NATURE'S COURSE
Unearthing the Kingdom of the Grey

by

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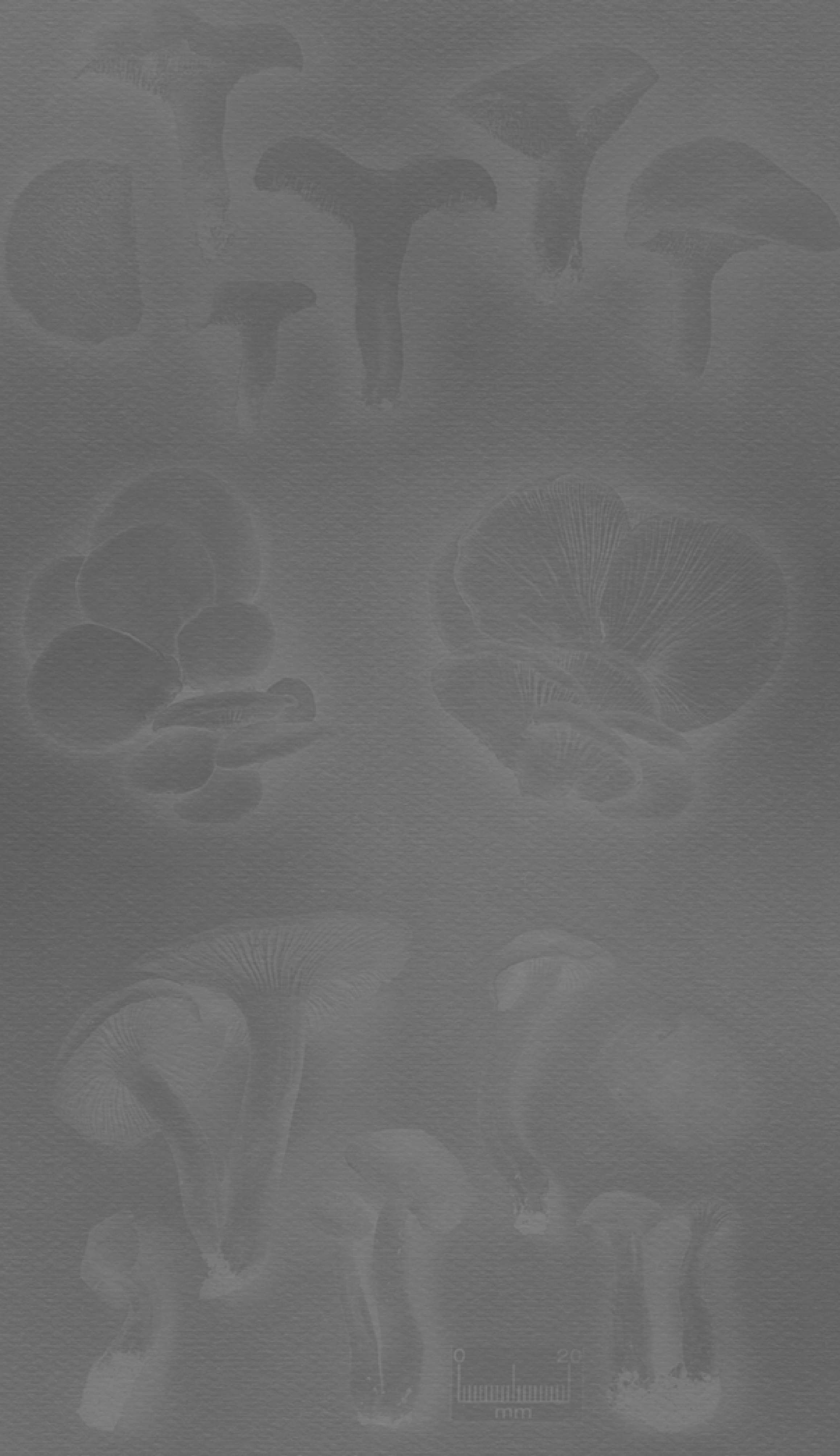
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ABSTRACT

This thesis examines historical concepts of nature in the context of Windmill Point, a wharf at the entrance of the Lachine Canal in Montreal's Old Port. It does so to understand how the conceptualization of nature has formed the way humans have mapped, shaped, and exploited it as a resource. Humans' self-ascribed dominion has shaped and reshaped the environment to fit economic aspirations, aesthetic desires, and cartographic reiterations which speak to a faith in measurability, order, and linear progression. By studying a series of archival maps, images, and documents in conjunction with regular site immersion, materials explorations, and design propositions this thesis investigates fungi as a design tool which can begin to challenge assumptions held on the production and commodification of space. It proposes a series of interventions at Windmill Point which invite fungal possibilities while accepting and celebrating the non-linear and often erratic agency of fungi in "stories of making and unmaking".[1]

1 Robert Macfarlane, *Underland: A Deep Time Journey* (London: Hamish Hamilton, 2019), 15.

Aknowledgements

I would like to thank my thesis advisor, professor Suzy Harris-Brandts for her constant support and understanding during this particular and challenging year. Her guidance, encouragement, and trust were a constant positive force over the course of this thesis with its many twists and turns.

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I would like to thank my parents for their love, for everything they have done and taught me, it is immeasurable. Finally, to James, for his love, and for always being there, pushing me to stay curious.

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Diclaimer: *Please be advised that this thesis contains detailed imagery of fungi in various states of growth and decay.*

part one

STORIES OF MAKING & UNMAKING

"Deep time is measured in units that humble the human instant: epochs and aeons, instead of minutes and years. Deep time is kept by stone, ice, stalactites, seabed sediments and the drift of tectonic plates. Deep time opens into the future as well as the past. [...] For to think in deep time can be a means not of escaping our troubled present, but rather of re-imagining it; countermanding its quick greeds and furies with older, slower stories of making and unmaking." [1]

- Robert Macfarlane, Underland

Foundations

In *Underland: A Deep Time Journey,* Robert Macfarlane explores the human relationship to the underground, inviting a repositioning of the scale and scope considered when thinking about the physical world and built environment. For those in the design professions, his work raises important questions regarding what it would mean to have architecture situated within these '*slower stories of making and unmaking*'. The way space has been typically conceptualized is rooted in the tradition of two-dimensional mapping and image-making, which offers a time-specific snapshot of select real-world three-dimensional conditions. These representations simplify space and omit past conditions, future possibilities, and complex relationships. Such maps and images falsely give the impression of static permanence without accounting for cycles and processes of decay and renewal. By contrast, "when viewed in deep time, things come alive that seemed inert. New responsibilities declare themselves. A conviviality of being leaps to mind and eye. The world becomes eerily various and vibrant again. Ice breathes. Rock has tides. Mountains ebb and flow. Stone pulses. We live on a restless Earth." [2]

Sitting on deep hydrological, geological, ecological, and socio-political layers, Windmill Point, a wharf at the entrance of the Lachine Canal in Montreal—alongside the canal's toxic waters and the abandoned Silo nº5 grain elevators—present a unique site to explore architecture at different scales. The toxic sediment of the canal, the industrial debris littering the site, and the concrete grain silos are considered in this thesis at the micro scale through the introduction of fungi. Additionally, this thesis reflects on the deep sectional and far-reaching geographical implications of altering cycles of decay by amplifying and accelerating the role of fungi. The unique history of the site, so intimately wrapped in stories of empire, sovereignty, industrialization, and capital accumulation, serves as a backdrop to understanding the conditions which have led to the site's current state and the way we think about post-industrial sites, riverine landscapes, and natural/unnatural dichotomies.

This thesis proposes fungi as a tool which can begin to break down and blur the ideals and beliefs typically held about the built environment. It proposes to create a series of interventions and new environments at Windmill Point which invite fungal possibilities while accepting and celebrating the non-linear and often erratic agency of fungi. The aim is to create a new experience of the site which exposes deep cyclical connections and agency in 'stories of making and unmaking'; to explore architecture which takes emphasis away from humans. It imagines a future which releases control over every architectural detail by acknowledging the often delightfully surprising and unforeseeable possibilities that emerge in a world we can never fully master.

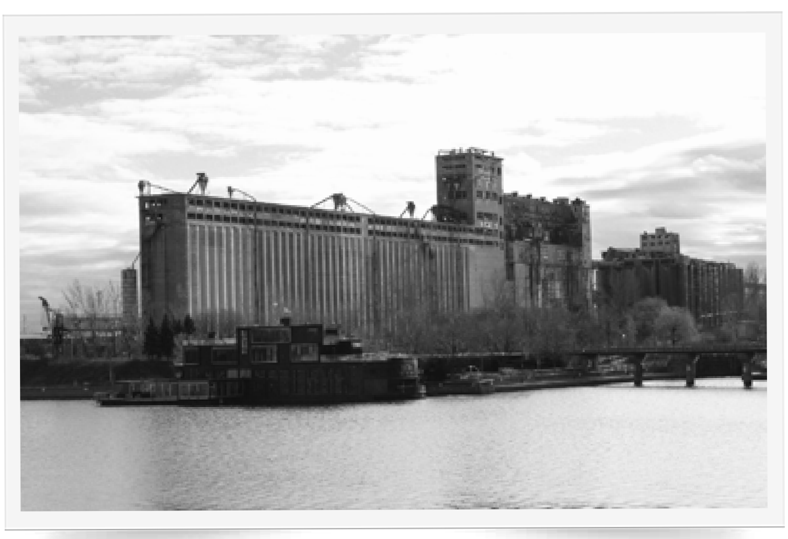


Fig. 01. Site Photo
Author, 2020

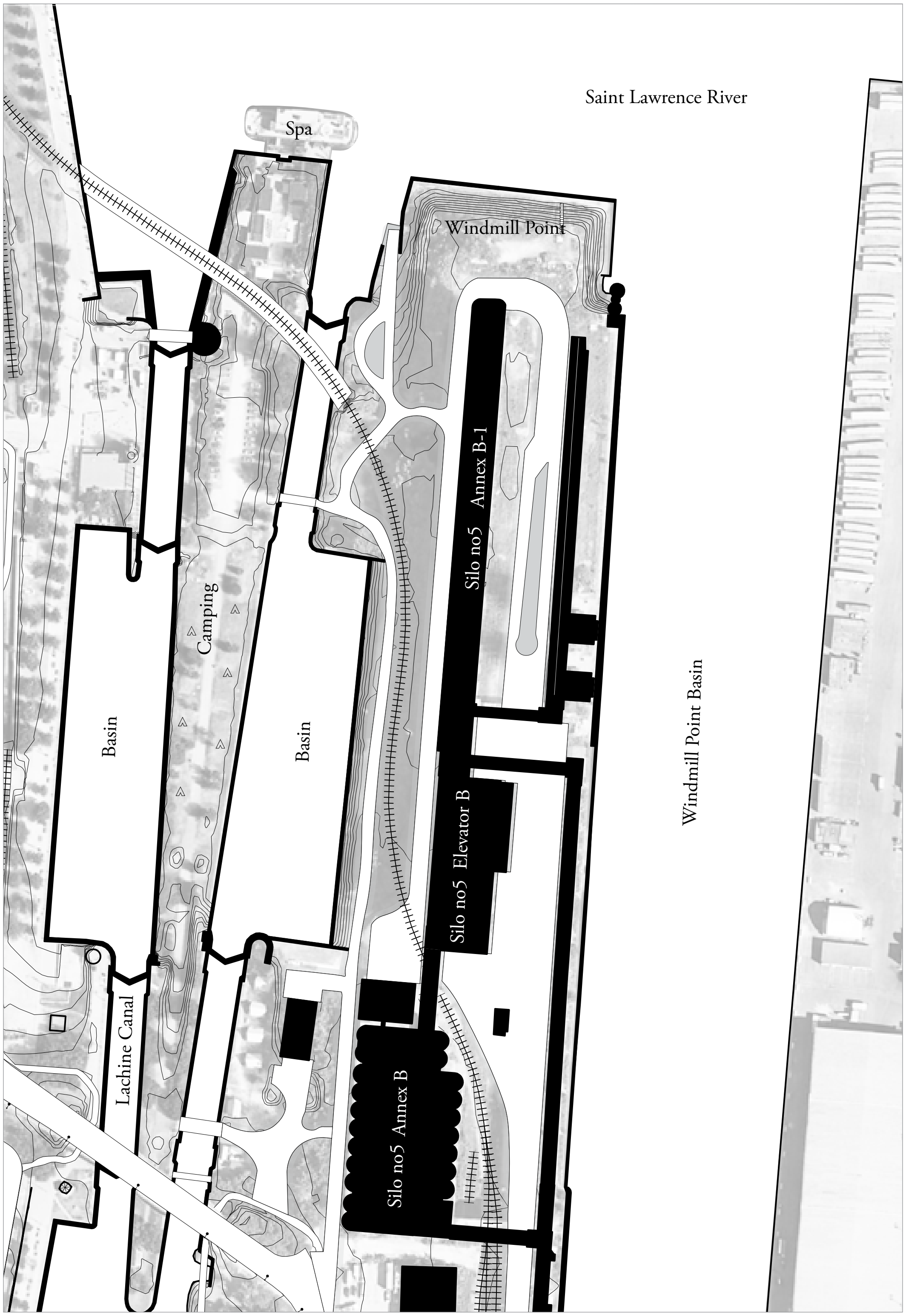


Fig. 02. Windmill Point site plan
Author, 2021

Questions

The first question driving this thesis is: what are the physical and metaphysical depths of the Saint Lawrence River? This was borne out of an interest in understanding how our perception of the Saint Lawrence has changed over time and how it has shaped the infrastructure of the river and river's edge. There was a fascination with the dualities observed when looking at or making maps of the river versus experiencing it firsthand. There were dualities too in the way the river could be both a commodifiable resource, a piece in a larger global machine, while also holding an intangible sense of environmental wonder. Every new map, image, account, or visit revealed a new piece of information, a new connection.

In focusing on the specific site at Windmill Point, an environmental and infrastructural web of connections emerged. This expansive web, which includes weather systems, river systems, canal systems, ecosystems, international ports, and cross-continental railway systems, also revealed itself to be in constant flux. Some of these changes were slow, evolving, deep time ebbs and flows, while others were dramatic but often short-lived human-driven changes which kept step with technological developments, evolving science, and changing politics.

So, the thesis question changed from wanting to understand something which to date had proven itself to be infinitely more complex and interconnected, to wanting to expose the ways in which our perceived understanding—which necessarily depends on binaries, simplifications, the limits of human science, and the drive of human agendas—fails to accept or account for impermanence and non-human actors in the built environment. A similar line of questioning is taken up in the work of Anna L. Tsing, particularly in *The Mushroom at the End of the World" On the Possibility of Life in Capitalist Ruins* which uses matsutake mushrooms to explore "precarious livelihoods and precarious environments".[3] In so doing she says, she finds herself "surrounded by patchiness, that is, a mosaic of open-ended

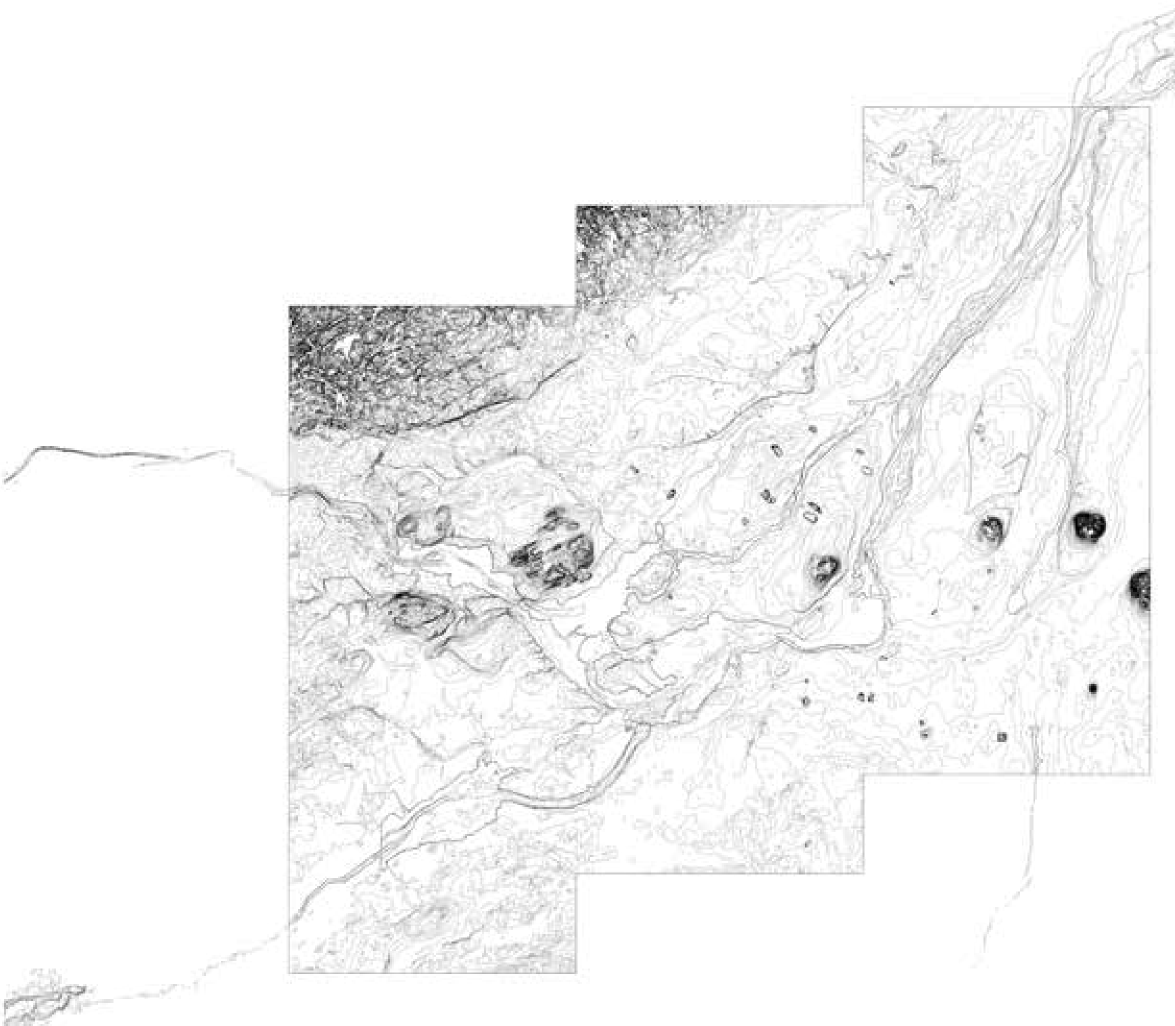


Fig. 03. Continuous land contours and bathemetry of Montreal and the Saint Lawrence River
Author, 2020

assemblages of entangled ways of life, with each further opening into a mosaic of temporal rhythms and spatial arcs."[4]

Tsing's work takes an ethnographic approach to understanding matsutake's global supply chain, reminding us of the multiplicity of human experiences and how they shape or inform global systems. While this thesis deals with post-colonization structures of power and capital, there is a vast and important human history with connections to Windmill Point to acknowledge which warrants its own in-depth research and exploration but falls outside the scope of what is treated here. The first recorded human settlement around modern-day Montreal was a group known as the Saint Lawrence Iroquois whom Jacques Cartier had met in their village Hochelaga. By the time of permanent European settlement at Montreal, the Saint Lawrence Iroquois has disappeared and the area was now inhabited by the Kanien'kehá:ka, also known as the Mohawk nation of the Haudesosaunee confederation. Subsequent histories of displacements, warring powers, waves of settlement and immigration have added to the richness and complexity of human connection to the reaches of Windmill Point. The course of this thesis however, is anchored more so by an interest in considering those non-human actors which are ignored, fought back against as undesirable, or excluded from the index of actors which have been approved to play a part in our built environment, including fungi.

Within architectural theory, this has been examined by a group architects and theorists which Lydia Kallipoliti categorizes as the *subnaturalists.*[5] The term derives from the work of David Gissen, whose book *Subnature: Architecture's Other Environments,* defines subnatures as the forms of nature which "are envisioned as threatening to inhabitants or to the material formations and ideas that constitute architecture" in contrast to the elements of nature which can be honed or harvested to benefit human pursuits. [6] Explained by Gissen:

"In numerous books, we have learned to engage sunlight, climatic systems, and the wind currents that stretch across the Earth's surface. While these strategies address energy conservation and foster an appreciation of nature, as employed, they advance a seemingly neo-Victorian and neo-Haussmannite vision of urbanism in many global cities. I call this approach neo-Victorian because, like the reformers of the nineteenth century, green architecture often entails the utilization of nature as an instrument that cleans the world, increases productivity and efficiency, and transforms our existing natural relationship, while advancing the social sphere as it exists. I consider these approaches neo-Haussmannite because, like the remaking of Parisian space under Georges-Eugène Haussmann, the introduction of green building often enhances the power of urban wealth in the name of mending a natural relationship." [7]

Gissen's book presents a series of subnatural categories, which include dankness, dust, puddles, mud, debris, and weeds, amongst others. "They are also those natures that stand against the remaking of the world into a pulsing circulatory apparatus." [8] Forms of subnatures, then, appeared as an appropriate tool for investigating ways of exposing how our perception of the relationship that exists between the built environment and the

Fig. 04. Scattered debris
Author, 2021

Fig. 05. Mud, puddles, and debris
Author, 2020

biophysical world, seemingly separated by some invisible line or selectively joined in instances of "green" architecture, could not be so clearly defined. There are always elements which threaten to invade, to seep through the cracks, to overcome the carefully engineered barriers we have constructed to keep them in their rightful places out of sight and mind.

Fungi, a strange and often misunderstood kingdom, came to mind as an exciting avenue which could also be understood as a form of subnature. While carefully packaged mushrooms on grocery store shelves, bioengineered penicillin strains, or select yeasts in some of our favourite alcoholic beverages are well appreciated, outside the assurances of consumer standardization, fungi are considered at best a curiosity, more generally a nuisance, and frequently as something to be feared. This is particularly true in architecture; fungi are the last organisms you would like to discover growing in your walls. This duality of good fungi and bad fungi, defined by standardization, is ironic and limiting for a kingdom which is notoriously difficult to predict and control.

Fig. 06. Lichen covered tree
Author, 2020

Fig. 07. Dying bolet mushroom
Author, 2018

Much like weeds, they invade. They are the first colonizers of space, digesting stone into mineral rich soil; they are the makers of ruins and debris. They will creep in where there is dampness, then they invite other life forms to follow their path, supplying them with nutrients through symbiotic relationships and then breaking them down and devouring them once they have died. Teetering between creating and taking life, fungi are in a constant state of simultaneous decay and renewal as their underground networks advance and retreat in search of new food or send out puffs of spores to claim new territory. They are a reminder of the fate that everything in our world eventually faces, however far off: a return to the earth. As they writhe up stone walls and into the cavities of our cities, they begin their slow feast, the hard clean edges of our world, once so carefully traced and staked, begin to fade.

Methods

This thesis began with a traditional map and traced a one-and-a-half-kilometer perimeter in the Old Port of Montreal to investigate the social, political, economic, and environmental relational and connective roots and tendrils of the site. This parcel of space today includes a piece of the Saint Lawrence River, the entrance to the Lachine Canal, and the Windmill Point Wharf with its imposing Silo nº5 structures. However, the deeper history of the site reveals just how recent and comparatively short-lived are the hard distinctions seen today between island, river, wharf, and canal. The *'slower stories of making and unmaking'* for this parcel of land (which from here on out will simply be referred to as 'Windmill Point'), emphasize the complexity of natural or unnatural forces and slow evolving circumstances that brought about the conditions for what it would eventually become. 450 million years ago, Windmill Point was immersed within a sea. This sea gave way to sedimentary rocks, then an ice age brought a thick sheet of glacier to the area before its gradual retreat, leaving what is known as the Champlain Sea in its wake, which itself slowly retreated between 12 000 - 10 000 BCE.[9]

Fig. 08. Canadian bodies of water and former extent of the Champlain Sea
Author, 2020

It is not that this long legacy of slower movements has stopped, but rather that unless accompanied by cataclysm, it is imperceptible at the human scale or simply surpasses the processes considered in daily spatial thought. Infrastructure and megastructures like the Silo nº5 buildings, as conceptualized, experienced, and represented, carry with them

Fig. 09. Windmill Point in relation to Montreal
Author, 2021

an illusion of permanence. By breaking down the current conditions of the site and cross-analyzing them against the site's history and its accompanying intellectual *milieu*, human-driven patterns begin to emerge. When viewed as a series, these patterns or maps confirm an anthropogenic confidence and their eventual ecological consequences. Since the sixteenth century, there is a recorded history of the site and surrounding area's potential exploitability and value in terms of capital accumulation with infrastructural projects following suit.

These projects, or 'quick greeds and furies' as Macfarlane calls them, shaping the new line separating land from river, adjusting to shifting climate, conditions, and economies, have since grown and evolved. The clean solid lines on maps mask deeper cycles of change and present reassuring solidity and permanence. However, not all 'slower stories of making and unmaking' are intangible, deep-geological processes of glacial expansion and retreat, fungi, however small or common or ignored, have played a role in moulding our world for a billion years. In investigating fungi as methodology for creating space, this thesis explores an architecture with a degree of independence from human whims or agency in recognition of the relative short-sightedness and often harmful nature of infrastructural progress.

Frequent site visits and digital recordings have been important and insightful in informing this thesis. Beyond what can be gleaned from a series of historic maps or reports, years visiting the Saint Lawrence River, river basin, Old Port, and Windmill Point at different spots along the expansive network at different points in its annual and daily cycle provides a different experience and understanding of scope and scale. There is often a subtlety in environmental differences or in the transition from landscape to cityscape, water to land, animated to forgotten. There are other moments or transitions which are far more abrupt or impactful than a map would lead you to assume such as changes in elevation, the sudden concrete drop from the edge of the wharf to the river, the actual mass of buildings, the full expanse of the river or the strength of its current.

These visits have offered an experience of the site at a human scale and revealed a different understanding than the one gathered from maps or research. It is a scale at which you also notice that the irrelevance of cartesian lines; the gravel from the road extends into the tall grass, weeds grab hold onto the paths and in the weathered cracks of stone, bits of debris shed from the structures and blend into the landscape. It is also at this scale that you can begin to notice life. There are more shrubs and bushes, more species of grass and wildflowers, there are insects, there are more trees, some of them are young, others dying, most are covered in a green wash of lichen. Each return also reveals something new; the site is in a constant state of change. Windmill Point follows Montreal's dramatic seasonal changes, and a restless sun highlights new elements as the angles of reflection shift. Awareness of these ground conditions, details, and connections has been critical in determining the thesis intention and response.

Fig. 10. Site detail photos
Author, 2020-2021

In addition to the intentional observation and experience of the site, the response is informed by years of developing a familiarity with wild mushrooms in the provinces of Quebec and Ontario. Seeking or noticing fungi in settings which range from wild to urban, coupled with a fascination and appreciation for the forms and functions of fungi creates a mental inventory of the environments in which they grow and an awareness of their variety and mystery. Empirical observation begins to form connections and patterns in your mind: which mushrooms are often found together, what tress or plants are often nearby, how much sunlight reaches the ground, how common are different species of mushrooms, what time of year do they grow, how quickly do they grow and rot, which are also favoured by nibling animals and insects, what kind of soil do they grow in, do they grow on trees, do they grow on exposed roots, how much wetness do they require, what are the smells, how does the weather advance or stunt their growth?

Fueled by disillusionment with market-driven construction, these parallel experiences of the site and of mushrooms, when coupled with research into Windmill Point and some of the material possibilities of fungi and mycelium, incited a desire to marry the two by bringing fungi to the wharf. A series of material tests were subsequently carried out to provide more tangible experience with fungi as an architectural material once it has been isolated from the ecosystem in which it typically lives and is forced to respond to domestication attempts. Mycelium, the vegetative network of fungi, was left to inoculate substates which could be moulded and tested in different conditions. These experiments, with their successes and failures, offered a glimpse of some of the possibilities and challenges of fungal materials which are later proposed as an ephemeral future for Windmill Point.

Fig. 12. View of the river, Orléans island, and Laurentian Mountains from LaDurantaye
Author, 2018

Fig. 11. Aerial view of land-water transition
Author, 2017

Fig. 13. Low tide at Saint Michel-de-Bellechasse
Family photo, c.2007

Fig. 14. Detail, pedestrian bridge
Author, 2020

Fig. 15. Detail, Historic canal walls and water levels
Author, 2021

Fig. 16. Exposed remnants of the old retaining wall
Author, 2021

Fig. 17. Fall, Winter, Spring
Author, 2020-2021

Fig. 18. Footpath in the Fall
Author, 2020

Fig. 18. Footpath in the Fall
Author, 2020

Fig. 19. Footpath in the Winter
Author, 2021

Fig. 20. Winter plant details
Author, 2021

Structure

Following this introduction, *part two* of the thesis, “Setting Course” probes archival maps, images, primary and secondary sources to unearth the hidden layers of history at Windmill Point, beginning with the arrival of French colonial explorers. These first voyages and the subsequent arrival of settlers marks the beginning of the site’s inclusion within the global repository of exploitable resources via maps and written accounts. It traces the changing ways Windmill Point and the Old Port were viewed and understood and how these perceptions manifested themselves through the built environment. The section concludes by looking at the state of Windmill Point today and outlining major redevelopment plans for the site as a way of setting the stage for the imagined fungal intervention.

Part three, “Breaking Course” touches on the evolutionary history of fungi to explore its role in ‘stories of making and unmaking’ and examines the possibilities of fungi as world-makers. This section also presents some of the prominent ways mycelium is being used and experimented with as an emerging design material. Then follows a series of material explorations which play with the different possibilities of making and using mycelium bricks and testing the unusual life cycle of lichen.

Next, *part four,* “The Grey” summarizes the guiding theoretical framing and architectural precedents which have informed this thesis. It then gets into a breakdown of the three facets of the proposed intervention proposed for Windmill Point, titled “Inviting Fungal Possibilities”, “Tunneling” and “Leaving Traces”. *Part five* is the Afterword, “Weathering, Decay, Renewal”, an ongoing process of reimagining the ground conditions post-intervention and a personal reflection on some of the lessons and questions extracted from the thesis process. While *part four* presents an architectural intervention in plan and section, *part five* starts to take this apart and starts the imagine the site in time.

Endnotes

1 Robert Macfarlane, *Underland: A Deep Time Journey* (London: Hamish Hamilton, 2019), 15.

2 Macfarlane, 15–16.

3 Anna Lowenhaupt Tsing, *The Mushroom at the End of the World : On the Possibility of Life in Capitalist Ruins* (Princeton, N.J: Princeton University Press, 2015), 4.

4 Tsing, 4.

5 Lydia Kallipoliti, 'History of Ecological Design', in *Oxford Research Encyclopedia of Environmental Science* (Oxford: Oxford University Press, 2018), https://doi.org/10.1093/acrefore/9780199389414.013.144.

6 David Gissen, *Subnature: Architecture's Other Environments* (New York: Princeton Architectural Press, 2009), 21–22.

7 Gissen, 23.

8 Gissen, 24.

9 Aime Bensoussan et al., 'Geology of Montreal, Province of Quebec, Canada', ed. Luc Boyer, *Bulletin of the Association of Engineering Geologists* 22, no. 4 (1985): 333–94.

part two

SETTING COURSE

"We "moderns" believe, even in a postmodern age, that we have the power to control the earth, despite our deep ambivalence about whether we know how to exercise that power wisely. On the other hand, our nostalgia for the more "natural" world of an earlier time when we were not so powerful, when the human landscape did not seem so omnipresent, encourages us to seek refuge in pastoral or wilderness landscapes that seem as yet unscarred by human action. Convinced of our human omnipotence, we can imagine nature retreating to small islands – "preserves" - in the midst of a landscape which otherwise belongs to us. And therein lies our dilemma: however we may feel about the urban world which is the most visible symbol of our human power-whether we celebrate the city or revile it, whether we wish to "control" nature or "preserve" it - we unconsciously affirm our belief that we ourselves are unnatural. Nature is the place where we are not." [1]

- William Cronon, Nature's Metropolis

Drawing the Line

Mapping has taken many different forms throughout human history, the record of which enables us to begin understanding the organizational structures and priorities of a society. Viewed as a series, maps tell a story of some slow and some rapid changes. In the Western tradition, the trend has been towards an evermore accurate two-dimensional transcription of the physical, visible, and measurable elements of the Earth's surface, which is steeped in a long history of land conquer and exploitation. To claim ownership over a parcel of the Earth's surface, one must first determine the boundaries of this claim. The search for new frontiers, or new lands to map, has been synonymous with exploitative ambitions. In his book, *The Invention of Rivers: Alexander's Eye and the Ganga's Descent,* Dilip da Cunha traces the history of mapping rivers to make sense of how it has legated harmful policies that ignore the fluctuating three-dimensional relationship between land and water. Unlike maps would have you believe, a well-defined hard line separating land from water does not exist; attempts at actualizing this line perpetuates cycles of increased infrastructure to maintain, expand, or increase the economically advantageous possibilities of this separation. As da Cunha writes:

> "Separating land from water on the Earth's surface is one of the most fundamental and enduring acts in the understanding and design of human habitation. The line with which this separation is imaged on maps, etched in the imagination, and enforced on the ground with regulations and constructions has not only survived centuries of rains and storms to become taken-for-granted presence; it has also been naturalized in the coastline, the riverbank, and the water's edge."[2]

Establishing settlements on newly colonized land involves an element of decision making as to where these settlements ought best to be located. William Cronon, in his book *Nature's Metropolis: Chicago and the Great West,* explores Chicago's environmental history in terms of the perceived relationship, or dichotomy, between humans and Nature. He discusses contemporary language in the selection of new boom towns which spoke of the *natural advantages* of a given place to foretell upcoming economic prosperity. [3] Similarly, Montreal's natural advantages were many, and the rhetoric evolved over time to suit changing economic aspirations.[4] Maps, images, and accounts of Montreal produced by state officials, colonial explorers, and other powerful stakeholders tell the story of how natural advantages, which equated economic gain, translated to a fluctuating line separating land from water.

Beginning with Jacques Cartier's 1535 visit, it was the island's fertility and airiness, which equated potential trade, agriculture, and defensibility, that was emphasized.[5] Decades later, Samuel de Champlain wrote of the "land cleared up like meadows, where grain can be sown and gardens made" around Montreal's Saint Pierre river which ran from the Saint Lawrence inland just north of the present day site and the Lachine Canal.[6] The agrarian rhetoric continued when Ville Marie (Old Montreal) was established as a Christianizing mission in 1642 at the juncture of the Saint Lawrence and Saint Pierre rivers because

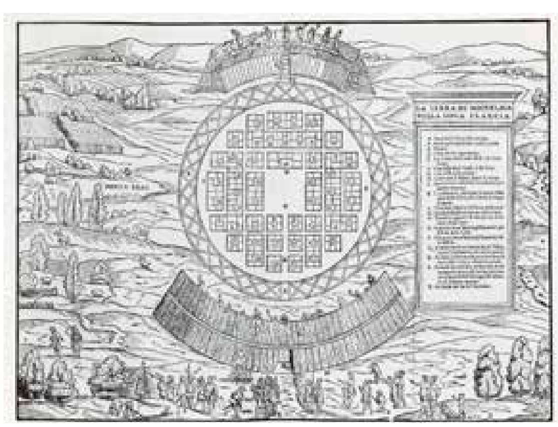


Fig. 21.La terra de Hochelaga nella Nova Francia
G.B. Ramusio, after J. Cartier, 1556, Archives Montreal. VM6-D4000-3-1.

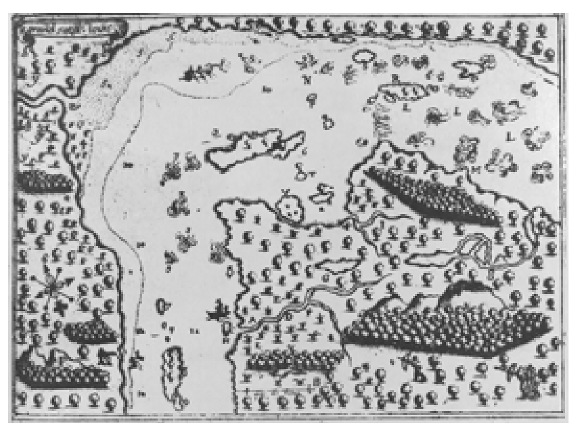


Fig. 22.Map of Montreal
Samuel de Champlain. 1611. Archives Montreal. VM066-1-P004.

of the importance of food independence in establishing a viable settlement. This mandate was eventually abandoned however, and the primary objective and economy turned instead to the fur trade, a period which lasted until the early nineteenth century. [7]

After British imperial forces take Montreal from the French in 1760, emphasis shifts from land fertility to the navigability of the river which appealed to the naval strength of the new colonial ruler.[8] The decline of the fur trade was followed by a rapid period of deforestation and the production of grain at

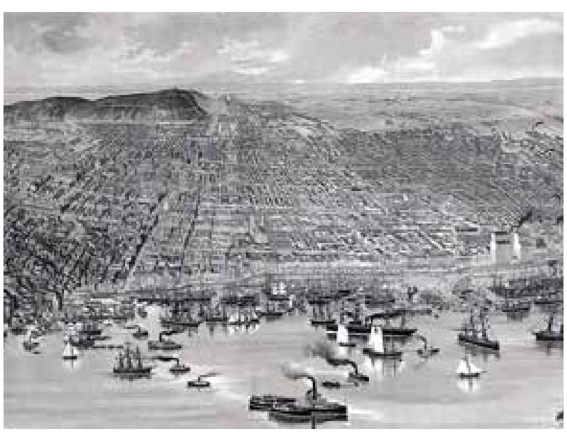


Fig. 23.Montreal's Port
1889, Library and Archives Canada, C 06673

an industrial scale. Montreal's port, which until this point had been shaped by an assortment of more temporary structures constructed at the directive of private merchants, passes from a natural dry port dependent on fluctuating water cycles to a heavily engineered international port within a few decades following the creation of the Harbour Commission in 1830.[9] The Saint Lawrence after all, connects the Atlantic Ocean to the Great Lakes with tributaries, including the Ottawa River at the north-western tip of Montreal, reaching far in every direction. Called Kaniatarowanenneh, or the *big waterway,* by the local kanien'kehá:ka nation, its basin reaches Ontario, Quebec, Illinois, Indiana, Minnesota, New York, Ohia, Pennsylvania, Vermont, Wisconsin, and Michigan and had been used as an important trade route and source of sustenance by indigenous nations for millennia. By contrast, for colonial powers and settler populations, "more than the river's physical characteristics, what drew their attention was its economic potential. Emerging from these accounts is a representation of the river as a bona fide "organic machine", a waterway that could be adapted to improve its performance."[10] By 1704, the Sulpicians had constructed the first of a series of windmills at the river's edge at Windmill Point to harness nature's free labour, the legacy of which lives on in the name of the present-day wharf.

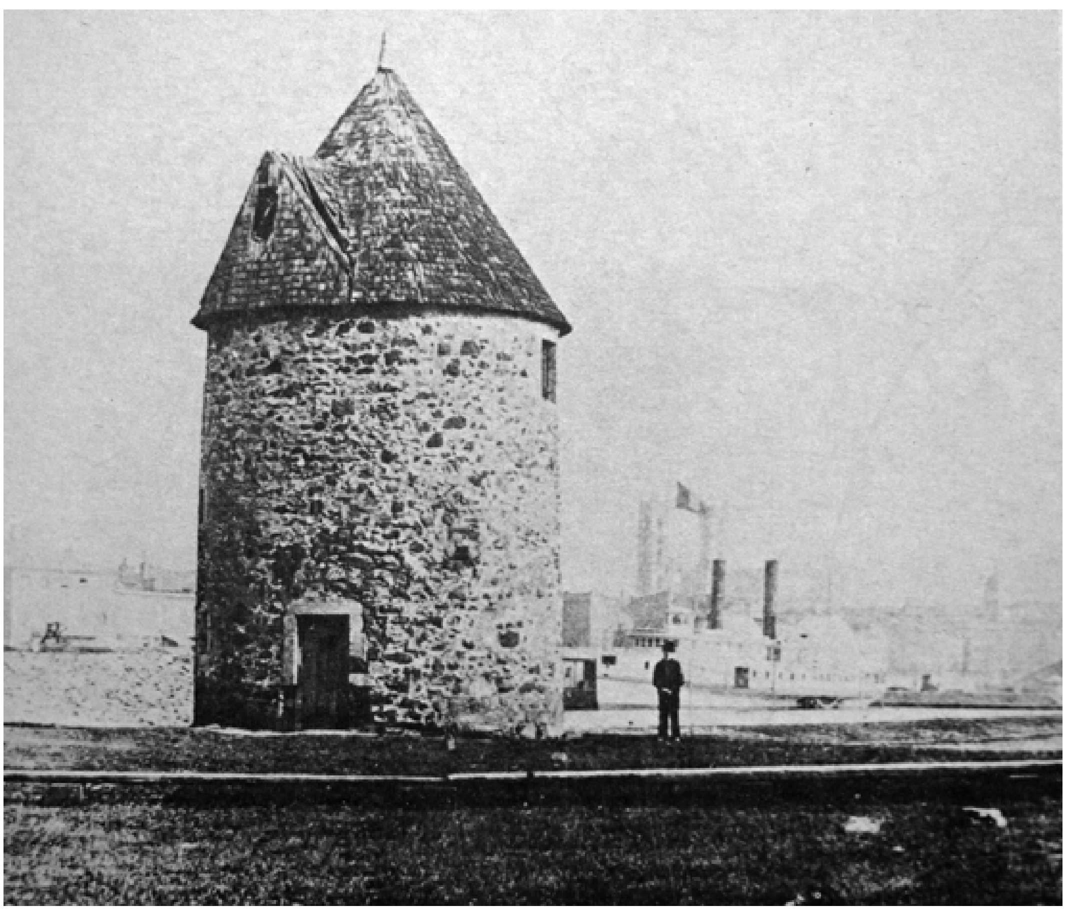


Fig. 24. The last windmill
1895

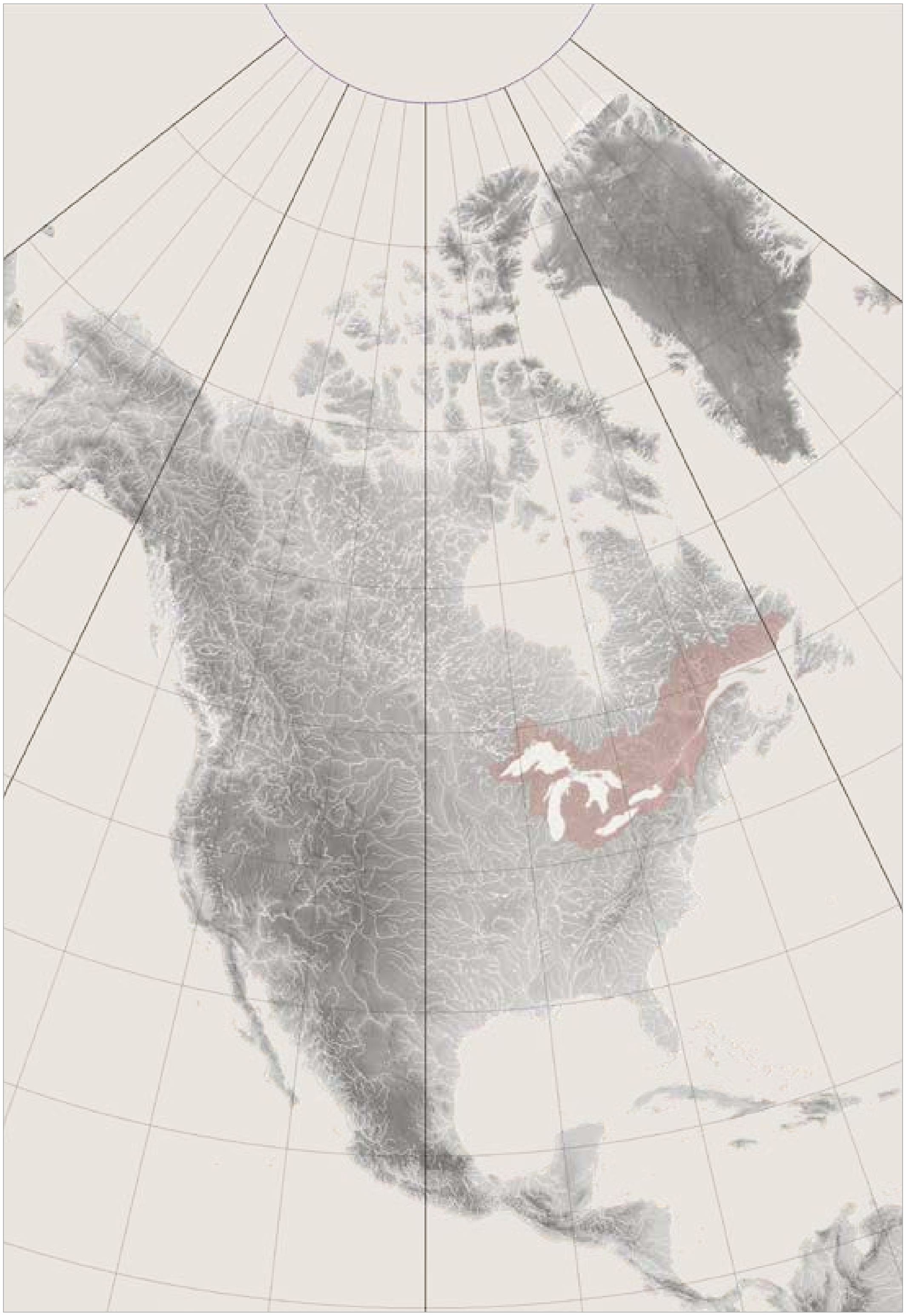


Fig. 25. Saint Lawrence basin and river system of North America
Author, 2021

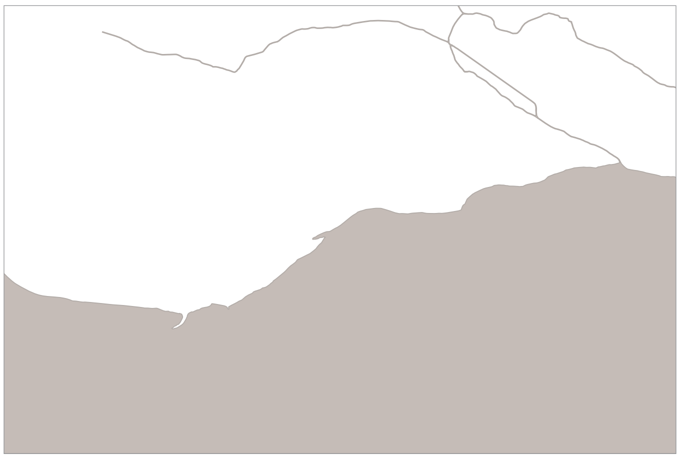
The Unrestrained Course

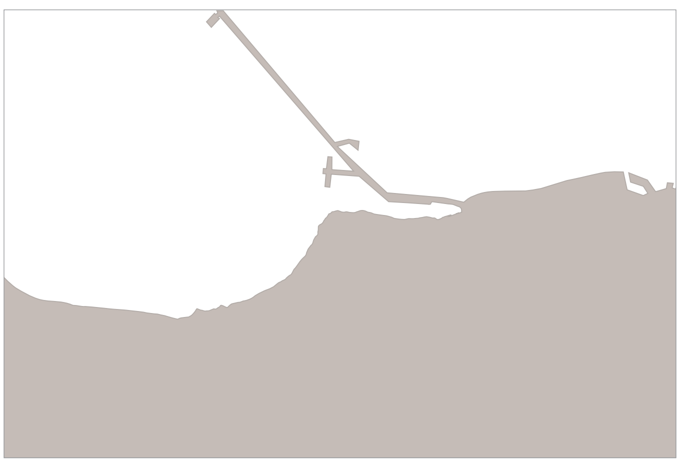
Cronon's argument, however, is that natural advantages or geographical arguments alone do not explain the success or trajectories of cities; culture and history do.[11] Natural advantages first present a host of opportunities and then decisions are made that shape and reshape the environment to fit economic aspirations, aesthetic desires, and reiterations of the drawn line. This is especially true of waterfronts which explicitly see their prized 'natural' ports met by human intervention and resistance in the form of wharfs, walls, dikes, and dredging, the progression of which can be followed on juxtaposed series of maps. The earliest maps of Montreal's Old Port indicate fluctuating water levels, drifting shorelines, and an impractical riverbed. For all its natural advantages, the seasonal and epochal ebb and flow of the river presented many challenges to Montreal's inhabitants and progressively went through many cycles of making and unmaking, reminding us that the hard lines seen today have and will continue to change. At the early stage of European settlement, Windmill Point did not exist, it was part land, part fluctuating wetland, and part river.

Cronon speaks of the development of frontier cities as having this kind of self-propelling force which enabled cities to bypass obstacles and boom:

> "for real women and real men were no more present in the city he described than real nature. Individual people and their real landscapes had dissolved into that favorite device of literary naturalism, the abstract dichotomy between man and nature. In an opposition that was far more ideological than real, man was masculine, singular, active, and all-controlling, while nature was feminine, singular, passive, and ever more controlled. Their relationship was larger than life, played out upon a landscape of heroic mythology. Vast forces created and moved through the city, but they were the work of "man," not individual people."[12]

In this context, "man" is taken not to mean a collective of individual people but rather the greater working of humans and their





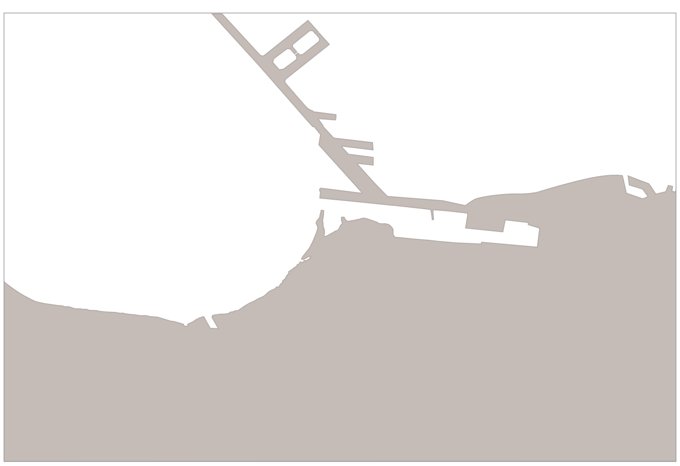


Fig. 27. Shoreline, 1843
Author, 2021, after Civiliti + Lafontaine & Soucy,2017

Fig. 28. Shoreline, 1857
Author, 2021, after Civiliti + Lafontaine & Soucy,2017

Fig. 26. Shoreline, 1801
Author, 2021, after Civiliti + Lafontaine & Soucy,2017

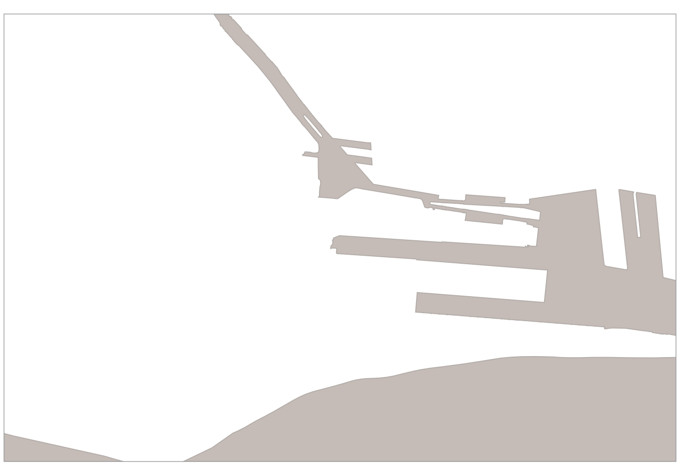


Fig. 29. Shoreline, 1890
Author, 2021, after Civiliti + Lafontaine & Soucy,2017

Fig. 30. Shoreline, 1949
Author, 2021, after Civiliti + Lafontaine & Soucy,2017

Fig. 31. Shoreline, current
Author, 2021, after Civiliti + Lafontaine & Soucy,2017

Fig. 32.Changing Shoreline
Author, 2021

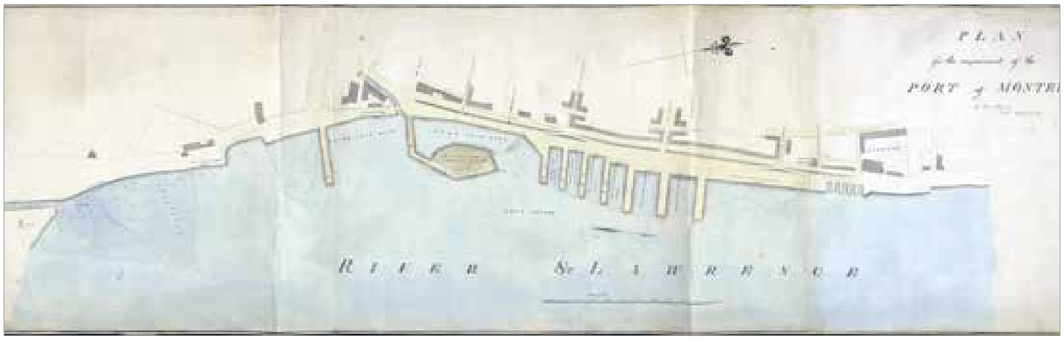


Fig. 35. Plan for the Improvement of the Port of Montreal
Peter Flemming, 1829

Fig. 34. detail from Bathymetric plan of Montreal's Harbour
Captn. H. W. Rayfield et. al., 1858, Archives Montreal, CA M001 VM066-4-P045

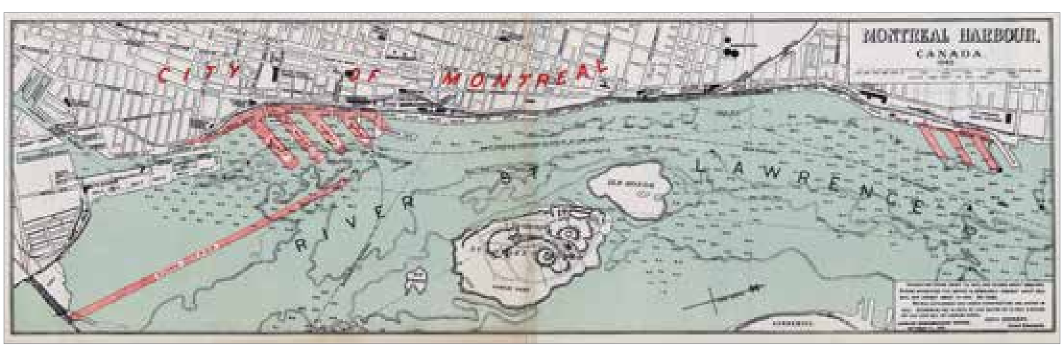


Fig. 33. Montreal Harbour showing proposed wharves and bathymetry
John Kennedy, 1892

systems – systems of production and systems of environment shaping. While the hard lines of the port in Montreal were being drawn, erased, and redrawn by merchants seeking to ease commerce, massive public infrastructure works also began reshaping the city.

Nineteenth century public health crises were largely attributed to public sanitation failures. Edwin Chadwick, the English senior official who initiated Montreal's sanitation project in the 1840s, "hypothesized that the solution was continuous water flow. Wherein lay the means of eliminating stagnation and draining the soil, the means of cleansing the city, the means of removing refuse – in short, the means of improving living and health conditions.", echoing David Gissen's assertion that as opposed to beneficial flowing water, stagnant water or puddles are subnatures which are expelled in the built environment.[13]

The city decided to acquire the previously privately owned waterworks, gradually elaborated a sewer system, and secured continuous flowing water for its citizenry by pumping water from the Saint Lawrence river into reservoirs on Mount Royal thus "turning fresh water into a commodity that could be measured, channeled, transported, used, and taxed."[14] This was in addition to earlier public works beginning at the turn of the century which focused more on ridding the city of stagnant surface water. "Getting the water to flow and, eventually, drain involved a whole series of complementary earthworks to reshape the territory. Such projects included the digging of roadside gutters and ditches, the grading and leveling of mounds and hillocks, and the elevating or lowering of the surface level."[15] One of the most important public works, however— and what ultimately began to give shape to Windmill Point as we know it today—was the construction of the Lachine Canal.

Jason W. Moore, an environmental historian and historical geographer, proposes that capitalism reshaped spatial relationships to the extent that humans settled according to new economic potential.[16] This is true for Montreal and the Lachine Canal insofar as the construction of the canal attracted people and businesses which completely reshaped the neighbourhood. Building a canal had been a longstanding dream that would enable bypassing the Lachine Rapids south of the island where there is a sudden fifteen-meter change in elevation. After an abandoned attempt by the Sulpicians towards the end of the seventeenth century, a local merchant successfully tabled a bill for its construction in 1796. The project began construction in 1821 and was completed by 1825. From the very opening however, it was judged that the canal was not wide or deep enough for economic ambitions. Work to expand the canal began in the 1840s and recommenced for further expansion in the 1870s. [17] Between 1846 and 1945, an estimated 600-800 companies settled on the banks of the canal, a period which legated deeply polluted water and sediment which was recently deemed too uneconomical to remove or remediate.[18]

Fig. 36. Infilled basin and parking spot
Author, 2020

Fig. 37. Écluse no. 1
Author, 2021

Fig. 38. Frozen Winter Port
Author, 2021

Fig. 39. Boat launch in the Winter
Author, 2021

Expansion and Infrastructure

Much like the Saint Lawrence river system or mycelium networks branch out in all directions, often with hidden depths and unknown connections, the myriad of infrastructure that touches Windmill Point courses deeper and farther than initially obvious. Looking at these networks and their history helps to understand how their current form came about and highlights some of the policies and politics that were involved. The layers of stone and concrete of the wharf's retaining walls, the imposing series of grain elevators, a train line connecting to Canadian grain supplies and further maritime systems of canals, ports, and seaways to sell and distribute.

In "Following the infrastructures of empire: notes on cities, settler colonialism, and method", Deborah Cowen traces how "'national infrastructure' holds together seemingly disparate archives of Indigenous dispossession and genocide, of the transatlantic slave trade, and of unfree migrant racial labor regimes."[19] Specifically analyzing the infrastructure of Canadian Pacific Rail (CPR), she examines its role in the "making of settler colonial space – a geography carved out of relations and circulations that well exceed this national geography and that are organized through cities and urban life."[20] Cowen demonstrates how railways were the tool that economic and political forces jointly used to secure colonial power over the vast territory of what is now Canada. Railways successfully displaced indigenous populations, established new and more populous settlements, and revolutionized cities like Montreal as new hubs of accumulation, trade, and power.[21] A major competitor of CPR, the Grand Trunk Railway (GTR) which was headquartered in Montreal, is the company which built the Silo nº5 grain elevator complex that we see today at Windmill Point.

Following the Lachine Canal's completion, the location was strategically chosen to enable the efficient loading and unloading of grain by connecting GTR rail infrastructure with nautical infrastructure. Canadian grain was thus able to reach new global markets in greater and greater quantities. Initially, this infrastructure was privately funded and owned. GTR laid the first railway tracks along the water's edge in 1871, followed by CPR in 1885; contributing to a phenomenon of corporate monopolization of urban waterfront access which is a common problem in many global cities.[22] This monopoly by GTR and CPR would hold until 1907 when the Harbour Commission took control and opened waterfront rail access to all companies.[23] While tracing the infrastructural development of Montreal's Old Port, Jason Gilliland reminds us that while

> "development is usually portrayed as beneficial to everyone; [...] its advantages and disadvantages are, in actuality, unevenly distributed. [...] The built environment of the port therefore reflects the decisions of people who controlled property and deployed the labour of others, with the purpose of raising the values of their property and the stream of profits derived from it. The development of the port of Montreal during the industrial era was orchestrated by local entrepreneurs who were in a position to benefit most directly from an enhanced flow of goods and people through the city: merchants, industrialists, landowners, shippers, customs brokers and financiers." [24]

Fig. 40. Montreal's Industries, with Silo no. 5
1906, Archives Montreal, CA M001 VM066-5-P090

Windmill Point was the center of accumulation and capital administration which coordinated the successful storage and movement of grain as a surplus or commodity. Here we see and understand Jason W. Moore's explanation that capitalism worked not because it was a market system but rather because market exchange and production have always been contained within very definite spaces. He

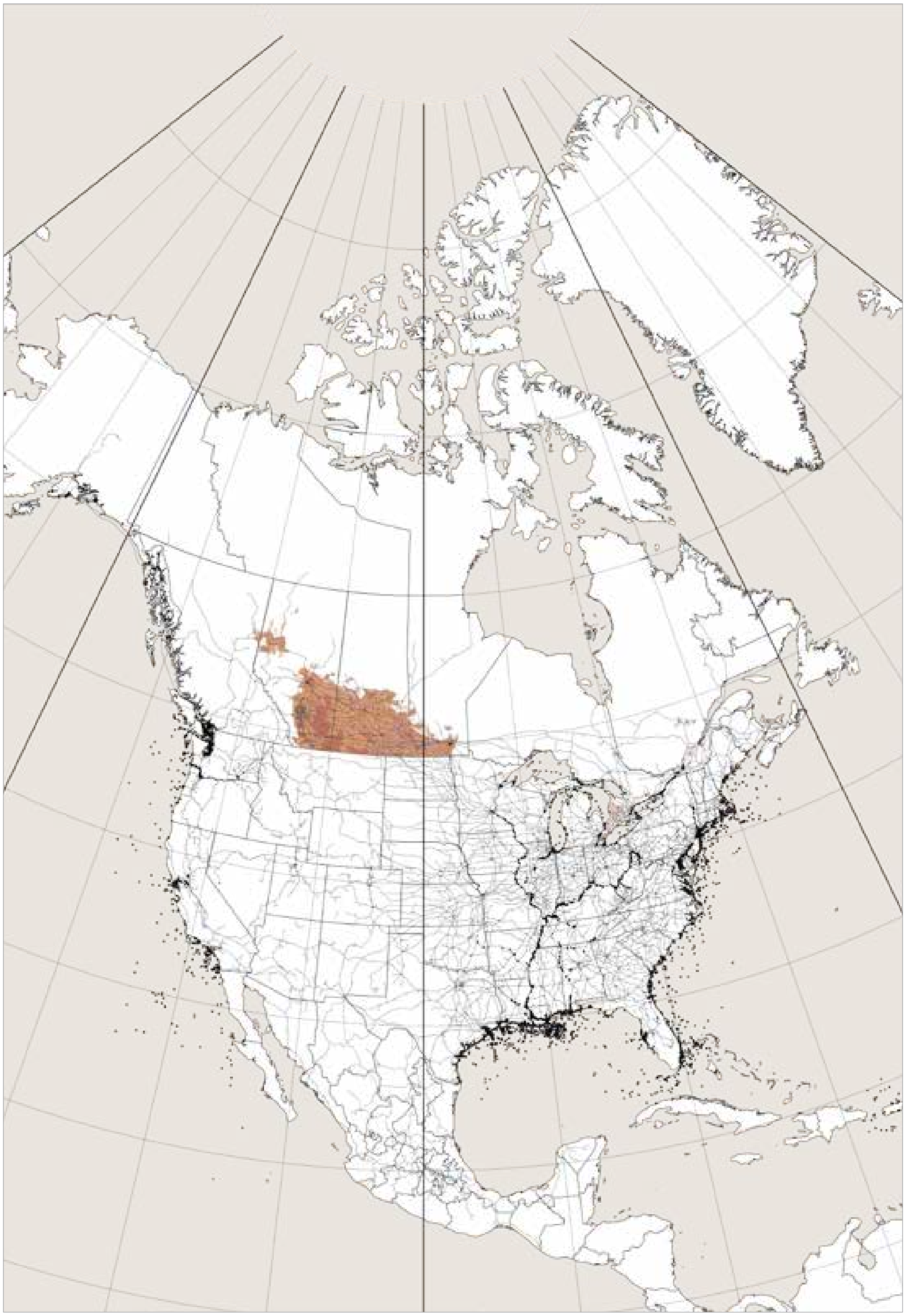


Fig. 41. Current North American Rail infrastructure showing connection to grain density
Author 2021

calls this 'islands of commodity production and exchange' within 'oceans of cheap or potentially cheap natures' which are labour, food, energy, and raw materials. [25] The massive, reinforced concrete structures, which were considered "the first modern elevators at Montreal", were expanded in three main stages beginning in 1903, then 1913, and 1958.[26] To give an idea of what this meant in terms of expanding capacity, the silo built in 1903 had the capacity to store 1 million bushels of grain and ten years later, by 1913, the capacity was 2.5 million bushels.[27] By 1923, Montreal had become the world's largest grain handling port. Ease of transportation necessitated continuous and evermore ambitious dredging campaigns[28] as well as the creation of hard-edged solid ground to support the new massive concrete buildings and the continuous arrival and departure of ocean liners.

Fig. 42. Dredging in Quebec
1910, Rapport Technique RT-140

The ethos which enabled the construction of the canal was expanded in the twentieth century to bring about the Saint Lawrence Seaway, built from 1954 to 1959. Policy has been consistently aligned with an assumption of dominion over the river and nature itself. Building off the work of James Scott,[29] Daniel Macfarlane attributes this to High Modernism which privileged "bureaucratic and technocratic expertise over local knowledge, without recognition of the limitations of this top-down approach, in large-scale attempts to make "legible" – through simplification, standardization, and ordering – social and natural environments in order to control them and prescribe utilitarian plans for their betterment." [30] A joint venture between Canada and the United States, the seaway increased shipping capabilities exponentially. Its success also rendered the Lachine Canal obsolete by 1970, and Windmill Point's Silo n°5 by 1994. Other former industrial buildings along the canal have more recently been converted into higher-end housing units and office spaces which capitalize on the contemporary appreciation of a post-industrial aesthetic. This aesthetic has been sold in conjunction with the value-making promise of downtown proximity and waterfront views complete with the recreational revitalization of the canal which re-opened in 2002.

Fig. 43. Old Port, 1870

Alexander Henderson, 1870, McCord Museum MP 1452 (51)

Fig. 44. Train at Windmill Point
Author, 2020-2021

Windmill Point Today

Since closing in 1994, Silo nº5 has remained vacant and unmaintained. While mostly fenced-off, the area is currently used officially and unofficially for several disparate activities. There is an adjacent high-end spa facility, grounds for urban camping, walking, cycling, a park with fantastic views, urban exploring, an active train line, and recreational boating and fishing. Its designation as part of Montreal's industrial heritage, proximity to the downtown core, and position at the juncture of the historic port, canal, and river has made Windmill Point highly coveted land which was slated for re-development a couple years after being acquired by the Canada Lands Company in 2010. A public consultation process was launched in 2017 to gauge public opinion on development master planning for the Old Port, including Windmill Point.[31] In February 2019, the official Request for Proposals was launched by the Canada Lands Company and Melanie Joly, the Minister of Tourism, Official Languages, and La Francophonie.[32] Later that year, it was announced that Devimco a local real estate development company responsible for many of the high rises in the nearby formerly working-class area of Griffintown, was selected as the winning proposal.[33] While no details have been released on the winning proposal, profits from the sale reportedly enable the preservation of Silo nº5.[34] Approximately half the wharf, the southern part, will be transformed into a mixed-use site aimed at integrating the space into the expanding urban fabric. No official proposals for this restoration project have been made public other than converting the grain elevator into a public walkway and panoramic viewing platform.

Of the three buildings that make up the Silo nº5 complex, the one known as Annex B, which was constructed in 1913, will be demolished. The original Grand Trunk Railway building, built in 1903-1906 out of steel, as well as the largest building, known as Annex B-1, built in 1957 of reinforced concrete, will be preserved. The concrete of Annex B is in a considerable state of decay and was deemed to be the least important heritage wise.[35] While preserving Silo nº5 is beneficial in that it conserves the high embodied energy of concrete and preserves public space by dispelling development to one half of the site, there is an element of irony and historical chance to the initiative. The silos only exist there today because they destroyed all the layers that previously existed and would otherwise have been as much a part of Montreal's natural and built heritage. A second irony is in how destructive Montreal's industrial heritage was to the Saint Lawrence River and how we are still dealing with a lot of the contaminants and pollutants, particularly in the Lachine Canal.

Fig. 45. Development proposal
During the consultation process, a hotel, meeting halls, conference centre, commercial, light industrial, office, mixed-use community orientented facility, parking, office space, and residential towers were the new programs proposed for the site. The conveyor belt would be transformed into a public walkway and circulation to and on the site would be improved.
Old Port Montreal, Renderings: Daoust Lestage, 2017

Changing Cycles

The infrastructure built at Windmill Point and in the Old Port of Montreal have brought more than aesthetic changes, they have fundamentally altered the seasonal experience of the site. Historically, there was regularly flooding in the Old Port which caused severe damage. Low scale infrastructural solutions were gradually built but all eventually proved to be unsatisfactory at keeping water out of the city. After floods in 1838, 1840, and 1841, the Royal Engineers built a five meter tall stone wall which was effective until a flood in 1848 surpassed it. There were then more floods in 1861, 1865, 1867, 1873, 1885, 1886, and 1887. In 1889, an ambitious infrastructure plan resembling the current shoreline of the Old Port which includes the breakwater wall of Cite du Havre was developed and approved.[36] With these measures, the land around the Old Port, also known as the Ville Marie borough, is no longer at risk of cyclical flooding. It is not that the water has disappeared however, it simply swells onto land elsewhere along the river system where there is less built resistance. In addition to limiting flooding in Ville Marie, the infrastructure has also eliminated ice shoves. This phenomenon, whereby broken ice chunks clog together and surge onto shore, used to be a regular occurrence. These crushing pileups would destroy many of the wooden structures and wharves that had previously lined the water and would have been a reminder of the river's might. Ice shoves no longer happen primarily thanks to the man-made peninsula, today known as Cite du Havre, built in 1898.[37]

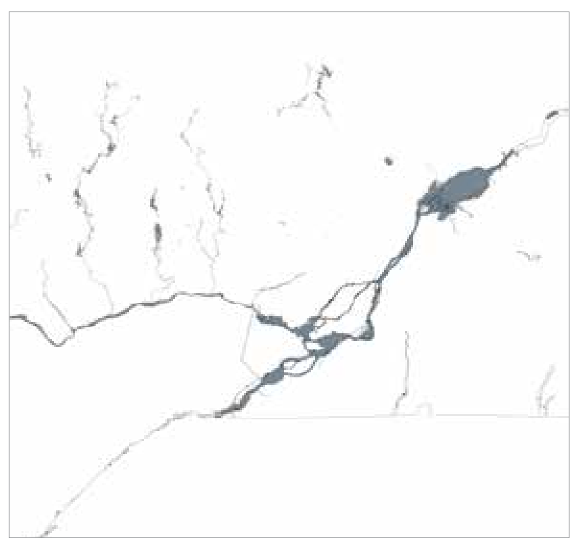


Fig. 46. Current extent of Quebec's flood zone
Author, 2020

In terms of climate for the Saint Lawrence River Basin, total precipitation has been increasing (by about 13% between 1955-2004) and is expected to continue to do so, primarily effecting summers and winters and includes a shift in ratio between rainfall and snowfall “consistent with warmer air temperature”.[38] Warmer climate also reinforces a cycle of increased evaporation rates and decreased ice coverage which continuously feed into each other. It is expected that precipitation levels in the region will increase by up to 10% over the first half of this century, and by up to 20% in the second half. [39] The St Lawrence Basin has seen an increase in extreme weather events, specifically more frequent and extreme flooding, and this can be expected to continue and even amplify. With this expected shift in temperatures, as well as increased rainfall, it could mean unpredictable site conditions at Windmill Point or a transition to different flora and fungi. These projections also reinforce the need for flexibility and room for spontaneity in design. A landscape that can move and flow with changing patterns as opposed to concrete-laden attempts at submitting it to human will should be explored.

Fig. 47. Ice shove
Wm. Notman & Son, 1884, McCord Museum, VIEW-1498

Fig. 48. View today
Author, 2021

Fig. 49. Superimposed photos
Author, 2021

Fig. 50. Ice shove on Victoria bridge abutment
Alexander Henderson, 1873, McCord Museum, MP-0000.1452.62

Fig. 51. Snow piles in parking lot
Author, 2021

Fig. 52. Superimposed photos
Author, 2021

Fig. 53. Ice shove on railway tracks
Harry Sutcliffe, c.1935, McCord Museum, M2011.64.2.5.42

Fig. 54. Snow drifts on railway tracks
Author, 2021

Fig. 55. Superimposed Photos
Author, 2021

Fig. 56. Ice shove at City Hall
Alexander Henderson, 1873-4, McCord Museum, MP-0000.1452.49

Fig. 57. Present day artificial beach
Author, 2021

Fig. 58. Superimposed Photos
Author, 2021

Fig. 59. Montreal wharves in winter
Alexander Henderson, c.1865-75, McCord Museum, MP-0000.1452.50

Fig. 60. View today, Pointe-a-Callière Museum and tracks
Author, 2021

Fig. 61. Superimposed photos
Author, 2021

Fig. 62. Innondation rue Des Commissaires
Leclerc, 1886, Archives Montreal, VM94-Z1807

Fig. 63. View today, Bonsecours Market
Author, 2021

Fig. 64. Superimposed photos
Author, 2021

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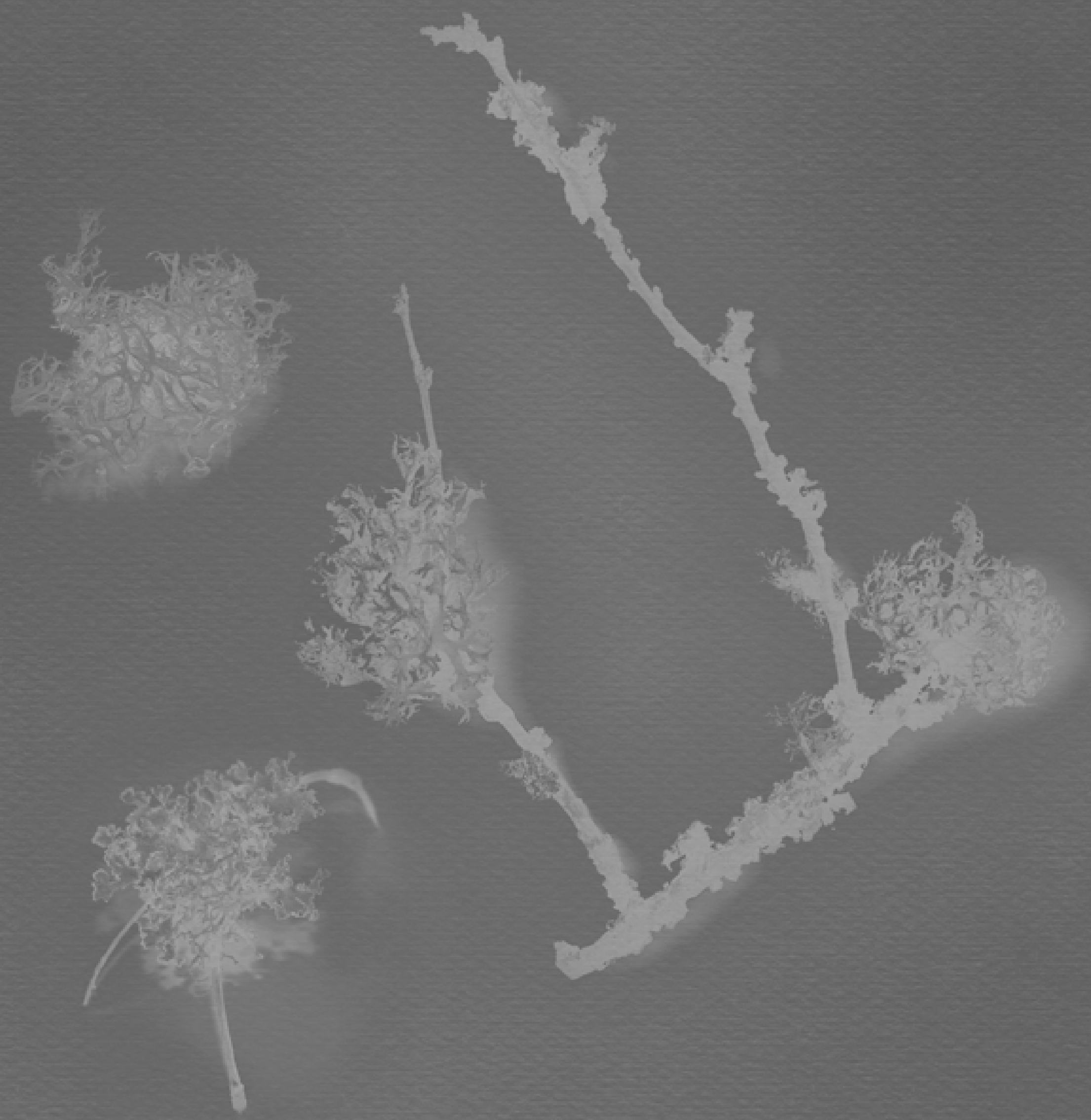
part three

BREAKING COURSE



“Certainly, orthodox ‘Western’ understandings of nature feel inadequate to the kinds of world-making that fungi perform. As our historical narratives of progress have come to be questioned, so the notion of history itself has become remodelled. History no longer feels figurable as a forwards-flighting arrow or a self-intersecting spiral; better, perhaps, seen as a network branching and conjoining in many directions. Nature, too, seems increasingly better understood in fungal terms: not as a single gleaming snow-peak or tumbling river in which we might find redemption, nor as a diorama that we deplore or adore from a distance – but rather as an assemblage of entanglements of which we are messily part.” [1]

- Robert Macfarlane, Underland

Unearthing

In “Understorey”, a chapter within *Underland* which explores the realm of fungi, Robert Macfarlane recalls a haunting descriptor: *the kingdom of the grey.* “It speaks to fungi’s otherness – the challenges they issue to our usual models of time, space and species.” [2] Fungi are everywhere but rarely noticed unless you train your eye to look for them. They can sustain or attack, build or decompose, and act as silent companions to cycles of decay and renewal. Fungi made the leap from water to land over one billion years ago, modern fungi are the culmination of an incredibly rich evolution. Having developed the ability to secrete acids and enzymes to absorb nutrients or mine minerals, these first colonizers of space ventured into the hostile prehistoric landscape and created the nutrient rich conditions for the lushly forested world our species has thrived in.[3]

By mining minerals from stone, fungi set off the creation of soil in an otherwise barren landscape and formed a first symbiotic relationship with algae, the ancestor of modern plants, by trading minerals for photosynthesized sugars, thus enabling the terrestrialization of plants. [4] It is estimated that more than ninety percent of modern plants rely on my mycorrhizal fungi which form a vast underground network connecting plants to each other and to nutrient sources through symbiotic relationships.[5] Mycorrhiza are connected to mycelium, which is the vegetative mass of the fungal organism while mushrooms are their fruiting bodies. A 115-million-year-old fossil found in Brazil, has shown that mushrooms have had their typical current form of cap, gills, and stem for at least as long.

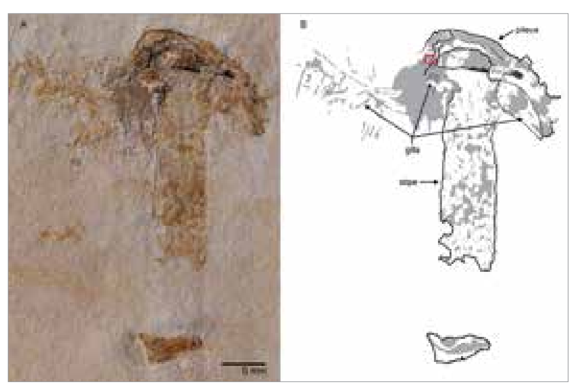


Fig. 65. Photo & drawing of 115 m.y.o. fungus fossil
Jared Thomas, Danielle Ruffatto, 2017, U. of Illinois

A mysterious 420-million-year-old fossil unearthed in 1859, would have to wait until 2007 to be identified as a giant fungus. Named *prototaxites,* the mushroom was first discovered by Canadian paleontologist John William Dawson on the shore of Gaspé Bay in Quebec and have since also been found in Saudi Arabia and Australia. [6] They are believed to have been "widespread across the landscapes of the Paleozoic era" and by far the largest organisms on land, towering over 8 meters tall.[7] Dominating for approximately 50 million years, *prototaxites* was eventually supplanted by trees and larger plants. Fossil records indicate that after a major cataclysm 250 million year ago set off a mass extinction of plant and animal life, fungi once again brought about the eventual proliferation of life by devouring the dead and creating new conditions for life. This cycle would be repeated after a cataclysm 65 million years ago set off another mass extinction which included the end of dinosaurs and made way for the age of mammals.

Fungi have adapted to survive extreme conditions and cycles of dramatic environmental change; they are often the first organisms to return to a site after a disaster as well. Our limited understanding of them today indicates we have only begun to appreciate their complexity and abilities. As a network, fungi are uniquely positioned to adapt, expand, and retreat when facing new threats. They can create a host of chemicals to respond to new needs, some of which form the basis of our most valuable medicines.

Fig. 66. Prototaxites - Artist rendering
David Marshall, 2016, Palaeocast

Lichen, are a fascinating category of fungi which defy our traditional understanding of individuality. They are a composite organism which live in symbiosis with species of algae, in fact, the word symbiosis was invented to explain this new-found relationship in 1877 by the German botanist Albert Frank.[8] The discovery of a mutually beneficial relationship in nature and "the prospect that a single organism could contain two separate lineages" in an age where evolutionary thought favoured ideals of conquer and 'survival of the fittest', would have been quite remarkable.[9] As Merlin Sheldrake a biologist and author of the book *Entangled Life: How Fungi Make our Worlds, Change our Minds, and Shape our Futures,* put it, "the closer we get to lichens, the stranger they seem".[10]

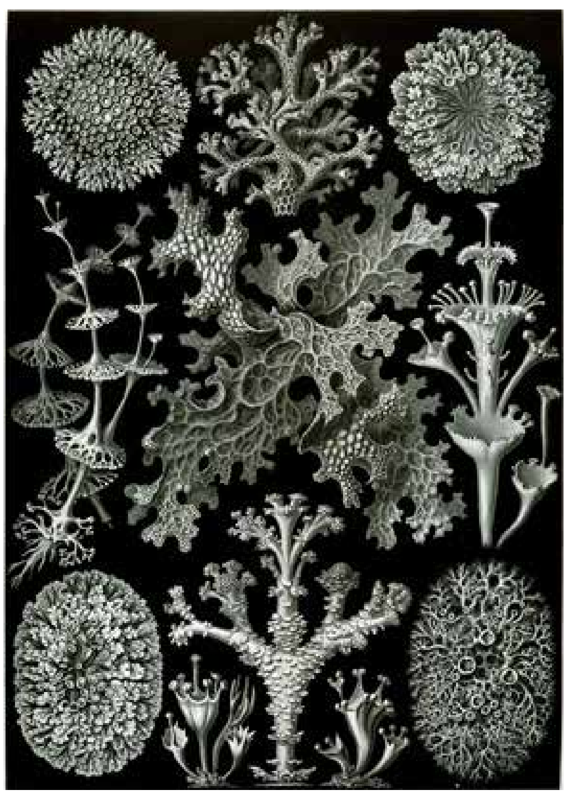
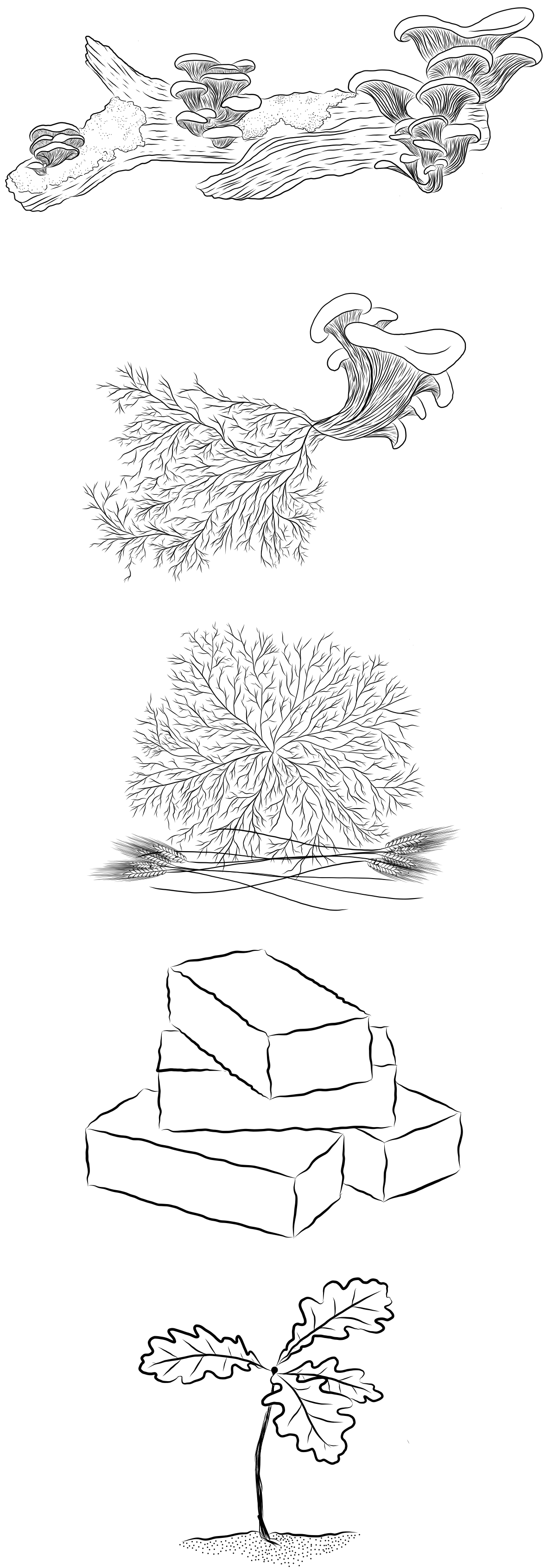


Fig. 67. Various Species of Lichen
Ernst Haeckle, 1904, Art Forms in Nature, Plate 83

Fungi become lichen through a process known as lichenization, some of these symbiotic relationships have evolved over millions of years to create the elaborate forms we typically think of today. Some fungi will even delichenize or will switch between living as lichen or living as an individual fungus. Studies have shown that "fungi and algae come together at the slightest provocation" to become a lichen, the only criteria seems to be that they each have something to offer the other.[11] By introducing new species to each other, you therefore run the possibility of creating a new connected lifeform. While lichen prefer unpolluted air conditions[12] they can survive the harshest and most extreme terrestrial and extraterrestrial conditions.

Various experiments have brought them to space, frozen them in liquid nitrogen, hit them with twelve thousand times the human lethal dose of radiation, dehydrated for a decade, and still managed to resuscitate them to their regular functionality afterwards.[13] When conditions are unfavourable, they become dormant until the tides change in their favour, suspended in a half life, covering an estimated eight percent of the earth's surface. They cover trees, stones, and buildings to "mine minerals from rock in a twofold process known as "weathering." First, they physically break up surfaces by the force of their growth. Second, they deploy an arsenal of powerful acids and mineral-binding compounds to dissolve and digest the rock. Lichens' ability to weather makes them a geological force."[14] It also means that while seemingly innocuous, the fungi and lichen currently present on the site, the ones that cling to concrete or anchor onto rusting debris, are already transforming the site.



Pleurotus ostreatus living on a log

Representation of mycelium under visible mushroom

Mycelium added to substrate

Substrate moulded into structural form

Bricks biodegrade and return to the earth as nutrients for new life

Fig. 68. Life cycle of mycelium
Author, 2021, (Work in progress)

Radical Mycology

Radical Mycology is the title of a book and project by Peter McCoy which seeks "to create a people's mycological movement that is not only versed in the cultivation of fungi and the applications of mycology, but also in how to actively and significantly contribute to the advancement of the science as a whole." [15] Amateur mycologist such as McCoy have been experimenting at home to develop the field of mycology by testing new ways of growing fungal cultures and testing fungal solutions such as mycoremediation (bioremediation with fungi).[16] In learning about the movement, Merlin Sheldrake, discovered that the non-institutionalized nature of groups and movements such as Radical Mycology had more to do with the unavailability of institutional interest and funding than disregard or contempt for them.

Mycology is still very much in its infancy and because fungi can be difficult to control and predict outside of controlled laboratory conditions, they are not the most attractive investment. Bioremediation for example, is often "undertaken by reluctant companies under pressure to fulfill a legal obligation" who have no vested interest in experimental fungal solutions.[17] However, "in principle, fungi are some of the best-qualified organisms for environmental remediation. Mycelium has been fine-tuned over a billion years of evolution for one primary purpose: to consume." [18] Some grassroots examples of mycoremediation include CoRenewal, an organization researching the use of fungi to remediate toxicity resulting from crude oil extraction in the rainforest and harmful rainwater runoff following wildfires,[19] or Paul Stamets' MycoBooms™ which are floating mycelium buoys intended to clean up after oil spills.[20]

Outside of mycoremediation research and trials, there has also been a number of more commercially minded applications. MOGU, for example, manufactures highly designed mycelium-based acoustic panels and flooring.[21] Loop sells the Loop Cocoon, a mycelium coffin which accelerates bodies

Fig. 70. Mycelium acoustic panels
MOGU

Fig. 69. MYLO mycelium leather x Stella McCartney
Bolt Threads' MYLO, design by Stella McCartney, 2021

Fig. 71. Mycelium packaging
Ecovative for Origins

decomposition process with the intention of returning our bodies to the earth to create new life through our bodily nutrients instead of traditional interments.[22] In fashion, BoltThreads has developed Mylo™ mycelium leather and Microsilk™, a silk-like textile created by bioengineering yeasts.[23] Ecovative Design has developed a number of mycelium based materials with different applications and support a growing licensing network including partnerships with IKEA and Dell. Their current products include MycoFlex™, a mycelium-based foam, MycoComposite™ mycelium packaging to replace Styrofoam, and Forager™ hides, a leather-like material as an alternative to traditional animal hides and vegan leather made of plastic.[24] They are currently working on scaling Mushroom Insulation, a mycelium based rigid board insulation material.[25]

In architecture, there have been a number of mycelium-based projects raging in scale, the largest being Hy-Fi for MoMA's PS1 by The Living Studio in 2014. Due to the biodegradable nature of mycelium, projects have either been temporary or shielded from the elements. Redhouse Architecture, for example, have been researching using pulverized construction waste as substrate to create new mycelium structural materials which would be shielded inside wall cavities.[26] The early performance success of mycelium based products and materials suggests it will continue to be developed and scaled up, particularly given the increasingly pressing awareness that current consumption of polluting non-renewable, recyclable, or biodegradable materials is frighteningly unsustainable. This awareness generates a creative drive for innovative products as well as a consumer market thirsty for goods which are both *green* and luxurious.

While this thesis embraces these necessary material advancements, it is more curious about how a shift in materiality might reframe our understanding of the built environment. When you use materials that are outside the typical scope of industrialization, do you try and fit fungi and mycelium into the mould of the current economic system or can it be a gateway to a new way of thinking about building and the long-term impacts of humans on deep cyclical processes? By accounting for the entirety of fungi's life cycle and the lasting traces it would leave on the otherwise seemingly permanent man-made modifications brought to Windmill Point, its hope to open up a conversation on subnatures, designed decay, and a reorientation away from anthropocentric solution-based interventions.

Mycelial Materiality

This chapter presents a series of material tests which were carried out over the course of the thesis to enable a familiarization with mycelium as an independent material which has been isolated from its typical environment and tested under different conditions. These experiments present some of the challenges of creating materials out of living organisms which a habit of spontaneous co-living as well as some of the opportunities for its application. The focus was on testing a couple different substrates with *Pleurotus ostreatus* mycelium and then following the different journeys of inoculation, fruiting, dehydration, exposure to wetness, and decay. *Pleurotus ostreatus* was the chosen fungus because it is one of the most used mycelia for both mycoremediation and material creation. It fruits oyster mushrooms, which you can readily find at grocery stores or growing on fallen logs in yards, parcs, and forests in Quebec and elsewhere.

TEST ONE

The first test was an attempt at seeing just how easy growing mycelium could be. Spent coffee grounds are frequently used as a substrate for growing mushrooms since they are an organic waste product and retain most of their nutritional value after the coffee has been brewed. Coffee grounds from an espresso machine were collected in a jar over a couple days. Attempts were made at breaking these up to let heat and moisture out rapidly and then a lid was placed on top to limit incoming bacteria and mould fungi (when espresso pucks are left in knock boxes uncovered, it typically only takes 3-4 days before mould growth becomes visible).

Oyster Mushrooms were purchased from a local grower in Montreal who also uses spent coffee beans in their production. Two small pieces were then cut from the base of mushroom cluster and placed in the jar with the lid loosely on to permit some air circulation. Mycelium did grow, but so did other species of fungi. After 3 days, the small jar was teeming with colourful life. Considering this an educational failure on the importance of somewhat sterile environments, the jar was sealed and placed aside where it died off and the oyster mushroom pieces decomposed.

This experiment had been conducted to test the limits of growing mycelium in a non-sterile environment to better understand the level of control required in the initial growing phase of mycelium. It confirmed that any mycelium used at Windmill Point would have to be grown in more sterile and controlled conditions before being exposed to exterior elements. Otherwise, the mycelium risks moulding before achieving structural viability.

Fig. 74. Test 1 - Spent coffee ground
Author, 2021

Fig. 72. Test 1 - After 4 days
Author, 2021

Fig. 73. Test 1 - After 2 months
Author, 2021

TEST TWO – STAGE ONE

Building off the first experiment, a second test was devised which employed greater control over the growing environment but remained short of full laboratory conditions. First, an Oyster mushroom growing kit was purchased from a local mycology store, *Mycoboutique*. This growing kit includes a sterilized mixed-composite substrate which had been moistened and inoculated with *Pleurotus ostreatus* mycelium. Hemp straw was also purchased as an additional substrate to inoculate.

Once the mycelium had fully colonized the contents of the growing kit, the additional substrate was prepared. Two porous bags of hemp straw, with slightly different densities, a bag of cardboard pieces, and a bag of cracked wheat were set to boil for three hours to sterilize. Simultaneously, some of the purchased substrate from the growing kit was broken into pieces and moulded into six cubes to create mycelium bricks.

Next, alternating layers of inoculated substrate and new sterilized substrate were placed in three sterilized jars and covered with plastic film puncture with small holes to provide a flow of oxygen while limiting the possibility of exterior contamination. These were left in a dark temperate place and monitored over 10 days.

Fig. 75. Test 1 - Sterilizing substrate
Author, 2021

Fig. 76. Growing Kit
Author, 2021

Fig. 77. Mycelium growth over 10 days
Author, 2021

Fig. 78. Mycelium cubes
Author, 2021

TEST TWO – STAGE TWO

None of these jars grew anything other than *Pleurotus ostreatus.* Once fully inoculated, jars A and B, which contained only hemp straw as secondary substrate, were moulded into 7 cylinders, covered with a punctured lid and left once again to inoculate in their new form. The cylinders were removed from their moulds approximately 48 hours from each other to observe different growing densities. The longer they remained in the mould, the thicker the layer of mycelium had become. The mycelium grew surprisingly quickly, though predictably, those which had been left to grow longer in the cylinder mould grew a denser layer of mycelium.

Once removed from their casings, some of these were then left to air dry in the open air while others were placed in a larger enclosed space with controlled humidity to test if they would continue growing, which they did. Here, oxygen flow and humidity levels showed themselves to be the key determining factor in the formation of mushrooms, continued mycelium growth, or drying out.

This experiment demonstrated a possible balance between controlled laboratory conditions and more informal home growing of mycelium bricks. However, it also established the necessity for further research into substrates, particularly the necessity of achieving an appropriate substrate density in addition to adequate inoculation to produce a brick which could be considered structural. While relatively strong under compression, the resulting bricks from this experiment were incredibly lightweight since coarsely cut straw was used as the primary substrate and the mycelium had not created enough density to withstand serious forces, particularly bending or shear forces.

Fig. 81. Removed from mould March 9
Author, 2021

Fig. 79. Removed from mould March 11
Author, 2021

Fig. 80. Removed from mould March 13
Author, 2021

Fig. 84. Removed from mould March 14
Author, 2021

Fig. 82. Removed from mould March 15
Author, 2021

Fig. 83. Removed from mould March 18
Author, 2021

Fig. 85. Test one - Phase two
These seven hemp straw mycelium bricks were innoculated for different lengths of time. Longer innoculation time meant more dense mycelium was formed while a lack of oxygen for some of the forms (which had been wrapped in plastic film) led to a yellowed appearance.
Author, 2021

Fig. 86. Initial growth
This mycelium brick was left to continue growing in a humid environment. Mushrooms began to form but remained limited because of an apparent lack of oxygen.
Author, 2021

Fig. 87. More growth

A second mycelium brick was left to continue growing in a humid environment. Mushrooms began to form but remained limited because of an apparent lack of oxygen.
Author, 2021

Fig. 88. Superimposed growth
These bricks were later superimposed and left to continue growing. A bond formed between the two and more mushrooms began to grow.
Author, 2021

TEST TWO – STAGE THREE

The third stage involved placing two live (not yet dried out) cubes side by side. The purpose of this was to test how live bricks might react to each other when arrayed into a structure at Windmill Point. These were left in non humidity-controlled conditions and spritzed with water everyday to mimic warm weather conditions at Windmill Point and the effect of daily dew. After a couple days, a visible mycelium connection had been formed where the two bricks met. Because of the slightly rounded edges of the cubes, owing to the soft silicone mould in which they had been formed, this connection only formed at the center where the surfaces were touching. It suggested however, that had a more symmetrical mould been used to create flat surfaces, a more complete bond would have formed.

Next, one of the now-dried cubes was placed in a glass jar filled with water to observe buoyancy, decomposition, and possible mushroom growth. This experiment informed the decision to place two of the proposed mycelium interventions at Windmill Point in the water. Further experimentation would be required to understand mycoremediation properties and structural strength when subjected to moving water. By day two the water had yellowed, likely due to releases from the substrate, but had otherwise remained unchained. By day six, a mycelium growth ring was visible on the water surface and tiny mushrooms had began to grow. By day ten these mushrooms were fully formed and their weight had begun to sink the floating cubes so that they were partially submerged. At the time of writing, it has been sixteen days, the mushrooms are still alive and almost entirely submerged. A green mould has begun to form on the exposed peak of the cube.

The implications of this for a proposal at Windmill Point is that any mycelium structure with regular water submersion is likely to sprout mushrooms, but also other moulds, particularly if submerged in stagnant water. A second consideration is the necessity and role of a secondary structural system to support the more rapidly decaying mycelium bricks. Any water-based installation would have a shorter lifespan than those in drier conditions as well.

Fig. 89. Merging bricks - Day 1
The mycelium bricks are removed from their mould and placed next to each other.
Author, 2021

Fig. 90. Merging bricks - Day 5
The bricks have started to dry and have yellowed, a bond has formed between the two bricks where the previously seperate bricks had touched. Pinheads (baby mushrooms) have begun to form.
Author, 2021

Fig. 91. Merging bricks - Day 8
Small oyster muchsrooms have begun to grow on one of the bricks. Pinheads remain on the other brick along the base where conditions remained more moist.
Author, 2021

Fig. 92. Merging bricks - Day 10
The mushrooms have continued growing but the pinheads remain small, suggesting the bricks are consentrating nutrients and efforts towards the right.
Author, 2021

Fig. 93. Merging bricks - Day 13
The mushrooms have continued to grow but begin to dry and split around the edges, suggesting conditions are too dry.
Author, 2021

Fig. 94. Merging bricks - Day 21
Daily watering has stopped and the mushrroms and pinheads have completely dried out.
Author, 2021

Fig. 95. Pleurotus ostreatus detail
Author, 2021

Fig. 96. Water jar - Day 1
Mycelium brick is placed in water, it floats.
Author, 2021

Fig. 97. Water jar - Day 2
The water has begun to yellow but is otherwise unchanged.
Author, 2021

Fig. 98. Water jar - Day 4
The water has yellowed more and small pinheads have begun to form along the surface of the water.
Author, 2021

Fig. 101. Water jar - Day 7
Mushrooms have grown along the surface of the water and mycelial filaments are visibly branching out from the brick.
Author, 2021

Fig. 100. Water jar - Day 11
The water has continued to yellow and the mushrooms have continued to grow. The added weight has begun to tip the brick, submerging the base of the mushroom cluster. Mycelial filaments have also continued growing and a small amount of mould has become visible.
Author, 2021

Fig. 99. Water jar - Day 18
The brick is still flowting but has toppled further to the side from the weight of the growing mushrooms, which are now significantly decayed and covered in multiple mould species.
Author, 2021

What these experiments have offered is first-hand experience of the predictable and unpredictable outcomes of mycelium as an isolated material. They suggested that while mycelium is easy to grow, more controlled conditions and studies are necessary to achieve a brick which could be used as a structural material. Inadequate and uneven inoculation produced bricks which were able to maintain their form when exposed to water or moisture but remained too brittle if subjected to force. While only one fungal species was tested, it confirmed the diversity of possible substrates. Variety in aesthetics and properties (namely strength and mass) was achieved through variety of substrates and inoculation time. Predictably, the bricks which had been inoculated longer had grown more evenly.

If removed from their casing and left to continue inoculating in a humidity-controlled environment, the growing process continued and formed a thicker coating of mycelium around the substrate and the occasional mushroom. Live bricks placed next to each other would form a bond between themselves to share nutrients. The most important determining factor to have presented itself was moisture, seconded by oxygen. If contained within a sterile environment moisture meant continued growth whereas moisture in uncontrolled environments invited passing mould fungi to take root. Oxygen was also necessary for continued growth; insufficient ventilation stunted mushroom growth and yellowed the appearance of the mycelium whereas excessive ventilation meant the fungus would dry out due to lack of moisture.

The simplicity with which life was initiated and difficulty with which it was controlled affirmed many of the ironies and complexities of working with organic materials. The hope is that when this desire to control meets non-human agency, a conversation can happen on anthropogenic impacts and short and deep cycles of change while contributing to the knowledge base of sustainable material possibilities. The vision that these mycelium tests has opened is one in which architecture can begin to act like fungi in its adaptability and connection to broader environmental conditions and actors. A vision which blurs the line between singular organisms, positive and negative actors, living and decaying. It is also one in which *post-mortem* traces reverberate life rather than contributing to the stockpiles of toxicity and spent usefulness in linear understandings of newness and material improvement.

Blurring the Line

Our emphasis on measurability and scientific methodology has meant studying things in a vacuum. Often, our concern ends at the edge of the map, the edge of our research field, or the edge of what we have measured. The solutions we have come up with and the spaces we have made also reflect this. Every solution appears to entail another eventual problem. There is unlikely to be any singular solution to the site's problems, rather, this thesis proposes to use fungi as a means of re-framing and blurring the lines between the dichotomies held *vis a vis* humanity and nature and to place ourselves via our built environment in the slow stories of making and unmaking.

Robert Macfarlane wrote that "at its best, a deep time awareness might help us see ourselves as part of a web of gift, inheritance and legacy stretching over millions of years past and millions to come, bringing us to consider what we are leaving behind for the epochs and beings that will follow us." [27] This thesis hopes to help achieve this with a fungal-centric design. For Merlin Sheldrake, fungi are a realm where dichotomies begin to fall apart. When talking about yeasts in his book *Entangled Life,* he notes how their "transformational power blurs the line between nature and culture, between an organism that self-organizes and a machine that is built." [28] So many of the divisions we take for granted start to fall apart when we look at fungi.

Fungi do not fit into the typical ideals of our society; they are difficult to measure, control, and understand. Sheldrake attributes the relative infancy of mycology and fungal solutions in part to this unpredictability. [29] "Just because a given fungal strain behaves in a certain way in a dish doesn't mean it will do the same thing when introduced to the rumpus of a contaminated ecosystem."[30] There is an interesting parallel to be drawn between the erratic and spontaneous nature of fungal strains found in or introduced to complex environments and the way in which James C. Scott describes the relationship between State orchestrated plans or maps and the messy, improvised reality of ground conditions. Scott argues that modern Western statecraft is characterized by a devotion to "rationalizing and standardizing what was a social hieroglyph into a legible and administratively more convenient format".[31] The observed disastrous "state-initiated social engineering" includes an "administrative ordering of nature and society" as well as high modernist ideology which is best conceived as a strong, one might even say muscle-bound, version of the self-confidence about scientific and technical progress, the expansion of production, the growing satisfaction of human needs, the mastery of nature (including human nature), and, above all, the rational design of social order commensurate with the scientific understanding of natural laws. [32] However, Scott argues, this ordering and planning by States have failed in that they make no allowances or suppression plans for the necessary and inevitable improvisations that arise in real-world conditions with its complex societies and ecosystems.[33]

Much as authorities might attempt to achieve and present environments or societies in their jurisdiction as adhering to carefully calculated formulae based on scientific principles, once removed from the cartographic scale, the reality is a lot less orchestrated. This thesis attempts to embrace that by working spontaneity into the design process. The following chapter presents a more speculative design proposal for Windmill Point. Part of this process involves working through and trying to negotiate the ironies that architectural drawing plays in these large scale simplifications and their promise of static social betterment. The first stage of this process involves a series of plans and sections to illustrate the intent behind the design. The second stage involves deconstructing some of this through a series of perspectives by imagining the ground conditions once the temporal aspect and free-flowing agency of fungi have acted in this story of making and unmaking.

Endnotes

1 Robert Macfarlane, *Underland: A Deep Time Journey* (London: Hamish Hamilton, 2019), 103.

2 Macfarlane, 101.

3 Paul Stamets, *Mycelium Running: How Mushrooms Can Help Save the World* (Berkeley: Ten Speed Press, 2005), 2.

4 'CBC Gem - The Nature of Things - The Kingdom: How Fungi Made Our World', accessed 15 February 2021, /media/the-nature-of-things/season-57/episode-16/38e815a-00e3ed7c794.

5 Merlin Sheldrake, *Entangled Life: How Fungi Make Our Worlds, Change Our Minds & Shape Our Futures*, First edition (New York: Random House, 2020), 10.

6 'Prehistoric Mystery Organism Verified as Giant Fungus', accessed 10 March 2021, http://www-news.uchicago.edu/releases/07/070423.fungus.shtml.

7 Stamets, *Mycelium Running*, 6.

8 Sheldrake, *Entangled Life*, 78.

9 Sheldrake, 79.

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11 Sheldrake, 92.

12 S C Fabius LeBlanc and Jacques De Sloover, 'Relation between Industrialization and the Distribution and Growth of Epiphytic Lichens and Mosses in Montreal', *Canadian Journal of Botany* 48 (1970): 1485–96.

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15 Peter McCoy, *Radical Mycology: A Treatise on Seeing & Working with Fungi* (Portland, Oregon: Chthaeus Press, 2016), 19.

16 Sheldrake, *Entangled Life*, 192.

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18 Sheldrake, 189.

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27 Macfarlane, *Underland*, 15.

28 Sheldrake, *Entangled Life*, 24.

29 Sheldrake, 190.

30 Sheldrake, 189.

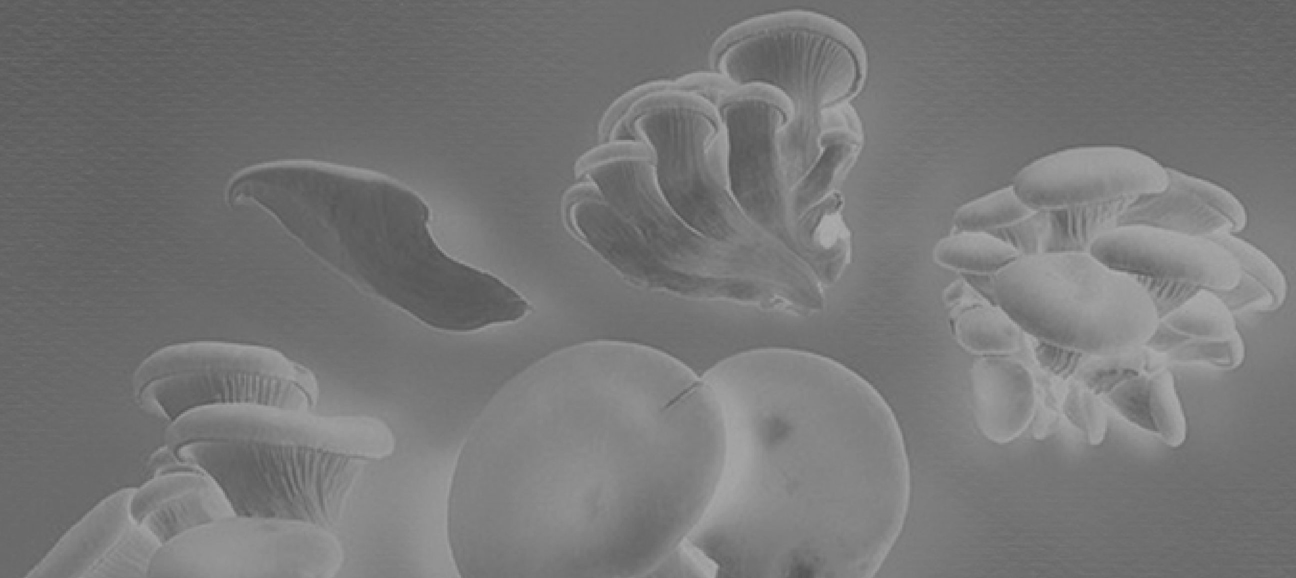
31 James C. Scott, *Seeing Like a State: : How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1999), 19.

32 Scott, 20.

33 Scott, 22–23.

part four

THE GREY



Making worlds is not limited to humans. [1]

- Anna Tsing, The Mushroom at the End of the World

Determining Course

When detailing the emergence and course of *ecological design*, broadly defined by an interest in replicating natural systems in architecture, Lydia Kallipoliti notes that this was accompanied by a "realization that any designed product, space, or environment has an expansive presence in the world" which "projects and extends the presence of all things relative to larger environmental forces and the nexus of global flows." [2] This relates to the work of Anna L. Tsing which presents *frictions,* or the "unexpected and unstable aspects of global interactions", as critical world-making moments which live outside the limiting framework of recognized formal relationships. [3] In her later work, Tsing specifically highlights the connection between economy and environment which make "both humans and nonhumans into resources for investment" resulting in "alienation, that is, the ability to stand alone, as if the entanglements of living did not matter."[4]

This alienation eliminates the presence of interconnections or entanglements in its drive for simplification, a statecraft tool earlier mentioned in the work of James C. Scott. "The dream of alienation inspires landscape modification in which only one stand-alone asset matters; everything else becomes weeds or waste." [5] And once the asset has been exhausted, the site can be abandoned in favour of the next frontier, much like the way Windmill Point and Silo nº5 were dropped once infrastructural advancements in the form of the Saint Lawrence Seaway exhausted the use-value of the wharf at the entrance of a now economically obsolete canal. However, these abandoned frontiers Tsing proposes, can offer up exciting sites of new life and new entanglements. "In a global state of precarity, we don't have choices other than looking for life in this ruin."[6] In *The Mushroom at the End of the World,* she sees the matsutake as emblematic of collaborative survival in disturbed landscapes uses them to explore new ways forward which depart from modernist ideals.

I address the imaginative challenge of living without those handrails, which once made us think we knew, collectively, where we were going. If we open ourselves to their fungal attractions, matsutake [fungi] can catapult us into the curiosity that seems to me the first requirement of collaborative survival in precarious times.[7]

In determining course for a spatial proposal at Windmill Point, this thesis similarly sought to wander outside the limits of more classic approaches to spatial intervention. This site's fascinating overlay of infrastructural networks, mirroring the reaches of the chaotic riverine system and fungal networks, is at the edge of another chapter in its long story of making and unmaking. The speculative proposal runs as an ephemeral intervention, present alongside the eventual 'rejuvenation' of the site into a multi-use site integrated with the circulation, aesthetics, and ideals of contemporary Montreal. Within the framework outlined by Lydia Kallipoliti, this proposal operates somewhere between the *subnaturalists* and what she terms the *living fabricators* insofar as this later group includes mycelium architecture and "involve[s] the blurring of boundaries between living and nonliving entities". [8] Fungi are tested as biological building materials but also as subnatural tools of blurring boundaries, making slow processes of making and unmaking visible, and exploring architecture which actively releases a degree of control to avoid continuous drive towards space as "a pulsing circulatory apparatus." [9]

Fig. 102. Windmill Point site plan with proposed interventions
Author, 2021

Precedents

Hy-Fi, The Living Studio, 2014

Hy-Fi is a pavilion completed for MoMA's 2014 PS1 gallery by The Living studio. The pavilion uses grown mycelium bricks to construct a tripart tower, reminiscent of silos, open to sky to let in light and passively ventilate the interior space through stack effect. As the first large scale outdoor construction using primarily mycelium, Hy-Fi was particularly innovative and interesting for its focus on engineering. The material's thermal and structural properties were tested at Columbia University Laboratory, Arup consulted on engineering, Ecovative tested various combinations of substrate and growth density, and irregularly shaped bricks were designed to interlock. After its intended lifespan, Hy-Fi was dismantled, transported to facility where it decomposed and was then used as compost in various city gardens.[10] This pavilion spearheaded new architectural possibilities for mycelium structures and biodegradable buildings. It also raises questions on how to tighten the closed loop to limit transportation of compost after its initial useful life. It also begs the question of how removing the structure from public view influences or limits the conversation on biodegradable materials and more broadly, on material life-cycle assessments and embodied energy? What role should visible weathering and decay play in design and how might keeping these processes in public view shift consciousness on architecture and construction waste more generally?

Fig. 103. Hy-Fi
Photograph: Kris Graves, MoMA PS1.
Design: The Living Studio, 2014

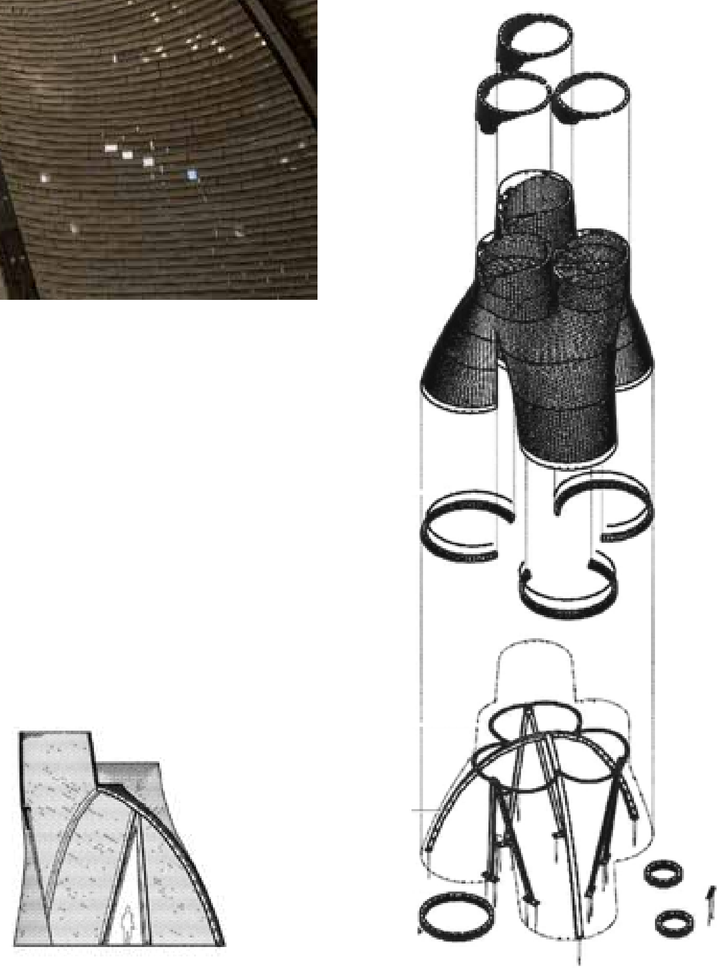
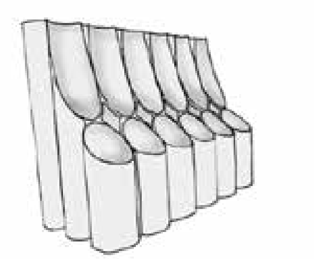


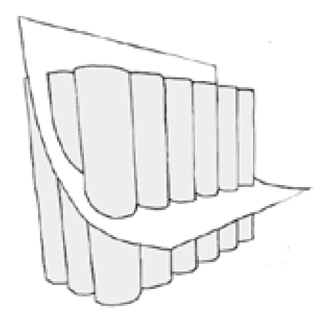
Fig. 104. Hy-Fi architectural drawings
The Living Studio, 2014

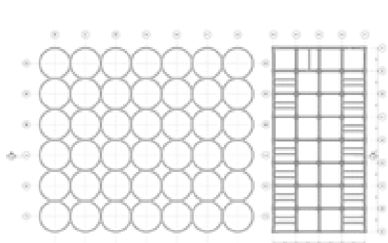
Zeitz MOCAA, Heatherwick Studio, 2011

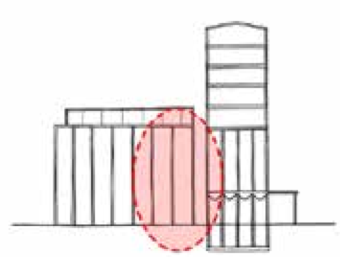
While concrete's durability and ease of application have made it the second most widely used resource on earth after water, it also raises serious environmental and sustainability concerns. Cement production alone accounts for approximately 8% of total annual CO_2 emissions.[11] Finding innovative ways to adapt and reuse old concrete structures is an important step towards a more sustainable future. In Cape Town, South Africa, Heatherwick Studio chose to adapt an old concrete grain elevator complex into a contemporary art museum by carving out large voids in the tightly packed silos to create space for light, movement, and art exhibition.[12]

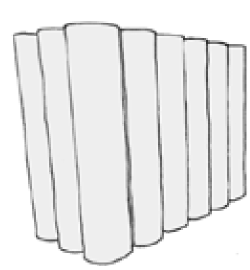
Fig. 105. Zeitz MOCAA photograph and architectural drawings
Heatherwick Studio, 2017











Conical Intersect, Gordon Matta-Clark, 1975

For the Paris Biannale of 1975, artist Gordon Matta-Clark (who had trained as an architect) contributed Conical Intersect. This project literally tunnelled large holes through historic seventeenth century buildings which were slated for demolition to make way for the Centre Georges Pompidou. In so doing, Conical Intersect critiqued urban gentrification and "contemplated the poetics of the civic ruin". [13] The holes also revealed the guts or internal workings of the buildings for pedestrians. The project raises interesting questions for Windmill Point in terms of the value of and relationship between preservation, decay, demolition, and gentrification. What is the role and value of built heritage, or specifically industrial heritage in the case of Windmill Point? How do you negotiate preservation by historical chance, insofar as the existing heritage depended on the destruction of earlier heritage?

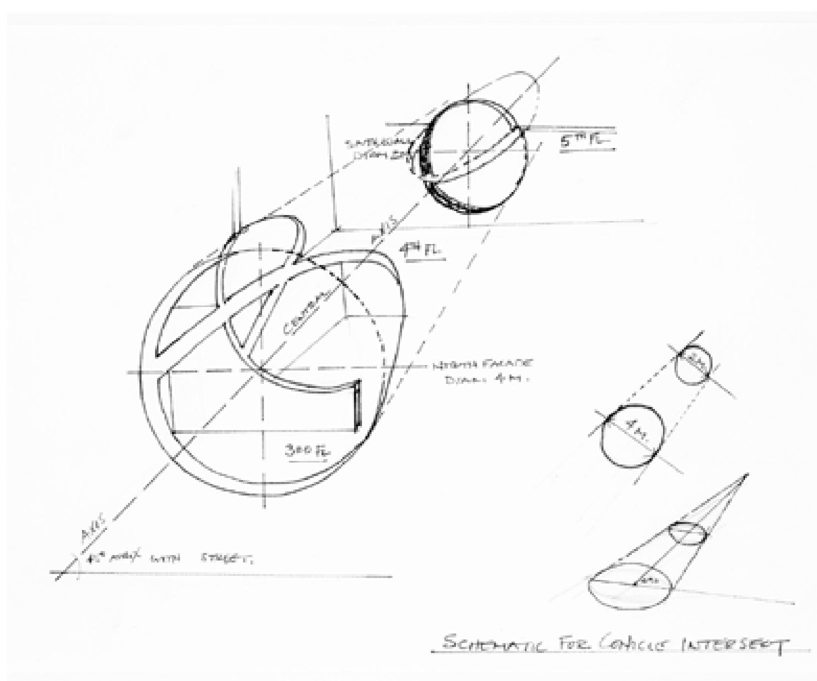


Fig. 106. Conical Intersect
Gordon Matta-Clark, 1975, MACBA ,1878

Fig. 107. Schematic for Conical Intersect
Gordon Matta-Clark, 1975, CCA,
PHCON2002:0016:073

Veg House, Peter Cook, 1996–2001

Consisting of a series of 6 drawings, Veg House explores themes of metamorphosis, boundaries, and hybridity. What begins as a geometric plan of a house, is gradually taken over by vegetation. "By the time of the fourth stage, the filigree nature of many of the growths is replacing the chunky hedges and the language is increasingly that of nuance, ambiguity and the hybrid."[14] Cook's invasive vegetation blurs the lines of architecture. The distinction between enclosure and vegetation breaks down in the way vegetation invades designed space, and that which is an acceptable environment for architecture is turned upside-down vegetation is accompanied by the necessary environment to support it, here, 'crypto-marshlands', as opposed to the architecturally desired dry and controlled environment. There is also the "suggestion that which is growing is also feeding".[15] This is literal in the sense that plants and their fruits nourish us but could also more metaphysically point to the way in which the vegetation feeds off the house by using the structure as scaffolding for continued growth. If we were to place certain fungi in this environment, then this would be taken one step further as they would literally feed off the materiality of the enclosure.

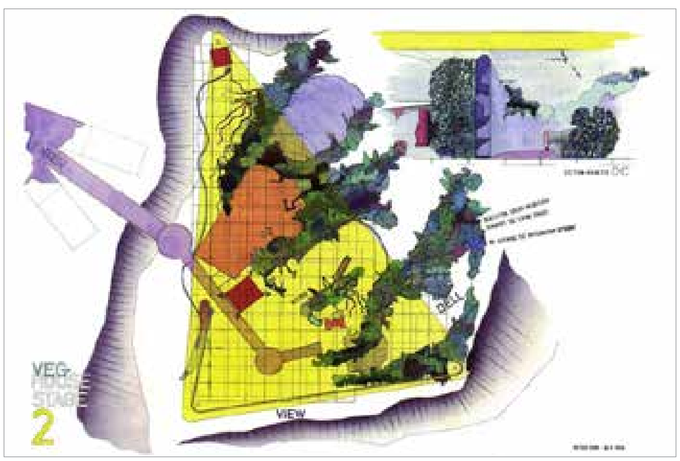
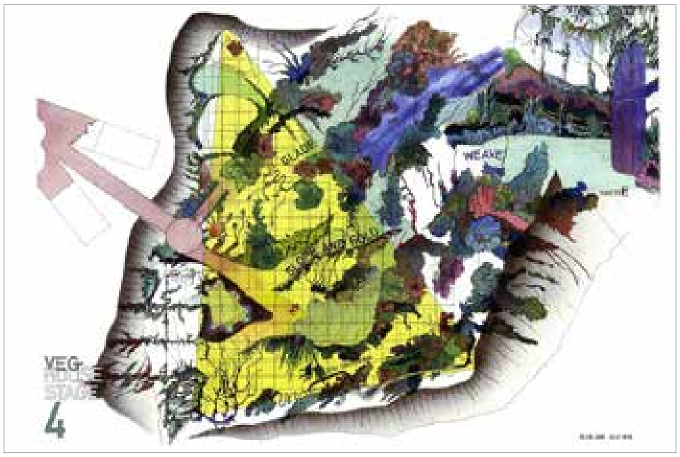


Fig. 110. Veg House, Stage 1
Peter Cook, 1996

Fig. 108. Veg House, Stage 2
Peter Cook, 1996

Fig. 109. Veg House, Stage 3
Peter Cook, 1996



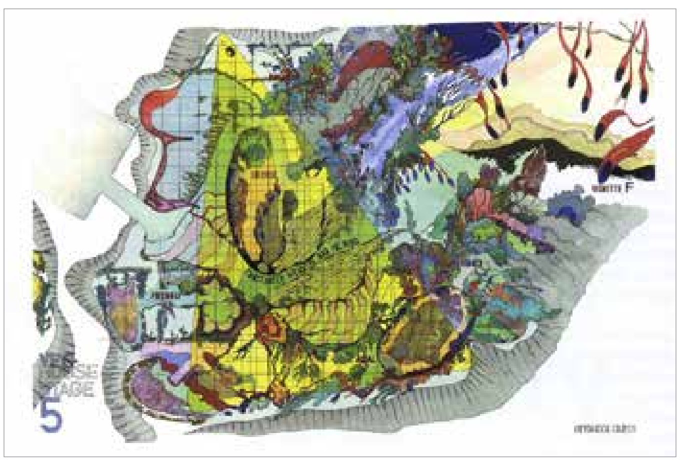


Fig. 113. Veg House, Stage 4
Peter Cook, 1996

Fig. 111. Veg House, Stage 5
Peter Cook, 2001

Fig. 112. Veg House, Stage 6
Peter Cook, 2001

Inviting Fungal Possibilities

The first intervention at Windmill Point focusses on experimentation to help test and discover the material properties of mycelium in outdoor conditions. A series of six monoliths, each with their purpose, will be scattered across the site. The first of these, based on the small-scale experiments discussed in *Mycelial Materiality*, will be a live pillar from which *Pleurotus ostreatus* can be harvested. The second is an investigation of the mycoremediative properties of mycelium when partially submerged in water. Water levels in the basin fluctuate over the year so that at times the base would be submerged and at times on dry infill. Similarly, a third will be located on the boat launch which experiences fluctuations in water levels and is more directly subject to the Saint Lawrence River. A fourth monolith would be composed of different layers, each using a different substrate, while a fifth would have layers of different fungal species to observe how they look, feel, and act out in the elements. A final monolith would be located inside the grain silos to test long term resistance or decay.

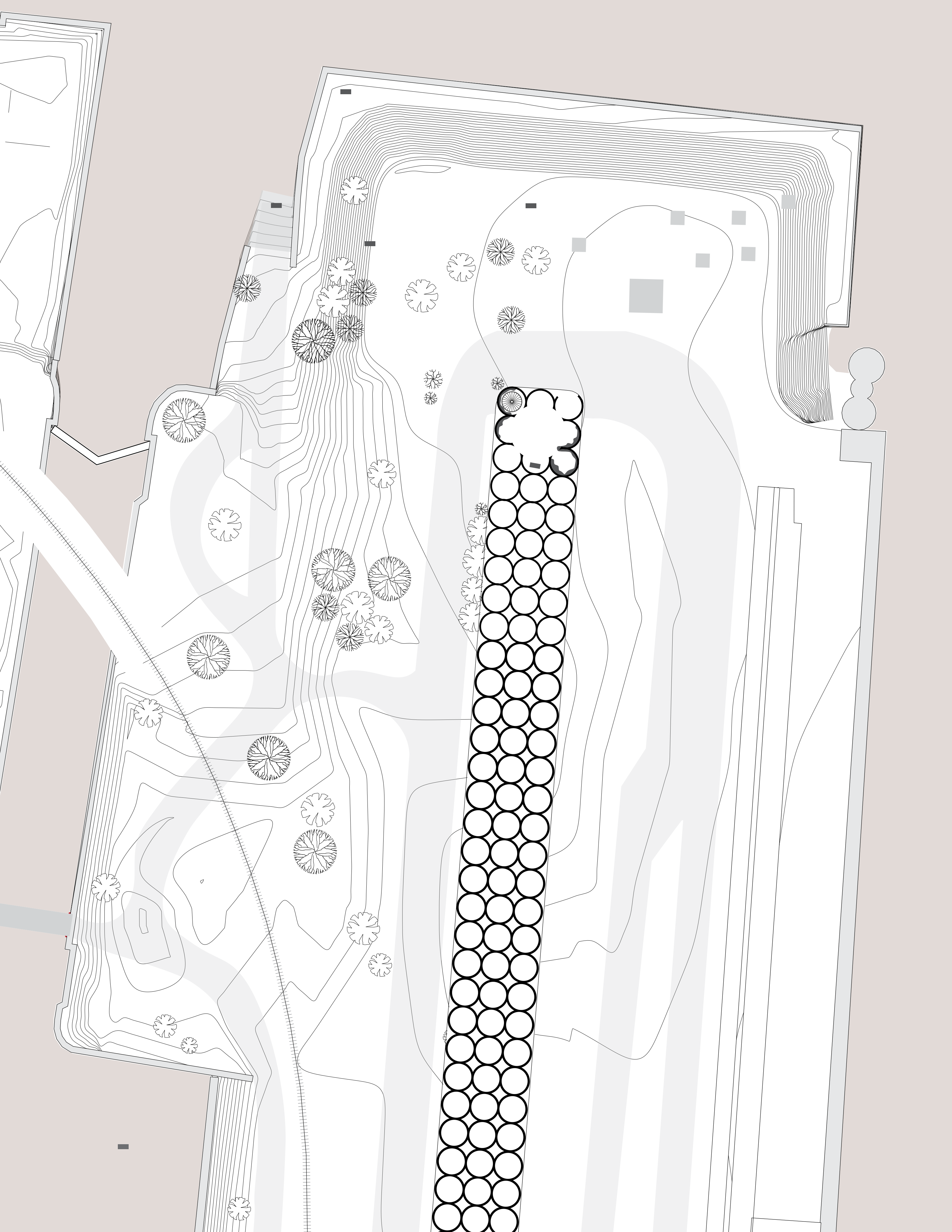
Over time, these monoliths will begin their decay and return to the earth. An adjacent purpose to their varied placement, composition, and exposure to elements is to investigate possible mycoremediation properties. A siloed lab-designed remediation plan is not likely to perform the way we would hope in a complete and exhaustive fashion that would allow us to tick the box indicating the problem has been solved: balanced nature restored. By inviting possibilities of a gradual reduction in toxicity, fungi are left to surprise us with processes and outcomes not yet dreamed up or sought after. Part of the beauty of fungi is specifically their unpredictability and uncontrollability, which are also the elements which make them difficult to commodify and engineer on a large scale. These pillars instead aim at creating a new environment or atmosphere in which mycoremediative strains can proliferate and gradually feed off toxins to improve the environment while reframing distinctions between natural and unnatural, toxic and healthy.

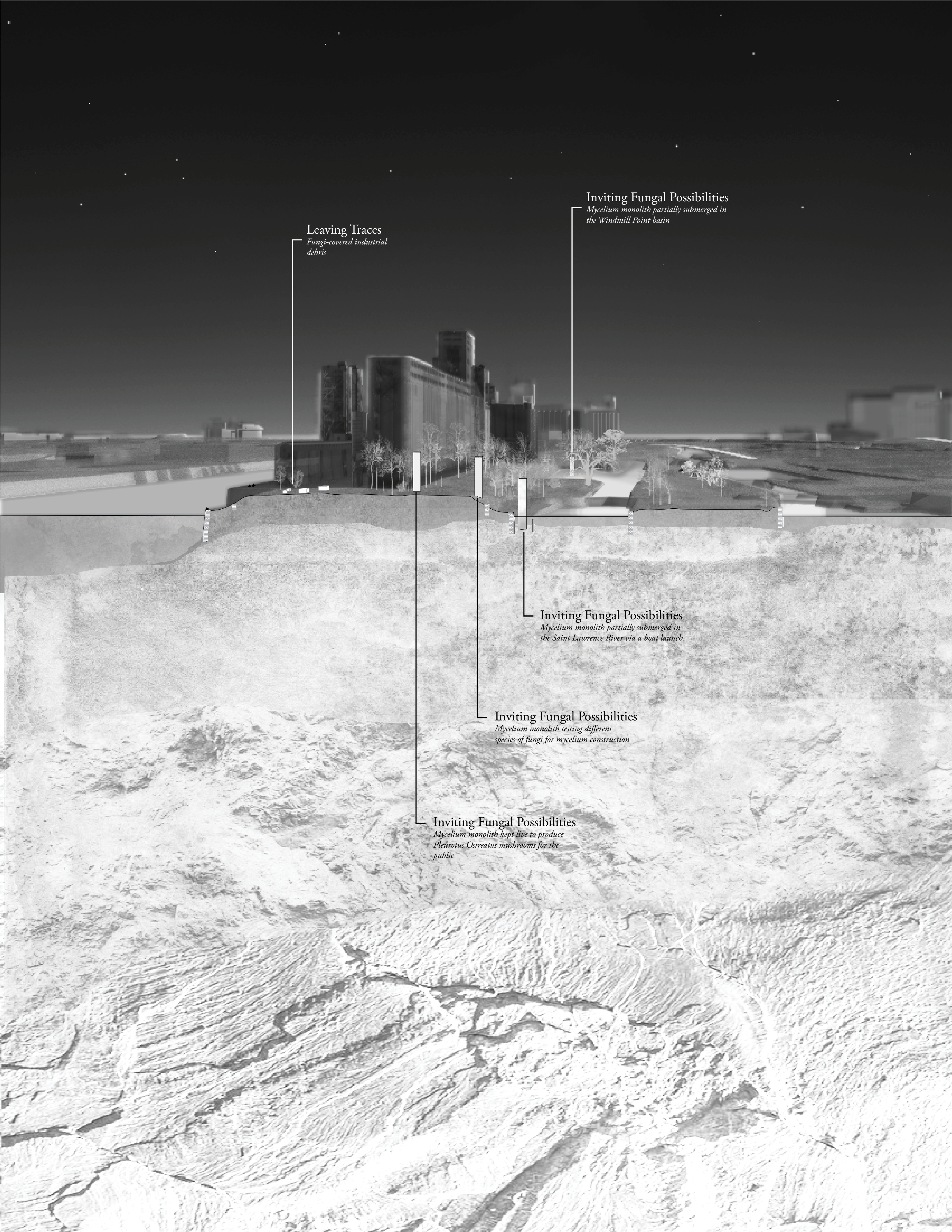
The monolithic shape is in part inspired by the giant *prototaxites* mushrooms that once dominated the landscape. It is also in part inspired by stratigraphic columns and the impact that this imagery, which "became the central representation of deep time", had on the nineteenth century psyche. [16] As detailed in Rosalind William's *Notes on the Underground*, "as imagination reached further into the past, it also leapt further into the future. The sight of the ruins of past civilizations inevitably suggested what the present would be in the future, when what was now on the surface would become part of the buried past. […] The rest of the nineteenth century was haunted by that prospect of future burial." [17] So too are these monoliths intended to remind the visitor of the eventual burial and cyclical nature of the physical world.

The pillars also echo the form of the nearby perpetually more numerous skyscrapers, some of which are built by the same developers who are eventually going to build a series of towers on the site, while also reminding us of their eventual decay. If cloud-grazing towers, successors to the Heaven-reaching Church steeples which had preciously dominated the Montreal skyline, are the monoliths celebrating a culmination of human engineering and consolidation of wealth, then the pillars proposed here hope to be their antithesis. Intending to reflect and mimic in such a way that instead draws attention to material temporality and surrender to processes which are ultimately not in our control. The monoliths are intended to tower over humans and serve as markers which simultaneously invite people to pick the occasional mushroom when in reach.

Following pages:
Fig. 114. Site plan and building section
Author, 2021

Fig. 115. Deep section I
Author, 2021




Inviting Fungal Possibilities
Mycelium monolith partially submerged in the Windmill Point basin
Leaving Traces
Fungi-covered industrial debris
Inviting Fungal Possibilities
Mycelium monolith partially submerged in the Saint Lawrence River via a boat launch
Inviting Fungal Possibilities
Mycelium monolith testing different species of fungi for mycelium construction
Inviting Fungal Possibilities
Mycelium monolith kept live to produce Pleurotus Ostreatus mushrooms for the public

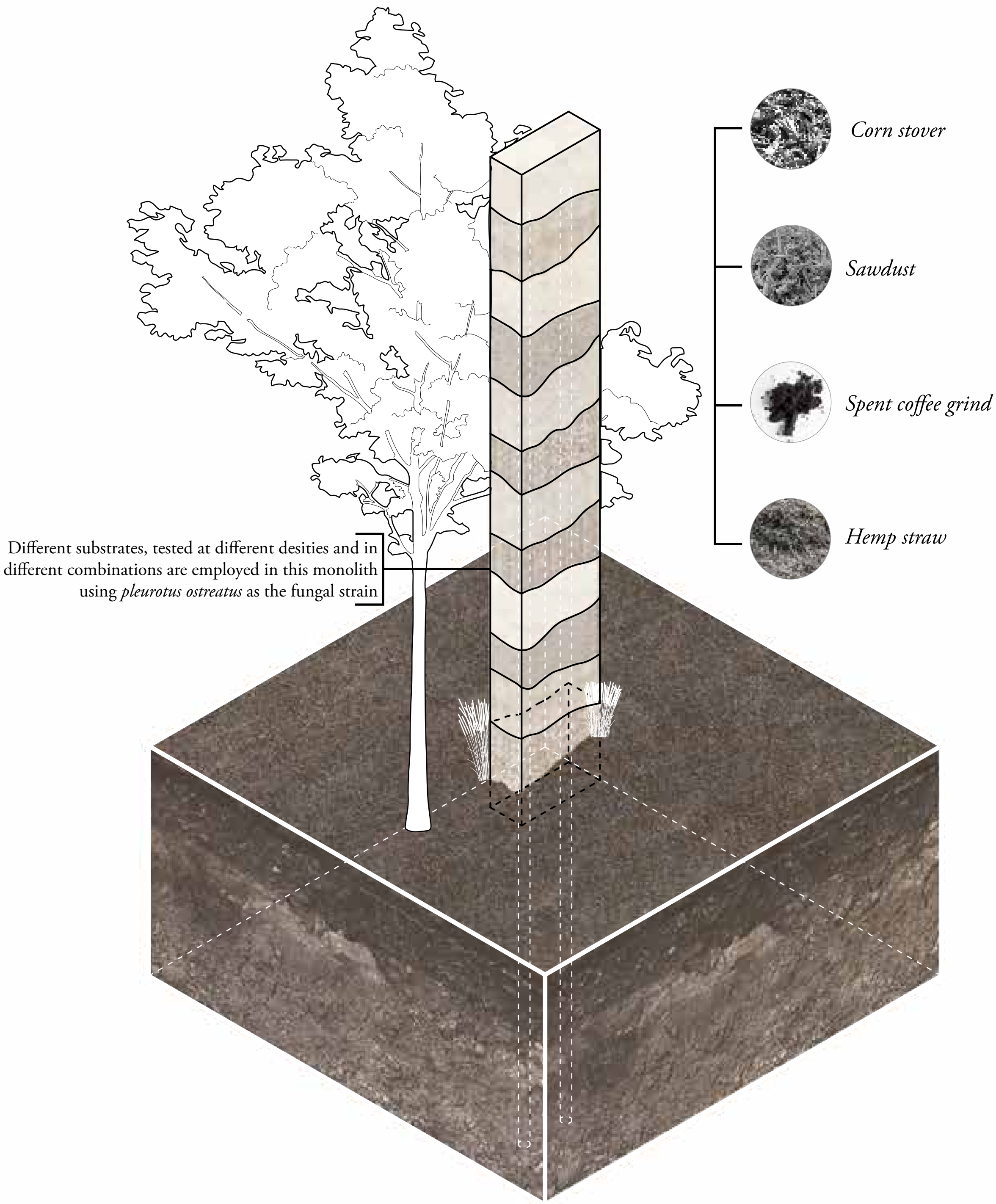


Fig. 116. Monolith I: Testing substrates
Author, 2021

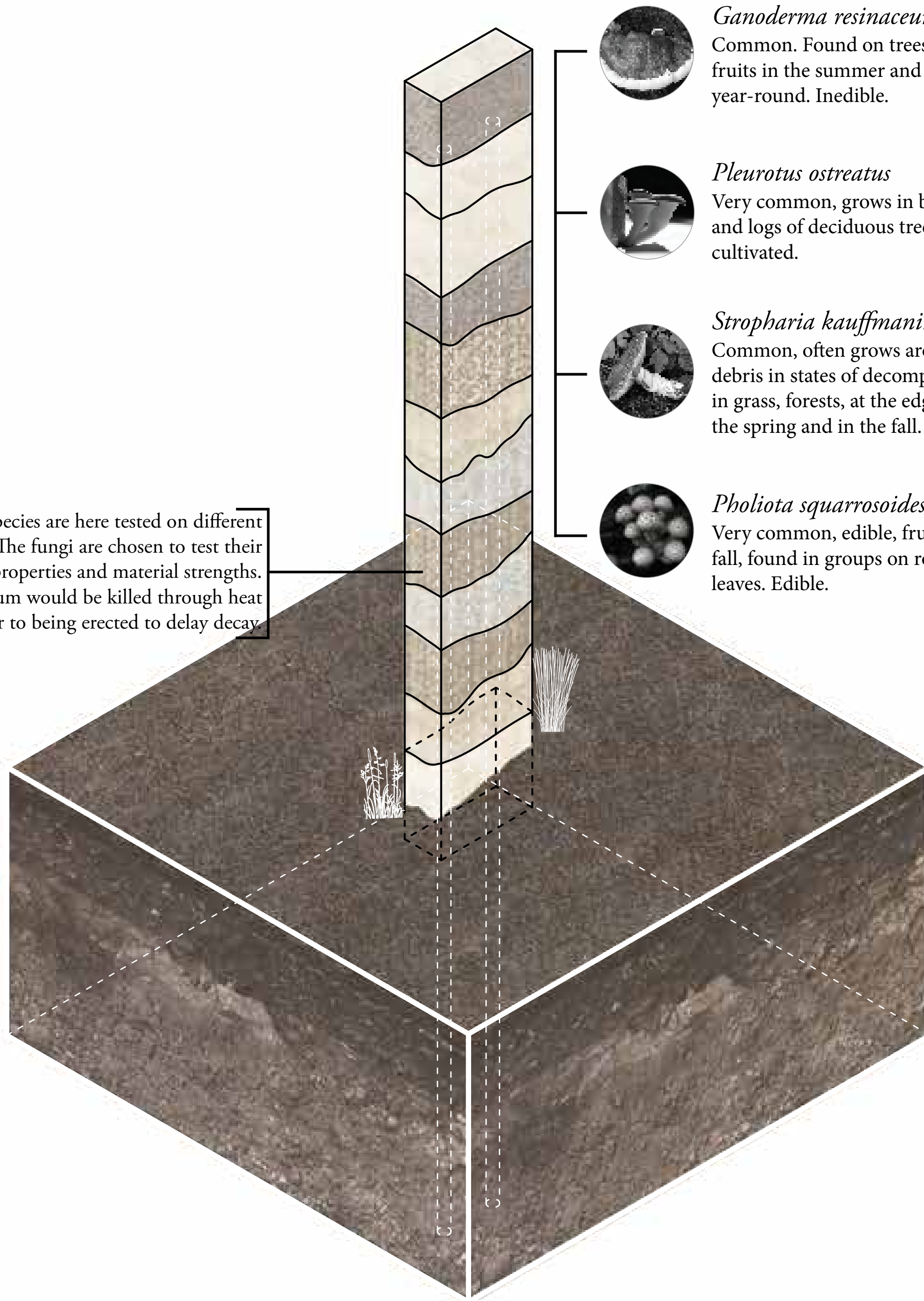


Fig. 117. Monolith II: Testing fungal species

Author, 2021

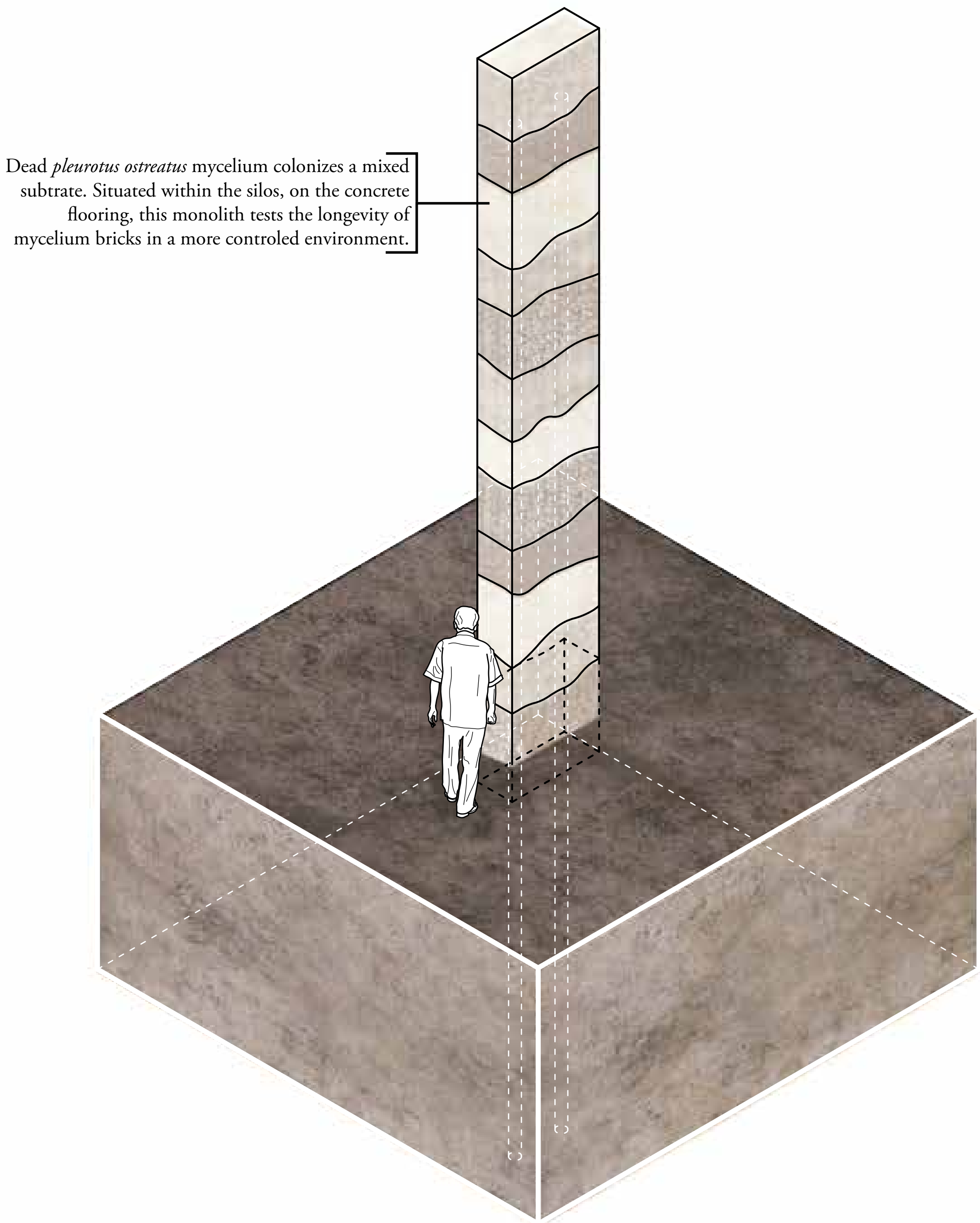


Fig. 118. Monolith III: Testing longevity

Author, 2021

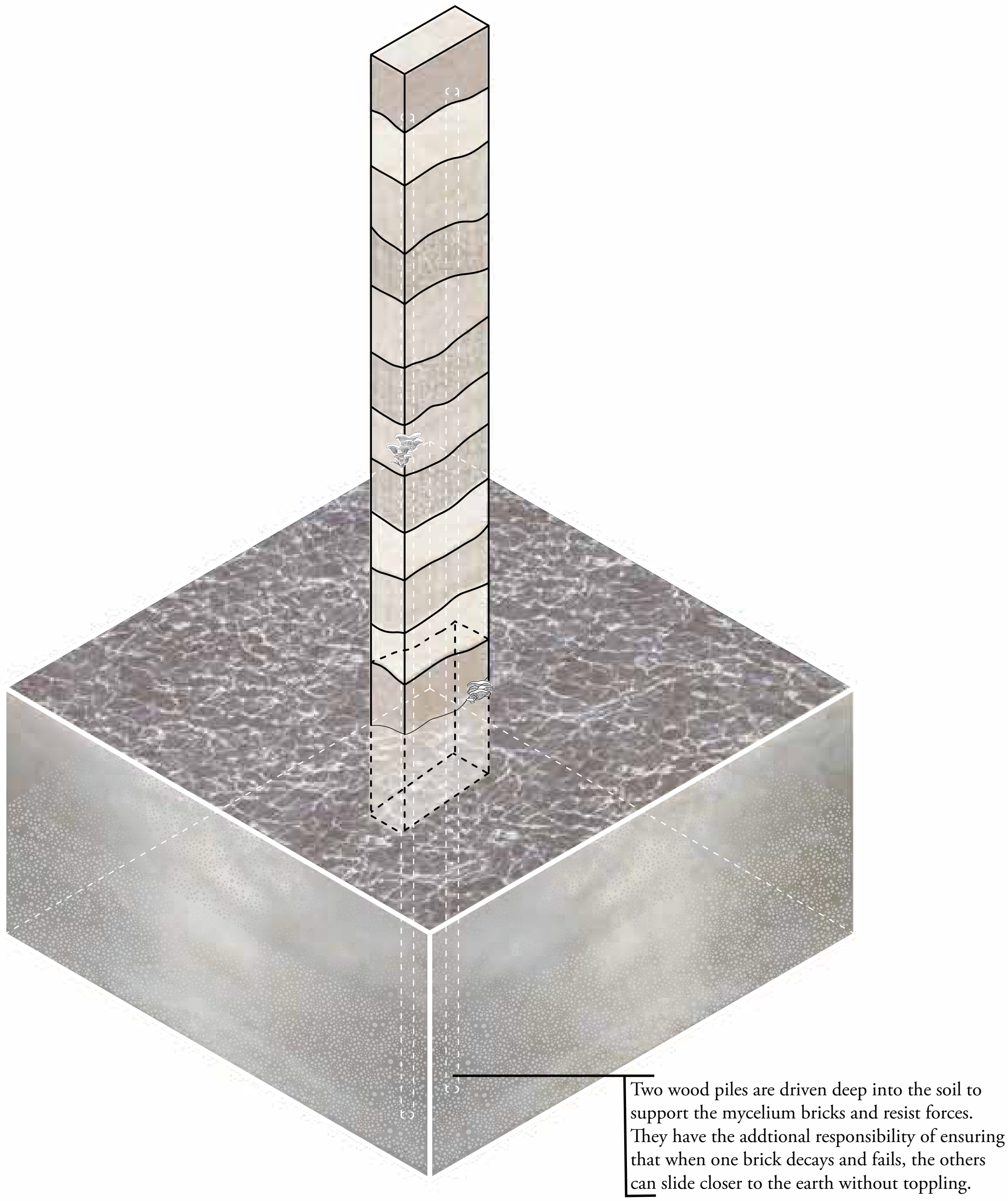


Fig. 119. Monolith IV: Testing waters - Basin

Author, 2021

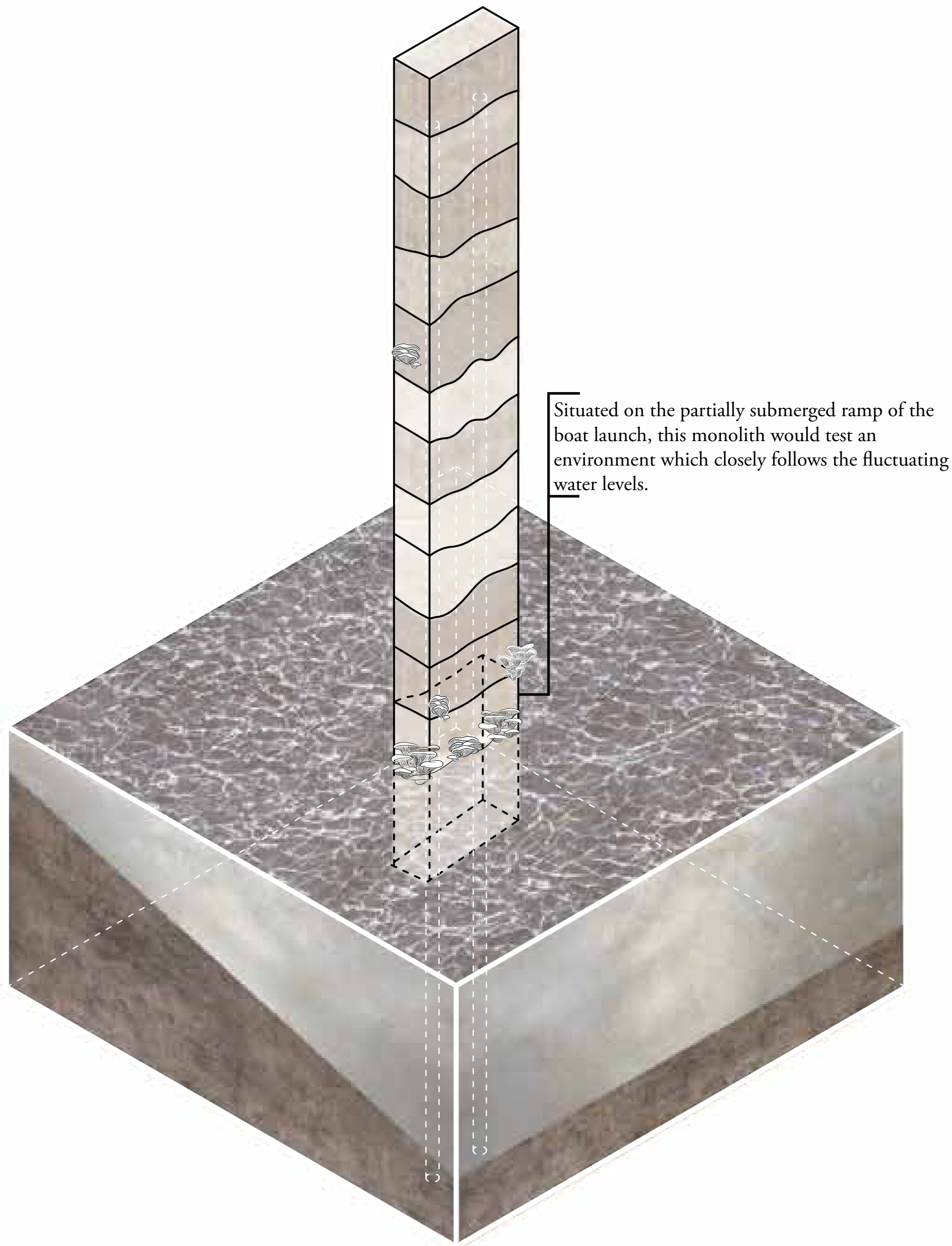


Fig. 120. Monolith V: Testing waters - River
Author, 2021

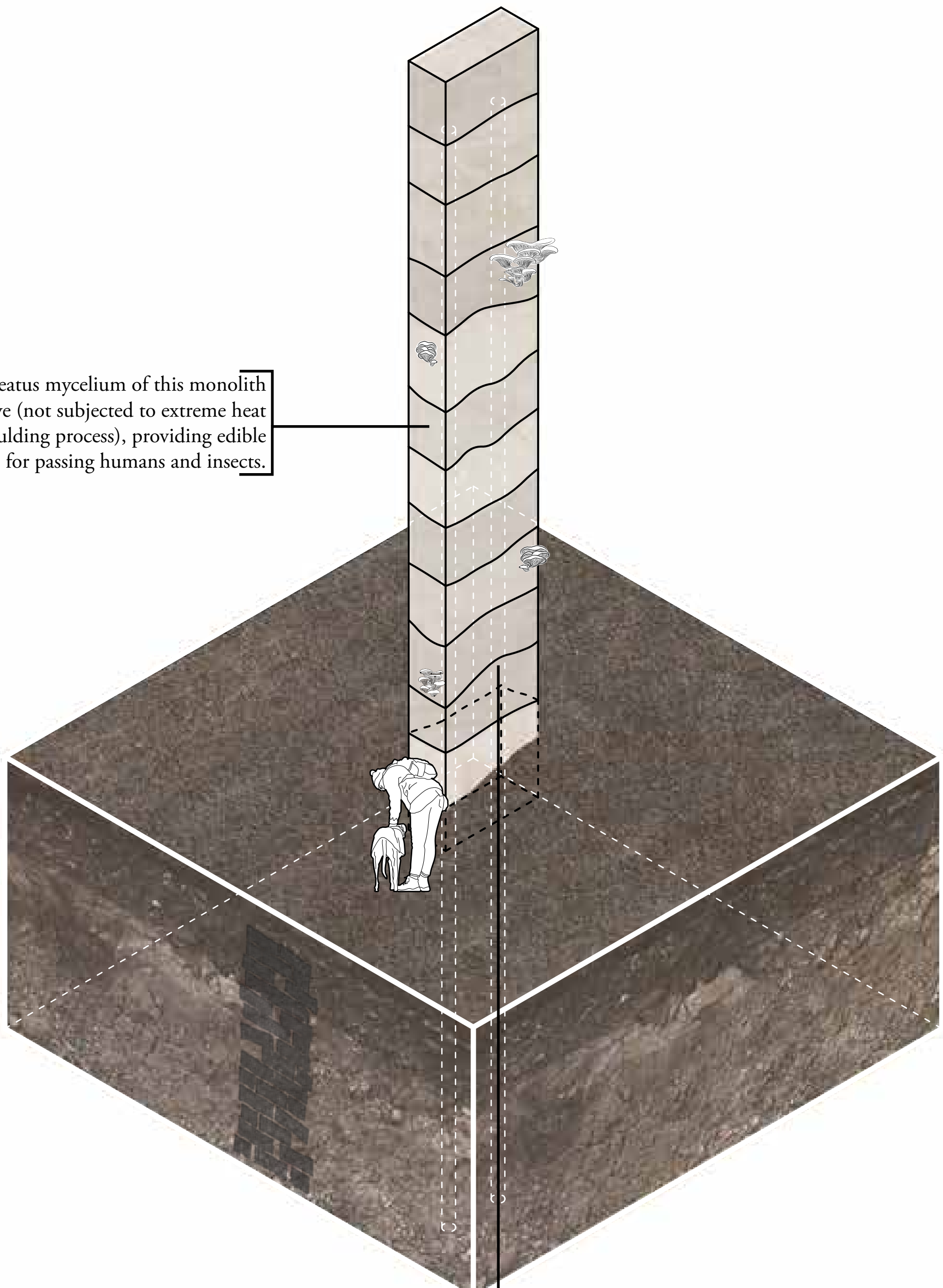


Fig. 121. Monolith VI: Testing fungal life

Author, 2021

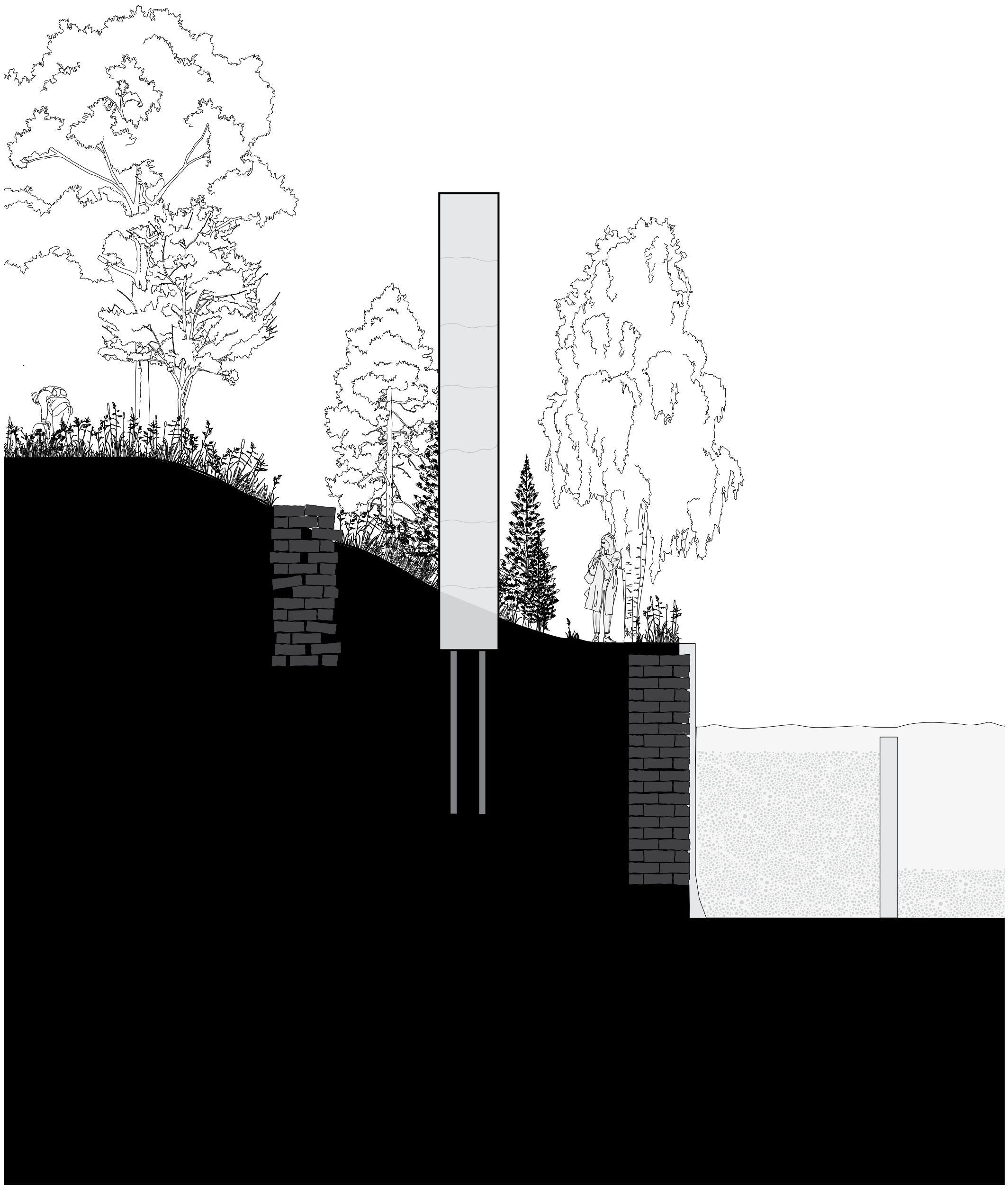


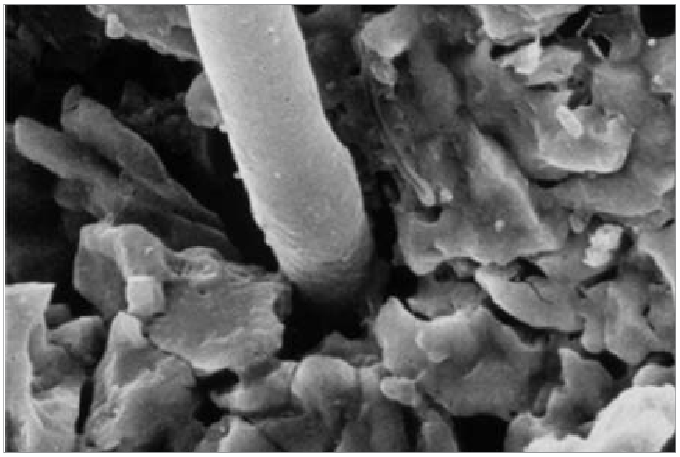
Fig. 122. Section of monolith I
Author, 2021

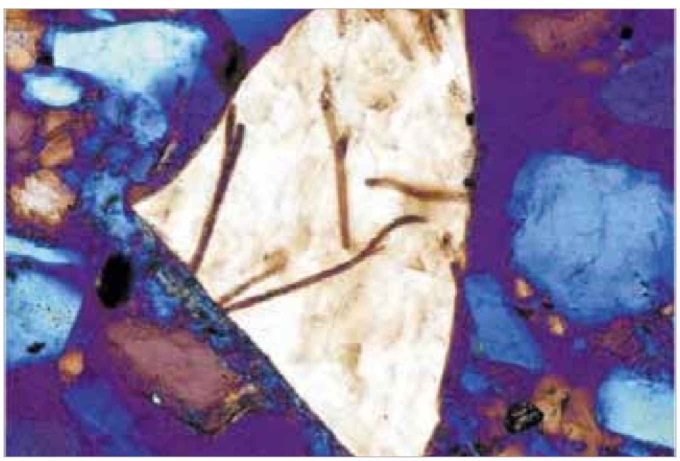
Tunneling

The second intervention, drawing from the precedents outlined above, was inspired by the historic occurrence of ice shoves. Mycelium is brought inside Silo n°5 as an external 'destructive' force which grabs hold and invades an artificial human-made space and left to spill out of drilled holes in the concrete. The mycelium follows the contours of these new tunnels and voids and pools into a mound at the base. Due to the porous nature of the concrete, if brought in alive, the mycelium bricks, as suggested by the material studies, would self-adhere to the concrete in search of new food. These living mycelium walls would temporarily produce mushrooms and then eventually decay once they ran out of nutrients. The hope is that this initial intervention would however invite continuing cycles of life in its ruins.

Bringing part of the intervention inside means a more controlled environment for the fungi. In addition to letting some of the mycelium spill out, the tunnels through the silo walls were strategically placed to let in diffuse sunlight and ventilation to ensure adequate oxygen. While some mushrooms can grow in complete darkness, such as those historically grown in the Paris Catacombs, most prefer a light source. Each silo would have slightly different light conditions to test the effects of exposure to sunlight. These drilled tunnels are also a macro scale imitation of the drilling and mining that fungi perform on stone and other surfaces.

This interior space would be vast and cavernous. People can walk through the space to experience the different lighting conditions and observe the way the mycelium grows and eventually decays over time through repeat visits. While it is expected that this space will eventually be adapted and transformed into a new program that conforms to the city and the developers' vision of a modern and prosperous Montreal, the traces made by this intervention will survive and continue to shape the experience of the site.





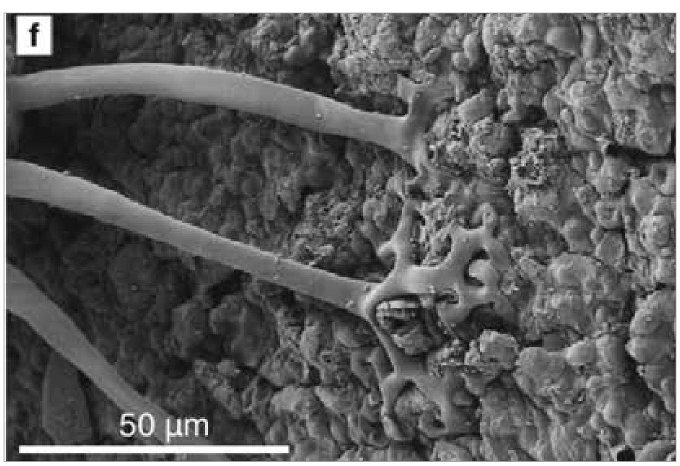


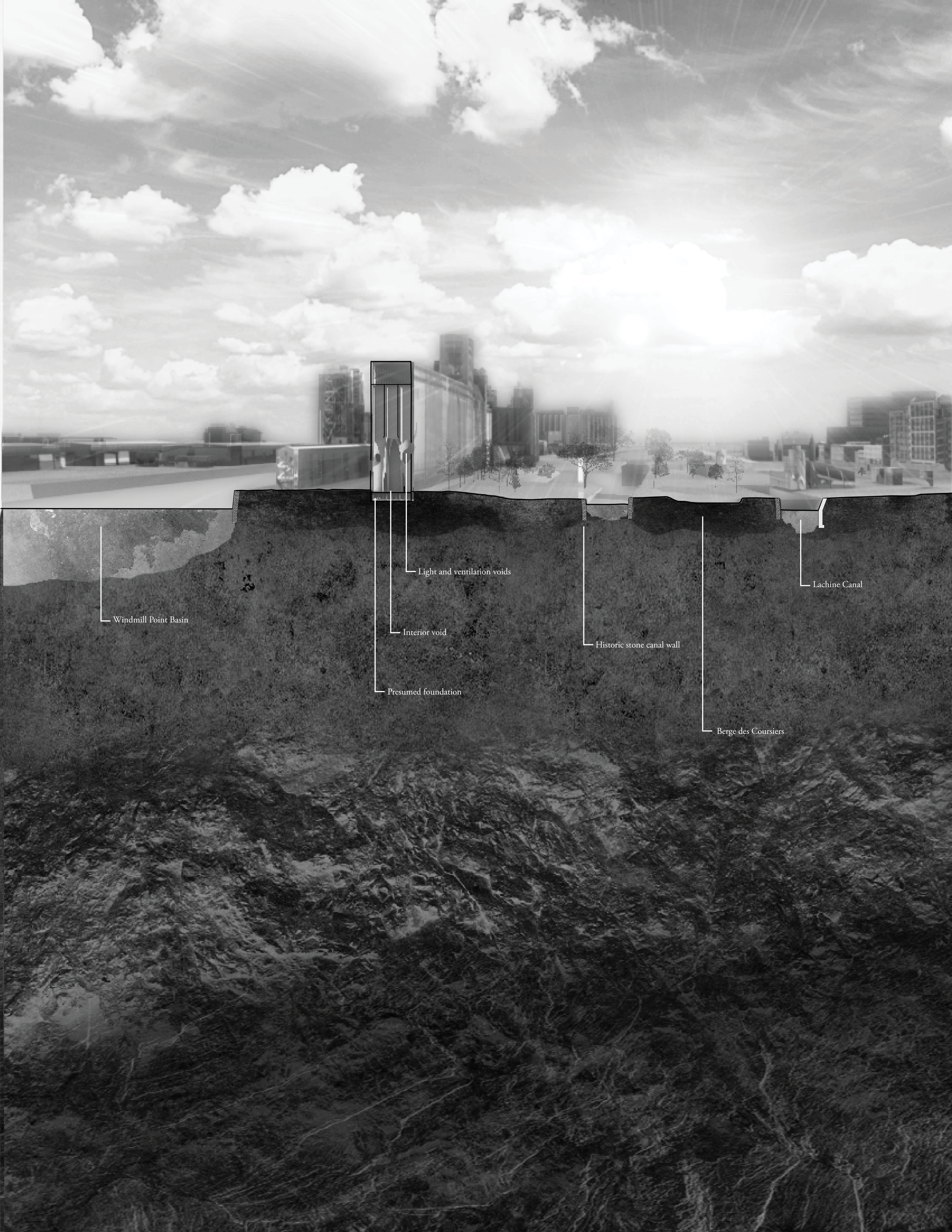
Fig. 124. Fungal hypha penetrating a mineral grain

Mark Smits, 2008

Fig. 125. Micrograph of tunneled feldspar
Landeweert et al., 2001

Fig. 126. Lichen fungi hyphae associated with meneral particles
Wanja Wedekind, 2013

Following page:
Fig. 123. Deep section II
Author, 2021


Light and ventilation voids
Lachine Canal
Windmill Point Basin
Interior void
Historic stone canal wall
Presumed foundation
Berge des Coursiers

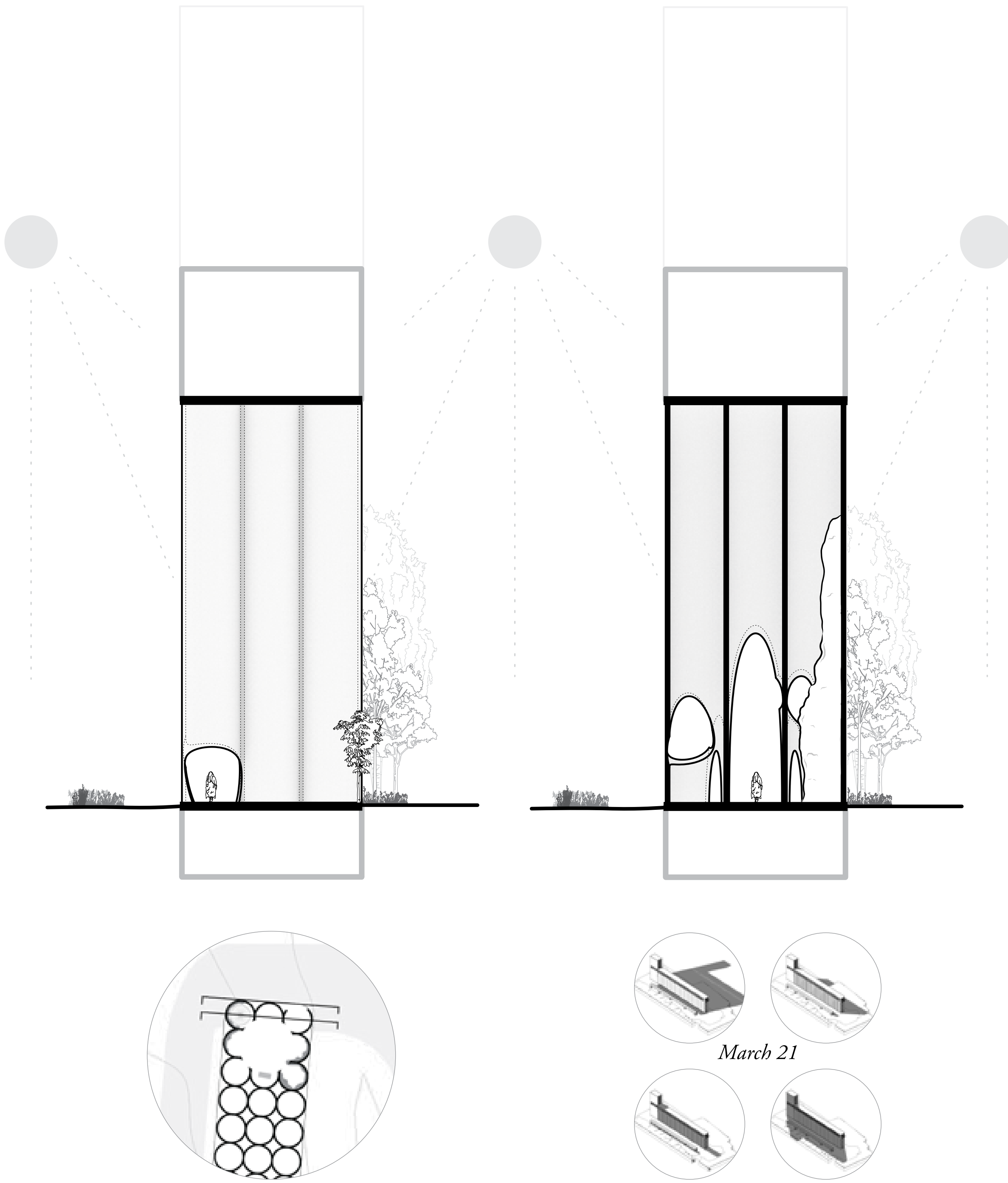


Fig. 127. Silo no. 5 section (I - II)
Author, 2021

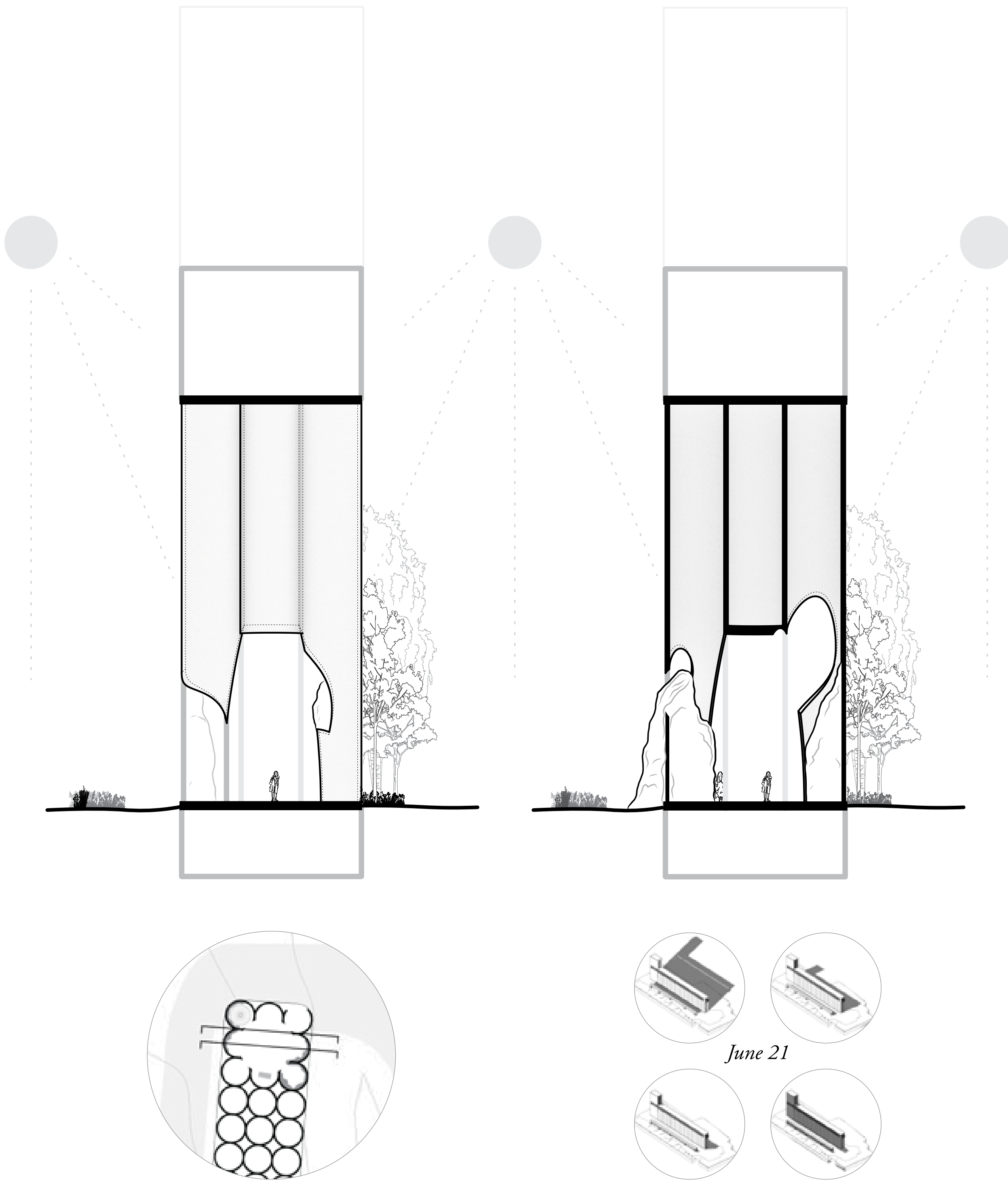
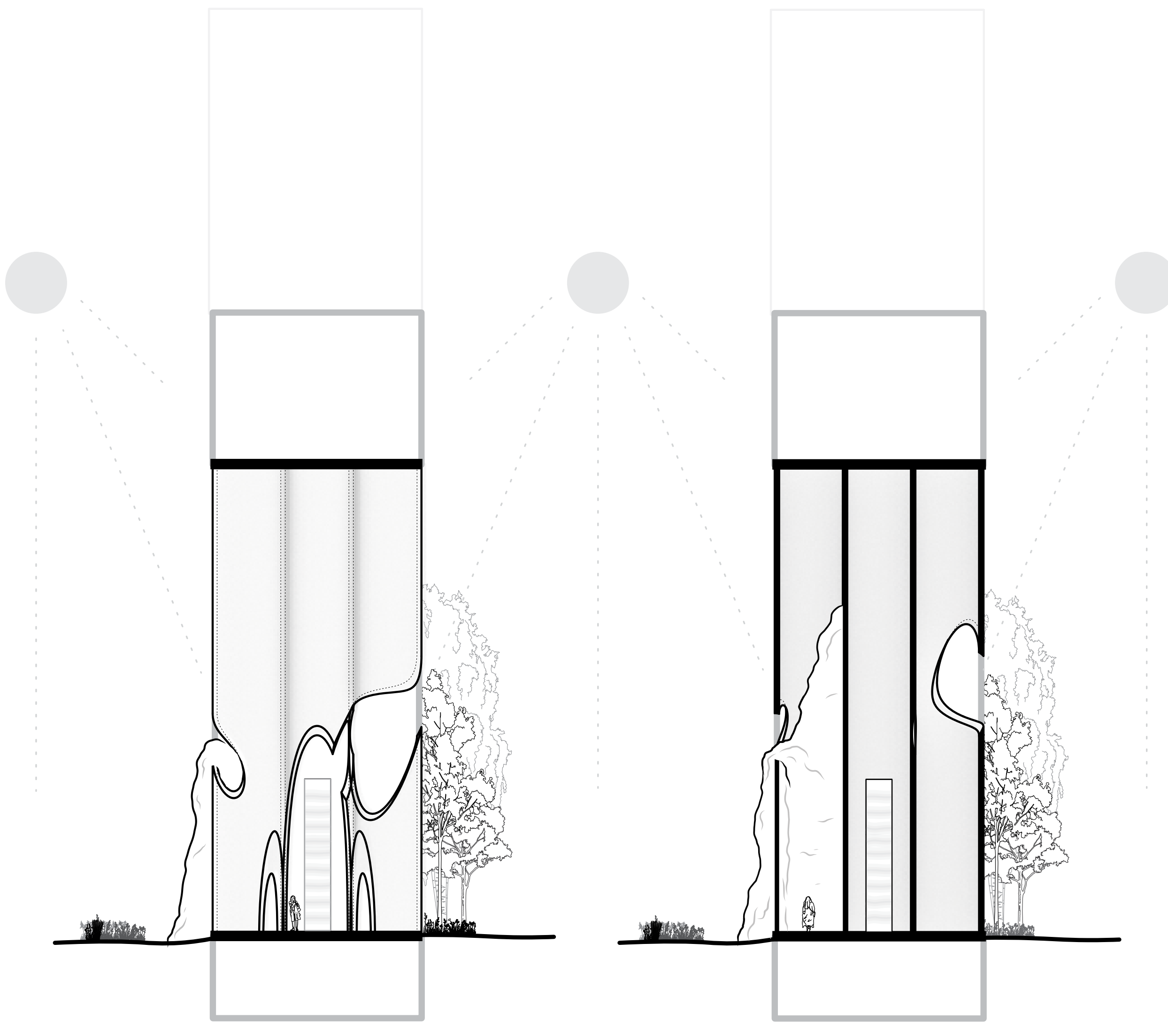
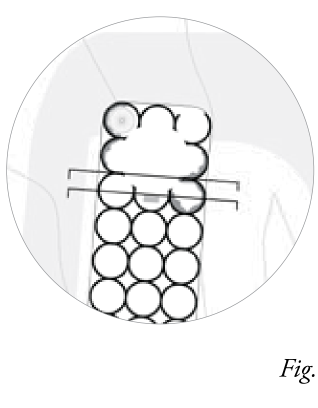


Fig. 128. Silo no. 5 section (III-IV)
Author, 2021





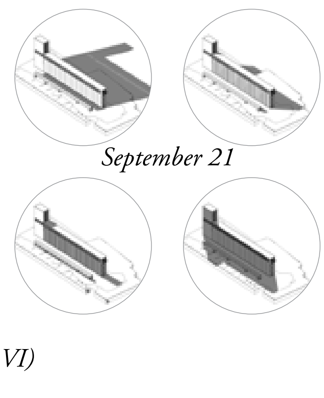


Fig. 129. Silo no. 5 section (V - VI)
Author, 2021

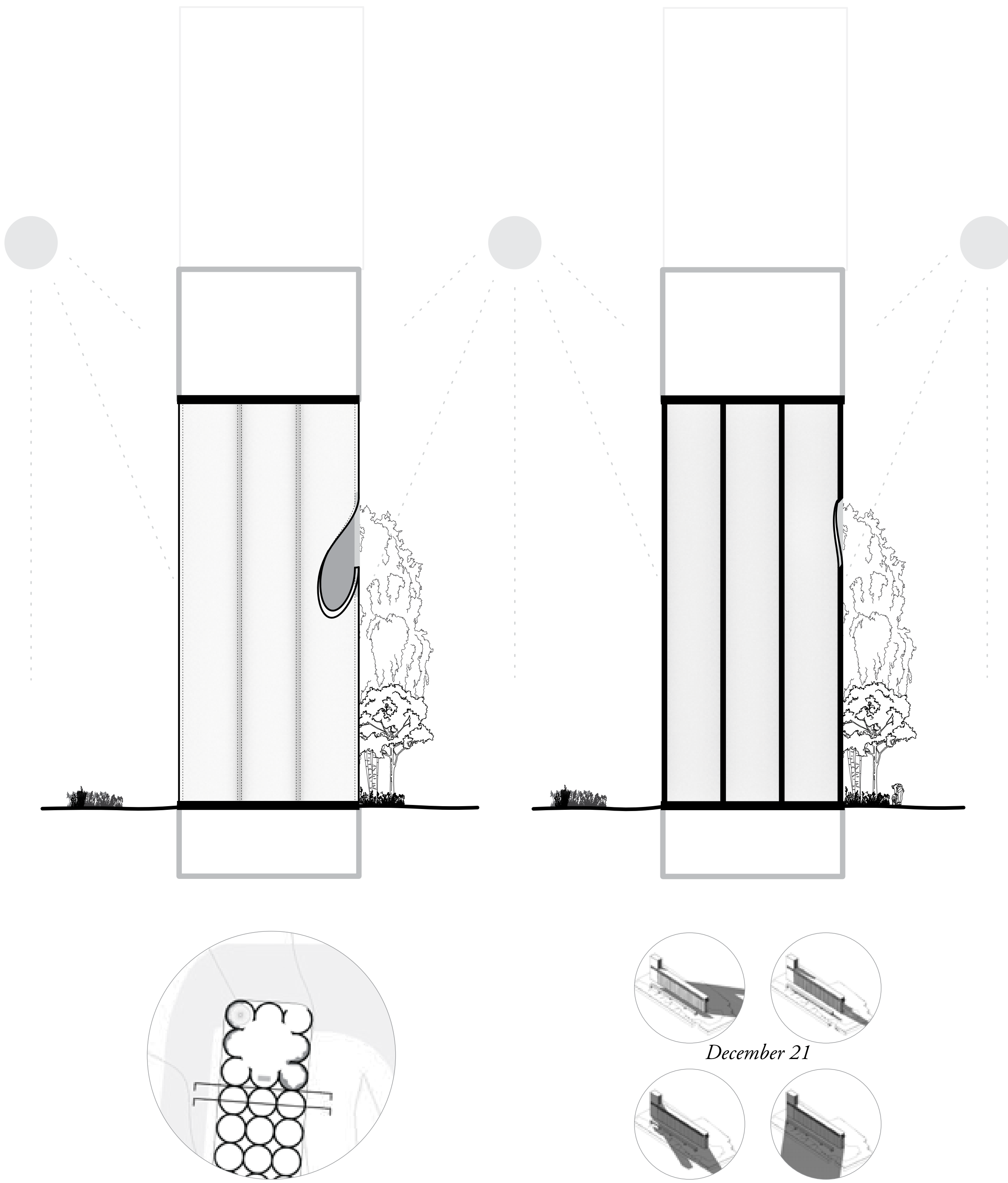


Fig. 130. Silo no. 5 section (VII - VIII)
Author, 2021

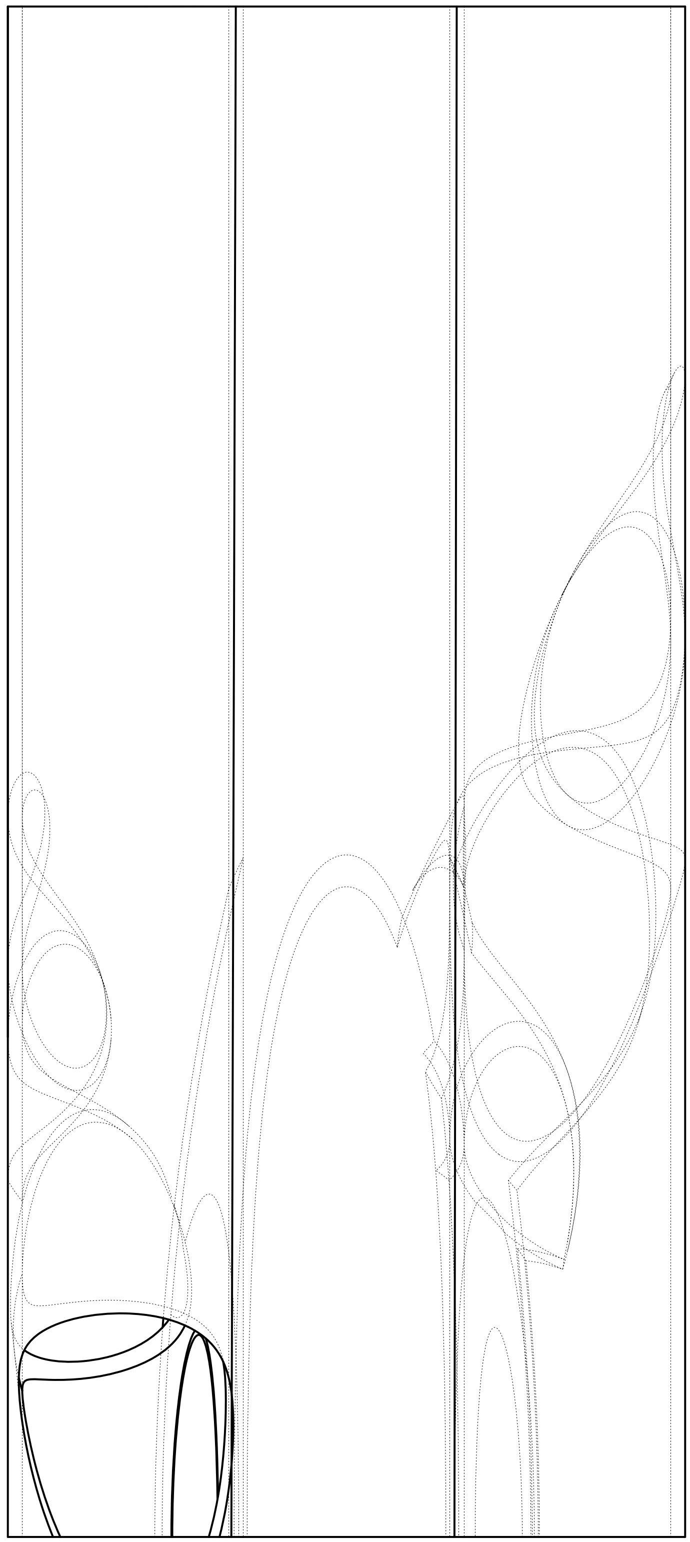


Fig. 131. Silo no. 5 x-ray of voids
Author, 2021

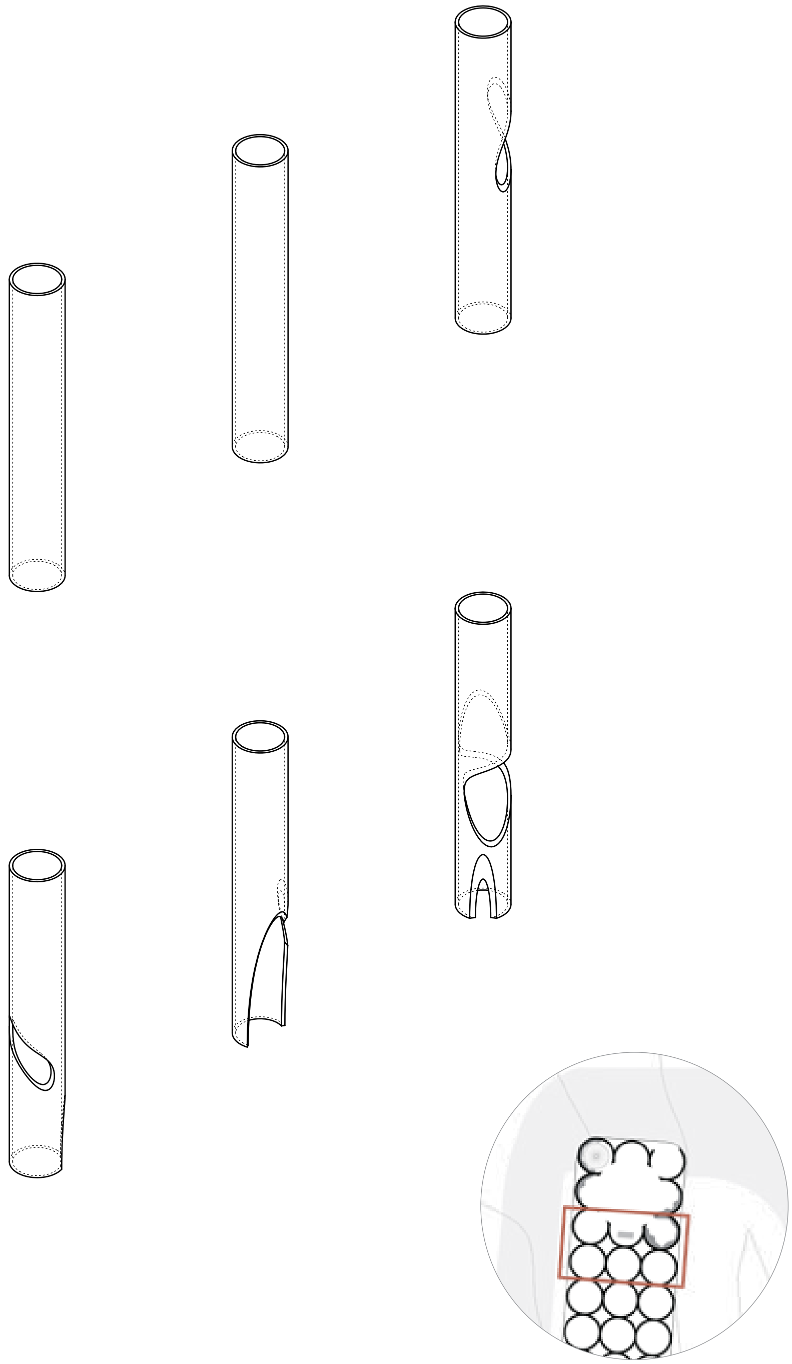


Fig. 132. Cut details I
Author, 2021

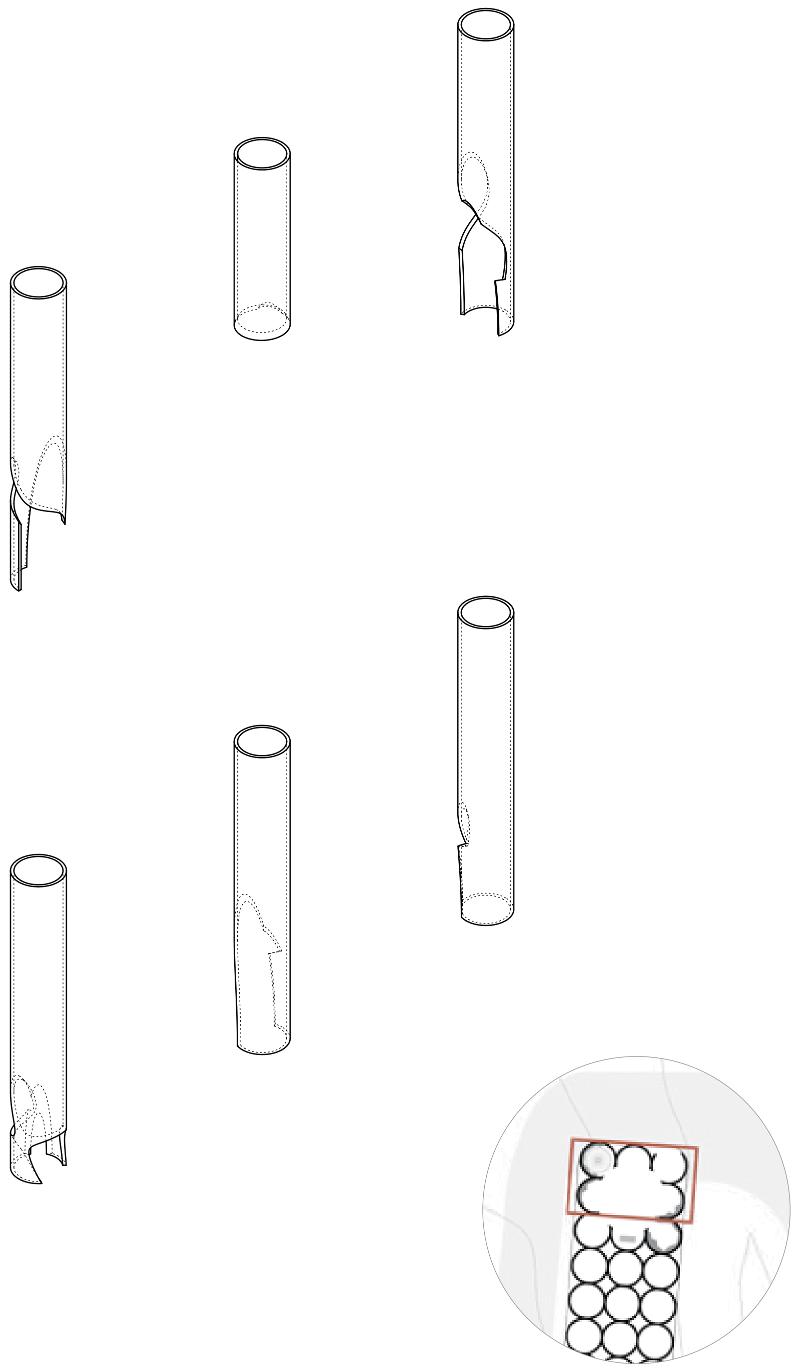


Fig. 133. Cut details II
Author, 2021

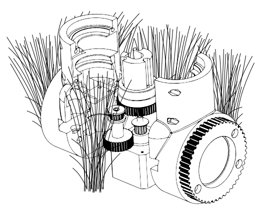
Leaving Traces

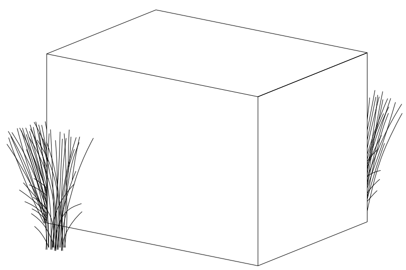
The third dimension of the intervention involves leaving a series of long-term traces once the obvious mycelial structures have faded away. This looks at the role that fungi play as markers of time's passage. By inviting fungi and lichen to colonize the concrete constituting the grain elevators and the wharf's retaining walls, it hopes to accelerate processes of weathering and decay to expose deep time connections and 'stories of making and unmaking'. An agar solution, which is typically used in petri dishes to grow and sustain mushroom spawn for long periods of time, comes into play as inclusions in the mycelium substrate. Small biodegradable capsules filled with agar and fungal strains would be released once the mycelial mass has started to decay. These live fungal strains would then proliferate in the ruins of the mycelium blocks and the surrounding environment. Species would include a number of cultivatable and typically non cultivatable mushrooms, a number of common lichen species, and some would contain algae to invite the possibility of new interconnected species. The purpose is to create a veritable explosion of fungal species, some will likely proliferate, others will inevitably fail.

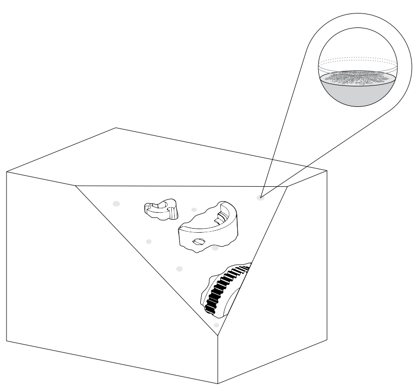
In addition to having these inclusions in the monolithic pillars and growing on the concrete surfaces, large mycelium blocks would cover the large concrete and steel industrial debris that litters the site. A box would be built around the bits of debris, filled with substrate, inoculated and left to grow. The mould would then be removed so the mycelium could dry out and begin its slow decay. Once decomposed, lichen are left clinging to the debris for minerals and new life can grow out of the compost. While the blocks are still intact, people would be able to sit on them and enjoy views of the city and river. Eventually, as they decay, the experience of this intervention shifts to the altered environment left in their wake. Colourful mushrooms and lichen will proliferate on the surfaces that had been covered and eventually spread in the tall grass and on trees. The hope is that this intervention will call attention to the role that fungi play in the ecosystem and introduce more people to wild mushrooms and fungal possibilities. There is a proliferating interest in the province for foraged mushrooms, chanterelles are particularly prominently featured on the growing number of *terroir*-oriented menus.

The focus however is on the more temporal conversations that fungal traces can open on short and deep cycles of change. Ultimately nothing is permanent, even the massive reinforced concrete silos or wharf walls (themselves covering older stone walls) are always in a slow state of weathering and eventual decay. Fungi are these first colonizers of space, they are often the first organisms which enter a hostile landscape and do the work of creating the conditions for new life. Visibility of these processes can hopefully reframe how we understand our lasting legacy on the earth and how we choose to build in consequence. Rather than fight against these cycles of change, then tear down and start over once they begin to show or our carefully crafted lines begin to fail, how can we work with them to create a built environment which is more sustainable and more aligned with the messy fluctuating reality of our world?

Fig. 134. Industrial debris at Windmill Point
Author, 2021







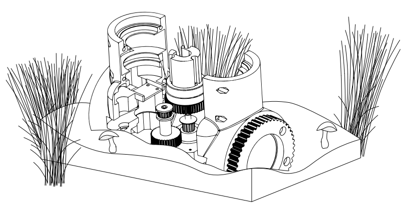


Fig. 138. Leaving Traces stage I: Existing debris
Author, 2021

Fig. 137. Leaving Traces stage II: Debris covered in mycelium block
Author, 2021

Fig. 136. Leaving Traces detail: Agar-fungal strain inclusions
Author, 2021

Fig. 135. Leaving Traces stage III: Mycelium block biodegrades and leaves fungi
Author, 2021

Following page:

Fig. 139. Deep section III
Author, 2021


Cité du Havre Peninsula
Brickerdike Basin
Brickerdike Terminal
Windmill Point Basin
Current presumed interior
Basin mostly infilled
Berge des Coursiers
Mill Street Bridge
Functioning basin
Montreal
Water
Infill
Cenozoic
Mesozoic
Paleozoic
Quaternary
66.4 m.y.a.
Tertiary
Cretaceous
Jurassic
245 m.y.a.
Triassic
Permian
Carboniferous
Denovian
Silurian
Ordovician
570 m.y.a.
Cambrian
Monteregian intrusive through plutons, dikes, and sills moves creates igneous rock and breccia incorporating limestones blocks from Denovian age
Sandstone
Siltstone
Shale
Black Shale
Shale
Limestone
Limestone
Dolomite
Limestone
Dolomite
Sandstone
Poor drainage surfaces
Eolian and alluvial
Fluvial
Estuarine
Peat
Marl
Sand
Champlain Sea
Silty Clay
Glacial lake
Silt
Re-advance in Glacial Lake
Till
Glacial Lake
Silt
Sand
Gravel
Till
Malone ice sheet
Till
Laurentide Ice Cap
Till
Preceding glacial and interglacial episodes
Till

Endnotes

1 Anna Lowenhaupt Tsing, *The Mushroom at the End of the World : On the Possibility of Life in Capitalist Ruins* (Princeton, N.J: Princeton University Press, 2015), 22.

2 Lydia Kallipoliti, 'History of Ecological Design', in *Oxford Research Encyclopedia of Environmental Science* (Oxford: Oxford University Press, 2018), 2, https://doi.org/10.1093/acrefore/9780199389414.013.144.

3 Anna Lowenhaupt Tsing, *Friction: An Ethnography of Global Connection* (Princeton, N.J: Princeton University Press, 2005), 3.

4 Tsing, *The Mushroom at the End of the World*, 5.

5 Tsing, *Friction*, 5–6.

6 Tsing, *The Mushroom at the End of the World*, 5–6.

7 Tsing, 2.

8 Kallipoliti, 'History of Ecological Design', 39.

9 David Gissen, *Subnature: Architecture's Other Environments* (New York: Princeton Architectural Press, 2009), 24.

10 The Living Studio, 'Hy-Fi', 2014; 'How Arup Engineered The Living's Mushroom Tower', *Metropolis*, 1 July 2014, https://www.metropolismag.com/technology/how-arup-engineered-the-livings-mushroom-tower/; 'HyFi Reinvents the Brick', Arup, accessed 14 March 2021, https://www.arup.com/news-and-events/hyfi-reinvents-the-brick.

11 'Trends in Global CO2-Emissions. 2016 Report', n.d., 65.

12 Heatherwick Studio, 'Zeitz MOCAA', Heatherwick Studio | Design & Architecture, 2011, http://www.heatherwick.com/project/zeitz-mocaa/.

13 ‘Conical Intersect’, The Guggenheim Museums and Foundation, accessed 14 March 2021, https://www.guggenheim.org/artwork/5211.

14 Peter Cook, ‘Motive 5: The English Path and the English Narrative’, in *Architecture Workbook: Design Through Motive* (Chicester: John Wiley & Sons, Incorporated, 2016), 158.

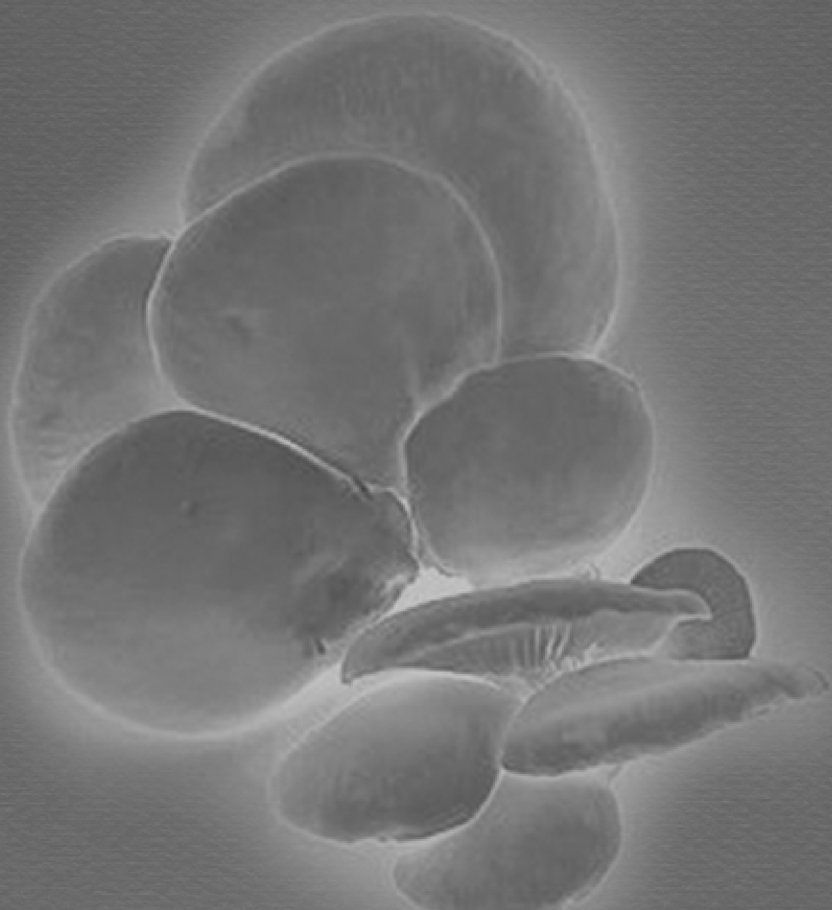
15 Cook, 161.

16 Rosalind H. Williams, *Notes on the Underground: An Essay on Technology, Society, and the Imagination*, New ed (Cambridge, Mass: The MIT Press, 2008), 29.

17 Williams, 43.

part five

AFTERWORD



"Our first step is to bring back curiosity. Unencumbered by the simplifications of progress narratives, the knots and pulses of patchiness are there to explore. [Fungi][1] are a place to begin: However much I learn, they take me by surprise." [2]

- Anna Tsing, The Mushroom at the End of the World

Weathering, Decay, Renewal

Much of this thesis was about reframing the some of the ways we think about space. This particular site, with such a rich history as a place which has been altered to serve the commodification of nature on a grander scale and changing ethos, is now about to undergo yet another major transformation. It presented itself as a good place to explore the role that fungi can play in processes of reframing, thereby contributing to a conversation and new non-linear understanding of the built environment. Fungi blur lines both physically and metaphorically. By introducing them to the site, it was both a statement on the need for more conscious and sustainable architecture, and a reflection on the divisions and dichotomies we repeat to ourselves when constructing our world view. So, I chose to explore something that has interested me for years, fungi, and consider the ways it is incorporated or exists outside those dichotomies by introducing it to a site which is in many ways representative of flawed vision of the earth as a 'pulsating circulatory apparatus' subjected to the whims and desires of the day.

I will conclude this thesis with an exercise in imagination and drawing. Based on the outcomes from the ongoing material studies, empirical observation of fungi, and a little creativity, a series of perspectives are presented which imagine the new experience of Windmill Point over time, following the proposed interventions. The purpose of this exercise is to reflect on those surprising moments that fungi can bring and what the questions asked, and connections made in this thesis can bring as an immersive spatial experience. These drawings hope to blur some of the lines drawn in *part four* of this thesis, and offer a sense of the world-making possibilities of fungi.

Fig. 140. View from the perspective of a mushroom - The Monoliths
Author, 2021

Fig. 140. View from the perspective of a mushroom - The Monoliths
Author, 2021

Fig. 141. View from the perspective of a mushroom - The Monoliths II
Author, 2021

Fig. 142. View from the perspective of a mushroom - Inside the silos
Author, 2021

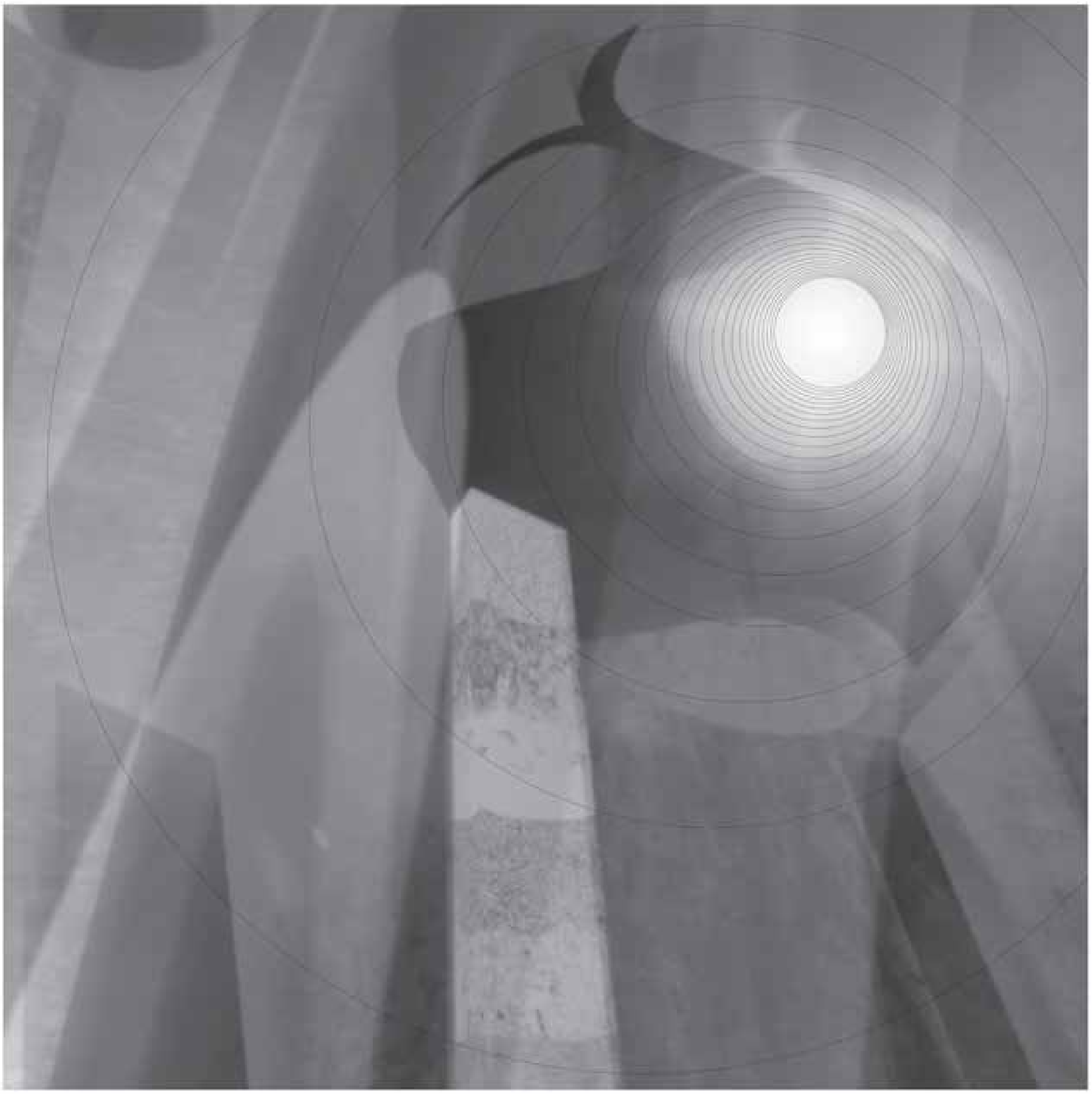


Fig. 143. View from the perspective of a mushroom - Inside the silos II
Author, 2021

Fig. 144. View from the perspective of a mushroom - Boring into stone
Author, 2021

Fig. 145. View from the perspective of a mushroom - Underwater
Author, 2021

Endnotes

1 Please note the word 'Matsutake', a specific mushroom, was replaced by 'Fungi' by the author to reflect the broader fungal scope of the thesis.

2 Anna Lowenhaupt Tsing, *The Mushroom at the End of the World : On the Possibility of Life in Capitalist Ruins* (Princeton, N.J: Princeton University Press, 2015), 6.

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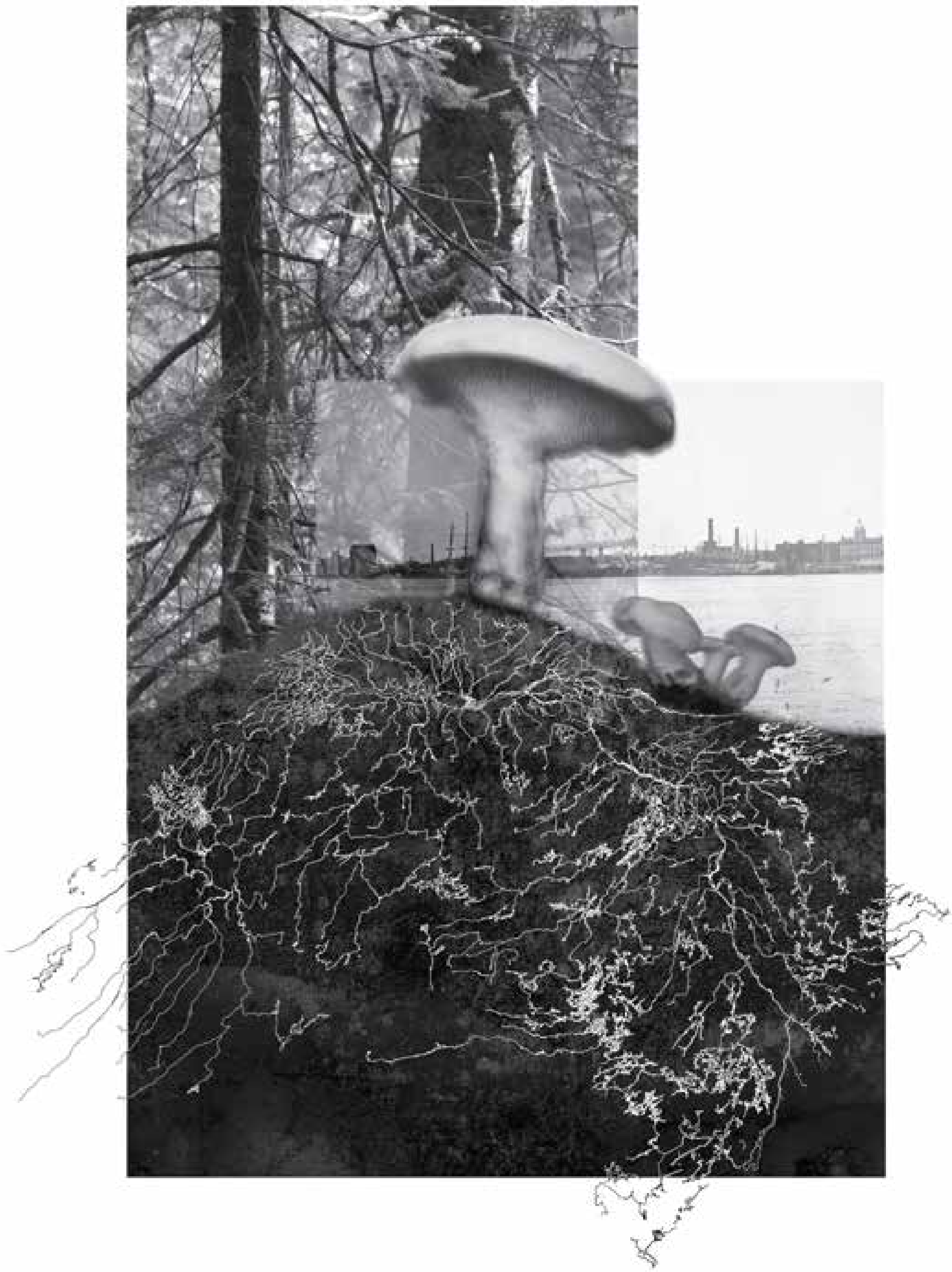

Fig. 146. Collage I
Author, 2020