimately, air-conditioning techniques conditioned more than the temperature and humidity levels of air. These techniques eventually acquired such momentum that they also conditioned the design of buildings, cities, energy policies, pedagogies, and expectations for human comfort. Technique, as described by Jacques Ellul, "does not mean machines, technology, or this or that procedure for attaining an end. In our technological society, *technique is the totality of methods rationally arrived at and having absolute efficiency* (for a given stage of development) in *every* field of human activity."[2] Air-conditioning as a technique exceeds itself, ultimately affecting multiple aspects of built environments.

The following text presents the origins and development of this technique; in particular through the instrument of the psychrometric chart (Figure 14.1). In




**14.1**
The psychrometric chart

doing so, it uncovers problematic oversights inherent in this approach to thermal comfort that inversely help identify alternate techniques for the thermal conditioning of buildings. To understand air-conditioning as a technique in its fullest form, this narrative must include a range of sources (e.g., technical, historical, social, economic) to begin to understand the technique and its derivation. Several historical factors influenced this technique including the entrepreneurial ambitions of its industry, marketing and consumer choices, the agency of technological momentum, and architecture's persistent technological determinism. Its unconsidered assumptions and incorporation in twentieth-century architecture has yielded a pattern of received and repeated thought that holds an unwarranted command on building design that constitutes dubious default design practices characterized by technological acquiescence. Today, however, multiple economic and ecological factors place this unsustainable capitulation in doubt. Other, more technologically prudent, ecologically sane, physiologically responsive, and architecturally advantageous thermal conditioning systems exist; one basis for my integrated design practice and consulting. As such, this chapter is also demonstrative of a more reflexive view of technological research and approach to innovation that engages the history of architecture's disciplinary procedures as a sound basis of systemic transformations for building in the twenty-first century. It is an example of how technique stands to change in the twenty-first century as the epistemological context of thermal energy in architecture shifts from a model of unreflective acceptance to one of requisite research, formal possibility, and strategic innovation.

## The Radiant Void and the Unwarranted Technological Momentum of Air-conditioning

*Why do we heat and cool buildings with air?*

*How did a thermodynamically and physiologically irrational technique of heat transfer – air – come to dominate the design and conditioning of buildings?*

The origins and effects of air-conditioned techniques and technologies, as well as their incorporation into buildings, are well documented.[3] The development of air-conditioning techniques advanced our understanding of thermal comfort and indoor air quality. At the turn of the twentieth century, our milieu became increasingly controlled and increasingly managed for human comfort. During this period, building types and programs, design practices and industries, levels of energy consumption, and expectations for human comfort all fundamentally changed alongside the burgeoning techniques of air-conditioning. However, air-conditioning itself did not impose these transformations. Any technology is itself neutral. As Lewis Mumford wrote, "the machine itself makes no demands and holds out no promises."[4] Rather, social and economic assemblages presuppose and determine the adoption of new techniques and technologies. As Gilles Deleuze among others has noted: "the machine is always social before it is technical. There is always a social machine which selects or assigns the technical elements used."[5] The transformations that accompanied air-conditioned buildings and policies were designed and specified by design, by choice; again, technique is ourselves. This is what Thomas P. Hughes described as "technological momentum."[6] The concept of technological momentum suggests that technologies are determined as social need and desire dictate and then, through a period of collective choices, come to dominate a period's technique. In the case of air-conditioning, this momentum helped shape multiple aspects of buildings and design practices. What is of particular interest here, therefore, are the instruments and means by which air-conditioning acquired its technological momentum; the engendering agency of its widespread diffusion and repeated use. A primary enabler of this momentum was the derivation and dissemination of the psychrometric chart (Figure 14.1). So, more specifically, the pertinent question is: What were the origins and effects of psychrometric techniques for buildings?

## Charting the Psychrometric Chart: How Air – Almost Nothing – Acquired Such Great Momentum

At the turn of the twentieth century, psychrometric research on the relationship between water vapor, temperature, and air pressure was distinctly, yet nearly simultaneously, developed by three individuals in North America and Europe: Richard Mollier in Germany, Leonid Ramzin in Russia, and Willis Haviland Carrier – the so-called "Father of Air-conditioning" – in the United States.[7] This simultaneous yet distinct research in disparate parts of the world reflects a period-specific convergence of new thermodynamic science with developing interests around human health and, particularly in Carrier's case, entrepreneurial ambitions. While

respective air-conditioning systems emerged from each of these researchers, Carrier's approach ultimately acquired the greatest momentum in North America and will thus be the focus in what follows.

Carrier presented a paper on what he described as his "Rational Psychrometric Formulae" in late 1911.[8] Margaret Ingels, Carrier's biographer, noted, "His 'Formulae' was translated into multiple foreign languages and became the engineering core of the air-conditioning industry."[9] The psychrometric chart instrumentalized the science of air-conditioning, and, as such, prepared the pervasive psychrometric techniques of the twentieth century. Thus the scientific derivation of the psychrometric techniques for air in buildings – notable equally for its insights and its oversights – deserves attention.

Carrier first conceptualized the principles of what would become his Rational Psychrometric Formulae while he was standing on a train platform one humidity-laden winter night in Pittsburgh.[10] Ingels documented this foggy insight as recounted by Carrier:

> Here is air approximately 100% saturated with moisture. The temperature is low so, even though saturated, there is not much actual moisture. There could not be at so low a temperature. Now, if I can saturate air and control its temperature at saturation, I can get air with any amount of moisture I want in it. I can do it, too, by drawing the air through a fine spray of water to create actual fog. By controlling the water temperature I can control the temperature at saturation. When very moist air is desired, I'll heat the water. When very dry is desired, that is, air with a small amount of moisture, I'll use cold water to get low temperature saturation. The cold spray water will actually be the condensing surface.[11]

Carrier based his "Rational Psychrometric Formulae" on psychrometric tables from the National Weather Bureau used to calculate relative humidity in regional weather forecasting.[12] While these macro-scale relationships of ambient temperature and humidity mixtures describe the behavior of mixing air masses, such meteorological behavior does not accurately account for the more discreet physiological processes of the human body within interior milieus. As a result, neither did Carrier's approach to the thermal milieu; an enabling subterfuge of the psychrometric chart. A body in the interior milieu of a building operates with a much more nuanced combination of temperature and humidity interactions as well as more discrete physiological responses of the human body to a range of heat transfer conditions. Carrier's psychrometric process was, though, an astute approach for solving humidity problems in hygroscopic machines within the printing and textiles factories – Carrier's entrée into the burgeoning field of air-conditioning applied science. However, this preoccupation with humidity and temperature that is the basis of his "Rational Psychrometric Formulae" was not revised to account for other equally important roles such as radiant heat transfer, for example, in interior milieus when psychrometric techniques for hygroscopically sensitive machines were transferred to conditioning systems for other building types and their corporeal *raison d'être*. This sustained preoccupation with mechanized vapor, and its neglectful omission of other important physiological factors, is evident in Carrier's authoritative definition

of air-conditioning in his subsequent publications that disseminated psychrometric techniques:

> Air-conditioning is the control of the humidity of air by either increasing or decreasing its moisture content. Added to the control of humidity are the control of temperature by either heating or cooling the air, the purification of the air by washing or filtering the air, and the control of the air motion and ventilation.[13]

One such publication that Carrier co-authored was *Modern Air Conditioning, Heating, and Ventilating,* an early textbook on air-conditioning technology.[14] This text instrumentalized his research on the "Rational Psychrometric Formulae," perpetuating his early insights and oversights. In their presentation of "Psychrometrics and Comfort," the authors at once recognize the role of surface temperatures as a factor in human comfort but then quickly disregard surface temperature, limiting their focus to air temperature, humidity, air motion, and air purity as the constituent factors of psychrometric processes.[15] Despite their awareness of surface temperature effects in both this section and an earlier section on historical thermal conditioning systems, the authors of this text routinely dismissed all but convective systems. However, since the body exchanges nearly half of its thermal energy between the thermally active surfaces of the body's dermis and the warm or cool surfaces of a building, the accumulative neglect of radiant transfer processes in psychrometric practices has contributed significantly to the inefficient energy strategies that characterize the technique of air-conditioning, depriving human comfort and unnecessarily wasting resources. As such, this thermodynamic and physiological oversight created a radiant void in the history of thermal conditioning practices. As these techniques diffused through engineering schools and practice, air-conditioning systems multiplied and gathered momentum during the twentieth century; so inversely did this radiant void.

## The Biology of Technique

The psychrometric chart was derived in order to solve a problem with printing machines rather than of human bodies. One reason Carrier's work to mechanize the conditioning of air was so successful was because he grossly simplified the issue by excluding aspects of the human physiology. This was consistent with broad technical and intellectual patterns characteristic of a period in which, as Jacques Ellul described, "everything had to be reconsidered in terms of the machine."[16] "Man-made Weather" – Carrier's moniker for his work – reveals his mechanistic habit of mind. It also reveals the psychro-meteorological source of his work. This name, while being rhetorically compelling as a marketing tactic, from the beginning lacked a proper physiological understanding of the human body; *the Man* in his "Man-made Weather."

Reyner Banham portrayed Carrier as "content to solve problems as they were put to him – often with startling ingenuity and depth of technical or intellectual resource – that one may doubt whether he had any general means of conception of the art he was founding until long after he had fathered it."[17] For the problem

of humidity and temperature control for printing press milieus, Carrier's research and system was astute. But his presence in the larger air-conditioning field owes as much to his marketing acumen and entrepreneurial ambitions as his engineering. As Carrier himself stated, "between a fundamental demand for a product and the scientific knowledge of its requirements, the former is the most essential . . . in fact, the all essential factor."[18] This influence of consumer demand and entrepreneurial ambition became a primary impetus of air-conditioning and its techniques rather than physiological efficacy.

Banham's book *The Architecture of the Well-tempered Environment* demonstrates that, as air-conditioning systems permeated building design, architects unequipped with even rudimentary knowledge of thermodynamics or physiology capitulated to air-based systems; often with heralded excitement such as Renzo Piano and Richard Roger's Pompidou Center in Paris (Figure 14.2). This generation of architects found, at best, space and expression for the presence of these mechanical systems as an emblematic component of architecture's burgeoning modernization rather than a deeper, more poignant integration of the body within architecture. In many cases, architects thus willingly, if not euphorically, reconfigured building envelopes, building budgets, and expectations of human health and comfort in buildings around the demands imposed by these non-architectural systems and techniques.

The psychrometric chart was a prime agent in this technique that was collectively granted such grand momentum in the twentieth century. As psychrometric techniques were received and repeated through the century, this unnecessarily energy-intensive mode of thermal conditioning began to dominate buildings, often with little architectural intent. Since such mechanical systems can, depending on building type, account for about a quarter of a building budget, this thermal technique is grossly underperforming on physiological, economic, ecological, technical, architectural, and experiential levels. This will change. In a

**14.2**
The Pompidou Center. Centre Georges Pompidou, 1971–1977, Renzo Piano and Richard Rogers. Courtesy http://photoeverywhere.co.uk.

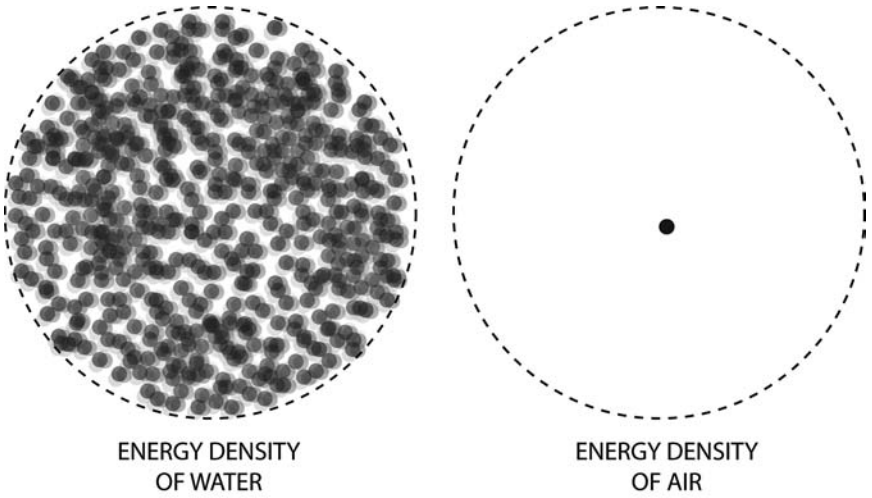
context of increasing demand for diminishing energy resources in this century, an assemblage of social, economic, and ecological needs will require alternative thermal energy systems. Given the oversights inherent in psychrometric techniques, alternative systems will inevitably become more preoccupied with the dynamic systems of human bodies as the basis for sound energy, economic, construction, and formal practices. In short, buildings will finally perform the way in which bodies perform, rather than the way in which a printing press operates; an example of what Jacques Ellul called the "biology of technique."[19]

## The Hydronic Turn: Lower Technology, Higher Performance Buildings

> In a world more humanely disposed, and more conscious of where the prime human responsibilities of architects lie . . . [it] would have been apparent long ago that the art of and business of creating buildings is not divisible into two intellectually separate parts – *structures*, on the one hand, and on the other *mechanical services*. Even if industrial habit and contract law appear to impose such a division, it remains false.[20]

The unconsidered body in Carrier's air-conditioned world of mechanized interior weather is at the crux of Banham's above "Unwarranted Apology," the opening statement to his *The Architecture of the Well-tempered Environment*. Thus, an approach to buildings that places the thermodynamics and physiology of the body at the center of an integrated approach to the construction and conditioning of buildings stands to be an essential transformation of our air-based techniques and their wanting, if not deleterious, effects. Central to this paradigm shift is the medium that modulates human temperature: water. In the way that Lewis Mumford characterized periods of technical activity based on the most pervasive, underlying materials of each respective epoch in his book *Techniques and Civilization* – the Eotechnic ("a water-and-wood complex"), the Paelotechnic ("a coal-and-iron complex"), and the Neotechnic ("an electricity-and-alloy complex") – one may also discern the profound transformations that will occur in building and energy practices as thermal conditioning shifts from techniques of air and convective heat transfer to techniques of water and radiant heat transfer. These liquescent transformations will be evident as the discipline shifts from habits and traditions that neglect the physiology of the human body to a period that builds buildings that finally occupy the same thermodynamic system that bodies occupy.

Since water is 832 times denser than air, it has a significantly higher energy density. As such, more energy can be captured and channeled with water than with air (Figure 14.3). Because of this density, the body transfers about twice as much energy through radiant transfer– via the integrated circulatory and skin surface system – when compared with convective transfer. The human body is first a thermally active surface system. It is difficult to imagine how or why the human body would use air to heat and cool itself. The human body would be about 800 times the size it is. The size of the respiratory system, the diameter of veins and arteries that would channel air, and the caloric intake required to breathe the required air




**14.3**
Energy density of water and air

would all be as absurd, as it would be inefficient. It is hard, then, to discern why buildings are designed and conditioned in this way.

Like a body, a building with thermally activated surfaces circulates thermal energy from its core to its skin and the milieu, and vice versa. Like a body, thermally active surface buildings decouple its ventilation loads from its thermal conditioning. Like a body, when a building's surface becomes its primary thermal conditioning system – a highly integrated system – a catalytic set of effects emerges for our buildings as well as for the distribution of building budgets, energy policies, and formal potential. Peter Zumthor's Kunsthaus Bregenz and SANAA's Zollverein School of Management and Design are seminal examples of thermally activated surface techniques that develop these multifarious and deeply integrated technical and formal ends with equal rigor.

Thermally activating surfaces and structures in buildings with water is a technique that collapses thermal conditioning systems, finish material systems, and structural systems. The resulting, more robust, thermally active surface construction defragments our buildings, thereby reducing the physical and organizational complexity of building that so often seems to increase, often adversely, in architecture with each new advancement of technical systems in architecture. David Noble describes this ultimately untenable technological escalation as a "machine mentality" which is the "understandable perhaps but nevertheless self-serving belief that whatever the problem, a machine is the solution. This manifests itself in a preference for, and tireless promotion of, capital–intensive methods and in the widespread but mistaken belief that the more capital intensive the process of production, the higher the productivity."[21] There is also an implication in the machine mentality that, as social, ecological, economic, and political problems escalate, technology must also escalate. However, it is apparent that when technology strategically de-escalates, it becomes more appropriate and more applicable throughout a variety of social, economic, and ecological contexts. Higher performance, lower technology solutions typically are more durable, may consume less, and are applicable in the developed and developing worlds. E.F. Schumacher's notion of "intermediate technology" counters the ideology of the machine mentality:

> The idea of intermediate technology does not imply simply a "going back" in history to methods now out-dated, although systematic study of methods employed in the developed countries, say, a hundred years ago could indeed yield highly suggestive results. It is too often assumed that the achievement of western science, pure and applied, lies mainly in the apparatus and machinery that have been developed from it, and that a rejection of the apparatus and machinery would be tantamount to a rejection of science. This is an excessively superficial view. The real achievement lies in the accumulation of precise knowledge, and this knowledge can be applied in a great variety of ways, of which the current application of modern industry is only one. The development of intermediate technology, therefore, means a genuine forward movement into new territory.[22]

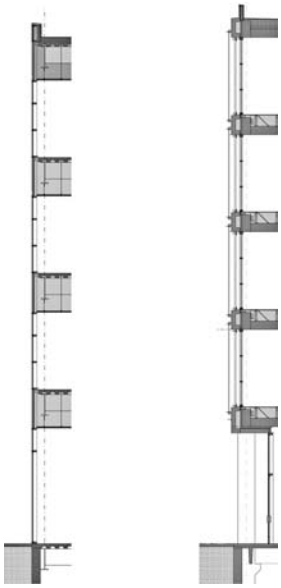
Schumacher asks us to think of technology not as an inevitable, deterministic progression but rather as ethics: a practice of the situationally appropriate. In a context of increasing demand for diminishing resources, a paradigm of higher performance through lower, more appropriate techniques suddenly gains great efficacy. In contrast to the technological escalation of the required cost and knowledge inherent in technologically determined approaches, situationally appropriate techniques engage what Schumacher called "simple equipment":

> Simple equipment is normally far less dependent on raw material of greater purity or exact specification and much more adaptable to market fluctuations than highly sophisticated equipment. Men are more easily trained; supervision, control, and organization are simpler and there is far less vulnerability to unforeseen difficulties.[23]

In contrast to the multi-layered, highly additive approach of most contemporary construction – a paradigm in which a new system or material is added with every issue encountered in design – the distillation of architecture's many, additive systems into the fewer, more robust systems in a thermally active surface that is at once structure and thermal conditioning system is a compelling direction in practice.

One recent example of a thermally active surface approach is a proposal for a pair of office buildings in downtown Denver. In addition to the typical constraints that determine much market-driven office space in North America, this pair of office buildings (about 100,000 square feet each) was limited to sixty-five feet in height due to a landmarked Beaux-Arts structure next door. Thus competing, air-based proposals were limited to four storeys (Figure 14.4). By decoupling the thermal loads of the buildings from its ventilation loads, the thermally active surface approach by AndersonMasonDale Architects with myself as a consultant, however, was able to insert another level of office space by altering the floor-to-floor height, and removing most of the ducts and other equipment that typically occupies increasingly thick ceiling and floor plenums. Further, as rooftop units were not an option in this historically sensitive context, the architects also opened up considerable floor space by removing nearly all fan rooms and duct chases. In their place, the thermally active structure handles heating and cooling loads while a radically

reduced Dedicated Outdoor Air System (DOAS) provides ventilation air exchanges. Taken together, these leasable gains significantly transformed the developer's pro forma. For instance, the building envelope budget was calculated as a percentage of the leasable floor space. With the extra level of leasable space, the architects can invest more design time and budget in the building envelope; a key effort in thermally active surface strategies. Further, budget otherwise spent on ducts and drop ceilings was redirected toward a more robust pre-cast concrete thermally active surface structure with an exposed plaster ceiling. The thermally active surface strategies are optimal for the developer in terms of maintaining unleased office space because such systems utilize a low-air temperature approach to heating, thus saving operating costs for the owner and because it can be so easily zoned. This technique also engenders the possibility for a much more durable building with its increased building envelope budget and pre-cast concrete structure. Durability remains a primary obstacle to sustainability in a North American tendency for the obsolescence of buildings determined more by mortgage periods than by the efficacy of our built environments to contribute to the prospect of sustainability. When these multiple advantages are conflated with less energy consumption, greater human comfort, and consequently greater office productivity, the thermally active surface approach gained momentum in this case.



**14.4**
Two options for an office buildling in Denver. *Left*: Typical, air-based wall section. *Right*: Thermally active water-based wall section. Courtesy of AndersonMasonDale Architects.

## Conclusion: Reflexive Research and Practice; Patience is a Creative Search

As neurologist Kurt Goldstein wrote, "there is greater revelation in pathological phenomena."[24] In the case of architecture's thermal milieus, study of air-based techniques reveals alternate pathways to its own panacea. The conditions and conditioning of the dominant, convective approaches to thermal comfort in buildings are endemic to a range of problems in contemporary buildings from energy performance and indoor air quality to durability and the increasing complexity of contemporary construction. By re-evaluating existing techniques – and the overlooked principles in their historical development and repeated implementation – a pathway for the reorientation of building science and systems emerges.

As architecture rushes toward technologically rich – if not often technologically determined – research and practices, a more patient study of its own disciplinary assumptions and habits is a source of potent transformation. Architecture has as much to gain from a reflexive evaluation of its own eternally recurrent procedures and techniques – its received and repeated knowledge – as it does leaping its disciplinary bounds for borrowed agendas or new software, techniques, or technologies. German sociologist Ulrich Beck has described such an approach as reflexive modernization: "a radicalization of modernity, which breaks up the premises and contours of industrial society and opens paths to another modernity."[25] Reflexive modes that place the increasingly relevant material and energy practices of our techniques at the center of architectural production and formation stand to more strategically advance architecture's practices. Stan Allen has called for:

> a notion of practice flexible enough to engage the complexity of the real, yet sufficiently secure in its own technical and conceptual basis to

> go beyond the simple reflection of the real as given . . . a rigorous forward movement, capable of producing new concepts out of the hard logic of architecture's working procedures.[26]

When contrasted with the machine mentality cul-de-sac of so-called "new" or "emerging" technologies, a reflexive, if not iconoclastic, approach to disciplinary procedure is no less creative, radical, or adventurous; as the questioning of basic assumptions and tactics must always be. In this case, an interrogatory, reflexive mode of research yields an approach to our current techniques that retires the discipline's thermodynamic and physiological acquiescence in favor of enriched thermodynamic imagination capable of advancing architecture's standing preoccupation with form in our current resource-constricted context. By burrowing into unconsidered disciplinary assumptions, the research on hydronic, thermally active surfaces creates multiple possibilities for architecture. Such engenderment is crucial not only to our current fiduciary responsibilities but more importantly will be fundamental to the achievement of the integrated ecological, economic, social, cultural, technical, thermodynamic, and formal performances that can make architecture so rich. Today, architecture must escape its self-imposed twin constraints of technological inertia and technological acquiescence with sufficient escape velocity to imagine technique anew, for its own techniques are the architecture of sustainability.

## Notes

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2 Jacques Ellul, *The Technological Society* (New York: Vintage Books, 1967); emphasis in original.
3 See Michelle Addington, "The History and Future of Ventilation," in *Indoor Air Quality Handbook*, ed. Samet Spengler and McCarthy (New York: McGraw-Hill, 2001), 2.1–2.16; Bill Addis, *Building: 3000 Years of Design, Engineering, and Construction* (London: Phaidon Press, 2007); Reyner Banham, *The Architecture of the Well-tempered Environment* (London: Architectural Press, 1969); Robert Bruegmann, "Central Heating and Forced Ventilation: Origins and Effects on Architectural Design." *Journal of the Society of Architectural Historians* 37, 3 (October 1978): 143–160; Gail Cooper, *Air-conditioning America: Engineers and the Controlled Environment, 1900–1960* (Baltimore, MD: Johns Hopkins University Press, 1998); Cecil D. Eliot, *Techniques and Architecture: The Development of Materials and Systems for Building* (Cambridge, MA: MIT Press, 1992).
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8 Willis Carrier, "Rational Psychrometric Formulae," *American Society of Mechanical Engineers (ASME) Transactions* 33 (1911): 1005.
9 See Margaret Ingels, *Willis Haviland Carrier, Father of Air Conditioning* (Garden City, NJ: Country Life Press, 1952), 42.

10 Ibid., 20.
11 Ibid., 20–21.
12 Ibid., 15–17.
13 Ibid., 17.
14 Willis H. Carrier, Realto E. Cherne, and Walter A. Grant, *Modern Air Conditioning, Heating and Ventilating* (New York: Pitman Publishing Corporation, 1940).
15 Ibid., 6.
16 Ellul, *The Technological Society*, 5.
17 Banham, *The Architecture of the Well-tempered Environment* 171–172.
18 Quoted in Cooper, *Air-conditioning America*, 81.
19 Ellul, *The Technological Society*, 22.
20 Banham, *The Architecture of the Well-tempered Environment*, II.
21 David F. Noble. "Statement of David F. Noble at Hearings on Industrial Sub-Committee of the 98th U.S. Congress," in David F. Noble, *Progress Without Peopl*e (Chicago, IL: Charles H. Kerr Publishing, 1993), 100.
22 E.F. Schumacher, *Small is Beautiful: Economics as if People Mattered* (New York: Harper Perennial, 1989), 198.
23 Ibid., 191–192.
24 Kurt Goldstein, *The Organism* (New York: Zone Books, 1995), 29.
25 Ulrich Beck, "The Reinvention of Politics: Towards a Theory of Reflexive Modernization," in *Reflexive Modernization: Politics, Tradition, and Aesthetics in the Modern Social Order* , ed. Ulrich Beck, Anthony Giddes, and Scott Lash (Stanford, CA: Stanford University Press, 1994), 3.
26 Stan Allen, "Practice versus Project," in *Practice: Architecture Technique, and Representation* (Amsterdam: G + B Arts International, 2000), xvi.

Chapter 15

# How Is LEED Faring after Five Years in Use?

*Nancy B. Solomon**

There is no question that Leadership in Energy and Environmental Design (LEED), the green-building rating system developed by the U.S. Green Building Council (USGBC), has been a success. After all, its original mission was one of market transformation. "In my professional career, no other tool has been as powerful in encouraging designers and builders to look at the environmental performance of buildings," says Bob Berkebile, FAIA, principal of BNIM Architects in Kansas City, Missouri, founding chairman of AIA Committee on the Environment (COTE), and former board member of USGBC.

Today, LEED has virtually become a household word. More and more projects have been registered, and LEED ratings increasingly find their way into marketing brochures distributed by developers, building owners, architects, and contractors. Accredited professionals proudly add "LEED" to their titles, and, most significantly, numerous federal agencies and state and local governments require some form of LEED certification. Green architecture is no longer a fringe phenomenon.

Despite the fact that LEED has been – and remains – a critical tool in making this necessary transformation, it's far from perfect. Recent assessments of LEED from various sources have pointed out some of its more glaring flaws. This does not surprise many of its original developers. Referring to that pivotal moment when the decision was made to release a sustainable measurement tool that would address commercial office buildings, Berkebile recalls that the USGBC volunteers "knew that it was clumsy and limited, and many wanted to wait until it could be put on more scientific footing, but more wanted to get something out quickly." Berkebile continues, "What was shocking was that many agencies and cities so quickly embraced it as their tool, not realizing that it was not regional, did not do life-cycle analysis, and was focused on corporate buildings."

*From *Architecture Record* (June 2005): 135–142. Reprinted with permission from *Architecture Record* © 2005, The McGraw-Hill Companies.

## The ABCs of LEED

In the early 1990s, many facets of the building sector appeared skeptical – if not outright hostile – about the green movement. The construction industry, like a tanker cruising in one direction, was not in a position to quickly or easily turn 180-degrees. For example, some building-product manufacturers, unprepared for questions regarding the environmental impact of their materials, were fearful of releasing proprietary information. And contractors, accustomed to certain business practices, saw no financial incentives in changing their ways. Although scientific evidence suggested that standard construction processes contributed to environmental degradation, no one was able to clearly quantify which methods were worse or which alternatives were better. The industry was still groping for a widely accepted definition and measurement of green building. Many sought a safe forum within which the different facets could consider the economical, environmental, and social costs and benefits generated by various design and construction options, and could forge a path through the many unknowns to establish a workable, positive action plan.

The USGBC was formed in 1993 as a coalition of a handful of building-related organizations to serve this role. By 1995, staff and volunteers began to develop a digital measuring tool for sustainable buildings. Version 1.0 of LEED for New Construction (LEED-NC) was piloted in 1999, and version 2.0 publicly launched in March 2000. Since then, about 1,900 projects have registered to use LEED-NC, and another 200 have been certified under it.

The rating system is divided into six categories. Five address specific environmental concerns – sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality – and one is set aside for innovations that do not fit neatly in the others. The categories are broken down into specific design goals that have the potential to improve a building's environmental performance within that area of focus. Some of these goals are considered prerequisites to any LEED certification. Others are optional. Whether required or optional, each goal is worth one point. Certification is based on the evaluation of the design team's intent in improving the building's performance. For a project to be certified, 26 points must be achieved; 33 points for silver; 39 points for gold; and 52 points for platinum. A total of 69 points is theoretically possible.

Projects register early in the design process and receive tools to assist with documenting project performance. The current fees range from $750 for small projects (less than 75,000 square feet) that are submitted by members to $3,750 for large projects (greater than 300,000 square feet) that are submitted by nonmembers. A separate fee, ranging from $1,500 to $7,500, is charged at the time project documentation is presented for certification review. Thus, the total certification fees run from $2,250 for a member's small project to $11,250 for a nonmember's large project.

From the onset, USGBC recognized that LEED would have to evolve over time. LEED 2.1 came out in November 2002 to streamline the documentation process. In addition, starting in 1999, USGBC began to address the needs of different building markets by developing more than one LEED product. Spinning off the basic template for new construction, USGBC began to develop other rating

systems for existing buildings (EB), commercial interiors (CI), core and shell projects (CS), homes (H), and neighborhood development (ND).

## Assessing the Assessment Tool

Now that LEED has been available in one form or another for some five years, it's appropriate that the system has been reviewed externally and internally for various purposes. Among others, Chris Scheuer and Gregory Keoleian of the Center for Sustainable Systems at the University of Michigan evaluated LEED in a report for the National Institute of Standards and Technology titled "Evaluation of LEED Using Life-Cycle Assessment Methods," which was published in September 2002. Lisa Fay Matthiessen and Peter Morris of Davis Langdon analyzed the cost of green projects, including both those that did seek LEED certification and those that did not, and released their findings in a July 2004 document called "Costing Green: A Comprehensive Cost Database and Budgeting Methodology." This year [2005], Auden Schendler, director of environmental affairs at Aspen Skiing Company, and Randy Udall of the Community Office for Resource Efficiency, both in Aspen, Colorado, co-authored a critique of LEED called "LEED is Broken . . . Let's Fix It," that reads like a call to arms. And, although more politic in tone, Jay Stein and Rachel Reiss of Platts, a subscription Web division of The McGraw-Hill Companies, in their "Ensuring the Sustainability of Sustainability Design: What Designers Need to Know About LEED" point out inconsistencies and unknowns in the LEED system and suggest ways for designers to work around them.

## Two Big Glitches

In its laudable desire to create a national rating protocol that could be easily understood and applied by all, USGBC developed a simple, universal system in which one goal, or credit, receives one point. From this seemingly reasonable structure, however, comes what appears to be two of the most fundamental criticisms of the current LEED framework: its bioregional insensitivity and its relatively tenuous connection to life-cycle analysis.

In truth, many sustainable design strategies are regional in character. They must take into account local climate, geography, resources, wildlife, and habitat. As Stein and Reiss note, " . . . water conservation is more of a priority in hot, dry climates, yet the USGBC awards the same number of credits for water conservation in Seattle as in Phoenix. . . . " One unintended consequence is that less environmentally conscientious design teams may choose the least expensive strategies recognized by LEED to get the respective credits, even though the implementation of those strategies may not substantially improve the project's sustainable contribution.

Life-cycle analysis, or LCA, refers to the scientific discipline of measuring the material resources and energy consumed, and the environmental impact created, by a particular product throughout its life. By comparing this data for alternative products, designers could – at least in theory – select the materials and components that cause the least environmental damage. But LEED's one-point-per-credit

structure doesn't encourage this more sophisticated analysis. Stein and Reiss continue, "when designing renovation projects, developers can save more material resources by reusing 75% of an existing building's structure and shell . . . than by incorporating at least 5 percent of salvaged or reused building materials, but both strategies earn one point in the LEED rating."

## Additional Concerns

Many accuse LEED of being too bureaucratic. Some complain about the time and paperwork involved in documenting applicable strategies. Others point to USGBC's reliance on just one wood certification program – Forest Stewardship Council – as too narrow-minded. And yet others describe experiences in which LEED certifiers got so bogged down by technical details that they lost sight of the tremendous environmental progress being made right before their eyes by noteworthy design and practice strategies.

The list of complaints and suggestions go on – from frustration with the cost of pursuing certification and a confusing energy-modeling protocol to a proposal that the final evaluation be based on environmental health indicators (from habitat diversity to water quality) after the building is up and running.

## Peer Pressure

In addition to external critiques, LEED is facing its first potential competitor – Green Globes, a Web-based sustainable design tool for new commercial construction. First released for the Canadian market several years ago, Green Globes was adapted and brought to the U.S. in 2004 by the Green Building Initiative (www.thegbi.org), which got its start working with the National Association of Home Builders to promote the association's Model Green Home Building Guidelines. In a March 2005 article in *Environmental Building News*, Nadav Malin wrote that "GBI is supported by the Wood Promotion Network and a number of other industry groups that object to some provisions in LEED . . . "

Although Green Globes offers some features not currently in LEED – including its online platform and links to energy-modeling and LCA software tools – it still lacks many of the characteristics that give LEED its strength. According to Vivian Manasc of Manasc Isaac Architects in Edmonton, Alberta, a founding member of Canada's Green Building Council, "No other rating system is as broadly based in the marketplace as is LEED. With USGBC's 4,000-plus members getting to vote on what is in the rating system, LEED has large public input. It's easy to write an elegant system as long as you don't have to deal with the messiness of the marketplace."

## USGBC Plans on the Horizon

To a great extent, LEED is suffering from its own success. Because there was such a great need for environmental guidance, people latched onto it so quickly – and demanded so many versions for different building types – that USGBC has yet to

have enough time and resources to fully refine and add depth to the original model. Nonetheless, says Peter Templeton, USGBC director of LEED and international programs, "We are very much listening to the feedback."

Templeton believes some concerns will be addressed in LEED 2.2, which is currently under development for tentative release in the fall [2005]. For example, this version will reference the 2004 edition of ASHRAE 90.1, thereby avoiding the vexing energy-modeling problem created by the 1999 version of the standard. It will also include an online tool that promises to be more user-friendly and cut down on the paperwork. Templeton expects other changes in the documentation and review process to make it easier for applicants to cope with the administrative process. And he anticipates some refinement in the credits themselves.

Larger, more structural plans are being considered down the road for LEED version 3.0, which Nigel Howard, vice-president of LEED and international programs at USGBC, believes will be a template toward which all the LEED products can gradually progress according to their respective timetables. Says Howard, "We don't envision making LEED 3.0 more stringent – but we want to make it much smarter."

As an example, Howard suggests an ecological index for sustainable sites. In this scenario, there could be a greater range of possible points, depending on the potential impact of a project on its local habitat. A project built on a derelict site with no species of flora and fauna will show a net improvement – and therefore earn more points – if part of the area is landscaped. And a project built on woodland could be penalized to a greater extent than one built on farmland, because the original woodland would have had far more ecological diversity to start with than the farmland, and therefore the construction would have a greater negative effect on site conditions.

Howard suggests that LEED will be increasingly underpinned by LCA-type thinking, although he is quick to point out that some important sustainable design issues are not typically addressed by LCA. "Traditional LCA has focused on materials and products," he explains. It tends to look at global impact (such as loss of natural resources and toxic emissions) rather than local impact (such as storm-water management and light pollution) or interior consequences (such as thermal comfort and views of nature). Searching for the right mix, USGBC recently established a committee to consider the role of LCA within LEED and the appropriate methodology, data, and tools that would be needed to make it a reality.

Last, but not least, Howard expects that LEED 3.0 will establish bioregionally weighted credits in order to reward those strategies that offer environmental benefits appropriate to a specific locale.

## The Future of Green

It's hard to know if USGBC's anticipated changes will satisfy all the critics, or come quickly enough for them. But those who have long been at the forefront of this movement take a broad view of the situation. Practitioners like Bill Reed, AIA, vice president of integrative design for Natural Logic in Arlington, Massachusetts, see LEED as part of a larger, more comprehensive, and more far-reaching process. When potential clients call him about doing a LEED project, he tells them, "We don't just

do LEED. We work at the restorative level." The fact that people are calling and asking the questions is demonstration enough that LEED has been a resounding success. "I think LEED is serving its intended purpose," says Reed, "but it is not the ultimate purpose."

Chapter 16

# LEED after Ten Years

*Michael Zaretsky*

In the past five years there has been an ever-increasing number of projects registered for Leadership in Energy and Environmental Design (LEED) certification as well as a phenomenal increase in the number of LEED Accredited Professionals (AP). Yet five years after Nancy Solomon published an article about the LEED green building rating system[1] many of the critiques she raised remain unresolved.[2] Solomon's article is only one of many that critique the LEED green building rating system of the US Green Building Council (USGBC).[3] In spite of these widespread criticisms, public fascination and acceptance of LEED has continued to grow steadily.

At the most recent annual USGBC expo and conference, Greenbuild 2009, there were 27,373 attendees from 78 countries[4] as compared to less than 10,000 attendees in 2005.[5] As of November 2009, there were 25,608 registered and 3,858 certified commercial projects and 19,063 registered and 3,050 certified residential projects. In 2005, there was no LEED residential rating system, but there were approximately 3,200 LEED commercial registered projects and just over 400 LEED commercial certified projects. In 2005, there was just under 6,000 members, and as of 2009 membership increased exponentially to approximately 20,000.[6] In 2005, there were just over 20,000 LEED APs and as of November 2009, there were 133,489 LEED APs.[7]

There are now hundreds of federal, state, and local initiatives requiring or encouraging different levels of LEED certification for new buildings.[8] This includes many branches of the US government and military. One notable commitment comes from the US General Services Administration:

> In order to objectively measure its sustainable design achievements, GSA decided in 2000 that beginning in 2003 all capital building projects must earn LEED Certified, with a target of LEED Silver. In 2008, in response to the changing market, GSA began requiring all lease construction to earn LEED Silver certification.

> The General Services Administration is the nation's largest civilian landlord, managing space in over 8,600 owned and leased buildings for over one million federal employees. GSA was US Green Building Council's first federal member and supported the development of LEED for Commercial Interiors. As of January 2008, GSA has 24 certified projects including courthouses, laboratories, office buildings, a border station, and a childcare facility.[9]

I don't think anyone truly expected the LEED Green Building Rating System to catch on at the rate that it has. However, in the fuzzy world of "green," there is an undeniable comfort in having something assessed and certified by an organization that has the backing of dozens of Fortune 500 companies, the US Government, most US Universities and other cultural institutions.

LEED is not the first green building rating system, but it is certainly the most commonly used in the US. With any organization there can be growing pains. However, as described in this chapter, more recently LEED and the USGBC have met with some significant backlash and competition.

There are dozens of articles and books that address recent criticisms of LEED, though I am only referring specifically to a few. Reviewing these publications, one noticeable difference between 2010 and 2005 is that the original embrace of LEED as a tremendous step toward fundamentally changing the design and construction industries has been replaced by a growing body of criticism. This chapter will address some recent critiques of LEED as well as some of the alternatives being developed.

## An Evolving Mission

In response to the recent criticisms of LEED, in their most recent version (v3.0 from 2010) the USGBC has made some important changes, which will be discussed later. However, institutional changes are also evident in the USGBC Mission, which has broadened its scope, shifting from buildings to the scale of communities. In 2005, the USGBC mission was "to promote the design and construction of buildings that are environmentally responsible, profitable, and healthy places to live and work."[10] In 2010, according to their website, the USGBC mission is: "Transform the way communities and buildings are designed, built, and operated, enabling an environmentally and socially responsible, healthy and prosperous environment that improves the quality of life."[11] In 2010, the USGBC describe their vision as follows: "Buildings and communities will regenerate and sustain the health and vitality of all life within a generation."[12]

The new USGBC message is that they have become more committed to the social aspects of the triple bottom line of sustainability (social, economic, and environmental). However, there is little evidence in LEED that social or environmental concerns are being taken seriously.

## Critiques of LEED

No one would deny that the USGBC and the LEED green building rating system has brought important attention to critical issues of "green design," including site impacts, energy efficiency, water usage, materials and resources usage, and indoor air quality. Yet, the line between "green design" and "sustainable design" has become much clearer since LEED began. At this point, projects that offer nothing constructive to the wider perspective of social, economic, or ecological considerations are receiving LEED certification without addressing larger scale issues of sustainability.

The criticisms of LEED and the USGBC can be organized into four categories:[13]

1. LEED is not addressing sustainability.
2. USGBC claims of LEED project results are inaccurate or exaggerated.
3. The costs associated with the USGBC ensure that only wealthy entities can participate in the LEED certification process.
4. The goals of the USGBC are misguided.

### *Unsustainable LEED Certification*

- LEED does not address issues of sustainability. As Lance Hosey points out in a 2008 article, the 81-page LEED manual for new construction barely mentions the terms "sustainable" and never with any definition. He continues, "Architects equate LEED with sustainable design, but LEED itself does not clarify what sustainable design is."[14]
- If triple bottom line sustainability requires social and economic equity, as well as environmental equity, is it acceptable to suggest that achieving LEED certification somehow equates with sustainable design? By ignoring the social issues of sustainable design, LEED purports a message that a "green" building is not required to address social and economic issues.
- Buildings can become LEED certified without actually adding any positive benefit to a place socially or architecturally.
- There is no ongoing assessment of building performance. A project that receives LEED certification is not required to reapply for LEED certification, regardless of what changes may be made in the building design, construction, operation, or maintenance.
- There is no LEED credit for NOT using a material. If one chooses to minimize material usage by leaving a poured concrete slab as a finish floor, there is no credit in the LEED Green Building Rating System. However, if recycled carpet is placed over the concrete floor, this may achieve LEED credits.

### *Exaggerated Claims*

- There is no requirement that a LEED certified project proves its energy performance since the certification is based on energy modeling (not on actual energy data).

- The USGBC can be exaggerated and hyperbolic about LEED. As CEO Rick Fedrizzi stated in the opening plenary of Greenbuild 2004, "If it's not LEED, it's not green."[15]

### *Costs of Certification*

- Although the USGBC is a non-profit organization, they are catering to corporate clients. There are local USGBC registration fees as well as national registration fees. For the three-day, 2009 Greenbuild conference, attendance costs $600 for USGBC members and $775 for non-members.
- There is an excessively high cost structure within the USGBC. Rick Fedrizzi was a founding chairman (1993) and was appointed president and CEO of USGBC in 2004. If a local USGBC chapter seeks a presentation by Mr. Fedrizzi for their local chapter, the cost in 2008 was $4,000 in local chapter funds. This is out of the reach of many local chapters.

### *Misguided Goals*

- The LEED green building rating system has no specific credits available for reduction of carbon or greenhouse gas emissions.
- Critical environmental impacts of projects can be ignored in projects that receive LEED certification. There are numerous examples of inordinately large (more than 4,000 square foot) single family homes that have achieved LEED for Homes certification. Simply having a smaller home would nearly always have a smaller environmental impact than a huge "green" home.
- Inequitable weighting of credits is such that a LEED point can be achieved either by significantly upgrading mechanical systems (costing thousands of dollars) or adding a few bike racks to a project (costing little).
- Although the USGBC is a non-profit organization, there are claims that it is not sufficiently transparent. One example of this is provided in reference to the Gifford article, described later.

## USGBC Claims of LEED Energy Savings

> From now on, not one more building should be rated as green or environmentally friendly without its utility bills first proving that it is energy efficient.[16]
>
> Rated buildings should mount award plaques with removable screws, because each year the building's energy bills would have to be reviewed.[17]

One recent purported exaggeration by the USGBC led to significant criticism of LEED which eventually garnered national media attention: the question of whether LEED buildings actually save as much energy as is claimed by the USGBC. This

began when USGBC CEO Rick Fedrizzi stated in his 2007 Greenbuild address that "buildings built to LEED New Construction (NC) guidelines save on average 30 percent on energy over the traditional constructed buildings. And the higher your LEED rating the better the energy performance. [Energy savings are] LEED Certified 25 percent, LEED Silver 35 percent, LEED Gold and Platinum over 45 percent or more."[18] These statistics came under close scrutiny in a 2007 Web-only article entitled "A Better Way to Rate Green Buildings: LEED Sets the Standard for Green Buildings, But Do Green Buildings Actually Save Any Energy?" written by independent energy contractor Henry Gifford. Gifford is co-founder of Architecture and Energy Limited and has been involved in over 70 energy-efficient buildings. This article generated a lot of attention[19] and provoked a flurry of discussion on the accuracy of the claims of energy efficiency coming out of the USGBC.

The critique of LEED caught the attention of public media with Mireya Navarro's article "Some Buildings Not Living Up to Green Label," published in the *New York Times*.

> The [USGBC] council's own research suggests that a quarter of the new buildings that have been certified do not save as much energy as their designs predicted and that most do not track energy consumption once in use. And the program has been under attack from architects, engineers and energy experts who argue that because building performance is not tracked, the certification may be falling short in reducing emissions tied to global warming.[20]

Navarro refers to research by the New Buildings Institute (NBI) and others that have pointed out how the long-term energy savings of LEED certified buildings may not be as effective as expected. Immediately following the publication of the *New York Times* article, USGBC chapter leaders were issued with a warning that they should not speak with the USGBC membership about the article and should instead refer all questions to the official USGBC national response. A letter was sent to all chapter leaders discrediting the Gifford article. On Gifford's website, he responded to these claims and the debate rages on.[21]

One of the criticisms of the USGBC is that there is a lack of transparency in their business affairs. For example, on the USGBC website, in the section "News & Events" in the subsection "In The News" there is what appears to be a comprehensive list of published articles on LEED in the media. However, the article cited above is not included in the list.[22]

## Rating System Alternatives

Throughout the industrialized world, LEED is the most widely used building rating system nationally and internationally. There is a world Green Building Council as well as national Green Building Councils for several countries. However, as Solomon mentions, Green Globes has a significant market share among residential projects in parts of the US and abroad and there are several others, including BREEAM (Building Research Establishment's Environmental Assessment Method),[23] SPeAR (the Sustainable Project Appraisal Routine) developed by Arup, Inc.,[24] MBDC

(McDonough Braungart Design Chemistry) Cradle 2 Cradle certification,[25] Energy Star Qualified homes,[26] to name a few. None of the rating systems has had the growth of LEED and none has approached the issue of green design with as effective marketing.

What follows are descriptions of some alternatives to LEED that are rapidly growing in popularity for a variety of reasons. The Living Building Challenge grew directly out of LEED as a more rigorous, holistic rating system. Passivhaus is a long-standing rating system from Germany that only addresses energy efficiency, but does so effectively. SEED is a socially oriented assessment that addresses the larger social and economic impacts of projects and SIB is an example of a local initiative to address aspects of sustainability that are not covered in LEED.

## *Living Building Challenge*

In 2006, the Cascadia chapter of the USGBC developed an alternative building rating system that challenged LEED to produce "living buildings." It was entitled The Living Building Challenge from the International Living Building Institute.[27] There was a recent update (v2.0), which is described below:

> Living Building Challenge 2.0 is a cohesive standard – pulling together the most progressive thinking from the worlds of architecture, engineering, planning, landscape design and policy.
>
> It challenges us to ask the question: What if every single act of design and construction made the world a better place?
>
> What if every intervention resulted in greater biodiversity; increased soil health; additional outlets for beauty and personal expression; a deeper understanding of climate, culture and place; a realignment of our food and transportation systems; and a more profound sense of what it means to be a citizen of a planet where resources and opportunities are provided fairly and equitably?
>
> The Living Building Challenge is comprised of seven performance areas, or "Petals": Site, Water, Energy, Health, Materials, Equity and Beauty. Petals are subdivided into a total of twenty Imperatives, each of which focuses on a specific sphere of influence.[28]

It is a thorough and challenging assessment process and although there are no buildings that have received certification as of January 2010, there are 60 projects underway that are registered for certification.

## *Passivhaus*

The Passivhaus rating system has been available in Germany since 1993.[29] This system focuses purely on minimizing energy usage and its central tenets are summarized below:

> In a Passive House the consumption for space heating is reduced by 90 percent compared to average houses of the building stock and

> by 75 percent compared to ordinary new construction – the energy requirement for heating Passive Houses is 15 kilowatt hours per square meter living space each year and thus far less than in low energy houses. But, at the same time the comfort in a Passive House is significantly better. In contrast to ordinary buildings, which in European climates lose a lot of heat and have to be heated actively, a Passive House uses the free heat sources inside of the building envelope – e.g. the heat from the persons in the house and from solar energy incident through windows – and the heating system is simplified significantly. Special windows and an envelope built from highly efficient insulation panels help to keep the heat inside. Fresh air is constantly delivered by a ventilation system without drafts. A highly efficient heat recovery unit reduces the ventilation losses to a great extent.[30]

For those interested in seriously reducing energy consumption, Passivhaus is the commonly accepted standard. There are thousands of projects built to Passivhaus standards and significant data evaluating their performance following construction.

## *SEED: Social Economic Environmental Design*

As a result of a round table at the Harvard Graduate School of Design in 2005, which included over 30 notable experts in the field of public interest design who were addressing large-scale issues of sustainability, a new rating system emerged entitled SEED – the Social, Economic, and Environmental Design Network. Clearly responding to the limited scope of LEED, the SEED Network's mission is to "advance the right of every person to live in a socially, economically, and environmentally healthy community."[31]

The SEED Network believes that "design can support a community from the ground up." There are five SEED principles:

1. Advocate for those who have a limited voice in public life.
2. Build structures for inclusion that engage stakeholders and allow communities to make decisions.
3. Promote social equity through discourse that reflects a range of values and social identities.
4. Generate ideas that grow from place and build local identity.
5. A community's design should help conserve resources and minimize waste.

The SEED Network is not a building rating system, but is a committed network of practitioners committed to the principles of sustainable community design.

## *Social Impacts of Building (SIB) Rating System by emersion DESIGN*

Throughout the US, Cincinnati, Ohio is not known for its progressive thinking. However, there is a young architecture firm that is pushing the boundaries for

assessing the social impacts of design decisions while fully embracing the positive attributes of LEED. The 21-person firm began in 2007 and has shown a clear commitment to the USGBC and LEED building rating system since its inception. Employees include two previous USGBC Cincinnati chapter chairpersons and the most recent USGBC Cincinnati chairperson. According to their website, "emersion DESIGN is the first Architecture and Engineering firm to have a LEED Platinum office in the world."[32]

According to emersion employee and SIB co-author Shawn Hesse they use LEED as a "verification" tool for energy, water, and material usage goals on approximately 90 percent of their projects, whether or not the projects are going for certification.[33] However, they also recognize that LEED does not address social issues to which they are committed. As a result, they developed their own Social Impacts of Building Rating System in 2008, with several updates since that time. emersion DESIGN has received an AIA Architectural Advancement Award for SIB and they have been asked by the USGBC to work on social equity initiatives through the chapter network. According to Hesse,

> Social equity has been elevated as a core tenant of sustainable building for at least 10 years, but the amount of work that the profession has devoted to the topic pales in comparison to the level of sophistication we have developed as an industry around the questions of environmental sustainability. . . . There are a myriad number of ways that construction projects impact the social fabric around them, and it appears that not much is being done to understand and evaluate the thousands of projects that are not either affordable housing or rural community centers. Our goal in developing SIB was to create a tool that could measure the social impact of any project, and could be used to evaluate the social sustainability of each project. Questions about worker safety, health, and ability to support their family, the level of community voices heard during design processes, diversity of voices helping to make the decisions, knowledge of material sources, and even understanding how the project could be part of the community after construction and during operation are all elements of social impacts that construction projects have that can be measured.[34]

emersion DESIGN's SIB rating system is worth noting not only because of the content, but also as a growing example of a modest firm committed to creating, implementing, and continually reconsidering the potential of a rating system.

## The Benefits of a Building Rating System

There are numerous environmental benefits as a result of LEED and other rating systems. As compared to typical building construction, LEED certified buildings use a lower percentage of materials with high levels of toxicity, use less water and energy, and have less negative impact on the physical landscape. Clients are requesting "green" buildings and LEED provides a system that can lead to these benefits.

Another advantage of building rating systems is the increased commitment by clients and owners, once a project is registered or enrolled in a rating system. Once financially committed, a project team can leverage this commitment toward larger environmental benefits for projects. Although there are long-term cost savings in a "green" or energy-efficient building due to decreased energy costs, water usage, or even by measuring the increased productivity of occupants as a result of daylight[35] during any design and construction process, there is a high likelihood that there will be a period of "value-engineering" when the cost benefit of each design decision will be assessed in an effort to decrease either the cost or time needed to complete the project. If a client has not made a financial commitment to achieve a specific building rating, there is a much higher likelihood that the aspects of the project with additional upfront cost will be eliminated. However, a project that is LEED-registered can be leveraged by a project manager, architect, or client group to use the LEED Green Building Rating System commitment as a stepping-stone toward comprehensive sustainable design measures that would address larger scale impacts of design decisions. In this manner, designers, project managers, and others can proliferate sound decision-making in the name of a building rating system.

The greatest impact of the proliferation of green building rating systems is the increase in dialogue about sustainability, sustainable design, and green building. Clients are pushing designers and builders to become more educated on these issues and students are demanding much more sophisticated discussion within institutions of higher education. As a result of the increase in green building, there are many more resources available both online as well as on the ground. Resources such as the Chicago Center for Green Technology[36] in Chicago, Illinois, and Southface[37] in Atlanta, Georgia are providing owners, builders, designers, contractors, developers, and other resources to achieve whatever types of "green," environmental, or sustainable strategies they desire. In addition, these centers often spur community groups based on shared interests. In this manner, green design is having social impacts.

## LEED v3.0

There is clear evidence that the USGBC is responding to its critics. On April 27, 2009, LEED v3.0 was delivered and there were several significant updates from previous versions.[38] These include an attempt to simplify the LEED certification process, a "harmonization of LEED products" to further simplify the registration process, the weighting of credits based on their "ability to impact different environmental and human health concerns," and a potential of four points that are regional priority credits which respond to bioclimatic differences and priorities.

Along with these changes in v3.0 came a significant restructuring of the LEED accreditation process (previously the LEED Accredited Professional, now the LEED Professional). There are now three levels of LEED Professionals, achieved by passing the exam as well as by having experience working on a LEED project.

According to Hesse, the USGBC is in the process of creating a "Social Equity Working Group to advise on ways to better incorporate social equity into the LEED rating system."[39] This is welcome news, though nothing happens quickly in a non-profit organization with democratic aspirations serving 130,000+ members.

These changes represent positive changes for the LEED Green Building Rating System. However, there are still a seemingly endless number of architecturally deplorable and socially exclusive, developer-based projects showcasing their "green" status as a result of their LEED certification. Until these projects are held to a higher standard, some of the criticisms referred to in this chapter will inevitably increase. As a broader, more nuanced understanding of sustainable design enters the public imaginary, LEED will need either to more rigorously and tangibly respond to the mounting criticisms or it will be replaced by more comprehensive building rating systems.

## Notes

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17 Ibid., 9.

18 Quote from http://greenlineblog.com/2007/11/efficiency-is-king-by-rick-fedrizzi/ (accessed February 10, 2010). These facts were referenced from a New Buildings Institute study. The New Buildings Institute (NBI) is a non-profit organization devoted to building performance research (http://www.newbuildings.org).
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32 emersion DESIGN is a 21-person architecture, engineering, interior design, planning, and sustainable consulting firm with projects in higher education, corporations and non-profit organizations, science and technology, and the Federal government. Projects range from a façade renovation of the University of Cincinnati's Procter Hall to a master plan for NASA framing over $1 billion in investment over 20 years. They have won design awards for interior design, architecture, and architectural research. They were the first architecture and engineering firm in the world to operate out of a LEED Platinum office, which was built for under $27 per square foot (www.emersiondesign.com).
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Chapter 17

# Interview with Christof Jantzen of Behnisch Architekten

February 2010

*Michael Zaretsky*

**What is your definition of sustainable design and how do you approach this in your design process?**

The term "sustainable design" has many interpretations. The Brundtland Report, which illustrated the widespread concern for the state of the environment and popularized the phrase "sustainable development," defined it as a way to "meet the needs of the present without compromising the ability of future generations to meet their own needs." The political definition of sustainable development has since been extended to include social development and economic progress. Unfortunately, sustainability has come to mean all things to all people. Increasingly misused in architecture, the term is in danger of becoming a mere label.

For the past fifteen years, ever-increasing pressure has come to bear on our developments in terms of building technology and architecture. The predominant focus has been upon handling natural resources in a more economical and responsible manner. While we must obviously acknowledge the finite nature of resources, it is also necessary to use the opportunity afforded by each project to carefully review behavioral patterns; for this offers clues as to how we may learn to live and work with our environment in such a manner where, despite future demographic developments, we can reduce the risk of future shortages. It is essential that we do not solely focus on the constraints imposed by nature, but also celebrate its wealth and diversity, for economic circles now widely accept that the protection of our environment is seen as a fundamental opportunity for potential growth, social development, and economic progress.

Our approach to the design of buildings is one of full integration where "sustainability" is not considered as a mere "add-on," but critical to every design decision. It is driven by two primary desires: the first is to maximize user comfort, and the second is to establish an understanding of what constitutes responsible design. We believe that we are charged with making a balanced, considered

**17.1**
Entrance to Genzyme Center, Behnisch Architekten. Photograph by Roland Halbe.

response to resolving the respectful tempering of the natural environment based on local cultural and climatic conditions – with the basic necessity of providing shelter.

Rather than relying on preconceived notions about form or environmental design, each of our projects evolves from concerns for the specifics of the task. Numerous progressive design strategies are to be adopted, combining passive and technologically advanced analysis, with a view to reducing dependency upon mechanical systems while maintaining high levels of safety and energy efficiency. The results are built environments that are comfortable from a climatic standpoint while being architecturally innovative and aesthetically pleasing.

**Do these goals include social, political, cultural, or economic factors that are impacted by a given design project?**

We believe that the most significant part of any sustainable design rests in its larger context. It addresses aspects such as quality of life, health, and inclusiveness for a diverse community. As such, we seek a high level of "civic sustainability"; for example, the ability to sustain the needs and ambitions of a larger community. Thus, our design approach is holistic and often long term, addressing the quality of the experience in creating healthy and inspiring environments.

**What is the role of the designer in terms of educating the client, owner, and user about sustainability and sustainable design?**

The architect is instrumental in this process. Very often, high-achieving, innovative concepts never make it past the second phase of design development because they fall victim to the measurable demands of the construction process. This is a very fragile phase from conception to realization and the architect's task is "to make it work."

**How do you measure whether you have achieved your environmental and sustainability goals?**

Genzyme Corporation continues to measure energy consumption and has found that the costs for their headquarters are 42 percent less than their previous building. An example of an energy-saving feature that is also an employee-friendly feature is the double-glass curtain wall, allowing for increased insulation and fresh airflow throughout the building. An extensive natural light-enhancement system allows 75 percent of all employees to work using natural light alone, further reducing energy consumption.

**What are your thoughts about building rating systems such as LEED and their role in the design process?**

A rating system is an excellent tool to create awareness in the design and building industries. It will never be able to replace good design though. A successful green building is based on deliberate implementation of broad design strategies intended to result in the most sustainable building possible, and design is one part of this equation.

**Do you encourage clients to use specific building rating systems? Do you use building rating systems even when they are not required by the client?**

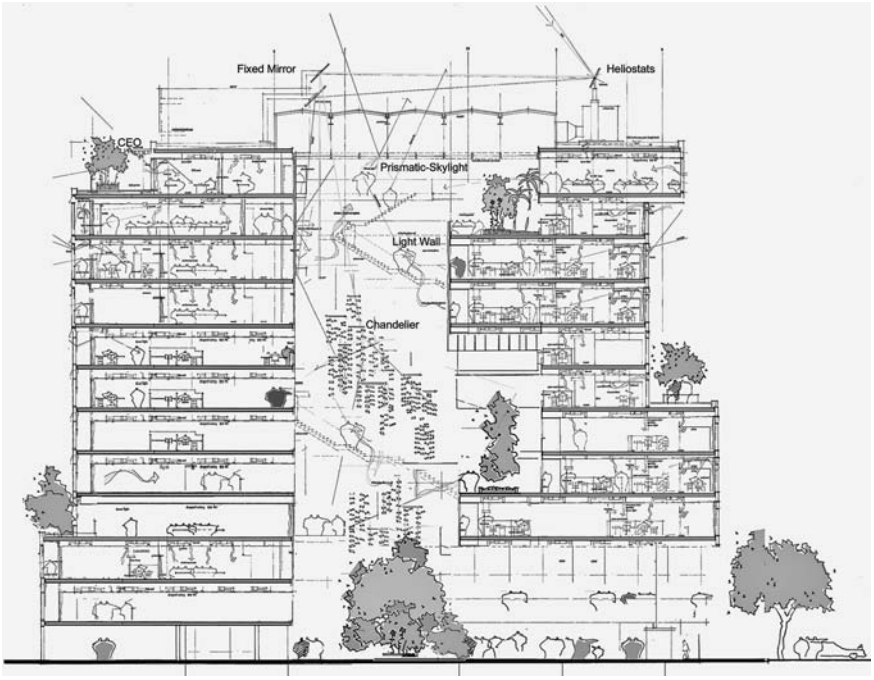
In many project cases it makes sense to develop a project along a rating system to create a measure of "checks and balances" – not only for the client, but also for the design team and the contractor. It has been proven successful in many of our projects to establish a Project Charter that is aimed at formulating the project goals at the beginning of the design process. Later on this Charter helps to keep the project focused on the overarching goals, including the sustainability measures.

**Were the sustainability and environmental design goals for the Genzyme Center defined by the architect, owner, user, or other?**

As a pilot project for the application of "green" design concepts in corporate architecture in the USA, the building provided the planning and construction industry with valuable feedback regarding not only the cost analysis of environmentally responsible architecture but also new design options available to clients, architects, and the construction industry.

In this project, all parties – developer, tenant, and architect – were committed to creating a sustainable project.

**17.2**
Section drawing through Genzyme Center Atrium, Behnisch Architekten. Courtesy of Behnisch Architekten.




**How did you measure whether you achieved those goals in the Genzyme Center?**

The Genzyme Center's success is not only measured in terms of its energy efficiency achievements and other technical achievements that are primarily focused on the performance of the building materials and systems. The real success in my mind can be seen in the way technology is helping to change the quality of the workplace and the fact that the users of the building wholly embraced their new work environment.

**Do you feel that you achieved these goals in the Genzyme Center?**

Genzyme Performance:

- 34 percent less water usage
- 42 percent less electricity costs
- 75 percent of all materials include recycled content
- 80 percent of workspaces can do without artificial lighting
- 82 percent of workers say their productivity has significantly improved
- 90 percent construction waste recycled
- 100 percent of all regularly occupied spaces have outdoor views.

**The Genzyme Center is a LEED Platinum building. Was this a goal from the outset of the project?**

The Genzyme Center Project was based on an international design competition. From the outset we had proposed to develop a building with a strong focus on

environmentally responsible and healthy quality work environments. This concept is integral and covers all systems and components of the building. LEED in 2000 was a fairly new rating system and was made part of the design consideration only during the Design Development Phase.

**Who set the LEED Platinum certification as a goal for the Genzyme Center?**

LEED Platinum as a goal was set by the user/client (Genzyme Corporation) in agreement with the developers (Lyme Properties).

**For any given project how do you prioritize the various principles of green design (energy, water, materials, etc.)?**

Once design commences on a project, we often, along with our cost consultant, perform cost–benefit studies to determine the most economical design direction for selected key components. Here it is important not just to consider the capital cost alone, but also maintenance and repair costs, thermal insulation properties, life expectancy, appearance, and the possible effect on value arising from the various choices available. These should include detailed analyses of initial cost versus long-term operating and maintenance costs, and associated energy cost differentials. We regularly perform cost studies for design alternatives relating to sustainable issues and would include such work under this category.

For us, this means that money is to be invested wisely, not on the basis of a simple bottom line, but in terms of value. To achieve this value, our work has been founded upon a search for the appropriate balance between demands of budget, program, and vision. This balance is only achieved if cost analysis is a complementary part of the process throughout the design development and that it is rigorously pursued. This approach has continued to yield projects that are successful in meeting programmatic needs and creating an uplifting environment while meeting strict budgets and being the most value for the investment.

Chapter 18

# Reinventing the Wheels

*Amory B. Lovins**

> New ways to design, manufacture, and sell cars can make them ten times more fuel-efficient, and at the same time safer, sportier, more beautiful and comfortable, far more durable, and probably cheaper. Here comes the biggest change in industrial structure since the microchip.
>
> (Amory B. Lovins and L. Hunter Lovins)

On September 29, 1993, the unthinkable happened. After decades of adversarial posturing, and months of intensive negotiations with Vice President Al Gore, the heads of the Big Three automakers accepted President Bill Clinton's challenge to collaborate. They committed their best efforts, with the help of government technologies and funding, to developing a tripled-efficiency "clean car" within a decade, and a year later they reported encouraging progress. Like President John F. Kennedy's goal of putting people on the moon, the Partnership for a New Generation of Vehicles (PNGV) aims to create a leapfrog mentality – this time in Detroit. However, the PNGV's goal is both easier to attain and more important than that of the Apollo program. It could even become the core of a green industrial renaissance – instigating a profound change not only in what and how much we drive but in how our whole economy works.

The fuel efficiency of cars has been stagnant for the past decade. Yet the seemingly ambitious goal of tripling it in the next decade can be far surpassed. Well before 2003 competition, not government mandates, may bring to market cars efficient enough to carry a family coast to coast on one tank of fuel, more safely and comfortably than they can travel now, and more cleanly than they would with a battery-electric car plus the power plants needed to recharge it.

*From *The Atlantic Monthly*, January 1995 (http://www.theatlantic.com/past/docs/issues/96apr/oil/wheels.htm). Reprinted with permission from Amory Lovins and the Rocky Mountain Institute (www.rmi.org) and the *Atlantic Magazine*.

To understand what a profound shift in thinking this represents, imagine that one seventh of America's gross national product is derived from the Big Three typewriter makers (and their suppliers, distributors, dealers, and other attendant businesses). Over decades they've progressed from manual to electric to type-ball designs. Now they're developing tiny refinements for the forthcoming Selectric XVII. They profitably sell around 10 million excellent typewriters a year. But a problem emerges: the competition is developing wireless subnotebook computers.

That's the Big Three automakers today. With more skill than vision, they've been painstakingly pursuing incremental refinements on the way to an America where foreign cars fueled with foreign oil cross crumbling bridges. Modern cars are an extraordinarily sophisticated engineering achievement – the highest expression of the Iron Age. But they are obsolete, and the time for incrementalism is over. Striking innovations have occurred in advanced materials, software, motors, power electronics, microelectronics, electricity-storage devices, small engines, fuel cells, and computer-aided design and manufacturing. Artfully integrated, they can yield safe, affordable, and otherwise superior family cars getting hundreds of miles per gallon – roughly ten times the 30 mpg of new cars today and several times the 80-odd mpg sought by the PNGV.

Achieving this will require a completely new car design – the ultralight hybrid, or "hypercar" (a term we now prefer to our earlier term "supercar," because that also refers to ultrapowerful cars that get a couple of hundred miles per hour rather than per gallon). The hypercar's key technologies already exist. Many firms around the world are starting to build prototypes. The United States is best positioned to bring the concept to market – and had better do so, before others do. Hypercars, not imported luxury sedans, are the biggest threat to Detroit. But they are also its hope of salvation.

## The Ultralight Strategy

Decades of dedicated effort to improve engines and power trains have reduced to only about 80–85 percent the portion of cars' fuel energy that is lost before it gets to the wheels. (About 95 percent of the resulting wheelpower hauls the car itself, so that less than two percent of the fuel energy actually ends up hauling the driver.)

This appalling waste has a simple main cause: cars are made of steel, and steel is heavy, so powerful engines are required to accelerate them. Only about one sixth of the average engine's power is typically needed for highway driving, and only about one twentieth for city driving. Such gross oversizing halves the engine's average efficiency and complicates efforts to cut pollution. And the problem is getting worse: half the efficiency gains since 1985 have been squandered on making engines even more powerful.

Every year automakers add more gadgets to compensate a bit more for the huge driveline losses inherent in propelling steel behemoths. But a really efficient car can't be made of steel, for the same reason that a successful airplane can't be made of cast iron. We need to design cars less like tanks and more like airplanes. When we do, magical things start to happen, thanks to the basic physics of cars.

Because about five to seven units of fuel are needed to deliver one unit of energy to the wheels, saving energy at the wheels offers immensely amplified

savings in fuel. Wheelpower is lost in three ways. In city driving on level roads about a third of the wheelpower is used to accelerate the car, and hence ends up heating the brakes when the car stops. Another third (rising to 60–70 percent at highway speeds) heats the air the car pushes aside. The last third heats the tires and the road.

The key to a super-efficient car is to cut all three losses by making the car very light and aerodynamically slippery, and then recovering most of its braking energy. Such a design could:

- cut weight (hence the force required for acceleration) by 65–75 percent through the use of advanced materials, chiefly synthetic composites, while improving safety through greater strength and sophisticated design;
- cut aerodynamic drag by 60–80 percent through sleeker streamlining and more compact packaging;
- cut tire and road energy loss by 65–80 percent through the combination of better tires and lighter weight.

Once this "ultralight strategy" has largely eliminated the losses of energy that can't be recovered, the only other place the wheelpower can go is into braking. And if the wheels are driven by special electric motors that can also operate as electronic brakes, they can convert unwanted motion back into useful electricity.

However, a hypercar isn't an ordinary electric car, running on batteries that are recharged by being plugged into utility power. Despite impressive recent progress, such cars still can't carry very much or go very far without needing heavy batteries that suffer from relatively high cost and short life. Since gasoline and other liquid fuels store a hundred times as much useful energy per pound as batteries do, a long driving range is best achieved by carrying energy in the form of fuel, not batteries, and then burning that fuel as needed in a tiny onboard engine to make the electricity to run the wheel motors. A few batteries (or, soon, a carbon-fiber "superflywheel") can temporarily store the braking energy recovered from those wheel motors and reuse at least 70 percent of it for hill climbing and acceleration. With its power so augmented, the engine needs to handle only the average load, not the peak load, so it can shrink to about a tenth the current normal size. It will run at or very near its optimal point, doubling efficiency, and turn off whenever it's not needed.

This arrangement is called a "hybrid-electric drive," because it uses electric wheel motors but makes the electricity onboard from fuel. Such a propulsion system weighs only about a fourth as much as that of a battery-electric car, which must haul a half-ton of batteries down to the store to buy a six-pack. Hybrids thus offer the advantages of electric propulsion without the disadvantages of batteries.

## One Plus Two Equals Ten

Automakers and independent designers have already built experimental cars that are ultralight or hybrid-electric but seldom both. Yet combining these approaches yields extraordinary, and until recently little-appreciated, synergies. Adding hybrid electric drive to an ordinary car increases its efficiency by about a third to a half.

Making an ordinary car ultralight but not hybrid approximately doubles its efficiency. Doing both can boost a car's efficiency by about *tenfold*.

This surprise has two main causes. First, as already explained, the ultralight loses very little energy irrecoverably to air and road friction, and the hybrid-electric drive recovers most of the rest from the braking energy. Second, saved weight compounds. When you make a heavy car one pound lighter, you in effect make it about a pound and a half lighter, because it needs a lighter structure and suspension, a smaller engine, less fuel, and so forth to haul that weight around. But in an ultralight, saving a pound may save more like five pounds, partly because power steering, power brakes, engine cooling, and many other normal systems become unnecessary. The design becomes radically simpler. Indirect weight savings snowball faster in ultralights than in heavy cars, faster in hybrids than in nonhybrids, and fastest of all in optimized combinations of the two.

All the ingredients needed to capture these synergies are known and available. As far back as 1921 German automakers demonstrated cars that were about twice as slippery aerodynamically as today's cars are. Most of the drag reduction can come from such simple means as making the car's underside as smooth as its top. Today's best experimental family cars are 25 percent more slippery still. At the same time, ultrastrong new materials make the car's shell lighter. A lighter car needs a smaller engine, and stronger walls can be thin; both changes can make the car bigger inside but smaller outside. The smaller frontal area combines with the sleeker profile to cut through the air with about one third the resistance of today's cars. Advanced aerodynamic techniques may be able to double this saving.

Modern radial tires, too, waste only half as much energy as 1970s bias-ply models, and the best 1990 radials roughly halve the remaining loss. "Rolling resistance" drops further in proportion to weight. The result is a 65–80 percent decrease in losses to rolling resistance, which heats the tires and the road.

Suitable small gasoline engines, of the size found in outboard motors and scooters, can already be more than 30 percent efficient, diesels 40–50 percent (56 percent in lab experiments). Emerging technologies also look promising, including miniature gas turbines and fuel cells – solid-state, no-moving-parts devices that silently and very efficiently turn fuel into electricity, carbon dioxide, water, and a greatly reduced amount of waste heat.

In today's cars, accessories – power steering, heating, air conditioning, ventilation, lights, and entertainment systems – use about a tenth of the engine's power. But a hypercar would use scarcely more energy than that for all purposes, by saving most of the wheelpower and most of the accessory loads. Ultralights not only handle more nimbly, even without power steering, but also get all-wheel antilock braking and anti-slip traction from their special wheel motors. New kinds of headlights and taillights shine brighter on a third the energy, and can save even more weight by using fiber optics to distribute a single pea-sized lamp's light throughout the car. Air conditioning would need perhaps a tenth the energy used by today's car air conditioners, which are big enough for an Atlanta house. Special paints, vented double-skinned roofs, visually clear but heat-reflecting windows, solar-powered vent fans, and so forth can exclude unwanted heat; innovative cooling systems, run not directly by the engine but by its otherwise wasted byproduct heat, can handle the rest.

Perhaps the most striking and important savings would come in weight. In the mid-1980s many automakers demonstrated "concept cars" that would carry four or five passengers but weighed as little as 1,000 pounds (as compared with today's average of about 3,200). Conventionally powered by internal combustion, they were two to four times as efficient as today's average new car. Those cars, however, used mainly light metals like aluminum and magnesium, and lightweight plastics. The same thing can be done better today with composites made by embedding glass, carbon, polyaramid, and other ultrastrong fibers in special moldable plastics – much as wood embeds cellulose fibers in lignin.

In Switzerland, where more than 2,000 lightweight battery-electric cars (a third of the world's total) are already on the road, the latest roomy two-seaters weigh as little as 575 pounds without their batteries. Equivalent four-seaters would weigh less than 650 pounds, or less than 850 including a whole hybrid propulsion system. Yet crash tests prove that such an ultralight can be at least as safe as today's heavy steel cars, even if it collides head-on with a steel car at high speed. That's because the composites are extraordinarily strong and bouncy, and can absorb far more energy per pound than metal can. Materials and design are much more important to safety than mere mass, and the special structures needed to protect people don't weigh much. (For example, about ten pounds of hollow, crushable carbon-fiber-and-plastic cones can absorb all the crash energy of a 1,200-pound car hitting a wall at 50 mph.) Millions have watched on TV as Indianapolis 500 race cars crashed into walls at speeds around 230 mph: parts of the cars buckled or broke away in a controlled, energy-absorbing fashion, but despite per-pound crash energies many times those of highway collisions, the cars' structure and the drivers' protective devices prevented serious injury. Those were carbon-fiber cars.

In 1991, fifty General Motors experts built an encouraging example of ultralight composite construction, the sleek and sporty four-seat, four-airbag Ultralite, which packs the interior space of a Chevrolet Corsica into the exterior size of a Mazda Miata. The Ultralite should be both safer and far cleaner than today's cars. Although it has only a 111-horsepower engine, smaller than a Honda Civic's, its light weight (1,400 pounds) and low air drag, both less than half of normal, give it a top speed of 135 mph and a 0-to-60 acceleration of 7.8 seconds – comparable to a BMW 750iL with a huge V-12 engine. But the Ultralite is more than four times as efficient as the BMW, averaging 62 mpg – twice today's norm. At 50 mph it cruises at 100 mpg on only 4.3 horsepower, a mere fifth of the wheelpower normally needed.

If equipped with hybrid drive, this 1991 prototype, built in only a hundred days, would be three to six times as efficient as today's cars. Analysts at Rocky Mountain Institute have simulated 300–400 mpg four-seaters with widely available technology, and cars getting more than 600 mpg with the best ideas that are now in the lab. Last November a four-seater, 1,500-pound Swiss prototype was reported to achieve 90 mpg cruising on the highway; at urban speeds, powered by its 573 pounds of batteries, it got the equivalent of 235 mpg.

Similar possibilities apply to larger vehicles, from pickup trucks to eighteen wheelers. A small Florida firm has tested composite delivery vans that weigh less loaded than normal steel vans weigh empty, and has designed a halved-weight bus. Other firms are experimenting with streamlined composite designs for big trucks. All these achieve roughly twice normal efficiency with conventional drivelines, and could redouble that with hybrids.

Hypercars are also favorable to – though they don't require – ultraclean alternative fuels. Even a small, light, cheap fuel tank could store enough compressed natural gas or hydrogen for long-range driving, and the high cost of hydrogen would become unimportant if only a tenth as much of it were needed as would be to power cars like today's. Liquid fuels converted from sustainable farm and forestry wastes, too, would be ample to run such efficient vehicles without needing special crops or fossil hydrocarbons. Alternatively, solar cells on a hypercar's body could recharge its onboard energy storage about enough to power a standard Southern California commuting cycle without turning on the engine.

Even if a hypercar used conventional fuel and no solar boost, its tailpipe could emit less pollution than would the power plants needed to recharge a battery-electric car. Being therefore cleaner, even in the Los Angeles air shed, than so-called zero-emission vehicles (actually "elsewhere-emission," mainly from dirty coal-fired power plants out in the desert), ultra-light hybrids should qualify as ZEVs, and probably will. Last May the California Air Resources Board reaffirmed its controversial 1990 requirement – which some northeastern states want to adopt as well – that two percent of new-car sales in 1998, rising to 10 percent in 2003, be ZEVs. Previously this was deemed to mean battery-powered electric cars exclusively. But, mindful of hypercars' promise, the CARB staff is considering broadening the ZEV definition to include anything cleaner. This alternative compliance path could be a big boost both for hypercar entrepreneurs and for clean air: each car will be cleaner, and far more hypercars than battery cars are likely to be bought. By providing a large payload, unlimited range, and high performance even at low temperatures, hypercars vault beyond battery cars' niche-market limitations.

This result brings full circle the irony of California's ZEV mandate. Originally it drew howls of anguish from automakers worried that people would not buy enough of the costlier, limited-range cars it obliges them to sell. The business press ridiculed California for trying to prescribe an impractical direction of technological development. Yet that visionary mandate is creating the solution to the problems. Like the aerospace, microchip, and computer industries, hypercars will be the offspring of a technology-forcing government effort to steer the immense power of Yankee ingenuity. For it is precisely the California ZEV mandate that radically advanced electric-propulsion technology – thereby setting the stage for the happy combination with ultralight construction, which we call the hypercar.

## Beyond the Iron Age

The moldable synthetic materials in the GM and Swiss prototypes have fundamental advantages over the metals that now dominate auto making. The modern steel car, which costs less per pound than a McDonald's quarter-pound hamburger, skillfully satisfies often conflicting demands (to be efficient yet safe, powerful yet clean): steel is ubiquitous and familiar, and its fabrication is exquisitely evolved. Yet this standard material could be quickly displaced – as has happened before. In the 1920s the wooden framing of U.S. car bodies was rapidly displaced by steel. Today composites dominate boatbuilding and are rapidly taking over aerospace construction. Logically, cars are next.

Driving this transition are the huge capital costs of designing, tooling, manufacturing, and finishing steel cars. For a new model, a thousand engineers spend a year designing and a year making half a billion dollars' worth of car-sized steel dies, the costs of which can take many years to be recovered. This inflexible tooling in turn demands huge production runs, maroons company-busting investments if products flop, and magnifies financial risks by making product cycles go further into the future than markets can be forecast. That this process works is an astonishing accomplishment, but it's technically baroque and economically perilous.

Moldable composites must be designed in utterly different shapes. But their fibers can be aligned to resist stress and interwoven to distribute it, much as a cabinetmaker works with the grain of wood. Carbon fiber can achieve the same strength as steel at half to a third of the weight, and for many uses other fibers, such as glass and polyaramid, are as good as or better than steel and 50–85 percent cheaper. But composites' biggest advantages emerge in manufacturing.

Only 15 percent of the cost of a typical steel car part is for the steel; the other 85 percent pays for pounding, welding, and smoothing it. But composites and other molded synthetics emerge from the mold already in virtually the required shape and finish. And large, complex units can be molded in one piece, cutting the parts count to about one percent of what is now normal, and the assembly labor and space to roughly 10 percent. The lightweight, easy-to-handle parts fit together precisely. Painting – the hardest, most polluting, and costliest step in auto making, accounting for nearly half the cost of painted steel body parts – can be eliminated by laid-in-the-mold color. Unless recycled, composites last virtually forever: they don't dent, rust, or chip. They also permit advantageous car design, including frameless monocoque bodies (like an egg, the body is the structure), whose extreme stiffness improves handling and safety.

Composites are formed to the desired shape not by multiple strikes with tool-steel stamping dies but in single molding dies made of coated epoxy. These dies wear out much faster than tool-steel dies, but they're so cheap that their lack of durability doesn't matter. Total tooling cost per model is about half to a tenth that of steel, because far fewer parts are needed; because only one die set per part is needed, rather than three to seven for successive hits; and because the die materials and fabrication are much cheaper. Stereolithography – a three-dimensional process that molds the designer's computer images directly into complex solid objects overnight – can dramatically shrink tooling time. Indeed, the shorter life of epoxy tools is a fundamental strategic advantage, because it permits the rapid model changes and continuous improvement that product differentiation and market nimbleness demand – a strategy of small design teams, small production runs, a time to market of only weeks or months, rapid experimentation, maximum flexibility, and minimum financial risk.

Together these advantages cancel or overturn the apparent cost disadvantage of the composites. Carbon fiber recently cost around forty times as much per pound as sheet steel, though increased production is leading manufacturers to quote carbon prices half to a quarter of that. Yet the cost of a mass-produced composite car is probably comparable to or less than that of a steel car, at both low production volumes (like Porsche's) and high ones (like Ford's). What matters is not cost per pound but cost per car: costlier fiber is offset by cheaper, more agile manufacturing.

## Shifting Gears in Competitive Strategy

Ultralight hybrids are not just another kind of car. They will probably be made and sold in completely new ways. In industrial and market structure they will be as different from today's cars as computers are from typewriters, fax machines from telexes, and satellite pagers from the Pony Express.

Many people and firms in several countries are starting to realize what hypercars mean; at least a dozen capable entities, including automakers, want to sell them. This implies rapid change on an unprecedented scale. If ignored or treated as a threat rather than grasped as an opportunity, the hypercar revolution could cost the United States millions of jobs and thousands of companies. Auto making and associated businesses employ one seventh of U.S. workers (and close to two fifths of workers in some European countries). Cars represent a tenth of America's consumer spending, and use nearly 70 percent of the nation's lead, about 60 percent of its rubber, carpeting, and malleable iron, 40 percent of its machine tools, 15 percent of its aluminum, glass, and semiconductors, and 13 percent of its steel. David Morris, a cofounder of the Institute for Local Self-Reliance, observes, "The production of automobiles is the world's number-one industry. The number-two industry supplies their fuel. Six of America's ten largest industrial corporations are either oil or auto companies. . . . A recent British estimate concludes that half of the world's earnings may be auto- or truck-related." Whether the prospect of hypercars is terrifying or exhilarating thus depends on how well we grasp and exploit their implications.

The distribution of hypercars could be as revolutionary as their manufacture. On average, today's cars are marked up about 50 percent from production costs (which include profit, plant costs, and warrantied repairs). But cheap tooling might greatly reduce the optimal production scale for hypercars. Cars could be ordered directly from the local factory, made to order, and delivered to one's door in a day or two. (Toyota now takes only a few days longer than that with its steel cars in Japan.) Being radically simplified and ultra-reliable, they could be maintained by technicians who come to one's home or office (Ford does this in Britain today), aided by plug-into-the-phone remote diagnostics. If all this makes sense for a $1,500 mail-order personal computer, why not for a $15,000 car?

Such just-in-time manufacturing would eliminate inventory, its carrying and selling costs, and the discounts and rebates needed to move existing stock that is mismatched to demand. The present markup could largely vanish, so that hypercars would be profitably deliverable at or below today's prices even if they cost considerably more to make, which they probably wouldn't.

America leads – for now – both in start-up-business dynamism and in all the required technical capabilities. After all, hypercars are much more like computers with wheels than they are like cars with chips: they are more a software than a hardware problem, and competition will favor the innovative, not the big. Comparative advantage lies not with the most efficient steel-stampers but with the fastest learning systems integrators – with innovative manufacturers like Hewlett-Packard and Compaq, and strategic-element makers like Microsoft and Intel, more than with Chrysler or Matsushita. But even big and able firms may be in for a rough ride: the barriers to market entry (and exit) should be far lower for hypercars than for steel cars. Much as in existing high-tech industries, the winners might be some smart, hungry, unknown aerospace engineers tinkering in a garage right now – founders of the next Apple or Xerox.

All this is alien to the thinking of most (though not all) automakers today. Theirs is not a composite-molding/electronics/software culture but a diemaking/steel-stamping/mechanical culture. Their fealty is to heavy metal, not light synthetics; to mass, not information. Their organizations are dedicated, extremely capable, and often socially aware, but have become prisoners of past expenditures. They treat those historical investments as unamortized assets, substituting accounting for economic principles and throwing good money after bad. They have tens of billions of dollars, and untold psychological investments, committed to stamping steel. They know steel, think steel, and have a presumption in favor of steel. They design cars as abstract art and then figure out the least unsatisfactory way to make them, rather than seeking the best ways to manufacture with strategically advantageous materials and then designing cars to exploit those manufacturing methods.

The wreckage of the mainframe-computer industry should have taught us that one has to replace one's own products with better new products before someone else does. Until recently few automakers appreciated the starkness of the threat. Their strategy seemed to be to milk old tools and skills for decades, watch costs creep up and market share down, postpone any basic innovation until after all the executives' planned retirement dates – and hope that none of their competitors was faster. That's a bet-the-company strategy, because even one superior competitor can put a company out of business, and the company may not even know who the competitor is until too late. The PNGV is stimulating instead a winning, risk-managed strategy: leapfrogging to ultralight hybrids.

It is encouraging that some automakers now show signs of understanding the problem. In recent months the PNGV has sparked new thinking in Detroit. The industry's more imaginative engineers are discovering that the next gains in car efficiency should be easier than the last ones were, because they will come not from sweating off fat ounce by ounce but from escaping an evolutionary trap. Although good ultralight hybrids need elegantly simple engineering, which is difficult, one can more easily boost efficiency tenfold with hypercars than threefold with today's cars.

Little of this ferment is visible from the outside, because automakers have learned reticence the hard way. A long and unhappy history of being required to do (or exceed) whatever they admit they can do has left them understandably bashful about revealing capabilities, especially to Congress. And firms with innovative ambitions will hardly be eager to telegraph them to competitors. Corporations share a natural desire to extract any possible business and political concessions, and to hold back from extending to traditional adversaries (such as the media, politicians, and environmentalists) any trust that could prove costly if abused or not reciprocated. Thus automakers are more likely to understate than to trumpet progress. Also, the Big Three are progressing unevenly, both internally and comparatively: their opacity conceals a rapidly changing mixture of exciting advances and inertia. Only some executives appreciate that hypercars fit the compelling strategic logic in favor of changing how their companies do business, especially by radically reducing cycle times, capital costs, and financial risks. It is difficult but vital for harried managers to focus on these goals through the distracting fog of fixing flaws in their short-term operations. But signs of rapid cultural change are looming, such as General Motors' announcement, last February 3, that its corporate policy now includes the CERES (Coalition for Environmentally Responsible Economies) Principles, formerly known as the Valdez Principles – a touchstone of environmentalists.

## The Cost of Inaction

The potential public benefits of hypercars are enormous – in oil displacement, energy security, international stability, forgone military costs, balance of trade, climatic protection, clean air, health and safety, noise reduction, and quality of urban life. Promptly and skillfully exploited, hypercars could also propel an industrial renewal. They're good news for industries (many of them now demilitarizing) such as electronics, systems integration, aerospace, software, petrochemicals, and even textiles (which offer automated fiber-weaving techniques). The talent needed to guide the transition is abundant in American labor, management, government, and think tanks, but it's not yet mobilized. The costs of that complacency may be high.

Cars and light trucks use about 37 percent of the nation's oil, about half of which is imported at a cost of around $50 billion a year. We Americans recently put our sons and daughters in 0.56 mpg tanks and 17-feet-per-gallon aircraft carriers because we hadn't put them in 32 mpg cars – sufficient, even if we'd done nothing else, to have eliminated the need for American oil imports from the Persian Gulf. Of course, more than just oil was at stake in the Gulf War, but we would not have sent half a million troops there if Kuwait simply grew broccoli. Even in peacetime the direct cost to the nation of Persian Gulf oil – mostly paid not at the pump but in taxes for some $50 billion a year in military readiness to intervene in the Gulf – totals nearly $100 a barrel of crude, making it surely the costliest oil in the world.

Had we simply kept on saving oil as effectively after 1985 as we had saved it for the previous nine years, we wouldn't have needed a drop of oil from the Persian Gulf since then. But we didn't – and it cost us $23 billion for extra imports in 1993 alone. Gulf imports were cut by about 90 percent from 1977 to 1985 (chiefly by federal standards that largely or wholly caused new-car efficiency to double from 1973 to 1986). Yet they are now re-approaching a historic high – the direct result of twelve years of a national oil policy consisting mainly of weakened efficiency standards, lavish subsidies, and the Seventh Fleet.

The national stakes therefore remain large. And even though the PNGV is starting to re-create Detroit's sense of adventure, hypercars still face formidable obstacles, both culturally within the auto industry and institutionally in the marketplace. Whether or not their advantages make their ultimate adoption certain, the transition could be either unnecessarily disruptive, shattering industrial regions and job markets, or unnecessarily slow and erratic in capturing the strategic benefits of saving oil and rejuvenating the economy. Automakers should be given strong incentives to pursue the leapfrog strategy boldly, and customers should be encouraged to overcome their well-known lack of interest in buying fuel-thrifty cars in a nation that insists on gasoline cheaper than bottled water.

## Market Conditioning and Public Policy

The usual prescription of economists, environmentalists, and the Big Three – though, it seems, a politically suicidal one – is stiff gasoline taxes. After painful debate Congress recently raised the gasoline tax by 4.3 cents a gallon, leaving the price, corrected for inflation, the lowest both in the industrial world and in U.S. history. But in Western Europe and Japan taxes that raise the price of motor fuel to two or four times that in the United States have long been in place, with

unspectacular results. Gasoline costing two to five dollars a gallon has modestly reduced distances driven but has had less of an effect on the efficiency of new cars bought. New German and Japanese cars are probably less efficient than American ones, especially when performance, size, and features are taken into account. Costlier fuel is a feeble incentive to buy an efficient car, because the fuel-price signal is diluted (in the United States today, by seven to one) by the other costs of owning and running a car. It is, as well, weakened by high consumer discount rates over a brief expected ownership, and often vitiated by company-owned cars and other distortions that shield many drivers from their cars' costs.

This market failure could be corrected by strengthening government efficiency standards. But standards, though effective and a valuable backstop, are not easy to administer, can be evaded, and are technologically static: they offer no incentive to keep doing better. Happily, at least one market-oriented alternative is available: the "feebate."

Under the feebate system, when you buy a new car, you pay a fee or get a rebate. Which and how big depends on how efficient your new car is. Year by year the fees pay for the rebates. (This is not a new tax. In 1990 the California legislature agreed, approving a "Drive+" feebate bill by a seven-to-one margin, although outgoing Governor George Deukmejian vetoed it.) Better still, the rebate for an efficient new car could be based on how much more efficient it is than an old car that's scrapped (not traded in). A rebate of several thousand dollars for each 0.01-gallon-per-mile difference would pay about $5,000 to $15,000 of the cost of an efficient new car. That would rapidly get efficient, clean cars on the road and inefficient, dirty cars off the road (a fifth of the car fleet produces perhaps three fifths of its air pollution). The many variants of such "accelerated-scrappage" incentives would encourage competition, reward Detroit for bringing efficient cars to market, and open a market niche in which to sell them. Feebates might even break the political logjam that has long trapped the United States in a sterile debate over higher gasoline taxes versus stricter fuel-efficiency standards – as though those were the only policy options and small, slow, incremental improvements were the only possible technical ones.

Perhaps people would buy hypercars, just as they switched from vinyl records to compact discs, simply because they're a superior product: cars that could make today's most sophisticated steel cars seem clunky and antiquarian by comparison. If that occurred, gasoline prices would become uninteresting. Scholastic debates about how many price elasticities can dance on the head of a pin would die away. The world oil price would permanently crash as superefficient vehicles saved as much oil as OPEC now extracts. Feebates would remain helpful in emboldening and rewarding Detroit for quick adaptation, but perhaps would not be essential. The ultralight hybrid would sweep the market. What then?

Then we would discover that hypercars cannot solve the problem of too many people driving too many miles in too many cars; indeed, they could intensify it, by making driving even more attractive, cheaper, and nearly free per extra mile driven. Having clean, roomy, safe, recyclable, renewably fueled 300 mpg cars doesn't mean that eight million New Yorkers or a billion still-carless Chinese can drive them. Drivers would no longer run out of oil or air but would surely run out of roads, time, and patience. Avoiding the constraint du jour requires not only having great cars but also being able to leave them at home most of the time. This in turn

requires real competition among all modes of access, including those that displace physical mobility, such as telecommunications. The best of them is already being where we want to be – achievable only through sensible land use.

Such competition requires a level playing field with honest pricing, so that drivers (and everyone else) will both get what they pay for and pay for what they get. But least-cost choices are inhibited today by central planning and socialized financing of car-based infrastructure, such as roads and parking, while alternative modes must largely pay their own way. Happily, emerging policy instruments could foster and monetize fair competition among all modes of access. Some could even make markets in "negamiles" and "negatrips," wherein we could discover what it's worth paying people to stay off the roads so that we needn't build and mend them so much and suffer delays and pollution. Congestion pricing, zoning reforms, parking feebates, pay-at-the-pump car insurance, commuting-efficient mortgages, and a host of other innovations beckon state, local, and corporate experimenters. Yet unless basic and comprehensive transport and land-use reforms emerge in parallel with hypercars, cars may become apparently benign before we've gotten good enough at not needing to drive them – and may thus derail the reformers.

If the technical and market logic sketched here is anywhere near right, we are all about to embark on one of the greatest adventures in industrial history. Whether we will also have the wisdom to build a society worth driving in – one built around people, not cars – remains a greater challenge. As T. S. Eliot warned, "A thousand policemen directing the traffic / Cannot tell you why you come or where you go."

## Author's note

Since this article was written in late 1993, many things have changed. The simple GM mathematical model we'd used to simulate car efficiency turned out to overstate superefficient cars' efficiency by about twofold, but plug-in hybrids, entering major automakers' showrooms in 2010–11, roughly offset that error, and the technological data proved valid. In the seven years after I open-sourced the hypercar concept in 1993, the industry committed roughly $10 billion to this line of development, making hybrids now ubiquitous and lightweighting (led by Ford, Nissan, Audi, and the Chinese industry) a rapidly spreading strategic focus. In 1999, RMI spun off Hypercar, Inc., which in 2000 designed with European partners an uncompromised 67-mpg midsize SUV (114 mpg with hydrogen), respectively 3.6x and 6.3x normal efficiency. The capital market collapsed just as we sought production funds, but this highly integrative design (www.rmi.org/rmi/Library/T04-01_HypercarsHydrogenAutomotive Transition) remains influential, and in 2004 (www.oilendgame.com) we showed a one-year payback for its extra cost (which is only because it's a hybrid – the ultralighting was indeed free). In 2007, Toyota showed the first major-automaker concept hypercar: the carbon-fiber 1/X had the interior volume of a Prius, half its fuel use, and one-third its weight (926 lb with extra batteries to make it a plug-in hybrid, or, matching my early-'90s predictions, 880 lb without them). The previous day, top carbon-fiber maker Toray announced a factory to "mass-produce carbon-fiber car parts for Toyota." Honda and Nissan did similar deals in 2008 and Mercedes in 2010, when Toray, Toyota, and Mitsubishi Rayon announced they're commercializing the process. In the mid-2000s, Hypercar, Inc. had morphed into Fiberforge Corporation (fiberforge.com) and pioneered manufacturing technology for cost-effective carbon-fiber-composite structures with one-minute cycle times, now being commercialized with aerospace, automotive, and other customers worldwide. In 2009, another RMI spinoff (brightautomotive.com) showed a driving prototype of a 3–12x-more-efficient aluminum-intensive commercial van that, unlike other plug-in hybrids, needs no subsidy because its reduced weight and drag eliminated most of its costly batteries. Thus by 2010 the leapfrog we'd envisaged in 1993–5 was off and running. Regrettably, as we'd warned, two of the Big Three didn't adapt in time, and even today, government policy is only starting to catch up.

Part V

# Concepts

Chapter 19

# The Sustainability of Concepts

## Knowledge and Human Interests

*Claire Colebrook*

Climate change studies – a burgeoning field prompted by government research initiatives and university opportunism as much as by the impending crises associated with global warming and resource depletion – is, in general, formed by combining the "hard" sciences (geography, geology, physics, biochemistry, biology, and genetics) with the social sciences (geography again, psychology, political science, demographics, sociology, and economics). As a consequence of most major research institutions producing some type of climate change research network the humanities, too, are beginning to contribute to understandings of the problems presented by climate change. Before considering why any simple *inclusion* of the humanities to climate change studies needs to be questioned, I would like to open a series of considerations.

First, the combinations of the hard sciences and human sciences that make up climate change studies – even though *inter*disciplinary research networks bring these sciences together – keep the disciplinary borders of various fields in place. There are, of course, some sciences – geography, psychology – that are in part both hard and social sciences, but even this division within the subject presupposes something like the idea of a *human science.* That disciplinary distinction, as Michel Foucault argued in *The Order of Things,* is not simply a division of labor that takes a single subject such as nineteenth-century natural history and then divides the same practices of gathering information into different disciplines: what counts as true or false alters dramatically, with the very idea of a distinction between hard science and social or human science creating "man" as a distinct object of knowledge.[1] Foucault argues, for example, that we cannot see natural history as simply preceding biology or the science of life. Nor can we read Adam Smith's theory of wealth as leading seamlessly to economics; nor can we see theories of grammar as similar in type to the social science of linguistics.

To understand how these new disciplinary distinctions create a curious new object of knowledge – man – we can take our lead from the present. Even popular

economic theories, such as *Freakanomics*,[2] or the Chicago school theories that directly influence government policy, presuppose a certain concept of man.[3] Either – as *Freakanomics* theories posit – we constantly miscalculate the effects our "choices" will have on our well-being (by being lured into paying more for our daily coffee if only we can be seduced by a special offer that will create a habit); or, we are naturally competitive and self-interested animals who, if left to ourselves, will allow the most efficient players to rise to the top while the muddling remainder of the population can benefit from economic prosperity in general. What economics as a social science assumes is a "subject of interests":[4] it is not sufficient just to look at relations among goods and prices but also to have some notion of human behavior, especially if the operations of human behavior are not immediately apparent to humans themselves.

Foucault agued that Adam Smith's *Wealth of Nations* (1776) explained how human work produced commodities, how these could be exchanged, and how a system of circulating goods produced an overall stability and system that benefited all concerned.[5] What happens when Karl Marx forms a theory of labor is that the human animal is added to the way questions are posed: why, we might ask, do human beings labor and enter into exchange? For Marx the answer presupposed *man's* species being: we must labor, collectively and with the help of technology, in order to meet our needs. This, in turn, explains the existence of *ideology*, since there are forces that determine the relations we establish with each other – forces of production that place some bodies in greater servitude to production than others. These forces determine our social being, even if they are not directly experienced, and are capable of being interpreted only after the fact. Marx's theory of ideology, for example, relies upon *interpreting* the way in which we live our social relations: what we experience as natural – that I go to work for an employer who pays me for my time – needs to be understood as the outcome of a historical process whereby those in command of the means of production that will ultimately reduce human effort (e.g., factory owners) are capable of buying the labor of other individuals from whom they profit.[6] The human sciences, such as economics, do not just chart the circulation of goods (as did Adam Smith's theory of wealth); they presuppose something like human interests that can explain systems of exchange.

Second, this production of "man" in the human sciences would also yield the possibility of the humanities. Not only would we have social sciences looking at the mechanisms of "life, labour and language"[7] through which social systems are effected, we can also have humanities disciplines that would be interpretive in their examination of human cultural production, and would also presuppose "man" as a historical, social, and productive animal. Foucault, referring to the knowledge practices of his own day, was critical of some of the key discourses that made up the humanities, such as phenomenology, structuralism, and psychoanalysis.[8] These approaches would examine cultural production while presupposing what Foucault referred to as man as an "empirical-transcendental" double. Man is empirical – a being whose language, social relations, and bodily habits are determined by the material relations he must take up in relation to his environment and others; but man is also a being who can analyze those material forces and thereby "read" the ways in which he has come to be the specific social being that he is. Psychoanalysis, for example, will argue that we can only exist and live if our desires take on some acceptable, socially sanctioned form; we can, however, always read these socialized

forms to discern something like *desire as such.* Phenomenology, also, insists that we exist only insofar as we make sense of ourselves and our world; we need to see all that we do – from daily habits to great artworks – as a mode of world production. Structuralism, too, regards language, culture, and social relations as a product of a transcendental need for ordering: the specific forms of social ordering are empirical (or to do with how this or that social formation comes into existence); but the requirement that there be some mode of ordering is necessary or transcendental, characterizing any and every culture.

We can pause and look at how these first two considerations open up questions for climate change studies. How does the distinction between the physical sciences and moral sciences not only alter the way in which we approach climate change (as something with a physical base that may affect different humans differently) but produce the very concepts through which we think about ways of tackling climate change? First, as long as we assume something like the possibility of a social science, in its distinction from hard sciences, we will not only have a bifurcation between data (such as the evidence yielded by the earth sciences for global warming) and social impact (such as the work done by social geographers who gauge how gender, class, and race produce disproportionate and unequal impacts of climate change); we also presuppose a subject of interests. That is, it is assumed that there is a physical world of material forces and constraints and that this physical world is the milieu, environment, or climate within which we are located. The concept of *climate* may be the most telling of all, deriving from concepts of surface and habitation. *Climate change* would therefore refer to a material and physical locale that may be treated as material resource for goods and data (by the physical sciences) or as a restraining and determining condition that will alter how we produce our world and our polity (by the human sciences). The word "climate" originally refers to a specific region, indicating different modes of human life, but once we refer to "climate change" and have something like *the climate,* we also generate the concept of something like humanity in general. That is, if we now have something that is not a specific "clime" or territory but a single condition for all living beings then there is also something like a general concept of life that comes to be threatened.

Second, this leads to the specific possibility of the humanities. This possibility may seem, at first glance, to produce something quite distinct from either the physical being of the hard sciences or the social systems of the human sciences. If political theory, economics, and sociology can examine the impacts of climate change and climate change policy on different nations, social groups, ethnicities, and gender – and if these social sciences can also explain non-physical aspects of climate change, such as the needs of developing nations and peoples to maximize production without being able to afford strategies of mitigation – what they cannot do is examine the meaning of climate change: how it is lived by "us" and what modes of understanding and cultural production led to climate catastrophe and disdain for the environment upon which we depend and which also produces us as the beings that we are. This is where the humanities may, and has, entered climate change studies. One might even argue that the humanities has *always* taken the form of climate change studies: has always asked what humanity or "the human" *is* such that it may have come to treat its own milieu as so much raw material for profit, consumption, and energy maximization and not as a body

worthy of care. The humanities, we might say, has always considered the earth as climate or environment – the home of our being, or our unavoidable terrain and surroundings – and never as mere stuff, matter, or potential energy. The humanities originates in a humanizing mission, reacting to the disenchantment of the world by the supposed "hard" sciences. This humanizing motif occurs as early as the first formulations of English studies in the late nineteenth and early twentieth centuries, concerned to develop a moral framework in an increasingly secularized and disenchanted world, and is reiterated – today – in various calls for the humanities to be led by life and praxis against the mechanizations of globalization and capitalism.[9] By the time the humanities *explicitly* takes up these concerns of eco-criticism or environmental philosophy it has a wealth of material to draw upon which would demonstrate that we are, primarily, ecological beings, and it would do so well before climate change studies became a research priority to which the humanities may or may not be added.

On the one hand, environmental philosophy – even though generalizing this area covers over many complexities – reacts critically to the fundamental concepts that are deemed to constitute Western metaphysics: the idea that we are self-determining "subjects" whose relation to the world is one of representation (knowledge) or use (with the world as mere raw material) needs to be supplanted by a relation of care, concern, or respect. The humanism and anthropocentrism that have marked Western thought need to give way to a new relation to the environment. This would not be a shift in the value we attribute to the planet and atmosphere that is our home; it would not be a question of valuing the environment *more, or of granting it greater worth, importance, or significance.* We would require what Nietzsche referred to as a transvaluation of values.[10] Rather than generating values on the basis of instrumental reason or utility – rather, that is, than assuming that the worth of an object or action is gauged by how much it furthers our own purposes – we would criticize means/ends rationality. We would not assume that all valid means are justified if they serve to maintain humanity in its current mode. We would, at the very least, consider values *as if from a point of view different from that of "man."* This would occur if, for example, we granted non-humans (animals, trees, ecosystems) rights, or if we questioned the concepts of rights and entitlement and instead developed values of mutual care, concern, and deep ecological connectedness. On the other hand, while insisting upon the need to alter the very structure of our thought away from instrumental (or use-oriented) and cognitive relations to the world in which we live, eco-criticism has already uncovered an implicit and long-running awareness of a complex relation to nature that might be unearthed in canonical literature.[11]

Despite a manifest assumption that humans are given the world as so much available property, eco-critical readings can show the ways in which there has always been an awareness that the earth is not mere matter, but an environing and meaningful place that is as much constitutive of our sense of self as we are of the significance it has for us. Again, like environmental philosophy, eco-criticism cannot be reduced to a common set of principles. What can unify both these ways in which the humanities disciplines have anticipated current attempts to approach our climate differently is both their target and some of their key concepts. What is targeted is the notion of human beings as self-sufficient and primarily rational agents whose relation to the world is ideally one of disinterested or disenchanted knowledge; the

use of key concepts, ranging from environment and ecology, to the privileging of place over space, along with concepts of care, concern, debt, and most importantly *life*, also serve to move from a philosophy based on individuals and matter to a mode of thought that is more relational, more sympathetic, and ultimately more concerned with meaning. That is to say, there is never a world as such, in itself, that we then have to manage and quantify, since "we" exist and have a sense of ourselves only insofar as we have a specific place that is always embedded in, and generative of, an entire world of possible futures (which involve other timelines and potentials beyond ourselves).

Perhaps the strongest mode of this critical relation to Western knowledge takes the form of Lovelock's Gaia hypothesis, where he insists that not only is it not a question of taking up a different attitude to nature, it is also imperative that "nature" no longer be seen as a distinct object that would be more worthy of our care. On the contrary, the Gaia hypothesis presents the world as a single organism, so that human life would not be placed within the world, or in relation to the world, since human life would be just one of the aspects of an intricate, complex, dynamic, interacting, and homeostatic system.[12] The Gaia hypothesis was formulated to challenge conventional ways of thinking about humans and their relation to the environment. It suggests that one of the responses to climate change requires a radical reassessment of our conceptual terrain.

We might consider some of the key terms that orient climate change policy, ranging from cap and trade, adaptation, and mitigation to sustainability and viability. These terms remain managerial and instrumental. Cap and trade is, of course, an explicit adoption of a calculative framework. Policy and negotiations focus on a single variable (carbon emissions) despite the volatility and complexity of factors that the physical sciences have consistently demonstrated to make up the problems of climate change. The very notion of *trading* carbon emissions – that as long as a payoff is made somewhere, further destruction can be sanctioned – not only (again) places human response in the mode of *homo economicus*, it also precludes any thought of the future. If carbon emissions can be managed, traded, and held at "acceptable" levels then we fail to confront the scientific evidence which indicates that even a halt in current carbon emissions would have a tailing effect that would continue to wreak havoc; the continued trade presupposes that the future will be different in degree, or a continuation of the present, and not different in kind. There is something anaesthetizing in the idea of *trading* carbon emissions and allowances: as though something like an economy were at work, an enclosed system of more and less, and not – as is becoming apparent – a future which will be unmanageable and have entirely different terms. One might make a similar remark about the concepts of sustainability, adaptation, mitigation, and viability. Sustainability assumes the value of continuity: if one changes it is only insofar as required in order for human life to continue, an implication that is less subtly contained in the strategy of mitigation. Not only do all these terms accept that humanity exists as something that has the right to continue, and that it must do so now in the mode of damage limitation; they also have a primarily calculative conceptual base. Climate change is a problem of disturbance, precluding us from continuing life in the same manner, so changes need to be made. Such changes will not be global in the full sense of the word; they will not alter the fundamental or entire system within which we are imbricated. They will rather occur

as responses to a predicament. Life may have continued unperturbed – had we been wiser and more cautious, perhaps less profligate and wasteful – but unfortunately we plundered nature excessively and with short-term thinking. Our response is therefore to *extend* our calculative approach to the future to include not only our maximal efficiency here and now but our ongoing existence, our sustained existence.

All these terms are aligned with what Gilles Deleuze referred to as extensive multiplicities: certain multiples have their units determined in advance, and are composed of equivalents.[13] In general we might say that the very possibility of the social sciences is built on calculations of extensive multiplicities: in relation to climate change studies one can look at how different members of populations respond to, or are affected by, policies or climatic disasters. More importantly, the timelines take the mode of more or less: what practices do we need to adopt to live longer? How might "we" adapt? Can we use less? Can we be more like developing nations? How much suffering and sacrifice will be demanded from our future generations? All such questions assume that the future would be a continuing time of *more or less*. It also presupposes some general underlying substrate – human life – that may vary culturally and historically, may have to *adapt,* but will have some mode of continuity. The social sciences may, then, lack the radical sophistications of the physical scientists: both social science-inflected policy and the academic disciplines oriented to policy would be mired in the nineteenth-century origins of social science as the study of populations, whereas the physical sciences that make up climate change studies already deploy intensive quantities. In intensive quantities it is not a question of equivalent units of more of less, but of speeds and thresholds that have the capacity to produce differences in kind. Climate change calculations, models, and scenarios have long been characterized by quantities that are not those of a single unit (beneficial or detrimental) but will alter in kind and relation depending on speed and quantity; not only are there tipping points (or thresholds where one more degree of heat will alter the entire system); there are also unpredictable feedback effects and incalculable productions of disequilibrium. Had the social sciences taken on a similar complexity they would have to consider the possibility that the units with which they work – humans, societies – would alter in kind, beyond recognition, at certain speeds and thresholds. This could be seen positively, whereby one might say that climate change will not simply disturb human life, requiring it to sustain itself in a more viable manner, but will alter the very unit of "the human."

Here, one would have to rethink the very being of "man" that was produced by the division between hard and social sciences: there could no longer be this animal blessed with language and history, who produces himself socially and technologically, but who can also study and read himself as an object of historical and cultural production. For there would no longer be man (historically and socially determined and determining) but a species tied to rhythms that were geological and beyond the historical and familial imagination. This would require us to consider that the question of the humanities and the human is not something that might be *added* to the problem of climate change, as though the environmental and policy problems could benefit from an examination of some concepts. Here is where we might return to how theories of ecology, environment, and (of course) climate as terrain or habitation have already been considered by the humanities.

Perhaps what may need to be rethought is the very concept of the human as it subtends the humanities.

Returning to Foucault's genealogy of the emergence of the human sciences in modernity, we may recall that "man" becomes possible as an object of knowledge only with the strict distinction between the hard sciences of matter, and the social sciences that chart man as a socio-historical cultural production. If we accept that construction of man then it also follows that he can add a further discipline of humanities: here, he not only studies himself as determined, in part, by his climate, since he can also reconfigure his intellectual climate, rewrite his concepts and vocabularies. He can alter himself from within his own history, sustaining himself, and rendering himself more viable by becoming more attuned, more sympathetic, less instrumental in relation to what will always be his climate and his environment. Indeed, in hypotheses such as the Gaia hypothesis, man can project his organic being on to life as a whole. No longer would he be fragmented from a climate that is unfortunately not bending to his will and knowledge; he would, rather, be part of a whole that in its dynamically self-sustaining manner would guide him away from self-seeking politics to a naturally forming politics of the whole. Ethics and politics – what "we" ought to do – would follow directly from the natural and vital norms of the one living earth. Lovelock's Gaia hypothesis, like any theory that assumes a natural sympathy (however occluded), reinforces what Foucault referred to as the specifically modern nature of biopower, and maintains an extensive and bourgeois approach to values.[14] That is, despite the recognitions of ecology, environment, climate, and biosphere, it is man who will read the conditions of this system, discern its proper order, break free from merely instrumental attitudes, and arrive at a proper mode of self-regulation.

The alternative to this privileging of climate, environment, ecology, and biosphere as offering ways in which life might continue to sustain and maintain itself was already prefigured when Foucault spoke about the possible erasure of man. Here, one would not assume that the future merely altered in degree in order for life to continue: one would ask whether the future would be one of life. That is, would all those disciplinary norms, including a distinction among hard sciences of data, human sciences of self-management, and the humanities as self-interpretive, not be fragmented following their dissolution and failure in the face of impending catastrophe? If we did *not* assume that life (as it is) were self-evidently worth sustaining, if life were not viable, could not be adapted, then we would no longer be reading and managing the human, via the humanities, but would be asking how we might think in the absence of sustained human life. This would lead, in turn, to thinking climate intensively – and this, in turn, would require not adjusting existing concepts but creating new concepts, or even thinking beyond concepts. At its simplest, climate change "policy" would have to shift from being *political* – the coming together of bodies in common via a common language of sustaining and adapting – to become *impolitic.* What ways of speaking would fragment, disturb, and destroy the logics of self-maintenance that have always sustained humanity as an animal that cannot question its existence? (Humanity has, of course, always questioned the *essence* of its existence – who is man? – but it has rarely questioned the actuality of its existence: that it may *not be*.) To consider the future *intensively* we would at least begin with the possibility that an event might occur to "us" that would create a mutation of such a force that "we" would no longer exist. What

we have known as human life, supposedly marked by instrumental reason, self-maintenance, risk-assessment, management of resources, and exchange with a view to relatively short-term futures, would give way to a being *that does not have a future.*

As long as we calculate the future as one of sustaining, maintaining, adapting, and rendering ourselves viable, the future will differ only in degree; this would mean of course that there would be no future *for us* other than an eventual, barely lived petering out. If, however, we entertained the elimination of the human (especially as defined through the discipline of the humanities, whereby humanity is that fragment of a self-maintaining nature that can sustain itself through reading itself) then there might be a future. This would not be a future of the *climate*, of a terrain or habitation, and certainly not of an environment, as that which environs or encloses. For if the experience of climate change were to be experienced, it would disclose that there is no climate, biosphere, or environment. There is not "a" world, existing like an organism that maintains and sustains itself.

## Notes

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Chapter 20

# Undoing the Subject

## Deleuze and the Makings of a Sustainable Life

*Jeffrey A. Bell*

In his influential analysis of *Ten Canonical Buildings: 1950–2000*, architect and theoretician Peter Eisenman draws upon Deleuze, Derrida, and others in demonstrating how modern architecture exemplifies a practice that cannot be reduced to the traditional dualisms of architectural practice – namely, the dualistic relations between subject/object, figure/ground, solid/void, and part/whole.[1] Eisenman draws particular attention to Deleuze's concept of the figural and Derrida's understanding of the undecidable as effective starting points for rethinking architecture as a practice that is irreducible to an either/or relationship. Eisenman could equally well have stressed Deleuze's concept of an assemblage, which, for Deleuze, entails a consistency of elements that is irreducible to a traditional dualism (e.g., the form–substance relation), and yet they "swing between a territorial closure that tends to restratify them and a deterritorializing movement that on the contrary connects them with the Cosmos."[2] In other words, for Deleuze assemblages risk yet manage to avoid collapsing into either an actualized stratification or an actualized deterritorialization (chaos), a blind repetition of the same or an unsustainable chaos. An architectural assemblage, likewise, and as will be discussed below, entails a similar "swing" between actualized opposites, and in doing so it is irreducible to either side of a dualistic relation.

From the perspective of sustainability, the Deleuze–Guattarian concept of assemblage is equally appropriate for diagnosing the unsustainable consequences of capitalism. As a form of assemblage, capitalism also either risks collapsing into the stratification of consumers predictably returning to purchase ever more of what they "need," or it risks becoming fully actualized as the chaos and unpredictability upon which capitalism thrives in order to create and subsequently capture new markets and commodities. It is for this reason that Deleuze and Guattari, in *Anti-Oedipus*, argue that "schizophrenia is the exterior limit of capitalism," a limit capitalism must continually displace if it is to continue to function – that is, if it is to maintain its self-identity as an assemblage.[3] In their critique of capitalism – what

they will call schizoanalysis among other things – Deleuze and Guattari will repeatedly draw attention to the immanent impossibility of a sustainable capitalism. As Deleuze and Guattari argue in this critique, desire is always already structured and assembled desire,[4] whereas the schizophrenic exhibits desire "in its raw state," as Ian Buchanan puts it,[5] or in its unassembled state. In contrast to the schizophrenic, however, who succumbs to chaos and is thus incapable of maintaining coherence and order, an assemblage functions much as "the great artist" does, Deleuze and Guattari argue, in that they are the "one who scales the schizophrenic wall and reaches the land of the unknown, where he no longer belongs to any time, any milieu, any school."[6] The great artist is one whose practice affirms a multiplicity that cannot be reduced to an either/or dualism and subsequently it is irreducible to "any time, any milieu, any school." A sustainable capitalism, therefore, if such a capitalism is possible, would be one that affirms multiplicity and avoids actualizing its exterior limit, the limit that would be its "exterminating angel."[7]

To avoid actualizing its exterior limit, capitalism continually reterritorializes these encounters with the limit upon a global subject, namely, money as the abstract commoditized subject.[8] For Deleuze and Guattari this abstract subject becomes the basis for the axiomatics of capitalism, an axiomatics that reduces capitalist processes to a denumerable set of extensive quantities (i.e., abstract monetary values). Marx made this point in *Economic and Philosophic Manuscripts*: '"That which is for me through the medium of *money* – that for which I can pay (i.e., which money can buy) – that am I myself, the possessor of the money."[9] Marx adds, "what I am capable of is by no means determined by my individuality,"[10] but rather by the abstract value of money as universal medium of capitalist exchange. Inevitably, however, capitalism continually "confronts its own limits."[11] In particular, the axiomatics of capitalism confronts the limits to axiomatics itself; that is, the limits to the dualistic assumptions that underlie the axiomatic rendering of capitalism (true–false, right–wrong, is–is not). Capitalism confronts the nondenumerable, or the intensive multiplicity that cannot be reduced to a dualistic metaphysics.[12]

It is at this point that Deleuze and Guattari's particular style of critique comes to the fore. Their concern is precisely in understanding the encounter with the nondenumerable, with multiplicity. Rather than respond, as is done within capitalism, to the nondenumerable by further axiomatizing and codifying it, a process Deleuze and Guattari claim ultimately undermines itself, they seek to understand how the artist, as mentioned above, is able to scale the "schizophrenic wall." One way in which this is done is exemplified by the martial artist. Instead of "adher[ing] to a code . . . [martial artists] follow ways," and in doing so "one learns to 'unuse' weapons as much as one learns to use them . . . the 'not-doing' of the warrior, the undoing of the subject."[13] The great artist and the warrior thus responds to the nondenumerable multiplicity not by codifying it but by affirming its very tendency to undermine and undo codes, subjects, and axioms, but affirming it in a way that does not lead to a collapse into stratification or chaos: it allows for "ways."

Is a sustainable capitalism thus to be compared to the great artist and the warrior? Or, to state this point differently, is capitalism capable, on its own, of maintaining a sustainable equilibrium? For Deleuze the answer is a resounding "no," and much of the critique of capitalism which Deleuze and Guattari put forth ties directly into the very impossibility of capitalism being forever able to stave off its exterior limit. Does that mean, then, that Deleuze and Guattari, in their critique

of capitalism, seek to push capitalism to the point where it actualizes its exterminating angel? Do they encourage unsustainable practices? Again, the answer here is "no." Deleuze and Guattari's critique of capitalism, it will be argued, is founded upon a philosophy of sustainability, and schizoanalysis reveals the necessary failure of capitalism to be capable of maintaining sustainable practices. To see that this is so we will return to the example of the great artist, turning in particular to the example of the great architects such as those analyzed by Eisenman.

Eisenman is certainly correct, from a Deleuzean perspective, to find in the practice of great architects an effort to avoid the traditional dualisms of architecture. To understand further, however, why Deleuze is especially helpful in illuminating the insights Eisenman's analysis develops, we need to clarify the relationship between architecture as an assemblage and the important role multiplicity plays for Deleuze in developing a philosophy that avoids dualism. This effort is significant, since, while Deleuze's (and Deleuze and Guattari's) philosophy does indeed rely upon numerous conceptual pairs (e.g., virtual/actual, deterritorialization/reterritorialization, intensive/extensive, etc.), Deleuze denies being a dualistic philosopher and argues that what he (along with Guattari) has sought to do is to "find between the terms . . . whether they are two or more, a narrow gorge like a border or a frontier which will turn the set into a multiplicity, independently of the number of parts."[14] Similarly, as we will see, the architect, as with the artist and the warrior, avoids dualism by finding an assemblage that is a functioning intensive multiplicity irreducible to the dualistic terms that are used to identify what it is the architect is doing. In short, it is an architecture that resists codifications, or, as Deleuze and Guattari might put it, it is an architecture irreducible to "any time, any milieu, any school."

Before we turn to examples from architectural practice we will, in the following section, show how Deleuze's understanding of multiplicity enables him to set forth a non-dualistic philosophy. The influence of Bergson is critical to this aspect of Deleuze's thought. We will then turn to see how this understanding of multiplicity may be used to rethink traditional relationships between needs and desires, and economic practices and institutions. We will turn to Aristotle in this section and see how Deleuze and Guattari's philosophy of sustainability is in many ways Aristotelian. With these discussions in place we will return to discuss architecture. This will enable us to clarify both the non-dualistic practice of architecture itself and in turn allow us to outline the role that architecture, at the level of urban planning, can play in maintaining sustainable practices more generally.

## Multiplicity

Deleuze shares with Bergson and Whitehead a fundamental vision concerning the role of philosophy. Philosophy, as Whitehead puts it, "reverses the slow descent of accepted thought towards the inactive commonplace,"[15] and for Bergson, similarly, the "mind *has to do violence to itself*, has to reverse the direction of the operation by which it habitually thinks, has perpetually to revise, or rather recast, all its categories."[16] Similarly for Deleuze, as we have seen, the warrior and the artist have to resist the tendency to settle into cliché, or into established ways of doing things. There is an important difference between Bergson and Whitehead in how they

characterize the reversal of this natural tendency. For Bergson and subsequently for Deleuze this reversal entails a necessary violence. For Bergson and Deleuze, therefore, when multiplicity and duration [Bergson's term which is roughly equivalent to Deleuze's use of the term multiplicity] are actualized, they are actualized as two divergent tendencies with two accompanying modes of violence.[17] On the one hand, accompanying the tendency for thought to settle "toward the inactive commonplace" there is the violence of philosophy and metaphysics against the way one habitually thinks. For Bergson this is the violence that tends toward pure duration, or what we will call nomadic violence. On the other hand, accompanying the nomadic violence of philosophy and metaphysics is what we will call the institutional violence that forcibly excludes/includes the nomadic such that the result is an autonomous, self-sufficient strata or pure present, a pure homogeneity, as Bergson puts it.[18] There is thus no pure state of multiplicity and duration, a primordial multiplicity so to speak, from which self-sufficient identities and institutions emerge and that are then undone through nomadic violence. This would be to presuppose an *already actualized* multiplicity or duration, which would in turn presuppose, *as actualized*, the actualization of two divergent tendencies, namely, the tendencies of institutional and nomadic violence. An actualized multiplicity thus presupposes the institutional violence that captures, delimits, and axiomatizes a multiplicity as an *identifiable* actuality, an actuality that in turn presupposes the nomadic violence that will undermine and transform this actuality. We have seen how capitalism exemplifies this process. In particular, capitalism exemplifies the effort to axiomatize and reduce an intensive, nondenumerable multiplicity into an extensive, denumerable set of identifiable elements. This distinction between intensive and extensive is critical to Deleuze's project, and, as Deleuze argues in *Difference and Repetition*, an intensive quantity is not to be confused with extensive quantities. The latter may indeed be axiomatized and reduced to predictable, mechanical forms and functions. Intensive quantities, by contrast, cannot be reduced to any identifiable function and/or end, since they are the unpredictable, intensive differentials that are, as Deleuze puts it, "only known as already developed within an extensity," and known as the bifurcation of two divergent tendencies. Intensive multiplicity is thus the condition for the identification of extensive properties and functions, or for an actualized extensive multiplicity, but rather than anticipate through resemblance the extensive properties that actualize intensive properties, the intensive assures the transformation and metamorphosis of the extensive and identifiable. Capitalism is therefore an extensive assemblage that continually attempts to reduce intensive quantities to denumerable, extensive quantities. This effort is unsustainable and destined to failure, since the nondenumerable cannot be captured by a denumerable set and consequently each effort to do so will inevitably lead to another effort, and to another, and so on.

To clarify this admittedly abstract point we turn now to discuss Aristotle's *Politics*. This move might at first seem unjustified since Bergson, Deleuze, and Whitehead are each quite critical of a number of Aristotle's central tenets.[19] However, in his efforts to set forth an ideal constitution in light of two distinct modes of acquisition, Aristotle's thought, as we will see, converges with and elucidates many of the preceding arguments.

## Aristotle and Sustainable Politics

In *Politics*, Book I, Aristotle distinguishes between "a certain natural kind of property-getting" that is limited to the needs of a self-sufficient household or state and an unnatural "'acquisition of goods [*Chrēmatistikē*]' where there is 'no limit' to wealth or property."[20] Aristotle notes that the two modes of acquisition resemble one another and are frequently thought to be "one and the same."[21] There are two important reasons for this confusion. The confusion results first when there is a failure to distinguish the property itself from the fact, for Aristotle, that "Every piece of property has a double use." A "shoe," to use Aristotle's example, "may be used either to put on your foot or to offer in exchange."[22] In itself, offering the shoe in exchange is not unnatural, since as Aristotle says, the "exchange [of] one class of useful goods for another . . . is not contrary to nature and is not a form of money-making [*Chrēmatistikē*]; for it keeps to its original purpose: to re-establish nature's own equilibrium of self-sufficiency."[23] When the result of exchange, however, is money itself rather than the goods necessary for "nature's own equilibrium and self-sufficiency," then "there is no limit to the amount of riches to be got from this mode of acquiring goods," and as a result it becomes an unnatural and unsustainable mode of acquisition.[24]

The second reason for confusing the two modes of acquisition as being one and the same results from our desire for life. As Aristotle understands it, many "are eager for life but not for the good life; so, desire for life being unlimited, they desire also an unlimited amount of what enables it to go on."[25] By confusing our unlimited desire for life with what is necessary for the good life, we are led to believe we need an unlimited amount of goods, or unlimited wealth. To state this in the terms used above, the unlimited desire for life is the multiplicity that comes to be actualized in two divergent ways – either as a natural mode of acquisition for the sake of "nature's own equilibrium and self-sufficiency," or as an unnatural mode that is unlimited and undermines the self-sufficiency and equilibrium of the good household or state. It is precisely for this reason that Aristotle, in Book VII of the *Politics*, separates the free public square, the place where political deliberation can occur for the sake of the good of the state, from the marketplace. The free square is intended for leisure, Aristotle argues, and in this square "nothing may be bought or sold, and no mechanic or farmer or anyone else like that may be admitted unless summoned by the authorities."[26] In order to prevent the unnatural mode of acquisition from undermining the self-sufficiency of the good state, therefore, the "essential tasks" of the market, both natural and unnatural, are forbidden admittance to the thoughtful places where the work of politics occurs.

With Aristotle's efforts to separate the free square from the marketplace, the two modes of violence discussed earlier become evident. On the one hand, the unlimited desire for life as intensive multiplicity may be actualized as institutional violence, or in this case the violence of the state that restrains and staves off the threat which the unnatural mode of acquisition poses to the self-sufficiency and autonomy of the state. The state is thus justified, for Aristotle, in restraining, by force if necessary, the unlimited desire for life of individuals. Nonetheless, since the self-sufficient state is inseparable from the unlimited desire for life of individuals, the state forever risks nomadic violence, the very violence that undermines the autonomy and self-sufficiency of the state. More to the point, despite the effort to

keep the unnatural forces of the marketplace at bay, the very powers that carry out this effort may very well become the nomadic violence they seek to suppress (they can become corrupted as Aristotle, Plato, and nearly all political theorists since have recognized). And it is here where Aristotle's thought, on our reading, reconnects with Bergson and Deleuze. In particular, for Bergson there are two similar modes of violence: there is the violence that leads to the autonomy and self-sufficiency of the pure present, to the autonomy of facts; the other violence overcomes our habitual ways of thinking and tends toward pure duration. "Between these two extreme limits," however, and as Bergson makes quite clear, "intuition moves, and this movement is the very essence of metaphysics."[27] The key, therefore, is the movement "between these two extreme limits" rather than the actualization of either one. Similarly for Deleuze, and as discussed earlier, an assemblage "swing[s] between a territorial closure that tends to restratify them [institutional violence] and a deterritorializing movement that on the contrary connects them with the Cosmos [nomadic violence]."[28] Aristotle's middle constitution may be seen to represent a similar effort. Aware of the tendency for states to succumb to faction, primarily the faction between the rich (few) and the poor (many), Aristotle argues that "in the matter of the goods of fortune . . . to own a middling amount is best of all."[29] Consequently, to find a position between the rich few and the many poor, the most stable state will "consist as far as possible of those who are like and equal, a condition found chiefly among the middle people."[30] For Aristotle, then, the middle constitution is a state that avoids actualizing the two modes of violence as faction. Rather than admit the unlimited and unnatural mode of acquisition which only exacerbates, as Plato himself argued, the disparities of wealth between the rich and the poor, the middle constitution and the middling people will incorporate the tendencies of nomadic violence only insofar as it staves off the stifling power of institutional violence, and it incorporates the tendencies of institutional violence insofar as it resists the unsustainable consequences of the unlimited and unnatural mode of acquisition. A state that is stable and yet capable of adapting to changing conditions will thus need to move between the two modes of violence, or it will be a state at the edge of chaos.[31]

We find Aristotle making a similar argument in his *Rhetoric*. In contrast to the understanding of rhetoric found in Plato's *Gorgias*, where rhetoric is famously dismissed by Socrates as dangerous in the public realm and useful only in cases of forensic rhetoric where it can be put to work resolving private legal matters, Aristotle will stress the importance of a deliberative rhetoric that seeks to argue for laws that will have the ability to be relevant in a wide variety of cases while at the same time maintaining enough integrity to prevent the possibility that a forensic rhetorician could manipulate the law to suit their own private ends. Aristotle thus seeks to avoid actualizing two tendencies of rhetoric. On the one hand a deliberative rhetoric would avoid becoming a tool of private interests to the detriment of the public good; and on the other it will avoid becoming a matter of dispensing commonly shared platitudes and commonplaces. A concept that looms large in Aristotle's arguments on this point is, ironically, common places (*koinos topos*, or *locus communes* in Latin). What Aristotle means here is quite different from what Whitehead was concerned with when he warns of "the slow descent of accepted thought towards the inactive commonplace."[32] As Aristotle makes the point, a common place "may be applied alike to Law, Physics, Politics," and these topics or places

will "furnish syllogisms and enthymemes equally well for Law, Physics, or any other science whatever, although these subjects differ in kind".[33] As an example of such a common place, Aristotle offers "the topic of the more or less." By contrast, specific topics, Aristotle argues, "are derived from propositions which are peculiar to each species or genus of things; there are, for example, propositions about Physics which can furnish neither enthymemes nor syllogisms about Ethics".[34] Common places, therefore, provide the flexibility for constructing arguments that are not actualized as a specific place or type of argument; nor do they become actualized as an inactive commonplace – they are, instead, as Aristotle saw it, a starting point for active deliberation. To state this point using our earlier terms, a common place is an intensive, nondenumerable place in contrast to an extensive, denumerable place. Since an intensive multiplicity, as we have seen, "is only known as already developed within an extensity," it thus entails a bifurcation, an actualization which presupposes two divergent tendencies, and therefore a common place is an intensive differential that comes to be actualized as two divergent tendencies – more or less, speeds or slownesses, motion or rest, which are the examples of common places which Aristotle most frequently offers.

## Architecture and Sustainable Design

We may now return to our earlier discussion of architecture, and in particular to Eisenman's claim that modern architecture is irreducible to a traditional dualistic analysis. To give a specific example, an important dualism among architectural theorists in thinking about modernist architecture is that between autonomy and heteronomy. Modern architecture, as exemplified by Le Corbusier and others, illustrates the importance of autonomy in opposition to an architecture that relies upon historically and culturally dependent designs and motifs. Le Corbusier is quite forthright on this point: for him it is function that provides for an autonomous architecture. His general premise in *Towards a New Architecture* is that "The Engineer's Aesthetic, and Architecture, are two things that march together and follow one from the other: the one [engineer's aesthetic] being at its full height, the other [architecture] in an unhappy state of retrogression."[35] It is for this reason that Le Corbusier will look to American grain elevators for inspiration and criticize, among many other examples, the ornately designed buildings found in the Baroque revival architecture of his day. The ideal for an autonomous architecture is to produce a building whose design is independent of the cultural context, including references to earlier styles and periods. For Le Corbusier, consequently, architects ought, as engineers do, to rely upon the primary forms most suitable to their function. Le Corbusier lists "cubes, cones, spheres, cylinders or pyramids [as] the great primary forms" that satisfy this demand.[36] This is why the grain stores and elevators, with their massive cylindrical structures, are beautiful for Le Corbusier whereas a gothic cathedral is not, in that in its design it "is a drama; a fight against the force of gravity" instead of being a reflection of the "great primary forms" that are in harmony with natural processes.[37] Proper architectural design, therefore, should rely upon primary forms that are independent of cultural and historical context. This is an autonomous architecture and is evidenced by Le Corbusier's Chandigarh project in India as well as in his proposals for Algiers, among many other

examples one could choose. The design of these buildings bears no relationship to the architectural styles one would find in India or Algiers, and hence the autonomy, for Le Corbusier, of the principles of architectural design.

Peter Eisenman will also stress the autonomy of architecture, which for him means that an architect ought to concern himself with addressing purely architectural problems and solutions and avoid drawing non-architectural elements into their work. Unlike Le Corbusier, however, Eisenman argues that a "building's function, structure, and type – its instrumentality – are not the criteria for understanding its importance in the discipline of architecture."[38] To the contrary, for Eisenman it is the way in which an architect reads and responds to the problems of design and hence how a building's function and instrumentality is represented in the work itself that gives significance to buildings *as* architectural works. Architectural expressions, therefore, are autonomous insofar as what gives the work its canonical value is the manner in which an architect's building articulates the terms and signs of architecture itself.[39] As Eisenman puts this point in an earlier essay, "Architecture, by its very creation, is institutionalizing. So for architecture to be, it must resist what it must in fact do . . . it must always resist being."[40] In doing this, and as Eisenman readily admits, architecture finds itself being "the least representative of all the arts,[41] in that it does not assume the traditional architectural vocabulary, namely columns, beams, walls, doors, and so on, but rather employs rhetorical figures that mark an absence that cannot be codified by traditional means. It is for this reason that architect Michael Graves argues "what Peter Eisenman is doing is not architecture."[42] As Eisenman interprets Graves's criticism, it follows upon Eisenman's view of a language of architecture that is "outside what he [Graves] assumes to be the natural vocabulary of architecture."[43] For Eisenman it is precisely an *autonomous* architectural practice that resists the codified, dualistic vocabulary, and hence it is autonomous architecture that affirms an intensive multiplicity and assemblage, thereby giving significance to architecture *as* architecture. In his attempt to put this theory into practice, Eisenman's Houses I–XI, for example, may be understood to be purely architectural assemblages whose value does not rely upon anything other than the architectural elements and syntax of the design itself.

The contrast between Eisenman and Graves is widely recognized among architects and architectural theorists.[44] In particular, Graves does not accept Eisenman's notion that the rhetorical figure in architecture marks an absence or undecidability that cannot be stated in a common, accessible form. Graves admits that there is an internal language to a building, but far from being inaccessible it is, as Graves puts it, "intrinsic to building in its most basic form – determined by pragmatic, constructional, and technical requirements."[45] In addition to this internal language, however, there are legitimate external concerns which architects ought to incorporate into their work. For Graves, "the poetic form of architecture is responsive to issues external to the building, and incorporates the three-dimensional expression of the myths and rituals of society."[46] For Graves, one cannot do without either these internal or external elements, and hence a "significant architecture must incorporate both internal and external expressions."[47] To drive the contrast between Graves and Eisenman home, for Graves it is precisely the extrinsic, heteronomous aspect of architecture that gives it its poetic form and hence its greatest aesthetic and architectural value. We can understand then why Graves does not hesitate to employ historical and cultural elements into his work,

such as his design for the Swan and Dolphin resorts at Walt Disney World, where a large swan statue is prominently placed within the design. For Eisenman, by sharp contrast, it is the intrinsic syntax and language of architecture that gives buildings their value *as* architectural works. It thus appears that despite Eisenman's concern for avoiding dualistic relationships and approaches within architectural practice, his work can nonetheless be given a dualistic analysis: namely, he practices an autonomous as opposed to a heteronomous architecture.

With our earlier arguments in place, we can begin to rethink this dualism between autonomous and heteronomous architecture. As a dynamic and consistent multiplicity of elements, an architectural assemblage swing[s] between, to recall Deleuze and Guattari's formulation cited above, territorial closure on the one hand and a deterritorializing movement on the other, or it swings between nomadic and institutional violence. An autonomous architecture thus swings in the direction of territorial closure and institutional violence, since it excludes and disenfranchises elements that are not part of the architectural territory; and a heteronomous architecture swings toward a deterritorializing movement, as nomadic violence, in that it includes non-architectural elements (e.g., swans, dolphins). As an intensive *assemblage*, however, the point precisely is the swing between these two tendencies, the dynamic tension that neither resolves the tension dialectically, nor does it become actualized as either of the opposing tendencies.[48] From this perspective, architecture is an assemblage that involves both territorial and deterritorializing elements, and architectural and non-architectural elements.

This is not to argue that Peter Eisenman and Michael Graves practice unsustainable architecture to the extent that their work does not maintain a dynamic tension between nomadic and institutional violence. It could well be argued that their work does indeed maintain such a dynamic tension – an argument that would require another essay – but more importantly sustainable design entails connecting more broadly to the processes associated with urban society. On this connection we can turn, among other places,[49] to Aldo Rossi's understanding of the city in *The Architecture of the City*.[50] Although he himself was not explicitly concerned with issues of sustainability, Rossi certainly recognized the problems that confront urban life when the city is approached from an abstract, utopian perspective. For Rossi, urban development is to be thought of

> not [as] utopian or abstract but [rather as] evolv[ing] from the specific problems both through its style and form as well as through its many deformations . . . because architecture, or the *fabricca* of the city, constitutes an essentially collective artifact and derives from this its characteristic features.[51]

In short, rather than approach urban planning from an abstract perspective, such as the abstract totalizing perspective of the globalized subject as Deleuze and Guattari understand it, Rossi recognizes that the city is a collective, or assemblage, and moreover "each part of the city," Rossi claims, "seems to be a singular place, a *locus solus*."[52] With his notion of *locus solus*, Rossi is able to set forth an understanding of the city that neither reduces it to being a single place, an organic totality, for instance, nor does it reduce the city to being the result of a totalizing plan or function (as was Le Corbusier's ideal). As for the latter point, Rossi could not be clearer: "one thesis

of this study, in its effort to affirm the value of architecture in the analysis of the city, is the denial of the explanation of urban artifacts in terms of function."[53]

Rather than a totalizing, abstract perspective, or a functional analysis, Rossi's approach understands a city as consisting of a series of singular places – or loci – that together constitute an assemblage that is irreducible to the places themselves but which is not a totality separable and distinct from these places. A city is thus an assemblage or emergent property of these singular places.[54] One can see then that Rossi's analysis implicitly recognizes the two modes of violence discussed above. On the one hand, a city is subject to the nomadic violence whereby it grows with unchecked, unsustainable abandon, as Douglas Farr has recently detailed.[55] There has been planning, but it has been a planning subordinate to the abstract demands of the global subject of capitalism and its immanent reliance upon nomadic violence. On the other hand, the city is equally subject to an institutional violence that suffocates the vitality and life of the city. Rossi refers to this as the tendency for singular places to become "pathological permanences."[56] The key to a vibrant, sustainable city, therefore, is to maintain a dynamic tension between these two modes of violence such that neither one is actualized.

Architectural design thus has a significant role to play in engendering a vital, sustainable culture, and the work of Deleuze and Guattari has provided us with a theoretical platform (or plateau as they might say) that enables us to understand the dynamics involved. Far from being the apologists for capitalism as some have argued,[57] Deleuze and Guattari show how capitalism forever confronts the very limits it thrives on, limits that ultimately undermine its successful functioning unless they are codified and reduced to the abstract, extensive quantities of the global subject. Capitalism in this form is unsustainable, since it seeks, as we have seen, to reduce the nondenumerable to the denumerable, which is impossible. The result is a futile and frenzied process of axiomatizing and quantifying productive processes – or, in what amounts to the same thing for Deleuze and Guattari, it results in an endless, unsustainable commoditization of the very creative processes that make capitalism itself possible. In Deleuze and Guattari's critique of capitalism, they show how a creative process can avoid becoming subordinate to the demands of extensive quantification (institutional violence) and avoid becoming undermined by an unpredictable, inconsistent chaos (nomadic violence), but become instead a process that "scales the schizophrenic wall" and affirms the intensive multiplicity that results in a dynamic assemblage which swings between institutional and nomadic violence without actualizing either one.

In Aristotle's understanding of the middle constitution we found a helpful comparison. As the desire for life is unlimited, it is mistakenly assumed that that which satisfies the needs of life must also be unlimited. The mistake, for Aristotle, is to confuse the unlimited desire for life with the desire for the good life. As a result of this confusion one attempts to satisfy an unlimited desire by means of limited, finite goods, and hence one ultimately ends up failing to achieve self-sufficiency (the good life) and simply ends up on a blind, ceaseless search for more and more. If one can strike a dynamic state that swerves neither too much toward the excesses of unlimited desire, nor too much to the stifling restrictions of life-denying simplicity, then one achieves the good life as an individual, or, in the case of the middle constitution, one achieves a good, self-sufficient state. It would require an entirely new essay to detail the similarities and significant differences between

Aristotle and Deleuze, but the comparisons enabled us to outline the broader philosophical implications of Deleuze's approach.[58] It has also enabled us to highlight the political implications of architecture.

With architectural design and practice understood as an effort to maintain a dynamic tension between institutional and nomadic violence, we were able to shed light on a number of issues – most notably, it helped us to clarify the role of the figurative in architecture and the related distinction between autonomous and heteronomous architecture. We then connected the dynamics of architectural design to an analysis of the sustainability of urban society, employing Rossi's *Architecture of the City* in this context to illustrate how Rossi's understanding of urban development exemplifies Deleuze and Guattari's philosophy of sustainability. Deleuze and Guattari are thus not apologists for capitalism, nor are they oblivious to issues regarding sustainability; to the contrary, when Deleuze and Guattari call for a "new earth and people that do not yet exist,"[59] it may well be argued that the new earth and people they call for will be one that maintains a dynamic, sustainable tension between two divergent, unsustainable tendencies. Instead of an unsustainable subordination of productive processes to the demands of the extensive quantification of the global subject of capitalism, the task is the undoing of this global subject and the creative invention of "ways" that swing between unsustainable alternatives. With architecture's prominent place in designing and building the spaces in which we live and find ourselves, the significant role it can play in forging a sustainable life should not be underestimated.

## Notes

1 Peter Eisenman, *Ten Canonical Buildings: 1950–2000* (New York: Rizzoli, 2008), 16.
2 Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987), 337.
3 Gilles Deleuze and Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia*, trans. Robert Hurley, Mark Seem, and Helen R. Lane (Minneapolis: University of Minnesota Press, 1977), 270.
4 See Deleuze and Guattari, *A Thousand Plateaus*, 531.
5 Ian Buchanan, *Anti-Oedipus: A Reader's Guide* (London: Continuum, 2009), 43.
6 Deleuze and Guattari, *Anti-Oedipus*, 69.
7 Ibid., 35.
8 Deleuze and Guattari, *A Thousand Plateaus*, 460.
9 Karl Marx, *Economic and Philosophic Manuscripts of 1844* (Buffalo, NY: Prometheus Books, 1987), 137 (emphasis in original).
10 Ibid., 138.
11 Deleuze and Guattari, *A Thousand Plateaus*, 463.
12 Ibid., 472: "At the same time as capitalism is effectuated in the denumerable sets serving as its models, it necessarily constitutes nondenumerable sets that cut across and disrupt those models."
13 Deleuze and Guattari, *A Thousand Plateaus*, 400.
14 Gilles Deleuze and Claire Parnet, *Dialogues*, trans. Hugh Tomlinson and Barbara Habberjam (New York: Columbia University Press,1987), 132.
15 Alfred North Whitehead, *Modes of Thought* (New York: The Free Press, 1966), 174.
16 Henri Bergson, *An Introduction to Metaphysics*, trans. T.E. Hulme (Indianapolis: Hackett Publishing Company, 1999), 51 (emphasis added).

17 Deleuze noted this aspect of Bergson's work in an early 1956 essay that "virtuality exists in such a way that it actualizes itself as it dissociates itself; it must dissociate itself to actualize itself." As this actualization unfolds, Deleuze adds a few pages later, "what is differentiating itself in two divergent tendencies is a virtuality." See Gilles Deleuze, "Bergson's Conception of Difference," in *Desert Islands*, trans. Michael Taormina (New York: Semiotexte, 2004), 40, 42.
18 Bergson, *An Introduction to Metaphysics*, 49.
19 For instance, in *Modes of Thought* and elsewhere Whitehead is critical of the subject-predicate metaphysics that is typical not only of Aristotle's thought and his understanding of the relationship between form and content, but also typical of much of the Western philosophical tradition. Similarly, in *Difference and Repetition* Deleuze argues that Aristotle never affirmed difference in-itself since difference is always understood, according to Aristotle, relative to a self-identical third. See Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (New York: Columbia University Press, 1994).
20 Aristotle, *The Politics* (New York: Penguin, 1982), 79, 81.
21 Ibid., 81.
22 Ibid.
23 Ibid., 82.
24 Ibid.
25 Ibid., 85.
26 Aristotle, *The Politics*, 425.
27 Bergson, *An Introduction to Metaphysics*, 49.
28 Deleuze and Guattari, *A Thousand Plateaus*, 337.
29 Aristotle, *The Politics*, 266.
30 Ibid., 267.
31 For more on this theme, see Jeffrey A. Bell, *Philosophy at the Edge of Chaos* (Toronto: University of Toronto Press, 2006).
32 Whitehead, *Modes of Thought*, 174.
33 Aristotle, *The Art of Rhetoric*, Vol. XXII, trans. J.H. Freese (Cambridge, MA: Loeb Classical Library, 1926), 31.
34 Ibid.
35 Le Corbusier, *Towards a New Architecture* (New York: BN Publishing, 2008), 1.
36 Ibid., 29.
37 Ibid., 30.
38 Eisenman, *Ten Canonical Buildings*, 21.
39 Ibid. In addition to drawing from Derrida's conception of a text, Eisenman also brings in Peirce's theory of signs to establish his claim that architectural representation need not be thought in terms of an established grammar, vocabulary, or syntax.
40 Peter Eisenman, "Architecture and the Problem of the Rhetorical Figure," in Kate Nesbitt (ed.), *Theorizing a New Agenda for Architecture: An Anthology of Architectural Theory* (New York: Princeton Architectural Press, 1996), 177.
41 Ibid., 177.
42 Ibid., 178.
43 Ibid.
44 See, for instance, Mario Gandelsonas, "On Reading Architecture," in Geoffrey Broadbant, Richard Bunt, and Charles Jencks (eds), *Signs, Symbols and Architecture* (Chichester, UK: John Wiley & Sons, 1980), 235.
45 Michael Graves, "A Case for Figurative Architecture," in Nesbitt (ed.), *Theorizing a New Agenda for Architecture*, 86.
46 Ibid.
47 Ibid., 87.
48 More recently Reiser + Umemoto have incorporated Deleuze's concepts of multiplicity

and assemblage into their architectural design procedures. In contrast to an Aristotelian model that would seek to find a mean between two extremes, Reiser + Umemoto call for an architecture that entails both extremes. In short, they seek to pursue assemblages that simultaneously swing toward territorial closure and deterritorializing movement, and in doing so develop an architecture that avoids the traditional dualisms of form/matter and order/disorder. This helps us to understand the important difference between Aristotle and Deleuze, despite the similarities stressed earlier. Whereas Aristotle attempts in his theory of virtue and the middle constitution to establish an extensive (that is, an actualized) assemblage that avoids two extremes, for Deleuze (and for Reiser + Umemoto) the effort is to draw upon an intensive assemblage in the process of creating extensive assemblages, and this process entails both extremes as the divergent tendencies that become bifurcated upon the actualization of the intensive in the extensive. Reiser + Umemoto, in *Atlas of Novel Tectonics* (New York: Princeton Architectural Press, 2006).

49 Among these other places, see esp. Henri Lefebvre, *The Urban Revolution*, trans. Robert Bononno (Minneapolis: University of Minnesota Press, 2003 [1970]); David Harvey, *The Urban Experience* (Baltimore, MD: Johns Hopkins University Press, 1989). Both Lefebvre and Harvey have argued persuasively for the significance of analyzing the urban in order to understand contemporary politics and society. This is no less true for a philosophy of sustainability.

50 Aldo Rossi, *The Architecture of the City*, trans. Diane Ghirardo and Joan Ockman (Cambridge, MA: MIT Press, 1984).

51 Ibid., 18.

52 Ibid., 21.

53 Ibid., 46.

54 An emergent property, as understood here, is an extensive assemblage that is inseparable from the dynamic, intensive assemblage that made it possible.

55 Douglas Farr et al., *Sustainable Urbanism: Urban Design With Nature* (Hoboken, NJ: John Wiley & Sons, 2007). Farr argues that not only has urban life taken an unsustainable turn in the United States since the 1970s but this turn has become normalized to the point where most municipal zoning codes disallow the types of dense development that would engender a sustainable city.

56 Rossi writes: "permanences present two aspects: on the one hand, they can be considered as propelling elements; on the other, as pathological elements . . . between permanent elements that are vital and those that are pathological . . . An example of a pathological permanence can be seen in the Alhambra in Granada." Rossi, *Architecture of the City*, 59. The Alhambra, in short, stifles the potential vitality of Granada by licking the life of singular places in Granada into a permanent past rather than allowing for the Alhambra to be a living, vital past in Granada's present.

57 Luc Boltanski and Eve Chiapello argue this point in *The New Spirit of Capitalism* (London: Verso, 2008).

58 See n. 44 above.

59 Gilles Deleuze and Félix Guattari, *What is Philosophy?*, trans. Hugh Tomlinson and Graham Burchell (New York: Columbia University Press, 1994), 108.

Chapter 21

# Cultural Symbolizations of a Sustainable Future

*Roland Faber*

> The world is a community of organisms; these organisms in the mass determine the environmental influence on any one of them; there can only be a persistent community of persistent organisms when the environmental influence in the shape of instinct is favorable to the survival of the individuals. Thus the community as an environment is responsible for the survival of the separate individuals which compose it; and these separate individuals are responsible for their contributions to the environment.[1]

A philosophy of sustainability does not arise merely through efforts to conceptualize the material fact that there is an ecological interdependence between humanity and ecosystems of the earth, or the cosmos for that matter. It only arises if we also engage in a process of cultural symbolization that successfully articulates possible categories of mutual responsibility for a sustainable future of the interaction between humanity and ecosystems.[2] In his discourses on environmental philosophy – *Symbolism* (1927) – Alfred N. Whitehead indicates that no environment is a priori bound to be favorable either to the existence of organisms or to their happiness. Really, for Whitehead, any community of organisms can only become or remain self-sustainable (persistent) in their environment if its systems of symbolisms are successful in expressing mutual sustainability, especially in terms of the multiple layers of the environment that surround the organism's self-organization. Hence, the quest for a philosophy of sustainability would amount to the formulation of new visions of "happy symbolizations" that, in all constitutional uncertainty, would allow for humanity to serendipitously partake in the mutual transformation of all organisms and environments.

In this context, sustainability would express a discourse on *fortunate* life (and its recourses and transformations) that does not preclude humanity as an emergent evolutionary feature of the very same environmental complexity it has left, as a

contingent appearance of an intersection of environments by which it has been shaped, and as a creative transgression into unprecedented constellations of organisms and environments in the future of the universe.[3] Nevertheless, sustainability will only name *happy* symbolizations of such a fortunate future if, as Gilles Deleuze reasons about Whitehead, we presuppose this world to be constituted by profound creativeness; that is, if we live in a "chaosmos" of unprecedented transformations of organisms and environments in the midst of their always uncertain structures – their unexpected appearances and their inevitable disappearances.[4] Only if we understand that "nature" is not complicit with our existence and happiness, but that it is patient with our involvement to further our fortunate existence, will we be freed from any fate hindering us from appreciating this fortune that we *share* with the chaosmos. The first insight in sustainability is that of the shared contingency of humanity within the chaosmos.

## Sustainability as Philosophical Problem

Sustainability is a notoriously elusive term like life, nature, culture, justice, or beauty. It is by no means neutral to humanity's survival but rather is an expression of the very means of such a survival. It becomes only virulent in situations of its absence; that is, at points when the survival of humanity is imperiled; and its meaningful application involves a broad scientific understanding of the mechanisms of material cycles that hold together all inorganic and organic matter on physical, chemical, biological, social, and cultural levels. Sustainability has a hybrid identity; that is, it partly describes cycles of energy transformation and partly prescribes our understanding of the inherent mechanisms of natural cycles as mandatory for human survival. Moreover, it names the conscious and conscientious "development" of humanity within its environmental limits; that is, it is visionary in imagining ideal states of such a future entanglement of nature and culture in a smooth, complex cycle of cycles that activate us toward the realization of such ideal states.[5]

Sustainability is inherently scientific and philosophical; it concerns investigations in eco-cycles and raises questions of human involvement.[6] Ideally, it is not just anthropocentric but ecological in nature, and not only geocentric but cosmological in scope. But even if it addresses the whole biosphere and, beyond that, the physical constitution of the universe as it immediately plays into the generation and disappearance of life-circles, it remains a human concept for reasons of human survival.[7] Even if it focuses on humanity as the very problem and would wish humanity to disappear, this would be a *human* disappearance such that, if humanity does not deserve to live because of its destruction of nature, in the moment of its disappearance humanity would have *become* humane with regard to the ecosphere. It is a conceptualization of the very intertwining of humanity with nature that has been conceived of as a function of harmonious survival and life in myriad entangled eco-cycles.[8]

The current use of the term "sustainability" indicates a set of cultural symbolizations by which this entanglement is addressed in its descriptive, prescriptive, and visionary dimensions. This set includes facts of environmental sciences and discussions of sociology, it formulates quantitative and qualitative measures for survival over and against extinction, preservation over and against destruction, eco-justice

over and against suppression, and reparation over and against exploitation; and it envisions a new togetherness of earth and humanity in their mutual advancement.[9] Its simplest description would be of the following: a *set of symbolic instruments* of analysis and rules of engagement for an economic, social, political, and cultural activation, which would allow for an *infinite perpetuation* of a "state" of balanced recycling of all forms of energy, matter, and ideas that *does not exhaust itself* in this process of being constantly transformed by natural and cultural metabolisms.

In fact, in its philosophical inclinations the concept of sustainability involves a spiritual movement that, beyond all technical issues of environmental conservation and the adaptive management of ecosystems,[10] wants to address the entanglement of humanity within this chaosmos as its inherent expression and, especially in its mental abilities, as a natural part of its fate. Eco-feminism and deep ecology, land ethics and holistic environmentalism, eco-justice, and the utopia of an eco-human peace stand for nothing less than a redefinition of humanity, its place in the eco-cosmos, and its possible future with the chaosmos; a future redirection of the parochial divisions (e.g., into sciences and humanities) in humanity's endeavor to understand the world and to activate for a different future.[11] Sustainability names the painful absence of such a future, addressing the present as precisely not geared toward liberation from mechanisms of power employed by capitalism, consumerism, the fact–value divide, ethnic and religious wars, and ideological manipulations for special interest profits, as well as a general fatigue of utopias of peace as the result of such a redefinition and redirection.

The term "sustainability" entertains at least these three meanings. First, it names the ability of a form of life to survive on the basis of its material substratum such that it does not exhaust its recourses of energy transformation; this is the *external* self-sustainance of a group of organisms in their environment. Second, sustainability names the very ability to perpetuate the identity of a form of life so that, in its transformation, it does not exhaust its own existence by mere extinction or evolutionary adaptation such that one could no longer recognize its ongoing existence; this is the *internal* self-sustenance of identity. Third, sustainability names the mutual entanglement of organisms and environments in their ability to sustain their respective integrity, diversity, development, or balances through one another; this is the *universal* sustainance of divergent evolutionary developments, emergences, and relative independences of forms of life in their respective or shared environments.

Whitehead calls the first meaning the *self-grounding* of societies of organisms within a given environment.[12] Just as poststructuralists do later, he banishes the second one as misplaced essentialism.[13] We can, with Deleuze, call the third one "aparallel evolution."[14] If we allow the second one—identity—to collapse, everything changes: sustainability would become a concept of becoming multiplicity; its direction would fail to find a measure of *permanence* and would instead embrace the value of *intensity*.[15] Sustainability would become a concept that now asks how intensity, gained by organisms as internal environments of other organisms and embedded in wider environments that are their own organisms for ever wider environments (first meaning), can be sustained through the mutual movement of organisms and environments one through the other (third meaning).[16] *This* – "seeking intensity, and not preservation"[17] – I suggest, and *not* self-identical survival, is the philosophic problem of sustainability. If so, *external* sustainability is about a

harmonics of intensity (contrast),[18] and *universal* sustainability will be about the very conditions of the possibility of a world that would allow for the mutual immanence of all organisms and environments.[19] *Internal* sustainability, however, transmutes into "creativeness"[20] – the promise of ever newly becoming multiplicity.

## General Economy and Dispossession

Capitalist economy is, besides the obvious omnipotence of monetary means of exchange, based on two principles: first, that the sphere of energy transformation in which goods are produced and consumed is only externally related to that of the recourses used in production and the wasteland left behind by its consumerism; and, second, that the recourses and means of production as well as the means of distribution for consummation are locally limited and, hence, must be strategically controlled by mechanisms of displacement and war in order to secure one's own recourses and to be able to expel the waste into the non-locus of an outside.[21] These principles are paradoxically related: while *universally* the first presupposes an infinite depth of resources and an infinite space of outland for disposed waste, *locally* the second implies a scarceness of recourses, means, and places of production and consummation. Together they urge an external expansion of the realm of control over recourses and means through exploration and possession of new areas of exploitation, and an internal creation of exchange values for the maximization of profit in substituting possession with monetary means – as the very potential for possession.

Both conditions are wrong. The first is obviously vitiated since neither our recourses for production are infinite nor can we expand indefinitely into empty spaces to turn them into wastelands after consummation.[22] Indeed, the very ecological recovery of cyclic processes as the natural behavior of matter has opened the capitalist closure of hermetic production–consummation to an ecological resource–waste cycle that demands the recycling of limited resources as a means of sustaining the economic basis of humanity's survival.[23] A soon as it became clear that the law of the conservation of energy implies that the metabolism of energy is not based on an indefinite external expansion of resources and wastelands but on an exchange of forms of energy, ecological cycles became *the place* for economic production and consummation.[24] Since on no level of environmental complexity is there a "free lunch," all transformation of energy must sustain its own cycles of generation and consummation. Even more importantly, in such cycles, nothing can be possessed that is not borrowed, that must be set into the flux of the ecological cycles, and that finally must always be "paid back" into these cycles.[25]

The second principle is contested, not only by the logic of energy exchange, but by the way in which natural cycles borrow energy. Georges Bataille in his "general economy"[26] has reversed the prejudice of scarcity as an evolutionary urge for survival with his insight that the very source of all modes of energy exchange on earth is the abundance of the energy emitted from the sun and the evolutionary ways to transform this energy into all kinds of forms of eco-cycles. They sustain themselves from the overflow and excess of this energy transmission. While this solar energy is also "borrowed" insofar as the sun will eventually burn out, on earth it creates more energy than necessary and, hence, leads to strategies to store this

surplus such that "something" seems to become exempt from the ecological cycle of production, transformation, and consummation.[27] Bataille's basic insight is that it is not scarcity but abundance that leads to the realm of *surplus* which may be utilized for the *possession* of energy (or money). This possessed surplus then defines the very power structures that generate the illusion of an infinity of resources and wastelands so as to direct themselves toward the maximum profit that enters the economic process only as a "gift" from this theft.[28]

While for Bataille the excess of energy may be given back either in the form of the growth of the economy or its consummation as luxury, its consummation becomes a necessity when growth exhausts its "space" and becomes impossible, except in its own consummation through all forms of war. Since growth is bound to be doomed by the reversal of the first principle, that is, the exhaustion of expansion, consummation in the form of non-profit also becomes a necessity. In other words: the non-functional consummation of surplus energy as *art* and the non-profitable infusion of surplus energy in the form of *sharing* the processes of the transformation of energy with the environment without return become mandatory for the very self-sustainance of natural and human societies.[29] Since in this regard art and ecology become only two sides of this process of dispossession of borrowed energy and its transformation into values other than monetary exchange values, their very sustainability as *shared abundance* is not a matter of permanence for survival but that of intensities within processes of sharing.

Intensive values,[30] not based on an exchange in the ream of power over energy transformation but as dispossession of profit, bind art and ecology to aesthetics, ethics, and justice;[31] they are virtues,[32] or as Deleuze says, virtuals,[33] that cannot be expressed in terms of power of possession and its derivatives. In fact, these values, virtues, and virtuals are directed against the inherent violence of such powers of profit and functionality.[34] Bataille describes them in terms of the desire for (lost) *intimacy* with animality like "water in water"[35] that we have left behind in becoming human in terms of the creation of realms of objects of functionality of empty means for always new means – empty of values that, non-functionally, would grant satisfaction to our strivings and desires as aims, goals, or inherent ends that cannot be exchanged as means for other means.[36] Baudrillard has taken this thought to its utmost consequence: the world cannot be exchanged.[37]

## Conception, Perception, Affection: The Art of Valuation

Virtuals only appear in a different perception of the world that allows us to experience a *non-functional* access to organisms and environments, *dispossessive* of powers of subjection and objection when *in our experience* we can feel, conceive, and gain insight into a non-functional worth in itself – the dignity of art and of ecological cycles.[38] Four shifts in our conception of organisms and environments will establish the sensibility of a different perception and affection of their sustainance – not as a defense of possessive permanence, but as the recycling of intensity.[39]

First, we must deconstruct enlightened substantialism, which has created a conceptual isolation of *res cogitans* and *res extensa* (Descartes), an isolation of sense-experience from the environment (Hume), and an isolation of projective subjectivity from "nature" and, hence, the "bifurcation" of aesthetics and practice from theory

(Kant) that Whitehead[40] describes in a similar way as Derrida: as the conceptual isolation of "presentational immediacy"[41] justified by a metaphysics of presence.[42] In rooting experience in consciousness and in viewing consciousness as the root of a self-sustaining unification, we obtain a logocentric presence of things that, in fact, hides, oppresses, and erases their own inherent environmental multiplicity, difference, and relationality, which actually constitutes this "sub-jective" (subordinating) consciousness, deconstructing it, at the same time.[43] Subjectivity and subjection are of the same essence: namely, that of the colonizing and all-pervading power (Foucault, Butler) over energy transformation (capital) that exchanges the world (Baudrillard) for the illusion of its control as "nature" through the possession of surplus production (Bataille). This "naturalization" of the power of subjection really creates a world of objects as material for manipulation (Bataille).[44] This has been the trick of substantialism ever since the division of the world into Ideas and sensible beings (Plato), form and matter (Aristotle), not to mention the bifurcation of environments and organisms from production and consummation.[45] For Whitehead, this bifurcation creates a "civilized" world from slavery – the "substratum" of the free world.[46]

Second, the newly regained conceptual recognition of our own bodily existence within environments has taken on many different forms in current philosophical discourses: the reconsideration of the Platonic *khora* as the all-relational *Within* of Ideas and sensible things in Derrida, Kristeva, Bataille, Deleuze, and Whitehead – as the surname of *différance* that deconstructs unities of subjection into multiplicities of becoming;[47] as the pre-symbolic realm of bodily diffusion;[48] as the "water in water" of the intimacy with our own animality;[49] as the sieve of the immanent consistency of multiplicities;[50] and as a medium of inter-communication.[51] In all of these approaches, which I view as essentially opening experience to the multiplicity of the entanglements of environments and organisms, we meet the paradoxical experience through which we transform sub-jective possession of conscious unity into dispossessed intensities of multiplicities. We cannot "possess" it (be united with it), since we experience *khoric* intensities, multiplicities, differences, and connections only in the state of expulsion from innocence: as lost multiplicities, as lost orgiastic connectivity, as lost communication, as abjection and poetic inconsistency.[52]

Third, the access to the realm of intensities can only be approximated through the dissolution of the sustainance of possessive identities. It is in this approximation that we gain access to values, virtues, or virtuals. Derrida's *différance*, which acts as a spatiotemporal deferral of identities, opening the wound of multiplicity in the midst of logocentric possessiveness, is a conceptual witness to this contrast of the deconstruction of sub-jective unities and processes of liberating intensive multiplicities – so is Deleuze's and Whitehead's deconstruction of substantial, hierarchical, arboreal stratifications of reality with non-hierarchical, univocal, rhizomatic, multiplicities of spatiotemporal events and their differential interconnectivity.[53] The non-functional character of values, virtues, or virtuals of worth in the midst of the experience of spatiotemporal events is their very intrinsic characteristic insofar as it characterizes environmentally conditioned organisms and environments of other organisms as continuous in their transitoriness *in these events*. This fleeting, non-hierarchical, univocal, rhizomatic intersection is the place of intensities in events of spatiotemporality, an intersection that decodes these events

as a process of valuation.[54] Hence, "the element of value, of being valuable, of having value, of being an end in itself, of being something which is for its own sake," must not be omitted in any account of an event as the "very texture of [intensive] realization in itself."[55]

Fourth, the conceptualization of intensities through processes of value-creation must, as its basic or transcendental condition, admit that ecological connectivity and diversification is not in any sense fixed, as suggested by the material mechanicism. Instead of Descartes's reduction of the bodily character of material processes to a merely empty *res extensa* that legitimates filling this emptiness with our own possessions of space and time, we must (with Whitehead and Deleuze) suppose a basic or transcendental creativeness of the chaosmos.[56] It allows for connectivity as novelty such that cyclic repetition is never bound by repetition of the same but by articulation of the conditions of the sustainance of intensities in the repetition of novelty, difference, and divergence.[57] In fact, the very ecological appearance of logocentric consciousness, for Whitehead, is an evolutionary emergent of creativeness, a gift of advantage in the struggle for survival within changing environments – partly evolutionary pressure toward survival and, hence, sustainance of permanence, partly intensification within a self-sustaining nexus of societies of organisms and, hence, sustainance of intensity.[58] While consciousness "is the acme of emphasis,"[59] the reduction to simplification to the same, it is also a "product of art," the surplus, the "morbid overgrowth of functions which lie deep in nature,"[60] that is, of creative artificiality (non-functionality) within the chaosmos itself.

Here art and ecological connectivity coincide: as the conscious recourse of values, virtues, and virtuals, as creative processes of non-functional connectivity that sustains intensities instead of preservation. This perception of the chaosmos by a "conscious consummation" of the all-assuming power of "presentational immediacy" becomes the art of valuation.[61] It accesses the pre-symbolic realm of *khora* (of multiplicities) such that we find ourselves in an indefinite and undetermined resonance between conscious immediacy and chaosmic intensity.[62] This is what Whitehead calls "symbolization" – the *arbitrary* process of signification within "presentational immediacy" and "causal efficacy."[63] As in Derrida, we cannot escape signification, but in its very process of resonating symbolization becomes profoundly contingent, a process of infinite negotiation. By avoiding any counter-identifications of ecosphere and humanity, this symbolization is always *cultural* symbolization since it articulates the *artificiality* of the chaosmos in all of its events of eco-connectivity itself.[64] The *art* of valuation, then, is the ability to become the medium of communication between the ecosphere and humanity such that the self-sustainance of human and non-human societies alike creates, establishes, and negotiates values, virtues, and virtuals that can express their mutual creative connectivity as harmonics of intensities by avoiding an "unfortunate evolution"[65] through their mutual destruction.

## Decomposition/Symbolization

Sustainability is the ability to always negotiate anew the arbitrary arrangements of concepts, percepts, and affects in such a way that they can express the connectivity

between consciousness and ecosphere as a *happy* coincidence of structural harmony and chaotic intensity, or between organic and orgiastic movements of chaosmic bodies.[66] The art of valuation is the ever new creation, feeling, and praxis of values, virtues, and virtuals that allow the eco-connectivity to become *momentarily* transparent in the *event* of their spatiotemporal connection in the respective bodies, organism, environments, and ecosystems. In other words, while the symbolization between consciousness and biosphere is *arbitrary*, its *contingency* is not a mere fantasy (a subjective projection) – which would entrap us again in the artificiality of the sub-jection of "nature" – but expresses *the very connectivity* between them; and although the happy coincidence is always a matter of *creative invention* it is, at the same time, a matter of their *mutual intervention* as modes of perception, affection, and conception.

Sustainable symbolization always works only as a mutual decomposition of any substantial isolation *between* immediacy and intensity.[67] While the former creates the *intensity of immediacy*, closed within a logocentric reflex of subjection of the ecosphere under the seemingly independent "mind," the latter lives in an *immediacy of intensities*, as "water in water," as instinctive animality or material causality. Their *connectivity*, however, is haunted by *mutual expulsion* such that their cultural symbolization can only reach sustainable values, virtues, and virtuals of the intersection of humanity and ecosphere *in* places of the danger, places of mutual monstrosity, dissolution, and destruction.[68] Nevertheless, since values, virtues, and virtuals can only be gained by this connectivity, they must be gained *in the spaces* of this danger and by risking decomposition.[69] Kristeva speaks of the danger of insanity in the approach of the inconsistency of *khora* that not only becomes transparent in poetry but also needs its disguise;[70] Deleuze warns of the decomposition of the human face in becoming a "body without organs"[71] (without hierarchical organization) through differentiation into pure multiplicity;[72] Derrida cannot avoid the risk of utter meaninglessness of *différance* in its indefinite deferral of sense;[73] Bataille knows of the conscious consummation of consciousness as utter sacrifice.[74]

Sustainability may only be addressed *from* this dangerous place and, hence, is *necessarily arbitrary* because of this *decompositional connectivity*. Accordingly, the art of valuation is a negotiation of fire: in this fire, values, virtues, and virtuals are created and dismembered. The *art* is to go through the fire of decomposition such that permanence, but not intensity, might be lost. Similar to Deleuze's "body without organs," Whitehead addresses the problem of sustainability as an "art of life";[75] that is, the symbolic negotiation of the arbitrary eco-connectivity through the emergence of *orgiastic* bodies *within* organic bodies – of pure Life (novelty) within structures (identity).[76] Since in the complex formation of "cosmic societies" and their structural repetition of the same, a nexus might appear that cannot "be construed purely in terms of environmental obligations," it would become so much the harbinger of novelty that in the "emergence of life"[77] it might lose its very social character, becoming an "entirely living nexus."[78] Precisely this chaotic connectivity of pure multiplicity will eventually destroy the organism, which it harbors as its environment or the organism, or the organism will rid itself of this instability in favor of its own survival. Whitehead relates the mutual devouring in nature to the restitution of organic order in the midst of this orgiastic Life.[79]

In avoidance of this mutual decomposition, cultural symbolization is the negotiation of humanity and ecosphere in their mutual connectivity of isolation or

expulsion. When the "obligations of social conformity" overflow into the arbitrariness of Life, the "secure instinctive response" of societies must find "various intricate forms of symbolic expression of the various purposes of social life."[80] Such symbolic expression must find the surplus of artificial arbitrariness in the chaosmos and the surplus of chaosmic values, virtues, and virtuals in the art of symbolization such that they can negotiate purposes that allow for the ever new, creative, and "happy" mutual symbolic transference between humanity and ecosphere:

> Thus mankind by means of its elaborate system of symbolic transference can achieve miracles of sensitiveness to a distant environment, and to a problematic future. But it pays the penalty, by reason of the dangerous fact that each symbolic transference may involve an arbitrary imputation of unsuitable characters. It is not true, that the mere workings of nature in any particular organism are in all respects favorable either to the existence of that organism, or to its happiness, or to the progress of the society in which the organism finds itself. The melancholy experience of men makes this warning a platitude. No elaborate community of elaborate organisms could exist unless its systems of symbolism were in general successful.[81]

## Viral Intervals of Happy Transfer

Cultural symbolization is the symbolic transference of *such* arbitrary characters (values, virtues, virtuals) between humanity and ecosphere that successfully provide the disposition for "miracles of sensitiveness to a distant environment, and to a problematic future." In this success, we become an elaborate community of organisms with the chaosmos that sustains its multiple intersecting environments as intensities within and between humanity and ecosystems.[82] The measure for ecological sustainability, therefore, is this successful transference of the *characters* of cultural symbolisms. Although they are "characters,"[83] that is, values, virtues, and virtuals, they must *successfully* transfer between organisms in their mutually favorable organization such that, at the same time, they may harbor and further the orgiastic irruption of the entirely living nexus of Life (their characterless multiplicity) by hindering their mutual destruction.[84] The question, hence, is what in our time and as reflected by the invoked philosophies are such "characters" for a successful symbolic transference between humanity and ecosphere, general economy and universal ecology, consciousness and chaosmos, intensity of immediacy (presence) and immediacy of intensities (multiplicity)? Instead of providing a categorical list, I will – with Whitehead and Deleuze – suggest *four transcendental conditions of sustainability* for the elaborate community of organisms as multiplicities of intensities in their happy transfer.[85]

First, cultural symbolization will be successful in its transfer if it *inverses* the substantialist conditions of the mutual isolation of humanity and ecosphere in the bifurcations of economy and ecology, consciousness and chaosmos, and presence and multiplicity.[86] Instead of the paradox of universal occupation of, and local competition over, resources and spaces of colonization, the happy transfer of the inversion constitutes *limited* resources and spaces in the form of eco-cycles of mutual

repetition and differentiation, and a *non-functional surplus* of values, virtues, and virtuals that always interferes and invents within the environments *of* organisms, organisms *as* environments, and environments *as* organisms in any event and nexus of their happening.[87] Their *diffusion* throughout these nexuses not only takes the risk of "an arbitrary imputation of unsuitable characters" as a condition of their "happiness"; but also, this diffusion is the very *risk* of trusting a cultural art – the *artificial intervention and invention* of values, virtues, and virtuals – to be the medium of happy transference.

Second, under the inversed condition, cultural symbolization must implement values, virtues, and virtualities that are *dispossessive* of the substantialist isolations and, hence, affirm the mutual immanence of all environments and organisms and their striving toward intensity of Life.[88] They will change the way in which our concepts, percepts, and affects relate to their own coming-to-be and creative responsiveness to their inclusive becoming from their environment. By inversing the colonizing violence of the substantialist isolation in our experience, such symbolization will allow for a mutual transparency by means of which we may "express in our actions, our hopes, our sympathies, our purposes, and [by] which we enjoy" ourselves and everything to be included in a "buzzing world, a democracy of fellow creatures."[89] A symbolic *transfer* of values, virtues, and virtuals, such as actions, hopes, sympathies, purposes, and enjoyments, that is, *intensities*, to the various non-human multiplicities in the chaosmos is, hence, not an anthropomorphic reduction, but a viral subversion of anthropocentric colonization of the *res extensa* as dead matter. Such an "arbitrary imputation" – as attempted by Whitehead – is not a restitution of subjective subjections of the chaosmos, but – with Bataille and Deleuze – all the more suitable as a dispossessed, infinitive mode of "*a* life" beyond the life of subjects and objects.[90]

Third, the success of symbolic transfer under the conditions of arbitrariness and creativeness of the chaosmos is always *unprecedented*; that is, it cannot be known before, and can only be won in, the risk of its very loss. The risk of symbolization implies that *cultural experiments of dispossession* become "characters" – values, virtues, and virtualities – of eco-societies as *condition*, not as consequence, of the new way we conceive, perceive, and are affected by the eco-chaosmos; they name non-functional diffusion of surplus energy into the ecosphere as investment into the potential happiness of a sustainable eco-society. In other words: The art of valuation consists in the cultural experiment of such characters of the non-functional surplus of the chaosmos in humanity and between all intersecting environments that, *as* values, virtues, and virtuals of transference, can be the very *medium* of the sensitiveness to distant environments (mutual intervention) and to a problematic future (creative invention).

Fourth, the sustainability as mediated by cultural symbolizations can address the mutual responsibility of an elaborate community of organisms *only from within* the spaces of ongoing negotiations between persistence and intensity. Sophisticated values, virtues, and virtuals of sustainable dispossession are *only* idealistic fantasies *if* they are not understood either as born out of the mutual abjection of our bifurcations or as the risk of the loss of identity, persistence, and the very "happiness" of an elaborate community of organisms. Elaborate eco-societies will, therefore, want to further the art and culture of *viral intervals* of valuing, become virtuous in, and being dispossessed by virtuals such as, cyclic communion, mutual dependence,

desubjectified multiplicity, polyphonic harmony, non-persistent intensity, tragic beauty, responsive non-violence, and a sense of peace in the midst of monstrosities of the chaosmos and power-possessed human societies.[91]

Cultural symbolizations of a sustainable future are transfers of characters, arts, and cultures of eco-connectivity within substantialist societies. This symbolic transfer is not directed toward an outside, a well of resources, a chaotic wasteland, an empty space for colonization, an external environment, or a vision of an upward evolution beyond humanity. Rather, it is a viral transfer *ad intra*, into the very interiority of societies in which they are always already constituted by, and as, communities of organisms. A culture of eco-transfer must become the multiplicity of viral intervals of Life *within and between* the powers with which we colonize them or abandon them into a nothing or a "natural" evil. The ancient philosophers were seeking this "way within" as a spiritual journey to the roots of our existence. If these "roots," however, are only the multiplicity of multiplicities in their becoming (Deleuze) or the infinite becoming of events of multiplicities (Whitehead)[92] that have no ground "outside" (above or beyond), this immanence of the manifold opens subversive concepts, percepts, and affects of viral intervals *in between* as the *intermezzo* of the environment[93] within power structures of isolation, subjection, and substantiation. Symbolic transfer *ad intra* is of such sophistication that any society interested, willing, and able to become sustainable, sustaining the intensities in the community of organisms, will need to experiment and experience the dispossession of the powers of colonization, subjection, and substantialization. With endless patience, it will need to become sensitive to the faintest viruses (values, virtues, and virtuals) of such a transfer in the midst of their constant erasure. It will need to achieve this level of sensitivity in order to sense in their non-functional reverence the decisive factors facing the always problematic future of sustaining the intensities of the chaosmos.

## Notes

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