

Subtle Matter and Delicate Bodies

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Abstract:*Subtle Matter & Delicate Bodies*

Stemming from an artistic mode of enquiry centred on the enmeshment of physical and virtual realms, four works are produced within seemingly paradoxical contexts of non-locality and site-specificity, distance and proximity, biology and data, and information as it pertains to technology and affect. The mediums of these works range from augmented reality, geo-locative technologies, sonic and spatial interactivity, dance choreography, 3D animation, public projection, and multimedia installation. Produced and exhibited in Kingston, Toronto, and Athens, I explore and define intersecting points of affect and materialism and the transmission of information. A new methodology is shaped through these stages of research creation, underscored by emergence, superimposition, offsets, and projection.

Drawing upon concepts developed and articulated by Karen Barad, Teresa Brennan, Ursula Franklin, and David Bohm, specifically their understanding of interconnectivity on a material level, *Subtle Matter & Delicate Bodies* makes a case for a more empathetic, equitable ethos to be implemented in urban development and city planning, and social infrastructures, within the consideration of a more-than-human existence. Underscoring downstream consequences from a historical context, the works aim to tenderly touch upon lack, absence, reverence, and resilience. Through creation, an artistic methodology has formed that interweaves science and technology with poetic and responsive expression.

This dissertation will also look upon the preceding research, studio experimentation, and exhibitions that have led to the four works of *Subtle Matters & Delicate Bodies*, and the approaches I have taken towards rendering invisible phenomena legible, felt, and considered.

Subtle Matter & Delicate Bodies

is dedicated to
The sudden fog of Lake Ontario
That stilled sails and time;
To my parents, who forged my heart with
toughness and grit;
and to Edie,
who softened and tempered it.

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Land Acknowledgment

With a growing knowledge of the history that predates the colonial oppressors who were the very architects of the genocidal Canadian residential school system, and whose names are monumentalized by the buildings and streets that I inhabit and traverse daily, I weigh the limits of words and the power of actions. The comprehensive and actionable information publicly provided by the efforts of Indigenous educators, particularly that of Kanonhsyonne/Janice C. Hill, who is the Associate Vice-Principal of Indigenous Initiatives & Reconciliation at Queen's University, Kingston, ON, of the Turtle Clan, Mohawk Nation, has provided a historical and contemporary context of the area, where I have lived since August 2020.

As I type in a safe, quiet, private location, I acknowledge holding space as an uninvited guest in the traditional territories of the Haudenosaunee Confederacy and the Anishinabek Nation. I too acknowledge the rightful stewards of this region, a region included in the Dish With One Spoon Wampum Belt Covenant, which is an agreement between the Iroquois Confederacy and the Confederacy of the Ojibwe and Allied Nations to peaceably share and care for the resources around the Great Lakes. The Anishinaabek and Haudenosaunee of the Kingston Indigenous community that live here today represent the roots of this area, where there are also Métis and First Peoples from other Nations across Turtle Island.

In developing the artworks and concepts described within *Subtle Matter & Delicate Bodies*, my research was also connected to and inspired by the plants, animals, and ecosystems within the treaty lands of the Mississaugas of the Credit First Nation, the traditional territory of the Attawandron, Haudenoshonee and Anishinaabek, where I lived and worked until the summer of 2020. The lives impacted and lost by the wrongdoings of all settlers, past and present, become more evident with the discovery of each unmarked grave, with each heart broken and the hearts that continue to break (and heal) across generations.

Acknowledgments

With long arms, open palms, and outstretched fingers, I reached into a fog I longed to explore. Within etheric climes and an opaque expanse, I sought out tender points of connection; I listened for echoing and reverberant surfaces; I felt for flows of vibrant currents, with plans to draw lines of connectivity between these findings to chart clear paths between you and me. And indeed, I came upon many such points in the form of delicate bodies swirling haze - they were the makeup of the fog itself. They were not static, however, and proved slippery to the touch. They moved exuberantly, both independently and in murmurations that would at times evade my grasp entirely, then engulf me wholly or swim right through me; my efforts to tie these kinetic points together wove more of a net than a navigable map, and I was often caught up in the lively mesh I had gathered (happily, frustratingly, entrancingly, forlornly, wholeheartedly). Some of the points I had grouped in the net swam freely through the gaps between knots, back into the fog and out of view. I thank my supportive mentors, colleagues, friends, and family who reached out to find me while I was ensnared in this vibrant entanglement and helped me navigate my way to you here and now. They remind me, *it is idle to fault a net for having holes.*¹

As you will read, the porous relationship we share on a material level is integral to my research and the body of work included in this dissertation; I imagine the holistic implications of an unbound, permeable ontology form a bubbly fascia that supports the connective tissue between the diverse media and approaches within the body of work detailed in the following chapters. The use of imagination, metaphor and analogy as processes in theoretical physics to convey an alternative dynamic to the fragmented, push-me-pull-me, cause-and-effect² linearity we perceive and experience in time and space was a point of inception for this *Subtle Matter and Delicate Bodies*. Many artists who explore the simultaneity of pluralism and wholeness through formal and conceptual means have shared this kind of imaginative methodology, sometimes explicitly and sometimes implied. Many thanks are owed to the writing of Linda Dalrymple

¹ Nelson, Maggie. *The Argonauts*. Greywolf Press, 2015.

² Franklin, Ursula. *The Real World of Technology*. Toronto: House of Anansi Press, Inc., 1999.

Henderson, particularly for her work *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, providing a rich, integral historical tome of formal analysis of countless works by artists engaged in the conceptual realms of theoretical physics.

As I explored the overlap of science and art within my doctoral degree, the abstract and esoteric concepts relegated to physics became more readily discernible through recent years of global crises; the model of an *implicate order*,³ as described by physicist David Bohm, on an overtly material level, evidenced by widely accessible, peer-reviewed data, and empirically observed in on collective and individual levels. My research's feathery, soft-spun, and intuitive beginnings became palpable in the collective losses, setbacks, and life adaptations in pandemic times. The inextricable relational continuum we share in which the well-being of one determines the well-being of all is no longer philosophical but is felt directly in our daily lives, as David Bohm had presciently and painstakingly detailed in his writings and televised conversations with Jiddu Krishnamurti, and in his research with neuroscientist Karl H. Pribram. I arrived at Bohm's concept of wholism and interconnectivity via Michael Talbot's accessible and fascinating synthesis, *The Holographic Universe*. Talbot's introduction to Bohm's philosophies and concepts and the transdisciplinary amalgamation of the holomovement in medicine, psychology, and neuroscience provided entry to Bohm's dense texts, for which I am immensely grateful.

Understandably, in a time marked by planetary upheavals such as the catastrophic effects of climate change, social unrest and injustices, war, a looming financial recession, a global pandemic that isolated us, that kept us still, and that devastatingly brought forth collective grieving, one may lose their footing, in all manners of life. At times, I found it difficult to recover and regain momentum in my graduate degree that was challenged and obstructed by COVID-related fallout, loss, and concurrent illness. Fortunately, the challenge to find words to express my gratitude for the support I have received from my collaborators, mentors, curators, advisory committee, and friends is one obstacle that I can live with - I face this impasse with the deepest thanks. To my supervisor, Marc Couroux, who introduced me to the works of Karen Barad and

³ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980.

Teresa Brennan, whose respective works provided a through-line with the grip and traction needed to navigate the nascent, intuitive beginnings I first shared in his Contemporary Theory course in 2016, eternal thanks for sharing this conceptual well from which to draw. Marc led our cohort through manifold theories, sharing his knowledge and time with us generously, with extraordinary kindness and grace. Mark's thoughtful consideration in building an exceptional advisory committee enriched the discourse surrounding my studio practice and research. To work with my committee of Marc Couroux, Janine Marchessault, and David Rokeby, has been a shimmering highlight in my professional career; their kindness, compassion, and support sustained me in moments of doubt and inertia. Thanks to Janine for entrusting me within her curated programmes *In/Future* and *Nuit Blanche* (Toronto, 2016, 2022), and for your insight and guidance, helping me surmount the bumps and obstacles that arose over my graduate degree with patience and empathy. As a media art hero to me since I was an undergrad student at OCAD University, to work with David Rokeby was surreal, but to know him as a generous, humble, kind person has further elevated my admiration of him.

Like everyone, graduate students ran towards shifting goalposts during COVID, wherein plans were postponed, rescheduled, or ultimately cancelled, studios and labs became inaccessible, and travel came to a standstill, impeding research and productivity. I am thankful to commiserate and share the experience with my lone Ph.D. cohort member of 2016, Kristie MacDonald, and the Ph.D. students of the following cohort years, including Ella Dawn McGeough, Ella Tetrault, and Annie Dunning.

Many thanks are paid to pioneering new media artist and professor emeritus Nell Tenhaaf, and to the meticulous and insightful administrator Dawn Burns, whose critical guidance led me to the Joseph-Armand Bombardier Canada Doctoral Scholarship Award, which enabled me to pursue my graduate degree with financial stability. Innumerable thanks to the brilliance and generosity of artists and mentors Suzy Lake, Susan Dobson, Sandra Rechico, and the FASTWÜRMS (Kim Kozzi and Dai Skuse) for their support in my application to York University, and for the nurturing friendship I have valued so greatly over the decades that I had

the fortune to know them. The FASTWÜRMES took me under their webbed and feathered wings when I was a 19-years-old undergraduate at the Ontario College of Art and Design where they modelled how rigour need not be antithetical to whimsy, camp, joy, and humour. Special thanks, too, to Allyson Mitchell and Deirdre Logue, for their humour, creativity, scrappiness, friendship, long held support, and for their hospitality to Edie and I during the our residency at the Feminist Art Retreat in 2022.

Many thanks to the Faculty of Visual Arts, Art History, and Cinema & Media Arts, who provided me with a wealth of resources and insight, including (but not limited to) Barbara Balfour, Nina Levitt, Jennifer Fisher, Pamela Phatsimo Sunstrum, Sarah Parsons, Taien Ng-Chan, Dan Adler, Yam Lau, Holly Ward, with particular thanks owed to those with whom I worked with as a Graduate Research Assistant and Teaching Assistant, including Brandon Vickerd, who mentored me as we worked on the Public Art Symposium hosted by York University in 2017, and Katherine Knight, with whom I can not only laugh with until we are both blue in the face but who was an invaluable creative and professional mentor to me during our time together teaching the Photographic Experience and Fundamentals in Art: 4D.

To my collaborators, I am thankful for their trust and the time and effort they invested with me. My art career has lead me to many fruitful co-creations and friendships, including several of the collaborative works detailed in this document with artists Christy Langer, Katie Ewald, Shary Boyle, musicians Bry Webb, Cormac Culkeen and Dave Grenon of Joyful Joyful, outreach facilitator Leslie Fisher, dancers, choreographers and somatic practitioners, Julia Garlisi, Ame Henderson, Janet Johnson, Andrea Nann, Kevin O'Connor, and Coman Poon. Steph Yates, Emily Pelstring, Alissa Firth-Eagland, Anna Bowen, Laura Watt, Julie René de Cotret, Krista Muir, Xuan Ye, and Sojung Bahng, I am endlessly grateful for our heartening art and friendship overlap.

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To my parents, whose seemingly polar fascinations of the sublime confounded and intrigued me, sent me grappling through the paradoxical conundrum I was born into; under the influence of an atheist, scientifically-minded father and a devoutly Catholic mother, there was a wide berth of exploration to peruse on the bookshelves of my childhood home. For this mishmash, textual trove, I am thankful to them. My mother died in the summer of 2020 after a sudden onset of illness under my care; there is little in *Subtle Matter & Delicate Bodies* that escapes the influence of her illness and passing during this transformative period.

Finally, to Edie. I love you with my whole heart, and thank you for being you, for enduring hard times, for your patience with the boredom that having a single parent who works long hours entails, for your frank and thoughtful feedback, your humour, creative spirit, and love.

Collectively and individually, much has come to an end, and much has been resurrected (at times, as a phoenix, at others, as a zombie). Hard won adaptations bring newness, and I am thankful for the foundation of support and care to build up anew.

Introduction.

It may surprise many that one of the most significant theoretical physicists of the 20th Century was deeply concerned with linguistics. David Bohm, a protégé of Einstein who made radical contributions to quantum physics, neuropsychology, and philosophy, paid tremendous attention and rigorous contemplation towards etymology, conjugation and sentence structure. He believed that relationships of structure-verb-object fundamentally and profoundly shaped how we understand our position in the world, particularly in regards to how we observe, measure, and categorize, meticulously analyzing and articulating how language forms problematize our psyche. Bohm insisted that “*the subject-verb-object is continually implying an inappropriate division between things but, even more, that the ordinary mode of language tends very strongly to take its own function for granted*” and argued at great length that this removes the symbolic function of the language, leading us to focus predominantly on the content discussed, rendering ourselves ignorant to the active and ongoing nature of relationality. For example, with words like ‘relevance’ and ‘irrelevance’, Bohm suggests that we *re-ordinate*, meaning, to reposition ourselves by transforming the noun of ‘relevance’ to the antiquated verb that it derives from, ‘to relevare.’ In doing so, we actively lift or elevate something into our attention rather than attributing the object with a quantifiable intrinsic value or relevance in and of itself. ‘To relevare’ is to behold something ‘in relief’, meaning, to be observable as a structure or model that is projected from a surface.

According to Bohm, in reorienting ourselves in language, a meaningful, interconnected relationship emerges based on an active, ongoing discernment that accounts for change, variables, and context. Bohm explains how our thinking is shaped by a flawed language system that elicits an “*atomistic attitude*” in which, like field theory in physics, particles are “*convenient abstractions from the whole movement*.”⁴ Bohm analyzes words like ‘totality’, ‘truth’, and ‘constant’ as misleading absolutes, indicative of the fragmenting force of language, and offers alternatives such as ‘wholeness’ and ‘conditioned things’; using syllogisms of Aristotelian logic

⁴ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980.

formed by deductive thinking to then reason through how ‘totality’, ‘truth’, and ‘constant’ fall apart. Bohm often leads his readers through poststructuralist paradoxes to make use of our pre-existing knowledge of words, logic, to deconstruct perception, to ultimately explicate interconnectedness. As Bohm believes that fragmentation is the cause of social injustice and inequalities, he offers a conceptual paradigm which he refers to us as the rheomode model. The rheomode model involves an exploration and experimentation of language and thought, wherein grammar and syntax are configured to foster a defragmented way of thinking that ultimately affects how we perceive and move through the world. Bohm’s view of language as world shaping is echoed in author and scholar Thomas King’s Massey Lectures, *The Truth about Stories: A Native Narrative*, “We [...] knew that stories were medicine, that a story told one way could cure, that the same story told another way could injure.”⁵ Professor of Contemporary Art and Theory Natalie Loveless reminds us in her manifesto, *How to Make Art at the End of the World*, of what Jeanette Winterson tells us: it is *language* that speaks *us*, rather than us speaking it.⁶

Bohm is arguably an unsung predecessor of New Materialism, which is a politically motivated revival of materialist ontologies shaped by the discursive practices of an interdisciplinary group of writers, philosophers, scientists, theoretical physicists, feminists, and cultural theorists, including (but certainly not limited to) Karen Barad, Jane Bennett, Rosi Braidotti, and Vicki Kirby at the onset of the millennium.⁷ New Materialism is rooted in the natural sciences, feminist discourse, and is inherently political. Arguably, it was equally ethically motivated, if not overtly political, for Bohm as well.

⁵ King, Thomas. *The Truth about Stories: A Native Narrative*. House of Anansi, 2003.

⁶ Loveless, Natalie. *How to Make Art at the End of the World*. Duke University Press, 2019.

⁷ Yi Sencindiver, Susan. “New Materialism.” *Oxford Bibliographies*, 26 July 2017, www.oxfordbibliographies.com/display/document/obo-9780190221911/obo-9780190221911-0016.xml#:~:text=Spearheaded%20by%20thinkers%20such%20as,both%20the%20human%20and%20natural.

In this, it was then somewhat validating that the term New Materialism was gently critiqued by wholistic thinker, theoretical feminist and physicist, Karen Barad, who, in a remote lecture hosted by the University of Toronto and moderated by artist and Goldsmith's professor, Jol Thoms in 2022, wondered aloud, *what's so new about it?* There are many overlapping considerations in the ethos of New Materialism that could be traced directly to Bohm; it has been curious to me that Bohm is rarely discussed in the recent upwelling of interest in theoretical physics; I equally wonder how his research would be shaped by present-day discourse and crises surrounding global pandemics, economy, equity, and access, which are considered here in *Subtle Matter and Delicate Bodies*.

To draw a through line across the amorphous realms of particle theory, affect theory, and epidemiology, is to map a constellation rather than a linear, static delineation, and is, to me, indeed a daunting, yet poignant task. In *Subtle Matter and Delicate Bodies* I cast a net to momentarily cluster the wholeness of multitudinous matter and mattering before it permeates out through the holes of twisted ephemeral fibres I have imperfectly knotted. As an artist and technologist without a formal scientific foundation (aside from a brief stint as an electromechanical student via correspondence through George Brown College), I am wary of the chasmic pitfalls of the pedestrian opine within the foreign fields of study that lay before me. My intention is to examine methodologies of theory in physics that employ imaginative means by such physicists as Bohm, Barad, and Ursula Franklin, who all use linguistic means as a orientational and perceptual device, and how art as a counterpart, can use a poetics to form and create moments of experience that touch on these concepts. In many ways, this dissertation is very much about methodologies for orienting in simultaneous local and world space positioning.

Subtle Matter also reflects upon how historical transportive visualizations have played a key in forming fundamental principles that shape our understanding of the physical world, and by extension, our ethics and ontological underpinnings, or, within the New Materialist purview,

our *ethico-onto-epistem-ology*⁸. These transportive imaginings explored breaks from the Wittgensteinian use of analogy and metaphor as an imperfect explicative or illustrative device, as they are capable of scaling up from their conceptual beginnings to an observable event in the real world, without running out of rungs while running up Wittgenstein's Ladder.

Drawing upon the vehicle of affective literature, including auto-fiction and experimental writing, *Subtle Matter & Delicate Bodies* forms an armature to inhabit and wander through the manifold trajectories of phenomena, matter, and affect that I have attempted to map, albeit circuitously. As particle theory physicist Chanda Prescod-Weinstein implores her readers to understand, science is not apart from scientists, from humans, and identity is very much implicated in the formation of what we have come to know as "science." Prescod-Weinstein's mattering of location, lineage, and identity offers a contemporary positional overlap to the rallying statement of *the personal is political* of second-wave feminism, a demand brought to the fore in the late 1960s for the experience of persons outside of the established political arena to be heard and legitimized in the larger discourse on rights and freedoms. In Chapter 1, processes of interiority, perception, and trauma are a means to place my experience within a larger narrative of the urgency of our times, and to enfold the micro and macro within the purview of the wholistic model and *ethico-onto-epistem-ology* key theoretical physicists and artists have detailed. Weaving affect theory through the device of auto ethnography and affective writing, I draw inspiration from the collaboration of cultural theorist Lauren Berlant and anthropologist Kathleen Stewart's *The Hundreds*, which uses first thoughts as a means to convey and evoke affect in a series of texts that adhere to a one-hundred word limit, or within a multiple of one-hundred words, as well as the experimental writing of Virginia Woolf, particularly in her exploration of interiority as the sole means of shaping the narrative in *The Waves*. Joan Didion's *The Year of Magical Thinking* was also an influence as a literary means to process grief as she strives to discern "the shallowness of sanity [and] life itself." Here, I write of collective and

⁸ Barad, Karen. *Meeting the Universe Halfway. Quantum Physics and the Entanglement of Matter and Meaning*. Durham – London: Duke University Press, 2007.

individual loss through the lens of contagion on pandemic and endemic scales which informed the creation of the four artistic works to be discussed.

In a continued articulation of local to world views through a perspective of interiority, Chapter 2 details my artistic and studio practice through the experience of observation. By looking at nature and moving through urban and naturalized landscapes, augmented reality experiences explore the practice of offsetting with the intention to *leviate* (to raise something into relevance as, Bohm detailed). By creating a mediated offset between subject and environment, the uncanny is evoked, an *object a* is digitally conjured, to be gleaned through the apparatus of a mobile device and navigated by the viewer's proximity and orientation in space.

Chapter 3 examines the relationship of the digital image vis-à-vis the natural environment shaped in the site-specific animated multimedia work entitled *Tributaries*. Responding to recent environmental events that occurred in and around the York University campus, *Tributaries* draws attention to the diversion of waterways and biodiversity of the surrounding area, including native and invasive species. *Tributaries* fans the increasingly thin veil between virtual and physical realms while exploring emergence and regress, visible and invisible natural phenomena. Through these dichotomies, electricity emerges as a defining agent in creation, animation, and creativity, both in the natural world and in the mediated framework of *Tributaries*. This is examined in a close reading of Barad's *TransMaterialities: Trans*/Matter/Realities and Queer Political Imaginings*, which draws upon experiments in Galvanic energy, Mary Shelley's *Frankenstein*, cellular (re)generation, and virtual particles in quantum field theory, factors that are figuratively imbued within *Tributaries*.

The alteration of waterways are again contemplated upon in the site-specific audio work, *Mnemonic Fish*. Located in Athens, *Mnemonic Fish* uses geolocate technology to anchor sound to the ancient buried river Ilissos. Folding in disparate literary, mythical, and historical allusions to thought, memory, and rivers together, Chapter 4 looks at *Mnemonic Fish* with Aby Warburg's

Mnemosyne Atlas in mind, through the lens of Giorgio Agamben's *The Signature of All Things*. *Mnemonic Fish* uses aural superimposition as a contemplative vehicle to explore distance and proximity, access and obfuscation, wherein location, performance, and technology enmesh disparate references.

Vibrant matter is further explored in Chapter 5 within the collaborative multidisciplinary and multimedia installation creation, *Valence: All the Rage* in which we explored the emergent processes formed by an amazing assembled group of dancers, somatic practitioners, teachers, therapists, musicians, artists, and community developers. This chapter looks at collaboration by way of Natalie Loveless' dive into the interloper's journey through diverse fields of study as a *polydisciplinamory*, using a psychoanalytic framework to speak to the methodologies of research-creation as a form of *eros*. *Valence: All the Rage* is a multi-disciplinary pedagogical and research-based creation, exploring sound vibrations, electromagnetic phenomena, and entrainment through empathetic exercises and experimentation with visualization technologies. Emerging from many conversations between Katie Ewald and I shared throughout previous collaborations regarding affect, matter, and my research into historical maverick figures in the annals of physics was a through-line of conceptual interest in Sophie Germain's research in elasticity, and the intricate patterns that emerge through vibrations, as seen in Chladni plates. In the near imperceptible disruptions of surfaces through vibrations, particulates move into ornate, organic formations of symmetry. As a collective, we are looking at how mathematicians and physicists, such as Germain, as well as artists, botanists, biologists and healers alike have equally embraced the study of geometries such as the Fibonacci sequence, some formally, others intuitively. It is also an embodied, cultivated mode of inquiry into how and where technique and technology differ and intersect, or as John Durham Peters writes in *The Marvelous Clouds: Towards a Philosophy of Elemental Media*, wherein technique is the embodiment of practice, in contrast to technology which is a robust externalization.⁹

⁹ Smit, Rik. "The Marvelous Clouds: Toward a Philosophy of Elemental Media." *TMG Journal for Media History, Sound & Vision*, 26 June 2017, tmgonline.nl/articles/10.18146/2213-7653.2017.289.

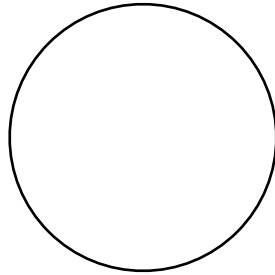
Chapter 5 returns to Bohm's rumination on thought as a material process, in which he makes distinctions between memory, thought, intellect, and perception. Here, Bohm's concepts of implicate order, a source beyond material processes, is explored. With Bohm's rheomode in mind, *Subtle Matter and Delicate Bodies* reflects on the study of matter as a relational agent within the contexts of research and reflection, and moreover, through the act of art making, where processes and methodologies have emerged. In this chapter and conclusion, parallels between affect and thought are considered, looking to Australian feminist philosopher and psychoanalytic theorist Teresa Brennan's posthumously published book, *The Transmission of Affect*.

As the works detailed in *Subtle Matter and Delicate Bodies* are largely site-specific and processed based, they can be viewed in multifaceted documentation in an expanded website, www.subtle-matter.com. Here, viewers can experience augmented reality, view video and photographic documentation, listen to audio compositions, and navigate the works through contextualizing texts.

**“Language always betrays us, tells the truth when we want to lie,
and dissolves into formlessness when we would most like to be precise.”**

— Jeanette Winterson, *Sexing the Cherry*

Chapter 1



O v e r f l o w

Everything's falling apart together

Practices of knowing and being are not isolable; they are mutually implicated. We don't obtain knowledge by standing outside the world; we know because we are of the world. We are part of the world in its differential becoming.

-Karen Barad

Meeting the Universe Halfway:

Quantum Physics and the Entanglement of Matter and Meaning

SUN PIECE

Watch the sun until it becomes a square.

winter 1962

- Yoko Ono

grapefruit

An Abject Vessel for Space Travel

Peering into the droplet of water held between my thumb and forefinger, a globular column is formed. The surface tension draws the molecules both upwards and downwards, refracting the world's image on its head, bending and stretching it. The minute trembling of my digits oscillate its shape between squat and hourglass forms. Held together in the embrace of its cylindrical meniscus, the droplet seems to defy gravity, refusing to run down my thumb and goose-bumped arm or to split into two. Unfazed and transfixed, I flatly note how this occurrence would surely reside in the realm of the uncanny if it wasn't so familiar and commonplace. The hydrogen bonding I observe in my pinching grasp occurs continually within and about us as a pillar of biology, forming myriads of shapes that allow life to carry on as it does, from plants nourishing their bodies with photosynthesis to the double helix that coils DNA within our cells¹⁰. How unremarkable this droplet would be to me if I hadn't isolated it from the rest of the water pooled below, if it were not offset in my tenuous grasp.

¹⁰ Roisen, Patrick, director. *Hydrogen Bonds. Brightstorm*, <https://www.brightstorm.com/science/biology/chemical-basis-of-life/hydrogen-bonds/>. Accessed 14 Feb. 2023.

Presently, I inhabit two places, contemporaneously and distinctively. I am here, naked, half submerged in the bathwater from which I have drawn this droplet in the doldrums of the late summer, and I am also here, hunched over my laptop in a tangle of blankets in my bed and the coolness of early spring, writing to you. The bath has chilled, diminishing its comforting effects. The bed is warm and soft, yet my bones press down sharply to support the weight of my focused gaze, my wrists upright and finger tips curled down towards the keyboard, my skin pinched against the giving surfaces of the mattress - just as it is pinched against the immovable ceramic tub. Here and there, gravity is a constant companion.

The pulse in my stomach ripples the water's surface in subtly arrhythmic diffractions, scattering the light of the overhead fluorescent fixture to shimmer above my body. Watching its patterns, I am reminded of the call of springtime toads who vibrate their sides with a sustained trill, rippling the water of the shallow pools they are perched in. Shaping space with the glimmering concentric outlines they emit from their toady contours, their call is felt, seen, and heard widely, as neighbouring toad calls traverse the spring air in an intermingling of sensoria. The minute waves my heartbeat emits now, however, meet none other than the cycloramic walls of the bathtub. Internally, neurons branch through the brain, producing an electrically induced wavelength phenomena¹¹, rippling fields of electric interference across a dense neural canopy, overlapping and affecting one another in holographic-like patterns. Neuroscientist Karl H. Pribram theorized that this electric diffraction within the mind functions much like a holograph.

¹¹ Talbot, Michael. *The Holographic Universe*. HarperCollins Publishers, 1991.

Memory is not localized, he postulates, but can be accessed from multiple parts of the mind, just as a cutout square inch of a holograph can project the entirety of an image when a laser shines through it, albeit in lower resolution.

The amount of information a holograph and a mind can store is staggering.

Mathematician and physicist John von Neumann estimated that the human mind stores 2.8×10^{20} bits of information (2.5 million gigabytes). As I type and as I soak, I feel the weight of this incomprehensible number upon my mind, though hushed and dulled, it occupies my headspace and presses down upon me. I fantasize about separating from the maleficent bits of information and attach them to the water molecules that surround me and wash them away in the vortex of the drain. But not just yet, nor for a long while yet. A vortex can be very stable. The Great Red Spot of Jupiter has whirled its monstrous vortex of 16,350 km in width¹² since it was discovered over three hundred years ago. Wide enough to engulf the Earth. With thoughts from Jupiter to the Earth, the dripping faucet keeps time as a watery metronome, haunting my ears with each lonely ascending note.

How long will this droplet hold shape between my fingers before it, bit by bit, rejoins the molecules that mingle about my lower half. These gathered atoms will find a way out of here, whether they run into the pipes below, evaporate from my pruning skin, or the crumpled towel on the bathroom floor, or the pools of wet footprints of the laminate flooring. Ever shapeshifting,

¹² Britannica, The Editors of Encyclopaedia. "Great Red Spot". Encyclopedia Britannica, 16 Apr. 2023, <https://www.britannica.com/place/Great-Red-Spot>. Accessed 4 June 2023.

they'll separate and gather, again and again, as torrents, clouds, rain, dew, and tears - but for now, this droplet tenuously keeps in my gaze and my grasp. I long for warm depths to submerge fully, free from weight, friction, and strain.

My bones continue to dig in and pinch the skin thinly beneath my elbow and lower vertebrae; does the longing to float stem more from gravitational fatigue, or from desire? To soar freely through space faster, further, higher? Is it less or more from reality that we want? Worldweary or rapt with wanderlust, a weightlessness where we are distinctly and uniquely free from the grounding effects of mass tugs on our heavy longings.

In *The Waves*, Virginia Woolf explored grief and isolation through an experimental prose wherein the plot unfolded through the interiority of each character, ultimately, underscoring the interconnectedness of all things, and writes, "*Alone, I often fall down into nothingness. I must push my foot stealthily lest I should fall off the edge of the world into nothingness. I have to bang my head against some hard door to call myself back to the body.*" Strangely, in the depths of my own isolation, I often feel that I will lose my footing to slowly fall away from Earth, out of reach and unmoored, where there is no up or down to orient oneself, only proximity and distance. Despite a localized perception of place in time and space, we are swept along as a clutch of many, like water molecules caught in the whirlpool of a drain, we are unwitting and incapable of moving against the pull towards the inevitable, falling together.

As frustrated as our waking and dream selves may be with the gravitational threads that tether us to an immense celestial body, we are indeed continually floating, falling, hurtling, through space. The illusory effects of stasis are rooted in the perception of our local environments, such as the minute doldrums of a chilling bathtub, or the quiet room where our typing resounds, feeling apart and distinct from a shared planetary movement through space. The short leash of gravity denies us the vantage to perceive our velocity as we spiral towards our closest star while our moon orbits about us; few have seen the Earth as a whole, with the distance that affords a fleeting objective perspective, to see outside of the myopia of Earth-bound vantage. The 1968 photograph, *Earthrise*, taken by astronaut Will Anders during the first crewed voyage orbiting the moon offers a glimpse of our planet as it is seen from afar, as a singular body, rising over the horizon of the lunar landscape. Astronauts and cosmonauts have described an emotional, profound paradigm and cognitive shift with this new perspective of our home, beautiful, vulnerable and small against the vast blackness of space, resulting in a psychological phenomenon author and space philosopher Frank White referred to as The Overview Effect in 1987. Those who have experienced it have expressed a desire to share its effects with others, as it imbued them with a transformative sense of connection to people and to Earth wholly.¹³

In 2015, the International Space Station (ISS) crew spent a year in orbit as an exploration of the challenges long-duration spaceflight entail, doubling the length of preceding missions, to examine sleep patterns, exercise routines, visual impairment, microbial and metabolic changes,

¹³ Yaden, David B.; Iwry, Jonathan; Slack, Kelley J.; Eichstaedt, Johannes C.; Zhao, Yukun; Vaillant, George E.; Newberg, Andrew B. (2016). "The overview effect: Awe and self-transcendent experience in space flight". *Psychology of Consciousness: Theory, Research, and Practice*.

immune system and effects of stress, and how the crew members interact with one another over time. As a means of public outreach, an episodic television series was produced that documented the yearlong experiment, wherein the mesmerizing phenomena of weightlessness was playfully explored and explained. In a segment dedicated to the effects of fluids onboard the ISS, Cosmonaut Mikhaïl Kornienko squeezes a globule of lemonade into the air from the spigot of a water bag. His movements are slow, as though submerged in watery depth, the liquid gathers at the spigot's tip, wobbles and grows into an amorphous blob. Similar to my little droplet, it is held together by the surface tension, settling into a perfect sphere as it detaches from the spigot and floats in the air untouched and without friction. Kornienko moves upon the newly formed crystal marble, mouth agape to gulp it in as a fish breathes in a floating morsel of food.

Though it appears that Kornienko and the globule of lemonade are floating in peaceful weightlessness, they are, in fact, perpetually falling at an incredible speed. The entirety of the ISS, including its occupants, careens around the Earth every 90 minutes, rounding on 16 orbits every 24 hrs, passing through 16 sunrises and sunsets every day in a low Earth orbit (LEO). To that end, the ISS is not in a zero gravity environment; it is only approximately 2000 km above the Earth's surface and shares a nearly identical gravitational pull as we terrestrials - and we are falling too.

Gedankenexperiment

The realization that we are all falling together is attributed to Einstein in 1907, in what he described as the “the happiest thought of [his] life.”¹⁴ This revelation came to him through something of a daydream, imagining a scenario of falling from a roof.¹⁵ Long before the International Space Station, Einstein determined that while in free fall, we would no longer feel the weight of our bodies, particularly if our perception of our environmental frame of reference appears static. Without air drag to ruffle our hair and clothes or brush against our skin to stimulate our haptic senses or to be heard as it rushes past our ears, it would be impossible to discern whether we were floating in space or falling. From hypothesis, he extensively contemplated the role of perception and sensation within our understanding of space, orientation, and trajectory, resulting in the formulation of the equivalence principle.

Einstein’s imaginative scenarios, often furnished with props and settings derived from the everyday, where activities could play out to a logical conclusion, functioned to conceptualize, visualize, and embody complex theories in physics and became a defining feature of Einstein’s theoretical methodologies. A scenario-based thought experiment, or *Gedankenexperiment*, as Einstein referred to it, not only helped explain complex theories to a broader public, but perhaps more remarkably, it served as a locus for conceptual inception. For instance, according to

¹⁴ Einstein, Albert. “The Fundamental Idea of General Relativity in Its Original Form.” 1919, unpublished essay written in longhand, *New York Times Archives* (1972): <https://www.nytimes.com/1972/03/28/archives/excerpt-from-essay-by-einstein-on-happiest-thought-in-his-life.html>

¹⁵ Einstein, Albert. “The Fundamental Idea of General Relativity in Its Original Form.” 1919, unpublished essay written in longhand, *New York Times Archives* (1972): <https://www.nytimes.com/1972/03/28/archives/excerpt-from-essay-by-einstein-on-happiest-thought-in-his-life.html>

Newton's second law of motion, all objects fall to the earth at the same velocity; however, this may not always be apparent to observers as it confounds on an experiential level; as we have learned that bodies moving through space are affected by numerous sensorial factors, but we can observe the second law of motion more readily in a vacuum. In a vacuum, a feather and a bowling ball dropped simultaneously from a height will fall to the ground at the same rate. It is an uncanny event to behold and requires immense environmental control. Without the technical resources to stage such an experiment in 1907, Einstein intuitively furnished his imaginings with what was familiar to him to formulate his hypothesis. Furthering the imagining of falling from the roof, Einstein conceptually inhabited the space of an enclosed elevator to experience and determine how it would feel for a human to fall within a vacuum. He postulated that in the interior of a windowless, hermetic chamber, akin to something like a sensory deprivation tank, plummeting to Earth at terminal velocity would confound our understanding of trajectory and gravity. Einstein used the familiar scenario of an elevator to set the scene for this *Gedankenexperiment*, where we could observe other objects falling in tandem with our descent, which appear equally weightless, floating together as though in a zero gravity environment, rather than falling to Earth at the same velocity. Letting go of a set of keys, we, the passenger, would see them hover before us. If we were to push off from the elevator floor, we would float upward without resistance, just as they do today on the ISS.

Similarly, yet perceptually inverse, if we were to be propelled upward in this enclosed elevator at a rate of 9.8 s/m^2 , the same rate as earth's gravitational acceleration, all the contents within this space would behave as they would on earth; the floor would be felt pressed up against

our feet, and if the keys in hand were let go, they would drop to the floor. Sensorially, there would be no way to determine whether we were hurtling through outer space, or resting stationary on earth. Without the interference of wind or the reference of a stationary landscape, direction is relative to what you perceive. In this imagining, Einstein had discovered that gravity and acceleration were one and the same, and this conclusion became known as the principle of equivalence. Gravity was not a force, as Newton had described, but an effect of the warping of space and time in the presence of mass. "There is no logical way to the discovery of these elementary laws," Einstein writes, "There is only the way of intuition."¹⁶

The use of analogies and metaphors that are comprised of everyday objects, or activities, are not only useful to illustrate an equation, but can also provide the genesis to complex theories. Einstein's experiential metaphor was not only a communicative device, but also functions in practice; unlike a rung in a Wittgensteinian ladder, Einstein's elevator was technically accurate. The experience of weightlessness on the ISS is a direct example of Einstein's "happiest thought" in action. And on Earth, we too are all falling together through the expanse of space. Beguiled by this continual free fall, without a frame of reference, we too might think that we are in stasis rather than hurtling towards the colossal gravity of the sun. We may even presume that bathwater droplets held in the tiny space between the open pinch of forefinger and thumb are so stable, they just might always hold still.

¹⁶ Holton, Gerald. "On the origins of the special theory of relativity." *American Journal of Physics*, vol. 28, no. 7, 1 Oct. 1960, pp. 627–636, <https://doi.org/10.1119/1.1935922>.

The cooled water and the whirl of the fan hardwired to the bathroom's stark light provide a sensorially uncomfortable chamber to fall within. This era, defined by the experience of quarantine and isolation, produces the illusion of stillness, seemingly held in state of social suspended animation. Yet, it has also underscored movement within our physical reality that is overtly porous that cannot be contained, despite our greatest efforts. A sneeze, a cough, to sing, to laugh, to exhale an exasperated sigh have become vehicles of catastrophe, and move with impunity through global populations. Invisible aerosol agents of contamination loom largely upon our minds, making unlikely villains of wet and lively molecules.

“[T]here is no such thing as “pure” water. There never was; we must abandon that false dream. We will always be breathing each other’s vapours, drinking each other’s exhaust[...],” Sophie Lewis writes in 2017, glibly invoking Donna Haraway to conclude that we are all, in fact, *“swimming in urine.”*¹⁷ In hindsight, Lewis, who is a polemic academic and proponent for the abolition of the family unit via mass use of surrogacy or exegesis had presciently described an abject underbelly of the material holism that we see so plainly today.

My point of focus shifts beyond the droplet to the sores that zigzag across my legs. I scan my body, visually connecting the red dots along the white subcutaneous channels, feeling like a necromantic surrogate of sorts, and this water is indeed contaminated with microscopic agents of calamity.

¹⁷ Lewis, Sophie, and Sophie Lewis. “Amniotechnics.” *The New Inquiry*, 31 Dec. 2017, <https://thenewinquiry.com/amniotechnics/>.

My mother has just died, yet, she is still with me in a sense, as the parasites that made her their home and feasted on her dermal tissue now bore through my skin. Although she succumbed to the mites that ravaged her weakened, immunocompromised body, the ancient communicable disease is easily treated when caught early. Without access to an in-person medical assessment due to the early precautionary restrictions of the pandemic, my mother, who had become deaf and blind in recent years, went on for months in agony in the isolation of her home. Until this staggering experience, I had previously associated this skin condition as a minor yet unpleasant affliction of kindergarteners. Reviewing the coroner's report that identified the mites as the cause of her organ shutdown following an elective adrenalectomy, I find the tenacious perseverance of these microscopic creatures tragically impressive. After finally being admitted to the hospital after her limbs blackened and her skin scaled and mottled, the entire ward became infected, as have I. The transmissibility of advanced stages of this communicable disease is staggering and unwieldy. Upon admitting her to the hospital, a confluence of contagion prevented me from seeing her conscious again.

This is the summer of 2020, a year in which the fear of breathing itself weighs heavily upon us. The inhalation of air carrying deathly particulates is the global catastrophic event of our time, yet the notice of contagion hung on my mother's hospital door had warned of a different threat, and as I sit here in an isolation brought forth by the catastrophic effects of both microbial agents, I contemplate how it is the infinitesimal that act as the pervasive disruptors of our era, and we, their hosts.

While transmissibility has become pronounced within an overt practical and scientific context, it is not new, or unprecedented. In fact, the case could be made, and is made by many, that embracing an inter-connective model ontologically, materially and philosophically, is the only sane path forward. David Bohm, a protégé of Einstein who was perhaps the most important theoretical physicist of the 20th century, expounded upon the negative impact that fragmented thinking has on not only a scientific practice, but on societal wellbeing as a whole. Bohm explained that while compartmentalization offers numerous practicalities to manage quantities and classifications of material substances and bodies, to intellectually set oneself apart from the world and nature is fundamentally detrimental to the individual and collective psyche.¹⁸ Bohm and his contemporaries were working in a time when the pluralistic nature of particles was a relatively new discovery. Wave-particle duality introduced atomic discontinuity and indeterminism, challenging the very principles of classic physics and birthing quantum mechanics. It became evident that the method in which we observed a particle determined its perceived position in space, and that a particle was in multiple places until it is observed by an apparatus in a specific location. We could align the concept with the familiar adage, “We don’t see things as they are, we see things as we are,” or moreover, as the complicated yet formative figure in the field of early quantum physics, German physicist Werner Heisenberg, is often quoted, “What we observe is not nature in itself but nature exposed to our method of questioning.”¹⁹

¹⁸ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980.pp.2-3.

¹⁹ Heisenberg, Werner, and Werner Heisenberg. *Physics and Philosophy the Revolution in Modern Science*. Allen & Unwin, 1959.

Throughout my graduate degree and in my artistic practice, I have been researching the nature of matter from a materialist lens and from that of an ontological and empathetic framework as defined by David Bohm's holomovement²⁰ model and later, by fellow theoretical physicist and feminist scholar Karen Barad, with their concept of *agential realism*²¹. The interconnectedness of the physical world unequivocally demands equity and compassion unilaterally on an individual level for the wellness of the whole. Looking to the insights of quantum physics, and specifically to the work of a contemporary of Einstein's and a formative figure in quantum theory, Danish physicist Niels Bohr, Barad offers an ontological and epistemological framework that positions matter as an active agent in the forming of reality, rather than a passive material to be shaped extrinsically. *Agential realism* shifts the notion of agency from something one possesses, to something that is affected and affects in a process Barad refers to as '*intra-action*'. In lieu of 'interactivity', wherein discreet bodies enact linear paths of causality, *intra-activity* posits that "*individuals exist because of the existence of given interactions: and, furthermore, that even matter exists as a phenomenon, i.e. as the materialization of relationships.*" Barad's *agential realism* asks that we see connectivity as an ethos to move through the world and interact with one another and with nature.

²⁰ "The **holomovement** is a key concept in David Bohm's interpretation of quantum mechanics and for his overall worldview. It brings together the holistic principle of "*undivided wholeness*" with the idea that everything is in a state of process or becoming (or what he calls the "universal flux»). For Bohm, wholeness is not a static oneness, but a dynamic wholeness-in-motion in which everything moves together in an interconnected process. The concept is presented most fully in *Wholeness and the implicate order* published in 1980."

David Peat. (n.d.). *David Bohm, implicate order and holomovement*. David Bohm, Implicate Order and Holomovement - SAND. Retrieved May 2, 2022, from <https://www.scienceandnonduality.com/article/david-bohm-implicate-order-and-holomovement>

²¹ Barad, Karen. Getting Real: Technoscientific Practices and the Materialization of Reality, Differences: A Journal of Feminist Cultural Studies, Vol. 10, no. 2, p 89

Theoretical particle physicist Chanda Prescod-Weinstein explains that her role in physics is connected to locality and identity, writing, *“I used to think that physics was just physics, separate from people. I thought we could talk about particles without talking about people. I was wrong. At different points I came to understand physics as something that involved people, and that particular understanding has gone through different phases of its own. Studying the physical world requires confronting the social world. I know personally that social barriers impact the practice of science, its results, and the people who comprise the community we call ‘science.’”*²² A relational existence has been evidenced in our direct experience in the repercussions that emerged from an imbalanced dispersement of COVID vaccines. Where there is a deficit of vaccinations, primarily in developing countries, variants emerge and affect the wellbeing of the global population. Vice Chair of Medicine for Data Integrity and Analytics, Department of Medicine of Johns Hopkins University, Dr Stuart Ray explains: “Geographic separation tends to result in genetically distinct variants.”²³ As long as there is a disparity in vaccinated populations there will be a delay in the pandemic entering the endemic phase, as Dr Christopher Labos MD, MSc of McGill University underscores the importance of equitable vaccine distribution to all regions: “It is not by accident that new variants emerge from countries with low vaccination rates and

²² Prescod-Weinstein, Chanda. *The Disordered Cosmos: A Journey into Dark Matter, Spacetime, and Dreams Deferred*. Bold Type Books, 2022. 6

²³ Maragakis, Lisa, et al. “Covid Variants: What You Should Know.” *Johns Hopkins Medicine*, John Hopkins University, 8 Apr. 2022, www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/a-new-strain-of-coronavirus-what-you-should-know.

uncontrolled spread of COVID-19 [...] Rectifying that imbalance is critical.”²⁴

This imbalance of access to COVID and other vaccinations is paralleled in my mother’s experience as a disabled person, and in that of other vulnerable populations. First made mentioned of in Leviticus in the Bible (1200 BCE), scabies has plagued humans since time immemorial. “Scabies,” notes biologists Larry Allan and Marjorie S. Morgan, “is a neglected, globally prevalent, contagious skin disease of humans and many domestic and wild mammals and causes significant morbidity and mortality.”²⁵ In tandem with my own experience and loss, my presumption that they were a mere annoyance for the parents of young children was wickedly displaced as the World Health Organization notes that scabies are highly prevalent in impoverished, densely populated areas causing kidney failure and other complications. The Canadian Paediatric Society states that 300 million people are infected annually, and furthermore the disease disproportionately affects many Indigenous (First Nations, Inuit, Métis) communities.²⁶ The rich and medically serviced are moreover ignorant of the life threatening epidemic or gravity of this disease, but the poor and vulnerable are tragically incapable of ignoring these microscopic bodies.

²⁴ Labos, Christopher. “Next, Preventing the Emergence of New Variants.” *Office for Science and Society*, McGill University, 28 Jan. 2022, www.mcgill.ca/oss/article/covid-19/next-preventing-emergence-new-variants.

²⁵ Arlian, Larry G., and Marjorie S. Morgan. "A review of *Sarcoptes scabiei*: past, present and future." *Parasites & vectors* 10 (2017): 1-22.

²⁶ Banerji, Anna. “Scabies.” *Canadian Paediatric Society*, 18 Feb. 2018, <https://cps.ca/en/documents/position/scabies>.

The reality of global pandemics and climate change has evidenced that we are not discreet bodies, regardless of our distance and physical compartmentalization. We flow in and through the world, and it through us. The strains of numerous contagions that have come to define life so drastically proliferate through currents of molecules in a transference of information; like data, the output of these wet and lively messages move, multiply, disseminate, are processed, translated and reconfigured to be transmitted anew, carrying new information with them. We are their conduits and channels through which they flow. Merleau-Ponty writes, "*Our body is not in space like things; it inhabits or haunts space. It applies itself to space like a hand to an instrument. And when we wish to move about, we do not move the body as we move an object,*"²⁷ though, I suspect the present context was not within the scope of his phenomenological meaning.

The hubris held in the presumption that our skin serves as a hermetic protective seal has historically maintained a societal individuated and compartmentalized mindset, while science has underscored that we are the vessels and actuators of relational causation, who shape and are shaped by the ripples of interference on an atomic and grand scale.

As an artist centred formally and conceptually within our engagement with space, I held the notion of inter-permeability as a kind of ideal, inspired to learn of the muons, electrons, and neutrinos that move through our bodies from across the universe, and the exchange of matter

²⁷ Maurice Merleau-Ponty, James M. Edie. *The Primacy of Perception: And Other Essays on Phenomenological Psychology, the Philosophy of Art, History and Politics*. Northwestern University Press, 1964. 5

between one another. The velveteen romanticism I wove from the threads of my imaginings of a unifying, holistic spacetime fabric has been altered by grief.

Canadian artist, author, and poet Lisa Hirmer succinctly describes the intermingling of boundless bodies in her poignant and timely book, *Tender Scores for the Here and the Not Yet Here*, published shortly after shutdown: “*I find myself with a sudden awareness of air; Of how with each breath the world comes into my lungs; Of how I am permeable and vulnerable; But cannot live without this exchange with the world.*”

I wait for the relief of the neurotoxins administered via an old drug that is newly controversial, Ivermectin, discussed prominently in the news and heatedly debated on the silos of the internet. When it takes effect, my skin will become an intoxicating oubliette, stilling this ancient communicable disease, drowning them in their own paralysis. Being submerged in water somehow eases the wait, as I cannot bear to touch anything for fear of infecting everything. In a time when I so longed to be held and consoled, multiple global and personal factors kept me isolated, with water as my companion, a friend who is safe to touch, to be held by, a place to wait, an elemental medium to float in. Circuits, channels, currents, draw my mind from the confines of my enclosed space, and reach out from my body, my home, my neighbourhood, my city, while I hold myself and this droplet of water as still as possible in a bath that I can’t seem to get out of, as if it could contain and control all that I cannot. The rest of the world waits with me, as we fall apart, together.

.....

Elemental Media

Analogies of water have long been used in shaping the vernacular of theories of data. We indeed move through as though swimming through a dense fluid, immersed in information that is biological, molecular, digital, and otherwise, physically and virtually. *“In an online world,”* media theorist John Durham Peters writes, *“every act leaves a trace, a record of some sort, and such documentation provides potent data to those who can access and read it.”* Like the proliferation of new strains of lively viruses and communicable diseases that are generated on a cellular level, when we move through space, we too retrieve, access, and use electronic data, producing new records that mark our location in time and space - each action produces a documented eddy, altering a current's flow, shaping a responsive, relational field.

Cultural theorist, philosopher, and author Sadie Plant makes use of a watery metaphor to describe the nonlinearity of information, writing, *“...floods of data which have burst the banks of traditional modes of arranging and retrieving information and are now leaking through the covers of articles and books, seeping past the boundaries of the old disciplines, overflowing all the classifications and orders of libraries, schools, and universities. And the sheer weight of data with which the late twentieth century finds itself awash is only the beginning of the pressures under which traditional media are buckling.”*²⁸

²⁸ Plant, Sadie. *Zeros + Ones, Digital Women + the New Technoculture*, Doubleday, 1997, p 10 - 11

Often using video as a starting point within my process, I create experiential multimedia installations that explore the diminishing boundaries between our physical and virtual realms. Having incorporated stereoscopic imagery, interactive video, animation, augmented reality, sound, and kinetic sculpture, I approach media as both a technologist and artist, combining pre-cinematic and contemporary display technologies. My interests in the intersections of information exchange, affect, and theoretical physics are perhaps best encapsulated in the words of the late research physicist, metallurgist, and author Ursula Franklin, who describes the porous and relational dynamic between our bodies and the natural world, in her lauded Massey Hall lecture:

*“Individually and collectively we live simultaneously in the bitsphere and the biosphere, sometimes more profoundly in one, sometimes more profoundly in the other [...] All we can do is try to understand, as well as possible, the current and potential dynamics of these interacting spheres of influence and try to monitor and mitigate their impacts, remembering Kant’s insight that time and space are ordering devices of the human mind.”*²⁹

In recent years, I have explored the notion of hauntings through technology in my multimedia installation work, site-specific audio compositions, and augmented reality series. Crafting immersive spaces and experiences within which historical figures can be superimposed

²⁹ Franklin, Ursula M. *The Real World of Technology (The CBC Massey Lectures)*, House of Anansi Press Inc. Kindle Edition. 166

within our present time and space is accomplished in order to form a connective tissue between a compassionate contemporaneity and an unresolved pain inflicted by a past injustice. The uncanny juxtaposition of time and space that augmented reality produces serves as a locative gathering of disparate historical, geographical, and contextual points, forming a temporary constellation where digital and physical realms merge, forming a furtive territory for meaning, perspective, and poetics, abridging temporalities and geographical distances. The emergent intention that prevailed in the creation of these works was to diminish distance, to make all near, to cultivate a non-linear relationship and understanding of time; in this, I sought to create an empathetic experience of connectivity. I found grounding for these far reaching objectives in the material considerations in the field of physics that provided a conceptual and tangible through line for the intuitive and emotional aspects of my studio practice and research.

The ethereal and phenomenological aspects of mobile media resonated with me, as these have been central thematics within my artistic practice of nearly two decades, throughout my immersive interactive installation work, kinetic sculpture, and in my own writing. Through the lens of augmented reality, I saw the potential for social intervention, site-specificity, and anachronistic experiences. With scientific papers and theoretical physics welling and stirring my thoughts paired with the practice of informal observation of the natural world, there was a growing impetus to create phenomenological experiences that utilize space as a medium. This has often resulted in kinetic sculpture, installation, augmented reality, and geolocate-technology-based artworks, in which familiar imagery and sounds are slightly offset within their environment: fish swimming over the horizon of a body of water, swans materializing from mist

upon a pond, trickling water heard above long buried rivers, sheets of metal that clang and quiver by touching the points in space that surrounds them. Working within these three distinct modes of making became pronounced: process oriented performance, temporal and spatial superimposition, and public projection.

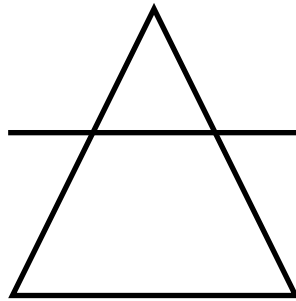
As remoteness emerged as the mode in which our communications could safely transpire, locality took on new meaning, while travel came to a near standstill, and our freedom to experience the world through touch had been curtailed. Distance, in every sense of the word, became profoundly weighty. My work, and the work of many, had changed as a consequence to COVID restrictions. Ironically unified in our isolation, we grappled with how to adapt to an existence so comprehensively reliant on screens, not only as workers, artists, performers, public practitioners, caregivers, but fundamentally, how to be a friend, a family member, a person, operating within a fragmented society. Having limited access to facilities and resources, we as artists crafted our own *Gedankenexperiments*, employing the imaginative practice of using familiar objects, materials and scenarios to speak to the connective threads of the physical realm.

Chapter 2

genii locorum

// Site-specificity + Times of Remoteness //

ELEMENTAL OFFSET



“[T]he posthumanist” point is not to blur the boundaries between human and non-human, not to cross out all distinctions and differences, and not to simply invert humanism, but rather to understand the materializing effects of particular ways of drawing boundaries between “humans” and “nonhumans”.”³⁰

- Karen Barad,

Nature’s Queer Performativity

³⁰ Barad, K. “Nature’s Queer Performativity*”. *Kvinder, Køn & Forskning*, nr. 1-2, marts 2012, doi:10.7146/kkf.v0i1-2.28067. p.31.

CLOUD PIECE

Imagine the clouds dripping.
Dig a hole in your garden to
put them in.

1963 spring

- Yoko Ono
grapefruit

“The boundary between physical and non-physical is very imprecise for us,” Donna Haraway writes in her 1985 essay, *A Cyborg Manifesto*. Exploring blurred boundaries of the physical and virtual is a mode of inquiry that I have employed throughout my artistic career, particularly apparent as an artist using display technologies as primary media, even as I have become more connected to physical location and ecosystems through my research, site-specific artworks, and lived experience.

A site-specific artwork must be contextually tethered to a location, inasmuch that if it were to be extracted from the site, it would lose its relational grounding, and its meaning would be lost. Author and professor of performance studies at Exeter University Nick Kaye explains that site-specificity consists of exchanges between a “work of art and the places in which its meanings are defined.”³¹ If we discern meaning as implicitly linked to the context, or situation, from which an “utterance, action and event” takes place within, Kaye posits that we may then see the meaning of a work of art to also be implicit with place and position. In this, location becomes

³¹ Kaye, Nick. *Site-Specific Art Performance, Place and Documentation*. Routledge, 2000.

part of the artistic process, as something to be read within a semiotic system. “One can go on from this to argue that the location, in reading, of an image, object, or event, its positioning in relation to political, aesthetic, geographical, institutional, or other discourses, all inform what ‘it’ can be said to *be*.”³²

Kaye uses the example of Richard Serra, whose 1981 sculpture, *Tilted Arc*, was under the threat of being removed from its location in Foley Federal Plaza in Manhattan. Serra claimed that to move *Tilted Arc* from its site would unequivocally destroy the work. As Kaye puts it, “To move the site-specific work is to *re-place* it, to make it *something else*.”³³

Swimming Upstream

In the summer of 2021, I created an augmented work in collaboration with the research collective, Belle Park Project³⁴, which includes scholar Laura Murray, documentarian Dorit Naaman and sound artist Matt Rogalsky, that drew upon the history and present day section of the Ka’tarohkwi/Cataraqui River in Kingston, Ontario. The Ka’tarohkwi is the base of the Rideau Canal and presently drains into Lake Ontario. This river was once teeming with fish, as noted by 18th-century French military engineer Pierre Pouchot while observing wildlife activity on a spring day on a mission to improve French entrenchments while England and France were at war

³² Kaye, Nick. *Site-Specific Art Performance, Place and Documentation*. Routledge, 2000.

³³ Ibid.

³⁴ This project is funded by the Social Sciences and Humanities Research Council of Canada (SSHRC). Belle Park Project is curator Erin Sutherland, public historian Laura Murray, and documentary filmmaker Dorit Naaman.

in the 1750s: “The quantities that go up on some days is inconceivable,” as he continues to list a plethora of species undulating, jumping, and disturbing the water’s surface³⁵.

As settlers arrived in the 1780s, the river was used as a mutable channel to harness the flow and fall of the waters to generate power for mills for the production of grain and logging. The shorelines were transformed and reshaped through dams, leading to the industrialization of the river soon lined with harbours, train tracks, factories, warehouses, large wharves, and commercial fisheries. Fish species were decimated, particularly populations of whitefish and Atlantic Salmon from Lake Ontario, by these alterations further impacted by the chemical toxins and garbage industrialization produced.³⁶ Biodiversity dwindled as spawning habitats were disrupted, and later by the construction of the St Lawrence Seaway power dams, hushing the busy waters of the Ka’tarohkwi.

My child and I relocated to Kingston in the summer of 2020 while the city was still largely in lockdown. While restaurants and cultural venues were closed, conservation areas and trails were then open to the public, a welcome respite from the spring of extreme quarantine restrictions enforced just weeks earlier. We got to know the city by walking the naturalized areas, and came across more wildlife than we had previously encountered: muskrats, porcupines, owls,

³⁵ Murray, Laura. “Swimming Upstream: Seeing Fish in the Cataraqui River.” *Belle Park Project*, Belle Park Project, 9 Sept. 2021, belleparkproject.com/blog-2/swimming-upstream-seeing-fish-in-the-catarauqui-river.

³⁶ Ibid.

water ferrets, beavers, turtles, foxes, and deer were common sights amongst the physical remnants of industry and mining that peeked through an overgrowth of brush, moss, and lichen.

We habitually walk the newly-paved path along the Cataraqui, looking at and recording the life of the river on a daily basis. I was drawn to the inner harbour's fauna and to the clear water itself, both of which induced calmness within me, coating the buzz of stress and loss in a meditative salve. Captivated by the lily pads bubbling with the kiss of hungry fish feeding on their undersides, with each probing nibble momentarily and percussively breaking the meniscus seal upon the water's surface, I listened intently. We learned to listen deeper still to hear the slithering of sunning snakes that would often flee into the watery reeds to evade the thundering bipeds stomping on the trail they felt in their bodies. Their long, scaled bodies moved lithely in a sine wave towards the still waters below while the heron stoically lurched above on a half-submerged tire. While the water serpents may elicit fear in the passerby, it is humans who pose an unwitting threat to one another with each exhalation, burst of laughter, and weighted sigh, and it is we who disrupt the snake and waterfowl, who would often take flight upon our notice, squawking and hissing in vexation. In a domino effect, creatures would dislodge from their resting places by our passing presence upon the path that cut an unwitting anthropogenic wake; one by one, turtles plummet into the water from anchored driftwood, muskrats dip beneath the surface, the mallards flap away, the geese hiss threateningly in concert with the scornful caw of the Red-winged Blackbird. In time, we learnt to tread lightly without creating ripples of unrest.

We breathe in the river's air that carries the fibres of the milkweed, bullrush, the aerosols of our yawns, song, and speech that intermingle with the sounds of slithering and screeches.

The invitation extended to me by the Belle Project collective to create an augmented reality experience that addressed the history of the ecosystem and the surviving watershed wildlife was an opportunity that resonated conceptually and personally with me. The desire from the collective to recreate or interpret Pouchot's account of the Cataraqui ecosystem was in part at odds with my own experience, as my initial observations of the area was an introduction to a wider range of nature than I had ever witnessed in my lifetime, yet, I was commissioned to make work about a dwindling ecosystem.

I created a 3-dimensional animated vista featuring prominent fish species that lived in a narrowly specific portion of the river. In this area, the water's current was calm and relatively still, ideal for minnows, the American Eel, Rounded Gobi, Largemouth Bass, and Pumpkin Seed Fish. I sourced 3D scans of these species with 4K photographic image textures (the skin of the models) made available via the Museum of Comparative Zoology at Harvard University, and integrated them into a scene that was accessible via the App Store and Google Play. Once the free standalone App I created was downloaded via a QR code, a fiducial marker (an image to which viewers aim the camera of their mobile devices) allowed visitors to view and move around accurate anatomical animated models of the species that lived and continue to live within a narrowly precise area of the Inner Harbour. Rather than creating the illusion that the fish were swimming in the water, the fish swam above the horizon, as though extending the river's

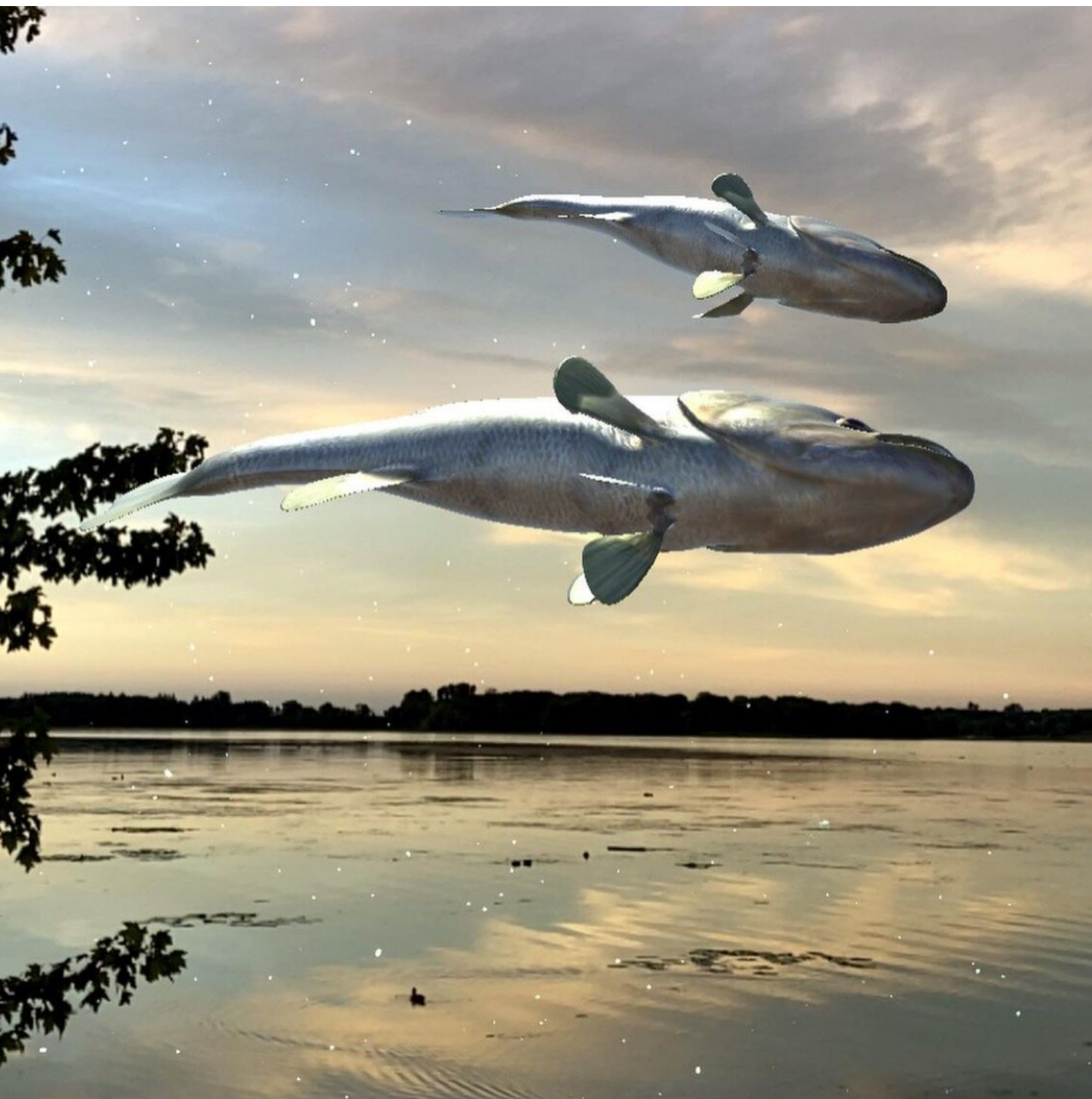


Figure 1 | *Swimming Upstream*, 2021, Detail, Site-Specific Augmented Reality Installation, photo by Josh Lyon.

population into the air. Binaural audio recorded with submersible microphones by Matt Rogalsky featured the sounds feet below the exact location where the fiducial marker could be found in the inner harbour. This offset of sound and image brought the ecosystem just outside of our perception beneath the surface of the water, into prominence during the mediated experience of the app. For me, I considered this to be an exercise in Bohm's rheomode model, in which unseen subjects cohabitating with us were seen as we re-ordinated while using the app, repositioning ourselves by transforming the noun of 'relevance' to 'relevante.'

Throughout the summer, there were engagements with the public and communities invested in



Figure 2 | Wenxi Feng with submersible drone

water health and biodiversity.

PhD Biology student Wenxi

Feng studying at Queen's

University visited *Swimming*

Upstream and offered

viewers the additional

perspective to look beneath

the water with a submersible

drone. Almost immediately,

through the large tendrils of

plants and fog of silt, the species featured in the augmented reality (AR) emerged from the darkness and were seen remotely on the handheld LCD console of the drone controls.



Figure 3 | *Swimming Upstream*, 2021, Detail, Site-Specific Augmented Reality Installation, photo by Josh Lyon.

These two modes of display technologies conflated the realms of above and below, realtime and animated, transported and attuned visitors to an historical past, as well the present, while raising questions about the future of the species as plans for waterfront development and dredging are announced.³⁷

The uncanny juxtaposition of perspective, time and space that augmented reality (AR) affords are explored in my *Swimming Upstream* and in my other recent AR works as a locative gathering of disparate historical, geographical, and contextual points. In this, I aimed to form a temporary constellation of media, where digital and physical realms merge, hosting a furtive territory for meaning, perspective, and poetics. This mediated experience of a site-specific location offers a unique intervention that brings the real to the fore through machine vision. Underscoring the intentional blurring of physical and digital spaces in their analysis of early augmented reality technologies, Tony Liao and Lee Humphreys state that,

“The use of these mobile technologies not only influences how people consume space, but creation of augmentation has the potential to reproduce space with code. As more spaces of everyday life are embedded with code that automatically (re)produces the order of those places (Thrift and French, 2002), the processes and politics by which content and code (re)produce meaning in physical places are beginning to be explored socially and spatially (Graham, 1998).”

³⁷ Farrar, Mary. “April Update 2021.” *Friends of Kingston Inner Harbour*, 19 Apr. 2021, www.friendsofinnerharbour.com/april-update-2021/.

Liao and Humphreys address “the blurring of physical and digital spaces”, and “the embodiment of mobile media”³⁸, concepts that resonate with me, as these have been central thematics within my artistic practice of nearly two decades, throughout my immersive interactive installation work, kinetic sculpture, and in my own writing. Through the lens of augmented reality, the contextual aspects further the potential for social intervention, as described by Liao and Humphreys.

Information, code, and data blended with natural phenomena, particularly those pertaining to water, such as currents, torrents, doldrums, eddies, and sinkholes have long served as reoccurring visual and metaphorical motifs in many of my installations and single-channel animations, in order to convey the transference of information, matter and affect.

The use of augmented reality aims to espouse a sense of presence in historical or otherwise unseen elements that are impactful upon our lived experience. In recent experiments in augmented reality, installation, animated, and 360° video works completed during my degree, the layering of temporalities has emerged as a prominent thematic, producing a sort of digital and sculptural palimpsest that is spatially superimposed upon our physical world. Using geolocate technologies and point-cloud shape detection, animated figures move in the user’s physical environment, often as though treading or swimming through water, and the user can navigate the

³⁸ Liao, Tony, and Lee Humphreys. “Layar-Ed Places: Using mobile augmented reality to tactically reengage, reproduce, and reappropriate public space.” *New Media & Society*, vol. 17, no. 9, 19 Mar. 2014, pp. 1418–1435, <https://doi.org/10.1177/1461444814527734>.

surrounding space of the subject through image recognition and the gyroscope of their mobile device. While it is inherently a two-dimensional display technology, our phenomenological relationship to the AR image and the ever-shifting edge-of-frame produced by our cameras lead us to respect the space of the three-dimensional model as though it were truly in our space. To me, the fish of *Swimming Upstream* are a haunting, an echo or a stand-in for the real body, while its scale, volume, and proximity evoke an uncanny relationship to our own body and presence.

Remotely Close - *Eros's Kiss*

The superimposition that *Swimming Upstream* effectuates within a specific location was a marked difference for me from the augmented reality work that I had created in response to COVID restrictions in the previous year, at the height of the pandemic. *Eros's Kiss* (2020) was an AR experience commissioned by Art Toronto, which invited would-be visitors of the art fair to bring my anthropomorphic roses into their homes, gardens, or wherever they wished. *Eros Kiss*' continues upon a series of AR works that I made to contemplate interspecies communication, drawing upon the allure of the blossom as the reproductive structure of the plant to attract pollinators, how information is transferred between plants, and how humans cultivate plant morphology. *Eros's Kiss* featured two roses of the same plant, embraced in an act of tender self-pollination, pressing their delicate petals into one another, deeply kissing, again and again. As roses encompass male and female organs in each flower, they are capable of self-pollinating, producing seeds that germinate into what many gardeners deem as underwhelming rose plants with smaller, less exuberant blossoms. Gardeners will often remove the rose's anthers when the

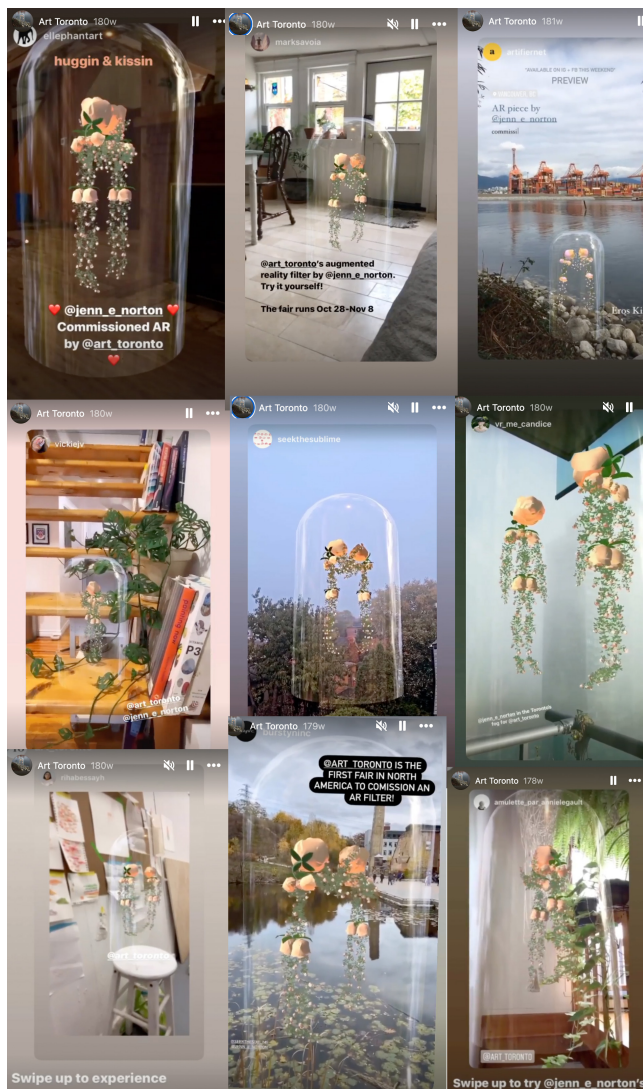
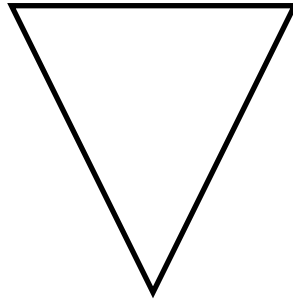


Figure 4 | Images of *Eros' Kiss* collected from the screen recordings of social media users, 2020

rose is a bud. Shielded under a covering, such as a paper bag, the developing stigma is allowed to mature slowly, whereupon the plant will be manually cross-pollinated with another rose plant to create a new rose hybrid. The embrace of the rose in *Eros' Kiss* is with its mirror self, protected within a glass vitrine to enjoy the freedom of autonomy and unmediated self-pollination. The apps act as sculptural GIFs, cyclically engaging in simple interactions. Thousands of people accessed *Eros' Kiss*, and shared screen recordings of the flowers kissing in their kitchens and studies, backyards and bedrooms. It was a way for the art fair to feature spatial work, albeit

digital, to patrons in a time when the fair was online, limiting artworks to a two-dimensional viewing experience. What I found striking was the intimacy that emerged from the public sharing their private spaces publicly online, sharing a tender moment with my roses in sites of familiarity. In a sense, it became an iterative, public generated engagement in site(s)-specificity.

Swimming Upstream and *Eros' Kiss* were stepping stones towards a broader exploration of form (both physical and non-physical), remoteness, and engagement with site-specificity. In the proceeding chapters, I will detail four works that represent the culmination of my research-creation practice over the course of my graduate degree. Each work employs the methodology of the offset to render the invisible visible, aural, or felt.



Chapter 3

TRIBUTARIES // Toronto

Electric Hauntings and Premonitions

“Our language is poorly suited to describe the complexity of technological interactions. The interconnectedness of many of those processes, the fact that they are so completely interrelated, defies our normal push-me-pull-you cause-and-consequence metaphors. How does one speak to something that is both fish and water, means as well as end?”

-Ursula Franklin,

The Real World of Technology

Imagine letting a goldfish swim across
the sky.

Let it swim from the West to the East.

Drink a litre of water.

Imagine letting a goldfish swim across
the sky.

Let it swim from the East to the West.

1963 spring

-Yoko Ono

grapefruit

Moments before lightning strikes, it has been documented that hair will stand up on end due to an increase in electrostatic charge.³⁹ Survival guides instruct us to immediately crouch down should such a sensation occur, with the explicit warning to not lie flat on the ground, as the ground beneath our feet threatens to become a platform of ground current, intensifying the degree of electrocution injury or mortality. Our hair acts as the telltale sign that we are in the

³⁹ Lim, Sunjung. "Hair-Raising Effects of Lightning." *Science Focus*, Science Focus, School of Science, HKUST, <https://sciencefocus.ust.hk/post-hair-raising-effects-of-lightning>.

imminent line of fire of a bolt of lightning.⁴⁰ Although a lightning bolt only spans the width of an average-sized human thumb, the heat it produces is five times hotter than the surface of the sun.⁴¹

Our bodies are not apart from the molecules of any given thing, creature, or clime, and react in accordance with the logic of natural phenomena. Cognitively, we may forget this, or be altogether ignorant of it, but our elemental makeup embodies this knowledge. Like hair rising alongside the fluctuating levels of electrostatic charge, our sense of smell also detects the atmospheric effects of lightening. Lightning reassembles the molecules of nitrogen and oxygen in the air with the drastic and sudden temperature change that a bolt of electricity produces, breaking atmospheric molecular bonds. The air about us is approximately 78% nitrogen and 20% oxygen and intermingles in pairs of N₂ and O₂. Once the lightning's heat has split bonds and has sent the atoms freely about, some lone oxygen (O) atoms combine with O₂ (the type of oxygen we breathe), and form O₃ (ozone),⁴² which creates the distinctive smell of a summer storm; our olfactory neurons and odour receptors can detect the molecular shift, producing a decidedly more pleasurable and more widely shared experience than that of the hair raising, violent event of being directly struck by lightning. And as for the nitrogen molecules sent asunder? Some re-bond with oxygen molecules to form nitrate, NO₃⁻, which attach themselves to water droplets in the

⁴⁰ US Department of Commerce, NOAA. "Lightning Safety." *Lightning Safety*, NOAA's National Weather Service, 5 Mar. 2015, <https://www.weather.gov/mqt/lightningtips#:~:text=If%20your%20hair%20stands%20on,5>.

⁴¹ Apsell, Paula. *Lightning Produces Nitrates* | *NOVA: Earth From Space*. PBS LearningMedia, NOVA, 12 Oct. 2021, <https://www.pbslearningmedia.org/resource/nves.sci.earth.nitrate/lightning-produces-nitrates/>. Accessed 2 Mar. 2023.

⁴² Cappucci, Matthew. "The Scent of a Storm: Here's Why Lightning Emits a Smell." *The Washington Post*, WP Company, 18 July 2018, <https://www.washingtonpost.com/news/capital-weather-gang/wp/2018/07/18/the-scent-of-a-storm-heres-why-lightning-emits-a-smell/>.

clouds above, fall to the earth as rain, fertilizing the soil, and are then absorbed through the roots of plants. This process provides the vital nutrient of NO_3^- to every living creature and plant, allowing both plants and the DNA within our cells to structurally form with the cellular protein it produces.⁴³ Lightning brings vitality to Earth, despite its violent effects, resonating in and about us, nourishing and shaping our cells long after its flashing brilliance has dissipated.

Inside of our bodies, electricity courses through our nervous system, as we see in the electrical signals sent between one neuron to another across the length of an axon, transforming electrical signals into chemical emission (neurotransmitters), and in our vascular systems within the cells of our cardiac conduction system, regulating our heartbeat. There is more to the internal function of electricity that we fully comprehend, as we shall soon see, in part, in the electric visage of a frog.

The Electric Veil

Karen Barad reflects upon the connections between lightning, vitality, and interiority, and even pursues the possibility that, on a material level, electricity and matter are imbued with agency and imagination: *Matter is promiscuous and inventive in its agential wanderings: one might even dare say, imaginative. Imaginings, at least in the scientific imagination, are clearly material. Like lightning, they entail a process involving electrical potential buildup and flows of*

⁴³ Apsell, Paula. *Lightning Produces Nitrates* | *NOVA: Earth From Space*. PBS LearningMedia, NOVA, 12 Oct. 2021, <https://www.pbslearningmedia.org/resource/nves.sci.earth.nitrate/lightning-produces-nitrates/>. Accessed 2 Mar. 2023.

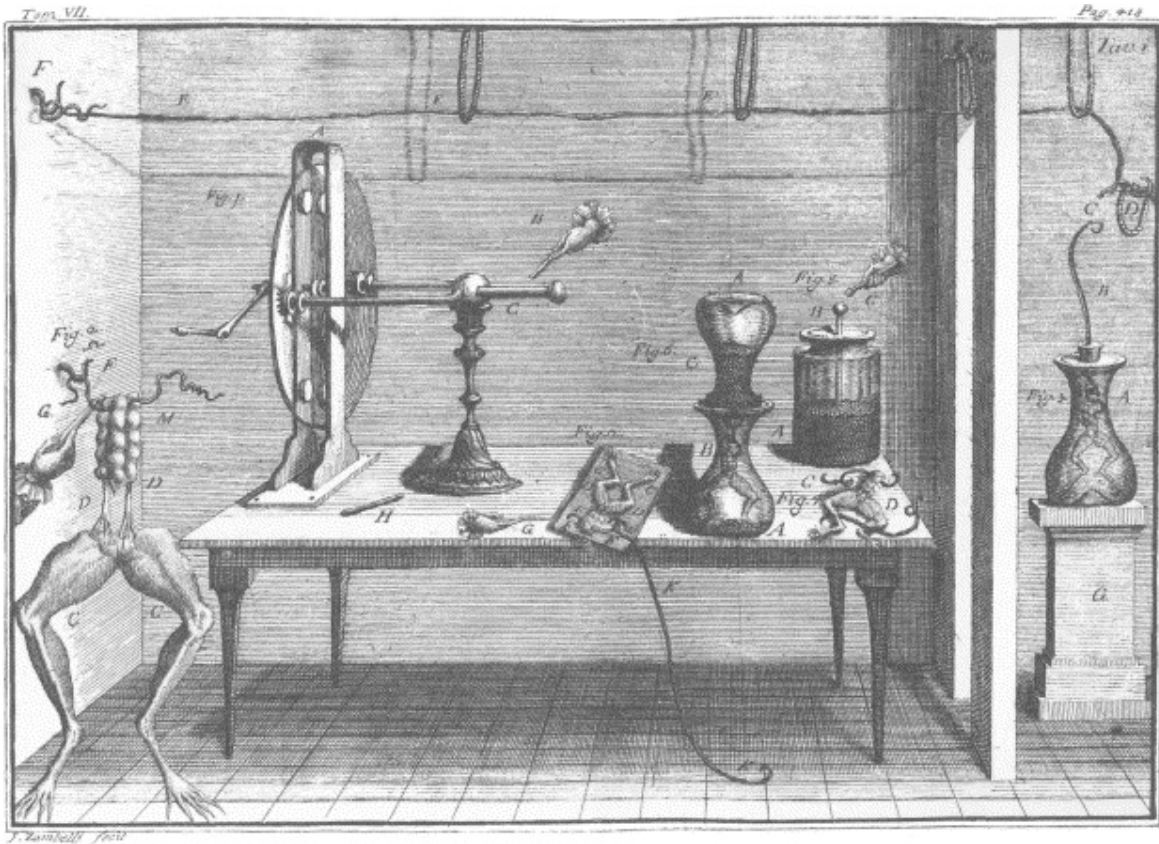


Figure 5 | An illustrative plate from *De viribus electricitatis in motu musculari* by Luigi Galvani. Electrostatic machine on the left generates charged particles, which are stored in the Leyden on the uppermost right corner.

charged particles: neurons transmitting electrochemical signals across synaptic gaps and through ion channels that spark awareness in our brains. ⁴⁴

Preceding Barad, Bohm had linked thought and electrochemical activity in the mind, an established correlation in neuroscience. But Bohm differentiates thought (a material process) and intelligence, as something of a similar process, and asks whether intelligence is “perhaps a more subtle nature?” We will return to this in time, but to explore Barad’s concept of creativity and imagination, we look to historical figures, such as Luigi Galvani and author Mary Shelley, as

⁴⁴ Barad, Karen. “TRANSMATERIEALITIES: Trans*/Matter/realities and Queer Political imaginings.” *GLQ: A Journal of Lesbian and Gay Studies*, Duke University Press, 2015.

well as contemporary fields of study in bioelectricity, all connected through the thin electric veil between life and death - in amphibians.

Luigi Galvani, an 18th century physician, biologist, and physicist, writes of his experiments and explorations in biological organisms and electricity in his 1791 *De Viribus Electricitatis in Motu Musculari Commentarius (Commentary on the Effect of Electricity on Muscular Motion)*. Placing a bronze and an iron lead upon the muscle tissue of a dead frog caused its limbs to twitch when the opposing ends of the leads connected. The metals expelled charged particles, generated by an electrostatic machine and stored in a Leyden jar, causing them to run from one nerve to another, twitching the frog's leg. He similarly observed such contractions and convulsions during a storm with each flash of lightning as he held the tips of scissors to a specimen's muscle, and again when a colleague accidentally touched the lumbar nerve of an animal's body with a scalpel while an electrical machine ran nearby. Galvani expanded his experiments beyond his laboratory to use surrounding environmental structures such as a well and an iron railing, drawing twitches from metals that were not infused with the charged particles from the Leyden jar or from the lightning overhead, and was able to create electric arcs between two specimens. Making the connection that the static electricity that he was using in his laboratory and the lightning flashing in the skies above were both generated by friction on a respective micro and macro scale, his multi-specimen experiments led his curiosity towards other sources of electricity, culminating in the formulation of the notion of animal electricity, a shaky stepping stone towards what is now known in the field of developmental



Figure 6 | Luigi Galvani demonstrating the twitching phenomenon on the body of a frog in an illustration published in *Le Journal de la Jeunesse*, Paris, 1880.

biology as bioelectricity (an electrochemical process that is generated within the animals).⁴⁵ Galvani believed that the twitching was indeed animal electricity, an innate force that was secreted from the brain and coursed through an organism's system to the tissue and muscle. This animal electric fluid, he deduced, could be activated by means of metal probes, which the body stored as energy, similarly to the electric charge stored in a Leyden Jar.⁴⁶

Alessandro Volta, a contemporary of Galvani, was

publicly critical of Galvani's findings, and went to

great lengths to disprove his methods. Despite his skepticism, Volta referred to animal electricity, or electricity produced by a chemical action as Galvanism, and deeply respected Galvani. Both scientists are foundational figures in the development of energy storage, and Galvani is credited as a major source of stimulus for Volta's development of the voltaic pile (the battery), as his emphatic scientific rebuttals laid the path for his experiments in chemistry and physics.

Barad makes note of another contemporaneous figure of Galvani who drew inspiration from the physician, physicist, biologist and philosopher in order to significantly rethink the destructive and generative effects of lightning. Mary Shelley centred galvanism and lightning

⁴⁵ "Animal electricity." Merriam-Webster.com Dictionary, Merriam-Webster, <https://www.merriam-webster.com/dictionary/animal%20electricity>. Accessed 3 Jun. 2023.

⁴⁶ Dibner, Bern. "Luigi Galvani". Encyclopedia Britannica, 30 Nov. 2022, <https://www.britannica.com/biography/Luigi-Galvani>. Accessed 3 June 2023.

within the premise of *Frankenstein*, pondering that, “*Perhaps a corpse would be re-animated; galvanism had given token of such things: perhaps the component parts of a creature might be manufactured, brought together, and endured with vital warmth.*”⁴⁷ Shelley looked to the divide of life and death, and imagined how an electric arc could obscure it in a gaussian distribution.

While electricity can temporarily reanimate tissue of an organism that has expired, what of tissue in gestation? How does electricity affect cells forming a future sentient being? Uncannily, it is once again the frog who offers a glimpse of what that could be, or “*what (never) was and might yet (have) be(en).*”⁴⁸ But first, a little more on touch and electricity.

Chimeric Touch

The touch of scissors, the touch of a scalpel, the touch of lead leads - all this touching surpassed the surfaces they landed upon as the body proved to be an effective conduit for electricity. Touch, it would seem, is the primary activator for elaborate sequences of causation. But how? What is touch on a material level? Barad tells us that “*Touch, for a physicist, is but an electromagnetic interaction,*” yet, in a confounding turn, they explain that according to classic physics, we never truly touch anything - there is always a space between our fingertips and that upon which they befall.

⁴⁷ Barad, Karen. “TRANSMATERIEALITIES: Trans*/Matter/realities and Queer Political imaginings.” *GLQ: A Journal of Lesbian and Gay Studies*, Duke University Press, 2015.

⁴⁸ Barad, Karen. “TRANSMATERIEALITIES: Trans*/Matter/realities and Queer Political imaginings.” *GLQ: A Journal of Lesbian and Gay Studies*, Duke University Press, 2015.

Despite the feeling of textures of surfaces, or sensing the temperature of substances, what is actually felt is the electromagnetic repulsion between electrons, or, in other words, a barrier formed between negatively charged particles, which creates a collider encasing around forms, making them distinct from others. To illustrate this with everyday objects, Barad offers the example of two negatively charged magnets that push away from one another; despite any efforts to manually connect, the magnets will hold space between their ends or dart one way or another in an almost comically obstinate manner as repulsion prevails.

But in Quantum Field Theory (QFT), the barriers are not so definitive, and touch is inherent amongst indeterminate ongoing. According to quantum mechanics, within a vacuum there are virtual particles that populate the void at any given time, which affect and are affected by other particles and ongoing within the kinetic field. This phenomenon is known as the indeterminacy principle, aka Heisenberg's uncertainty principle, which states that the exact location and momentum of a particle at a moment in time is unknowable as these virtual particles "constantly wink into and out of existence,"⁴⁹ causing a quantum fluctuation, or a vacuum state fluctuation, that changes the energy quantity in a point of space.⁵⁰ Virtual particles often make an appearance in couples (a particle and anti-particle duo) that almost immediately cancel one another out from perceivable existence. While fleeting and ephemeral, it has been documented

⁴⁹ Choi, Charles Q. "Something from Nothing? A Vacuum Can Yield Flashes of Light." *Scientific American*, 12 Feb. 2013, [www.scientificamerican.com/article/something-from-nothing-vacuum-can-
yield-flashes-of-light/](http://www.scientificamerican.com/article/something-from-nothing-vacuum-can-yield-flashes-of-light/)
#:~:text=One%20bizarre%20consequence%20of%20this,near%2Dinstantaneously%20cancel%20themselves%20out.

⁵⁰ Pahlavani, Mohammad Reza, editor. *Selected Topics in Applications of Quantum Mechanics*. InTech, 2015. Crossref, doi:10.5772/58514.

that virtual particles are able to emit “real” photons (a packet of electromagnetic radiation, or light particle)⁵¹, resulting in light “popping in and out of the vacuum.”⁵² While the traveled distance and duration of the existence of virtual particles are unknowable, they can quantifiably affect mass, as well as the electric force between two charged particles.⁵³

Virtual particles can change their charge, emit and reabsorb a virtual photon in a process that Barad refers to as self-touching, while the emitted photon can change into an electron positron couple, self-annul, then become a photon once again to be reabsorbed, affecting itself and others in the quantum field, or as Barad describes it, a “frothy virtual soup of indeterminacy that we ironically think of as a state of pure emptiness.”⁵⁴

This touching, self-touching, and intra-activity is not permitted in classic physics due to electromagnetic repulsion, and in this, Barad explains, “quantum field theory radically deconstructs the ontology of classical physics.” Barad is particularly interested in the liminality of virtual particles, their chimeric tendencies, their relational effects within the quantum field,

⁵¹ “Photon.” *Photon - Energy Education*, energyeducation.ca/encyclopedia/Photon#:~:text=A%20photon%20is%20a%20particle,%20and%20'wiggle')). Accessed 10 June 2023.

⁵² Choi, Charles Q. “Something from Nothing? A Vacuum Can Yield Flashes of Light.” *Scientific American*, 12 Feb. 2013, www.scientificamerican.com/article/something-from-nothing-vacuum-can-yeild-flashes-of-light/
#:~:text=One%20bizarre%20consequence%20of%20this,near%2Dinstantaneously%20cancel%20themselves%20out.

⁵³ Dukes, Craig. “Virtual Particles.” *Symmetry Magazine*, 22 Feb. 2022, www.symmetrymagazine.org/article/july-2009/virtual-particles?language_content_entity=und#:~:text=Virtual%20particles%20are%20short%2Dlived,charged%20particles%20E2%80%94in%20measurable%20ways.

⁵⁴ Barad, Karen. “TRANSMATERIEALITIES: Trans*/Matter/realities and Queer Political imaginings.” *GLQ: A Journal of Lesbian and Gay Studies*, Duke University Press, 2015.

and their “uncanny configurations”, making connections to transness, birthing and rebirth, identity, and its undoing. Because of this transformative and endless liminality, Barad comes to the crux of matter: it is sensing, feeling, responsive, and ultimately, creative.

Gestative Delineations

Barad directs us to a study by biologists Michael Levin and Dany Adams at Tufts University that examined frogs, specifically the African clawed frog, as a means to observe biological regenerative processes and how molecular bioelectric instruments might enhance regenerative capabilities. Levin and Adams were able to extend the limits of regeneration in tadpoles by identifying and using electricity as a means to manipulate ion transporters (the protein that enables regeneration) in the area of a damaged appendage.⁵⁵ It is the patterning of electrons through the body that led the research team to its influence on an organism’s morphology at both the embryonic stage, and in regenerative healing.

Bioelectric signals are used by all cells, Levin explains, and in this, electrical patterning is communicated between them, across the cellular makeup of an organism. According to Levin, this patterning can be altered to engineer the cells, and indeed, went on to regenerate entire frog

⁵⁵ Misia Landau, “Regenerative Biology: The Body Electric,” *Focus: News from Harvard Medical, Dental, and Public Health Schools*, March 9, 2007, archives.focus.hms.harvard.edu/2007/030907/regenerative_biology.shtml. via Barad, Karen. “TRANSMATERIEALITIES: Trans*/Matter/realities and Queer Political imaginings.” *GLQ: A Journal of Lesbian and Gay Studies*, Duke University Press, 2015.

legs (which they typically are unable to do, say, as salamanders do), grow extra heads, eyes external to their heads.

In gestating frogs, cells accumulate negative charges, acting as a battery, researcher Dr. Laura N. Vandenberg of Tufts University's Department of Biology explains. In a video of a gestating frog, we see an outline of a spinal column drawn in light in a fleeting flash across the germinal form, then the circumference of the brain, then the luminous features of a face appear, as though illustrated in electric ink. "*I love the caption, 'An Electric Face' ,*" Vandenberg exclaims. "*The amazing part [of the documentation on video] was that those negative charges overlap areas where those cells are going to become parts of the face.*"⁵⁶ The brief light demarcated where physiology would develop across the nebulous surface of ongoing cell division. Incredibly, all of these ongoings, explains Associate Professor Dany S. Adams, "*are in someway being regulated by a single type of signal.*"

"*[L]ightning,*" Barad writes, "*is an exploration of charged yearnings and the sparking of new imaginaries.*"⁵⁷ From the sky and within the cell, to the particle and anti-particle in the quantum field, we see how negative charges fuel the state of becoming, billowing the veil between creation and destruction, life and death.

⁵⁶ "The Face of a Frog." YouTube, uploaded by Tufts University, Jul 22, 2011, <https://www.youtube.com/watch?v=ndFe5CaDTII&t=2s>.

⁵⁷ Barad, Karen. "TRANSMATERIEALITIES: Trans*/Matter/realities and Queer Political imaginings." *GLQ: A Journal of Lesbian and Gay Studies*, Duke University Press, 2015.

The Sky Unearths

From the micro to the macro, storms have a way of bringing up all kinds of things; from the hair on our heads, to the uprooting of trees, to the sediment washed away, unearthing forgotten objects and structures, like the WWI-era railroad in Cape May, New Jersey, that resurfaced in the wake of a coastal storm in May 2022.⁵⁸ Forgotten architectures of infrastructure are not only resurrected into prominence by being resurfaced and made visible to the naked eye but also when submerged further below. Torontonians experienced this in 2005 when a powerful downfall drove Garrison Creek, buried and channeled through a pneumatic tube sewer system in the early 1900s, to flood Christie Pits, Trinity Bellwoods Park, and the train underpass of King and Atlantic Street.⁵⁹

The hurricane grade storm had also impacted the campus of York University. Anders Sandberg, Professor of Geography at York University, looks closely at the cause of the estimated 45 million dollar damage that ravaged Finch Avenue, which included broken water and gas mains, service holes, blocked and overflowed sewers, flooded 4,200 basements, and caused months of traffic disruptions.⁶⁰ In light of the extreme weather events due to climate change, Sandberg questions whether this level of destruction could have been avoided. Sandberg looks at

⁵⁸ Puleo, Mark. "New Jersey Coastal Storm Unearths 'Ghost Tracks'." *Zenger News*, Zenger, 18 May 2022, <https://www.zenger.news/2022/05/18/new-jersey-coastal-storm-unearts-ghost-tracks/>.

⁵⁹ Harrison, Todd. "Toronto Flood 2013: The Revenge of Garrison Creek." *Spacing Toronto*, Spacing, 9 July 2013, <http://spacing.ca/toronto/2013/07/09/toronto-flood-2013-the-revenge-of-garrison-creek/>.

⁶⁰ Sandberg, L. Anders. "Stong Pond: What Role Does It Play in Managing the Storm Water on Campus?" *Alternative Campus Tour Stong Pond What Role Does It Play in Managing the Storm Water on Campus Comments*, York University, <https://alternativecampustour.info.yorku.ca/sites/stong-pond/>.

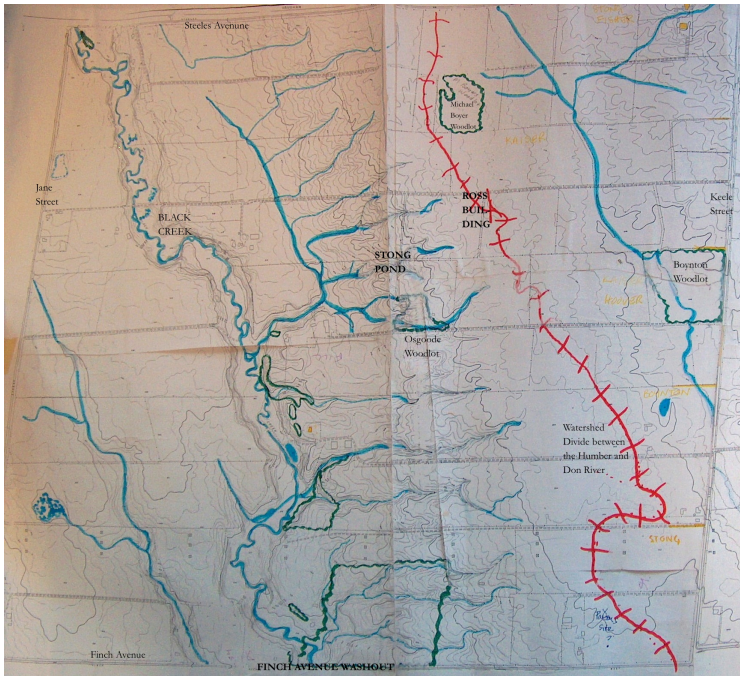


Figure 7 | Watershed divide between the Humber and Don Rivers in the 1950s before the university was developed. (yorku.ca) Topographic map and sketches courtesy of Helen Mills, founder of Lost Rivers Walks.

the role city planning had in these calamitous consequences, narrowing in on the alterations of the watershed, and how, if at all, York University bore any responsibility for the damage on Finch Avenue.

Before the development of the York University campus, approximately half of the

watershed in that area drained to the Don River, and the other half ran into the Humber River Watershed (Sandberg, 2017). The ensuing sewage system redirected all of the water to the Humber watershed, making room for campus construction, channeling the water into Stong Pond, a storm water pond, designed to retain water to prevent flooding; from there it flows to Hoover and Black Creek, the Humber River, then Lake Ontario. The pond, often at its full capacity, is not large enough to hold such large amounts of water, nor is the York University Storm Sewer built in 1963. Sandberg made the case that expanding this pond was not an answer to the overflow of rainwater, and that a more holistic approach was needed to work with nature, rather than to radically reshape it, in order to avoid such severe results in the future. If there were more trees, he argues, the water would run into the ground, allowing soil absorption, rather than just redirection, which caused the severe downstream consequences of flooding throughout Finch

Avenue in 2005. Despite concerted efforts from Sandberg, colleagues, and students, the pond was expanded nevertheless. The pollution of Stong Pond proliferated throughout the re-channelled water systems, and the very downstream consequences Anders warns of had become visually and infra-structurally evident, as they often do, once a major incident occurs.

But what is happening in the time being, when our alterations of natural landscapes aren't impacting us as overtly as we see with a torrential flood? A subtle shift in the ecosystem occurred when the yellow spotted salamander made a home within the human-made pond, sharing an adaptive habitat with groundhogs, Canada geese, squirrels, mink, and muskrat. The manmade pond supports these species and native species of deciduous and coniferous trees and shrubs. While this tiny creature offers hope within a dwindling habitat, the campus grounds oscillate between hospitable and unstable. The grasses and other native flora, for instance, are mowed and eliminated,⁶¹ inhibiting further expansion of biodiversity. Though migratory creatures, such as the Canada goose can leave and return with ease, this is not the case for the more habitat dependent creatures, such as the yellow spotted salamander, who may be displaced once again with further expansion of the pond.

There is another factor that threatens vulnerable species in storm ponds; they are teeming with species who do not naturally populate cooler, Ontarian environments. All over the province, retaining water pools and sewer systems are densely populated with goldfish that were released

⁶¹ Shuman, Patrick, and Gayla Weeks. "Pond Ecology." Environmental Assessment of Stong Pond: The Dynamics of DOC and Ice Extent During a Thaw Period in Stong Pond, York University, Toronto, ON, Canada (12/02/2013 - 11/04/2013): 4 Oct. 2013, <https://patrickshumangaylaweeks.weebly.com/pond-ecology.html>.

as disowned pets by individuals who may not have been aware of the huge ramifications of their actions. The goldfish feed on insects that inhabit the ponds, competing with the native species of reptiles and amphibians, some of which are endangered, like the yellow spotted salamander. The feeding habits of carp and koi uproot plants and muddy waters, ultimately destroying habitats. Due to climate change, the water temperatures support the proliferation of goldfish. The warming of the water lowers oxygen levels, which is catastrophic for many fish species, unlike the hearty goldfish. As humans reshape and re-channel bodies of water that feed into creeks and rivers, they make their way to the Great Lakes as unnatural tributaries, bringing the robust and perseverant goldfish with them.

As the famed forester and author Peter Wohlleben tells us, *nature is like the mechanism of an enormous clock*, in which interconnectedness and interdependence function in a delicate balance. The propensity to underestimate how difficult it is to return nature to its original working order once it has been meddled with is prevalent and wide-ranging across fields of study and industry.⁶² Media theorist and historian John Durham Peters argues that humans and their craft have altered all earth and sea based systems, and even systems in the sky, he adds, so much that “nature” as it is defined as something unmolested by humans, only exists where humans have designated and cordoned off as “natural”. He continues that, “The human steering of nature is not always smooth sailing, and stormy weather is blowing on the ship from several

⁶² Wohlleben, Peter. *Secret Wisdom of Nature: Trees, Animals, and the Extraordinary Balance of All Living Things -... Stories from Science and Observation*. GREYSTONE BOOKS, 2022. Translation by Jane Billinghamurst

directions.”⁶³ We see this here, at York University, and in a larger context that branches out from the locality of our physical interventions.

With the expansive effects of the Keele Campus of York University in mind, and my interest in marking buried rivers and waterways through publicly accessible poetic gestures, I created a site-specific projection and augmented reality installation entitled *Tributaries* in October 2022. The multimedia work involved a projection onto fog atop of the reflective pool outside of Vari Hall, as well as an augmented reality installation representing native and invasive species in order to mark and draw attention to the overbuilt watershed veins that coursed beneath the City of Toronto (particularly the watershed of the York University campus area) buried as a result of urban development.



Figure 8, Daytime view of the reflecting pool on the Keele Campus of York University in Toronto, Ontario.

The projection component of *Tributaries* consists of 3D-animated species that emerge and recede into the whirling ether. Here, we see native species of birds and fish, such as the

⁶³ Peters, John Durham. *The Marvelous Clouds: Toward a Philosophy of Elemental Media*. University of Chicago Press, 2016.



Figure 9, *Tributaries*, 2022, documentation of the fog projection at Nuit Blanche. Photo credit, Cam Miller



Figure 10, *Tributaries*, 2022, documentation of the fog projection at Nuit Blanche. Photo credit, Cam Miller

Canada Goose, Blue Jay, ruby throated hummingbird, minnow, bass, and the Chinook Salmon, as well as invasive species, including the goldfish, muted swan, and koi in an ethereal flurry, as though existing in a shape shifting fog, sharing matter in a unified spirit. The species intermingle through movements of swimming and flying, materializing and dematerializing in the fog. In addition to the progression in the animation where the creatures appear and disappear, the fog itself plays a formal role in the visibility of the content. A gust of wind creates a fade, a shift in direction brings the creatures closer to the viewer, or further away; the elements themselves were editing the projected content, compositionally and in pacing. This made the animated sequence unique in every cycle of the projected loop in an unpredictable, emergent collaboration between myself and the environment.

The salmon once swam up current in the GTA to spawn and feed populations of larger mammals, then giving precious nitrogen to the roots of the forest trees. In the absence of the salmon and other species, the earth itself has changed in its elemental makeup.

In *Tributaries*, the goldfish, grass carp, the muted swan, at times produce an overwhelming presence within the clouds of fog, but are just as beautiful and as graceful as the Ontarian species in their electric apparition. The 3D animation projected onto the fog also reflects on the water that is at times smooth as glass, and with a wind that swept up the fog, altering the image as the elemental editor, so too did the water's surface, rippling and diffracting the reflection and affecting the visibility of the concrete below. The ethereality I intended to imbue in the work was swept up to a level I could not have imagined or predicted.



Figure 11 | *Tributaries*, 2022, Goldfish and Chinook Salmon swim, documentation of fog projection at Nuit Blanche.
Photo credit, Cam Miller

While creating the animation, I imagined the projection would feel contemplative and evoke a sense of animism that would mesmerize and enchant. Nature had a greater hand in shaping the emotional peaks and valleys than I had accounted for, as it always seems to, and the experience of the projection was lively, wild, felt, seen, and heard in concert with the environmental stimuli, like the rustling leaves in the trees surrounding the reflecting pool, the whoosh of the sudden gusts of wind, the obscuring of visibility when the fog was allowed to gather, hiding the surrounding area and those who moved through it, an enveloping, eerie whiteness.

The swans appear to have many heads and tower over the pool, high into the fog. Emerging out from the array of white wings and long necks, swims a giant goldfish, high into the air, joined by two ruby-throated humming birds. As the swans flap their powerful wings, the long black necks of Canada geese unfurl snakily into view as an orange glow creates a silhouette within the fog. A bluejay sweeps in from the fog towards the viewers, growing in size and obscuring the array of long-necked water fowl. In the darkness, a school of Chinook salmon, long absent from the area, swim into the air, followed by giant orange and white koi and goldfish. As the animals appear and disappear in the whirling fog, it is like a phantasmagoric electric storm. Their movements at times appear to agitate their foggy surroundings, at other times the fog sweeps them away. In this apparition and disappearance, I think of the particles in flux within the quantum field, the frog's electric future face, the touch of electricity to reanimate deceased specimen. Like lightening in a cloud, the electric image produces fleeting luminous contours and line in the amorphous gaseous forms that traverse across the waters surface.

To witness this as the artist was intense on an emotional level; at the beginning of the 12-hour-long event, I was wracked with anxiety - the alterations the climate brought forth were so outside of what I had imagined that it felt like an unwieldy error, an oversight that would ruin the work. But as time passed, I relinquished the illusionary sense of control I had imposed on the work, realizing that it was formally inline with the central concept of the work, namely, that humans have no control over the liveliness of nature, despite all of the engineering, landscaping, channeling, and effort we invest in doing so. No matter how we push or pull, the world will spill in and inhabit the spaces we thought we had cleared; all of our solutions to what humans perceive as inconveniences, such as the wildlife that inhabits spaces we have designated for ourselves, have a way of unfurling in unpredicted, adaptive natural ways. While this wildness and unimagined climatic edit may be perceived as a consequence, I grew to welcome it, to marvel and appreciate each change in the wind's direction, each temporary clouding that hid us in the fog, and grateful for each time my creatures came back, no longer as a projection, but as sighting. This liveliness felt akin to improvisation, and the flatness of a rendered video became a responsive performer. As the projection and elements married upon and within the fog and the leaves above, they added another layer to the performative facets of projection Gene Youngblood reflected upon during the infancy of video art: *"In real-time multiple-projection, cinema becomes a performing art: the phenomenon of image-projection itself becomes the "subject" of the performance and in a very real sense the medium is the message."*⁶⁴

⁶⁴ Youngblood, Gene. Expanded Cinema, P. Dutton & Co., Inc., New York 1970.

The passersby, some unaware of the event, others having made York a destination for the city wide event of Nuit Blanche, would at times see nothing other than the reflecting pool with a small gathering of people mulling about, which is not an uncommon occurrence along a campus thoroughfare, to suddenly be confronted with the towering swans, which appeared to have four heads on their long, graceful necks, and as they flapped their powerful white wings in a kind of symmetrical fluttering, the vocal sounds of surprise and wonder filled the air. Then, a goldfish would swim out from the swan's huddle and into the sky, as Canadian Geese emerged from the darkness with their long black necks. In the surrounding trees, goldfish swam across and through the leaves of the treetops, while others treaded across the fog close to the surface of the water, creating the illusion that they were half submerged, looking upwards as their tails shimmied their plump bodies along.



Figure 12 | Augmented Reality Detail of *Tributaries*
Photo credit, Cam Miller

In the augmented reality component, viewers saw the superimposition of 3D animated fish swimming inches above the concrete. The augmented reality animations were viewable on mobile devices provided to the public onsite (and on a free app available on the App Store and on Google Play) on which viewers were instructed to aim the device's camera towards illuminated graphic symbols positioned along the circumference of the reflective

pool near Vari Hall. The machine vision of the phones or tablets track the graphic to superimpose and anchor the animated content in space, illuminated in the darkness and reflected in the pool of water.

Once activated, it is as though we are looking down into an invisible underground river where fish swim in darkened channels of the pavement, sidewalks, and thoroughfares. Forming a ghostly current, ethereal and silent, they haunt the campus as they slowly swim towards and about the ankles of the viewers. The fish koi, salmon, and goldfish, move as fluidly as the currents they swim in.



Tributaries draws attention to the historical landscape of Toronto as a site that supported a thriving ecosystem where numerous streams, creeks, and rivers fed into the vast body of Lake Ontario. These tributaries unified within the Great Lake, synergistically touching numerous cities, provinces and states, providing drinking water for 9 million people and countless non-humans.

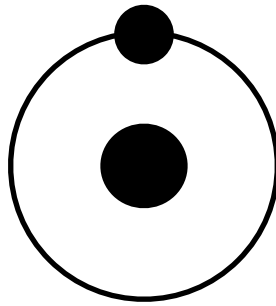
Figure 13 | Augmented Reality Detail of *Tributaries*
Photo credit, Cam Miller

Tributaries metaphorically demarcates the overbuilt veins that coursed beneath the City of Toronto, buried as a result of urban development.

In *Tributaries*, past and present, native and invasive species appear as though in a void, wherein photons blink in and out of view, shift chimerically becoming and unbecoming. Electricity flashes their likeness on amorphous fields, and virtual and physical realms are enmeshed momentarily, mixing water and air figuratively and literally, letting a goldfish swim across the sky.

Chapter 4

Mnemonic Fish - Athens



*The air, you see, is filled with sounds that are inaudible, but
that become audible if we have receiving sets...*

-John Cage

*“[W]hat strange chaos is this wide atmosphere we breathe! Every atom, impressed with good
and ill, retains the motions which philosophers and sages have imparted to it, mixed and
combined in ten thousand ways with all that is worthless and base. The air itself is one vast
library, on whose pages are forever written all that men and women has ever whispered.”*

- Charles Babbage

The Ninth Bridgewater Treatise

MAP PIECE

Draw a map to get lost.

1964 spring

-Yoko Ono

grapefruit

The impetus to demarcate and respond to invisible phenomena through media can be traced to our most ancient anthropological findings of visual expression. According to Shigeru Miyagawa, a professor of Linguistics at MIT, and his team, our earliest traces of figurative representation, date back some 45,000 years ago, demonstrating that some of the repetitiously produced images were not solely a pictorial form of language but potentially also functioned to map out a phenomenological relationship to the physical world. Preceding the illustrations found in Sulawesi, Indonesia, which include the first recognizable depiction of an animal, the warty pig,⁶⁵ and the epic scenes of hunting and ritual found in the *Grotte de Lascaux*, were the Indonesian stencils of hands. The contours of hands found on the roofs and walls of caves⁶⁶ are hypothesized to serve not only as an early form of language, but were also potentially used to

⁶⁵ Handwerk, Brian. "45,000-Year-Old Pig Painting in Indonesia May Be Oldest Known Animal Art." *Smithsonian.com*, Smithsonian Institution, 13 Jan. 2021, <https://www.smithsonianmag.com/science-nature/45000-year-old-pig-painting-indonesia-may-be-oldest-known-animal-art-180976748/>.

⁶⁶ Ann Gibbons. "Indonesian Cave Art May Be World's Oldest." *Science*, Science, <https://www.science.org/content/article/indonesian-cave-art-may-be-worlds-oldest#:~:text=Archaeologists%20assumed%20the%20paintings%2C%20discovered,at%20least%2035%2C400%20years%20old.>

identify acoustic hotspots on the rocky surfaces of caves.⁶⁷ Upon identifying which surfaces in the bright acoustics of the space were most reverberant, a spray of red pigment comprised of heated goethite and natural hematite was blown over the backs of outstretched fingers and palms to create a silhouetted-hand shape in the negative space.⁶⁸ The study of material forms that demarcate the sonic ongoingings of the cave-space, recorded in the pigmented media for posterity or to be observed by others gifted by our prehistoric ancestors, indicates that cave-art, as Miyagawa posits, “is a form of cross-modality information transfer, in which acoustic signals are transformed into symbolic visual representations. This form of information transfer across modalities is an instance of how the symbolic mind of early modern humans was taking shape into concrete, externalized language.”⁶⁹

As the visual imprint of hands have endured through the ages, so may have the sounds which bounced off of their bright surfaces, intermingling with all that has ever sounded there. Theorist and experimental music and media arts historian Douglas Kahn writes of sound on a molecular level in his book *Noise, Water, Meat: A History of Sound in the Arts*, in examining how ancient utterances and sonic broadcasts have reverberant and residual lives in space. Kahn investigates the materiality of sound via avant-garde composer and theorist John Cage’s developing fascination and desire for the amplification of small sounds, including the sounds of

⁶⁷ Miyagawa S, Lesure C and Nóbrega VA (2018) “Cross-Modality Information Transfer: A Hypothesis about the Relationship among Prehistoric Cave Paintings, Symbolic Thinking, and the Emergence of Language.” *Front. Psychol.* 9:115. doi: 10.3389/fpsyg.2018.00115

⁶⁸ “Prehistoric Pigments.” *RSC Education*, Royal Society of Chemistry, 1 Oct. 2015, <https://edu.rsc.org/resources/prehistoric-pigments/1540.article>.

⁶⁹ Miyagawa, Shigeru et al. “Cross-Modality Information Transfer: A Hypothesis about the Relationship among Prehistoric Cave Paintings, Symbolic Thinking, and the Emergence of Language.” *Frontiers in psychology* vol. 9 115. 20 Feb. 2018, doi:10.3389/fpsyg.2018.00115

“a fly walking on paper, magnified.”⁷⁰ Cage went to great lengths to pronounce the fullness of sounds in ‘silence’ through his writing and, most famously, in his seminal composition of ‘uninterrupted silence’, 4’33”.⁷¹ 4’33” was the ‘absence of intentional sound’, Kahn explains, wherein listeners became attuned to environmental and small sounds in the absence of composed or performed intentional sounds. His fascination with the fullness of silence led him to visit an anechoic chamber at Harvard University, where Cage experienced sound on a profoundly physiological level, which had a lasting effect upon him. He writes:

*Anybody who knows me, knows this story. I am constantly telling it. Anyway, in that silent room, I heard two sounds, one high and one low. Afterward I asked the engineer in charge why, if the room was so silent, I heard two sounds. He said, “Describe them.” I did. He said, “The high one is your nervous system in operation. The low one is your blood in circulation.”*⁷²

This insight led Cage to his 1962 piece, 0’00”, in which small and inaudible sounds, including bodily sounds and signals of radiation and transmission, were amplified.⁷³ Cage

⁷⁰ Kahn, Douglas. *Noise, Water, Meat: A History of Sound in the Arts*. MIT Press, 2001. 194

⁷¹ The precursor to 4’33” was *Silent Prayer*, which was notably three seconds shorter than 4’33”, fitting to the parameters of what Cage referred to as canned music (Muzak). *Silent Prayer* was conceptualized to be sold to the Muzak company, which Kahn presumes was inspired by Erik Satie’s *musique d’ameublement* (Furniture music), that was meant to be played live as background music. *Musique d’ameublement* was a collaboration with Darius Milhaud initially for the interludes of a play by Max Jacob.

⁷² Cage, John. *Indeterminacy*, (1958-1959), in *Silence*, Wesleyan University Press, Middletown, 1961. 262

⁷³ Kahn, Douglas. *Noise, Water, Meat: A History of Sound in the Arts*. MIT Press, 2001. 194

asserted that this piece demonstrated “*that everything we do is music, or can become music, or can become music through the use of microphones...By means of electronics, it has been made apparent that everything is musical.*”⁷⁴

Through Cage’s experience, Kahn draws our attention to the din that resounds all about us, but cannot be observed without mediation. English philosopher, mathematician, mechanical engineer, and inventor, Charles Babbage (1791-1871) claimed that the vibrations of sounds carried on in perpetuity, and if someone equipped with the necessary mathematics or technology could make these vibrating atoms legible they could relay the contents of their meaning,⁷⁵ to effectively interpret the movement of molecules like a recording. “*The pulsation of the air, once set into motion by the human voice,*” writes Babbage, “*cease not to exist with the sounds to which they give rise.*”⁷⁶ Though the sounds dissipate and disperse, Babbage believed that one day, with the right equipment, the voices could be traced back to their origin. Kahn regards technology as a means to reassemble sonic events on a material level, yet these diffused utterances cannot be discerned so long as they hang in the air, Kahn explains, but can once they are ‘inscribed on other media, such as water.’⁷⁷

Babbage regarded these enduring sounds coursing through space to be heard by potential ears to bear witness to all that has occurred; good, banal, and evil. In the final chapters of his

⁷⁴ Kahn, Douglas. *Noise, Water, Meat: A History of Sound in the Arts*. MIT Press, 2001. 194

⁷⁵ *Ibid.* 210

⁷⁶ Babbage, Charles. *The Ninth Bridgewater Treatise* (1837), (London: Cass,1967), 108-10.

⁷⁷ Kahn, Douglas. *Noise, Water, Meat: A History of Sound in the Arts*. MIT Press, 2001, 211.

Ninth Bridgewater Treatise, Babbage wrote of kidnapped and murdered Africans who had been drowned at sea during the slave trade:

*Interrogate every wave which breaks unimpeded on ten thousand desolate shores, and it will give the evidence of the last gurgle of the waters which closed over the head of his dying victim: confront the murderer with every corporeal atom of his immolated slave and in its still quivering movements he will read the prophet's denunciation of the prophet's king. ("And Nathan said unto David - thou are the man.")*⁷⁸

Babbage's concept of nondissipative sound caught the imagination and intrigue of many, including Victorian moralist and author, Charles Dickens.⁷⁹ *"It was suggested by Babbage,"* he wrote generations after Babbage, *"[...] that a mere word spoken - a mere syllable thrown into the air - may go on reverberating through illimitable space for ever and ever, seeing that there is no rim against which it will strike: no boundary at which it can possibly arrive."*⁸⁰

As Babbage theorized non-dissipating sounds, Buckminster Fuller speculated that our thoughts could similarly reverberate in space, musing in a materialist framework, writing that

⁷⁸ Babbage, Charles. *The Ninth Bridgewater Treatise* (1837), (London: Cass, 1967), 118-19.

⁷⁹ Although Dickens was taken with Babbage's nondissipative sounds as a means to encourage self-improvement, to speak goodly moral words, he also spoke in his address that this was of exception for "some savage African Tribes." Of this, Kahn writes, "It seems the acoustic atoms from the last pages of Babbage's treatise had yet to reach the midlands." 212

⁸⁰ Dickens, Charles. *The Speeches of Charles Dickens: Speech given at Birmingham and Midland Institute: Annual Inaugural Meeting*, September 27th, 1869, Humanities Press, London. 1988, 399.

“[...]it is possible that human eyes operating as transceivers, all unbeknownst to us, may be beaming our thoughts into the great night-sky void, not even having the sun’s radiation to interfere mildly with them. [...] Because humans consist of a myriad of atoms and because atoms are themselves electro-magnetic frequency event phenomena— not things — it is theoretically possible that the complex frequencies of which humans are constituted, together with their angular interpositioning, could be scaningly unraveled and transmitted beamwise into the celestial void to be received some time, somewhere in Universe [...].”⁸¹

While studying integrated media at OCAD (now OCAD University), I experimented with feedback loops in various mediums, as many an undergrad student of the analogue age was wont to do, and often used a video camera and the white noise from a CRT television set as a source signal. Observing my experiment with the geometric fractal forms produced by aiming the camera and its own signal lined-in upon the television screen, our electronics professor, new media artist Doug Back, informed the class that it was cosmic microwaves from the Big Bang that caused the snow we see and the white noise we hear on TV. He smiled and said, "If you ever get bored, just turn on the TV and watch the birth of the universe." Astounded, I repeatedly fact-checked this in case I altered my recollection of his statement as more incredulous than it was, and still hesitate in repeating this to others to this day. But indeed: turn your television to an "in between" channel, or tune into the background noise of the radio, and part of what you will

⁸¹ Youngblood, Gene. *Expanded Cinema: 50th Anniversary Edition*. Fordham University Press, 2020. P29-30.

observe is the afterglow of the big bang,⁸² a phenomenon otherwise known as Cosmic microwave background radiation (CMBR).

As this radiation pours into our television sets and buzzes through our speakers, we too must be enveloped in its vibrant noise. How long-lasting, and how far reaching are our own earthly broadcasts transmitted into space? Though infinitesimally modest in scope, I was swept up with ideas of the lasting effects of sound as a traveling record of an event, as an active archive of moving matter. Much later, when technology permitted, I began to make geolocative sound works, in hopes to make subtle ripples that touched listeners in a gentle, poetic manner, with the radiation that dances and moves the noise across our screens in mind.

Resonators

I began with historical sound sketches, augmenting sites that I could walk to with sounds that originated in those locations, imagining that sounds hung about their sites of origin to be rediscovered. Working locally, I sourced sounds in the form of voices that had shaped Toronto culturally, politically, intellectually and physically in a series entitled *Resonators*. The collection of these influential voices share the commonality of immigrating to Canada and were heard in their new home of Toronto. I chose source material that was publicly accessible, beginning with Ursula Franklin's address for the CBC Massey Lectures.

⁸² Dunbar, Brian. "Background on the Background Explorer and the Science of John Mather." *NASA*, NASA, 10 May 2006, https://www.nasa.gov/vision/universe/starsgalaxies/cobe_background.html.

Ursula Franklin

Ursula Franklin was a theoretical physicist who taught at the University of Toronto and wrote extensively on the societal impacts of technology in relation to power, authority, and identity. Her research was pertinent and resonated with interdisciplinary fields of sciences and social studies, resulting in Franklin being awarded over ten honorary degrees from Canadian universities, a Governor General's Award, and inducted into the Canadian Science and Engineering Hall of Fame. Born in Munich, she studied chemistry and physics at the University of Berlin until the Nazis expelled her and she was sent to a labour camp.⁸³ Surviving the Holocaust, Franklin returned to her studies, stating later, "I remember a sort of a real subversive pleasure that there was no word of authority that could change either the laws of physics or the conduct of mathematics."⁸⁴

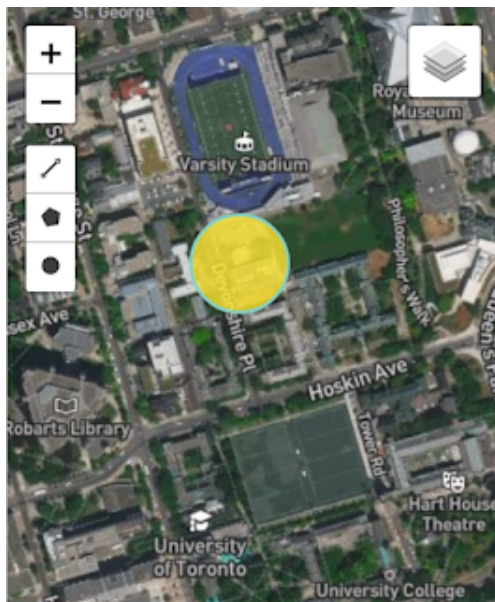


Figure 14 | Echo located at George Ignatieff

Using a web-based software called Echoes that uses GPS technology to create sound walks, I placed the archived recording of the CBC Massey Lecture Series where it was originally delivered at the George Ignatieff Theatre, located at 15 Devonshire Place. Franklin's lecture was later published as *The Real World of Technology* in 1990 and revisited in 1999. It appealed to me that Franklin's lecture existed in print, and in sound in radio format, as well as being an archived

⁸³ Raymond, Katrine. "Ursula Franklin." *The Canadian Encyclopedia*, The Canadian Encyclopedia, 18 Dec. 2007, www.thecanadianencyclopedia.ca/en/article/ursula-franklin.

⁸⁴ Franklin, Ursula M., and Sarah Jane Freeman. *Ursula Franklin Speaks: Thoughts and Afterthoughts*, McGill-Queen's University Press, Montreal, 2014, p. 21.

podcast, and now as a spatialized sound walk, the iterative media reflecting Franklin's observations on the holistic effects of technology and the natural world. "Individually and collectively," Franklin states, "we live simultaneously in the bitsphere and the biosphere, sometimes more profoundly in one, sometimes more profoundly in the other."

With the Echoes app installed on a mobile device, listeners can see the area that I have augmented with Franklin's voice, and when they physically move within the bounds of the area, they are able to hear her speak. A feature within the Echoes app allows you to create spatial sound, so the closer the listener is to the centre of the designated area, the louder the sound, which quiets on the edges of the site. This enabled the auditory illusion that Franklin's lecture was coming from within the George Ignatieff Theatre, while the sound diminished on the street.

I then repeated this process with Jane Jacobs employing a 1969 CBC Interview for "The Way It Is" in which Jacobs walked along University Avenue.

Jane Jacobs

Jane Jacobs settled in Toronto in 1969 from New York City after becoming renowned as the author of an influential book, *The Death and Life of Great American Cities*, as a journalist, and as a local activist in the efforts to preserve Greenwich Village from the encroachment of urban development. Jacobs continued these efforts in preserving neighbourhoods and green areas in Toronto, despite commuting to New York City for her trials relating to the charges incurred by

her activism.⁸⁵ Jacobs believed that it was people that made cities vibrant and emphatically made the case for walkable cities, rather than an infrastructure that favoured vehicles over pedestrians. I situated three Echoes of Jacobs as she shared her observations on Toronto streets, including her

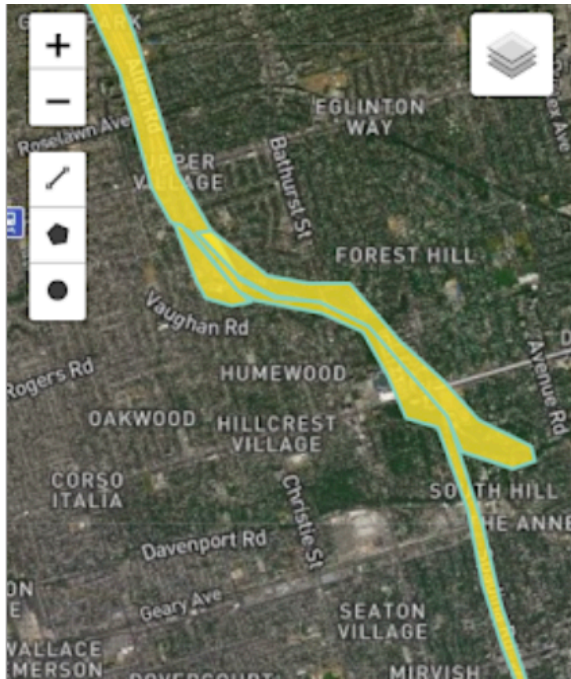


Figure 15 | Spadina Expressway Route, Cedarvale Ravine

admiration of Markham Street, her dislike for University Avenue, and her lament for the potential loss of Toronto's ravines should the planned Spadina Expressway have come to fruition. Much to her credit in rallying the support of the public, the expressway was not completed, preserving the Cedarvale Ravine as a park as well as the neighbourhoods in the path of the previously approved expressway route.⁸⁶ The first Echo runs the length of University Avenue, where Jacobs was interviewed as she walks,

offering her critique of the road and Toronto as a whole. The second Echo runs the span of the projected route of the thwarted Spadina Expressway. The third (and fourth) flank the portion of the route that would have crossed over the Cedarvale Ravine.

⁸⁵ Whelton, Clark. "Won't you come home, Jane Jacobs?". *The Village Voice*, 6 July 1974. pp. 1, 24.

⁸⁶ Forman, Gideon. "In Working to Preserve the Greenbelt, I'm Reminded of My Late next-Door Neighbour, Jane Jacobs." *David Suzuki Foundation*, David Suzuki Foundation, 4 Apr. 2023, davidsuzuki.org/expert-article/in-working-to-preserve-the-greenbelt-im-reminded-of-my-late-next-door-neighbour-jane-jacobs/.

Jackie Shane

Using the Live Sessions at the Sapphire Tavern, I created an echo of a performance by legendary soul singer Jackie Shane. Shane was from Nashville and made Toronto her home in 1959, entertaining packed clubs, such as the Sapphire Tavern, which was located at 20 Richmond St. E. It is at this location where I have placed a Shane's Echo, in which she performs her hit single cover of William Bell's *Any Other Way*, with the rewrite, "Tell her that I'm happy, tell her that I'm gay/Tell her that I wouldn't have it any other way."⁸⁷



Figure 16, 17 | Left, Jackie Shane between sets in Toronto circa 1960, Right, Echo at former Sapphire Tavern, Toronto

Although Shane was both celebrated and revered in Toronto, in 1971 she inexplicably disappeared for decades. Swirling rumours of tragic endings led many to presume the worst.^{88 89}

⁸⁷ Bengal, Rebecca. "Jackie Shane: Any Other Way." *Pitchfork*, Pitchfork, 25 Oct. 2017, pitchfork.com/reviews/albums/jackie-shane-any-other-way/.

⁸⁸ "No Other Way: The Story of Jackie Shane." *Museum of Toronto*, 2 Apr. 2024, www.museumoftoronto.com/collection/no-other-way-the-story-of-jackie-shane/.

⁸⁹ Milton, Anthony. "'Not All Trans Stories Are Rooted in Pain': Meet the Directors of the Hot Docs Tribute to R&B Legend Jackie Shane." *Toronto Life*, Toronto Life, torontolife.com/culture/not-all-trans-stories-are-rooted-in-pain-meet-the-directors-of-the-hot-docs-tribute-to-rb-legend-jackie-shane. Accessed 29 June 2024.

Upon the release of a 2010 CBC documentary produced by Elaine Banks entitled *I Got Mine: The Story of Jackie Shane*, a renewed sense of intrigue and appreciation for the legacy of Jackie Shane, as well as a growing curiosity surrounding her whereabouts were engendered. Shane was eventually discovered in Nashville, living a quiet life, having retired from the stage, where she remained until her death in 2019. While performing in the 50s and 60s Shane wore both male and female attire, wigs and makeup, often oscillating between gender pronouns in interviews, and later identified as a transgender woman in 2017. Jackie Shane's fan base was diverse in race, gender, and orientation, with many dressed in her likeness. The recent rerelease of *Any Other Way* has garnered a Grammy Award nomination and critical praise, perhaps speaking to a generation that is more readily prepared to celebrate Shane than its predecessors. The Echo utilizes the “spatialize” feature to increase the volume as the listener approaches the centre of the location, which is placed on the building where the Sapphire Tavern once resided, with the intention of creating the sense of the music to be heard from outside of the club.

Emma Goldman



Figure 18 | Emma Goldman (1869 – 1940)

The final work in the series featured a 1914 Speech by Emma Goldman, as read by Sandra Oh.

Russian born writer and anarchist activist Emma Goldman, who J. Edgar Hoover once named “the most dangerous woman in America”,⁹⁰ lived in

⁹⁰ Elizabeth, Fee, and Mary E Garofalo. “Red Emma (1869-1940): Idealistic Revolutionary.” *American Journal of Public Health*, U.S. National Library of Medicine, June 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC3093260/.

Toronto upon her exile from the United States, and other countries, for her politics, her views on contraception, free speech, free love, marriage, feminism, gay rights, gender identity, labour rights, violence and pacifism. Despite being regularly incarcerated, her reputation as a powerful orator drew large crowds at lecture halls and other public speaking events. Goldman was often nomadic, living out of suitcases as she travelled for speaking tours, or to visit areas of conflict in the fight against fascism. She resided at 322 Spadina Avenue in 1926-1927,⁹¹ and later on Vaughan Rd in the home of a friend, until her death in 1940.⁹² The Echo I placed at her Spadina home is unlike the other audio recordings I have included in this series as the sound does not originate from the location to which the Echo is attached, nor is it spoken by Goldman herself. While there is available audio of Goldman, a transcribed speech she delivered in 1914 in San Francisco, as read by Sandra Oh, *A reading from Voices of a People's History of the United States* performed on October 5, 2005, in Los Angeles California, was more suited to the experience of using Echoes.

⁹¹ O'Flynn, Siobhan. "Apt. of Emma Goldman, Anarchist & Social Activist." *Kensington Market: Hidden Histories*, 13 July 2017, kensingtonhiddenhistories.wordpress.com/2017/04/10/apt-of-emma-goldman-anarchist-social-activist/.

⁹² Bunch, Adam. "Emma Goldman in Toronto - One Last Victory for the Most Dangerous Woman in the World." *Spacing Toronto*, 11 Jan. 2016, spacing.ca/toronto/2016/01/12/53895/.

Mnemonic Fish: The River Ilissos, Athens

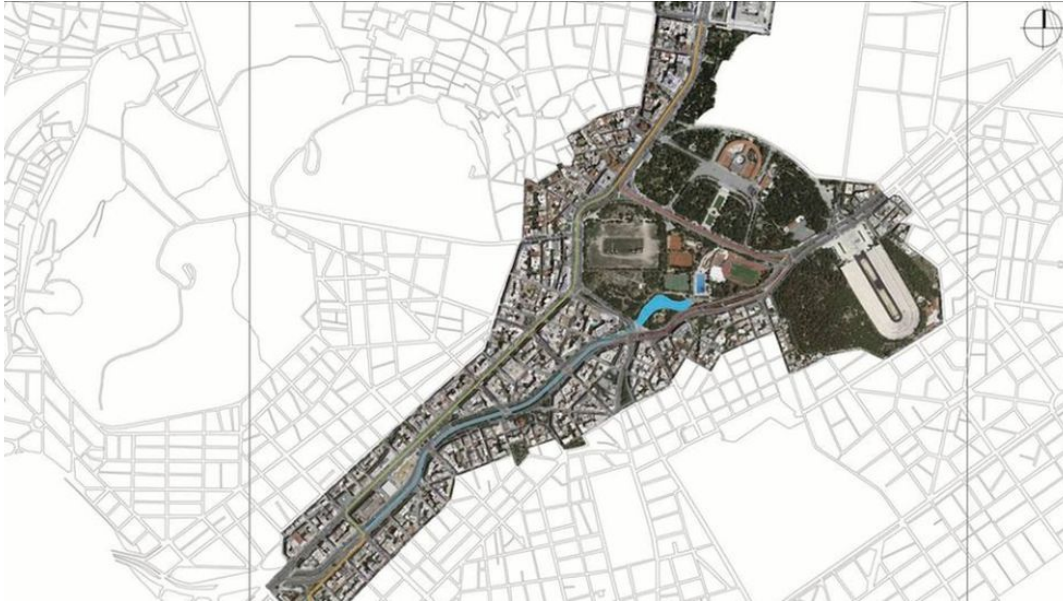


Figure 19 | Plans for the River Ilissos to emerge overground where it will run from the Temple of Zeus, where a portion of the river can currently be seen, to the National

These works were precursors to a more idiosyncratic and poetic exploration of geolocate sound that I created in 2022. In Athens, I traced a buried river once more using GPS and the Echoes app, which uses Google Maps to play audio in specific locations. As part of the non-commercial Platforms Art Fair, curated by Julie René de Cotret, I exhibited the public audio piece *Mnemonic Fish* that draws upon two of the five mythical rivers of the underworld of Hades, The River of Unmindfulness, known as Lethe, where the dead drink from its waters to forget their previous lives before rebirth, and The River of Memory, known as Mnemosyne. To drink from the pools of Mnemosyne would restore memory and spare the soul from transmigration. The actual underground river that I map out in Echoes, River Ilissos, is an ancient river that runs through Athens that was buried in a tunnel beneath the city of WWII in an

effort to modernize the city. Formed by the convergence of several seasonal creeks, Ilissos drains into the Athenian mountain range region of Attica, specifically the western flank of Mount Hymettus. During the 19th and 20th centuries, the river was overcome with pollution as the city of Athens expanded. It was then buried, designated as a conduit for rainwater runoff along the streets that were built over its original path. Flowing beneath Mesogesion Avenue, the river runs under the suburban avenues of Michalakopoulou and Vasileos Konstantinou, along the Panathinaiko Stadium, where it then seeps into the southeastern ruins of the Columns of Olympian Zeus, where a small portion of the river can be seen to this day. The ancient banks of River Ilissos, where Socrates and the Cynics would teach their philosophies, were written about by Plato.⁹³ Named after the demigod son of Poseidon and Demeter, the river is described idyllically in Plato's text, *Phaedrus*.⁹⁴

The goddess Mnemosyne was the daughter of Uranus and Gaea, Heaven and Earth, and the mother of the nine muses, all fathered by her nephew Zeus. It is said that although Plato used myth as a teaching tool rather than a belief system, he was known to call upon Mnemosyne to remember his narratives, as the titan's importance was understood by a society built upon oral culture:

*“But besides the gods and goddesses whom you have mentioned, I would
specially invoke Mnemosyne (Memory); for all the important part of my*

⁹³ Morgan, Martin. “Athens to Open up Ancient River.” *BBC News*, BBC, 27 Feb. 2019, www.bbc.com/news/blogs-news-from-elsewhere-47385140.

⁹⁴ Atsma, Aaron J. “Ilissos.” *ILISSUS (Ilissos) - Attic River-God of Greek Mythology*, Theoi Project, www.theoi.com/Potamos/PotamosIlissos.html. Accessed 27 June 2024.

discourse is dependent on her favour, and if I can recollect and recite enough of what was said by the priests and brought hither by Solon, I doubt not that I shall satisfy the requirements of this theatre.”

-Plato, Critias (trans. Bury)⁹⁵

Perhaps the oppositional counterpart of Mnemosyne is Lethe, the goddess of Oblivion, daughter of Eris, Goddess of Strife, who was described as dull, inhabiting the role of guard to the court of Hypnos, where the River of Unmindfulness encircled.⁹⁶ Though the mythological rivers are said to be located at the archeological site of Eleusis, where the ceremonies of the Eleusinian Mysteries were performed by the cult of Demeter and Persephone, I use the metaphoric and formal aspects of forgotten rivers buried underground as thematics within *Mnemonic Fish*.

When listening to *Mnemonic Fish* as we enter the activated zone, the sounds of water softly trickles into our ears, as though we are nearing a cool burbling spring. As the trickling swells, we hear synthesized instrumental tones that gently and slowly ascend. The binaural sounds of the water create the auditory illusion that we share the environment with a peacefully flowing river. We then hear a woman speak in low tones, as though we are privy to her pensive remembrances. She speaks as though observing a memory unfold in real time, a memory of a river and the sensation of staring into it,

⁹⁵ Greenberg, Mike. “Mnemosyne: The Greek Goddess of Memory.” *MythologySource*, 4 Jan. 2022, mythologysource.com/mnemosyne-greek-goddess/.

⁹⁶ “Book 10.” *Thebaid*, by P. Papinius Statius and Bailey D R Shackleton, Harvard University Press, 2003, pp. 89-ff.

falling deeper and deeper into contemplation as ideas spring forth. As she speaks, her voice enmeshes with the melodic drone and the water's current, evoking a sense of being swept along with her thoughts and sensations.

The fish referenced in the title are a reference to another geographically displaced poetic, in which thought and the inception of ideas are like fish that swim away when disrupted, as Virginia Woolf had described in *A Room of One's Own*.

Thought – to call it by a prouder name than it deserved – had let its line down into the stream. It swayed, minute after minute, hither and thither among the reflections and the weeds, letting the water lift it and sink it until – you know the little tug – the sudden conglomeration of an idea at the end of one's line: and then the cautious hauling of it in, and the careful laying of it out? Alas, laid on the grass, how small, how insignificant this thought of mine looked; the sort of fish that a good fisherman puts back into the water so that it may grow fatter and be one day worth cooking and eating.

But however small it was, it had, nevertheless, the mysterious property of its kind – put back into the mind, it became at once very exciting, and important; and as it darted and sank, and flashed hither and thither, set up such a wash and tumult of ideas that it was impossible to sit still. It was thus that I found myself walking with extreme rapidity across a grass plot. Instantly a man's figure rose to intercept me. His face expressed horror and indignation. Instinct rather than reason came to my help; he was a beadle, I was a woman. This was the turf; there was the path. Only the fellows and scholars are allowed here; the gravel is the place for me. Such thoughts were the work of a moment. As I regained the path, the arms of the beadle sank, his face assumed its usual repose, and though turf is better walking than gravel, no very great harm was done. The only charge I could bring against the fellows and scholars of whatever the college might happen

*to be was that, in protection of their turf, they had sent my little fish into hiding.*⁹⁷

Once disturbed from thought, the fish (or idea) swims away in the currents of consciousness, forgotten, perhaps to be retrieved in time. The tie between Woolf's fish and the waters of forgetfulness and remembrance, Lethe and Mnemosyne, speak to the actual waters that run below the fore of Athenian thought - its fate yet to be determined.

In the mediated confluence of references in *Mnemonic Fish*, such as the rivers, fact and myth, the multiple temporalities, and literary source material, I think of Aby Warburg's interconnected collection of media in his work, fittingly named *Mnemosyne Atlas*. Giorgio Agamben looks closely at binding structures as methodologies in his text, *The Signature of All Things*, in which he explicitly asks, "What is a Paradigm?"⁹⁸ Agamben uses Warburg's "atlas of images" as an example of a paradigmatic structure that tethers the general and particular to a discernible whole. Warburg's work, *Mnemosyne Atlas*, which bears the name of the Greek goddess of memory, is a culmination of assorted reproductions of historic art that he collected in 1924 to 1929 from newspaper, photographic, and manuscript sources. Warburg named the thematic, process of selection, collecting, and placement as *Pathosformeln*⁹⁹, a form for pathos, in which Agamben defines as "...an indissoluble intertwining of an emotional charge and

⁹⁷ Woolf, Virginia. *A Room of One's Own*. Arcturus. (Pp 11-12). Arcturus Publishing Limited, 2020 Edition, originally published by Hogarth Press, England, 1929.

⁹⁸ Agamben, Giorgio. *The Signature of All Things*, Zone Books. P 9

⁹⁹ *Ibid.*

an iconographic formula in which it is impossible to distinguish between form and



Figure 20 | Panel 39 of Aby Warburg's "Mnemosyne Atlas" (1925-1929).

content..."¹⁰⁰. Agamben posits that to see *Mnemosyne Atlas*, we must consider its singular elements in contiguity with each other and the whole. The images point to their historic origins, yet exist outside of it, as they are photographed, repurposed, and re-contextualized through placement, becoming neither archaic, nor contemporary, "but are undecidable in regards to diachrony and synchrony, unicity and multiplicity."¹⁰¹

In Warburg's configuration of the images, the references are simultaneously recognizable yet inhabit unfamiliar relational territory. The paradigm functions as a constellation to navigate the culmination of images, a relational movement that creates a third knowing of the content by the way it rubs images up against each other.

"In the paradigm, intelligibility does not precede the phenomenon; it stands, so

¹⁰⁰ Giorgio Agamben, *Aby Warburg and the Nameless Science*, Potentialities: Collected Essays in Philosophy, Daniel Heller-Roazen, trans and ed, Stanford: Stanford University Press, 1999, 90

*referenced from the scholarly paper by Colleen Becker, *Aby Warburg's Pathosformel as methodological paradigm*, published by the Department of Art History, University of Birmingham, 2013. p 10

¹⁰¹ Agamben, Giorgio. *The Signature of All Things*, Zone Books, 2009. p 29

to speak, "beside" it (*para*)".¹⁰² The paradigm does not function in a dichotomy, but rather, Agamben explains, as analogy. Analogy creates an imbalance in the equation of dichotomy, transforming it by implementing variance in the oscillation of polar forces. Analogy as a term becomes interchangeable with paradigm in Agamben's text, a perspective that maintains a *tertium datur*, "neither A or B". It is not, in the case of Warburg's atlas of images, the singular or the whole, but instead the movement through particular to particular, particular to whole, and whole to particular, which constitutes the 'analogical third'.

The River Ilissos is "seen" in an almost synaesthetic sense by the sound I am producing that speaks of Woolf's fish in an audio composition, folding and unfolding as though remembered and forgotten, buried and emerging, as environmental sounds of river currents and ambient abstraction are heard. The audio is made available on the mobile devices of participants as they walk along the river below Athens. Here, the digital palimpsest is sonic, temporal, and spatial, as though written in between memory and oblivion.

As media theorist Frances Dyson puts it "*Three-dimensional, interactive, and synesthetic, perceived in the here and now of an embodied space, sound returns to the listener the very same qualities that media mediates: that feeling of being here now, of experiencing oneself as engulfed, enveloped, absorbed, enmeshed, in short, immersed in an environment.*"¹⁰³

¹⁰² Agamben, Giorgio. *The Signature of All Things*, Zone Books, 2009. p 27

¹⁰³ Dyson, Frances. *Sounding New Media: Immersion and Embodiment in the Arts and Culture*, University of California Press, 2009. 4

To walk into an augmented sound environment is to walk into a zone of virtual and physical enmeshment. An invisible threshold that has an uncanny effect on the listener, as though encountering an aural apparition, a haunting. The haunting lands on the ear softly, with surprising presence and intimacy, seeming to emit internally (via headphones) as much as it is integrated



Figure 21 | *Mnemonic Fish*, 2022, Detail. Site-specific geolocate sound located in Athens, Greece.
Photo credit, Scott McGovern

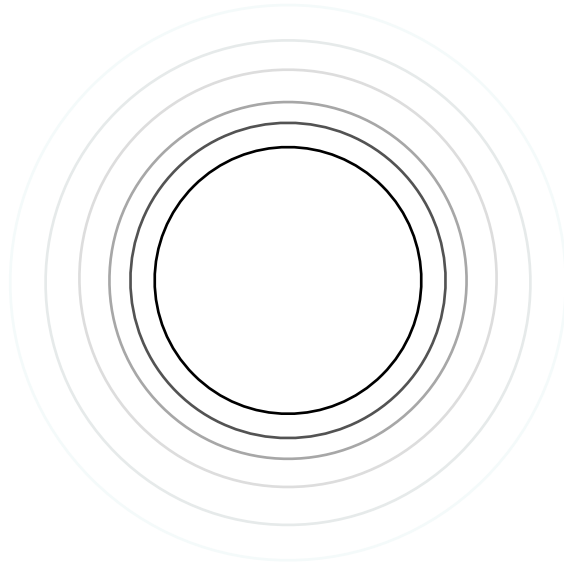
externally with the existing environmental sounds. To borrow from cinematic language, the superimposed media and the natural ambiance of the site results in a confluence of diegetic and non-diegetic sound, or trans-diegetic sound, that envelops the listener phenomenologically.

The sound works that I have tied to locations are rooted in history and are simultaneously anachronistic. They are as much tied to historical figures as they are to past and present societal contexts, media, and infrastructure. “*To understand media*,” writes John Durham Peters, “we

*need to understand fire aqueducts, power grids, seeds, sewage systems, DNA, mathematics, sex music, daydreams, and insulation[...].”*¹⁰⁴

¹⁰⁴ Peters, John Durham. *The Marvelous Clouds: Toward a Philosophy of Elemental Media*. University of Chicago Press, 2016. 29

Chapter 5



Subtle Matter

“But when we sit together, close,” said Bernard, “we melt into each other’s phrases. We are edged with mist. We make an unsubstantial territory.”

The Waves, Virginia Woolf

water talk

you are water

I'm water

we're all water in different containers

that's why it's so easy to meet

someday we'll evaporate together

but even after the water's gone

we'll probably point out to the containers

and say, "that's me there, that one."

we're container minders

-Yoko Ono

grapefruit

Thought, considered in its movement of becoming (and not merely in content of relatively well-defined images and ideas) is indeed the process in which knowledge has its actual concrete existence.

-David Bohm,

Wholeness and the Implicate Order

The Implicate and Explicate Order

David Bohm asks, “*What is the process of thought?*” Bohm explains his hypothesis in a phenomenological manner:

Thought is, in essence, the active response of memory in every phase of life. We include in thought the intellectual, emotional, sensuous, muscular and physical responses of memory. These are all aspects of one indissoluble process. To treat them separately makes for fragmentation and confusion. All these are one process of response of memory to each actual situation, which response in turn leads to a further contribution to memory, thus conditioning the next thought.

The movement of becoming. Outside, the sun is unforgiving, while inside, I am goosebumped, standing by one bed and sitting by another, watching and waiting, two summers apart. Both are ICU beds, while one is paediatric. I listen to the cacophony of machines bleep in both spaces. I hear fans whirl overtop even and uneven and breathing; I watch the scan line of the EKG machine cycle from left to right, refreshing waveforms and numerical units that correspond to shifting vitals. In one room, there is decline, in the other, blessed recovery. I hold still within the liminal space of the hospital, a structure that houses a network of machines, whirling microbial agents, and the overflow of affect that ride on currents of recycled air. It pours over, through, and out from me. Temporalities and memories flood in while I make choices that could and will alter everything. In the stillness of waiting, I am aware of the movement of becoming. I mull over the limited options I am presented with, and feel the heft with each plodding projection

and imagined outcome. Potentialities become decisions, decisions crystallize potentialities into consequences, consequences are then processed as new memories, memories to furnish thought processes.

As memories and feelings combine into thoughts, Bohm states that this process is more or less a mechanical function of combinations, comparing these configurations to roving compositions of a kaleidoscope. The assembled combinations that rise to the fore are then processed through an additional, inherently different phase of cognition, wherein our faculties of perception determine whether or not these combinations of memory, images, and emotion are relevant or irrelevant, and Bohm asserts that this process is distinctly non-mechanical. This process is derived from an energy, “an energy we will call *intelligence*.”¹⁰⁵ Using perception, new orders and structures become observable, enabling problem solving and arriving at solutions and comprehension that were previously elusive, that exist outside of memory. Bohm uses the example of mulling over a puzzle in which we have a flash of understanding and come to the realization that all of our previous approaches and modes of thinking were irrelevant in regards to solving it. Rather than a process of thought, Bohm characterizes this as an *act of perception*, explaining that we can see new structures and orders that may later be conveyed through thought. While thought is deemed to be a mechanical process, intelligence, or an act of unconditioned perception, is something more subtle in nature.¹⁰⁶ While Bohm acknowledges that many functions in the brain are material processes, such as the movement of thought, he is evidently

¹⁰⁵ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980. 65

¹⁰⁶ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980.63-66

not solely a materialist, particularly when it comes to consciousness. Bohm points to something other than what is conditioned or determined by any “knowable law” when discerning what intelligence is. Consciousness is part of what Bohm refers to as the “undivided wholeness”, or the “universal flux” where everything is in a state of becoming, an interchange between implicate and explicate orders.¹⁰⁷ Bohm defines the implicate order as “*a process of enfoldment and unfoldment taking place in the ordinary three-dimensional space.*”¹⁰⁸ Implicate, from the latin word, *implicātus*, past participle of *implicāre* “to fold about itself,” is an enfolded reality, “*one unbroken whole, including the entire universe with all its ‘fields’ and ‘particles’*”. From the implicate order abstractions emerge, producing what we can perceive in an unfolded manner as the explicate order. What we can perceive and comprehend are explicate abstractions that emerge from the implicate order. These concepts were key to Bohm’s understanding of both quantum theory and the nature of consciousness. Bohm believed that the curious behaviour of quantum particles, as seen in entanglement, was a result of unseen, underlying processes, derived from the implicate order, from where reality emerges.¹⁰⁹

Professor Jeffrey J. Kripal of Rice University, whose studies include gnosticism, esotericism, and mysticism, asserts that regarding the nature of consciousness, “*a materialist interpretation works so well only in as much as it rigorously leaves out everything that it cannot*

¹⁰⁷ Peat, David. “David Bohm, Implicate Order and Holomovement.” *Science and Nonduality (SAND)*, Science & Nonduality, 5 Oct. 2023, scienceandnonduality.com/article/david-bohm-implicate-order-and-holomovement/.

¹⁰⁸ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980. 236

¹⁰⁹ Peat, F.D. *Non-Locality in Nature and Cognition*. 1992. pp 297–311 In: Carvallo, M.E. (eds) *Nature, Cognition and System II. Theory and Decision Library*, vol 10. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-2779-0_17

explain, including individual, subjective experiences.”¹¹⁰ Bohm, Kripal asserts, held the belief of a dual-aspect monism, as did other notable polymaths, such as Baruch Spinoza, Gustav Fechner, Arthur Schopenhauer, William James, Bertrand Russell, fellow physicist Wolfgang Pauli, C. G. Jung, and Bernard d’Espagnat. Dual-aspect monism is a theory that traces both the mental and the physical to “a third substratum or superreality.” In this, when material processes such as thought and awareness unify, forms of greater complexity emerge, such as life and consciousness. Kripal speaks of dual-aspect monism in terms of ‘compositional’ and ‘decompositional’ forms: “*Compositional forms begin with plurality and work up to unity.*” While forms begin in what Kripal describes as a deep unity, they “decompose up” into plurality.”¹¹¹

“Wherever there is matter, then, there is also mentality or protomentality. In other words, dual-aspect monists can be thought of as panpsychists¹¹², but of a very special stripe, since they insist that the most basic “stuff” of reality cannot be understood as purely mental or conscious (as in panpsychism), but neither can it be thought of as purely material or physical (as in materialism)—the ground of reality is both, or, more technically, it is neither. It is “neutral.”¹¹³

¹¹⁰ Kripal, Jeffrey J. *The Flip: Epiphanies of Mind and the Future of Knowledge*. Bellevue Literary Press, 2019. 105

¹¹¹ Kripal, Jeffrey J. *The Flip: Epiphanies of Mind and the Future of Knowledge*. Bellevue Literary Press, 2019. 118

¹¹² panpsychism, (from Greek pan, “all”; psychē, “soul”), a philosophical theory asserting that a plurality of separate and distinct psychic beings or minds constitute reality. Panpsychism is distinguished from hylozoism (all matter is living) and pantheism (everything is God). (Encyclopedia Britannica)

¹¹³ Kripal, Jeffrey J. *The Flip: Epiphanies of Mind and the Future of Knowledge*. Bellevue Literary Press, 2019. 119

Bohm uses the analogy of a radio. It is capable of receiving all kinds of signals of noise that are irrelevant to our comprehension, including when its output feeds back into the input. In this, the receiver works in isolation, but, Bohm explains, when it picks up on a signal via a radio wave, its innate sequence of electric currents are transformed into sound waves that are in synchrony (or parallel) to the signal. Once sensitive to the signal, the receiver therein inputs what Bohm calls a meaningful order (something we can hear and discern), an order that originated from a level beyond itself (the radio), manifesting this signal from beyond into movements within itself.¹¹⁴

To Bohm, intelligent perception is the manner in which our minds and matter, which are distinct yet unified, draw upon the totality of the universal flux, a single origin, or as Bohm puts it, mind and matter *are abstractions from it*. From this, Bohm deduces that in “*intelligent perception, the brain and nervous system respond directly to an order in the universal and unknown flux that cannot be reduced to anything that could be defined in terms of knowable structures.*”¹¹⁵

¹¹⁴ Bohm, David. *Wholeness and the Implicate Order*. Routledge, 1980. 67

¹¹⁵ Ibid.

Sensitive Signals and Unfolding Orders: *Valence*

Though my formal training is rooted in visual art, primarily in digital display technologies and often in a solitary manner of making, over the past decade I have collaborated and worked with physicists, archivists, dancers, choreographers, startup tech companies, writers, and somatic practitioners to create works that were formed through a process of emergence, in which there is no one author. What occurs in this co-authoring is a crystallization of dynamics in which a practice emerges - we learn to hear what is meant in the searching, ponderous language of the querent, and in turn, make our own offerings to our collaborators. On several occasions, I have worked with my collaborators iteratively, building upon past projects methodologically, formally and conceptually.

One such collaboration began in 2018 when I created a six-channel video installation entitled *Slipstream*. *Slipstream* revisits the choreography and mirrored stage design of dancer, choreographer, and inventor of pre-cinema projection technologies, Loïe Fuller, whose likeness appears in the installation as an elusive apparition. In an otherwise empty gallery space, six 75" reflective panels are positioned in a ring, facing inward, catching one another in their reflection. A figure in the form of a spiralling flurry of silk appears within a reflective frame, disrupting the mirrored image, and dances from one panel to another, seemingly crossing the negative space between each panel. As the figure traverses the circumference of the hexagonal ring it appears in multiple locations in the cross reflection, where viewers and the dancing figure appear to share the same physical space. The movement of the dancer is reminiscent of Fuller's serpentine dance



Figure 22 | *Slipstream*, Detail, 2018, six-channel video installation

of the 19th century. Fuller, *la fée électricité*, was also a costume designer, stage designer, and was published in *Scientific American*. Credited as a pioneer of modern dance, she used her voluminous robes as performative sculptural objects, radically positioning dance within a conceptual realm. The choreographed movements of the dancer's robes in this installation create metamorphic and ephemeral sculptural structures that pass through shifting tones and colours. A trail of animated mercurial forms emerge from the silk robes, tracing their movements through the air, vivid, and fleeting, the structures growing as tendrils that delineate her path and diminish in her wake.



Figure 23 | *Slipstream*, Detail, 2018, six-channel video installation

Dancer and choreographer Katie Ewald performed as a dematerialized Fuller, recreating and interpreting Fuller’s famed Serpentine dance. Though Fuller died “a wildly famous woman, she quickly faded from popular consciousness. Today, it is largely only scholars who are familiar with her work. The general, educated public has lost sight of her.”¹¹⁶ This disappearance from public memory, her illusionary techniques of dematerialization, the many imitators that stand in for Fuller in the filmic relics of the 19th and 20th centuries, as well as the stand-in for Fuller in *Slipstream* performed by Ewald, were all contributing factors that led to my decision to remove the body of the dancer from *Slipstream* in post-production, leaving solely the silk garment to manifest the ephemeral shapes of the Serpentine dance. This omission of a visible living body elicits ghostly associations, perhaps not unfittingly as many of Fuller’s pre-cinematic projection

¹¹⁶ Garelick, Rhonda K. *Electric Salome: Loie Fuller’s performance on modernism*, Princeton University Press, 2006. 8

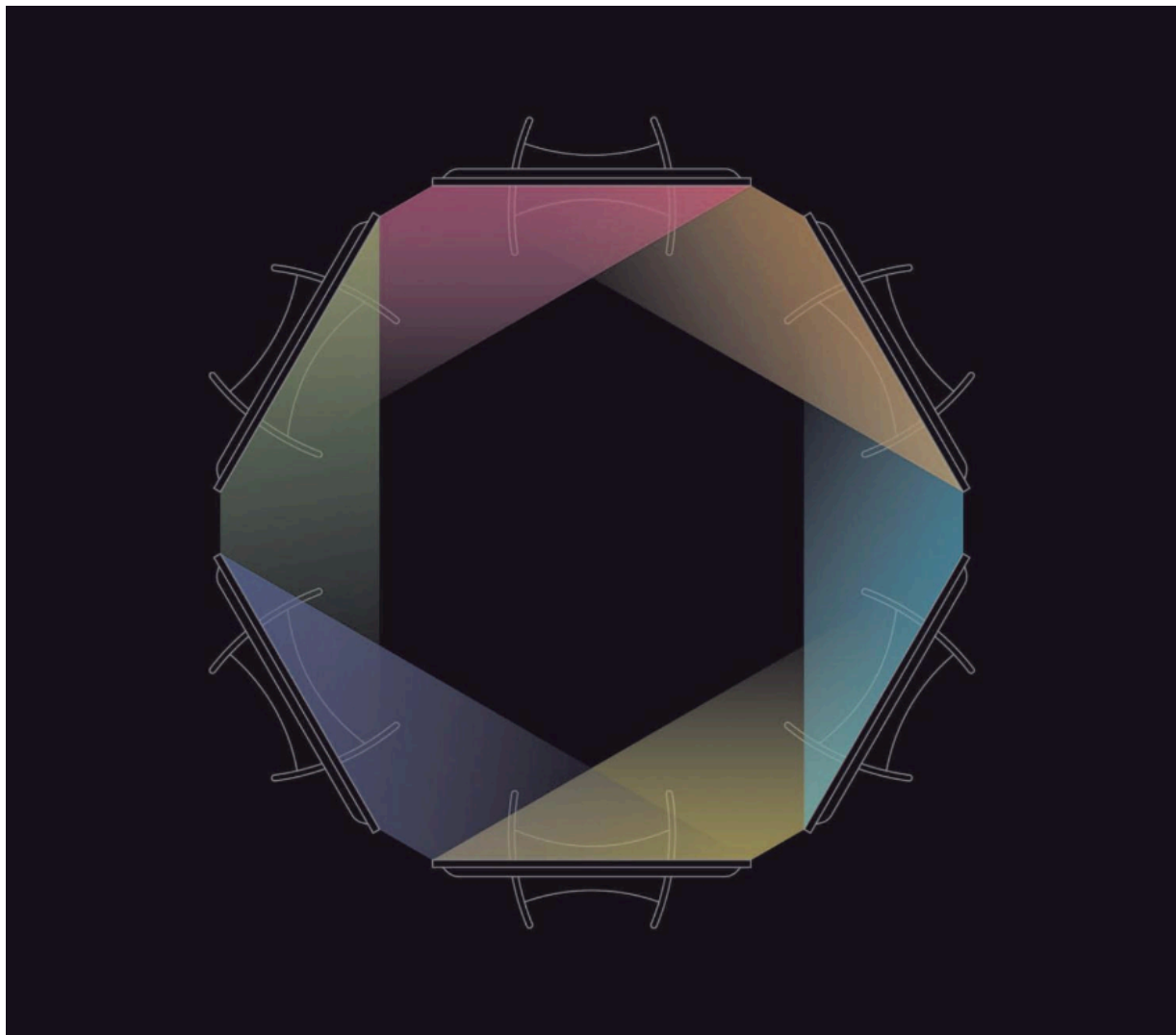


Figure 24 | Top view of *Slipstream*, illustration by Ken Ogawa for the *Slipstream* catalogue.

inventions were informed by magic lanterns, commonly used in phantasmagoria. The audio of the installation emphasizes the air that the silk rushes through as a force that shapes the garment's shifting forms, whirring around the viewer in a soundscape that pans from screen to screen. Fuller's movement through the monitors reflects this elusive yet far-reaching influence that had become part of the cultural fabric of the era, as a fleeting form, an apparition. Co-curator of the touring exhibition Crystal Mowry writes:

“Motivated by experiment and a desire to exceed the externalized limits of her body, she elevated the dancing body into what philosopher and theorist Jacques Rancière has described as “the potential that isolates a site and builds this site as a proper place for supporting apparitions, their metamorphoses, and their evaporation.”¹¹⁷ Norton invests Slipstream with an agency that is tethered to liminality; the dancer exists in both the past and the present, skipping temporal boundaries with every disappearance into the dark.”¹¹⁸



Figure 25 | Co-curator of *Slipstream*, Linda Jansma, viewing the installation at the Robert McLaughlin Gallery in Oshawa, Ontario. 2018

¹¹⁷ Jacques Rancière, *Aisthesis: Scenes from the Aesthetic Regime of Art*, trans. Zakir Paul (London: Verso, 2013), 94.

¹¹⁸ Mowry, Crystal. *Dream Sequence: Jenn E Norton: Slipstream, Slipstream: Dancer in the Mirror*, Published by the Robert McLaughlin Gallery and Kitchener-Waterloo Art Gallery, 2018. p 30-31

Slipstream furthered my research and reinterpretations of inventive women who cultivated unprecedented positions of creative command in entrepreneurial, scientific, and performative undertakings, during periods that otherwise negated women to inhabit these roles, as seen in previous works such as *Doline*, an installation that interpreted the sound collage of electronic musician and composer Delia Derbyshire as kinetic sculpture; *Sophie (in Absentia)*, an augmented reality app that invites users into the room of Sophie Germain, a French physicist, and mathematician as she studied covertly amidst domestic and societal oppression; and the multimedia installation, *21st Century Fox Sisters* (2010), an interactive installation space where the Fox sisters, famous child mediums of the 19th Century, are reimagined as producers and directors of a multimedia spectacle. In addition to performing in *Slipstream*, Ewald's performance work had inspired a sculptural video installation I had created in 2015, entitled *Arms Reach*. A custom configuration of Christie Digital MicroTiles which function like video display building blocks, *Arms Reach* depicts a haptic labyrinth, navigated by pain, tactility, and thermoception as the sensorial guides in this maze that can only be solved through touch. Lessons and methodologies learnt during the creation of these works were carried forward with Ewald and me, inspiring new creative endeavours and explorations.

Upon the creation of *Slipstream*, Ewald and I spoke of collaborating on a broader, more process-based project, aligning my research on Sophie Germain (which was exhibited alongside

Slipstream in an augmented reality series entitled *Resonators* in 2019 at the Judith & Norman Alix Art Gallery), and Ewald's practice as a choreographer, movement therapist, and dancer.¹¹⁹

In our many conversations, what emerged as a through line of conceptual interest was our interest in Germain's research in elasticity, and the intricate patterns that emerge through vibrations, as seen in Chladni plates. Germain produced a mathematical equation for surface elasticity, which articulates the phenomena of the emergent geometric patterns induced by the oscillation of surfaces. Through sound waves, the nearly imperceptible disruptions of surfaces displace particulates such as sand or poppy seeds, creating ornate, organic formations of symmetry.

We formed a collective with an interdisciplinary group of people that either Katie or I (or both) had worked with previously. From remote locations, we began to look at how mathematicians and physicists, such as Germain, botanists, biologists, and healers alike had embraced the study of geometries seen in Chladni plates and the Fibonacci sequence, some in more formal ways, while others did so more intuitively. The assembled group of dancers, somatic practitioners, teachers, therapists, academics, musicians, visual and media artists and community developers are Shary Boyle, Joyful Joyful (Cormac Culkeen and Dave Grenon), Kevin

¹¹⁹ *Resonators* is an augmented reality series that was created in tandem with the Echoes series of the same name discussed in Chapter 4. The *Resonators* series looked to the work of an innovator in the field of science who were overlooked for their significant contributions, or pursued their research under conditions of oppression and duress. Each augmented animation is anchored by a vinyl image, as with the icons of *Tributaries*, that serves as a fiducial marker derived from the actual notes, charts, and schematics of the featured innovators. This series was first inspired by the suppression and perseverance of Sophie Germain and the augmented reality portal that I created, *Sophie (in Absentia)*, in April, 2019, which allowed users to enter the virtual space where Germain focused on her studies, in the chill of night.

O'Connor, Katie Ewald, Julia Garlisi, Andrea Nann, Coman Poon, Bry Webb, Leslie Fisher, Ame Henderson, and myself. We began our collaboration with a presentation on my graduate research, looking at *Resonators*, David Bohm, Karen Barad, site-specificity and remoteness. Located in multiple cities and countries, we met through videotelephony software, presenting our research and findings to one another, and practiced somatic exercises that allowed us to experience one another's respective environments sensorially. These exercises included deep listening, sounding materials found at arm's reach, moving about in our respective spaces to find air currents, temperature changes, and the thresholds between light and shadows, all demarcated by our bodies in movement. Later, we met as hybrid in-person and remote groups, exploring sound vibrations, electromagnetic phenomena, and entrainment through empathetic exercises - we operated as a multi-disciplinary pedagogical and research-based creation.

In the summer of 2022 in Kingston Ontario, I hosted a larger group of our collective over the duration of a week at the Isabel Bader Centre of Performing Arts Queen's University. Working jointly and in smaller groups that were divided into somatic (movement, dance, empathetic exercises), sonic, and technical collaborators, we developed a vernacular to define our emerging practice, created dance phrases, and generated site-specific sounds and forms to explore resonance and elasticity. Our work was deeply experimental and was cultivated through our interdisciplinary dialogues. *"Interdisciplinarity,"* Roland Barthes writes in 1972, *"is not about confronting already constituted disciplines (none of which, in fact, is willing to let itself go). To do something interdisciplinary, it's not sufficient to choose a "subject" (a theme) and*

*gather around it two or three sciences. Interdisciplinarity consists in creating a new object, that belongs to no one.*¹²⁰



Figure 26 | Left to Right: Andrea Nann, Katie Ewald, Kevin O'Connor, Coman Poon, and Ame Henderson at the Isabel Bader Centre for the Performing Arts during the *Valence* residency, 2022. Photo by Norah Zhang

What emerged from our time together was a large-scale instrument that was finely tuned to the resonant frequency of the space, and was responsive to our bodies and voice. Bry Webb and Dave Grenon sourced metals from a junk yard that belonged Grenon's relatives. Webb cut the metal scraps into shapes to create Chladni plates. The six pieces were then suspended on wire in a hexagonal configuration, and emitted sound towards the centre, similar to the configuration

¹²⁰ Barthes Roland. Jeunes chercheurs. In: *Communications*, 19, 1972. Le texte : de la théorie à la recherche. pp. 1-5.

and effects of *Slipstream*. The metal was fitted with transducers that received signals that Grenon transmitted, tuned to find the resonant frequency of the studio of the Isabel Bader Centre. When the metal received a signal from the transducers it quivered, shimmering with the sonic



Figure 27 | Bry Webb affixing speakers to metallic plates during the summer residency

vibrations, casting caustics about the room, resembling trembling brass, silver, and copper flames. The room itself vibrated with the instrument, transforming sound into a haptic experience as the space was a buzz with vibrant matter. To me, the empty space of the studio seemed more discernibly plentiful in

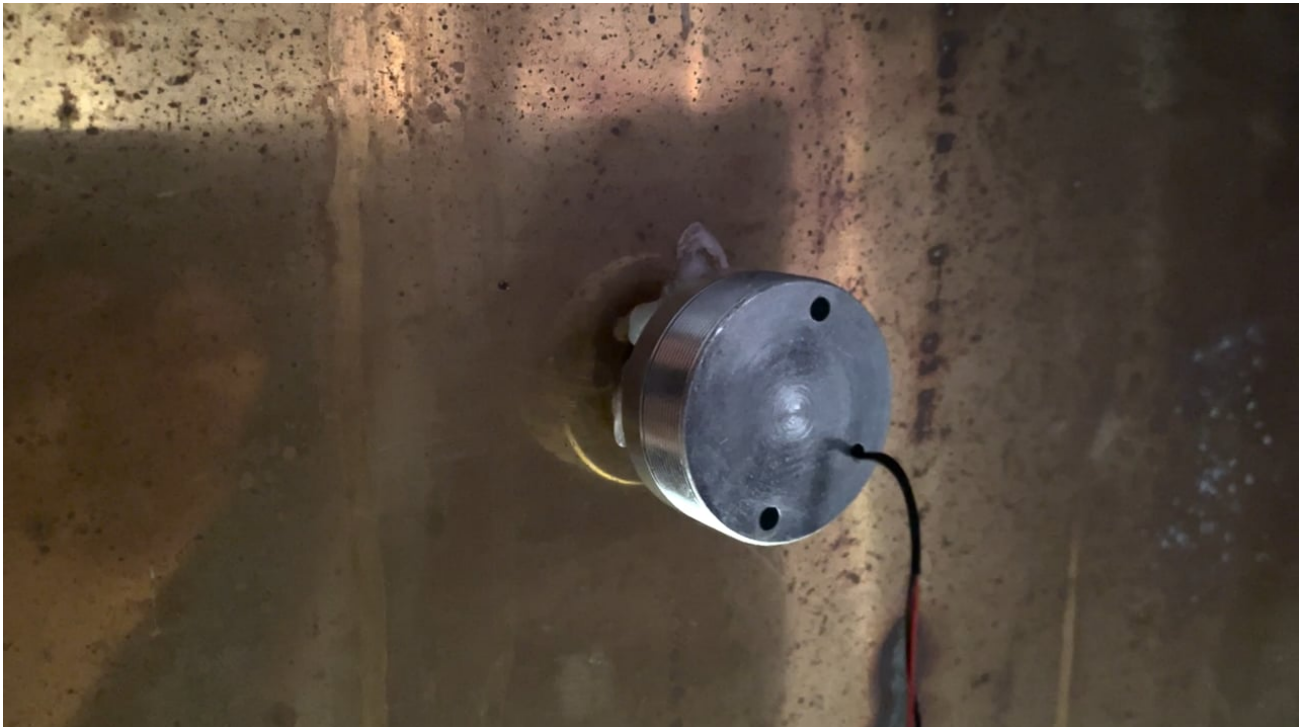


Figure 28 | A video walkthrough of the Instrument when tuned to the resonant frequency of the space. Click on the image to view.

this oscillation. As we walked through the internal space of the installation, the timbre of each

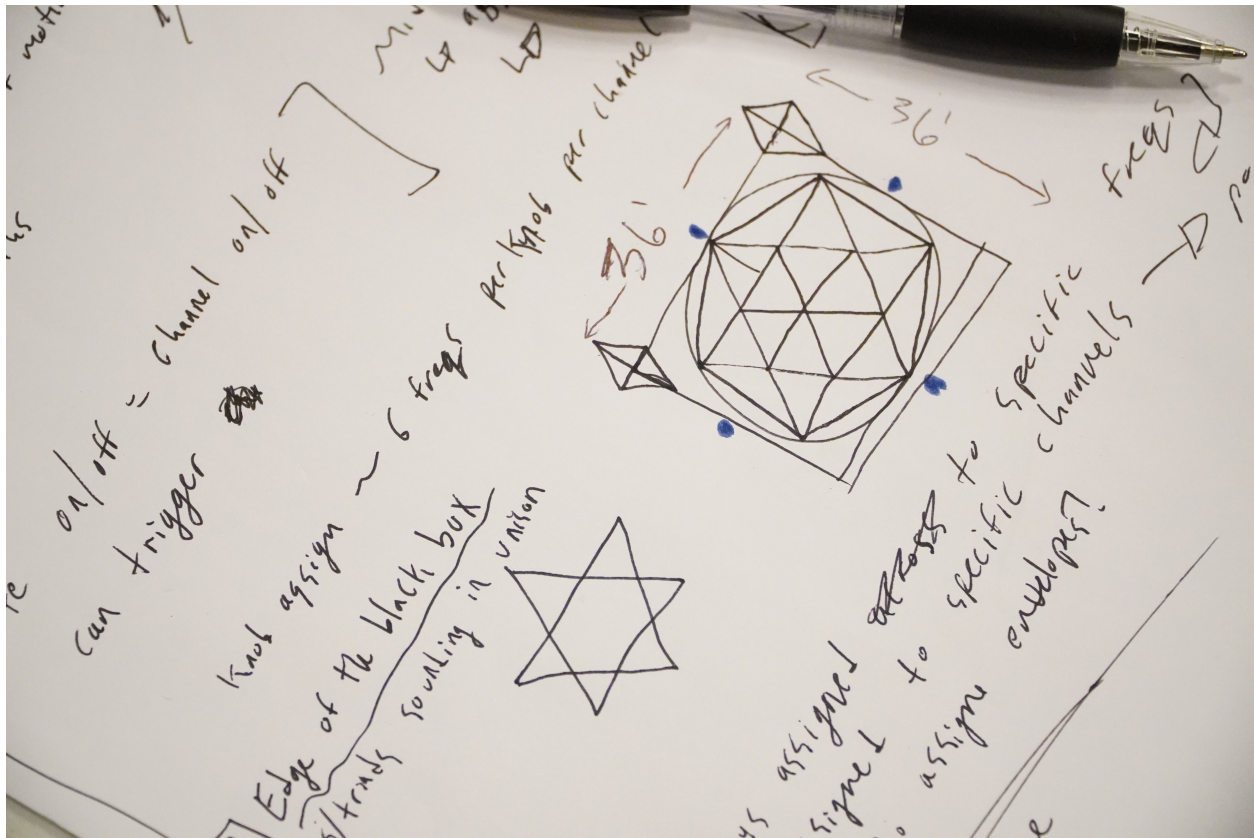


Figure 29 | Grenon's notes on the Instrument's geometry, summer 2022, photo by Emilie Surette

metal plate and gauge could be discerned, each signal sounding uniquely.

The six channels of the Instrument were observably directional - when standing in the centre, a slight turn of the head would shift the channel heard. The dancers moved through the instrument, feeling sound in their bodies, exploring the geometries within the structure viscerally.

We experimented in various ways through the Instrument. Using motion capture to record their movements in space to demarcate the geometry in space in another manner, their choreography recorded as data. We used sound reactive circuits to visually punctuate their steps across the floor. Cormac Culkeen sang into an input to cascade their voice through the series of

plates, transforming a singular voice into a multitude that sung the metal aloud, creating a choral-like round that encircled viewers standing inside the hexagonal ring.



Figure 30 | Cormac Culkeen of Joyful Joyful sings into the instrument at the Isabel Bader Centre for the Performing Arts, Photo by Norah Zhang

Named after German physicist and musician Ernst Chladni in 1787, a Chladni Plate produces distinctive patterns when vibrated with specific frequencies. Sprinkled with sand or poppy seeds upon the surface of the plate, the plate can be sounded by a bow or with a transducer. The patterns are a result of opposing oscillating lines within the plate, that are further defined by bounding negative spaces where there are no vibrations, which are called nodal lines.

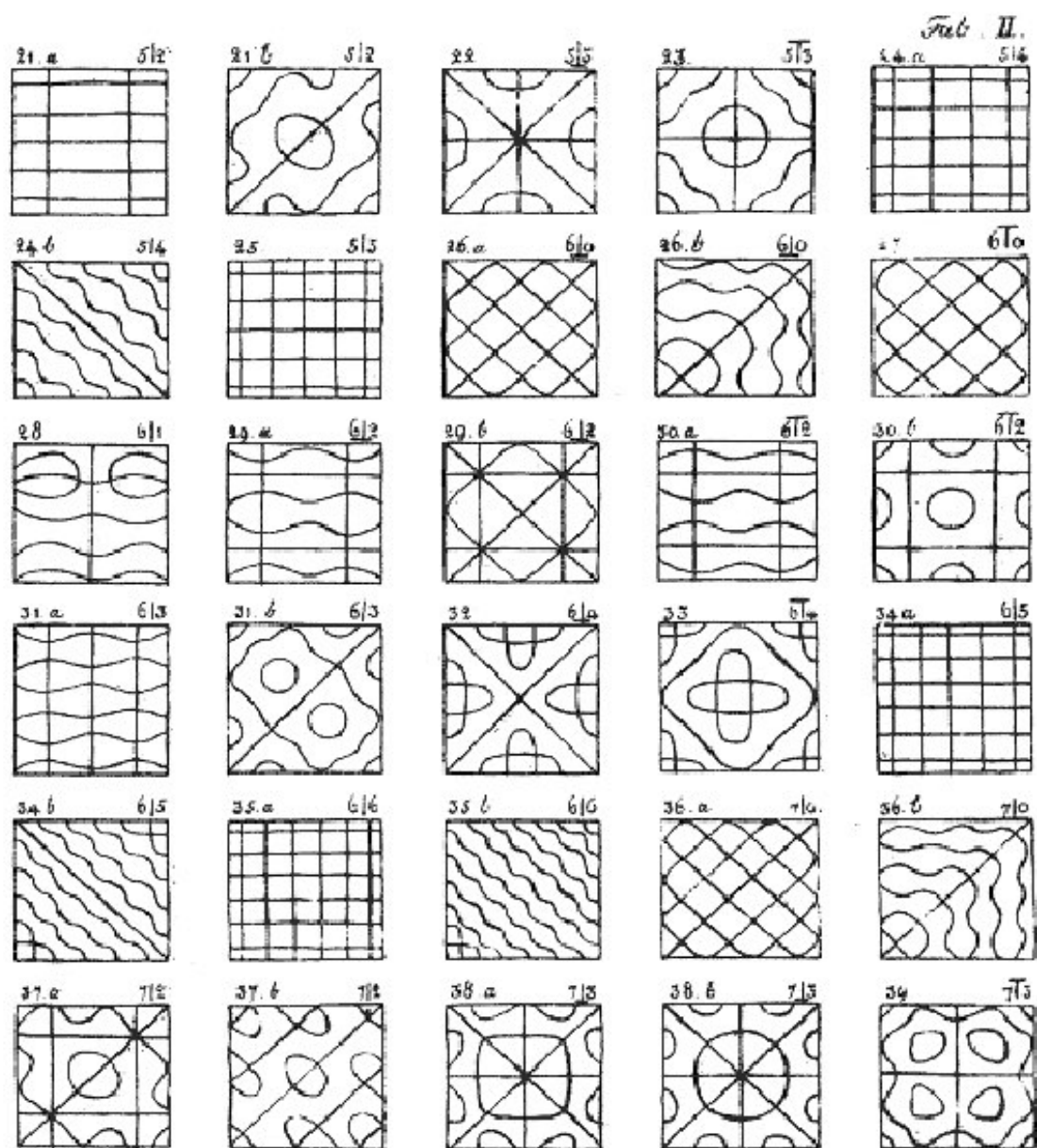


Figure 31 | Illustration of Chladni patterns on a vibrating plate.

We figuratively explored the idea of nodal lines in another version of the Instrument we constructed in November, 2022, at the Arcadia in Toronto, hosted by Coman Poon. I affixed a web camera above the space to create interactive regions of the space inside of the Instrument. We recorded sounds of the metal and linked them to the active regions using video tracking software. When the dancers passed through these zones, the clanging metal recordings were played through the plates. Ewald moved through space to find our nodal lines, and explored the range of quietness spatially and with attentive care to delineate their boundaries. The experiment was again conducted with tones in lieu of the percussive recordings, as Culkeen listened and responded to harmonize with their voice and feedback across the cascade of plates. In both instances, Ewald was sensitive to signals in space, searching, acting as a receiver, transforming space into sound waves that are in synch (or parallel) to the signal. As Bohm relayed with the analogy of the radio, once sensitive to the signal, the receiver (Ewald) therein inputs a meaningful order (something we can hear and discern) into the Instrument, an order that originated from a level beyond herself, manifesting this signal into movements within herself.

The Instrument was a structure and site of communion for our collective; like the spider uses its web as an extended cognition, it was an externalized expression of our thinking, wherein our collaborative efforts, experimental approach, exploration of materiality, resonance, liveliness, and presence emerged as a practice of continual calibration.

This emergent process was one of tuning - tuning of place and space through active perception, in which certain signals were channeled to the fore as discernible amplifications.

In thinking of emergence, it is useful to look to its etymology. The Latin root of emergence is *emergere*, which means, ‘bring to light’, ‘to surface’, ‘to arise’ or ‘come forth’. To my mind, emergent processes are evocative of Bohm’s example of the rheomode model, to ‘*relevate*’, meaning, to lift something into attention, to levitate it into relevance. Of emergence and



Figure 32 | Dancer Katie Ewald and musician Cormac Culkeen generate sounds through the Instrument, The Arcadia Housing Co-op, 2022. Click the image to play the video documentation.

research-creation based practices, Loveless writes, “*Emergence is relevant to research-creation not only because it is a recurring descriptor in writing on research-creation and its synonyms - which it is - but because it refigures disciplinary research objects in ways that invite us to think interdisciplinarity-as-emergence: as productive outputs that exceed what is demonstrably present in their constituent parts.*”¹²¹

¹²¹ Loveless, Natalie. *How to Make Art at the End of the World: A Manifesto for Research-Creation*. Duke University Press, 2019. 26

‘How to Make Art at the End of the World’, Loveless ponders, in her 2019 manifesto for research-creation. Loveless examines the seeping, porous strata of interdisciplinary research-creation through a feminist, psychoanalytic lens and embraces *eros* as a means to consider the insatiable, diverse curiosities of cross-study research-creation practitioners. Loveless goes as far to describe the academic wanderlust as a form of promiscuity, coining the term ‘polydisciplinamory’ to characterize the relationship of the researcher/creator to trans-disciplinary knowledges.

“Research-creation, [...] is a practice of love. It is an erotic, driven, invested practice. And, as such, it fails to fit into those models that see interdisciplinarity as a way to streamline and multiply research productivities. It is too disruptive for that. Research-creation follows desire, and builds spaces and contexts that allow the time and space to experiment in unpredictable directions.”

Interdisciplinary synergies are seen by many as a means to survive, or strive to survive, a troubled world. Like Donna Haraway’s *Staying with the Trouble* and Robin Wall Kimmerer’s *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*, Loveless sees cross-disciplinary research, collaboration, and the synthesis of diverse methodological literacies as a means of moving forward, to both work through and persevere in the Anthropocene/capitalism.¹²²

¹²² Loveless, Natalie. *How to Make Art at the End of the World: A Manifesto for Research-Creation*. Duke University Press, 2019.

Haraway describes these kinds of interdisciplinary collaborations as a kind of kinship of disparate disciplines that would not immediately come to mind when we think of collaboration, and may prove to be the means to eschew despair and foster new hope. “*Staying with the trouble requires making oddkin; that is, we require each other in unexpected collaborations and combinations, in hot compost piles. We become each other or not at all.*”¹²³ Or as Associate Professor at the Centre for Interdisciplinary Methodologies at University of Warwick, Maria Puig de la Bellacasa summates, “‘*staying with the trouble*’ appears as the only ethical option for knowledge mattering[...].”¹²⁴

Kimmerer explains how seemingly disparate perspectives can bring relationships in nature to light (which is a form of an emergent practice) from her own experience in learning from indigenous relatives and elders; as a botanist; and from the relational dynamics of the natural world. An example of this synergistic knowledge came to Kimmerer as a young undergraduate student when she wondered why asters and goldenrods look so beautiful together. When posing this query in the lab, she was admonished by her professor for asking an unscientific question. “[...]science is rigorous in separating the observer from the observed, and the observed from the observer;” Kimmerer writes, “*Why two flowers are beautiful together would violate the division necessary for objectivity.*”¹²⁵ It was only later through the experiences

¹²³ Haraway, Donna J. *Staying with the Trouble: Making Kin in the Chthulucene*. Duke University Press, 2016.4

¹²⁴ María, Puig de la Bellacasa. *Matters of Care: Speculative Ethics in More than Human Worlds*. University of Minnesota Press, 2017.19

¹²⁵ Wall Kimmerer, Robin. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants*. Milkweed Editions, 2013. 39-47

of collaboration, research, listening, and foray, that she learned why the purple of the asters and the yellow of the goldenrod grew together as complimentary pairings that pleased the eyes; it is rooted in the eyes of the pollinators who are drawn to this colour union, particularly that of bees. Kimmerer explains by citing poet and scientist Goethe, who in a 1809 treatise on colour perception stated, “*the colours diametrically opposed to one another [...] are those which reciprocally evoke each other in the eye.*” Though bee vision is very different from our own, bees detect these colour wavelengths in a similar manner as humans do, and are particularly drawn to flowers that strongly reflect ultraviolet light, which explains why we are drawn to the coupling of such flowers, why we find them as beautiful as bees do, and why the yellow and purple blossoms have evolved together. Kimmerer speaks of different kinds of knowledges, attained by different means to find a more wholistic way of knowing:

“There was a time when I teetered precariously with an awkward foot in both worlds - the scientific and the indigenous. But then I learned to fly. Or at least try. It was the bees that showed me how to move between different flowers - to drink the nectar and gather pollen from both. It is a dance of cross-pollination that can produce new species of knowledge, a new way of being in the world. After all, there aren’t two worlds, there is just this good green earth.”

In *Valence*, we worked with the liveliness of the present tense and embodied the relational qualities of our interdisciplinary collaboration, which underscored the affective phenomena of our emergent practice. While the sounds and vibrancy that resonated through the

plates, effected and affected by the dancers, Culkeen's voice, and the room's resonance, entrainment was palpable. Entrainment is a term used by neurologists to describe a physiological transmission that occurs wherein individuals "become alike", or in other words, when their nervous or hormonal system becomes aligned with one another.¹²⁶ This phenomenon can occur through various means, such as chemical entrainment, through the sense of smell, for example, or electrical entrainment, such as sight and rhythmic vibrations. "[S]ights and sounds," wrote the late Australian feminist philosopher and psychoanalytic theorist Teresa Brennan, "*are physical matters in themselves, carriers of social matters, social in origin but physical in their effects. Every word, every sound, has its valence; so, at a more subtle level, may every image.*"¹²⁷

The Instrument was a means of making porous the notion of self-containment, that leads us to believe that our affects and feelings are singularly our own. In the *Transmission of Affect*, Brennan writes of the subject/object relation, in which the subject is the transmitter of affect¹²⁸ and the object is the receiver.¹²⁹ She challenges our contemporary notion of self-containment, autonomy, agency and free will, arguing that the concept of self-containment is a construct that is developed during maturation and that this belief denigrates the communicative intelligence inherent to human reception and our ability to communicate non verbally, or in what Brennan

¹²⁶ Brennan, Teresa. *The Transmission of Affect*, Cornell University Press, 2004. 9

¹²⁷ Ibid. 71

¹²⁸ Brennan defines affect as a physiological change accompanying judgement, as the primary response to stimuli before it has been processed into language, wherein feelings emerge and discernment begins. Feelings are referred to in a positive manner by Brennan, such as "living attention" or energy, whereas affect is often regarded as negative impulses. This is exemplified in her comparison of demons and the seven deadly sins as affects, rather than as acts.

¹²⁹ Brennan, Teresa. *The Transmission of Affect*, Cornell University Press, 2004. 15

refers to as “language of the flesh.” The transmission of affect between individuals and within groups, she writes, occurs by several means, including olfactory, touch, sight and sound.

“*My hypothesis,*” states Brennan, “*is that the psyche's sense of its self-containment is indeed structured, but that therefore the state of experiencing both the “living attention” and the affects of others is both the originary and in some way the natural state: the transmission of energy and affects is the norm rather than an aberration at the beginning of psychical life.*”¹³⁰

For Brennan, affect is material, and is made up of an “energetic dimension”.¹³¹ In a review of *The Transmission of Affect*, Dorian Stuber writes, “Hell, for Brennan, isn't other people. Rather, it's the self, considered as a self-contained subject defined against those others.”¹³² This calls to mind Bohm's supposition on the catastrophic effects of atomistic thinking, in which the individual perceives themselves as separate from others and nature, creating a fractured worldview. “*Meaning is all around us,*” Stuber writes, “*in the interlocking systems that make up what Brennan reluctantly calls “the life drive.”*”¹³³ The material processes of thought married with that of affect resonated for me as we worked on *Valence*. As we developed our concepts for our practice, we were tentatively working under the title *All the Rage*. Depending on whether a dancer moved through the instrument alone, as a group, with Culkeen's voice, resonant

¹³⁰ Brennan, Teresa. *The Transmission of Affect*, Cornell University Press, 2004. 2

¹³¹ Stuber, Dorian (2006). Review of "Review of Teresa Brennan, *The Transmission of Affect*," *Bryn Mawr Review of Comparative Literature*: Vol. 5 : No. 2
Available at: <https://repository.brynmawr.edu/bmrcl/vol5/iss2/4>

¹³² Ibid.

¹³³ Ibid.

frequency, or with the motion activated sound, the room shifted affectively, emotionally, and materially.

*“Is there anyone who has not, at least once, walked into a room and "felt the atmosphere"? [...] The transmission of affect, if only for an instant, alters the biochemistry and neurology of the subject. The "atmosphere" or the environment literally gets into the individual. Physically and biologically, something is present that was not there before, but it did not originate **sui generis**: it was not generated solely or sometimes even in part by the individual organism or its genes.”¹³⁴*

The research of *Valence* allowed me to touch upon the relational qualities that I am drawn to in physics, shaping a field of study and exploration that is far from complete. In the state of becoming together and apart, in an act of perception, of calibration, of becoming sensitive to a signal (remote or near), I seek to foster in emergent methodologies with odd kin as a means of moving forward holistically and with hope. The liveliness, the perceptually present mode of being with an artwork, is a method of making and thinking I strive to imbue in my practice moving forward. While many of my installation, augmented reality, and sound works enmesh with the physical world through superimposition, the holistic integration *Valence* affords has only previously been enacted within my kinetic sculpture. As the late professor of philosophy, John Haugeland, who specialized in the philosophy of mind, cognitive science, phenomenology, and Heidegger suggested, if we leave our Cartesian prejudices behind, we “can look again at

¹³⁴ Brennan, Teresa. *The Transmission of Affect*, Cornell University Press, 2004. 1

perception and action, at skillful involvement with public equipment and social organization, and see not principled separation but all sorts of close coupling and functional unity...Mind, therefore, is not incidentally but *intimately* embodied and *intimately* embedded in the world.”¹³⁵

Andy Clark, British philosopher and Professor of Cognitive Philosophy at the University of Sussex, refers to this model of cognizance, or the act of cognizing, as EXTENDED, as opposed to the Cartesian model Clark refers to as BRAINBOUND (his capitalization). Clark states that in the EXTENDED model, there are feedback, feed-forward, and feed-around loops that we are inextricably entangled with: “*loops that promiscuously criss-cross the boundaries of the brain, body, the world.*”¹³⁶ In this, Clark proclaims that the ongoings of the mind do not solely reside in the head, but “*Cognition leaks out to the body and the world.*”¹³⁷ What is it to leak out to the body and word in interdisciplinary, collaborative ways? Is this thinking through form as a collective extension of the brain a means of dissolving the atomistic worldview that Bohm laments? Can it inform and affect our daily lived experience, our creative choices, our own compartmentalizations and prejudices? Can a wholistic model and *ethico-onto-epistem-ology* be gleaned or cultivated by a comprehensively responsive practice?

Through this time of remoteness, distance, and renewed proximity, searching through making has been a individual and collaborative process in shaping visible and invisible

¹³⁵ Haugeland, John. *Having Thought: Essays in the Metaphysics of Mind*. Harvard University Press, 1998. 236-237

¹³⁶ Clark, Andy. *Supersizing the Mind: Embodiment, Action, and Cognitive Extension*. Oxford University Press, 2011.

¹³⁷ Ibid.

phenomena into discernible forms to attune to subtle matter with compassion for our permeable and delicate bodies.

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language_content_entity=und#:~:text=Virtual%20particles%20are%20short%2Dlived,charged%20particles%E2%80%94in%20measurable%20ways. Accessed June 13, 2023.

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