Eco-logics

One could argue that much of architecture's disciplinary activities today are not just an ecology of thought. They are also concerned with the term "ecology" itself, in all of its wide-ranging definitions. But many architectural works done under the name of complexity remain "black-box" systems that achieve internal complication without external feedback. They are "hard" systems, which are unable to take into account critical but unquantifiable variables such as culture, politics, or social desires and interactions. They also do not take environment into account. By contrast, "soft" systems are in continuous exchange with their surroundings. "Building" gives way to "ecosystem," to a built organization that operates at the level of vivisystems—dynamic and complex systems that learn, adapt, evolve, and mutate in response to the feedback of other systems and to external conditions. Architecture-as-object becomes architecture-as-environment. Design in architecture, then—like that of micro-environments in biology—is not just a question of code or process but one of performance. The resultant "eco-logics" are responsive, evolving, and resilient—a field of aesthetic and affective, material and immaterial effects, or "thick atmospheres."

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> Cities happen to be problems in organized complexity, like the life sciences. –Jane Jacobs, *The Death and Life of Great American Cities* (1961)

> We ourselves are self-regulating systems; when we put out our hand for an apple, our movement sends back to us a continuous indication of where we are; similarly to the guided missile, we continuously correct for error as we seek our destination. –Gyorgy Kepes, *The New Landscape in Art and Science* (1956)

> Cities are always epiphenomenal: they are the expression of broader and more remote developments and sets of forces, specifically economic and social ones. –Sanford Kwinter, *Requiem for the City at the End of the Millennium* (2010)

In Christopher Alexander's 1965 essay, "A City is Not a Tree," he devotes a long passage to urban play:

> The playground, asphalted and fenced in, is nothing but a pictorial acknowledgment of the fact that 'play' exists as an isolated concept in our minds. It has nothing to do with the life of play itself. Few self-respecting children will even play in a playground… Play itself, the play that children practice, goes on somewhere different every day. One day it may be indoors, another day in a friendly gas station, another day down by the river, another day in a derelict building, another day on a construction site, which has been abandoned for the weekend. Each of these play activities, and the objects it requires, forms a system. It is not true that these systems exist in isolation, cut off from the other systems in the city. The different systems overlap one another, and they overlap many other systems besides. The units, the physical places recognized as play places, must do the same. In a natural city this is what happens. Play takes place in a thousand places—it fills the interstices of adult life. As they play, children become full of their surroundings.

In Alexander's astute observations, play is a fluid engagement with an urban context, responsive and evolving, that cannot be reduced to plastic "tot lots." A student of architecture at MIT, Alexander believed in the self-organization of social structures and their corresponding spatializations. To design in this terrain, then, required programming and, ultimately, evolving computer-modeled ecologies. "The intuitive resolution of contemporary design problems simply lies beyond a single individual's grasp," he wrote in *Notes on the Synthesis of Form* in 1964.

Alexander's is a systemic understanding of urban design that insists on the centrality of the subject, as a socio-cultural "ecology," and as an embedded and embodied participant in the urban ecosystem. Jay W. Forrester, head of the Sloan School at MIT while Alexander was a student and author of *Urban Dynamics* (1969), understood the city as a complex system in which feedback processes governed growth, fluctuation, and decay. Nicholas Negroponte also studied architecture at MIT (focusing on early CAD development), and founded the school's Architecture Machine Group—a combination of lab and think tank—in 1968. "It follows," he wrote in *The Architecture Machine* in 1970, "that a mechanism must recognize and understand the context before carrying out an operation… And to do this, it must have a sophisticated set of sensors, effectors, and processors to view the real world directly and indirectly." [Negroponte, 1970, 1.] Producing "an environmental humanism" needs devices "that can respond intelligently to tiny, individual bits of information that reflect each urbanite as well as the coherence of the city." [Negroponte, 1970, 1.] Programs must be able to sense and adapt to shifts in context, needs, and desires.

While MIT was a locus for operations research, cybernetics, and computational complexity, Penn, and other institutions (such as UC Berkeley), followed a different approach to holistics. This is seen in the sociological focus of Louis Kahn, Anne Tyng, Robert Venturi and Denise Scott-Brown; in Scott-Brown's intellectual allies, urban sociologist Scott Greer and cultural geographer (and founder of the influential journal, *Landscape*) J. B. Jackson; in the cultural "ecotechnology" of Thomas Hughes; in the linkage

between biology and structural geometry of Robert le Ricolais and Peter McCleary; in the ecosystemic approach of Ian McHarg and R. Buckminster Fuller; and in the notational approach to the diagram of Lawrence Halperin, which linked social, cultural, urban, landscape, and architectural elements in a dynamic system.

Much if not most of architecture's disciplinary activities today are concerned with the term "ecology" in all of its wide-ranging definitions. We know today to avoid "black-box" systems that achieve internal complication without external feedback: "hard systems" often focused on closed, autonomous technological loops that cannot take into account environmental conditions or other critical but unquantifiable variables within culture, politics, or society. With unprecedented prices for oil and gasoline, resource depletion, global climate change, and lobbying still fighting hard against investment in renewable energy technologies, we understand R. Buckminster Fuller's warning that using fossil fuels and nuclear power was a "folly no less illogical than burning your house-and-home to keep the family warm on an unprecedentedly cold midwinter night" [Fuller, 1981, xvii]. Strong policy, technology, and design techniques for energy efficiency, renewables manufacturing and use, "net positive," or "sub-zero waste" goals are urgent.

Yet the question we might ask is not only how architecture is directly engaging ecological issues at multiple scales—from environmentally responsive building skins to eco-cities—but also how the concept of "ecology" itself is redefining the ways in which we think about architecture. How might we re-imagine architecture if buildings and cities were reconceived as ecosystems themselves—built organizations that would operate at the level of dynamic, complex, intelligent, living, systems? Living systems should not be limited to fluid forms or form-generating code, as is evident in many architectures that have drawn from biological models to inform the development of evolutionary design processes. If the concept of architecture-as-object is displaced by architecture-as-environment, what might the different valences of environmental performance be within architecture, and how might they work together to create an "eco-logics"—a responsive, evolving, and resilient field of environmental, aesthetic and atmospheric effects? How might architecture be thought and reconstituted as a "soft" rather than a "hard" system? And how might we draw from theoretical models in the biological or natural sciences to inform our thinking about architecture as an ecosystem that both mediates and generates environments?

Soft systems are relational, in continuous exchange with their surroundings. They're able to learn, adapt, evolve, and change in response to feedback from other systems and their external environments. Introduced into architecture and landscape theory by Sanford Kwinter and James Corner, "soft systems" were developed in the 1960s by Gwilym Jenkins, Peter Checkland, and Brian Wilson. Their formulation within a wider context of relational thinking from the 1950s to the 1970s fell under the domain of "systems oriented thinking," which saw not objects on sites but systems

interacting with other systems in a given environment. Systems-oriented thinking studies holistic interrelationships and addresses context (physical environments, communities, climates, or socio-cultural contexts), feedback (which assumes things or systems interact with each other and their contexts), and dynamics (interactions taking place over time). Soft systems are "fluid, pliant, adaptive fields that are responsive and evolving," and have "the capacity to absorb, transform, and exchange information with [their] surroundings." [Corner, 2003, p. 63.]

Donna Haraway, in her discussion of the advent of holism in biology, notes:

> Meanings, communities, persons, organisms, landscapes, and artifacts are configured, constituted, brought into being—formed—in the relentless emergent relationality that is the world. Far from connoting a fixed type, form is formative process. No one could look at an embryo and think anything else. [Haraway, 1976/2004, p. xvii]

Haraway is interested in what she sees as the breakdown of dichotomies that had formed biological foundations for decades: "structure-function, epigenesis-preformation, form-process." [Haraway, 1976/2004, p. 17.] It is neither one term nor the other, but both. Ecosystems are *co*-evolutionary, *co*-adaptive, *co*-dependent. The analytical and developmental isolation of the object gives way to a dynamic relation between object and environment. Here, formations are embedded within a rich and unstable complex of forces and influences, and modulations of both intensive relations ("micro-architectures") and extensive relations ("macro-architectures") are equally important.

In the fields of cognitive psychology, organizational dynamics, and cognitive neuroscience, systems-oriented thinking refers to the dynamic interrelatedness of mind, body, and context: "The human mind emerges from self-organizing processes that tightly interconnect the brain, body, and environment at multiple levels." [Thompson, 2007, p. 37.] A dynamic, sensorimotor coupling with the world includes multi-modal perception, emotion, and action, with environmental contexts that include social, cultural, and historical dimensions of environs and experience. The enactive approach builds on the 1990s paradigm of "embodied dynamicism" (itself based in earlier computational models, such as neural nets), which uses the model of self-organizing dynamic systems to explain cognition as a product of "the nonlinear and circular causality of continuous sensorimotor interactions involving the brain, body, and environment." It is "the mind as embodied dynamic system in the world, rather than the mind as neural network in the head." [Thompson, 2007, p. 11.] This embodied and embedded mind is also enacted—that is, inclusive of human subjectivity and experience, "the social, historical, material worlds in which our own human drama unfolds." [Kwinter, 2008, p. 27.]"Ecosophy," Félix Guattari's term for the field of "cultural ecology," is defined as three ecologies—the environment, social relations, and human subjectivity—that together form an ethico-political inter-relation that is both global and molecular. [Guattari, 2000.] The resultant "eco-logics" is a generalized ecology that does not strive for resolution, and moves between collective action and individual

creativity. It allows for emergent orders and practices, the drift or bifurcation of a project from its initial path by the introduction of an unpredicted "event-incident." Eco-logics are practice and process, applied and theoretical, ethico-political and aesthetic. They are a course of "continuous resingularization:" continual mutation, reinvention, becoming. [Guattari, 2000, pp. 44-65.] Architecture "depends on exteriority, on a panoply of political, technological, and economic forces in situ." [Kwinter, 2010, p. 80.]

A follower of general systems theory, Fuller approached all his projects with the understanding that local actions have widespread effects: "Think global, act local." Everything, in his view, was inter-related. The word he liked to use was "omni-integrated." Fuller was a forerunner of the contemporary designers who, as science-fiction writer and technology "wrangler" Bruce Sterling puts it, "want to be active agents in a technosocial world." [Sterling, 2005, p 7.] Sterling asserts that the combination of innovation, creativity, aesthetics, and, above all, systemic thinking makes designers peculiarly well-suited to tackling the critical issues of resource depletion and climate change. "Design thinking and design action should be the proper antidotes to fatalistic hand-wringing when it comes to technology's grim externalities and potentials for deliberate misuse." [Sterling, 2005, p. 7.]

Gordon Pask wrote in 1969 that there was now "a *demand* for system-orientated thinking whereas, in the past, there was only a more or less esoteric *desire* for it." [Pask, 1969, p. 496.] Pask's influential essay, "The Architectural Relevance of Cybernetics," argued for context-driven intelligence: "A building cannot be viewed simply in isolation. It is only meaningful as a human environment. It perpetually interacts with its inhabitants, on the one hand serving them and on the other hand controlling their behavior." [Pask, 1969, p. 494.] Pask's model was a "systems of systems," or ecosystem: "The designer is controlling the construction of control systems and consequently design is control *of* control, i.e. the designer does much the same job as his system, but be operates at a higher level in the organizational hierarchy." [Pask, 1969, p. 496.]

Attacking le Corbusier's model of the house as a "machine for living in," Pask rejected architecture-as-tool:

> This notion will, I believe, be refined into the concept of an environment *with which* the inhabitant cooperates and in which he can externalize his mental processes, i.e., mutualism will be emphasized as compared with mere functionalism.

Here, in this unstable yet rich and dynamic relation between object, subject, and environment, is an "ecological" model for our field today. ◆