INTRODUCTION
Networked ways of knowing
KIM TANZER AND RAFAEL LONGORIA

> *I prefer 'both-and' to 'either-or,' black and white, and sometimes gray to black or white.*[1]

1 *Robert Venturi,* Complexity and Contradiction in Architecture *(New York: The Museum of Modern Art, 1966), 16.*

In selecting essays for this book we have embraced the concept of sustainability popularized through the 1987 UNESCO Report, *Our Common Future*, also known as the Brundtland Report, after its primary author, Gro Harlem Brundtland, Prime Minister of Norway.[2] The report asserts "sustainability is defined as meeting today's needs without compromising the ability of future generations to meet their own needs." In the nearly twenty years since the report was issued, critics have challenged several of its key elements, specifically alleging it capitulates to continued human development and emphasizes human needs at the potential expense of nonhuman environmental needs.[3] Nonetheless, the definition provides a minimal benchmark against which current human action can be measured. It also establishes, again, in a modest way, the principle that people have the responsibility to consider others' needs—particularly future needs—in conjunction with their own needs. It suggests that a chain of responsible relationships replace the autonomous individual actor.

2 *World Commission on Environment and Development, Gro Harlem Brundtland, Chairman,* Our Common Future *(New York: Oxford University Press, 1987).*

3 *See, for example, Thijs de la Court,* Beyond Brundtland: Green Development in the 1990s, *trans. Ed Bagens and Nigel Harle (New York: New Horizons Press, 1990).*

A second set of criteria, also following Brundtland, provided a further filter for the essays selected for this volume. *Our Common Future* asserted that three integrated behavioral trajectories are necessary to achieve a sustainable future—ecology, economy, and social equity.[4] Often described as "the three Es" the concept is also identified as the "three Ps" Planet, People, Prosperity, or, using the term popularized by William McDonough and Michael Braungart, the "triple bottom line."[5] Whichever specific shorthand is used, the joining of environmental outcomes with economic decisions allows us to recognize the crucial role architects play in brokering material and financial choices. Similarly the regrettable results of social inequity, whereby the world's wealthiest inhabitants consume a hugely disproportionate percentage of the world's resources, leave the globe's poorest citizens scrambling to meet daily needs in ecologically degraded and degrading circumstances.

4 *Brundtland,* Our Common Future, *37–38.*

5 *William McDonough and Michael Braungart,* Cradle to Cradle: Remaking the Way We Make Things *(New York: North Point Press, 2002). See Chapter 5.*

Reinforcing this triumvirate—the green braid that infuses sustainable architectural design—has several other advantages, as well. Architects too often resist engagement with economic aspects of our projects, believing the field is too mercurial or too banal to engage. However, without the abstract leveler of economics our work can be perceived as naively extravagant or, worse, injurious to planetary health in the short and long term. Emphasizing the role of social equity in creating a sustainable planet calls into play the many architects whose work has sought to level the playing field, particularly in heavily populated urban areas. Some of these architects, typically working without specific reference to environmental consequences, have been contributing inadvertently to long-term sustainability by enhancing living conditions, advocating for economic advantages, reinforcing relatively dense yet humane living patterns and honoring cultural sustainability which often holds keys to ecological sustainability. Finally, coemphasizing ecology, economy, and equity allows the architects who have, for more than a generation, worked hard to maximize energy efficiency and to modulate solar gain to share their efforts with colleagues whose goals are shared but who lack these well-developed, highly technical environmental means. In short, the use of the green braid metaphor, requiring three intertwined threads be woven into each sustainable project, allows us to reframe our own discipline's exclusionary categorizing logic as a network of relations.

CLASSIFICATORY LOGIC AND THE PROBLEM OF PERSPECTIVE

Prominent discourses within the academy, especially the sciences, have come to rely on the persuasiveness of classificatory logic. This logic has allowed us to understand a specific idea or thing as a piece of a larger whole, and it has allowed scientists to pursue a rigorous and exhaustive mapping of all the world's knowledge. This ambitious project was prefigured by the work of Raymond Lull and other proto-scientists in the early Renaissance who laid out a tiered, prioritized model of the world's knowledge in the form of "memory theaters."[6] Once the system was established by the great scientific philosophers of the seventeenth century, new knowledge could be fit neatly within existing categories, while the categories themselves, many worked out in the eighteenth and nineteenth centuries through the development of progressively more specific disciplines, remained fixed. But an important component of the memory theater was lost in the process, and with it the ability for knowledge to relate across categories. Memory theaters were originally imagined as combinatory systems, allowing new relations to be considered through the fresh juxtapositions of ideas or things.

A parallel or, some would say resultant, development to the hegemony of classificatory knowledge is the intellectual objectification of those things studied.[7] In order to fully understand an idea or a thing, the argument goes, one must avoid feeling a sense of relation to it. Fairness and thorough scrutiny require that the scientist exhibit objectivity, not empathy, toward the thing being studied. In the current language of cultural studies, Western knowledge requires the acting subject (the scientist or "self") separate him or herself from the object of investigation (the thing or "other"). Over centuries, the perceived scientific necessity to separate self from other, subject from object, has been generalized to a societal disconnect severing the individual from a larger network of relations.

6 *See Frances Yates,* The Art of Memory *(Chicago, Ill.: University of Chicago Press, 1966).*

7 *See Morris Berman,* The Reenchantment of the World *(Ithaca, N.Y.: Cornell University Press, 1981).*

Ironically, as members of human society reinforce such separation in many ways through daily action, scientists have changed course. In the early twentieth century, physicist Werner Heisenberg unveiled his uncertainty principle which stated that an elementary particle can be observed as either a particle or a wave, depending on the role of the observer. The concept that the observer is inextricably linked with the phenomenon observed is now well established among physicists, but other branches of science, other academic disciplines, and most of the human community have not yet adjusted their/our conception of the world to privilege relation over objectification.

The implications of this change of perspective are profound. While many writers, including some cited in this book, advocate for a knowledge of relations or networks, among the earliest modern authors to capture the spirit of the transformation now in progress was philosopher Martin Buber. In his famous 1923 book-poem he described the change from "I–it" thinking to "I–thou" thinking, which suggested a reverence for those things so often considered object, thing, or other. He wrote,

> *When* Thou *is spoken, the speaker has no thing for his object. For where there is a thing there is another thing. Every* It *is bounded by others;* It *exists only through being bounded by others. But when* Thou *is spoken, there is no thing.* Thou *has no bounds. When* Thou *is spoken, the speaker has no* thing; *he has indeed nothing. But he takes his stand in relation.*[8]

Underlying all the essays in this book is the conceptual foundation Buber described so beautifully. The authors, through their scholarly research and design proposals, demonstrate and indirectly advocate for I–thou relationships between our planet and all its citizens.

8 *Martin Buber,* I and Thou, *3rd edn, trans. Ronald Gregor Smith (New York: Charles Scribner's Sons, 1958), 4.*

THINKING SYSTEMS

Over the past century, several disciplines have recognized the limitations of the metaphorical tree of knowledge on which smaller and smaller branches hold increasingly rarefied and disconnected facts. This metaphor for classification fails to recognize the impact that apparently disconnected phenomena have on one another. Brief examples from several disciplines, each of which has historically contributed to architecture's disciplinary foundation, will serve as examples.

Albert Einstein famously complained "God doesn't play dice" when confronted with theoretical anomalies that suggested the universe is constructed of interconnected probabilities rather than causal chains. While physicists over the past eighty years have worked to develop theories that incorporate the element of uncertainty, identified by Heisenberg, into what Prigogine describes as a new extended rationality, architects have generally felt more comfortable with the world as described by Einstein, if not Newton and Descartes.[9, 10] Newtonian concepts of objectivity and temporality and

9 *Ilya Prigogine in collaboration with Isabelle Stengers,* The End of Certainty: Time, Chaos, and the New Laws of Nature *(New York: The Free Press, 1996).*

10 *Cubism is thought to echo ideas of simultaneity developed by Einstein, and some authors have attributed notions of simultaneity to the work of modern architects such as Le Corbusier. See Leonard M. Shlain,* Art and Physics *(New York: William Morrow and Company, Inc., 1991), 119–138 and 187–203 and Colin Rowe (with Robert Slutzky), "Transparency Literal and Phenomenal,"* The Mathematics of the Ideal Villa and Other Essays *(Cambridge, Mass.: MIT Press, 1988).*

Cartesian spatial logics, and the mindsets they incorporate, still prevail within the discipline of architecture.

Meanwhile physicists have come to identify self-organizing non-linear systems and nonequilibrium processes that operate probabilistically. They imagine a world of multiple, fluctuating fields evolving asynchronously at the microscopic scale of dynamic systems and the macroscopic levels of biological and human activities.[11] Heisenberg said, "The world thus appears as a complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole."[12] While Peter Eisenman's explorations of scale symmetry and chaos theory resulted in a series of compelling formal studies, quantum physicists are interested in participating in the convergence of different sciences that describe life.[13] Prigogine says, "We are observing the birth of a science that is no longer limited to idealized and simplified situations but reflects the complexity of the real world, a science that views us and our creativity as part of a fundamental trend present at all levels of nature."[14, 15]

Critical theory, too, seeks to understand the world without overly simplifying it. Critical theory is a term used in the humanities to capture the intellectual skepticism leveled at the privileged position given certain philosophical and literary texts in the twentieth century. Scholars who employ methods to critique, deconstruct or otherwise challenge existing intellectual hierarchies often argue that knowledge cannot be fixed in perpetual relations of power and prestige. Rather, it migrates through multiple channels of communication within and between texts, affecting and infecting other literary works. The phenomena of migrating knowledge and argumentation, typically occurring without regard for authorized and approved routes of acceptance, was described by Roland Barthes in his 1971 essay "From Work to Text" in which he says,

> *The intertextual in which every text is held, it itself being the text-between of another text, is not to be confused with some origin of the text: to try to find the 'sources', the 'influences' of a work, is to fall in with the myth of filiation; the citations which go to make up a text are anonymous, untraceable, and yet* already read*: they are quotations without inverted commas.*[16]

Gilles Deleuze and Félix Guattari, in their often cited book *A Thousand Plateaus*, articulate the concept of the rhizome in contrast to the tree, the latter described as part of an arborescent system.

> *Arborescent systems are hierarchical systems with centers of significance and subjectification, central automata like organized memories. In corresponding models, an element only receives information from a higher unit, and only receives a subjective affection along preestablished paths . . .*

11 *Prigogine,* The End of Certainty, *162.*

12 *Werner Heisenberg, quoted in Fritjof Capra,* The Web of Life: A New Scientific Understanding of Living Systems *(New York: Anchor Books, 1997), 30.*

13 *For a review of Eisenman's chaos theory studies see Peter Eisenman, "Moving Arrows, Eros, and Other Errors," in* Precis 6: The Culture of Fragments, *(New York: Rizzoli, 1987).*

14 *Prigogine,* The End of Certainty, *7.*

15 *For a readable yet thorough lay overview of quantum physics see Brian Greene,* The Fabric of the Cosmos: Space, Time and the Texture of Reality *(New York: Vintage Books, 2004).*

16 *Roland Barthes, "From Work to Text," in* Image Music Text, *trans. Stephen Heath (New York: The Noonday Press, 1977), 160.*

Accepting the primacy of hierarchical structures amounts to giving arborescent structures privileged status . . . In a hierarchical system, an individual has only one active neighbor, his or her hierarchical superior . . . The channels of transmission are preestablished: the arborescent system preexists the individual, who is integrated into it at an allotted place.[17]

17 *Gilles Deleuze and Félix Guattari,* A Thousand Plateaus: Capitalism and Schizophrenia *(Minneapolis, Minn.: University of Minnesota Press, 1987), 16.*

Instead, Deleuze and Guattari advocate for the rhizome, saying, "The rhizome is an a-centered, nonhierarchical, non-signifying system without a General and without an organizing memory or central automaton, defined solely by the circulation of states."[18]

18 *Ibid., 21.*

The metaphor of the rhizome allows these and other critical theorists to summarize their project, to loosen systems of classification and hierarchy within what is often known as the Western literary canon.

"Ecology" is the term Ernst Haeckel coined in 1866 by fusing the Greek words for household (*oikos*) and study (*logos*) to describe the study of nature's household. In the past century the concept has grown into a field of study, based in the natural and eventually the social sciences. Ecology explicitly looks at the relationships between natural systems, studying the impacts of change in one system on another system. A key feature is the concept of an ecosystem, comprised of elements of many diverse kinds of plant and animal life brought together by physical proximity. Such an ecosystem depends equally on contributions from all types of diversity, from earthworms to large mammals, from molds to trees. Ecology helps us understand that bigger is not better, nor is harder, nor more complex better. Ideas of hierarchy, often put forward by human beings as projections of our own characteristics in an attempt to rationalize the goal of planetary dominance, are inconsistent with evidence found by ecologists. McDonough and Braungart provide an example of the necessary relation between simple and complex, small and large and high and low creatures when they describe a forest ecosystem:

Each inhabitant of an ecosystem is therefore interdependent to some extent with the others. Every creature is involved in maintaining the entire system; all of them work in creative and ultimately effective ways for the success of the whole. The leaf-cutter ants, for example, recycle the nutrients, taking them to deeper soil layers so that plants, worms, and microorganisms can process them, all in the course of gathering and storing food for themselves. Ants everywhere loosen and aerate the soil around plant roots, helping to make it permeable to water. Trees transpire and purify water, make oxygen, and cool the planet's surface. Each species' industry has not only individual and local implications but global ones as well.[19]

19 *McDonough and Braungart,* Cradle to Cradle, *122.*

Another key principle of networked knowing we learn from ecologists relates to complex causality. In ecosystems change does not happen in a linear fashion. Unlike laboratory experiments, where one factor can be evaluated in isolation, in an ecosystem a change in one factor, seemingly innocuous, can have disproportionate impacts on other elements of an ecosystem, or on the health of the ecosystem itself. Nonlinear change, the value of diversity, nonhierarchical organization recognizing the equal importance of many elements of a system and the very concept of considering species in the context of complex systems—all these are concepts brought forward by practitioners of ecology.

The three disciplines briefly recognized for their roles in developing concepts such as the network, rhizome, and system, share several common threads. First, they all espouse nonmechanistic, post Cartesian thinking. They focus on the whole rather than just the parts. They are contextual. Second, they believe ideas and matter to be nonhierarchical. The object of study is always nested within larger and smaller systems. Indeed the concept of object or point is reimagined as an episode within a larger trajectory, pattern or "line of flight."[20] All parts of the system are recognized to be equally important. They specifically conceptualize networks operating within networks. Finally, they understand that systemic behavior is influenced by feedback loops which reinforce effective trial and error behavior and quickly communicate misdirection. In this way they recognize that early experiments influence outcomes and that methodical, thorough research, because it is less opportunistic, may not provide adequate timely feedback in systems that recognize many variables.

20 *Deleuze and Guattari,* A Thousand Plateaus, 9.

THE STRUCTURE OF SCIENTIFIC REVOLUTIONS

The preceding section briefly summarized several disciplines of historical significance to architectural thinking, and fundamental changes initiated within each discipline in the twentieth century. While the work of physicists, philosophers, and ecologists described above is widely accepted within each respective discipline, architects have not yet internalized the repercussions of a changed worldview into our own broader disciplinary thinking. For example, we refer to building systems (structure and various mechanical infrastructures) using the term popularized by ecologists, but we do not typically conceive of these building systems as interrelated. We embrace critical theory as a component of architectural theory, but habitually respond in what Deleuze and Guattari would describe as an arborescent fashion—subliminally promoting hierarchies and centers, in the form of centers of influence (New York, Los Angeles, London), spheres of influence (certain old and well-established universities), and personalities of influence whose work is disproportionately published in journals and promoted by word of mouth. We often cite the value of twentieth-century discoveries in physics on the work of the Cubists and certain early modern architects, but as a discipline we understand little of contemporary math and physics. Instead we refer back to the work of Plato, Descartes, and pre-Einsteinian physics to find touchstones for spatial order and the linear causality implied in program narratives.

In short, we have not internalized the networked worldview developed in these disciplines into our own fundamental knowledge base.

As Thomas Kuhn wrote in *The Structure of Scientific Revolutions*, such a transformation rarely occurs automatically.[21] Kuhn argues that disciplinary communities typically hold tight to the status quo and only relinquish control of shared knowledge bases when community members depart or when significant external forces emerge. It is worth reviewing in some detail Kuhn's analysis of the process through which scientific knowledge changes in the academy.[22]

Kuhn first identifies the concept of the disciplinary community. This consists of the producers and validators (through the peer-review process) of scientific knowledge. In many scientific disciplines this is a specialized group numbering in the hundreds. These knowledge producers and validators share what Kuhn describes as a disciplinary matrix, with several common features. First, the disciplinary matrix captures shared symbolic generalizations, "expressions, deployed without question or dissent by group members, which provide points at which group members could attach the powerful techniques of logical and mathematical manipulations in their problem solving enterprise."[23] Second, the disciplinary matrix holds beliefs in particular models that supply the group with preferred or permissible analogies and metaphors. By doing so these models help to determine what the validators will accept as an explanation and puzzle solution. Conversely, these beliefs assist the producers and validators to determine a roster of unsolved puzzles and to evaluate the importance of each in completing the discipline's picture. The disciplinary matrix thus serves to limit the scope of further investigations. Finally, the disciplinary matrix establishes values which provide the producers and validators with a sense of community. These values are especially important "when the members of a particular community must identify crisis or, later, choose between incompatible ways of practicing their discipline."[24]

Kuhn then describes the characteristics of a scientific crisis. In general, a discipline in crisis finds too many features of reality that cannot be explained using the prevailing model. Some degree of disarray results, as alternative explanations are offered and tested. Typically, those most invested in the existing paradigm are most resistant to efforts to replace it. As a result, among producers and validators the youngest and those otherwise marginalized are less invested in supporting the prevailing paradigm and more likely to pursue alternative models. When an alternative scientific model replaces an existing model, it is known as a paradigm shift.[25]

What precipitates such a paradigm shift? First, it is important to note that it is not always evident such a shift is occurring. Kuhn's research involved the analysis of contemporaneous scientific literature now recognized as central to historic changes. He found that such changes sometimes occurred over the course of decades, generations, or even centuries. Given that such shifts

21 *Thomas Kuhn,* The Structure of Scientific Revolutions, *2nd edn (Chicago, Ill.: University of Chicago Press, 1970), especially 52–76.*

22 *Kuhn specifically refers to scientific disciplines. We are taking the liberty in this essay to apply his analysis to the discipline of academic architecture.*

23 *Kuhn,* The Structure of Scientific Revolutions, *182–183.*

24 *Kuhn,* The Structure of Scientific Revolutions, *184–185.*

25 *Specifically, Kuhn says "When, that is, the profession can no longer evade anomalies that subvert the existing tradition of scientific practice—then begin the extraordinary investigations that lead the profession at last to a new set of commitments, a new basis for science. The extraordinary episodes in which that shift of professional commitments occurs are the ones known in this essay as scientific revolutions. They are the tradition-shattering complements to the tradition-bound activity of normal science,"* 6.

may not be obvious as they occur, Kuhn suggests several precipitating factors. First, within an academic community, defenders of the old paradigm might simply retire, thus losing interest in defending the models that have made their careers. Or, evaluators might be convinced by a compelling new explanation to a vexing problem, satisfying newly identified criteria. Similarly evaluators might recognize a "neater," "more suitable," or "simpler" theory to explain a known phenomenon, replacing the older theory. Finally, a new model might appeal to an individual's sense of the appropriate or the aesthetic.

MAPPING KUHN'S ARGUMENT ONTO THE DISCIPLINE OF ARCHITECTURE

What are the ramifications of Kuhn's argument for architecture's disciplinary community? Do we see evidence that architects have begun to acknowledge the value of sustainable thinking applied to our professional discourse? Are these values being applied in a systemic, networked fashion?

First, as Kuhn describes, the people who promote an outdated paradigm leave the university and therefore no longer guard their intellectual positions. The paradigm they promote essentially fades. Currently the professors who came of age at the height of the Cold War and during a time of apparently plentiful resources are retiring in record numbers across all disciplines within the university. In many universities during this time, the demands of the military industrial complex drove the research agenda.

In addition, we are now at the beginning of the end of a generation of architects who have strategically and assertively promoted theory and work through self-publication for almost half a century.[26] While this essay does not intend to denigrate the valuable service of communicating disciplinary knowledge performed by these author/designers, it is worthwhile to note that the entire process occurred at the margins of the academic system and without a formal peer-review process. This semi-private enterprise stands in contrast to most disciplines that operate within the context of the academy.

The retirement of baby boomers who were educated to trust technology, taught using curricular models that disperse and categorize knowledge rather than integrate it, and valued objectivity over empathy leaves a substantial gap in our disciplinary matrix. This gap is perhaps amplified by the relative lack of widely disseminated, peer-validated knowledge. Taken together, this seems a classic description of a fading paradigm.

Second, Kuhn suggests that an irreconcilable paradox between evidence and beliefs emerges within a discipline. As each day's news reports, evidence of environmental change on a planetary scale is mounting. The planet is demonstrating that our behaviors are unsustainable. Because architects participate in many of the decisions that are causing exponential planetary damage, it would seem that we have no choice but to reconsider what we build and what and how we teach, along with how we live. This powerful external

26 *Such self publication, in the most positive sense of the term, would include* Five Architects, *featuring the work of the so-called New York Five (Peter Eisenman, Michael Graves, Charles Gwathmey, John Hejduk, and Richard Meier) by Arthur Drexler;* Complexity and Contradiction in Architecture, *by Robert Venturi;* Oppositions, *published from 1973 to 1984;* Assemblage, *published from 1986 to 2000;* Deconstruction in Architecture, *published by the Museum of Modern Art, co-curated and co-authored by Philip Johnson and Mark Wigley in 1987 and* ANY (Architecture New York), *published from 1993 to 2000. Indeed Philip Johnson's first effort to serve as a disciplinary validator was the very persuasive* The International Style, *published and co-curated by Johnson and Henry Russell Hitchcock in 1932.*

trigger, combined with a generational changing of the guard, suggest that we have arrived at a fertile moment in the reconstruction of architecture's disciplinary matrix.

EXISTING AND EMERGING DISCIPLINARY STRUCTURES

It is necessary to briefly inventory our discipline's structures—the community-wide cultural forms that hold our discipline's knowledge. These structures, no less than the knowledge they contain, reflect certain values and unacknowledged habits of behavior.

The academy, the colleges and universities that teach architecture throughout North America, operate in two primary modes: teaching and research. The first is the delivery of education. Through the development of curriculum and the teaching of individual courses, faculty members distribute known information and ways of thinking to students. The world of academic architecture is neatly divided into "studios" and "support courses," each taught for prescribed numbers of credit hours and contact hours, typically in a sequence leading toward an increasingly complex understanding of the design and construction of a building. The subject matter is gathered into categories reminiscent of Beaux Arts curricula developed a century or more ago.[27] These categories have been further homogenized over the past half-century, in part due to the increasing influence of national accrediting standards.[28] Scale dependent subsets of what was historically known as architecture, such as landscape architecture, urban design, interior design, are often taught as separate disciplines.

Emerging trends in schools of architecture call into question the disciplinary segregation that has developed in recent decades. For example, community design programs, an outgrowth of the social activism of the 1960s, have found new life by providing visions for rapidly growing communities as a counterpoint to the private developers who often times promote their own large-scale planning initiatives. Community design often bridges architecture, landscape architecture and urban planning and design. Design-build programs, created in response to students' desire to see their designs realized, their anxieties about the building process, and their ambitions to help the larger world attain better living standards, are flowering within many schools of architecture. These programs confound institutional structures such as the semester system and stretch legal and professional roles within the academy. They also invert the traditional hierarchy of head over hands, by requiring physical and mechanical intelligence along with design skill and academic knowledge. Finally, many programs are finding that disciplinary categories developed in the past century are cumbersome and institutionally expensive. Thus a number of special programs, such as historic preservation or sustainability are found to span scale-based disciplines while other programs, such as architecture and landscape architecture, merge. The specialists hired to teach particular courses are finding themselves placed in new

27 Felipe J. Préstamo, "Architectural Education in Postindustrial America: An Application of the Tyler Model to the Development of a Curriculum Framework." Unpublished thesis, University of Florida, 1990, 57. The five main courses shared by early twentieth century American architectural curricula: 1) drawing, 2) graphics, 3) construction, including basic science prerequisites, 4) applied construction, such as materials and specifications and 5) history of architecture.

28 Michael A. Bunch, Core Curriculum in Architectural Education *(San Francisco, Calif.: Mellen Research University Press, 1993).*

combinations to pursue integrated multidisciplinary design issues of interest to students and the public.

Research is the generic term for the second mode in which the academy operates. Produced through peer-assessed writing, theoretical and built design projects and funded investigations, research allows faculty members to develop and disseminate new knowledge to other members of the architectural profession and to the public. Here, too, architects are increasingly working as part of collaborative teams on projects that cross disciplinary boundaries. Today architects design and write about landscapes while landscape architects design structures. Subject matter crosses more than just disciplines within environmental design, as professors of architecture work with environmental engineers, political scientists, cultural theorists or health care practitioners. While such interdisciplinary work is not new, it is again newly popular.

Within the architectural profession, traditions that have been stable for half a century are being questioned by a new generation of practitioners. Entrepreneurial practices are supplementing the client-initiated professional model. While many architects still wait for clients to contact them, court clients with the help of public-relations professionals, or respond to invitations to submit credentials, others are increasingly becoming developers, contractors, website designers or manufacturers. With the help of digital technology, architectural design can be practiced by partners working across the country, or by firms working around the clock and around the globe. A new generation of architects is designing everything from furniture to towns. Perhaps the most extreme case of scale swing is the work of graphic designer Bruce Mau, whose firm's designs range in scale from books to countries.[29] And, as suggested by the work of Mau, designers not trained as architects and individuals trained as architects but not acting in a professional capacity or with the advantage of licensure, are increasingly participating in the design of the built environment.

29 See Bruce Mau with Jennifer Leonard and the Institute without Boundaries, Massive Change *(New York: Phaidon, 2004).*

The turbulence described above—in changing academic subdisciplines, in the rearrangement of professional relationships and strategies for advancement, and in the incursion of non-licensed professionals into the heart of architectural practice—all suggest opportunities for a reformulated disciplinary matrix. How does the ethic and knowledge known as sustainability work in this changing context?

Currently, some schools of architecture and some established offices see sustainability as a set of technical parameters to be applied to design projects, like paint to an already built wall. We believe a far more substantial realignment, described above as a paradigm shift, is necessary. This will require that the discipline of architecture, in its academic and professional roles, move beyond a focus on ecology and energy conservation, important though they are. Instead, we should recognize that sustainability is being taught by more than just one or two faculty members per school and valued by more than one or two practitioners with a technical bent in each office. The values and expertise of these academics and professionals is typically disconnected from a shared vision of sustainability. This broad vision is one we hope to frame through the essays within this volume.

TWO COMMON THEMES

While the proponents of sustainability currently teaching, learning and practicing come from diverse specializations—from environmental technology to architectural theory to construction methods to design—they share several common traits.

First, they understand and cultivate relationships between the "parts" such as teaching areas, disciplines, or the boxes within their institutions' organizational charts. They are comfortable with fuzzy boundaries. They establish flexible relations between self/other. They have empathy with others and therefore are committed to social justice. They have respect for our planet's ecosystems and recognize that we cannot "beat" the natural world.

Second, they engage in time-based thinking. Rather than viewing architecture as an unchanging object they conceive of architecture as the physical part of a fabric intended to change over the course of a twenty-four hour day, through changes in season, and across human history and the over the course of the lifespan of planet.

FROM RE-SEARCH TO FEED-BACK

The paradigm of networked knowing, which has emerged in physics, ecology, and literary theory, among many other disciplines, prioritizes lateral linkages over vertical chains of command. Such linkages allow nonhierarchical networks-within-networks to flourish by complimenting deficits with strengths. Like an ecosystem, this paradigm relies on redundancy. Its organization is organic and flexible, responding to challenges quickly.

A critical feature of flexible and quick response to systemic challenges is the concept of feedback. Here, too, architecture can adapt from disciplines such as physics, literary theory, and ecology and incorporate immediate learning into our production of knowledge. Currently, the results of architectural production sometimes remain unknown or underappreciated by architectural producers. Most pertinent to our subject are examples of built design projects that are not sustainable, particularly using the criteria of ecology, economy, and equity. Our discipline's evaluative methods tend to value the persuasiveness of form, and even of heroic personalities, at the expense of important feedback regarding weathering, community acceptance, budgetary limitations, and numerous other less imageable issues.

While too many designers ignore feedback that conflicts with imageable fascinations as described above, others await research that is too slow in coming or is viewed as proprietary—that is owned knowledge rather than shared knowledge. Particularly in recent decades architects have avoided consideration of diminishing natural resources, planetary change, and social inequities because of the appearance of abundance, particularly in the United States. At the same time, the feedback to architects traditionally provided by craftsmen and draftsman has been significantly reduced by changed construction practices, outsourcing, and other aspects of globalization.

This book hopes to join the growing chorus of architectural echoes, returning good information back to the producers of architectural knowledge, whether in built, drawn, or written form. The diversity of authors, designers, and projects included reflects the vast network of academics working within the field now known as sustainability. Through variety and overlap, it seeks to builds redundancy into a disciplinary system too often conceived as univocal. It seeks to reinforce an astylistic cross section of our discipline doing excellent and ethical architecture. It seeks to capture Heisenberg's "complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole."[30]

30 *See Note 12.*