

# Posthumanizing Sustainability

“Reality is our game . . . If life worked perfectly, how could things evolve? Aren’t we Posthuman? . . . We act for life. Our ambitions have become the world’s natural laws. We blunder because life blunders.”—Bruce Sterling<sup>1</sup>

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Sustainability as an indexical metanarrative—with scorecards, ratings, and credentials—has finally run to an end. In this narrow view, sustainability standards have produced a static framework that ameliorates construction’s negative impact on natural environments by improving efficiencies in the use of materials, energy, water, and transportation. However, these standards overlook the diverse ecological entanglements that exist throughout a building’s territorial strata. Also, these rating systems tend to overlook the in-between-ness of buildings as they act on and are acted upon by other species, urban contexts, and climactic forces. In the commercial sphere of architectural production, we have relied on incentive-driven, human-centered approaches characterized by tables and checklists that do not offer, nor do they address fully, the interactions between emergent systems. Architectural production in an age of climatic change must arrive at approaches that address adaptive systems and biodiversity.

We attempt to reframe the theories that support the inadequacies of today’s sustainability guidelines. This paper explores emerging trends in posthuman theory and Speculative Realism, and considers their potential impact on sustainability as practiced commercially today. We attempt to offer a more fluid framework that avoids the pitfalls of linear systems and human exceptionalism by proposing affectivity, niche-driven diversification, and cohabitation in architecture. We do not address architectures that correlate human agency to the world of things. Instead, we advocate new architectural practices that consider buildings to be just one object in democratic arrangement with other environmental, technical, and biological systems. This democratized conception of nature aligns with what Bruno Latour calls “multinaturalism,” which can lead to plurality and experimentation in approaches to sustainability.<sup>2</sup>

Our purpose is to propose a more responsive approach to sustainability in architecture that avoids oversimplification and reduction to checklists. In order to clarify the qualities of this posthuman approach, we critique current approaches to sustainability practiced throughout the industry, unpack the novel operations and qualities of posthumanist theory, and then argue for a new framework where architecture—like a species of animal—blends symbiotically with its immediate ecological and urban contexts. Architects must transform the regimental constraints of the construction industry’s current treatment of ‘nature’ as a singular concern and redefine it as an adaptive, scalable, and emergent collection of ecosystems that deserves greater novelty and openness in formulating tactics toward sustainability.

### **GETTING THE LEED OUT: CAPITALISM AND THE PRODUCTION OF SUSTAINABLE BUILDINGS**

“I shall consider the physical environment as an evolving organism as opposed to a designed artifact. In particular, I shall consider an evolution aided by a specific class of machines. Warren McCulloch calls them ethical robots; in the context of architecture I shall call them architecture machines.” – Nicholas Negroponte<sup>3</sup>

The USGBC’s Leadership in Energy & Environmental Design program (LEED), the most widely accepted model for sustainable design in the United States, is an optional industry-generated regulatory system that seeks to persuade development toward greater sustainability. LEED, as Negroponte points out above, is a “designed artifact;” it operates as an incentive-based regulation system that brands a building in a way that elevates the profile of a given property by assaying its relative level of sustainability to precious metals. The level of the label is worth something to potential occupants who consider the USGBC’s LEED rating to be more valuable than a non-LEED rated property.

While the minor cost premium for acquiring a LEED rating is not an issue here, we contend with the fundamental approach LEED takes toward sustainability in architecture. The USGBC chooses to work within, and is made to be easily co-opted into, the existing building industry. On a purely temporary and pragmatic level, this is an acceptable course of action. However, it reinforces a regimental framework that may, in the broader sense, be detrimental to the ecosystems in which sustainable buildings must operate.

Clearly, other approaches exist that move beyond sustainability by considering restorative design practices or by postulating buildings as biological systems that can be grown instead of manufactured. Our paper attempts to critique the framework in which LEED operates; it then shifts attention to an alternative theoretical framework that may lead to a better response to sustainability as the profession of architecture continues to address the matter of climate change.

The vagaries, excesses, and exploits of late-capitalism demand critique. Whereas our essay could expand into a rigorous critique of capitalism’s relation to architecture today, we prefer to wage a loose critique of capitalistic systems and their relation to the production of buildings, ecologies, and climate change. Capitalism, understood as legal structures that protect the accumulation of wealth, extends from an Enlightenment narrative predicated on the sanctity of the individual, technological advancement, social

Darwinism, progress through perpetual revolution, and the exceptionality of human consciousness above material reality.

The medical industry, in its attempt to curb the effects of disease, degeneration, and illness, commodifies its remedies into pharmaceuticals, repeat therapies, and procedures that modify the body. However, the medical industry tends to overlook the broader social, economic, and environmental system of affects to which the body is forfeit. Likewise, architectural services, as a professionalized industry, comply with the same kind of limits. Architectural practice, due to the discrete nature of building upon a specific site, means that buildings are treated similarly to how the medical industry commodifies the body. In general, because of the finite resources and time constraints put toward a project, an architect must limit their time and attention commensurately in order to remain competitive and profitable. Constricted, architectural production cannot respond fully to a building's occupants, other species that may exist within and around a given project, and the surrounding environment. Therefore, in a capitalistic system, architecture is constantly born premature, malnourished, and can never develop fully.

Architecture, as a total expression of human values, cannot operate fully in the reductive context of capitalism where every aspect of real estate is commodified and measured in relation to exchange value. The built environment is stripped of sentimental value and broader ecological concerns except when the marketplace suggests that avoiding either of the two might impact the perceived stature of the brand. The ductility and adaptability of capitalism is in essence a false flexibility since its aim is always the same: competitive predation and the accumulation of wealth. Altruism is a value to be capitalized upon, but capitalism cannot reverse its motives and become altruistic. Capitalism's reversal is a philanthropy that never can quite remedy the social, economic, and environmental problems wrought by the exploits of material gain.

#### **THE LIMITATIONS OF LEED**

"So that is another rule for the whole nature of architecture: it must create new appetites, new hungers-not solve problems, architecture is too slow to solve problems."—Cedric Price<sup>4</sup>

Due to its point-based system and its adherence to denoted categories, LEED limits the range of possible outcomes. Could the work of TerraformONE or The Living be considered for LEED certification? In essence, LEED is a checklist (scorecard) to incentivize decisions that tend toward sustainability. So, to build within the confines of LEED's point-based framework will lead evidently to the making of a LEED-rated building that is as innovative as the standards tracked. Yet the range of inventive inquiry and experimentation into sustainable architecture is myriad with possibilities. Potentially better and more sustainable solutions exist far beyond the limits set by LEED. Clearly, there are experimental approaches and research-based architectural practices that explore alternative responses to building ecologies.

In other respects, LEED hinders innovation in the material and construction industry by establishing benchmarks for performance that limit material choices and construction practices. In other words, USGBC—through

the market-driving framework it establishes through LEED—constricts small-scale innovations or system-wide overhaul in the building industry. LEED, while accepted as an industry innovator, is actually a conservative force that by benchmarking sustainability, excludes diversification and otherwise radical solutions. The works of Matthias Hollwich and Marc Kushner of HWKN, Soo-in Yang and David Benjamin of The Living, Mitchell Joachim and Maria Aiolova of TerraformONE, Alisa Andrasek of Biothing, Francoise Roche of R&Sie(n), and Simone Ferracina of Organs Everywhere exemplify the diverse range of alternatives to LEED in the search for sustainable production in architecture.

LEED reduces the production of architecture to a series of decisions that can be selected independent of one another. LEED appears to forgo fundamental aspects of sustainability: ecologically-derived approaches, emergence within systems, irreversibility, and a basic understanding of the relational interdependence of agents within systems. Instead, LEED reduces sustainability to a scorecard of independent attributes and does not consider the immixing of benchmarks into a metabolic whole—like adding ingredients in a recipe while forgetting that the ultimate aim of the meal is palatability. Just as taste gets lost, so does a comprehensive definition of sustainability. That inescapable baseline of palatability is the missing framework of ecological thinking that LEED tends to miss.

We are not suggesting that all buildings enjoying LEED certification status are ecologically lame. Inescapably, all buildings foment into an ecological system. Not a single instance of construction is excluded from our planet-wide ecology. Instead, we propose that the means by which LEED strives to arrive at sustainable building might be backwards. A new understanding of sustainable architecture must be taught and made implicit in architectural education. Courses in biological processes, metabolism, codependence, and ecological systems must underpin the strategies implemented in buildings.

A building is a complex system and should be treated as a form of life. In this long quote by Steve Levy from his book *Artificial Life*, he unintentionally targets the fundamental oversight in LEED's rating system:

"A complex system is one whose component parts interact with sufficient intricacy that they cannot be predicted by standard linear equations; so many variables are at work in the system that its overall behaviour can only be understood as an emergent consequence of the holistic sum of all the myriad behaviours embedded within. Reductionism does not work with complex systems, and it is now clear that a purely reductionist approach cannot be applied when studying life: in living systems, the whole is more than the sum of its parts . . ."<sup>5</sup>

Le Corbusier once wrote that, "to make architecture is to make a creature"—implying that buildings are responsive conditions with their own metabolisms.<sup>6</sup> A building—if conceived as a creature—affects, and is affected by, conditions both inside and outside its body. But architecture is a special kind of creature. Architecture, except in special circumstances, is a niche creature. Whereas the construction industry is a mobilized force that crisscrosses the globe, all that rampant activity settles into particular spots on the planet. And once settled, a building becomes a coalescence that attracts the movement of goods and people through its particular nexus.

An architectural 'mesocosm' affects both its broader ecosystem and its ever moving collection of occupants in a limited triadic relation. Concerns over global climate change (the result of centuries of capitalism's exploits) and the emergence of new technologies have led architects from around the globe to consider ecologic, systemic and genetic approaches to architecture and urbanism. The best response to considering sustainable architecture is to look at it through the framework of posthumanism.

#### **POSTHUMANISM, SPECULATIVE REALISM, AND SUSTAINABILITY: OR THE GROUNDS FOR AN OBJECT-ORIENTED ONTOLOGY**

"Things-in-themselves? But they're fine, thank you very much. And how are you? You complain about things that have not been honored by your vision? You feel that these things are lacking the illumination of your consciousness? But if you missed the galloping freedom of the zebras in the savannah this morning, then so much the worse for you; the zebras will not be sorry that you were not there, and in any case you would have tamed, killed, photographed, or studied them. Things in themselves lack nothing, just as Africa did not lack whites before their arrival." – Bruno Latour<sup>7</sup>

Many thinkers today have abandoned the notion that humanity is the dominant species on the planet. We are just one species—a particularly dirty and destructive one—among many. Globalizing technologies and industrial production have become a new kind of nature—a third nature that intersects between our supposed 'human nature' and the nature of all other species. Posthumanism defines humanity as one being among many equally significant beings, environmental conditions, and technological objects—none more wondrous than another—but all considered in a broader relational schema than can be best understood ecologically. Posthumanism brings 'human exceptionalism' into question and relegates us to one object in a democratic arrangement with other technological, environmental, and biological objects.

Speculative Realism is a philosophical framework that explores emergence and contingency—such as exemplified by networks—and considers ethical implications and philosophical assumptions through the objectivity of mathematics. The works of both Alain Badiou and Quentin Meillassoux suppose the existence of a mathematical ontology which formulates into an object-oriented philosophy. Objectification, taking precedence over subjectification, is a main point of Alain Badiou, Quentin Meillassoux, Levi Bryant, and Graham Harman. These contemporary thinkers, who have been described as Speculative Realists, reject Kant's correlationalist philosophy—including the tenets of transcendental idealism—and instead concentrate on an object-oriented philosophy. This implies the existence of an object-driven external reality existing independent of our intentions and explainable only by scientific and mathematical means. Within this framework of axiomatic complexity that privileges qualities that can be mathematized, objects are understood as systemic agents that embody specific and localized information sets that can be evaluated through algorithmic interfaces.

Without arguing over the meaning of prepositions, there is a radical distinction between the phrases, 'building *in* nature,' 'building *with* nature,' and 'building *through* nature.' Most architects would concede that buildings are

analogical to human values. Buildings represent us and our existence in the world. Is it possible for buildings to become expressions of humanity's coexistence with the world? Even more precisely, is it possible for humanity to reenter into accord with nature through building? Or, as some architects speculate, should a greater proportion of building's design reflect natural systems and other species rather than address human expectations?

Humans tend to make buildings that negate nature. Architecture negates nature by distorting the ecological potencies within a building's environs. Is it possible to make buildings that retract humanity's deleterious impact on the planet? Or perhaps not 'negate' humanity as a living being, but as a conceptual framework. Posthumanism attempts to decenter the assumed preordination of humans as a species superior to others. Posthumanism puts into questions human exceptionality in regard to the evolution of the planet and in relation to the vast unfolding of the universe itself.

Human self-awareness is a relatively recent evolutionary phenomenon. This self-awareness has led to a curiosity about the world and humans' place within it. That question of our placement in the framework of reality led to human ingenuity and the manipulation of our surroundings in a much more impactful manner than other species. Our presumed self-importance has led to a redefinition of natural systems on a global scale. Like weather, humanity is a force that affects all aspects of the planet's fragile systems.

Our present understanding of architecture and its environmental impact, deeply centered on a decidedly anthropocentric model, denies the fundamental knowledge of how natural systems operate independent of humanity's sense of self-worth. Also, the underlying paradigm that began in the Early Modern period has led to the self-aggrandizement of a humanity that perceives itself as commanding priority over the rights to health and well-being for other creatures or ecosystems. Posthumanism shifts our focus away from ourselves and replaces that focus with inquiry into non-hierarchical systems that function both cybernetically and ecologically. It is perhaps through the interrelation of these two systems—one technical and the other living—that answers can be sought as to our place in the universe.

### **BLURRING THE BOUNDARIES OF PLACE**

"A machinic assemblage, through its diverse components, extracts its consistency by crossing ontological thresholds, non-linear thresholds of irreversibility, ontological and phylogenetic thresholds, creative thresholds of heterogenesis and autopoiesis. The notion of scale needs to be expanded to consider fractal symmetries in ontological terms."—Felix Guattari<sup>8</sup>

In *Ecology Without Nature*, Thomas Morton supposes that place is not a thing.<sup>9</sup> A building which humanizes place does not constitute into a thing but is instead a spread—a topological continuity within the whole. A building accommodates us in an environment that broadly entwines with a bigger environment. Architecture, whether we choose to acknowledge it or not, expresses our environmental orientation and destiny. Since a building is not a thing, it cannot be tallied, itemized, and classified fully without recognition of the kaleidoscope of relations evident in the topological system that a building forms with its surroundings. As Guattari points out, in the

ecological sense, scale is not fixed—it is translatable algorithmically and must be expanded so that its in-between-ness can be explored.

So LEED, which treats a building as a thing that can be subdivided into items in a checklist, misdirects our attention from the systemic nature of building, despite the inclusion of operations into its rating systems. In the end, a building is an ecology that includes human meaning while also linking to the broader ecology that undergirds any given place on the planet. Through an ecological framework, architecture can be understood as a meshwork of social forces, technical interactions, and metabolic flows. In other words, the mindset of the architect who is truly interested in sustainability should be invested in deconstructing fixed categories, seceding borders between things, and emphasizing the relations that enmesh various systems instead of classifying the systems themselves.

LEED, as a first major step toward mainstreaming sustainability, is also an impediment to developing a deeper and more penetrating understanding of the inescapable linkage between built environments and natural systems. LEED ratings employ the features of sustainability without the complex flows of multi-scalar interdependencies; neither does LEED establish a broad application of ecological thinking to the building industry or architectural production. Ultimately, things with metabolisms breathe. Building today mimic breathing like automatons that merely imitate life. But in reality, every building is always participating in the broader spectrum of geological and ecological exchange.

#### **AFFECTIVITY AND ARCHITECTURE**

“Returning to the difference between the physical and the biological, it is clear that there can be no firm dividing line between them, nor between them and the human. Affect, like thought or reflection, could be extended to any or every level, providing that the uniqueness of its functioning on that level is taken into account . . . In between lies a continuum of existence differentiated into levels, or regions of potential, between which there are no boundaries, only dynamic thresholds.”—  
Brian Massumi<sup>10</sup>

When it comes to sustainability, a relational network of affects should replace LEED’s scorecards; and the relational network should be woven into the specifics of the ecological conditions in which a building is sited. A building is a niche creature, and therefore it will only thrive in relation to its context. A building is surrounded by affects, and a building affects its surroundings. Much like the question of affect where touch implies ambiguities that arise out of asking: Which participant in the intimacy of touch completes the touching?

To say, “touché,” is to acknowledge being touched by your adversary in fencing. From the moment when “allez” is spoken to when “touché” is determined, there is a highly complex and responsive exchange between opponents. During the match, quickened combative attacks, mercurial shifts in attention, feigns, parries, incidental noises, and planned distractions form an ever-changing and emergent pattern that becomes something more expansive and entangled than if each fencer were acting out individually. The adversaries are defined more fully through the performance that one sets

against the other. Affect is not the outcome of the exchange; affect is emergent throughout the pattern of exchange. Like Guattari's machinic assemblage, things within an ecology are in a constant affective exchange with other things. Similarly, the interaction at work between two things defines each thing more fully than if those things were tallied individually on a scorecard. As architects, our aim should be to acknowledge the temporal and interactive forces at work in architecture in a manner more purposeful than merely classifying attributes and operations into a regimental framework of simple procedural linearity.

### **ECOLOGICAL INTERACTIONS AND ALGORITHMS**

"For the eyes of an architecture machine, the problem is the opposite; given a form, generate the criteria . . . learn from the criteria and someday generate new forms."—Nicholas Negroponte<sup>11</sup>

While considering the complexity of such a systemic framework based on multilayered associations, it seems appropriate to look at algorithmic processes. An algorithm, as an optimization technique, tallies items in a much different way than a checklist.<sup>12</sup> The algorithm reconditions each item in relation to its fellow inputs along an interlaced operational tree. An algorithm flows; and depending on the data it accepts into its parametric channels, the results will shift responsively. The algorithm, through which we can rearrange its operations or 'switch out' its inputs, concerns itself with the machinic interactions at work between elements. This relationally-driven instrument of mathematics and computer science better approximates the emergent characteristics found in biological systems, ecological exchanges, and weather patterns. The discrete items in a checklist cannot address the dynamic exchanges, relative proximities, and data-modifying interactions that work between inputs in an algorithm. If we are to try and redefine architecture into something sustainable, then we must forgo the patterns of thought that tend to bend reality down to a fixed and static tableau. Instead, we must adopt new ways of thought and tools that align with emergent ecological systems in which we want our works to operate.

But this means subjugating our tendency to anthropomorphize ecology, or to impose our intentions and mental limits on complex natural patterns. But also, we should not seek to see ourselves reflected in natural behaviors as though ecology were a compound intelligence looking back at us with a single face.<sup>13</sup> Instead, like the Speculative Realists suggest, it may make more sense to conceive of ourselves as objects interacting with other objects. To advance in our thinking, we should revise the ways we employ our sapience, affections, avarice, and sense of privilege that situates our human dispositions above the lives of other creatures and inanimate objects. Or for that matter, we should not seek to see human intelligence expressed in the world around us. In other words, we would do better to estrange ourselves from previous definitions of humanity, acknowledge the non-human reality as constituting our total reality, and develop a posthuman perspective.

### **CONCLUSION**

"The understanding of the connection between technology and the deepest aspects of biological necessity frequently stops at an acknowledgment of increased access to the direct material requirements of

existence. It rarely acknowledges the more abstract but arguably more fundamental underlying drive to create structures of collective organization, a principle not reducible to the action or instincts of a single organism, but an emergent drive from which all compound 'gain' or optimization can be derived."—Sanford Kwinter<sup>14</sup>

The affective touch established between organisms in a system defines both difference and solidarity, both detachment and connection, since by touching each organism displays (or acknowledges) the effects placed upon it by its other. So ultimately, what must be considered in sustainability is the affective relation between things participating topologically. We must focus on interdependent operations that reach well beyond the confines of a building's site and enter into a larger ecosphere. A building is part of an extended meshwork of relations; the pattern of forces at play in any given niche must be ascertained so as to produce an affective response through architecture and its attendant technologies. Just as with a physician's palpating touch, the architect's experiential understanding of the site's conditions should lead to understanding the site affectively—to think it, feel it, mathematize it, and act through it—as though it were a companion species and not a mere patch of ground. A new reality emerges in this framework of interaction.

If you change the playing cards, you change the outcome of the game. Also, you can play an enormous variety of games with a single deck of cards. The interaction between players, the crisscrossing exchange of cards, and the emergence of patterns of play are reified by the deck. A game cannot be played unless the cards interact. A checklist is nothing more than a tally of the card in the deck. But more than the cards in the deck itself is our recognition of the complex lines of contact that the system of play affords each time we are dealt a hand. Just as with each niche into which a building is ensconced, no two hands of cards will play out in time the same way. We must use digital tools and algorithmic processes to map a situation's ecological interactions, model its metabolism, simulate its weather patterns and climactic shifts, and aggregate this data into a comprehensible whole before we build. This approach recognizes that architecture is in close partnership with its situation and not something to be determined by a Procrustean checklist.

This weights the discussion on sustainability backwards upon the early stages of the design process and not on prescriptive outcomes. We suggest that the profession should research digital tools that can trace the long-term appropriateness of any design in order to predict how a building might distort its broader ecological system. Will the effects of that distortion release a new and enriched reality, leading to greater and more diverse speciation? If we meet places and their ecological constituents in a posthuman manner—not as capital to be exploited but as equals with commensurate rights—then we will make architecture cooperate with other agents as a complete system.<sup>15</sup> It is our place as humans to weigh the affectivity of relations between our urban selves and the ecology to which we all must cling.

Ecological principles—which are relational, emergent, and responsive to change—must exist as foremost in the posthuman mindset. Experimental architectures are today modeling systemic configurations and emergent frameworks by combining biological, social, and computational into a composite organism.<sup>16</sup> And despite all this, sustainability must also be human

to the extent that we humans must entwine our presence and our aspirations with natural systems. By questioning human exceptionalism, we can finally place humanity into a material universe fraught with complex interactions where all discordances might seek accord, and where standards are replaced finally by novelty.

## WORKS CONSULTED

Levi R. Bryant, *The Democracy of Objects* (Ann Arbor, MI: Open Humanities Press, 2011).

*The Speculative Turn*, edited by Levi Bryant, Nick Srnicek and Graham Harman (Victoria, Australia: re.press, 2011).

Philippe Descola, *The Ecology of Others* (Chicago, IL: Prickly Paradigm Press, 2013).

*The Affect Theory Reader*, edited by Melissa Gregg and Gregory Seigworth (Durham, NC: Duke University Press, 2010).

Donna Haraway, *The Companion Species Manifesto* (Chicago, IL: Prickly Paradigm Press, 2003).

Graham Harman, *The Quadruple Object* (Washington: Zero Books, 2011).

Ihab Hassan, *The Right Promethean Fire* (Urbana, IL: University of Illinois Press, 1980).

N. Katherine Hayles, *How We Became Posthuman* (Chicago, IL: University of Chicago Press, 1999).

Bruno Latour, *Politics of Nature* (Cambridge, MA: Harvard University Press, 2004).

Brian Massumi, *Parables of the Virtual* (Durham, NC: Duke University Press, 2002).

Quentin Meillassoux, *After Finitude* (London, UK: Continuum, 2009).

Timothy Morton, *The Ecological Thought* (Cambridge, MA: Harvard University Press, 2010).

Timothy Morton, *Ecology Without Nature* (Cambridge, MA: Harvard University Press, 2007).

Cary Wolfe, *What is Posthumanism?* (Minneapolis, MN: University of Minnesota Press, 2010).

## ENDNOTES

1. Bruce Sterling, "Sunken Gardens," from *Crystal Express* (New York: Ace Books, 1990) 100.
2. Bruno Latour, *Politics of Nature* (Cambridge, MA: Harvard University Press, 2004) 29 and 245 (glossary).
3. Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge, MA: The MIT Press, 1970) Introduction.
4. Cedric Price, *Re: CP*, ed. Hans-Ulrich Obrist, (Basel: Birkhauser, 2003) 57.
5. Steve Levy, *Artificial Life* (London: Jonathan Cape, 1992) 7.
6. Le Corbusier, "E.4 Caractères," from *Le Poème de l'Angle Droit* (Madrid: Círculo de Bellas Artes, 2006). In French: "Faire une architecture c'est faire une créature."
7. Bruno Latour, *The Pasteurization of France*, trans. Alan Sheridan and John Law, (Cambridge, MA: Harvard University Press, 1988) 193.
8. Felix Guattari, *Chaosmosis* (Bloomington, IN: Indiana University Press, 1995) 12.
9. Timothy Morton, *Ecology Without Nature* (Cambridge, MA: Harvard University Press, 2007) 171.
10. Brian Massumi, "The Autonomy of Affect," from *Parables of the Virtual* (Durham, NC: Duke University Press, 2002) 37-38.
11. Nicholas Negroponte, "Toward a Theory of Architecture Machines," from the *Journal of Architectural Education*, Vol. 23, No. 2 (March 1969) 9-12.
12. Dana Ballard, *An Introduction to Natural Computation* (Cambridge, MA: The MIT Press, 1997) 263.
13. The concepts in this paragraph are derived loosely from the Eugene Thacker's four stages of estrangement between human and non-human: *anthropic subversion* (human subjugation of the non-human), *anthropic inversion* (acknowledgement of the non-human), *ontogenic inversion* (knowledge that the human is an instance of the non-human), and *misanthropic subtraction* (the ultimate unknowability of the non-human). See Eugene Thacker's essay, "Black Infinity; or Oil Discovers Humans," from *Leper Creativity: Cydonopedia Symposium*, edited by Ed Keller, Nicola Masciandaro, and Eugene Thacker (Brooklyn, NY: punctum books, 2012) 173-180.
14. Sanford Kwinter, quoted in Johan Bettum's "An Interview with Sanford Kwinter: Communication as Cosmology," *Staedelschule Archive* (2003) 4. [http://www.staedelschule.com/architecture/uploads/media/070303\\_interview\\_kwinter.pdf](http://www.staedelschule.com/architecture/uploads/media/070303_interview_kwinter.pdf) (last accessed 8/3/13).
15. Philippe Descola, *The Ecology of Others* (Chicago: Prickly Paradigm Press, 2013) 3. Descola states that the distinction between nature and culture has to be reexamined by looking at those systemic sets of relationships that link humans and non-human (objects).
16. Theodore Spyropoulos, "Constructing Adaptive Ecologies: Notes on Computational Urbanism." *Adaptive Ecologies*, edited by Theodore Spyropoulos, (London: Architectural Association Publications, 2013) 21. For examples, see works from the Architectural Association Design Research Laboratory's (AADRL) Adaptive Ecologies studio.