Tomorrow's Ecologies a Synthetic Approach

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Our dreams, aspirations, and intimations provide whispers of a near future that is seamless, wild, and yet contained. How much are we willing to relinquish in order to meet the future? A philosophical approach that seeks to engage in a speculative realist agenda may help us to contend with new systems that will only increase in specificity, scope, and scale. Old notions of nature and the illusions of a dominant relationship to the biological world will not serve us well as we begin to imagine new futures. These persistent and oft times imperceptible biases hold us back as we formulate new modes of operating within an increasingly expanding and intertwined digital, biological, cultural, informational, and material space. The synthetic future we can see on the horizon looms forward from a present that is still very much grounded in the static. We can catch glimpses of a future that may be both illuminating and frightening. We can suggest that we would like our enclosures to be transformative, adaptive, evolving. What about sentience, agency, and control? What of chaos, risk, and unintended consequences? Can we abandon the reassuring tropes of modernism that assert that control and dominance assure us a temperate and insulated existence? We have become comfortable operating in linear and reliable ways. We seek to retain one foot on land while stepping out into new territories. To embody and engage with the future that we are rapidly beginning to see before us, will require a leap into conceptual and operational approaches that redefine our position to objects, materials, and environments. This way of thinking is easily dismissed as fiction. It is easier to imagine slight augmentations and gradual upgrades to our existing systems. The division between inside and outside, nature and artifice, us and them has served as a reassuring balm that is slowly cracking and revealing itself.

The increasing awareness of the incredible complexity and subtle entwinement of various phenomena and systems, forces us to drastically adjust our conception of our relationship to the world. Contemporary philosophers have attempted to grapple with these new developments and apply them to a more nuanced and speculative way of approaching the objects, relations, and substances of the world. The mechanisms and behaviors of complex systems, chaotic action, and the role of emergence all suggest that past notions of a static and linear operational agenda will not be productive as we move forward. In approaching the future there is a delicate revisionism that must occur that necessitates a broad and resilient philosophical and theoretical underpinning through which to grapple with these decisions. Things have become much less solidified, much less cohesive, and much fuzzier. This paper offers up a series of strategies that may be useful in approaching the synthetic ecologies of tomorrow.

SYNTHETIC RELATIONS

In looking at the mechanisms and specifics of a variety of complex systems and ecologies ranging in scale we begin to recognize some consistent realities. The interaction of these parts call into question traditional ideas of part and whole, complete object and subset, figure and ground. Manuel DeLanda in his book, *Philosophy and Simulation: The Emergence of Synthetic Reason*, pursues a rigorous unpacking of these mechanisms and relationships at various scales. In all of these systems he locates the presence, "of a contingent accumulation of layers or strata that may differ in complexity but that coexist and interact with each other in no particular order: a biological entity may interact with a subatomic one, as when neurons manipulate concentrations of metallic ions, or a psychological entity interact with a chemical one, as when a subjective experience is modified by a drug."[1] These layers or strata can each have their own complex dynamics and mechanisms operating at a particular physical and temporal time scale and dependent on any number or type of feedback or signal. The interaction of these layers will vary widely in differing localities, objects, and systems. A steady feature of emergent behavior in systems involves properties, tendencies and capacities. While we are fairly comfortable with working with a given set of properties for an object or system, tendencies and capacities suggest a much fuzzier reality. A tendency can be assessed in probabilistic terms but there will always exist anomalous or aberrant outcomes. Capacities suggest the potential limits of a system or behavior but do not suggest minimums or give insight into potential dysfunction. Both of these also involve a variety of interdependent exchanges of material and information, and there exists a wide terrain of indeterminacy. These properties may produce considerable anxiety. While looking at an organism from the outside, it appears as if things are orderly, constrained, and quite deterministic. But as the philosopher Timothy Morton suggests, if we look a bit closer,

> at a microlevel, it becomes impossible to tell whether the mishmash of replicating entities are rebels or parasites: inside-outside distinctions break down. The more we know the less self-contained living things become. Chemistry and physics discover how malleable and fungible things are, down to the tiniest nano-scale objects. We dream about total manipulation.[2]

This dream in its current form is predicated on an incomplete understanding of these mechanisms. When dealing with capacities and tendencies rather than actualities or set protocols, the intent would manifest in a loose but fuzzily cohesive way.

These tendencies and capacities are unpredictable because of the layered and embedded relationships present in these systems. As DeLanda suggests, "the objective reality of emergent properties can be established by elucidating the mechanisms that produce them at one scale and showing that emergent entities at that scale can become the component parts of a whole at a larger scale."[3] This relationship between part and wholes can be interrogated at many levels and involve material as well as informational and relational entities. This approach to component logic is much different than what we may be attuned to in current architectural production. Components here are understood as discrete yet integrated entities that have stable features and behaviors but are not viable or desirable as distinct stand-alone entities. The component is a subset ecology or dynamic system with its own rules and feedback mechanisms. The feedback may interact in either a positive or negative way and signal to other components in varying ways both above and below them in the overall informational hierarchy. The part or component here is understood not as a distinct unit reducible or able to be engaged singularly in any recognizable form. The whole is not simply the sum of its parts but rather the interrelationship both within the parts and with each other within any describable "whole."[4] Graham Harman in reviewing the recent philosophical work of Tristan Garcia describes his approach to living things. "Each thing can be viewed as having a self, halfway between that which is a thing and that which a thing is (in other words, its components and its situation). A living thing is "a thing that intensifies its self—that is to say, a thing which renders more intense the different [sic] between that which is in it and that in which it is."[5] This self that is differing in intensity suggests a whole that is slightly more coalesced, rather than fundamentally distinct or separate. The self maintains a relationship at multiple levels with both its component parts as well as exterior adjacencies. Ontological reductionism is meant to be avoided and one cannot simply take apart a whole and expect the composite sub parts to function outside of its system of interrelations. Marcum & Verschuuren explain that,

> the characteristics which result from the organization of the physical elements of life are not physical themselves; rather, their nature is relational and, therefore, informational. These characteristics organize and integrate novel relations between events.... Life does not obtain the necessary information from its physico-chemical elements alone, but generates it from entities based upon the codification of the relationship of these elements and their environment.[6]

Moreover these interrelations are governed by complex system dynamics and exhibit chaotic and unpredictable behavior at times. This highly enmeshed set of relationships that comprise these systems will need to originate in a drastically different way than we have approached building or design in the past.

HOMEOSTASIS

In designing or speculating on the synthetic, one needs to confront the nature of boundaries and distinctions that may comprise constituent parts and the resultant or desired whole. In a given ecology or organism a state of homeostasis involves a set of interrelated control mechanisms and involves sensing and reacting among different subsystems to regulate and modulate the balance of the whole. Homeostasis is an ideal state that is the opposite of stasis. It is in constant flux but in very subtle and nuanced ways and tied to the feedback received and given from parts of the system or subsystems to other parts as well as integrating external information. In a synthetic approach, homeostasis would be an ideal state of interactions. This is clearly in contrast to traditional static and linear assembly methodologies. It is productive to ask what is the whole? Is there a clear boundary or separation from exterior to interior, inside to outside, living versus non-living? Is there an arbitrary distinction made? Is one thing clearly coalesced into form and another not? Do these declared wholes still not have exchange, feedback, and relations with entities that lie beyond any imposed delineation?

At all levels of investigation and inquiry we could find examples to erode or weaken the legitimacy of these distinctions. The author Charles Eisenstein asks,

> Is a cell really autocatalytic? What about a human being? No. At best we can say that each contains autocatalytic systems and systems-within-systems. Each requires a "food set" of molecules that it cannot produce itself. A human being cannot produce sugar from sunlight, nor the free molecular oxygen our metabolism requires, nor a number of essential amino acids, fatty acids, and vitamins.[7]

Far more than a trite cliché of interconnectedness and interdependence, this set of relationships and the complex dynamic that exists in the feedback and interactions between them is a fundamental requirement for resilient living systems and subsystems. In thinking operationally about a synthetic approach, querying the part/whole relationship is fundamental. Eisenstein argues that,

> the resulting organism is often no more viable—that is, no more capable of survival and replication—than an isolated human organ or cell. Most life forms are so utterly dependent on symbiotic relationships with other life forms as to call into question the validity of the phenotypic definition. Without the bacteria in their rumens, for instance, cows would be unable to digest cellulose and would quickly starve. Is the bacteria part of the cow, or a separate organism?[8]

Bacteria, emotions, data, insects, weather; our current world holds a stunning multitude of discrete objects and relations which are interconnected and interacting in ways both subtle and more pronounced. These relations can be followed down to a very minute scale and followed up to ever-larger systems and interdependencies. In approaching these systems in an operational way, what is the role of determinism and control? This has resonance with design/architecture as we seek to define the operational terrain. What is getting designed and at what scale and level of system? How does one confront these requisite interdependencies and relationships? There is a certain amount of risk, uncertainty, and unpredictably that needs to be accepted.

UNCERTAIN ENTANGLEMENTS

> If there is anything monstrous in evolution, it's the uncertainty in the system at any and every point. Amazingly, the contamination of variation, speciation and so on is the reason why evolution works at all. Contamination is functional ... It's like language. For meaning to happen, language must be noisy, messy, fuzzy, grainy, vague and slippery.
>
> —Timothy Morton[9]

Issues of control and agency are paramount as we approach the synthetic. In our present design processes we cling to control. Eisenstein critiques our present relationship to technology, stating, "we can control reality only through reducing it: reducing complex ecosystems to the managed forest, the monocultured farm, the suburban lawn; reducing complex chemistries in herbs and food to just so many "active ingredients" and vitamins; reducing the complexity of human social relationships to the orderliness of a planned society."[10] This control has a variety of deleterious and unattended consequences; environmental degradation, social alienation, catastrophic outbursts of violence, or unforeseen side effects. It has been easy enough to dismiss these failures as accidents, fate, or bad luck. If instead we reorient our attention to the discrete variety of interacting parts and agents we will realize that these linear attempts at control have always been fiction. Alisa Andrasek suggests that, "recognizing the active participation of nonhuman forces in events and understanding that the agency spawns beyond just the human provide a ground for alternative ways of addressing design ecology."[11] The acknowledgement of these underlying and oft overlooked forces provides us with a whole new set of potential vectors to confront. These vectors can embody an unlimited array of potentially novel behaviors and agendas. They also may interact in any number of ways at multiple scales. The vast variety of potential states and outcomes creates a very messy situation to attempt to engage.

Francoise Longy asserts that the ontological entanglements that arise when dealing with these intricately interdependent entities reflect the messy reality of these entities.[12] Entanglement suggests a rather sloppy and nested set of relations that resists simplistic visualization or hierarchical clarity. The implicit relations in synthetic ecologies are entangled both conceptually and physically. Rather than a rigid set of explicit operations, a synthetic ecology could comprise thousands of subsystems each operating on their own set of protocols with each possessing a certain specific capacity or tendency and ability to interact with other subsystems. These subsystems could be inspired by existing biological mechanisms in terms of performing metabolic functions or sensing various substrates and reacting to other subsystems.

We could easily speculate on a range of more novel and interesting performance capacities. Instead of designing a space or topology we are instead interested in typologies or the potential of external wholes. DeLanda suggests that we specify the structure of the space of possibilities.[13] This space is not physical but rather a space of potential and involves the capacities and tendencies referenced above. He identifies these possibility spaces as well as the vast and nuanced variety of mechanisms contained within as the fundamental components to understanding and discussing emergent phenomena. These two domains give us a lot of area through which to begin to work. Mechanisms are specific actions or phenomena and can include chemical, biological and environmental processes. The possibility space as synthetic terrain provides a wide operational ground.

The nascent field of evolutionary design seeks to, "supplement traditional design methods with evolutionary algorithms that explore uncharted portions of design space."[14] The ability to search this space of possibilities and find potential optimal configurations is a compelling framework for a synthetic approach. This could be termed an implicit approach, and the design process is only loosely controlled and seeded. Preliminary research has indicated that this implicit strategy produces solutions to complex problems that in a more reliable and diverse way than explicit approaches.[15] An implicit approach requires us to develop a comfort with the opaque presentation of a myriad of subtle and often imperceptible interactions occurring. Similar to the way RNA and DNA are invisible and illegible without extensive mapping operations, they still code for protein expression that ultimately regulates phenotypic appearance and behavioral interactions at multiple scales. These surface level appearances are thus visible to us while the embedded operational mechanisms are not.

In speculating or conceiving a space of possibilities we must be open to emergent outcomes—the condition of emergence in a given set of interactions, "namely (a) properties that can be attributed sensibly to the system as a whole, but not to the parts of which it is made up, and (b) new causal powers that go beyond the causal powers of its parts."[16] Even if we had a fairly good sense of the information or rules encoded within a given system, the evolutionary mechanisms inherent to biological systems or hybrids will entail a certain amount of drift.[17] This drift would manifest as subtle or more pronounced shift in behavior or appearance at one or multiple levels and could affect features, behavior, or appearance of a given system and would by its very nature, be unpredictable.

An implicit approach to the synthetic requires an empathic approach to the subsystems embedded within. This empathy acknowledges the unsettling and yet very real opacity of the mechanisms at play and accepts uncertainty over specificity. This risk of contamination, of error, of the unsettling or the tragic has always been present. It will be helpful conceptually to embrace these darker aspects and acknowledge their presence alongside the many benefits. Timothy Morton states quite evocatively, that, "naturalness is a temporal illusion: like seasons, things seem static because we don't notice them changing, and when they do change, there is a rough predictability to the way they do so. Horror and disgust arise when the neat aesthetic frame breaks. In this ecological age we must take stock of these unaesthetic reactions."[18] It is clear that explicit linear operations and simplistic discrete assemblages are insufficient as we approach synthetic ecologies. This relinquishment of hegemonic authorship is quite hard to accept. We attempt to bargain or pursue quarter- or half-measures. Can we have a slightly emergent system? A moderately entropic ecology? This ignores the interdependency and entanglement at all levels of these complex systems. If we are to operate within these systems or approximate their robust homeostatic properties we must engage with them on these terms.

INSERTION

When approaching the densely entangled realities of biological and synthetic biological systems we need to move beyond an explicit design agenda. Instead of arising from a flat ground it may be strategic to consider how we insert behaviors, agendas, and performance into an existing series of interactions, ecologies, and negotiations. The approach to this terrain, requiring the conceptual dismantling of a *tabula rasa* or empty ground, necessitates a nuanced approach. In a resilient ecology or set of relations, the removal or insertion of additional elements may be compensated by the presence of redundancy in the system or the ability to form new interactions and operational programs. This reflects a homeostatic condition of balance that is not dependent upon fixed states but rather maintains a balance between multiple smaller interactions and is able to absorb various disturbances to the organism or ecology. In a highly diversified set of interactions the capacity to absorb new insertions seems promising. We need to determine what are we inserting to and what we are inserting. The biological theory of endosymbiogenesis may be instructive here.

Endosymbiogenesis is the process of incorporation of simpler organisms into higher organisms. Lynn Margulis, the biologist who pioneered the theory proposed that,

> serial endosymbiogenesis explains the evolution of the modern eukaryotic cell as the progressive incorporation of simpler organisms.... Normally bacteria import resistance-encoding genes from other bacteria via viruses, conjugation, and other means. And it's not just resistance. Recent studies have demonstrated that the genes for photosynthesis are also transferred horizontally among bacteria.[19]

This process evokes a multitude of design potentials for strategic operation through insertion. We could seek out and insert simpler organisms, mechanisms, and subsystems to form a robust synthetic ecology. The use of subsystem components that are already operating with an internal logic and homeostatic balance would replicate a process that is assumed to be quite common in biological assemblies over time and space. There are an intriguing number of biomedical innovations that offer some glimpse into structural and formal possibilities.

Tissue engineering techniques utilize either artificial or donor biological organs as scaffolding on which to propagate new organs. These scaffolds comprise, "intricate three-dimensional webs of fibrous proteins and other compounds that keep the various kinds of cells in their proper positions and help them communicate".[20] Soon it seems that we will have a vast and divergent tool kit of potential biological and synthetic hybrids that perform a multitude of functions. By assembling these components into larger interrelated, entangled systems perhaps we can speculate and generate novel hybrid ecologies which exceed the most enticing promises of their embedded parts.

LATENCY

We have acknowledged the inherent uncertainty that exists in emergent systems. The diversity of interactions contained within as well as evolutionary mechanisms combines to elicit a variety of possible outcomes and potentials. Latency offers another conceptual strategy for engaging the synthetic. By embedding a series of latent operations one would provide the broadest possibility space—one not just relying on random mutations, accumulations, and insertions but instead building on previously evolved intelligences embedded in the system. A flexible toolkit of possible latent behaviors and functions could respond to mutations or a given set of environmental thresholds or events. Understanding that linear control and fixed formal expressions will not be very resilient, we need a way to have a range of behaviors and performances embedded into any given ecology. Latency offers us the potential to further expand

ENDNOTES

1. Manuel DeLanda, (2011). *Philosophy and Simulation: The Emergence of Synthetic Reason* (*Kindle ed.).* New York: Continuum, Intro chapter, par.9.
2. Timothy Morton (2010). *The Ecological Thought*. Cambridge: Harvard University Press, 36.

our possibility space and provide a more robust and variant performance. We can embed both intentional insertions and more latent behaviors to maximize the synthetic ecologies' survival. The concept of an atavism is useful here. An atavism is a throwback or reversion to an earlier state of being or an embodiment of a previous operational state. It has been speculated that cancer is an atavism from our previous genetic operating system. Davies and Lineweaver detail this genetic upgrade:

> By 600 million years ago, ... the genetic apparatus of the new Metazoa 2.0 was overlain on the old genetic apparatus of Metazoa 1.0. The genes of Metazoa 1.0 were tinkered with where possible, and suppressed where necessary. But many are still there, constituting a robust toolkit for the survival, maintenance and propagation of non-differentiated or weakly-differentiated cells—'tumors'—and when things go wrong (often in senescence of the organism) with the nuanced overlay that characterizes Metazoa 2.0, the system may revert to the ancient, more robust way of building multicellular assemblages—Metazoa 1.0. The result is cancer. In evading one layer of genetic regulation—turning proto-oncogenes into oncogenes—cancer mutations uncover a deeper, older layer of genes that code for behaviors that are often able to outsmart our best efforts to fight them.[21]

Cancer as atavism is of a genetic variety, relating to instructions or operational logics that engage in an alternate regulatory response. In synthetic ecologies the inclusion of atavisms and latent potentials could compose yet another layer. Morton describes that, "organisms are palimpsests of additions, deletions, and rewritings, held together mostly by inertia."[22] The palimpsest is continually overwritten but traces of the old remain, and new relationships may emerge between the two. The more we are able to let go of singular narratives and clean categorizations and accept and encourage the chaotic and very messy realities of these operations, the better to approach the synthetic.

This paper has avoided the inclusion of specific architectural precedent because at the moment, while there are very tantalizing whispers of the beginning of deployment of the biological synthetic into our built fabric, we remain quite far from a technological toolkit to approximate synthetic ecologies. Architects such as Francois Roche, Phillip Beesley, and Zbigniew Oksiuta explore the boundaries of spatial enclosure, and each seeks to interrogate new material and biological systems and their potential impact on architectural matter. The synthetical hybrid work of this vein will surely increase as our access to new methodologies from science and technology further infiltrate our discipline. In embracing the darker and more unsettling aspects of biological systems we can begin to speculate our possible engagement with the synthetic realities of tomorrow. ◆

3. DeLanda, *Philosophy and Simulation: The Emergence of Synthetic Reason,* Chapter 1, par.9
4. James Marcum, & Gerard Verschuuren (1986). Hemostatic Regulation and Whitehead. *Acta Biotheoretica*, 35(1-2), 123-133. doi: 10.1007/BF00118370
5. Graham Harman, (2012). Object-oriented France: The Philosophy of Tristan Garcia. continent., 2.1, 6-21. Retrieved from http://continentcontinent.cc/ index.php/continent/article/viewArticle/74, accessed 9/11/12, 14.
6. Marcum & Verschuuren, Hemostatic Regulation and Whitehead, 124.
7. Charles Eisenstein, (2008). *The Ascent of Humanity.* Retrieved from http://www.ascentofhumanity.com/chapter6-6.php, accessed 9/14/2012
8. Eisenstein, *The Ascent of Humanity*. Chapter 6-6.
9. Morton, *The Ecological Thought*, 66.
10. Eisenstein, *The Ascent of Humanity,* Chapter 6-3.
11. Alisa Andresek, "Open Synthesis//Towards a Resilient Fabric of Architecture", Log 25 Reclaim Resi[lience]stance// (2012), 54.
12. Francoise Longy. (2009). How Biological, Cultural and Intended Functions Combine. In U. Krohs & P. Kroes (Eds.), *Functions in Biological and Artificial Worlds: Comparative Philosophical Perspectives* Cambridge, MA: MIT press. 58.
13. DeLanda, *Philosophy and Simulation*, Intro Chapter, par.8.
14. Wybo Houkes, (2009). The open border: Two cases of concept transfer from organisms to artifacts. In U. Krohs & P. Kroes (Eds.), *Functions in Biological and Artificial Worlds : Comparative Philosophical Perspectives* Cambridge, MA: MIT press. 237.
15. Houkes, The open border: Two cases of concept transfer from organisms to artifacts. 232.
16. Peter Kroes, (2009). Technical artifacts, Engineering Practice and Emergence. In U. Krohs & P. Kroes (Eds.), *Functions in Biological and Artificial Worlds : Comparative Philosophical Perspectives* Cambridge, MA: MIT press. 280.
17. Pablo Schyfter, (2012). Technological biology? Things and Kinds in Synthetic Biology. *Biology Philosophy*, 27, 29-48. doi: 10.1007/s10539-011-9288-9, 35.
18. Morton, *The Ecological Thought*, 44.
19. Eisenstein, *The Ascent of Humanity*, chapter 6-8.
20. Henry Fountain, (2012, September 15). Body builders, a first: Organs tailor-made with body's own cells. *New York Times*. Retrieved from http://www.nytimes.com/2012/09/16/health, accessed September 17, 2012
21. Paul Davies and Charles Lineweaver. "Cancer tumors as Metazoa 1.0: Tapping Genes of Ancient Ancestors" 2011 *Phys. Biol.* Volume 8, Issue 1, accessed September 10,2012, DOI:10.1088/1478-3975/8/1/015001
22. Morton, *The Ecological Thought*, p. 64.