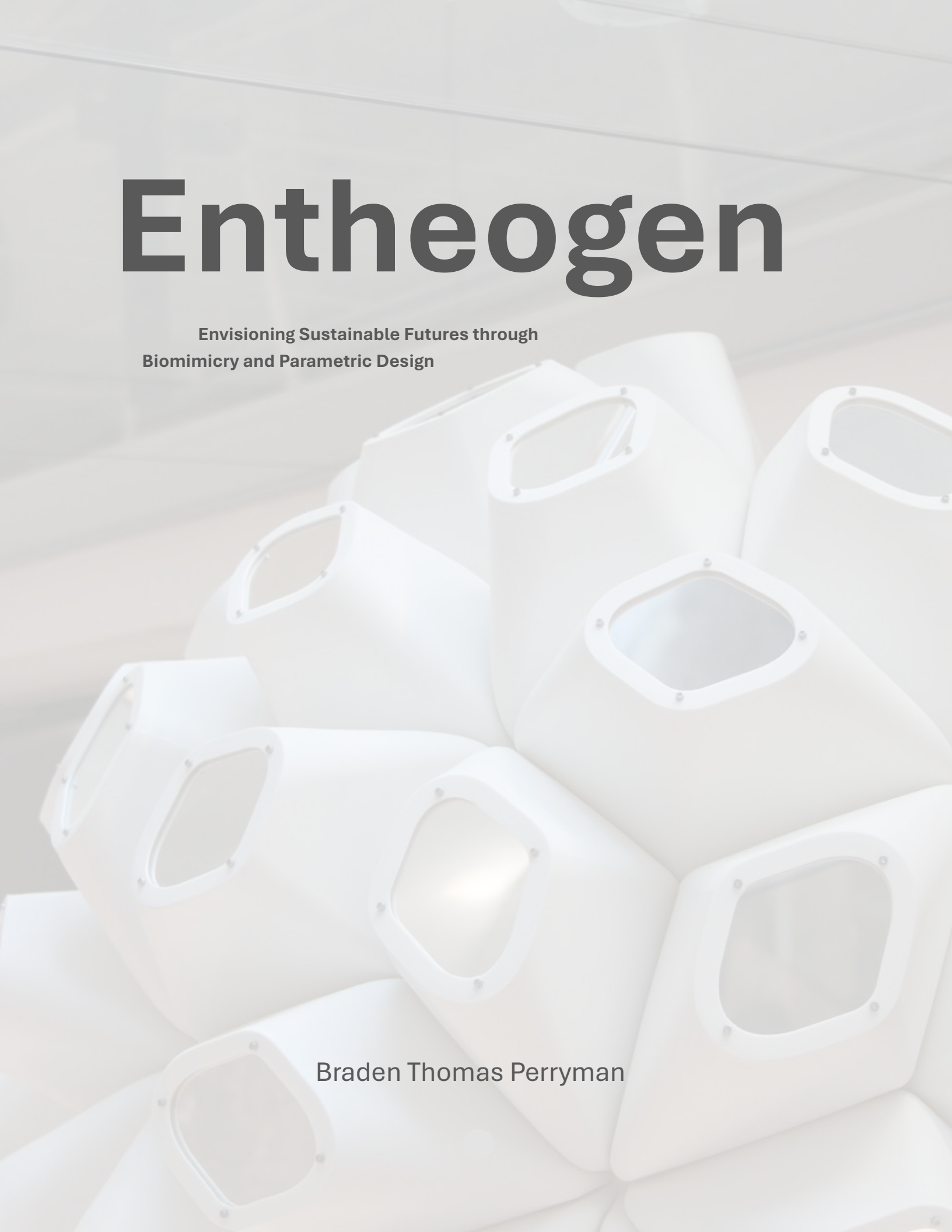
Entheogen

Envisioning Sustainable Futures through Biomimicry and Parametric Design



Braden Thomas Perryman

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Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

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Abstract

Entheogen, which roughly translates from ancient Greek as “becoming the divine within,” is a creative process envisioning sustainable futures with biologically inspired sculpture. Biomimicry is a design process that derives aesthetic and functional inspiration from evolved forms found in nature. Biomimicry is geared towards sustainability because it mimics evolution’s imperatives of ecological fit, material efficiency, and minimal waste. By mimicking evolutionary processes, parametric design tools such as Rhino+Grasshopper serve as powerful technological co-collaborators in the design project of biomimicry. Rhino+Grasshopper mimics evolutionary processes by allowing users to code systems where shifting input parameters iteratively evolves output forms in real time.

I posit that aesthetic discourse is a developed human technology. The function of this technology is to serve as a mirror, reflecting the current conditions and values of society, and in doing so, it allows us to better see ourselves. Yet art can do more than show us how to see ourselves in the present: it also allows us to envision and unlock possible futures. Aesthetic discourse has its own zeitgeist that is often theoretical and ‘out in front of’ slower-moving disciplines that directly shape our built environment, such as architecture and engineering. In this way, I hope that my biomimetic art practice may serve as blueprints or wayfinding stones for future architects and engineers, revealing possible pathways towards a more harmonious relationship with each other and with nature – a harmony that is at the essence of “becoming the divine within.”

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General Audience Abstract

Seashells, pinecones, coral reefs, beehives, flowers, and fruit are beautiful to humans. I posit that these forms appear beautiful to us because they play some significant role in humanity's future and are calling out to us to guide us towards this future. By celebrating the beauty of natural forms, my creative practice directs our attention back to the simple elegance of these evolved structures. It is only through paying close attention to these forms that we may unlock their secrets, which may show us how to construct our built environment in ways that are more sustainable and environmentally just.

Recognizing the beauty, agency, and intelligence of nonhuman lifeforms reveals this humbling fact: humans are but one small piece of a much larger cosmic puzzle. By recognizing that we are not the center of the universe, we may begin to heal our relationship with the world – and by living more harmoniously with the world, we also stand to heal our relationships with each other. This pathway towards harmony is at the essence of my creative practice. *Entheogen,* the title of my thesis, roughly translates from ancient Greek as, 'becoming the divine within.'

Acknowledgements

Where do I begin? I could not have completed this thesis without significant guidance from my family, friends, collaborators, and wonderful faculty members in SOVA. If I have learned one thing through this process, it is that humans, as individuals, have a limited capacity to affect change. Collectively, we are unstoppable. I would like to express my sincere thanks to the following members of my community:

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Introduction: Beauty in Nature

Figure *1* - a conch shell, a pinecone, and an asparagus flower.

My fascination with nature stems from memories of my childhood, where in playing outdoors I imagined entire worlds existing on each fallen seed pod of a bald cypress tree, and in each ridge and cavity of a conch shell nestled in a sandbar. Now, in my adulthood, I have gained the language to describe my more intuitive childhood fascination with the beauty of natural forms.

These forms are parabolic*,* exhibiting structure and complexity. By structure, I refer to a cohesion that withstands environmental pressures, evident in trees whose branching roots and limbs flexibly distribute dynamic loads, despite heavy winds, ice, and rain. By complexity*,* I refer to the mathematical beauty of spiral-structures in conch shells, the radial symmetry of a sunflower's seeds, or the orderly accumulations of cells in a paper-wasp's nest. By parabolic*,* I refer to double-curved surfaces such as those that compose the hydrodynamic forms coral reefs and the aerodynamic forms of winged maple seeds.

Each of these organisms, and their physical characteristics, are the result of millions of years of evolution through natural selection. The bodies of these organisms are their *technologies* – their negotiations of material reality, the physical embodiment of generations of accumulated wisdom. Yet these organisms did not evolve their beautiful structures with any understanding of aesthetics – only the evolutionary imperatives of survival, genetic propagation, and better fit in ecological collaborations with other organisms and the elements that compose their environments.

So why is it that the evolved structures of some organisms stand out over others to us humans? I posit that these forms appear beautiful to us because they play some significant role in humanity's future and are calling out to us*,* imploring us to pay attention. All that remains is for us to listen, so that they may guide us towards this future.

Figure *2* – Left: a fragment of ivory bush coral found on Holden Beach, North Carolina. Right: the fruiting body of a crown-tipped coral fungi found growing in the woods near Boone, North Carolina.

Flowers, seashells, and pinecones are easily recognized as beautiful due to their proximity to human life unfolding in the forests, fields, and shorelines. Yet many organisms, such as corals, exist deep under the sea, while others, such as fungi, reside mostly underground, deep in the woods. Corals and fungi live most of their beautiful and complex lives entirely out of the view of humankind – yet we have as much to learn from them as we do from sunflowers and seed pods.

Distance is not the only barrier to overcome when seeking inspiration from nature – we have biases towards nearer organisms, such as wasps and snakes, which we see as dangerous and undesirable pests. These biases prevent us from seeing these organisms for their own kind of complexity and beauty. As an introvert who often feels like an outsider among humans, I feel a natural affinity for both unseen and misunderstood organisms, and I seek to tell their stories through my artwork.

In my creative practice, I attempt to comprehend and celebrate the underlying mathematical structure of these organisms through sculpture. Designers call this work 'biomimicry,' or the translation of evolved organic forms into the realm of human concerns. Importantly, the project of biomimicry is not classical realism through simulation and faithful representation of appearances, but rather a new realism that celebrates the very imperfect, human act of translation. Biomimicry is humanity's effort to actively emulate and rejoin the process of evolution through mimesis and mutation.

My approach to sculpture continues the play I began as a child, where I solved puzzles and assembled modular blocks. Assembling and disassembling model kits lent me a predilection towards thinking about the world structurally and modularly - seeing wholes for their parts, and parts for their wholes. Much of my satisfaction in playing with these kits involved not just building them according to their instructions but in being able to at any time deconstruct the entire assembly and reconfigure its parts.

This desire for flexibility has seeped into my practice, where I use standardized connective hardware, such as nuts and bolts, rather than adhesives or welding, to attach prefabricated interlocking cells into larger modular structures. Serendipitously, this way of building resonates particularly well with natural structures, which are typically cellular and modular. Sculpture is my way of continuing to play and explore the world, as well as my way of showing the universe – as if by votive offering – that we are paying attention to and appreciating its wonder and beauty, even if only in our own imperfect way.

Author's Note

In each of the four sections that follow (Creativity, Technology, Biomimicry, and Responsibility), I will discuss one aspect of my thesis. In each of these sections, I construct a theoretical framework by referencing the work of philosophers, sociologists, anthropologists, creative practitioners, activists, and art historians. By outlining each of these four theoretical frameworks, I hope to better set the scene of each given topic.

Each of the four sections is further articulated with sub-sections that address how my sculptural practice connects with and further explores some of the ideas and concepts outlined in that initial section's theoretical frame. Each of the four sections contains projects that have common threads but explore these threads in different directions.

The four sections and their subsections are arranged by topic, rather than linearly or chronologically, because I am not engaged in the project of linear storytelling. Rather, I attempt to weave a circular story that is *about*[1] my central thesis, which begins to emerge upon reaching the conclusion, residing somewhere within the intersection of Creativity, Technology, Biomimicry, and Responsibility.

1. Creativity

Our bodies' complex nervous system allows us to access reality, yet in doing so it delays our immediate reaction to stimuli, increasing the indeterminacy of our actions and reactions.[2] When we further rely on equipment to observe reality, we add another layer of delayed reaction, becoming further removed from the 'really real.'[3] In essence, the effect of our bodies and our technologies is the delocalization and de-temporalization of humans from reality.[4] Our de-temporalization enables us to envision and manifest possible futures rather than simply react in a mechanistic way to present conditions. This *emergent creativity*, or free will, is a powerful tool, but when followed without intent, it reinforces our delusions of an entirely synthetic, anthropocentric reality.[5]

The future of life on earth is up to us – but in what kind of future do we wish to live? And how may creativity and art help us to develop a clear vision of this future? Various trains of new materialist thought posit that humanity is entirely constituted through technologies.[6] In this expanded sense of technology, art, or aesthetic discourse, is also a developed technology that allows us to show each other how to see. Art can be thought of as materially embodied metaphysics, a visual form of philosophy engaging with questions about existence, beauty, and the nature of reality.[7] Every creative act is an inherent proposition that states: *the world, as it is, is incomplete. By bringing this idea into the world, I attempt to make the world more complete, closer to how it should be*.

There is discourse in creative communities that posits that ideas find their form through artists by taking ahold of them and becoming an obsession. Rick Rubin, a prolific producer of popular music, argues that the responsibility of artists to their society is to be open, to engage in deep listening, and to serve as a conduit, channeling ideas into reality when their time has come.[8] This concept is echoed again by science fiction writer William Gibson, who argues that ideas enter the minds of humans when their material existence becomes necessary within certain social contexts. Gibson calls this teleological concept *steam engine time,* musing on the aeolipile invented by Hero of Alexandria in the first century CE, which was in essence a steam engine developed nearly 1,600 years before the steam engine which spurred the industrial revolution was developed by Thomas Savery, Thomas Newcomen, and James Watt.[9]

Gibson, Rubin, and others posit that ideas always pre-exist, in some ideal reality that is overlaid upon material reality, and that it is humans' emergent creativity that allows us access to this ideal reality. Ideas simply 'arrive on the scene,' in the minds of humans, when the right social conditions occur. Yet equally as important as receiving these ideas is understanding the social conditions and articulating these ideas in such a way that responds appropriately to contemporary discourse. Hero's discovery, after all, did not initiate an industrial revolution in the first century CE, for it was not yet *steam engine time*. As activist and community organizer adrienne marie brown states in *Emergent Strategy*,

“There is a conversation in the room that only these people at this moment can have. Find it.”[10] I have come to believe that it is up to artists to find and to further this conversation by serving as a bridge between their society and ideas whose time has come.[11]

1.1 […] 0, 1, 2, 3, 4 […]

Figure *3* – Four photographs from *[…] 0, 1, 2, 3, 4 […]*, a collaborative body of work created with Romona Maturano.

0, 1, 2, 3, 4, is a multimedia body of work created in collaboration with Romona Maturano, where we explored the concept of relinquishing authorial control to our materials and process to channel ‘pre-existing ideas’ that insisted on speaking through us. Working iteratively, we began with favorite photographs we had both taken - of street signs, tree bark, textures, graphic designs, and sculptures. We printed these images and physically collaged them, introducing rips, tears, cuts, and folds into the composition. We then scanned these collages and flattened them, sending them through illustrator’s image trace function. We then printed these scanned and digitally manipulated images and subjected them to an additional round of collage and deterioration. We then scanned these second-round collages, flattened them, and digitally manipulated them further.

Next, we projected images of these collages into a photography studio and onto a variety of assembled props, including fabric, pedestals, and laser cut panels generated from the linework of the collaged photographs. In the projected installation, light splashed and flowed across surfaces and our bodies, transforming everything it touched. We captured photographs from this performance/installation, shown above. Our iterative process yielded these digital images, alongside physical artifacts including a series of paintings we created based on projection performance photographs, and a handmade zine (mini magazine) documenting our process and design philosophy. See this endnote for a lengthier discussion between Romona (R) and I (B) on our philosophy and methodology.[12]

Though our intent was to remove intent, it became clear to us that even as simple editors or conductors, our biases and authorial intent crept into how we ended up portraying these emergent artworks – down to where we pointed the camera, or how we cropped an image in-post. Though the ideas that flowed through us were pure and inhuman, our very 'registering' of these flows was a human act demonstrating our human biases. Our decision to manifest these moments in ways that are recognizable to others 'as fine art' further reveals our own subjective systems of values and norms. The body of work was as much a product of cosmic flows as our own yearning to be recognized as "the artist" by our peers and our institution, and our desire to share what we had found with others. While our original concept was perhaps flawed from the start – there is no true escape from our humanity, and any pretense of objectivity, of simply 'registering the cosmic flows as a simple windsock' itself fails to acknowledge the very human process of registering – we nearly entirely removed of our own autobiography from the artwork.

While signs, symbols, textures, and patterns are present in the work, and while compositional choices were made to create scenes that were aesthetically compelling (both are aspects of the work that reveal our own situatedness in the cultural values and biases of our contemporary society), the visual language that we arrived at was exceedingly open, vast, and oceanic. We arrived at some of the most raw artwork either of us had made – characterized by color and form – scenes that were so novel and non-specific that they appear as if seen through a child's eyes – a bewildered soaking-in of stimuli without prior understanding, a true cosmic soup, served up for the viewer as fine art.

1.2 Intersection

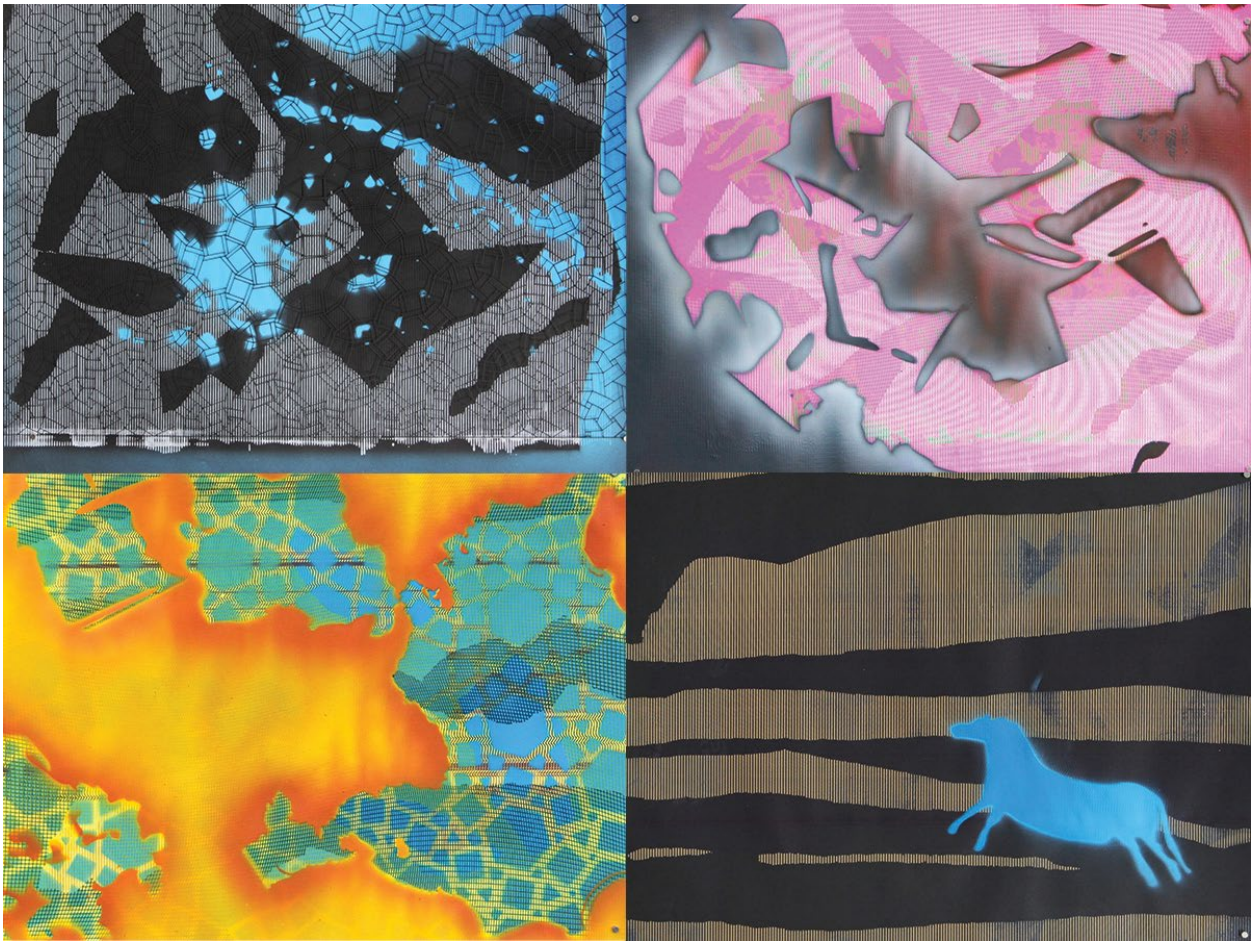

Figure *4*– Four screenprints from *Intersection*, a collaborative body of work created with Sarah Hammer.

One significant collaboration where I explored *emergent creativity* was in the project titled *Intersect*, where Sarah Hammer and I created a series of mixed-media works on paper composed of layers of screenprints and air-propelled paint. At the time, Hammer explored the emergent qualities of moiré patterning as part of her M.F.A. thesis research. Moiré patterning is a phenomenon that emerges when two screens or grids overlap and then slightly shift or rotate off-center, yielding a 'banding' effect that was not preset in either of the original screens. Hammer contrasts the rigid, mathematical quality of the original grids with the loose, unpredictable, hallucinatory quality of these patterns.

Moiré pattern matrixes that emerge from overlapping screens serve as strong metaphors for our intersectional identities, which are themselves emergent phenomena resulting from the complex and situational interplay between our identities and the identities of those around us.[13] Hammer likens moiré patterning to queerness, defined as a misalignment felt by queer people within their surrounding heteronormative society. Hammer argues that like moiré, queerness is a joyous, disorderly emergent phenomenon

that arises, somewhat inexplicably, and in spite of, the orderly, binary nature of our cishet sexual and gender socialization.[14] Hammer argues that like moiré patterns, our 'selves' are both relationally construed (requiring two or more grids), contextually dependent (requiring an off kilter shifting), and always in the process of becoming.[15]

My contribution to the body of work was through the process of laser-cutting stencils and using a High-Volume, Low-Pressure (HLVP) spray gun to apply paint in layers on top of, underneath, or between Hammer's layers of screen prints, concealing the moiré in some places and revealing it in others. We used laser laser-cut stencils I made from print-bed scanning and image-tracing the ever-flaking and shedding tree-bark of Sycamore trees. We used these stencils to create more 'organic' edge-textures, serving as compositional frames or 'islands' that we used to direct attention towards certain chunks of moiré, while eliminating or obscuring other elements of the composition.

This way of working in accumulative layers reminded me heavily of my studies of physical anthropology, particularly my study abroad experiences conserving mosaics in Macedonia. This sort of 'reverse archaeology' instilled in my mind this gradient between archaeologists – those who uncover and interpret ancient material culture – and artists – those who create and uncover present material culture. This dichotomy compelled me to explore ancient signs and symbols, in particular, imagery from humanity's earliest artistic creations, the cattle and horses painted on the cave walls at Lascaux, and the impressions of hands painted on the walls of the Cueva de las Manos. I was interested primarily in this moment that humanity began to understand themselves as distinct from other forms of life – the moment we began to use paint and cave walls to better understand ourselves and our relationships life-sustaining sources of food such as wild cattle and horses.

Intersect serves as a visual embodiment of identity formation that occurs at the intersection of all our relationships, with each other, with other life forms, and with our technologies. One of our main conversations was this concept of queerness – that of not fitting in, not belonging to one's surroundings. Perhaps early cave painting was humans' dawning recognition of our own inherent queerness – we became aware of ourselves as somehow distinct from our surroundings and have since been grappling with this awareness of difference. Perhaps art was our first and most fundamental way of externalizing ourselves to understand ourselves, in coming to terms with this unbelonging. Regardless, *Intersect* serves as a material record of the conversation between Sarah and I – a conversation that only we, in that moment, could have had.

2. Technology

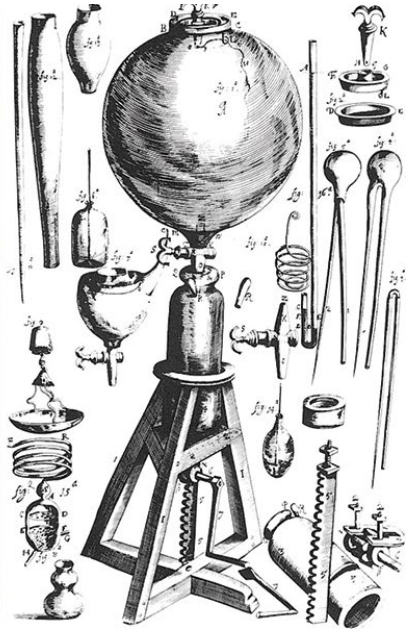

Figure 5 – Right: *An Experiment on a Bird in an Air Pump,* an oil painting completed by Joseph Wright of Derby in 1768.[16] Left: *An illustration of the Air Pump,* drawn by Robert Boyle in 1661. [17]

Much of our development of technology stems from our attempts to tame uncertainty.[18] To make sources of food more predictable, we developed agriculture, and to make access to shelter more predictable, we developed sedentary settlements.[19] Today, we use technologies to predict the trajectories of climate change, or the stock market. Yet through developing sophisticated systems that seek to increase stability and certainty, we have further delayed immediate reaction to internal and external disturbances, paradoxically increasing uncertainty and unpredictability in these same systems.[20] Archaeological evidence suggests that humans have been grappling with this feedback loop since the first sedentary settlements.[21] Within the context of humans and their technologies, *emergence* can be defined as this cascading unpredictability whose unruliness defies attempts to be made certain.[22]

Technologies are directional in that they are the products of certain pasts and lead us towards certain futures. Technologies intersect with flows of human thought and social conventions, lending them destructive or creative potential. The technologies we develop enable us to perceive reality in new ways, uncovering knowledge we were previously unaware of. In doing so, these instruments become agents in the creation of truth.[23] Physical anthropologist Ian Hodder investigates the case of Boyle's gas pump, which rendered air visible to us, radically reshaping our understanding of what we had previously conceived of as "empty" space. As a scientific instrument, the gas pump shifted our conception of reality as deeply as the telescope, which enabled us to understand humanity

as infinitesimally small in the cosmic scheme, or the microscope, which allowed us to see the incredible complexity of the cells which comprise the human body.[24]

Hodder describes the relationship between humans and their technologies as characterized by both *dependence* and *dependency*. Certain futures "depend" on technologies' capacity to enable us to do certain things – this "dependence" slips into "dependency" when we come to rely on technologies to realize these futures, becoming entrapped by their enabling capacities.[25] Through using advanced technologies to create artwork, I have come to understand that tools eventually restructure our understanding of the nature of reality, determining not solely how (or what) we see, but the direction in which we look, the questions we ask, and what phenomena we see as worth our attention.

Figure 6 – Left: a well-loved paintbrush floating in a bucket of water that reflects the sky. Right: a fingerprint on the lens of a DSLR camera. Painting and photography are both key elements, but not final outputs, of my creative practice.

Again, aesthetic discourse is itself a technology – it is how we show each other how to see both our present circumstances and future possibilities. Since the beginning, new creative technologies have disrupted traditional ways of thinking and making, a phenomenon well-articulated by Walter Benjamin in *Art in the Age of Mechanical Reproduction*.[26] But while photography radically changed the way we think about painting as image-making, it ultimately did not replace painting. For a time, painting became surreal, then abstract, and then minimal, but it has not been replaced, as any contemporary artist or art critic can attest to. Indeed, even realist representation persists in contemporary painting. So, while new creative technologies invariably change the way we think about our existing ways of making, they do not ultimately replace traditional ways of

making – they simply change the social context in which creation occurs, and the social role of traditional forms of art.[27] In *The Phaedrus*, Plato states,

> "They will cease to exercise memory because they rely on that which is written, calling things to remembrance no longer from within themselves, but by means of external marks." -Plato, writing from the perspective of Socrates in *The Phaedrus,* completed c.a. 370 BCE[28]

Above, Plato remarks on how writing will inevitably degrade our capacity to remember stories, as we come to rely on writing to "externalize" our memory.[29] However, writing has not replaced oral storytelling – it has simply changed its role in society. Oral storytelling persists around campfires and bedsides, in our places of worship, and through the conversations we have every day. Many of us can agree that in hindsight, writing has opened many more possibilities for humanity than it has closed. This discourse surrounding the social ramifications of new technologies is not itself new – as Plato attests, we have been grappling with this disruption since the beginning of recorded history.

2.1 Parametric Design and Computer Aided Manufacturing

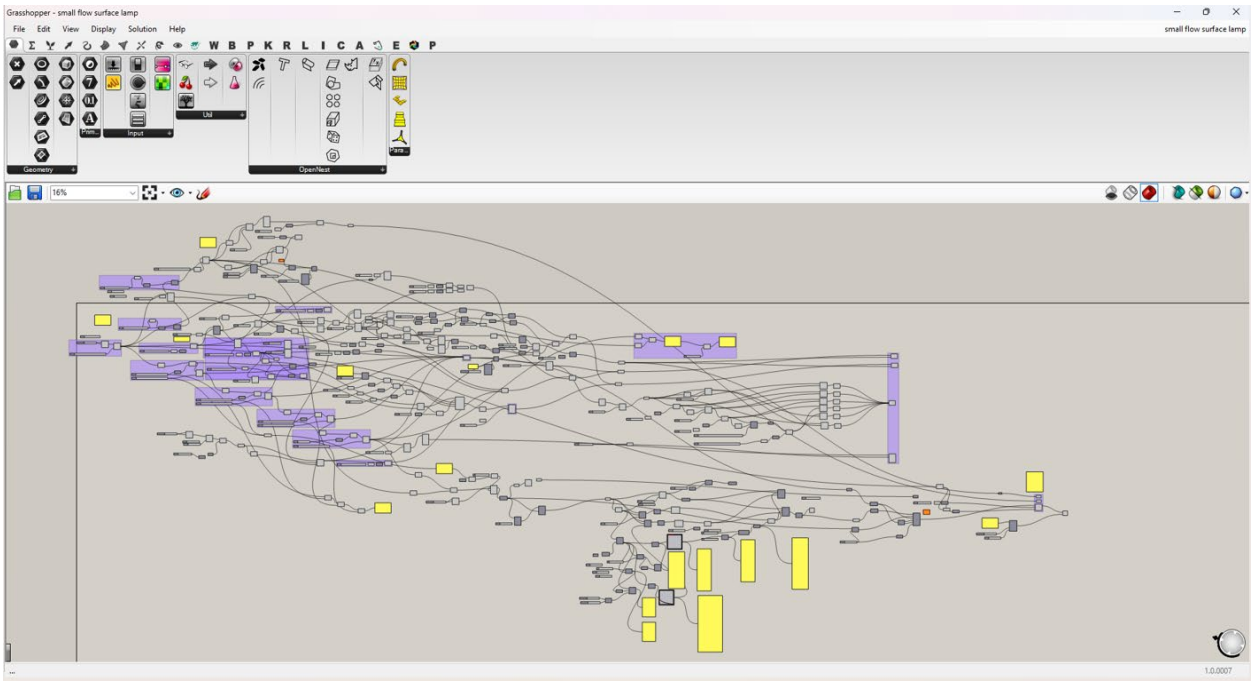

Figure 7 - Code I wrote to parametrically generate a sculpture in Rhino+Grasshopper. Small blocks perform mathematical functions, while the thin strings dictate where and how data flows between these functions.

Parametric design tools are perfect for designing modular, organic structures out of standardized materials – but they are not so great at designing an antique ornamental

armoire, where embellishments are improvised by the craftsperson who responds to the grain of the wood with which they work. Likewise, Computer Aided Manufacturing (CAM) equipment excels at creating precise, repetitive cuts – but these machines produce formwork that is cold, mechanical, and lacking in human idiosyncrasy. By using parametric design and CAM tools in my creative practice, my sculptures lack that aura which is uniquely afforded by the human hand – an aura which is especially evident in mediums such as oil painting, wood carving, or raku ceramics.[30]

Yet parametric design appeals to me for another reason: it mimics the flow of energy through ecosystems, or the process of evolution itself, where systems accumulate in complexity over generations, receiving external inputs into the system, and adapting outputs, working iteratively to achieve equilibrium. Rhino+Grasshopper allows me to subtly shift input parameters, updating generating outputs in real time, without having to go back and recreate the forms from scratch with every iteration.

Parametric design and biomimicry go hand in hand – they are both 'organic,' evolving processes that work iteratively and adaptively. Though design intent is still present in every step of the process, from constructing the system to modulating the input variables, parametric tools allow me to offload some lower-level decision-making, such as the connective details of modular structures, onto my tools, enabling me to focus on higher-level decision-making concerning the overall form and aesthetics of the sculpture.

By applying parametric design and CAM tools to my creative practice, I do not seek to displace or diminish traditional art forms – these art forms are essential to our humanity and to the preservation of traditional cultures and old ways of knowing. Rather, I explore a vein of thought where humans are merely one creative agent among many – a view of creativity where humans, their technologies, and nonhuman organisms serendipitously intersect to create a future that is more-than-human. Personally, I am delighted by the notion that there is room in this world for both traditional craft and massive, helpful robots. While CAM robots excel at advanced manufacturing, they do not excel at replicating traditional craft techniques and they will not replace traditional craftspeople.

I have come to see these technologies – such as parametric design software, and computer aided manufacturing tools such as 3D printers and CNC cutters as intelligent collaborators as much as my human collaborators. They exist, much like Sarah, Rude, Trevor, and Romona, as entities with their own capacities and limitations that "respond" to my inquiries. These technologies both offer insight that opens possible pathways and impose limitations that narrow the overwhelming array of available pathways.

Some limitations of my mechanical-collaborators include that cutting tools can only cut flat sheet material, which suggests certain design techniques – such as dovetail joinery, or kerf-cutting, over others. 3D printers can only extrude certain materials – such as thermoplastics, or vicious admixtures of ceramics or cements. Parametric coding is

superfluous when creating simple forms, but necessary for generating and modifying complex, modular structures. New creative technologies have built-in limitations that ensure they will not displace traditional ways of making. Rather, they simply open new conversations – conversations that only we, at this moment, can have.

2.2 Interstice

Figure *8* – Braden Perryman, *Interstice,* 2024.

I first began to conceive of Interstice while looking at the seed pods of sweetgum trees and the fruit of the Kousa dogwood tree that litter my yard towards the end of summer. While I normally consider these small and intricately detailed organic structures a nuisance, one day, they seemed to whisper to me, suggesting that they offered wisdom upon closer inspection. These seed-containing structures are composed of smaller cells, modules, or components, that fit and lock together in organic seams. The sweet gum seed pod's spikes serve to deter animals from consuming the seeds within, while the Kousa dogwood's fruit's sweet flesh encourages consumption, so that the seeds can be spread far and wide, carried in the guts of animals. This idea of a seed, contained either in intimidating, bristly armor, or seductive, sweet fruit, reminded me so much of art itself: an idea, a concept, buried in a form that either provokes the viewer, or draws them in.

As interested as I was in the structure of seed pods, I was also interested in the materiality of steel – its ductility, its strength, and its ability to distribute stress loads through both tension and compression. I decided to try and mimic the form of these seed pods by CNC plasma cutting flat sheet steel and convincing these flat cut panels to dance with each other into three dimensions by using bolts. Over the next few months, I felt

compelled to bring *Interstice* into being in ways that directly contradicted my own self-interest and well-being – *Interstice* had become my obsession.

Plasma cut steel has rough, sharp, slaggy edges left by molten remnants of the metal sheet blasted out by the plasma torch tip. Upon completion of its six cells, *Interstice* had left a series of unsightly scars on my hands. However, I was no longer in control of the assemblage - rather, the possibility of *Interstice's* existence was so seductive that in its birth phase, it wore my body as its vehicle, directing my actions towards its creation, much as *Ophiocordyceps unilateralis* 'wears' the bodies of ants during one phase of its reproductive cycle.[31] This experience was rather unsettling, but one that many creative practitioners can attest to, where an idea takes hold and will not let go.

Interstice exists at the intersection of parametric design and digital fabrication techniques that are necessary 'prerequisites' to unlock its form and channel it into existence within the material world. The form was procedurally generated with Rhino+Grasshopper, from which the surfaces of resulting lofted cell-forms were deconstructed and unrolled, while fabrication tabs and material offsets were added in extensive hand-drafting. The fabrication file was prepared using Fusion360 and sent to the CNC plasma cutter. Custom 3D printed PLA brackets hold interior sconces in place at appropriate angles. Light diffuser panels were laser-cut from .125" green tinted acrylic that was hand-frosted and fitted into the sculpture's interior.

Interstice was one of these always-pre-existing concepts 'waiting in the wings' to be uncovered and realized, using myself and the complex technological assemblage within which I am entangled to usher itself into reality. During its creation, *Interstice* would regularly appear in my dreams; a mere fragment of a larger whole, incomprehensibly complex geometries that tumble and click, snapping and locking into place. It was through making *Interstice* that I began to understand my place as a bridge between organic forms and design technologies. There is some mysterious puzzle that exists somewhere between the seed pods, Rhino+Grasshopper, and the plasma cutter – through *Interstice*, I was tasked with figuring out how these puzzle pieces fit together.

3. Biomimicry

In *Vibrant Matter*, political theorist Jane Bennett advocates for a theoretical perspective that widens our definition of who, or what, we may consider social actants.[32] Bennett weaves this account of distributive agency through a deep attentiveness to things-in-themselves, especially typically unseen things such as stem cells, fish oils, electricity, and trash. By decentering humans from our understandings of the world, this view questions our modern, western, and scientific 'fantasies of human uniqueness [...] of escape from materiality, or of mastery of nature."[33] Bennett makes a convincing argument that anthropocentrism, or the view that humans are somehow exceptional, unique, and "above" mere matter, hinders human flourishing by blinding us to the wealth of nonhuman agency and wisdom which always surrounds us.[34]

Figure 9- Stone, algae, and fungi collaborate to create lichen. Photo taken in the woods around Blacksburg, Virginia.

This attending to the wisdom of nonhumans through deep listening is highly reminiscent of Ursula K. Le Guin's delightfully humorous and imaginative short story, *The*

Author of the Acacia Seeds, where human *therolinguists* (researchers who study nonhuman languages) begin translating the languages of nonhumans. In Le Guin's story, the only limit of human knowledge is the extent to which we are open to listening. Therolinguists begin with the poetry of lichen but eventually come to realize that the rock the lichen calls home is itself sentient, simply speaking on a vast timescale incomprehensible to humans.[35] Le Guin's geolingusim is the science of radiometric dating – even matter we perceive as unalive and inert is full of wisdom if only we pay attention to it.

In line with Bennett's task of attending, designer and aesthetic critic Michael Pawlyn argues that biomimicry is a political act that takes seriously human-caused climate change by learning from the wisdom inherent in evolution and nature. In essence, we must adopt the humility and attentiveness required to be the student of nature and not its master. Imitation, as they say, is the sincerest form of flattery. Our current profit-driven economic systems thrive when more is extracted, processed, and consumed, producing vast quantities of waste. In contrast, biomimicry aligns with evolutionary pressures that seek to minimize unnecessary waste – biomimicry's most basic principle is material efficiency – we should use only as much as we need, and no more.[36]

The resource efficiency that biomimicry affords us is a very human-oriented benefit that comes, paradoxically, from attending to nonhumans and decentering humans from our worldview.[37] Like the accounts offered by Le Guin and Bennett, Pawlyn argues that biomimicry's attentiveness is typically directed 'beneath' the spatiotemporal scale of the human, at the micro-scale of the tissue structure of living organisms and microorganisms, which lend organisms their unique capabilities to better fit into their ecological niches.[38]

Figure 9 - Left: a 3D printer extruding a hollow, variable density cell-like structure. Right: a ghost pipe flower, an autoheterotroph that is rare and can be found only in areas with old growth forests.

Traditional manufacturing techniques are insufficient to produce biomimetic forms such as variable-density cellular shell structures because they are centered around cutting standardized, mass-produced materials down to specified sizes. However, new computer-aided design (CAD) and manufacturing (CAM) techniques generate much less waste than traditional subtractive manufacturing processes, as parts can be 'nested' and cut more than by humans operating traditional machinery.[39] Advances in additive manufacturing also allow us to create hollow, variable density components, allowing us to mimic form such as seashells or the bone structures of birds.

Figure *10* – An owl moth mimics the eyes of an owl to deter predation from birds; an Acanalonia insect mimics the form of a leaf as camouflage.

While advances in x-ray imaging and computational modeling that allow us to better perceive and mimic nature are new, biomimicry itself is not. [40] Biomimicry is found time and again in the process of evolution, where one organism mimics another to gain an evolutionary advantage. One example of this can be found in the owl moth, which mimics the eyes of owls, deterring predation from other birds. Another can be found in the *Acanalonia* insect, which mimics the form of a leaf, an effective camouflage. These are examples of convergent evolution, where similar characteristics evolve in organisms that are not genetically similar and do not share any recent common ancestors. Convergent evolution, once again, is reminiscent of *steam engine time* and examples of independent invention, such as how Gottfried Leibniz and Isaac Newton independently invented calculus in the late 17th century. It seems that these "ideal forms" are always already out there, arrived at through different paths in response to social or environmental pressures.

Figure *11* – Top left: the scales on a green anole lizard. Top right: traditional ceramic shingles found on the rooftop of a historic building on the island of Zakynthos, Greece. Bottom left: a coiled common rat snake found in my garden in Blacksburg, Virginia. Bottom right: The siding on a new building on the campus of The University of Texas at Dallas.

Biomimicry is also radically continuous with traditional human knowledge: for example, roof shingles are an ancient example of humans mimicking the scales of fish or reptiles in the design of rooftops. Like evolution, human biomimicry is iterative and always improving as we pay closer attention to the world around us. Note how the shingles on the rooftop of a historic building in Zakynthos, Greece are similar to the scales of a lizard – many small, repetitive bumps that overlap, routing water down the slope of the rooftop, while the siding tiles on this academic building at the University of Texas at Dallas go

further than function, mimicking also the subtle iridescence found in the scales of snakes or fish. New materials intersect with new design and fabrication techniques that "unlock" certain possibilities and allow us to better mimic the natural world.

Biomimicry is itself a conceptual instrument – a lens that shapes the way we see. Like any instrument, biomimicry can be used for good or for ill. While the practice of biomimicry increasingly depends on advanced technologies, its outcomes can lead us towards more sustainable futures if applied in ways that are ethical rather than extractive. Through applying biomimetic principles to the design of objects which do not directly serve a function to humans, I seek to make visible the complexity of nonhuman organisms which typically go unseen. By celebrating the beauty of their stories that surround us all the time, I hope to shift the way we see the world, much as Boyle made air visible with the gas pump.

Through biomimicry, I seek to emulate those "always pre-existing ideal forms" that evolution has arrived at after eons of trial and error. As Audre Lorde insists, "the master's tools cannot dismantle the master's house."[41] The solutions to our current predicament must come from outside of modernity, outside of humanity, so that we do not reify our current problematic power structures, just in more invisible and insidious ways.[42] Biomimicry is one way in which we may use our emergent creativity to collaborate with our technologies and other organisms to direct ourselves towards beyond-human futures.

3.1 Nesting

Figure *12* – Braden Perryman, *Nesting,* 2023.

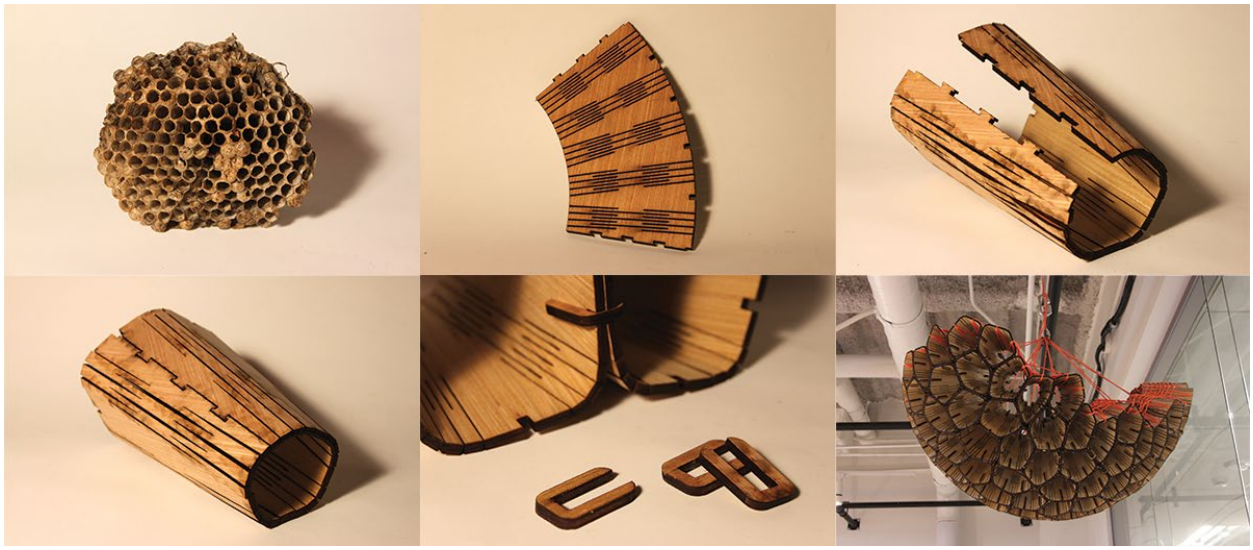

Figure *13* – Braden Perryman, *Nesting Process,* 2023.

Nesting are biomimetic sculptures derived from the form and accumulative process of paper wasp nests. Paper wasp nests are emergent structures composed of relatively simple repeating forms that conglomerate to produce more complex wholes. Through

Nesting, I question whether humanity alone can produce what we consider architecture. *Nesting* revealed itself to me while I was closely observing the form of a fallen paper wasp nest I found under my deck. It occurred to me that nonhumans subtly shift material reality on physical and temporal scales imperceptible to humans, and due to this subtlety, their architecture often goes unrecognized as manifestations of evolved intelligence.

Nesting was created through hand-drafting five and six sided gently sloping cellular lofted forms, with minimal living hinge scoring along fold edges of unrolled cell forms. Due to the extensive use of living hinge scoring and the subtle 'give' afforded by the malleable natural fibers pressed into 5mm plywood sheets, the overall structure is springy and flexible, gently finding a resting point when picked up, transported, and suspended from the ceiling. The woven paracord netting around the exterior edges offers a secure tethering of the attached cells to the suspension point, a stainless-steel climbing carabiner.

Nesting makes use of two traditional woodworking techniques: kerf-cutting to induce flexibility from a rigid material, and dovetail joinery to attach the cells to each other. The repetitive nature of these cells was perfectly suited to the laser-cutter, which can reproduce nearly perfect cuts thousands of times – in accordance with Pawlyn's insistence that we apply CAM to biomimetic design, this biomimetic sculpture, and the story of the wasp it tells, would have been impossible to create with traditional fabrication techniques. *Nesting* is another one of those conversations that only we, at this moment, can have.

3.2 Emanate, Synthesis, and *Mitosis*

Figure *14* – Left: Braden Perryman, *Emanate,* 2024. Right: sweetgum seed pods.

Figure *15* – Left: Braden Perryman, *Synthesis,* 2025. Right: the fruit of the Kousa Dogwood tree.

Figure *16* – Left: Braden Perryman, *Mitosis,* 2025. Right: pomegranate seeds.

Three of my more recent projects make use of parametric design and 3D printing to create sculptures mimicking natural forms. The first is *Emanate*, which mimics the form of the sweet gum's spiky seed pod. The second is *Synthesis*, which draws inspiration from the fruit of the Kousa Dogwood tree, which is composed of many small cells which accumulate to create a complex whole, with small, detailed "ports" at the center of each cell. The last is *Mitosis*, based on the internal seed structure of a pomegranate fruit, and takes parametric

form generation a step further, using a Voronoi diagram with an attractor field that modulates both the height and aperture size of each cell.

Each of these sculptures was carefully designed to prevent 'overhangs,' which do not print well on 3D printers, which print 3D forms layer-by-layer, with each successive layer requiring a solid foundation to be deposited on top of. Designs with 'overhangs' require the use of support material. Support material is a scaffolding structure generated by the 3D printing slicer software that provides support to any part of the form that hangs over empty space. By designing these forms intentionally to prevent the use of support material, waste is kept beneath 1% of the total weight of the sculpture, mimicking evolutionary pressures that emphasize efficiency and minimize waste.

3.3 Biomaterials Research

Figure *17* – Braden Perryman and Stella Park, *three experiments with agar bioplastics,* 2025.

One significant component of biomimicry that is currently lacking from my practice is the use of sustainable biomaterials that mimic not only the forms of nonhuman organisms, but the materials that these organisms are composed of. Agar-agar is one such material: derived from seaweed, it shows promise as a possible replacement for plastics derived from oil and gas products. I have been working with Stella Park to cast agar bioplastics into 3D printed molds. Once dried, these bioplastics have incredible toughness and tear-resistance and can even be cast or injection-molded into multipart 3D printed molds as a form of bio-resin. The minimum resolution of these bioplastics is extremely fine and can cool and dry to a usable point within two to three days. Agar bioplastics are food safe, water soluble, and can be composted at home.

4. Responsibility

Ecologist and indigenous scholar Robin Wall Kimmerer begins *Braiding Sweetgrass* by comparing two different creation myths. Kimmerer starts with the North American indigenous story of Skywoman, who, fallen from the Skyworld, works with animals to create a bountiful garden for all creatures to share on the back of a turtle swimming in an endless sea. Next, she sums the European / Christian story of Adam and Eve, exiled from the garden of heaven for the sin of tasting its fruit. Kimmerer states, "One story leads to the generous embrace of the living world, the other to banishment."[43] It is in storytelling that we glimpse the social purpose of art: it is through art that we tell our histories and express our values. Equally important as the stories we tell about our past are stories we tell about our future. Art may serve as science fiction, showing us the way forward, by helping us to better understand the anthropocentric paradoxes and technological feedback loops in which we are presently ensnared.

Through my collaborations with fellow humans, organisms, and technologies, I have come to understand that one of the most valuable skills to develop as a collaborator is knowing when to step aside, allowing my fellows to express themselves more fully. Collaboration is intrinsic to storytelling: after all, the stories we tell are learned from others, and told to others. And like collaborating, being a good storyteller is as much about knowing when to be silent and listen, as it is knowing when to speak. The storyteller must first learn the story, and learn it well, before it can be told faithfully.

The story I find myself telling, time and again, is that of nonhuman organisms and that of our machines – and part of this responsibility involves stepping aside and allowing these organisms and machines to speak for themselves. However, this occasional 'stepping aside' does not abdicate one from taking responsibility for the story one tells, and the way one tells it. I hope that the nuance here is clear – the responsibility of the storyteller is first and foremost to listen to others and to learn the story, so that it can be told as honestly as possible. Part of this honesty involves not the pretense of objectivity but in being transparent about one's positionality and motives.

Storytellers have the responsibility to amplify the stories of those who cannot speak for themselves: my most difficult responsibility as a storyteller resides in this telling of stories which are not my own. My responsibility towards the organisms and the technologies I collaborate with is to tell their stories well. This involves telling their stories in a way that sings and reaches resonance with the humans I speak to, so that they may more fully empathize with these nonhuman forms of life. Achieving this resonance involves making compromises – in the realm of human affairs, I would not be a very intelligible storyteller if I spoke solely in lichen, or stone, or extruders, or lasers. This is the second responsibility of the storyteller: meeting one's audience halfway to tell a compelling story.

4.1 Infrastructure

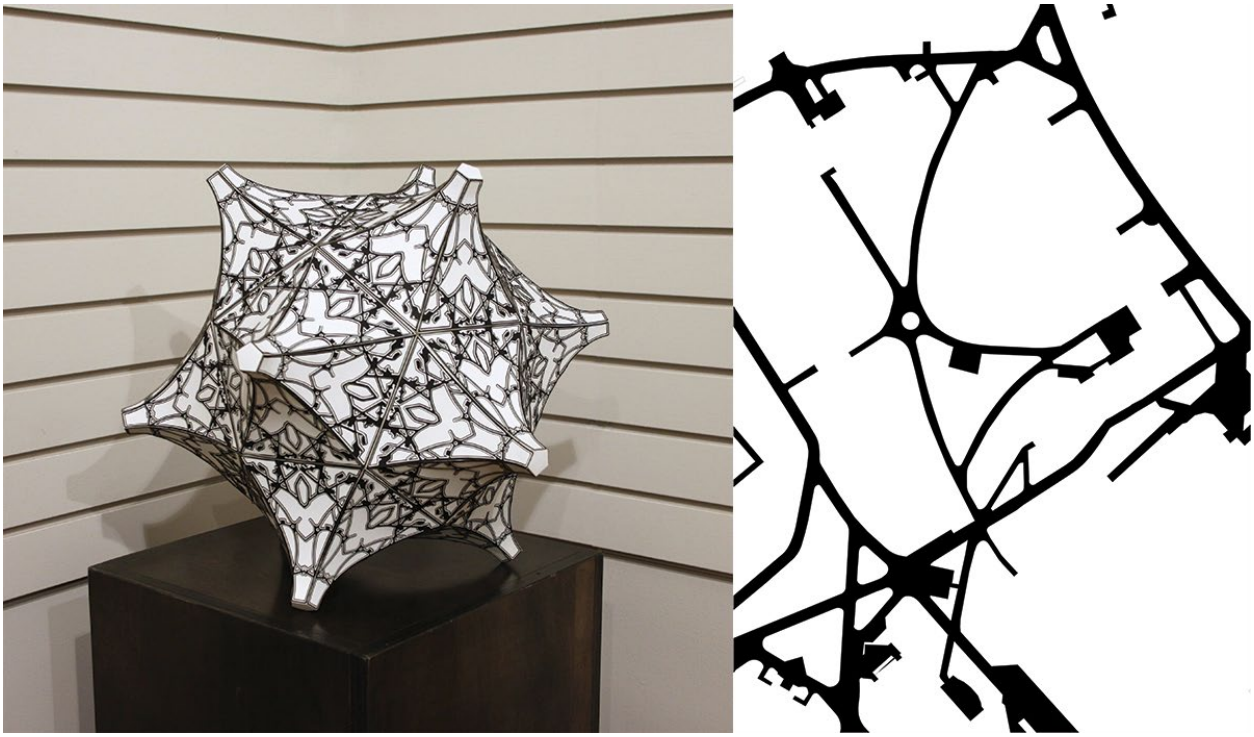

Figure *18* – Left: Braden Perryman, *Infrastructure,* 2024. Right: vectorized image of Blacksburg city streets.

I began to grapple with these concepts while making *Infrastructure*. I was interested in how our infrastructural systems silently and invisibly shape the way we move through the world. This sculpture, at first glance, is a delicate spherical assembly of facets which sweep towards tapered points, embellished with decorative linework. Upon closer inspection, it becomes clear that this detailed linework traces the routes of city streets. This linework was extracted from the city of Blacksburg's open-source Geographic Information System (GIS) files, specifically the street and sidewalk network layer. This linework was vectorized, rescaled, and mirrored to generate the resulting patterning.

Infrastructure speaks to this self-reifying nature of technology: the ways in which we design and build our material environments have ripple-effects, cascading back the ways in which we inhabit and transport our bodies through space and time. Just as the way in which a doorknob's design impacts the way thousands of hands reach for it during its lifetime, so too does the way we design our mobility networks create complex choreographies that play out in and through our bodies over an extended duration.

These complex choreographies are not politically neutral but are the result of power struggles between pedestrians and the automobile-owning upper class, between those who are able-bodied and those who are not, and between humans and nonhumans.

Infrastructure further embodies the imperatives of our economic system which require the construction and maintenance of channels through which extraction, production, and reallocation occur.[44] Infrastructure is both a tool and technique of power that has become so ubiquitous in its mediation of our lives that it has become invisible.[45]

Art's role is to make visible the invisible, to direct our attention, to help us to better see ourselves and understand our present situation. It is my view that one of the most significant things that art can do is respond to how our political and economic systems manifest themselves in the design of our built environment. In doing so, art can both unpack the implications of past and present design and inform the future of design. Through *Infrastructure*, I hope to direct the viewer's attention towards the role that infrastructure plays in shaping our lived experience.

4.2 Labyrinth

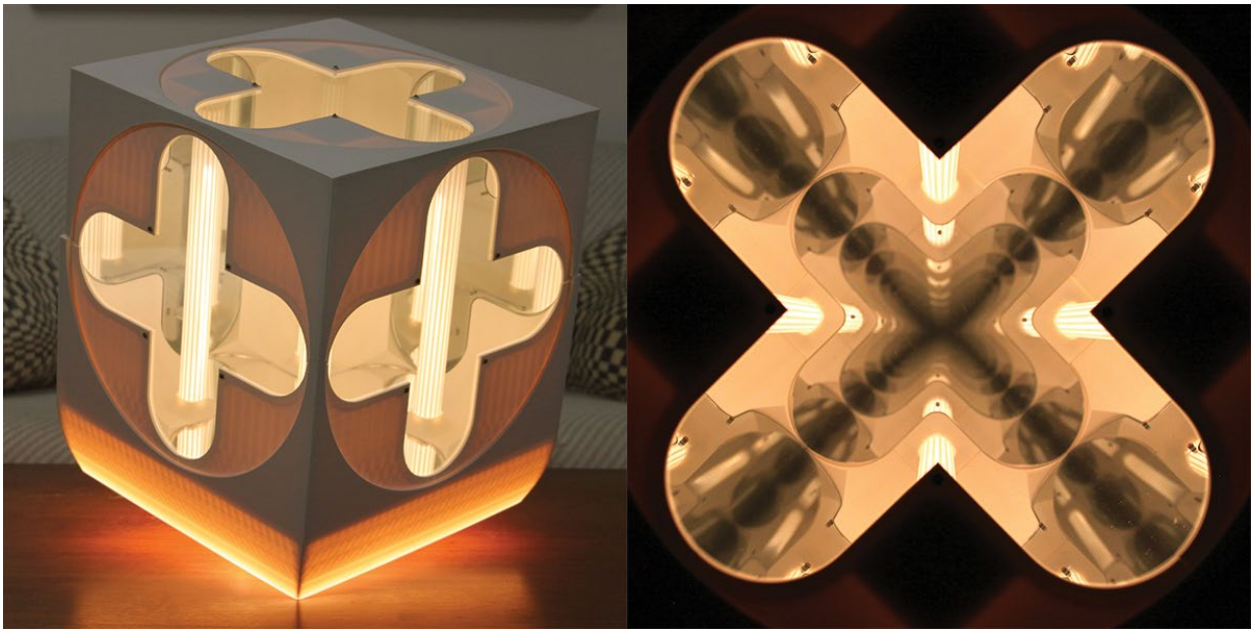

Figure *19* – Braden Perryman, Labyrinth, *2024.*

Perhaps the most visually direct reference to paradox and entrapment is found in *Labyrinth,* which draws on visual language established by artists James Turrell and Yayoi Kusama. *Labyrinth* seeks to show that the 'labyrinth' nature' of human meaning-making is an infinite abyss which is tantalizing and beautiful, but a mere simulation that we may transcend by stepping outside of it. The seemingly infinite *Labyrinth* references the ancient Greek mythology of Dedalus and the Minotaur, as well as the literary work of Jorge Luis Borges and Suzanna Clarke.[46] In this way, the *Labyrinth* serves as a warning sign, helping to guide viewers towards a better understanding of themselves and the path they must take towards uncovering their true purpose in life.

Labyrinth was inspired by a near-death experience I had several years back. This experience exhibited many of the documented hallmarks of near-death experiences (NDEs) and allowed me to 'step outside' of my life and perceive its 'simulation / labyrinth nature.'[47] I sought to emulate these NDE hallmarks by creating a small, reflective chamber where the viewer can see in, but someone on the inside cannot see out. Even white light emanates from Grecko-Roman style pillars positioned at four corners of the room. Colonnaded archways offer glimpses into infinitely receding chambers that open into yet more multidirectional chambers in every direction.

This near-death experience compelled me to change my life's pathway away from self-destructive pursuits (life within the labyrinth) and to create artwork that serves as a shortcut to these kinds of realizations without the viewer having to nearly expire. This is the most autobiographical of all my artwork, a moment where I had clear authorial intent and used signifiers such as architectural features and infinite space to tell a story. Though the interpretation of this artwork is still ambiguous, it conveys a somber sense of significance and wonder that points towards those spiritual experiences we must all face at some point in our lives – those moments when finally manage to step outside of our labyrinth.

4.3 Assisted Migration

Figure *20* – Braden Perryman, *Assisted Migration,* 2024.

Assisted Migration seeks to tell the stories of trees. Because trees exist on a timescale much slower than humans, with some varieties living for hundreds or thousands of years, our short attention spans lead us to ignore their stories. *Assisted Migration* asks us to slow down and be attentive to the wisdom of trees. The artwork will not be complete until its collaborators – two *Acer palmatum* saplings – reach maturity, roughly three decades in the future. Based on the 100+ year lifespan of *Acer palmatum*, it is probable

that the trees will outlive the rolling containers, eventually consuming their constituent parts with probing roots as the wood panels rot and the Corten steel panels rust away.

Studies have shown that trees are able to communicate with each other and share nutrients via symbiotic relationships with underground mycelial networks.[48] We often think of plants as unintelligent because unlike animals, they cannot move themselves to avoid situational or environmental hazards – but perhaps we simply need to lengthen our temporal perception to grasp the intelligence within the gradual generational movement of trees. Already, in forests around the world, tree species' distribution patterns are gradually migrating away from the equator and upwards in elevation to follow their optimal growth conditions as USDA zones shift with climate change.[49]

Figure *21* - Nina Katchadourian, *Uninvited collaborations with nature,* 1998.[50]

The work responds to Nina Katchadourian's *Uninvited collaborations with nature*, where Katchadourian mends broken spiderwebs with sewing thread without invitation. Katchadourian notes, somewhat abashedly, that spiders rarely return to webs she repairs with thread. This work is also in large part inspired by the eponymous concept of assisted migration, an environmental policy proposition wherein humans help species find new niches by spreading their seeds in favorable conditions to ensure some semblance of future biodiversity.[51] Yet once again, trees are already doing this, without our help: ecologies are emergent and reactive; while humans are slow to catch up.

This work, a five-sided planter-bed on wheels, explores the absurd predicament that we find ourselves in where we seriously consider the environmental policy of assisted migration. By enabling trees to be relocated to optimal conditions, the work also speaks to

the transience of humans. Rather than being rooted in a certain place for generations as we once were, we now tend to relocate often – this detachment to place contributes to our extractive view of nature. If we ruin our surroundings, we can always move.

Anthropocentric mindsets muse, "if only I could move that shade-tree over to myself instead of having to move myself over to that shade-tree." *Assisted Migration* asks of us, why is it that rather than change our consumption habits, we find it easier to entertain ideas of shifting entire forests? Or rather than consume more responsibly, do we find ourselves relocating entire cities and their inhabitants away from rising sea levels?

4.4 Emergence

Figure *22* – Left: Braden attaching one of the last cells from the inside of *Emergence.* Right: Braden Perryman, *Emergence,* 2025. Photos taken by Damon Brewer.

One of my professors from Rice, Josh Bernstein, once told me that the destination of a work of art determines its politics. Throughout the fall of 2024, Trevor Finney and I discussed this concept at length, spurring our interest in ensuring that art experiences remain accessible to a broader swath of the public. Public art is inherently democratic, accessible, and stands to touch many more people than artworks hoarded by private collectors and kept out of sight of the public.

Serendipitously, in the spring of 2025, Trevor and I were approached by Ben Knapp, director of the Institute for Creativity, Art, and Technology to create a large public sculpture for Virginia Tech's Innovation Campus in Alexandria, VA. The design we chose to proceed with was an offshoot between *Interstice* and *Emanate*, a large spherical assembly taking the shape of a buckminsterfullerene. We were interested in the concept of *emergence*, where many small cells accumulate into a complex whole more than the sum of its parts.

Figure *23* – Braden and Rude working on the anchoring system for *Emergence.* Photos taken by Trevor Finney.

This project unfolded within an extremely condensed timeframe – we received funding on January 13th, 2025, and installed *Emergence* on February 23rd, 2025. *Emergence* is approximately 96" in diameter and weighs roughly 1,200 lbs. The sphere is composed of 42 cells, 3,500 bolts, and an internal frame structure with 1" thick-walled steel pipes converging on a 3D printed multipipe connector that serves to redistribute weight and anchor the sphere into the ground.

We designed the sculpture so that it could be entirely disassembled into its constituent parts for ease of transportation and assembly, allowing the sculpture to be more easily melted down and recycled once it reaches the end of its use life. This, too, responds to Josh Bernstein's commentary on the "destination politics" of works of art. By designing the sculpture to be recyclable, we acknowledge that nothing lasts forever, and that inevitably, future humans may need to use this steel in different ways rather than mining new iron. We hope that by designing and constructing in this way, our "destination politics" will be circular rather than linear, with the sculpture eventually incorporated into bridge trusses or building beams, rather than existing as a heap of scrap rusting in a landfill.

Figure *24* – Left: A prototype of *Emergence* sits on a table with *Emergence* in the background. Right: the laser-engraved sign Trevor designed for *Emergence,* with *Emergence* in the background. Photos taken by Damon Brewer.

The fabrication of this sculpture was especially grueling, requiring over 300 hours of labor involving operating a CNC plasma cutter, hand-bending steel plates, and tightening thousands of bolts. Trevor and I are lucky to have had the assistance of expert art handler Rude Graves and retired navy aircraft builder Damon Brewer for the installation phase of this project. On-site assembly was particularly challenging as we ran into issues with parts not lining up and had to innovate solutions without access to a fabrication shop. The cells had to be attached from the inside, requiring me to remain on the inside of the sphere until the last cell was attached. This last cell was specially fabricated to allow its attachment from the outside without visually standing out from the other cells.

One of my most favorite parts of this project was talking with the folks walking into and out of the metro station, who were curious about what we were doing and wanted to learn about the project. One older fellow came up to us with a grin on his face, pulled out his phone, and angled to take a photo. Lining up his shot, he exclaimed, “I’m so glad we finally got one of these!” Seeing the wonder that others experienced seeing our project has inspired our installation team to apply for several more public art projects. Please see the entire list of attributions in the end notes for all our collaborators on this project.[52]

Conclusion: Stacking Cairns

Throughout my education I have experienced a sense of liminality, as I see my life's work as residing somewhere between sociology, anthropology, design, architecture, engineering, and art. Despite swimming in this sea between disciplinary boundaries, I have chosen to pursue my life's work through art over these other disciplines.

Artists are storytellers – but the question is not so much what kinds of stories we *can* tell, as what kinds of stories we *must* tell. It is well established that aesthetic discourse unfolds somewhere between creators and experiencers - it is in this delicate choreography that new understandings emerge, often with deeper and broader implications than its creators could have originally imagined.[53] Philosophers of art have posited that the artist's role is to hone our perception and direct our attention; and that through doing so, art's social function is to serve as a mirror, helping us to better see ourselves.[54] Contrast this view of art with Bruce Mau's view of design, which solely seeks "design nirvana," becoming invisible through their commercial success, intuitive function, and cultural ubiquity.[55]

Good design should be so intuitive and easy to use that it becomes invisible to us – we are not aware of our phone screens because of how effectively they convey images and information to us – at least until they break. In everyday use, the screen itself recedes into the background.[56] Nor are we aware of the way in which roads are gently graded or curved according to the appropriate speed of travel, resulting in a more seamless driving experience. As pedestrians, we are often unaware of the simple elegance of curb cuts that allow people in bicycles, wheelchairs, and strollers to negotiate the boundary between the sidewalk and the street. In each of these examples, layers of design and engineering are so seamlessly executed that they become invisible to us – at least, until the power goes out, the road is closed, or a truck is parked in such a way that obstructs a needed curb cut. Art's role is exactly the opposite of design and engineering – art's strength, quite literally, is its visibility, its refusal to "step into the background" of our daily lives.

The conversations I am interested in having also unfold in anthropology and sociology, disciplines similarly tasked with unpacking past and present conditions to uncover sustainable and equitable futures. Yet I feel that art is more accessible and democratic than these disciplines, which possess a high bar to entry for those who seek to engage in their discourses. Art is intuitive, comprehensible on many levels by many kinds of readers with differing levels of abilities. Through emphasizing organic forms, I hope that my art is as "readable" to a child as it is to an adult, while still embodying deep philosophical arguments – such as the ethics of sustainability, or the importance of biomimicry – and making them as visually intuitive as possible.

Through opening the viewers up to these philosophical ideas, whether consciously or subconsciously, my work seeks to create inflection points for radical reimagining of

futures. [57] In laying this pathway towards more-than-human futures, I draw on the concept of *cairns*, or way-finding stones: stacks of flat rocks showing the way forwards on rugged or not-often-traversed trails.

Figure 26 – Left: a cairn that I stacked in the woods near Boone, North Carolina, still standing months later. Photo by Jesse Perryman. Right: following trails in Big Bend National Park, Texas. Photo by Ethan Perryman.

Hikers who have completed the journey to the top will often stack cairns as clues for less experienced hikers, pointing the way towards shortcuts and away from pitfalls. Stacking cairns is an act of generosity that is at the essence of humanity: the desire to make things easier for those who come after you, so they do not repeat your own mistakes. My artworks are cairns along this pathway of becoming the divine within; a trail of breadcrumbs leading up the often-treacherous craggy peaks and towards a way of living that is in harmony with the more-than-human world.

I feel that it is my responsibility to stack cairns: to share the knowledge I have gained through listening deeply to the world. This knowledge informs my creative practice, a form of visual storytelling that celebrates the intersection of human and nonhuman intelligence and urges us to be more attentive to the more-than-human world. I have found this effort – to help others find meaning in their lives – to be the meaning of my life. [58]

Understanding more broadly the role of creativity and technology in the trajectories of human societies has allowed me to better articulate my specific contributions to the field of creative technologies, my responsibility to society. I have come to understand that my unique contribution is to elucidate the negative feedback loops we are caught within and to direct our imaginations towards the creation of more ethical and sustainable futures. When I imagine these futures, my internal vision blossoms with flowers, spirals into seashells, and prickles into pinecones. Since childhood, I have been fascinated by the complexity of natural forms. They speak to me, urging me to pay attention to them.

Figure *25* – Left: the feathers of a fallen bluejay. Right: Braden Perryman, *Bluejay,* 2023, a temporal painting performance.

I posit that evolved forms appear beautiful to us because they play some significant role in humanity's future. Evolution has arrived at these 'always pre-existing' ideas through eons of trial and error. Their beauty is their way of calling out to us to guide us towards this future – as an artist, it is my job to be open and receptive to this call. Equally as important as attending to nonhuman organisms is attending to our equipment, the creative technologies that artists use to create art, which also calls out to us, enabling and suggesting creative pathways. Though computer aided design and manufacturing technologies unlock certain futures by allowing us to better mimic organic forms, they will not on their own bring about beyond-human futures – it is only through intentional and responsible use that we can direct ourselves towards these futures.

By paying attention to and serving as a bridge between the bodies of other organisms and the capacities of our technologies, I hope to tell a story about a harmonious future that has room not just for humans, but for all beings. Through responsible collaboration with technologies and nonhuman organisms, I hope to bring our world a little closer to this story becoming reality. Advocating for a beyond-human future, does not deny a place for humans in this future – a bridge between the delicate but durable structure of

bird bones and the capabilities of parametric design software depends on the emergent creativity of humans to perceive this link, sense its importance, and bring it into reality.

The goal of my practice is to initiate a spark of curiosity that draws the viewer out of their human-centric story and into a greater awareness of this beyond-human world, where organisms exist not solely to be consumed, and technologies exist not solely to be used. By helping the viewer understand that we are but one small link in a much longer cosmic chain, I hope to begin to heal our relationship with the earth and with each other.

This healing is at the very essence of my creative practice, which I call *entheogen,* translating roughly from ancient Greek as,

becoming the divine within.

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Endnotes

[1] "About" is used here both semantically, where "about" refers to the subject of discourse, and prepositionally, where "about" refers to a physical position of proximate surrounding but not occupying the exact space of another more central entity. In line with my art practice, I attempt to create the conditions in which meaning can be made by the viewer or reader – in creating these conditions, it is critical to lead the viewer or reader up to the edge of this lacunae from all sides but allow them to fill it for themselves. I hope that the effect of this rhetorical strategy is that meaning is shown, rather than told.

[2] See (Lyotard 1991, 12). For the role of the human body as a perceptual apparatus that allows us to access reality, see also discourses in phenomenology such as (Merleau-Ponty 1945) and particularly (De Landa 2021) for an in-depth analysis of how human neurochemistry and physiology intersect to create human perceptions of reality, and how perceptions come to be imbued with meaning.

[3] This is an argument made by scholars in fields ranging from science and technology studies (Latour 2012) to media studies (Postman 2005) as well as social and cultural studies (Baudrillard 1994). See particularly (Baudrillard 1994) for discussion on Simulation and Simulacra, and the nature of the "really real."

[4] See (Lyotard 1991, 49, 64). See also (Bélanger 2009) for the impacts of infrastructure on our conceptions of reality and reifications of power structures. See (Kupfer 2007), (Seamon & Sowers 2008), and (Relph 1976) for further discussions on place, placelessness, and displacement.

[5] I argue that technology is a self-inscribing objectification of meaning. By "objectifying meaning," technologies physically manifest their creators' way of seeing the world. Technologies are "self-inscribing" in that they persist temporally, bringing these inscribed past meanings into present and future realities. Technologies ultimately make concrete and naturalize the epistemic frames that created them (Lyotard 1991, 48). Virginia Eubanks' description of how automated systems take present inequalities and project them into future realities further articulates this point (Eubanks 2018). Technology, by inscribing and re-actualizing meaning and memory, directly displaces past conditions and other ways of knowing – a conversation as old as time see (Plato c.a. 370 BCE) translated by Nichols and republished in (Plato 1998).

[6] See (Lyotard 1991, 12). Echoing this expanded definition of technology, science fiction author Ursula K. Le Guin states, "Technology is how a society copes with physical reality [...] technology is the active human interface with the material world" (Le Guin 2005). See also (Hodder 2012, 9-10) for a thought experiment on a "stimuli-less" human. Hodder posits that this being would not be a human at all.

[7] Poet and aesthetic critic Bruce Hainley quotes Lisa Lapinski as having once said, "I am interested in the paradoxical or even imaginary process by which a sculpture might be advanced as a form of argument, as if it were a political pamphlet realized in three dimensions" (Bader et. al 2023, 22). This idea has stuck with me – that sculpture can contain and embody political and philosophical arguments – whether overtly or subtly.

[8] Rubin states, "If you have an idea you're excited about and you don't bring it to life, it's not uncommon for the idea to find its voice through another maker. This isn't because the other artist stole your idea, but because the idea's time has come. In this great unfolding, ideas and thoughts, themes and songs and other works of art exist in the ether and ripen on schedule, ready to find expression in the physical world. As artists, our job is to draw down this information, transmute it, and share it. We are all translators for messages the universe is broadcasting." (Rubin 2023, 7).

[9] Gibson states, "Nobody knows why the steam engine happened when it did. Ptolemy demonstrated the mechanics of the steam engine, and there was nothing technically stopping the Romans from building big steam engines. They had little toy steam engines, and they had enough metalworking skill to build big steam tractors. It just never occurred to them to do it." This quote is originally attributed to William Gibson, in a 2011 interview in The Paris Review, and was reproduced in (Bridle 2019, 77).

[10] See (brown 2017, 41).

[11] Rubin, Gibson, and brown argue that this conversation in which artists are engaged is not always linear, straightforward, and logical. Lyotard states that "it is always both too soon and too late to grasp anything like a 'now' in an identifiable way," making historical periodization a rather Sisyphean task (Lyotard 1991, 25). Poststructuralists such as Foucault work to reveal the subtexts of historical narratives that only come to light when we become aware of the perspective and biases from which these narratives emanate – see

particularly Foucault's *Archaeology of Knowledge* (Foucault 2002, 1-19). The view of time as linear and progressive directly benefits a society that conceives of itself as occupying the pinnacle of human history. The genealogy that Foucault performs reveals that all historical narratives are inherently incomplete, unable to encapsulate all voices: a narrator has a perspective, after all – a *point of view* from *somewhere*. See *The Crisis of European Sciences* (Husserl 1936/1970) and *Being and Time* (Heidegger 1927/1962) for further conversation on perspectivity, subjectivity, narrative, and truth. Though time is continuous, human perception of time is not – we are eternally trapped in the present. Time itself is the fourth dimension: a further extrusion of the third dimension. Perhaps to a fifth-dimensional being, who could perceive all times overlapping, humans would appear as worms, tubes, or networks that branch as we are born, splitting off from our mothers, and terminating as we die. With our limited perception, all we can see is the small cross-section of these networks that we call the 'present.'

[12] *The edited transcription of Romona (R) and I's (B) full conversation proceeds as follows:*

B: We were interested in exploring an iterative process that 'pulls' the work through a variety of mediums, both 'degrading' the original image yet complexifying and transforming the original image with each step. Yet in contrast to the process of 'deep frying' a meme, we thought that the stages of the process, if adhered to intuitively/blindly, could lead us towards a more perfect aesthetic form or outcome, rather than a lesser form or outcome, i.e. data gained rather than data lost. Each work inherently bears the traces of all prior steps, as well as the order in which they were performed within its outward appearance. In this way, each image gathered a 'patina' (a weathering or corrosive layer that develops over time and exposure to certain sets of conditions) that ultimately lent the work some sense of temporal age or gradual sedimentary accumulation, even though the entire body of work was completed in less than two weeks. Pieces were not treated as 'precious,' rather as whimsical playthings, a small world where no action was a *mistake* – a faulty action, a source of blame, mired in authorial intent – rather simply a series of *accidents* – chance occurrences, outside the realm of pure agency, unfolding somewhere between the affordances of the material and the inclinations of the authors – that themselves gained lives of their own and 'offered' us glimpses into what they could become, or could have become, should alternative pathways have been followed. Each work thus offered a sense of branching multiplicity collapsing towards singularity. The work exists in hybrid digital/material space, somewhere 'in-between' the physical collages, the scanned and photographed images, and the physical paintings. Working with and within this realm of liminality was important to us, as it is the medium of experience itself - nondual, nonlinear, ephemeral, fleeting, and largely ineffable.

R: I for one don't believe in individual failing- the idea someone's failures are an indication of some shortcoming of which they are solely responsible for. Not only am I always actively being shaped by the external world, but so too are my reactions to the external world deeply conditioned. And where else could that conditioning originate from apart from the world? And that is not to say we don't possess any agency or choice, but rather we are deeply and irrevocably interrelated. In the same way I don't feel that I can make any claim to any of the things that I currently possess or are being granted to me. I do not feel like I possess any will outside of that greater flow. Rather, I am simply a vessel for something larger than myself.

B: This idea - that our embodied 'selves' do not stop at the boundaries of our skin, but rather 'reach out' into the world, emerging through our embodied dance with the materiality of things, was important to us. In this view, the idea of individual authorship is a delusion, an ego-trip, born of the modern, western concept of the 'self' as bounded individual agent. I particularly resonate with your description of the role we play as simple conduits for greater flows of social and aesthetic discourses - all authors fulfill this role as vessel, whether they acknowledge it or not.

R: Acknowledging this role - as windsocks registering the larger cosmic-human flow (the zeitgeist, if you will) we began exploring circular or iterative time as measured in degrees of increasing unrecognizability. In other words, the degradation or disintegration of the familiar through exposure to the ebb and flow through currents of time. We became fascinated with harnessing this change, and in abdicating our authorial intent, we became conduits of change itself. We gave ourselves over to processes which stretch and distort, allowing the work to speak for itself and giving it permission to find its final form. What we found was that the

material was not the only thing transformed: our *selves* were also stretched through too many roles: the bricoleur, the assembler of the piecemeal, the performer, the image-maker, the technologist, the perspectival viewfinder, the editor, the creator, the destroyer, the actualizer. We found that our *selves* were made unfamiliar yet more intimately known through the fluidity of roles, roles ever necessarily changing through the fluidity of medium- and process- translation. Only through eroding our own authorial intent were we able to serve more fully as conduits for the work, which began to create itself of its own accord.

B: In this way, what the artwork ended up being 'about' was not so much the physicality of the work, the process of decay, or even its hybrid existence in digital space, but rather the very formative impact it had upon ourselves, the makers of the work, and by extension, we hope, those who engage with the work with open eyes and receptive minds, and experience it for what it is and what it does, rather than interpret what it represents or what it means. *[End of transcription.]*

[13] For more discourse on the concept of intersectionality and identity formation, see (Crenshaw 2014/2019).

[14] See (Hammer 2024, 20).

[15] See (Hammer 2024, 21).

[16] See ("Joseph Wright of Derby" 1768).

[17] See (Boyle 1662).

[18] See (Bridle 2019, Chapter 3) for descriptions of how the development of computational technology was tied to predicting climate, and (Bridle 2019, Chapter 5) for how predictive techniques are applied to stock market exchanges. Bridle's *New Dark Age* makes a compelling case for why more information and more complex computational systems do not necessarily correlate with better social and economic outcomes for humans. Bridle further articulates some of the specific causes and effects of emergent uncertainty.

[19] Through agriculture, nonhuman organisms exert agency over us, such as in the ways in which tobacco or poppies intersect with the neurochemistry of humans '*reaching out and compelling*' us to aid in their reproduction, despite their deleterious effects on human health (Pollan 2021, 78-79). See also (Hodder 2012, 18). This exertion of agency over humans is exemplified by the exponential increase in electricity we allocate to data centers to generate artificial intelligence, another example of nonhuman systems bending the collective will of humanity in their reproduction and maintenance. See ("AI has an Environmental Problem…" 2024), (Zewe 2025), and (Ren & Wierman 2024) for discussions on AI's hunger for energy.

[20] Sociologist and philosopher Jean-François Lyotard argues that the more complex a system becomes, the "more one observes that the immediate reaction [a mechanical impulse followed by a necessary movement] is delayed […] and that this inhibition explains the *indeterminacy*, *unpredictability*, and *growing freedom* of the actions these [systems] can perform" (Lyotard 1991, 41), emphasis mine. What Lyotard describes here is the concept of *emergence*, where "the properties of the whole exceed those of the sum of the parts" (Lyotard 1991, 49). As complexity, interrelatedness, and connectivity increases, so too does probabilistic uncertainty, as outcomes become more chaotic and unpredictable. This is the foundation for my argument that the complexity of humans' techno-systems lends us the unique characteristic of *emergent creativity*. See also (Hodder 2012, 163) for descriptions of the 'butterfly effect' in complex, interrelated systems.

[21] For more on how agriculture constitutes an energy trap and how humans degrade environmental conditions through sedentary agriculture, see (Hodder 2012, 80-84).

[22] In essence, we are becoming subsumed by our technologies, which use us for their maintenance and reproduction in return for the conveniences they afford us. Lyotard suggests that the tools we create use us for their own benefit as much as we use them for ours, stating, "it is clear that with techno-science in its current state […] the human race is its vehicle much more than its beneficiary" (Lyotard 1991, 53). Lyotard adds that humanity is "pulled forward by this process without possessing the slightest capacity for mastering it" (Lyotard 1991, 64). Another notable evolutionary instance of entities becoming subsumed within broader systems is the endosymbiotic engulfing of mitochondria into early eukaryotic cells around 1.45 billion years ago (Martin & Mentel 2010). Humanity is the mitochondria becoming subsumed within the larger cell that is technological systems. While this relationship with technology began symbiotically, we are now in full service to our cell-hosts.

[23] Hodder argues that "instruments shape the way we see […] their role is hermeneutic" (Hodder 2012, 15).

[24] See (Hodder 2012, 15). See also (Shapin & Schaffer 1985), (Latour 1993) for further discourse on Robert Boyle's air pump and the role of scientific instruments in socially constructing truths.

[25] See (Hodder 2012, 17-18).
[26] (Benjamin 1935/2023).
[27] For a more pessimistic take on new technology replacing older mediums, see (Birkerts 1994). While I agree with Birkerts that new technologies disrupt and displace older mediums, I argue that these mediums rarely vanish, they simply become less ubiquitous, and shift to adapt. Old mediums become used by a smaller subset of the population or begin to play a more niche or nuanced role in cultural discourse.
[28] Quote from (Plato c.a. 370 BCE), translated and republished in (Nichols 1998).
[29] Note similar language to Hodder's concept of *dependence* (Hodder 2012, 17-21).
[30] Again, I want to reiterate that technologies are directional: the type of technologies we engage with inherently leads us towards certain creations and away from others. Likewise, advanced fabrication technologies rely on and compel us to maintain global supply chains that are not required for creations such as hand-carved furniture, oil painting, or raku ceramics. Though CNC technologies can usher in more equitable and sustainable futures, we must first disentangle them from extractive global supply chains.
[31] See (Sheldrake 2020, 96-98).
[32] Bennett describes this perspective as "distributive agency" (Bennett 2010, ix).
[33] See (Bennett 2010, ix).
[34] Bennett argues that our prevailing view of matter as inert and waiting to be instrumentalized by humans "feeds human hubris and our earth-destroying fantasies" (Bennett 2010, ix). Furthermore, Humanity's view of an "intrinsically inanimate matter [impedes] the emergence of more ecological and more materially sustainable modes of production and consumption" (Bennett 2010, ix).
[35] In *The Author of the Acacia Seeds* ..., Le Guin writes from the perspective of a therolinguist, who states, "So late as the mid-twentieth century, most scientists, and many artists, did not believe that Dolphin would ever be comprehensible to the human brain—or worth comprehending! Let another century pass, and we may seem equally laughable. "Do you realize," the phytolinguist will say to the aesthetic critic, "that they couldn't even read Eggplant?" And they will smile at our ignorance, as they pick up their rucksacks and hike on up to read the newly deciphered lyrics of the lichen on the north face of Pike's Peak. And with them, or after them, may there not come that even bolder adventurer—the first geolinguist, who, ignoring the delicate, transient lyrics of the lichen, will read beneath it the still less communicative, still more passive, wholly atemporal, cold, volcanic poetry of the rocks: each one a word spoken, how long ago, by the earth itself, in the immense solitude, the immenser community, of space" (Le Guin 1988). Le Guin's *geolingusim* is in essence the geological technique of radiometric dating, which allows us to better understand not only tectonic movements and the age of the earth, but also human pasts. See ("Radiometric Age Dating" 2018) for a better description of how radiometric age dating works. Even matter we perceive as cold, unalive, and inert is full of wisdom if only we pay attention to it.
[36] See (Pawlyn 2019, 65). See also *Half Earth Socialism* (Vettese & Pendergrass 2024), for a more thorough account of how we as humans can thrive through limiting our use of resources such as land, electricity, and certain types of food. Vettese and Pendergrass make a compelling argument that imposing global regulations on the consumption of electricity, we can raise the quality of life in regions in the global south, while reasonably limiting excess consumption in the global north. Other aspects of their *gosplant* include limiting meat and dairy consumption (two significant sources of carbon dioxide and land use), rewilding half of the Earth's landmass, changes that they posit can only come about through global socialist governance.
[37] In the realm of architecture, a substantial reduction in material use is possible by creating variable-density, hollow structural elements – steel beams, for example, that are thick and solid towards the base of a structure that needs to bear more weight, but which gradually thin and hollow towards the top of the structure that bears less weight, which also results in a reduction of the load that the bottom of the structure must bear. Pawlyn estimates that if we were to mimic the structure of bamboo when creating steel frames for buildings, we could minimize our material usage to ~20% of current totals, without drastically reducing the structural integrity of the steel frame (Pawlyn 2019, 2).
[38] See (Bridle 2022, 28-58).
[39] In this pursuit of "less materials, more design," Pawlyn advocates for the use of advanced Computer Aided Design (CAD) techniques such as "Soft Kill Option" and "Computer Aided Optimization" to generate lighter, stronger structures (Pawlyn 2019, 3, 7-9).
[40] (Inamuddin et al. 2023, 7-9), (brown 2017, 46-47).

[41] This is both the central premise and title of the eponymous work by Audre Lorde (Lorde 2018).
[42] See (Lyotard 1991, 28). Michelle Alexander expands on this idea further in her work *The New Jim Crow*, which details how old power structures (such as Jim-Crow era laws) are in essence "still on the books," just in more bureaucratically worded and subtly institutionalized ways (Alexander 2020).
[43] See (Kimmerer 2013, 7).
[44] Design critic and philosopher Pierre Bélanger investigates the relationship between infrastructure, landscape, and society in his chapter of *Is Landscape…?*, arguing that "the outstanding feature of the modern cultural landscape is the dominance of pathways over settlements … [governments] have transformed spatial relations by establishing lines of force that are privileged over the places and people left outside those lines" (Bélanger 2016) in (Doherty and Waldheim 2016, 190). See also (Yarbrough 2021) for further discussion on how infrastructure is used to displace and disenfranchise vulnerable communities.
[45] In MC24 / *Massive Change*, designer and architect Bruce Mau writes about the presence of design in our lives, and the end goal of design: "For most of us, design is invisible. Until it fails. In fact, the secret ambition of design is to become invisible, to be taken up into the culture, absorbed into the background. The highest order of success in design is to achieve ubiquity, to become banal. The automobile, the freeway, the airplane, the cell phone, the air conditioner, the high-rise - all invented and developed first in the West but fully adopted and embraced the world over - have achieved design nirvana. They are no longer considered unnatural. They are boring, even tedious" (Mau 2003/2020, 3-6).
[46] See *Labyrinths: Selected Stories and Other Writings* (Borges 1962/2007) for beautiful, labyrinthine short stories that are highly metaphysical, as well as *Piranesi* by Suzannah Clarke (Clarke 2021). If it is not clear from my references to these authors, as well as authors such as Octavia Butler and Ursula K. Le Guin, literary fiction is a significant source of inspiration for my creative practice.
[47] For more in-depth analysis on Near-Death Experiences (NDEs), see (Hashemi et al. 2023) for a qualitative analysis of the phenomena as reported and perceived by experiencers, and (Thonnard et al. 2013) for a qualitative analysis of the salience and profundity of these experiencers on those who experience them.
[48] See (Sheldrake 2020, 123-128).
[49] (Aitkin et al. 2008).
[50] (Katchadourian 1998).
[51] (Handler et. al 2018).
[52] Trevor Finney and I could not have completed this project without the help of our friends David Baker, Ben Knapp, Rob Gonzales, Melissa Wyers, Holly Williams, Rude Graves, Damon Brewer, Mir Ahnaf Kabbya, Burkley Lyons, Nylah Desnoyer, Elena Ahwee-Marrah, Preston Aycock, Jackson Childers, Max Ofsa, Jack Davis, Clare Suess, Rodney Kimbangu, and Sasha Mkrtchyan. We sincerely thank each of these individuals for their contributions to this incredible project.
[53] For further reading on the relationship between the author/artist and the reader/viewer, see *Against Interpretation* by Susan Sontag (Sontag 1966/2013) and *The Death of the Author* by Roland Barthes (Barthes 1977). These texts are extremely formative on my views of the relationship between myself as a person, my artwork, and my audience – I have always leaned in the direction of giving the viewer space to create their own meanings by using simple, universal geometries and placing an emphasis on form over concept.
[54] For further reading on the responsibility of the artist to their society, see *Ways of Seeing* by John Berger (Berger 1972) and *The Creative Process* by James Baldwin (Baldwin 1962). These authors articulate why art is important, and why the artist holds such great responsibility far better than I am able.
[55] See (Mau 2003/2020, 3-4).
[56] See (Hodder 2012, 6).
[57] See (Joseph Campbell in Osbon 1992, 77) for a description of the hero's journey.
[58] Psychologist and holocaust survivor Viktor Frankl argues the meaning of life cannot be found through internal contemplation. Rather, our meaning can only through external action – in fulfilling the responsibilities entailed by our relationships with others (Frankl 2006, 110-111). Life makes demands of us; to fulfill these demands with just actions is to uncover the meaning of life (Frankl 2006,144). Further, the meaning of life cannot be generalized – life makes different demands of each of us: meaning takes the form of specific and difficult situations uniquely presented to every individual – the path one takes, and the meaning found therein, cannot be compared to any others (Frankl 2006, 76-77).