

Listening to Climate Change

INTEGRATING AWARENESS & ACCEPTANCE
THROUGH A MORE-THAN-HUMAN MUSIC

by

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This is the sound-free version of the thesis book.

As sound is important to the project's research and design, please click on the following link or enter it into your web browser to view the media-rich version:

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joshbrucewallace@gmail.com for the media-rich version.

Thank you.

ABSTRACT

This thesis understands climate change as a physical entity; a cultural object that, to humans, only becomes manifest in fragments of local weather and environmental phenomenon.

How can climate change be woven into human imagination and memory through the medium of sound? This question is investigated through the design and construction of environmentally-activated instruments, or *listening devices*. Participants interface with climate through these devices, devising a new method of music-making; a new sonic form of interacting with geophonic processes as they are articulated by architectural augmentations.

This thesis addresses and reimagines temporal landscapes to remap and remake connections to climate through designed listening devices. Common human relationships with climate change are often conceptual and abstract, informed by popular media, buzz words, and large datasets that are incompatible with a human-scale of understanding. Augmented interactions between humans and environmental phenomena may facilitate the development of a visceral knowledge of climatic realities. Part of this knowledge lies in the differences between human-produced music and environmentally produced sound. Players engaging these new devices and landscapes must listen and adapt, letting go of accepted musical norms to incorporate the climate's sonic language into their musical sensibilities. It is anticipated that this "letting go" may aid the necessary philosophical and behavioural shift towards adapting to a new climate paradigm.

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It is a great gift to be given the space and resources to study and explore one's own interests, curiosities, and desires for understanding. I especially want to thank my family, who have continuously given me unyielding support, warmth and encouragement.

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GLOSSARY OF TERMS

Sound “Any vibration in the air or other medium, some types of which are able to cause a sensation of hearing.”¹

Music In the spirit of 20th century composer John Cage, all sound, whether composed intentionally or not, is considered “music”. Cage’s famous piece, “4:33”, illustrates this by instructing the conductor and orchestra to get on stage and play nothing for four minutes and thirty-three seconds, allowing audience members to listen to the “music” of everyday experience by bringing attention to the atmospheric sounds of the room.

Listening A mode of attention that is necessarily both conscious and sensitive, being perceptive to a given sound without a preconceived notion of what that sound should or ought to be. The listening mode of attention cultivates an understanding towards a sound or entity on its own terms.

Attunement The process of becoming perceptively and behaviorally aligned with any given environment or entity. Becoming attuned to something is greatly enhanced through listening to it.

Aural Architecture “Aural architecture is that [sonic] aspect of real and virtual spaces that produces an emotional, behavioral, and visceral response in inhabitants. A space can produce feelings of intimacy, anxiety, isolation, connectedness, warmth, as well as a mystical sense of spirituality. Such responses parallel those of visual architecture, except that the space is experienced by listening rather than seeing.”²

“Ecology is the study of the relationship between individuals and communities and their environment. Soundscape ecology is thus the study of the effects of the acoustic environment, or soundscape, on the physical responses or behavioural characteristics of those living within it. Its particular aim is draw attention to imbalances which may have unhealthy or inimical effects.”³

Acoustic Ecology

The sounds present within any given environment, audible or otherwise. The sounds of any group or individual’s immediate environment can be considered as their immediate soundscape.

Soundscape

Sounds produced by humans (i.e. voice, radio signals, machinery etc.).

Anthrophony

Sound produced by non-human biological entities (i.e. bird calls, dog bark, ants crawling etc.).

Biophony

Sound produced by earthly processes (i.e. wind, thunderstorms, rain etc.).

Geophony

Often rhythmic and tonal, sonic patterns that serve culturally specific functions.

Human-produced Music

Often arhythmic and atonal, sonic densities or patterns that change with earthly cycles.

Environmentally-produced Sound

A method of layering and augmenting recorded sounds to generate architectural imagination on what kinds of architectural assemblages might produce those sounds in a particular environment.

Audio Collage

Also referred to as a “sound mass” or “sound wave”, many sounds coalesce to produce an overall effect.

Sound Density

Underwater microphone.

Hydrophone

Tempered Tuning

The process of adjusting the frequency of tones in a scale. Usually the purpose of doing this is to reduce the number of tones in the scale, going from frequencies based on exact ratios to those which produce equal intervals.”⁴

Autopoietic Systems

“Autopoietic (self-producing) systems are autonomous units with self-defined boundaries that tend to be centrally controlled, homeostatic, and predictable.”⁵

Sympoietic Systems

“Sympoietic (collectively-producing) systems do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change. Since they cannot be identified by boundaries, sympoietic systems must be identified by the self-organizing factors involved in their generation.”⁶

END NOTES - GLOSSARY OF TERMS

1. Barry Traux, *Handbook for Acoustic Ecology*, (Vancouver: A.R.C. Publications; A.R.C. Aesthetic Research Centre; The World Soundscape Project, 1978), 114.
2. Barry Blesser and Linda-Ruth Salter, *Questions and Answers about: Spaces Speak, Are You Listening? Experiencing Aural Architecture*, (Minneapolis: MIT Press, 2006), 1.
3. Traux, *Handbook for Acoustic Ecology*, 127.
4. *Ibid.*, 140.
5. M. Beth L. Dempster, “*A Self-organizing Systems Perspective on Planning for Sustainability*”, (Master’s thesis, University of Waterloo, 1998) v.
6. *Ibid.*, v.

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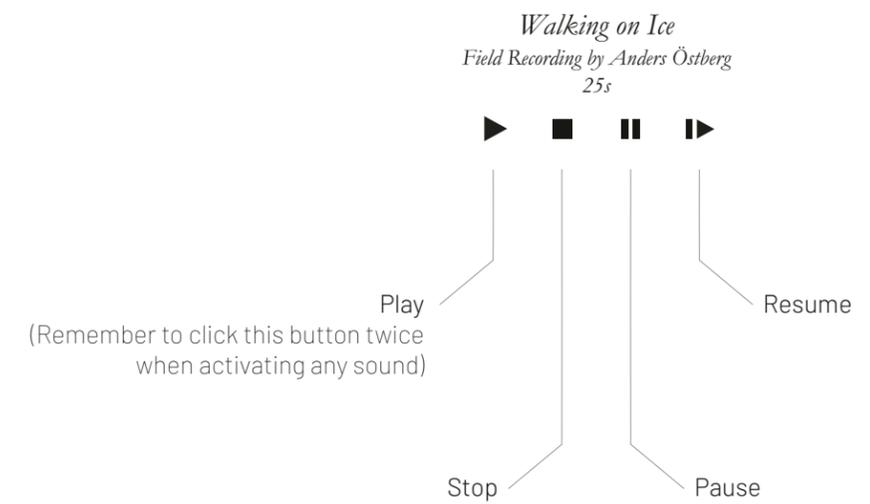
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PLAYING SOUNDS AND STOPPING SOUNDS

In the digital version of this book, a “play” and “stop” button has been added to photos and drawings that are accompanied by sound. Sounds will stop playing when the reader clicks the “stop” button, or once the track has ended. Readers can play a sound and continue listening while flipping forward or backward to other pages. Readers may also overlay sounds, playing multiple tracks simultaneously across pages. To stop a sound at any point, return to the page the sound was first activated, and click its corresponding ‘stop’ button.



*To my mom, dad, sister, brother,
partner and canine-companion.*

*To all those who make music,
and to all musics everywhere,
whether audible or not.*

When the Animals Come to Us

by Gary Lawless

When the animals come to us,

Asking for our help,

Will we know what they are saying?

When the plants speak to us

In their delicate, beautiful language,

Will we be able to answer them?

When the planet herself

Sings to us in our dreams,

Will we be able to wake ourselves, and act?

INTRODUCTION

“The first concern of all music in one way or another is to shatter the indifference of hearing, the callousness of sensibility, to create that moment of dissolution we call poetry, our rigidity dissolved when we occur reborn - in a sense hearing for the first time.”¹

-Lucia Dlugoszewski

Considering the fear and despair that so many experience in regards to climate change, in what ways can humans relate to climate change with awareness and even compassion? How might architecture and sound assist in nurturing a visceral understanding of this changing reality, and stimulate receptiveness and an ability to respond? What would be learned from the contemporary fluxing earthly condition if one were to listen?

Chapter 1, *Where to Listen*, sets the stage of locations described in this thesis. Primarily focusing on the sounds of melting and groaning glaciers, this chapter investigates what locations and sounds might be most effective in raising awareness of climate change, and also explores what problems arise when listening to climate change *only* at a glacier.

Chapter 2, *Learning to Die*, forms the theoretical basis of the project, exploring music’s potential to facilitate and strengthen a listener’s ability to “let go” of the contemporary modes of living that have produced the

climate crisis. Arguing for a divergence in thinking and philosophical outlook, this chapter provides the basis for why listening devices can be viewed as productive tools for stimulating a transition away from anthropocentrism and its related destruction.

Chapter 3, *Learning to Listen*, explores listening as an ethic towards change. This chapter also describes acoustic space as a shaper of human sonic output. By augmenting acoustic space with listening devices that make climatic phenomenon audible, human responses may adapt to accommodate these non-human sounds.

Chapter 4, *Human-produced Music & Environmentally Produced Sound*, analyzes various recorded sounds to consider what rhythmic and melodic structures a human player might be letting go of when adopting the climate’s sonic language into their musical sensibilities. This chapter also considers what an interaction between humans and non-humans might sound like, and provides a framework for assessing the instrument designs in the two following chapters.

Chapters 5 and 6, *Domesticating the Unfamiliar* and *Defamiliarizing the Domestic*, are developed in tandem to provide a framework of *where* and *how* climate change can be listened to and sonically engaged, each attempting to fill in the gaps the other misses. *Domesticating the Unfamiliar* speculates on the ability of listening devices to reach outwards and make audible the usually unheard realities of climate change. By contrast, *Defamiliarizing the Domestic* attempts to reevaluate the normalcy of domestic sound, considering any listener’s immediate soundscape as sonically relevant and informative.

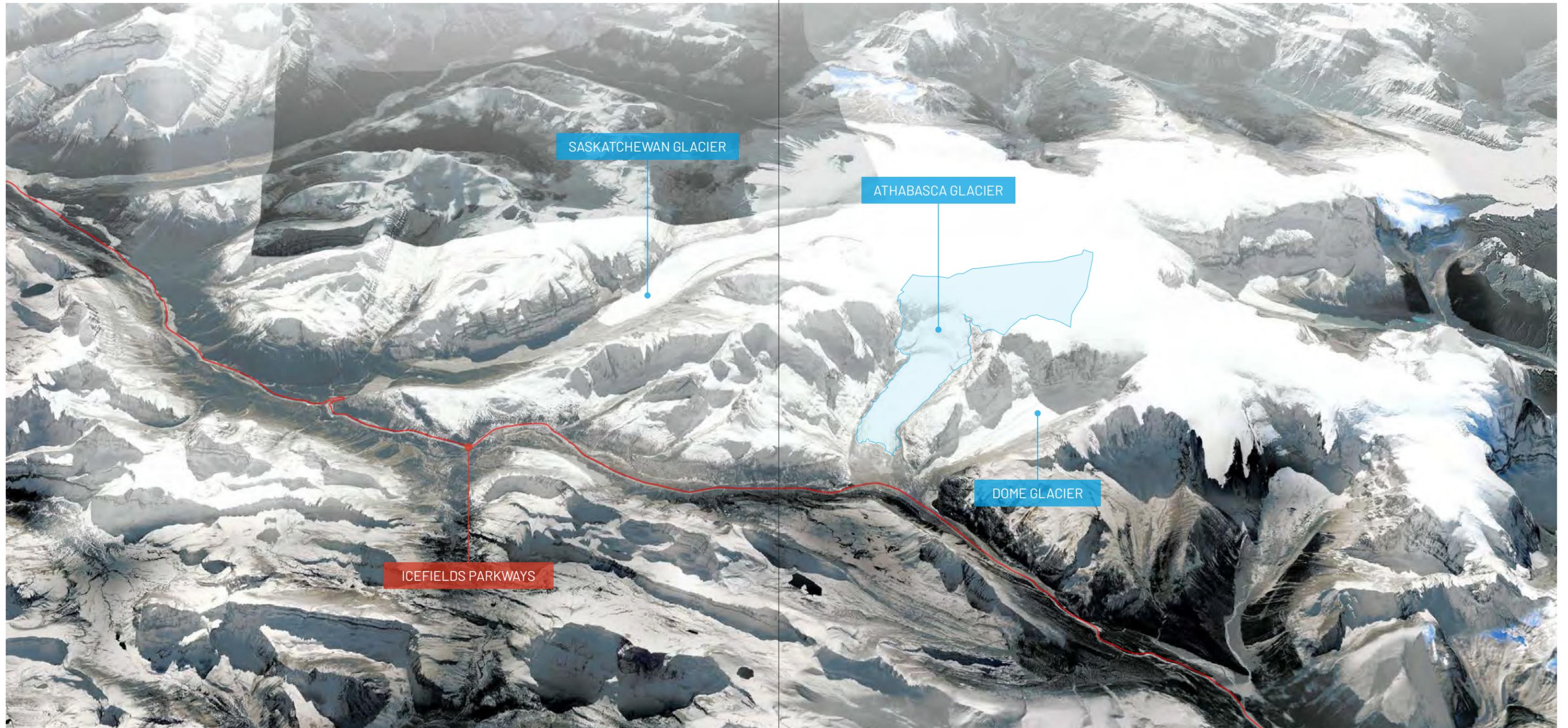
CHAPTER 1: WHERE TO LISTEN

1.1 Sound as Document

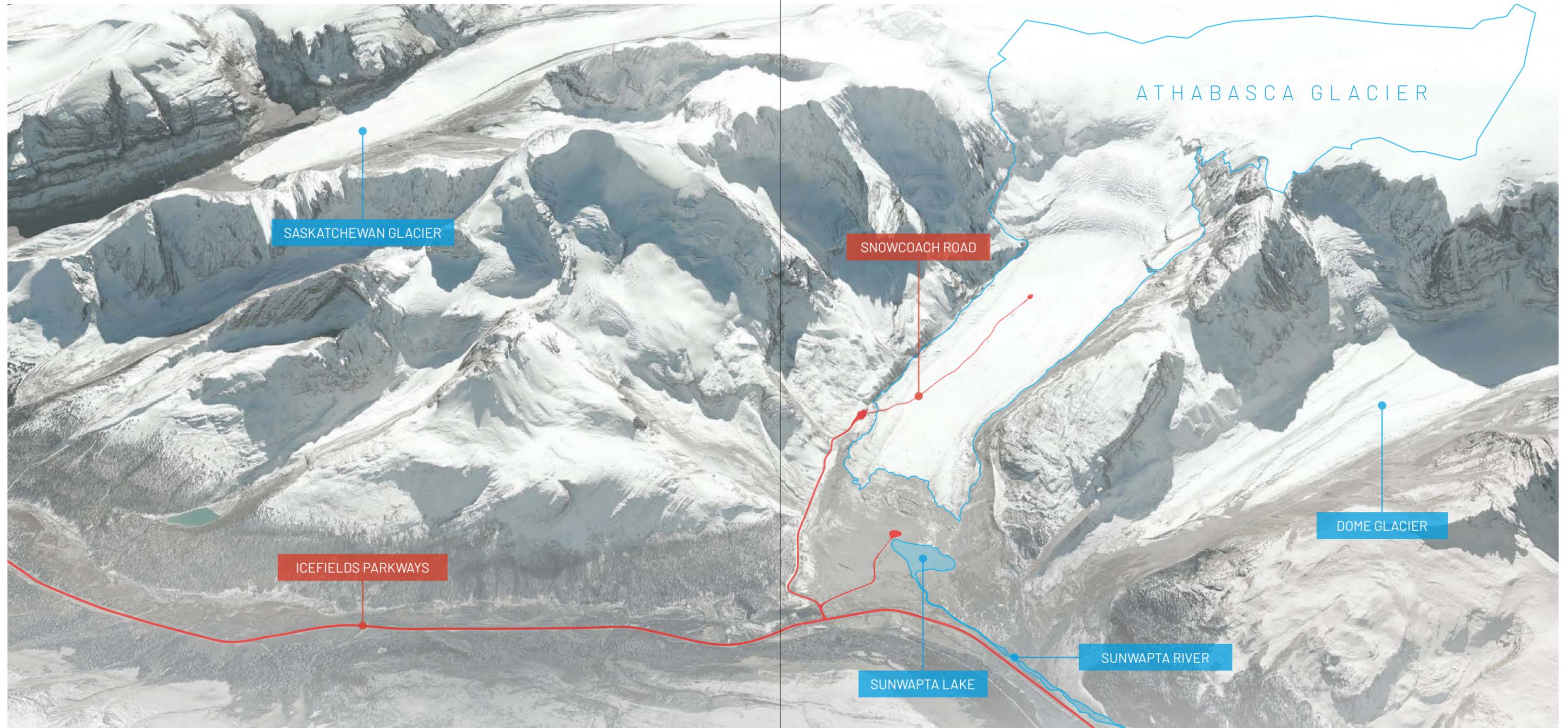
My interest in studying glaciers began during a six-week design studio that aimed to make apparent the effects of global warming in the largely unaffected city of Ottawa I wanted to raise awareness of climate change and stimulate thought. Understanding that reports and data sets related to climate change do little to shift most people's perceptions, I drew inspiration from Bernie Krause's lecture statement that "geophonies [sound produced by earth processes] are the signature voices of the natural world, and as we hear them, we're endowed with a sense of place, the true story of the world we live in."² Additionally understanding Robert Smithson's notion that "the city gives the illusion that the earth does not exist,"³ I wanted to sensorially connect myself and other city-dwellers to these glacial protagonists, to understand them tangibly and personally. Finally, combined with another very basic idea that humans care about the things they understand in detail,⁴ recording the "voices" of these glacial protagonists as they vanish then become a kind of climate-activism through sound, hopefully promoting care for these disappearing landscapes and positive behavioural change. With a growing curiosity in field recording, I decided to listen to the Athabasca Glacier after reading Bernie Krause's instruction score from his book *Wild Soundscapes* (text continues on page 13):



1.1.1 Satellite view of the Columbia Icefield with the Athabasca Glacier highlighted, Alberta, Canada



1.1.2 Columbia Icefield, 2019



1.1.3 Athabasca Glacier, 2019



1.1.4 and 1.1.5 (above):
Recording surface river
Photograph by Stephanie Murray

1.1.6 (far left):
Stephanie Murray recording
water before passing into a
crevasse with hydrophone

1.1.7 (left):
Stereo recording of a crevasse
Photograph by Stephanie Murray

Follow Water from Its Source

Pick a well-known river like the Hudson, the Mississippi, the Colombia, the Rhine (Germany), the Seine (France), the Volga (Russia), the Amazon, or the Nile, and trace the route it follows from its source in the mountains to its outlet. Recording and archiving each type of habitat along the way. The river will eventually flow into some other river, a freshwater lake, or the ocean. Following its entire course will certainly take you through many different ecological zones and places you might not otherwise visit. All along the route you will hear variations in water flow, creature voice density, and human sounds, all of which are part of the soundscape.⁵

At the glacier, I found myself engaging space in an all-together different way when navigating with my ears. My companion and I heard so much, and were particularly focused on listening to a sound Krause describes in another instructional score:

Listening to Ice

You can capture the sound of glaciers moving over land by dropping a hydrophone down into a crevasse. What you'll likely hear is the terrifying and powerful low-frequency signature of the mass of ice moving slowly over the ground and, in the process, forming the moraine.⁶

We didn't capture the glacier's low-frequency signature that day. We did, however, capture many glacier sounds. I began to consider what kind of instruments or devices might reveal these sounds of the glacier's fluctuation and eventual disappearance. What will the riverbeds the Athabasca feeds sound like once its all melted?

1.2 Protagonists & Personhood

There are roughly 200,000 glaciers on Earth with nearly every glacier's outline collectively mapped and catalogued by various cryospheric initiatives such as the Randolph Glacier Inventory (RGI) and Global Land Ice Measurements from Space (GLIMS).⁷ Glaciers are classified by their unique contexts and their unique effect on that context; valley glaciers (such as Athabasca) carve and smooth out valleys between mountains while tidewater glaciers flow out to sea, producing icebergs as they calve. There are also mountain glaciers, piedmont glaciers, hanging glaciers, cirque glaciers, ice aprons, rock glaciers and ice streams.⁸ Glaciers vary greatly in size, the smallest classification being 0.1 square kilometers large while the biggest, the Lambert-Fisher Glacier in Antarctica, is 400 kilometers long and up to 100 kilometers wide.⁹ Glaciers are described as having two main areas: the "accumulation zone," a high-altitude area where snow and ice accumulates, and the "ablation zone," a low-altitude area where the ice dissipates by calving, melting, evaporating, and aeolian processes such as snow-blowing among others.¹⁰ A glacier advances, or grows, when the rate of precipitation in its accumulation zone is greater than the rate of melting in its ablation zone. When the rate of melting is greater than the rate of precipitation, as is the case with most glaciers today, the glacier retreats, or shrinks.



1.2.1 Symbols the WWF uses in their endangered species lists.

“As receding glaciers are widely accepted as one of the primary indicators of global warming, they are increasingly becoming protagonists in the story and collective imagination of climate change, offering a rich ground for both objective measurement and cultural mythology.”

This was the opening statement of my travel bursary application to Carleton Architecture to travel to the Athabasca Glacier in Jasper National Park in Alberta in the summer of 2018, and I still regard it to be largely true. However, and as I'll attempt to demonstrate in this chapter, the existing "glacier as protagonist of global warming" mythology is as much a compelling lure into the discourse of climate change as it is a problematic use of a terrestrial landform for political argument. What makes this argument problematic came to light while developing an addition to the thesis' early research and design: an *Atlas of Endangered Glaciers*. At that point in time, having recently traveled to the Athabasca Glacier and mapped various glaciers in a design studio the year prior, an atlas was felt to be an appropriate extension of inquiry. The *Atlas of Endangered Glaciers* was initiated in the hopes of raising awareness of the effects of climate change by demonstrating tangible evidence of it in the depletion of glacial ice. This depletion was shown in the form of satellite imagery with an overlay mapping each glacier's temporal boundaries.

Each glacier's edge condition is outlined at various times using satellite imagery between 1984 and 2016 made available through Google Timelapse (fig. 1.2.2) as well as various other historical sources. However, as glaciologist and associate professor at Carleton University Derek Mueller pointed out to me, this is a relatively short period of time when studying geologic processes. Although glaciers do retreat



1.2.2 Athabasca Glacier retreat as seen from Google Timelapse.

somewhat consistently between 1984 and 2016, their fluctuation patterns are best observed over a longer period.¹¹ Of course, other experts describe a relevance to this short time frame, given the increasing temporality of glaciers. Discerning important glacial change in the context of this thesis may not require the lengthy timescales geologists are accustomed to working with. According to David Hik, a professor of terrestrial ecology at Simon Fraser University, “probably eighty percent of the mountain glaciers in Alberta and B.C. will disappear in the next fifty years.”¹² As atlases are often updated periodically, it may be appropriate to make an atlas whose timespan begins in 1984 and is updated over a lifetime (possibly my own), as that may be all the time it takes to melt completely.

The atlas itself, although largely undeveloped at this point, has been included in the appendix as it is illustrative of a larger discussion informed by various texts and conversations during this research. In fact, the majority of the “work” done on the atlas isn’t the atlas itself, but the intellectual and ethical struggle born from the process of making it.

1.3 Icons for Global Warming

In his comparison of various historical archetypal conceptions of water to the plumbing of modern-day cities, Ivan Illich demonstrates how the substance called water undergoes transformations within the social imagination.¹³ “For not only does the way an epoch treats water and space have a history: the very substances that are shaped by the imagination – and thereby given explicit meaning – are themselves social creations to some degree.”¹⁴ The same extraordinary variance in human imagination towards the substance called water is also present

1.3.1 (right):
Image from the
Atlas of Endangered Glaciers

Ice extent lines between 1714-1981
according to a 1981 study that
determined ice extents by dating
various moraines.

Ice extent lines between 1984-2016
traced from Google Timelapse.



in historical and contemporary perspectives towards the masses of ice called glaciers. My intuition to promote a specific glacier mythology for a specific purpose is not a unique one; in Mark Carey's overview of this topic, he concludes that "implicitly or explicitly, environmental narratives promote specific agendas because they construct nature and environmental problems in certain ways."¹⁵ Throughout the 18th and 19th centuries, glaciers have been viewed and experienced as many things: menaces, scientific laboratories, sublime scenery, recreation sites, places to explore and conquer, and symbols of wilderness. Most recently, melting glaciers have been used as platforms to implement ideologies within the global warming discourse, resulting in their becoming an "endangered species."¹⁶

My primary ambition in compiling the *Atlas of Endangered Glaciers* was to promote the existing 'endangered species' narrative by representing glaciers as knowable and relatable icons of global warming. This position was sought out through the act of cataloguing glaciers, and with this, certain aesthetic decisions were made. What became of particular interest was gesturing towards a kind of "personhood" of the glacier in that personhood may be a prerequisite to having rights within a human domain of thought, and even law. As botanist and author Monica Gagliano states, "when we give personhood to others," in her case, plants, "besides humans, we can start talking about the ethical and also the legal aspects of how we relate to these others, or use them, or even abuse them."¹⁷ Gagliano isn't alone in advocating this concept towards non-human entities: on March 20th, 2017, the river Ganges and its main tributary, the Yamuna, were ruled by a court in the northern Indian state of Uttarakhand to be given the same status and legal rights as living human, a decision whose legal precedent was

the same ruling towards the Whanganui River in New Zealand a week prior.¹⁸ Rulings such as this afford non-human entities a heightened respect both in our collective imaginations and institutions. By tapping into existing 'endangered species' modes of representation, the atlas aims to demonstrate the degree of severity each glacier is becoming "extinct," hopefully resulting in a heightened degree of personhood for each and promoting care for them amongst human entities.

In order to promote this personhood, I began to draw and arrange the glaciers within the atlas in a particular way. Every glacier is shown in the same orientation, their 'heads' at the top of the page and their 'toes' at the bottom. By showing the glaciers in a sequence of consistent renderings, readers may begin to understand the similarities between each, while also identifying each glacier's unique characteristics, adding to their unique "personalities." When a human being deepens their attention to the nuances of any creature, compassion for that creature emerges. Psychologist and proponent of Buddhist meditation, Tara Brach, demonstrates this phenomenon in her book *Radical Acceptance* with the example of her son watching ants, during which he discovers that "they are *real*... changing, animated, hungry, social."¹⁹ As this capacity for care emerges, a person is less likely to turn their eyes from that entity's suffering and, in the case of climate change perhaps, less likely to engage in denialism. Such a human-to-nonhuman example as also possible in a human-to-terrestrial landform capacity; the possibility of care remains a question of awareness and attention. Pursued in the form of an atlas, this can be guided and engendered through techniques of representation.

One example of communicating each glacier's uniqueness and knowability is the use of existing symbols from the World Wildlife Fund's online endangered species list. These symbols were inserted as a placeholder for future glacier-specific symbols and data (fig. 1.2.1). As well, when searching for glaciers to include in the atlas, only those with high resolution satellite images available were chosen (their resolution also seems to correlate to their level of popularity among humans). Other lesser known glaciers of a lower resolution were omitted because they are visually less defined and more ambiguous, making them difficult to read, less relatable, and therefore less effective in the atlas's ambitions. Other glaciers as well, such as Paddy Peak Glacier which I visited this summer, are less fitting to what most people imagine as a glacier in that they lack the long and iconic tongue-like form that most famous glaciers have. Paddy Peak also doesn't display the pristine white surface more well-known glaciers have, such as the Athabasca. Glaciers without clearly defined edges are less discernible, and thus more difficult to characterize as endangered species in the struggle against global warming. In order for the atlas to function as intended, the glaciers need to become a community within a crisis narrative that calls upon us, their newly made comrades, to save them.

These aesthetic judgments felt somewhat uncomfortable and strange while formulating the atlas, but became more visible during a conversation with Dr. Natalie S. Loveless, an artist and educator from the University of Alberta, who gave a talk at Concordia University entitled *Sensing the Anthropocene: Aesthetic Attunement in an Age of Urgency*.²⁰ Loveless compared the 'glacier as protagonist' narrative to Greenpeace's electing of endangered tigers, polar bears and other, in her words, "cute and cuddly megafauna" for their larger political

campaigns. She then asked, "but what about the *slimy toad* of the rainforest, who is ignored but also so eco-systemically crucial to that habitat?"²¹ From this perspective, Paddy Peak and other less-iconic glaciers are a kind of "slimy toad." These glaciers, like so many others, are crucial to their immediate and down-river habitats within their drainage basins, both human and non-human; both in isolation and in their cumulative effect.

In our decisions, both Greenpeace and I showcased relatable and knowable icons for our campaigns. This might be described as an anthropomorphization of the non-human in order to amplify public appeal. If ecological philosopher Timothy Morton is correct in describing anthropocentrism as a central obstacle to effectively responding to climate change,²² then Greenpeace's use of *only* the animals with anthropomorphic features may act to perpetuate the problems anthropocentrism inspires.

The risk of anthropocentrism and anthropomorphizing is a limited understanding of one's environment, as it results in a human not understanding non-human entities on their own terms. Although impossible to erase one's own subjectivity, to assume "reality is knowable exclusively by (human) subjectivity"²³ as anthropocentrism does, is a wedge that widens the human-world gap. As this thesis intends to minimize that gap via a more engaged interface between human and non-humans, the *Atlas of Endangered Glaciers* felt counterproductive and came to what I felt to be its ethical end.

If the atlas were to be further developed, its representation would deserve a careful examination as to what narratives it promotes. Like

the early ecologists who found that studying an animal in isolation from their environment only took them so far, a glacier's context, where it accumulates mass and where and to whom it drains is important. As has been eloquently stated by author Thom Van Dooren, such brands of "holist ecological philosophy which emphasize that 'everything is connected to everything,' will not help us here. While we may all ultimately be connected to one another, the specificity and proximity of connections matter - who we are bound up with and in what ways."²⁴ By showing the glaciers as a singular entity on each page, they become a constellation of protagonists - knowable, cherishable, heroic – but, isolated and disconnected. The story of each glacier ends on the boundary of each page, while the cascade of effects that their disappearance gives rise to remains out of view.

1.4 An Ecological Divergence

The problematic nature of demonstrating climate change through a glacier's rate of recession also spawns ecological questions as to *where* and *when* climate change is and accordingly, where and when it can be observed and listened to. Is climate change *only* at the glacier, or does the glacier simply offer a heightened degree of tangibility? If glaciers really are the "cute and cuddly megafauna" adopted by various political campaigns, then what is the "slimy toad" of climate change Dr. Loveless described as being ignored, and where is it?

Timothy Morton conceptualizes climate change as what he calls a "hyperobject," that is, an object "massively distributed in time and space relative to humans."²⁵ A qualifying factor of a hyperobject is its being everywhere and nowhere simultaneously. "When I look at the

sun gleaming on the solar panels of my roof, I am watching global warming unfold... Yet, global warming is not here. Hyperobjects are *nonlocal*."²⁶ In recalling again my own ethical struggle to justify listening to climate change through the glacier's groan and melt, an uncanny realization emerges. Although understood intellectually that I along with all other human and non-humans were the enmeshed innards of climate change, this understanding was not *felt*, at least not consciously.

In attempt to frame this problem, Part II of this book is organized into two categories. The first, *Domesticating the Unfamiliar*, continues the same line of thinking since beginning the project: the value of bringing the unfamiliar sounds of climate change into the human sphere of awareness and attention. The second, *Defamiliarizing the Domestic*, explores the notion that "nature" and "ecology" are not only "over there" at the glacier, but are equally within the domestic sphere.²⁷ Humans and human habitations are inherently ecological, yet for many, the ecological relation between the immediate and the far off is not felt and thus does not inflect upon human behaviors and decision-making.

CHAPTER 2: LEARNING TO DIE

*“While dying may be the easiest thing in the world to do,
it’s the hardest thing in the world to do well.”*

–Roy Scranton

The primary argument of this thesis is a response to Roy Scranton’s notion of “learning to die” from his book, *Learning to Die in the Anthropocene: Reflections on the End of a Civilization*.²⁸ Throughout the book, Scranton’s use of the word “die” has two meanings. One meaning is to die gracefully, to accept the demise of our species and most others in the face of a potential climate catastrophe. The other meaning (and the one I am concerned with for this thesis) is learning how to let “die” the accepted norms and ways of life that have produced the climate-crisis in the first place, while transitioning to other forms of kinship towards each other, between species, and towards Earth.²⁹ I will attempt to thread this line of thinking, exploring how sound and listening might be-come modes of “dying” or letting go of ingrained behavior patterns, as well as their potential for opening alternative avenues for accepting and adapting to the current climate condition.

“Learning to die” means learning to let go; learning to think laterally; learning to step out of unconscious reactivities that continually feed ecosystemic destruction; learning to interrupt these patterns simply by recognizing them as they are and no longer feeding into them. Most of

these patterns are ones that are taken for granted to such a degree that they become difficult to see. Upon recognition, deciding which social patterns to opt of out of is additionally difficult; is it petrocapi-talism? Consumerism? The nuclear family? Some of these patterns are “stickier” than others: for example, as a student in a professional program, it is my job to manage and conduct my scholarly and professional work, necessitating the purchase of a laptop roughly every four or five years and charging it roughly every day. The same is true for billions of automobile drivers who need to get to work everyday. Of course, we cannot erase ourselves. One powerful step, however, might be cultivating an awareness towards which social patterns we are tied to, as well, how those patterns influence our desires and ultimately our decision-making.

2.1 Music as Social Process

I am testing Scranton’s use of “dying” as “letting go” in the field of music. Norms in music create, are created by, and perpetuate societal norms and philosophies. This can be a valuable stabilizer of norms, however, and as many authors on the subject of climate change claim, it is precisely these current norms (politically, philosophically, and aesthetically) that render us incapable of transitioning to this unfamiliar reality called climate change. In this way, offering a new musical aesthetic may facilitate a destabilization of entrenched modes of thinking inherent in traditional conceptions of music.

The not-so-easy challenge of dying in Scranton’s sense is that no one really knows what it looks like, and less so, what it *feels* like. This is because interruption is divergent, and doesn’t point towards singular solutions

and everlasting modes of being and feeling: “it is counterproductive and anarchic.”³⁰ The first step however is an awareness of which patterns we are tied to; which patterns any individual might participate in as “a conductor in a stress-semantic chain.”³⁰ To add a further sense of urgency, Harari writes, the “global dimension of our personal lives means that it is more important than ever to uncover our unwitting complicity in institutional oppression.”³² Although there are many theories that speculate on music as a tool of social oppression, such as the Nazi’s shift from a 432 Hz tuning system to 440 Hz to help agitate their country’s population into mobilizing against a common “enemy,” some less lofty ones exist, and don’t necessarily rely on evil politicians pulling the strings of propaganda. The oppression Harari refers to can come in many forms, be it ugly, pretty, or just plain invisible.

Conventions of music are imbued with certain views and assumptions towards living and one’s relation to society or the status quo.³³ One very common example is how in Western music, the key of a song is almost always the first note played as well as the last, meaning that if a song is in the key of B, it will most often start a B-note and end on a B-note. As well, the rhythmic and melodic phrasing throughout the song also usually follows this system, making for a repeated and predictable pattern, which becomes familiar and expected. Within this musical norm, one must always return to what is expected. When a melody goes into strange territory it will *still* return back to B, solidifying the expectation even more. This musical device is so ubiquitous that songs sound strange when straying away from it. In composer and educator Jessie Stewart’s *Jacob’s Pillow* for instance, he intentionally ends the song on a different note than he begins it with.³⁴ This piece doesn’t “tuck one in goodnight” as most Western music’s do, and leaves one feeling somewhat unsettled or off-kilter. Here, *divergence becomes musical form*.

This divergence might be music’s role in acting against the perpetuation of beliefs and norms that Scranton describes as “collective fields of excitation.” He illustrates this by using a metaphor in which he suggests “the role of the philosopher in the human swarm [is] that of an aberrant anti-drone slow-dancing to its own rhythm... continually self-immunizing against the wave of social energy we live in and amongst by perpetually interrupting its own connection to collective life.” Human swarms create the fields of excitation, and the philosopher is acting against conventions in the same way that alternate orderings of notes disrupt a listener’s expectations of normalized musical patterns.

Scranton doesn’t suggest that the philosopher become isolated from collective life, but should reconnect to it in alternate ways - music holds potential to model and enact alternate ways of being in the world.³⁵ By generating a more-than-human music, a divergence in listening and sounding may emerge between human and non-human, repatterning our perceptions as well as the way we think, expanding what is known to be possible. Here, sound is used as a medium through which to inform and nurture ecological relationships.

CHAPTER 3: LEARNING TO LISTEN

“In order to play in a cistern environment, we had to learn to listen in a new way. We had no plan, no written score, and had no discussion beforehand. We simply improvised, played, and learned that the cistern was playing with us. We had to respect the sound that was coming back to us from the cistern walls and include it in our musical sensibility. All this was unspoken and simply experienced by the three of us.”

-Pauline Oliveros, "The Difference Between Hearing and Listening"

3.1 Space as Composer

Acoustic space shapes whatever sounds emerges within it. Likewise, as W.A. Mathieu states, “a sound mirrors the shape of its container.” He continues, “the sound of a church bell in a valley reflects the shape of the whole valley.”³⁶ David Byrne takes this one step further, describing how acoustic space profoundly influences not only a sound, but a player’s making of sounds.

This is similar to Louis Kahn’s idea that “a brick wants to be an arch,” or to put it in musical terms, a note played in a large Gregorian church wants to have enough silence framing its edges as to not be drowned out by a slur of other notes.³⁷ Byrne’s research makes the case that as a playing environment changes, so too does a player’s creative response within it: “in a sense, we work backward, either consciously or unconsciously, creating work that fits the venue available to us.”³⁸

If that’s true, then music and architecture are coevolutionary; shifts in playing environments produce shifts in musical structure and form, as well as the other way around.

This collaborative interplay between human and something-other-than-human is not only reserved for spatial acoustics. What this thesis attempts to do is add the sounds of environmental phenomena into the mix. As enabled through architectural listening devices, earthly phenomena become guides in initiating novel modes of sonic form and structure; novel modes of listening and sounding.

3.2 Hearing - Watching / Listening - Acting

In her continuing research project on art and ecology, under the working title *Sensing the Anthropocene*, Natalie S. Loveless makes a distinction between art *on ecology* and art that is *formed ecologically*.³⁹ She illustrates art *on ecology* with Olifer Eliasson’s *Ice Watch* (fig. 3.2.1), a public artwork in which icebergs from Greenland were transported and placed in a public square outside the Tate Modern in London, England, and in a previous rendition, outside the UN Climate Conference COP21 in Paris, France. Although this project is most certainly poignant in that it brings the faraway consequences of global warming into public space and view, it is, in Loveless’ framework, art *on ecology*. Art on ecology generally asks that viewers *watch* something happen, whether it is taking place in visual media, performance art, theatre or other approaches. The “watching” mode of attention is an especially dangerous one in this age of human-produced climate change.⁴⁰ Viewers *watch* as ice melts outside the Tate Modern just as one might *watch* glaciers recede in an atlas. In both cases, viewers may

be interested, but are potentially left with a feeling of powerlessness to influence what is happening in front of them. “Watching” might only further promote the “game over” attitude already too prevalent, an outlook that if strengthened might indeed become a self-fulfilling prophecy.⁴¹

By contrast, art that is *formed ecologically* is art that positions itself not outside the problem it addresses.⁴² Through *Sensing the Anthropocene*, Loveless advocates for artworks that include and engage audience members as key elements of the art itself. In this kind of ecologically formed art, participation and interactivity is integral. For the purposes of this thesis, I replace “art” with “architecture” and similarly seek an architecture that invites people to participate instead of watch. By inviting people to participate instead of watch, architecture may empower participants to take action and respond to climate change, while acting against the “watching” mode of attention and its inadvertent problematic and negative consequences.

It has long been recognized educationally that changing attitudes and acceptance of new knowledge is a prerequisite to behavioural change of first individuals and then the norms of behaviour of their groups.⁴³ As psychologist Carl Rogers famously said, “the curious paradox is that when I accept myself just as I am, then I can change.” Although I believe that an *Atlas of Endangered Glaciers* may ignite interest and concern through a personification of glaciers as protagonists in global warming, it is, in Loveless’ framework, a work *on ecology* rather than one *formed ecologically*. As this thesis stems from a gathering sense of urgency towards responding to climate change, one must continually ask what methods are most effective in integrating awareness and acceptance,

the prerequisites for positive behavioural changes. Whereas an atlas surely raises *awareness* of climate change, *acceptance and the behavioural changes that follow* may be less certain. As discussed earlier, instruments that invite participants to interact with climatic phenomena aim to stimulate a deeper integration of climatic realities. Whereas art on ecology runs the risk of further cementing a human’s viewing of the world from a distance, interactive instruments seek to minimize the human-world gap, hopefully enabling positive behavioural change.

Should the atlas be developed further, what might strengthen its ability to integrate awareness, as well as acceptance and even behavioural change, might be to include each glacier’s groan or soundscape, perhaps streaming in real time, in addition to their satellite-view temporal ice extents image.



3.2.1 *Ice Watch* by Olafur Eliasson and Minik Rosing, Place du Panthéon, Paris, 2015.

Photograph: Martin Argyroglo, © Olafur Eliasson 2015.

END NOTES - PT. 1: AWARENESS & ACCEPTANCE

1. This quote from Polish-American composer, performer and instrument inventor Lucia Dlugoszewski, is the opening quote of *Deep Listening: A Composer's Sound Practice* by Pauline Oliveros. As I follow Dlugoszewski's and Oliveros' intention to "dissolve rigidity" through certain modes of listening and sounding, I also use it to open and frame this book, understanding it as a means of continuously and effectively transitioning to the contemporary climatic condition. This notion of rigidity and solution is further explored in Chapter 2, *Learning to Die*.
2. Bernie Krause, "The Voice of the Natural World," *TED*. June 2013. Accessed July 20, 2018. https://www.ted.com/talks/bernie_krause_the_voice_of_the_natural_world?language=en.
3. Robert Smithson, "A Sedimentation of the Mind: Earth Projects," *Artforum International*, September 1968, 83.
4. Tara Brach, *Radical Acceptance: Embracing Your Life with the Heart of a Buddha* (New York: Bantam Books, 2004), 221.
5. Bernie Krause, *Wild Soundscapes: Discovering the Voice of the Natural World* (New Haven: Yale University Press, 2016), 116.
6. *Ibid.*, 117.
7. "International team maps nearly 200,000 global glaciers in quest for sea rise answers," *Science Daily*. May 6, 2014. Accessed February 3, 2019. <https://www.sciencedaily.com/releases/2014/05/140506120246.htm>.
8. "What types of glaciers are there?" *National Snow & Ice Data Center*. Last modified 2019. Accessed February 3, 2019. <https://nsidc.org/cryosphere/glaciers/questions/types.html>.
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10. "Ablation Zone," *Wikipedia*. Last modified June 25, 2017. Accessed February 3, 2019. https://en.wikipedia.org/wiki/Ablation_zone.
11. Derek Mueller, Interview by Josh Wallace. Conversation about glacier characteristics and representation. Carleton University, November 20, 2018.
12. Hina Alam, "Western Canada glaciers retreating at an unprecedented pace because of climate change: experts," *The Globe and Mail*. Last modified December 18, 2018. Accessed November 8, 2019. <https://www.theglobeandmail.com/canada/article-glaciers-in-western-canada-retreating-at-unprecedented-pace-because-of/>.
13. Ivan Illich, *H2O and the Waters of Forgetfulness* (Dallas: The Dallas Institute of Humanities and Culture, 1985).
14. *Ibid.*, 4.
15. Mark Carey, "The History of Ice: How Glaciers Became an Endangered Species," *Environmental History*, 12, no. 3 (2007): 518.
16. *Ibid.*, whole text.
17. RadioBue.it, "Listening plants: a study reveals that plants can hear, interview with Monica Gagliano," *YouTube*. April 27, 2017. Accessed August 5, 2018. <https://www.youtube.com/watch?v=G7mffBMLT7o>.
18. Michael Safi, "Ganges and Yamuna rivers granted same legal rights as human beings," *The Guardian*. March 21, 2017. Accessed February 8, 2019. <https://www.theguardian.com/world/2017/mar/21/ganges-and-yamuna-rivers-granted-same-legal-rights-as-human-beings>.
19. Brach, *Radical Acceptance*, 221.
20. Natalie S Loveless. "Sensing the Anthropocene II: "Aesthetic Attunement in an Age of Urgency." Lecture, Event from the Centre for Sensory Studies, Montréal, November 28, 2018.
21. Natalie S. Loveless in discussion with the author. November 28, 2018.
22. Timothy Morton., *Hyperobjects: Philosophy and Ecology after the End of the World* (Minneapolis: University of Minnesota Press, 2014), 22.
23. *Ibid.*, 22.
24. Thom Van Dooren, *Flight Ways: Life and Loss at the Edge of Extinction* (New York: Columbia University Press, 2014), 60.
25. Timothy Morton, *The Ecological Thought* (Cambridge, Mass.: Harvard University Press, 2010), 130-35.
26. Morton, *Hyperobjects*, 38.
27. Timothy Morton, "Being Ecological | Timothy Morton | RSA Replay," *YouTube*. January 29, 2018. Accessed December 20, 2018. https://www.youtube.com/watch?v=d_5UWI-SEVE.

28. Roy Scranton's *Learning to Die in the Anthropocene: Reflections on the End of a Civilization* became important to me during a design studio last year that asked how architecture can communicate and effect various global phenomenon such as climate change. The design for that studio was a series of simple aluminum posts that whistled in the wind. Organized linearly, the posts drew the outline of the Athabasca Glacier in Alberta, Canada (at a 1:1 scale), marching out across the city of Ottawa for some kilometres. Hypothetically, the posts would be moved every winter during the annual Winterlude Festival in a collective ritual that brings awareness to and honours the shrinking glacier. This is where my interests in soundscape and climate change began to align.
29. Roy Scranton, *Learning to Die in the Anthropocene: Reflections on the End of a Civilization* (San Francisco: City Light Books, 2015).
30. Ibid., 87.
31. Ibid., 87.
32. Yuval Noah Harari, *21 Lessons for the 21st Century* (Toronto: Signal, an imprint of McClelland & Stewart, a division of Penguin Random House Canada Limited), xvi.
33. Jesse Stewart, "Music & Visual Culture," Class discussion, Carleton University, Ottawa, September 19, 2018.
34. Ibid.
35. Jesse Stewart in discussion with the author. November 15, 2018.
36. W.A. Mathieu, *The Listening Book: Discovering Your Own Music* (Boulder: Shambhala Publications, Inc., 2011), 20.
37. David Byrne, "How architecture helped music evolve," *TED*. 2010. Accessed September 10, 2018. https://www.ted.com/talks/david_byrne_how_architecture_helped_music_evolve?language=en.
38. David Byrne, *How Music Works* (Edinburgh: Canongate Books, 2013), 16.
39. Loveless, "Aesthetic Attunement in an Age of Urgency," Lecture.
40. Ibid.
41. Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016), 3-4.
42. Loveless, "Aesthetic Attunement in an Age of Urgency," Lecture.
43. J. Dixon, "Evaluation criteria in studies of continuing education in the health professions: A critical review and a suggested strategy," *Evaluation & the Health Professions*, 1. (1978): 47-65.

CHAPTER 4: HUMAN-PRODUCED MUSIC & ENVIRONMENTALLY PRODUCED SOUND

Although sonic interactions between humans and non-humans are not new, this phenomenon gains new meaning during an epoch of such vast and swift ecological destruction. I recall my own experience interacting with non-humans while singing, or cooing, with a group of pigeons cooing back at me in an empty water cistern that had been carved into solid stone (fig. 4.0.1). Excited by the incredibly long acoustic reverberation of the space, I couldn't help but get carried away, throwing a large stone in the air just to hear its loud smack onto the hard floor. In my child-like naivety, I somehow didn't foresee the birds flying away at the sudden boom of the rock. They did, and our communication ended. Other more experienced players however are far more skilled when sonically interacting with non-human entities.

Pigeons in a Cistern

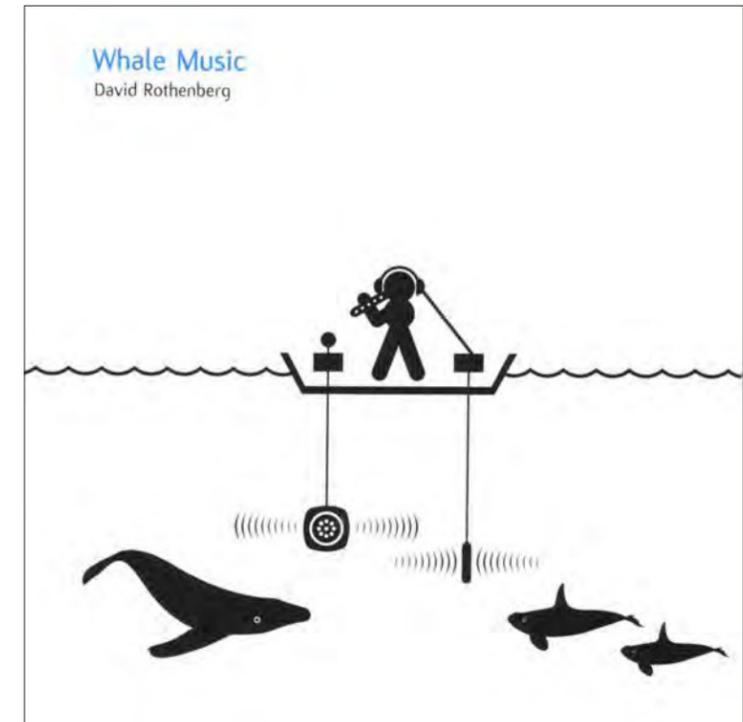
Field Recording by author

March 28, 2018 - 00s

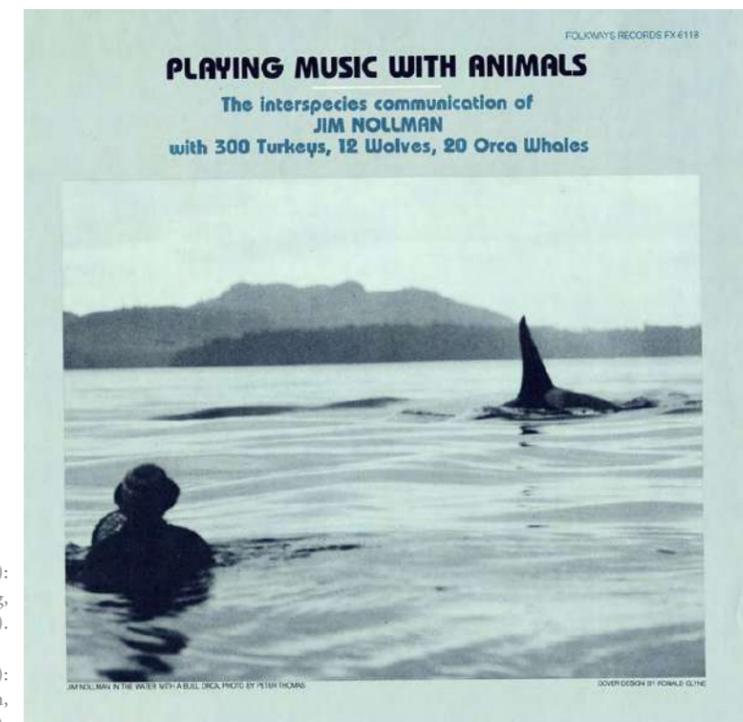


4.0.1 Interacting with pigeons in an empty stone cistern atop Mt. Masada.

Jim Nollmann's album *Playing Music with Animals: The Interspecies Communication of Jim Nollman with 300 Turkeys, 12 Wolves and 20 Orca Whales* includes a series of surprisingly dynamic interplays between human and non-humans (fig. 4.0.3). This artist's work, like



4.0.2 (above):
David Rothenberg,
Whale Music (2008).



4.0.3 (right):
Jim Nollman,
Playing Music with Animals (1982).

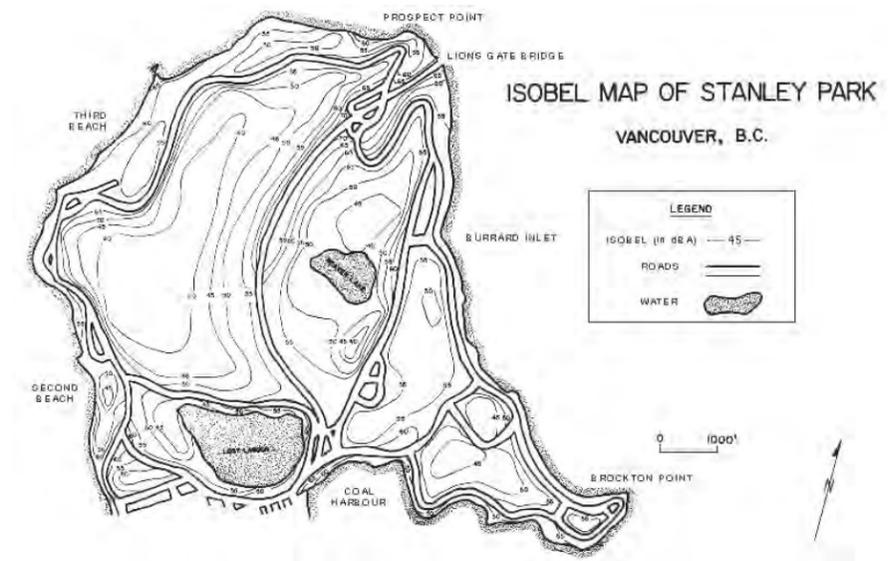
that of Bernie Krause, became a mode of relating to animals and their habitats.¹ Another composer that became a naturalist through sound is David Rothenberg. His album *Whale Music* involves listening to humpbacks, belugas, and killer whales via hydrophone while also transmitting his own clarinet into their sonic spaces by dropping an underwater speaker into the water, enabling interaction (fig. 4.0.2). These interactions sparked my own explorations in sound analysis and sound comparison.

This chapter is comprised of four catalogues intended to develop a design language towards human and non-human sound in space. The topics of exploration are as follows: (1) imagined isobel maps, (2) human and non-human sound analysis via polar spectrograms, (3) imagined sonic interactions between humans and non-humans, and (4) diagrams that frame the design work in the next chapters. Each catalogue begins with an introduction and description.

4.1 Imagined Isobel Maps

An isobel map, or sound contour drawing, is typically a plan view mapping of sound intensities in geographic space via contours, hues of grey or colors, or other means. The maps in this catalog are imagined and are not located in any specific site. They serve as tests in mapping an imagined sonic condition, a step towards informing an aural architectural imagination.

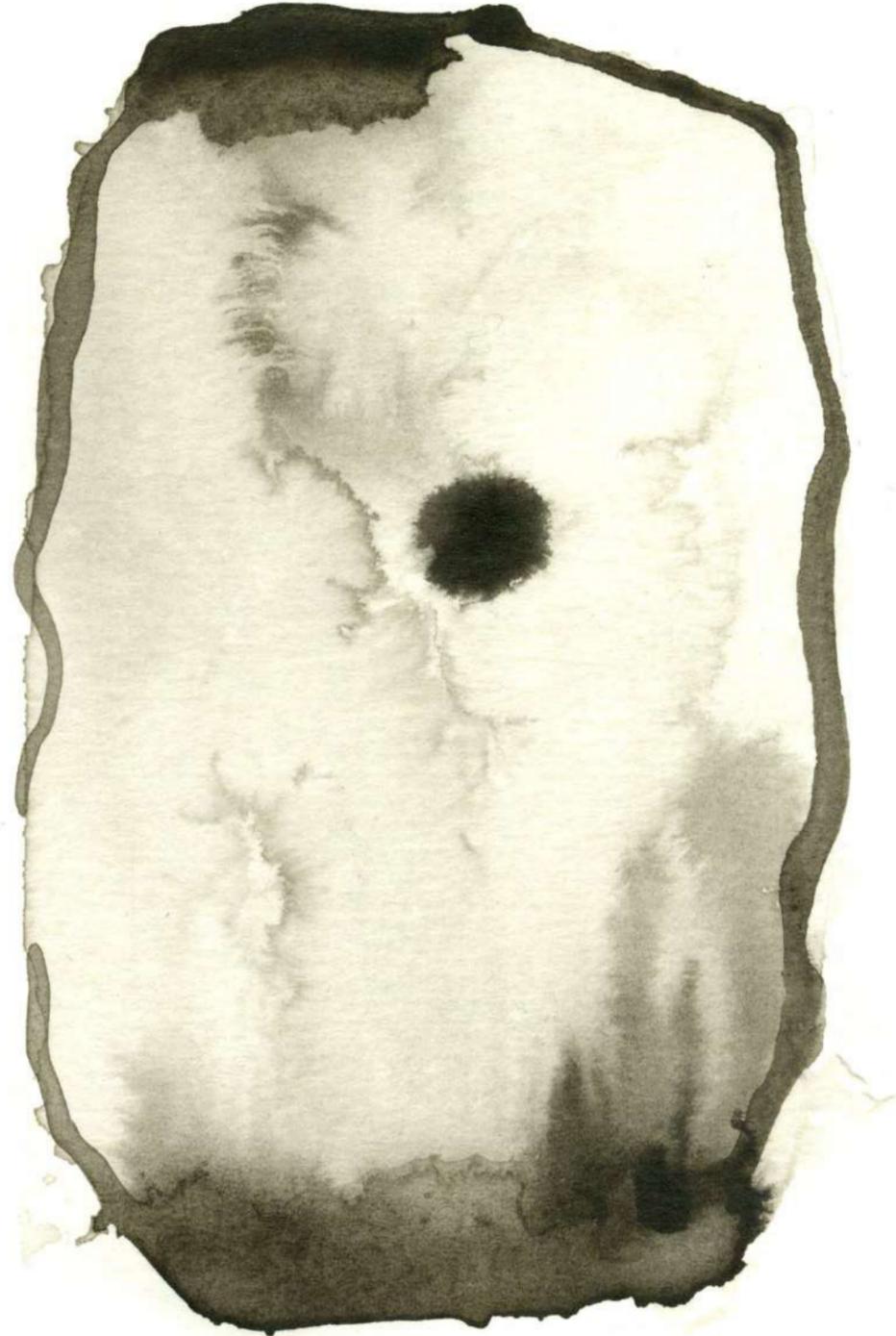
Each imagined isobel map is drawn first with black India ink and water on watercolor paper. The hues of black and grey indicate varying levels of sound intensity, or loudness. The darkest areas indicate a high intensity



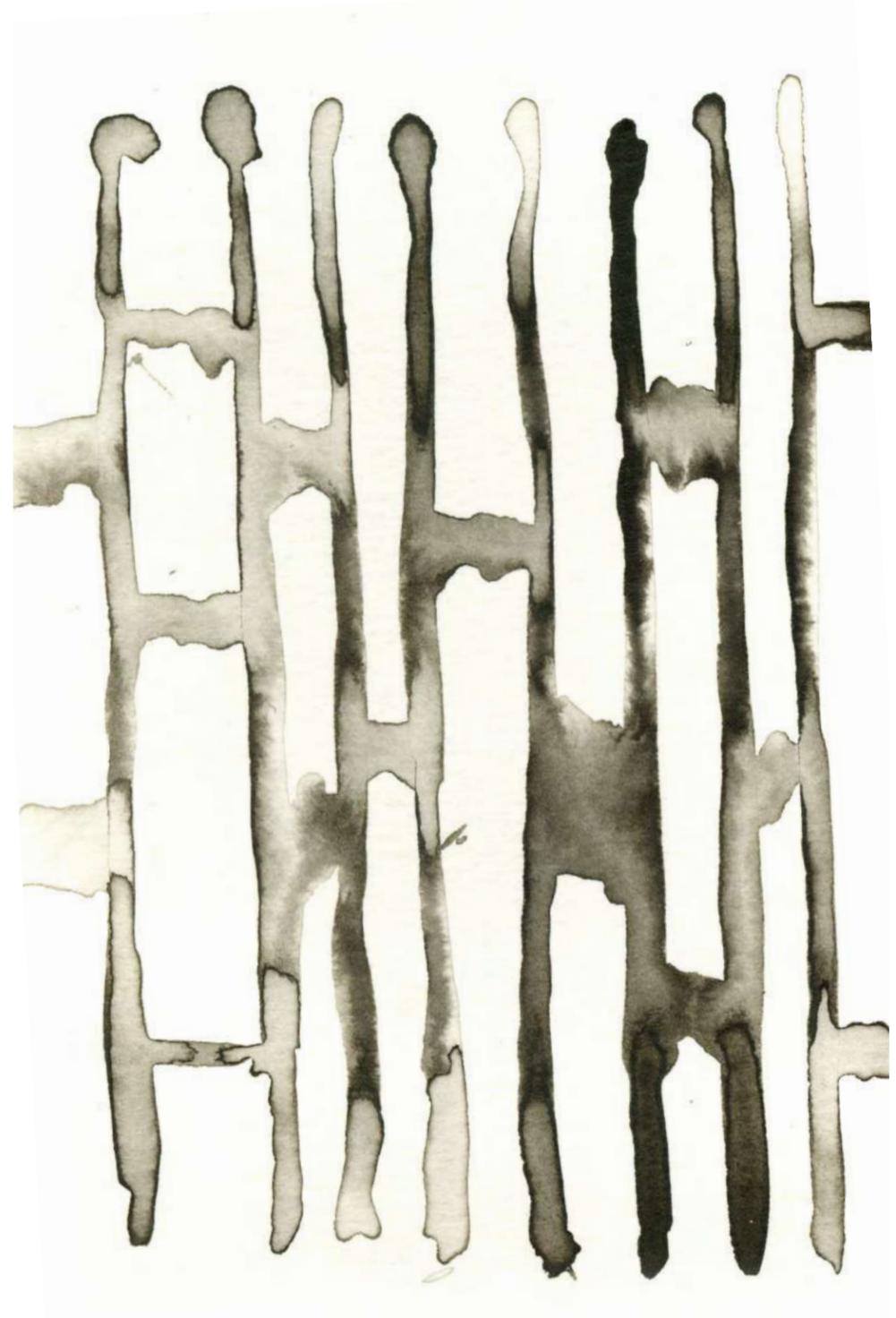
4.1.1 R. Murray Schaefer, Isobel Map for Stanley Park (1974). Contour lines are used to delineate intensities of sound.

while the lighter or white areas indicate a lower intensity or silence. The ink drawings are also filtered through the ‘image trace’ algorithm in Adobe Illustrator, converting the wide range of ink hues into discrete color intervals. The use of discrete color intervals is intended to translate a complex sonic phenomenon into a measured visual language, similar to a geographer’s use of contour lines to describe surface elevation.

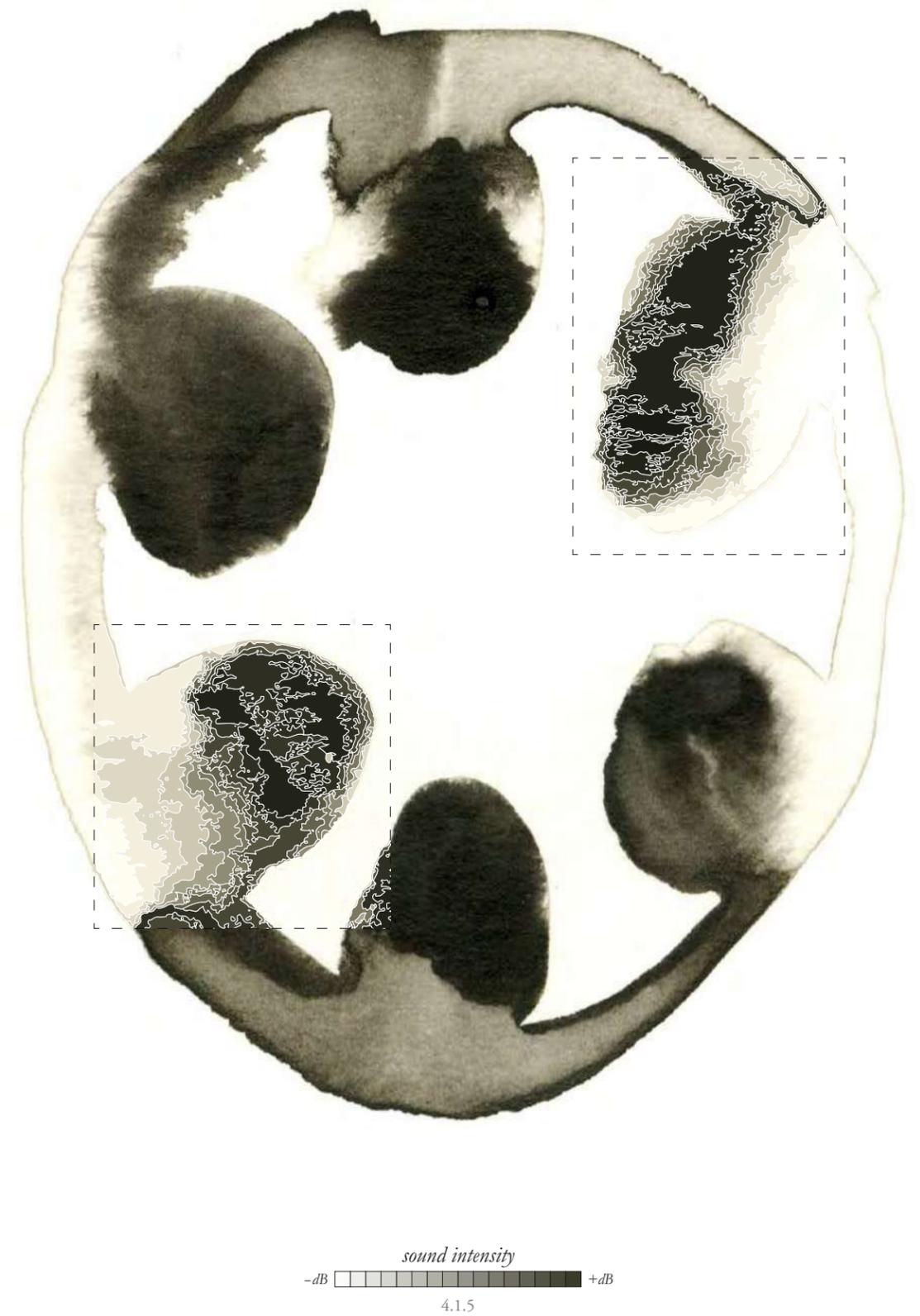
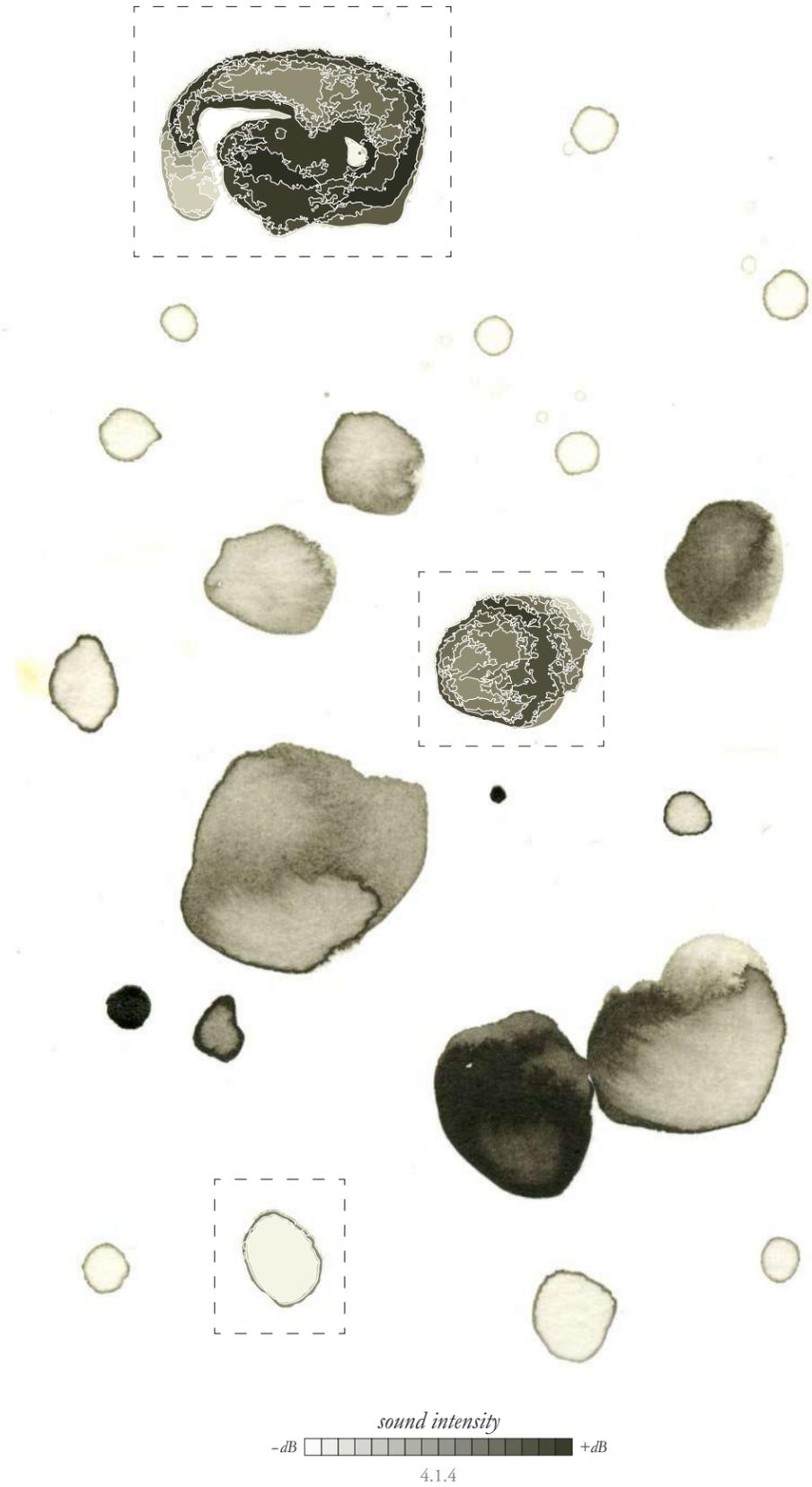
At this point in time, there are few conventional languages for soundscape notation. As a precedent, I am beginning with an isobel map drawn in 1974 by R. Murray Schaefer for the World Soundscape Project’s *Music of the Environment* series titled “Isobel Map of Stanley Park” (fig. 4.1.1). Although this example is drawn as a ‘plan’, isobel maps can also be drawn as sections, axonometrics, and perspective views etc. With no scale, these maps can be imagined as vast landscapes, a few drops of rain on a wooden shingle, or the tiny vibrations of a critter’s nervous system.



sound intensity
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4.1.2

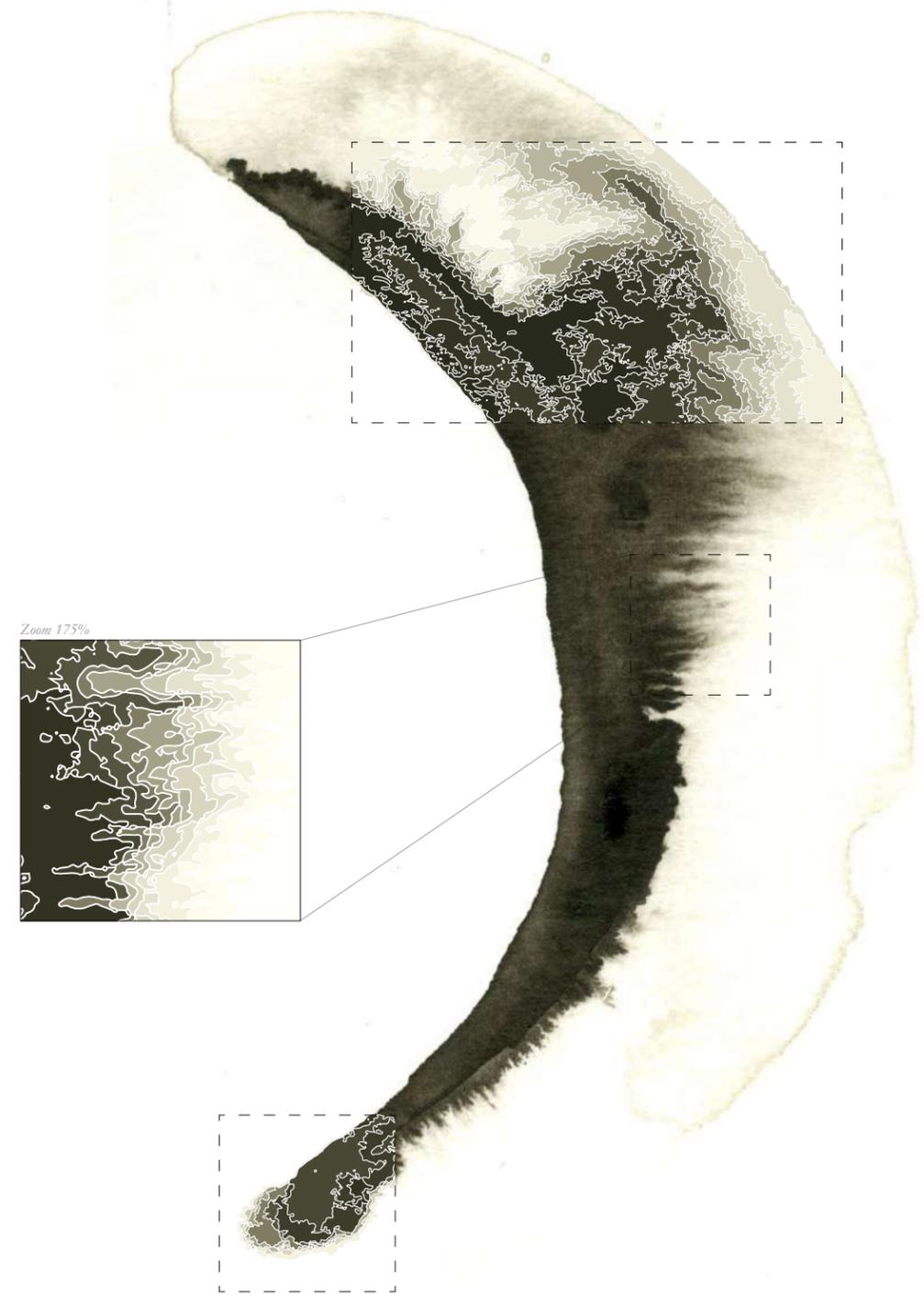


sound intensity
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4.1.3

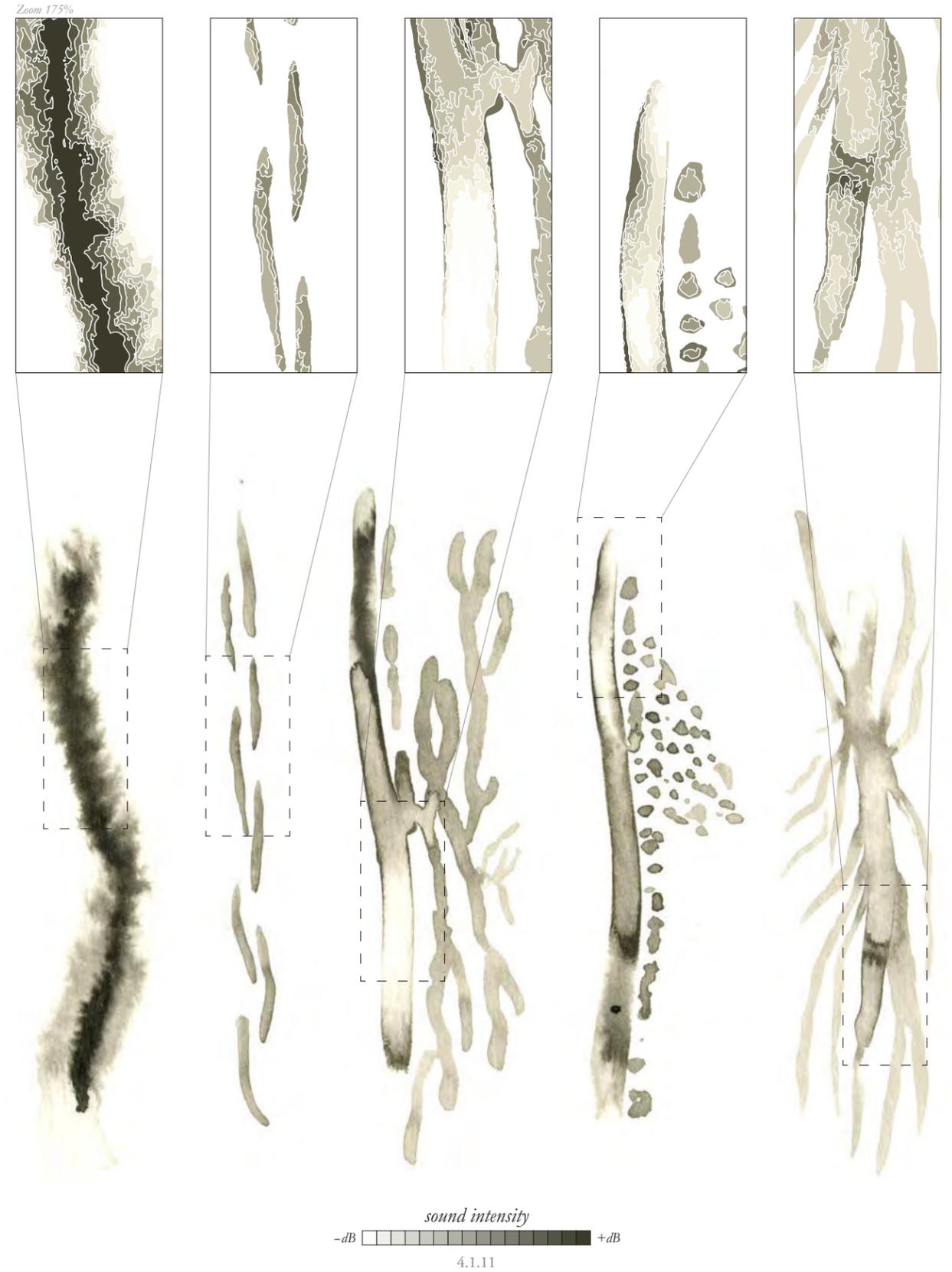
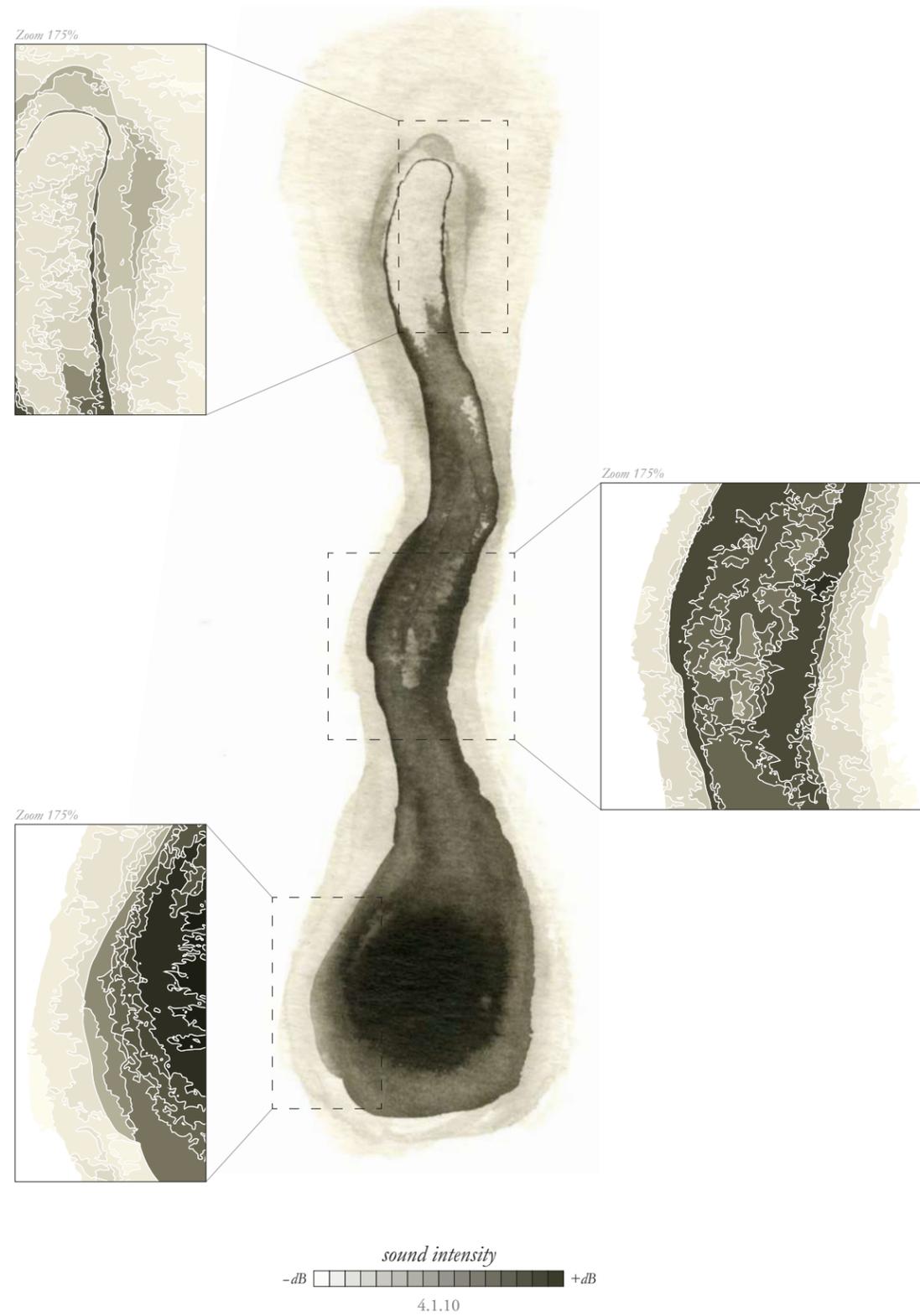




sound intensity
-dB  +dB
4.1.6



sound intensity
-dB  +dB
4.1.7



4.2 Polar Spectrograms

This thesis theorizes that “letting go” of human logics while music-making and adopting a more-than-human mode of engaging sound is a productive practice grounds for non-anthropocentric thinking. What would a participant engaging in this kind sympoietic sounding-making be letting go of, and what might they be adapting to? What are differences between human-produced music and environmentally produced sound?

To probe this question, structures and patterns of various recordings have been catalogued visually as spectrograms to understand their differences and similarities. Like how an isobel map describes sound intensities in geographical space, a spectrogram is a mapping of sound intensities and their frequencies over time. Again like the isobel maps, darker moments of spectrograms indicate higher signal gain (loudness) and lighter or white spaces indicate a lower signal gain or silence. Frequency or tone is mapped from bottom to top in the y-axis, and time is mapped from left to right in the x-axis. Because time is mapped this way, vertical lines within the spectrogram indicate a short-lived burst of sound or “beat,” like a drum hit. Correspondingly, horizontal lines indicate a sustained tone, and diagonal lines indicate a gradual ascent or descent of tone.

A range of sounds have been translated into spectrograms for analysis: music from the Medieval era and today (my own and others), various field recordings of environmental phenomenon (my own and others) and animal calls (which were explored in relation to the ‘glacier as endangered species’ narrative). The recordings were made with a wide

range of microphones, sensitivity settings, and acoustical environments. The software used to produce each spectrogram is Raven Pro, a bioacoustics software from Cornell University’s Lab of Ornithology. The spectrograms are also filtered through a ‘polar coordinates’ algorithm, warping each into a circle. As polar arrays, each spectrogram fills the same amount of space on each page, regardless of duration. This is intended to produce a uniform read across a field of spectrograms that quickly characterizes each sound. It is also intended to visualize the unique rhythmic and frequency structures of each sound to reveal the differences and similarities between human music and environmental sound.

Human-produced music is often tonal and rhythmic, meaning its frequencies only occur within discrete interval relationships and its tempo is generally consistent and repeating. Environmentally produced sound, however, is often *atonal* and *arhythmic*, consisting of an enormous range and granularity of frequencies and frequency relationships.

Structures of human-produced music are revealed through polar spectrograms. In the case of Holborne’s “The Fairie Round (Galliard No. 3),” the piece is divided into clear sections or quarter-circles. This spectrogram only shows the first 94 beats of the piece as divided into 24-beat chunks, but this rhythm of timing as well as melodic note-placement remains consistent through the composition.

Consistent timing intervals are especially legible in the “Guitar Elements” spectrogram. This composition is constructed with a series of short musical phrases, or parts, laid side-by-side like bricks, some

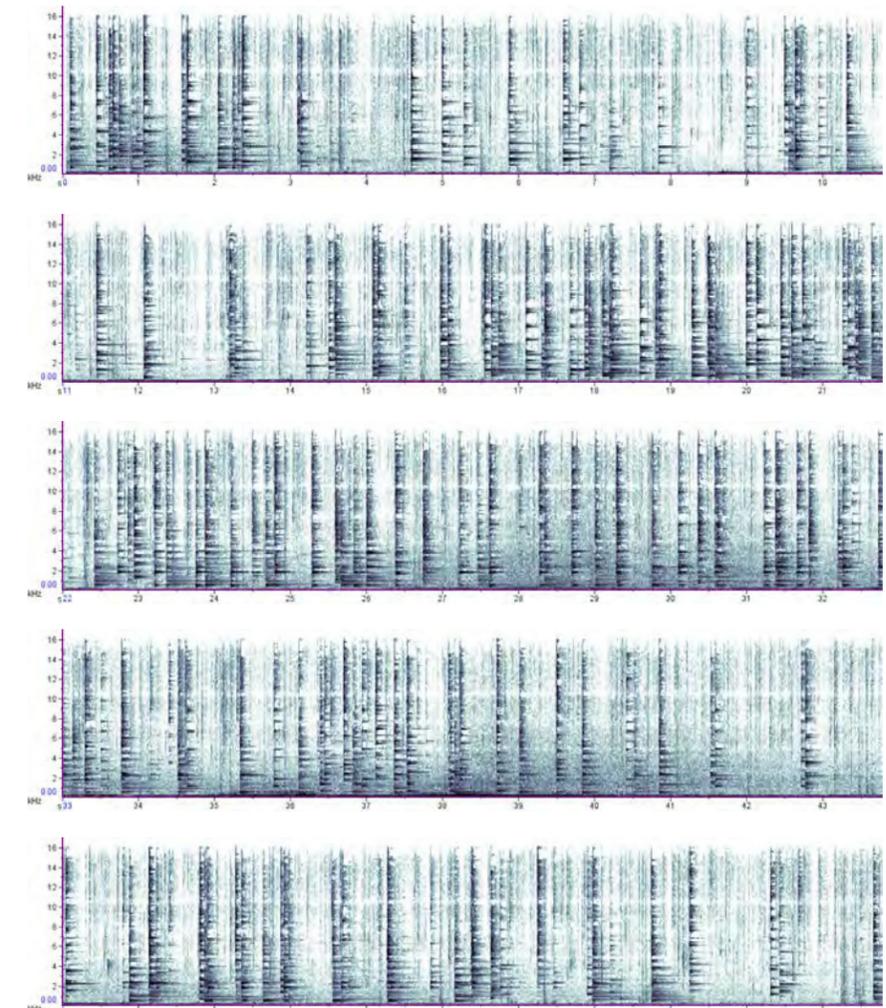
repeating while others occur only once. Here, the spectrogram is not shown from start to finish like the others, but is organized in terms of these parts and their rhythmic organization. Mapped over 8 beats, the count of 4 beats occurs twice in one cycle, meaning that as one reads it, their eye moves in concentric circles from inner to outer. The timing structure acts as a scaffold, permeating each layer of the spectrogram and guiding the placement of the notes. In this way, a timing structure is an incredibly enabling organizational device, like that of an underlying grid organizing so many human architectures. Like parcels of land, humans regularly delineate time into consistent chunks, guiding the organization of melodic and rhythmic patterns within their boundaries and divisions.

Although environmentally produced sound doesn't consist of "set" tempos, its sounds do align with earthly and biological rhythms. These rhythms (according to my ear) however, "repeat" or manifest over a much longer duration than those of human-produced music. This might be chorus of birds sung every dawn and dusk, the crunch of crispy leaves every fall, or the mating song of the cicadas sung only at the end of their 17-year long lives.² At the human scale of listening to music (3-5 minutes to 1 hour for instance), these longer rhythms are not perceivable. What is present however within this duration of listening has more to do with density than it does with rhythm. As environmentally produced sounds are not governed by set time intervals, their sounds



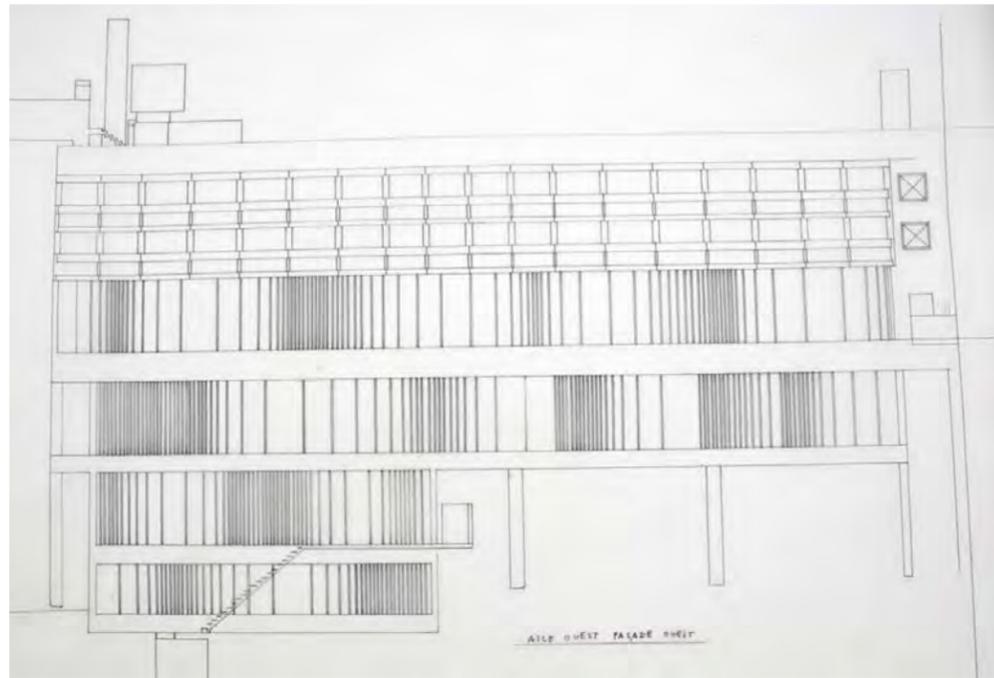
4.2.1 photograph during "Rain on Bowls" recording. Bowls are placed directly below the eaves of a house.

might occur more as densities of notes rather than evenly or regularly spaced beats. This density of notes is particular present in the "Rain on Bowls" spectrogram (fig. 4.2.2) and bares a strong resemblance to the compositional methods of 20th century architect and composer Iannis Xenakis. (The same "Rain on Bowls" recording has also been made into a polar spectrogram and is included on the first spread of that series.)

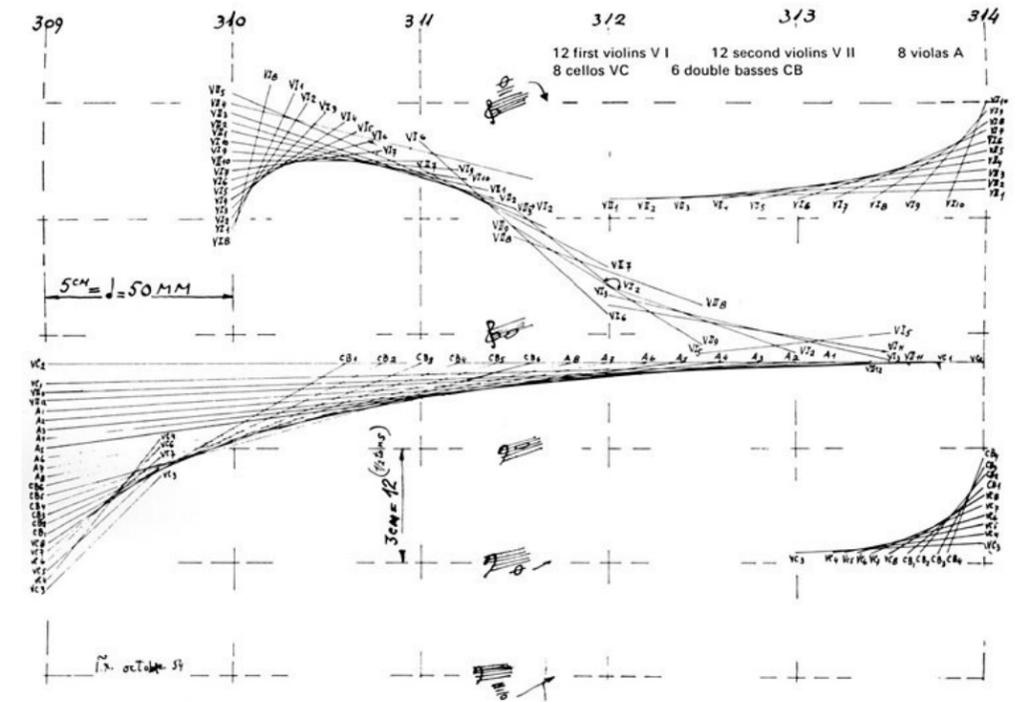


4.2.2 Spectrogram of "Metal Bowls in the Rain" recording demonstrates densities of sounds rather than a consistent rhythm.

When designing the façade for the Monastery of La Tourette, Xenakis replaced the concept of rhythm within the placement of window mullions with that of density, producing an undulating effect of glass panes (fig. 4.2.3).³ This organizational strategy stemmed from his explorations of rhythm in *Le Sacrifice* (1953). “Contrary to traditional Western music, where the pulse of time is an externally determined, fixed element, in this work, it varies throughout the piece, and thus becomes intimately linked with the development of the musical material.”⁴ The translations between music and architecture didn’t stop here. For example, the hyperbolic paraboloid (or ruled surface) employed in the Philips Pavilion at the 1958 World’s Fair in Brussels was used four years prior as a series of glissando (glide from one pitch to another) in his *Metastasis* composition in 1954. The ruled surface in its sonic translation results in a rather intense “wave” or mass of sound.



4.2.3 Iannis Xenakis, Drawing for the Monastery of La Tourette facade. Undulating window panes are generated through varying densities of mullions.



4.2.4 Iannis Xenakis, *Metastasis* (1954). Graphic score of bars 309-314.

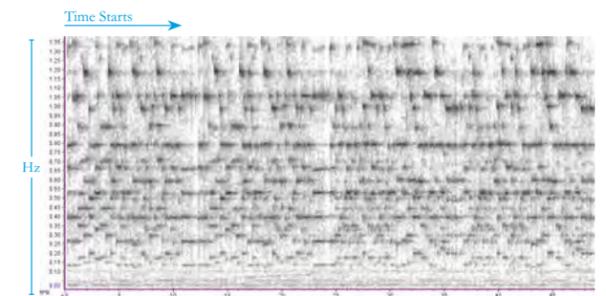
This compositional strategy again stands outside of traditional Western music, and bares resemblance to the “waves” of rising and falling sound present in the “Wind Howling” polar spectrogram (fig. 4.2.19).

Sven Sterken writes, “Xenakis’ goal has always remained the same, namely to propose new auditory experiences and explore alternative modes of listening.”⁵ This thesis shares that goal. Arrhythmic and atonal patterns of environmentally produced sound challenge the Western ear when considered as “musical” in their own right. It is hoped that designed listening devices lubricate a listener’s transition to considering their immediate soundscapes as sonically relevant and informative, legitimizing its patterns and the intelligence they carry.

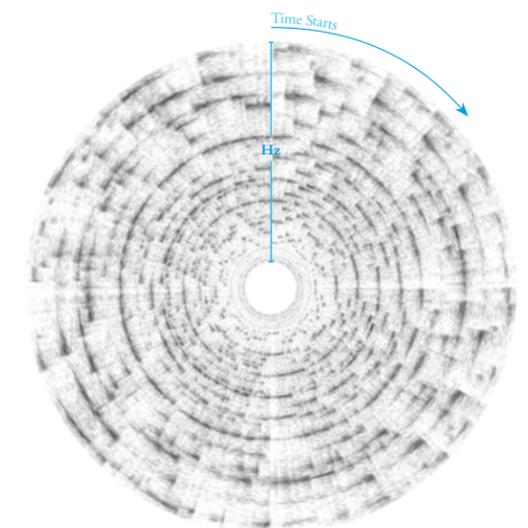
Reading a Polar Spectrogram

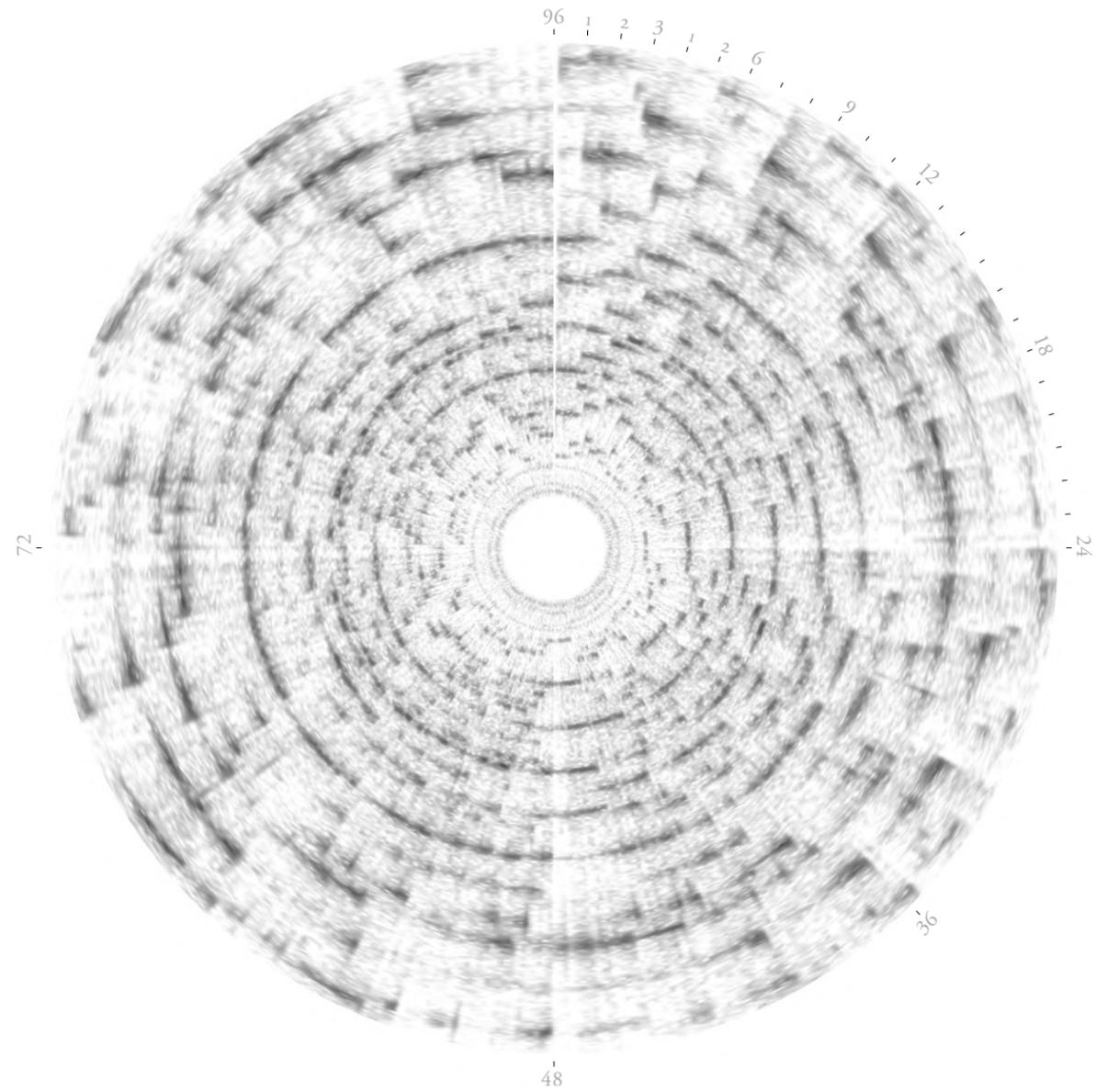
A spectrogram is visual translation of sound showing time, pitch, and signal gain (loudness).

To the right is a typical spectrogram. Time is mapped from left to right in the x-axis, frequency from bottom to top in the y-axis. The loudness of each sound event corresponds to the darkness of that moment in the image.



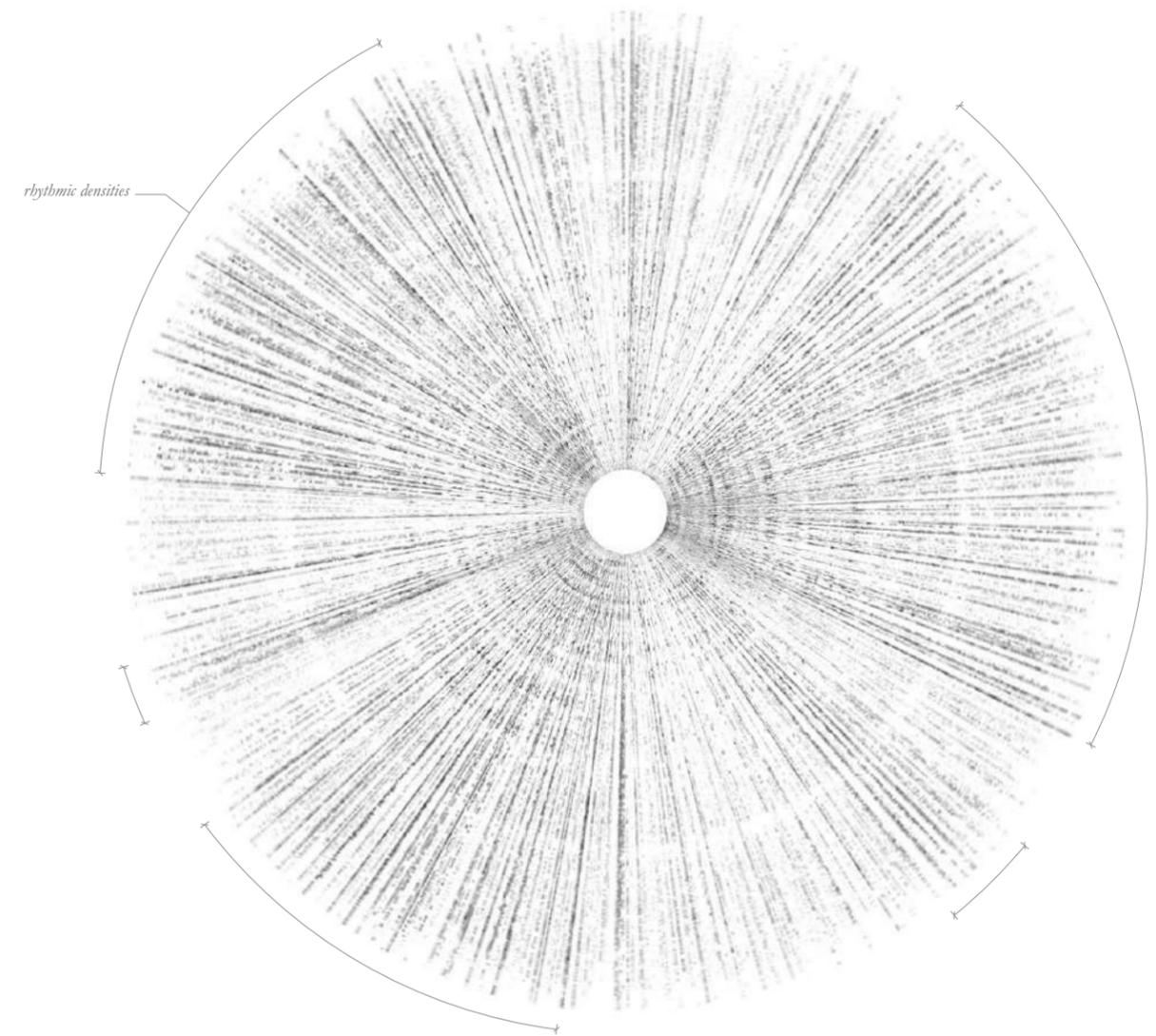
This is a polar spectrogram. The original spectrogram above it has been sent through a polar coordinates filter, reforming the image into a circle. The spectrogram now ends where it began. Lower frequencies are towards the center, while higher frequencies are towards its outer edges.





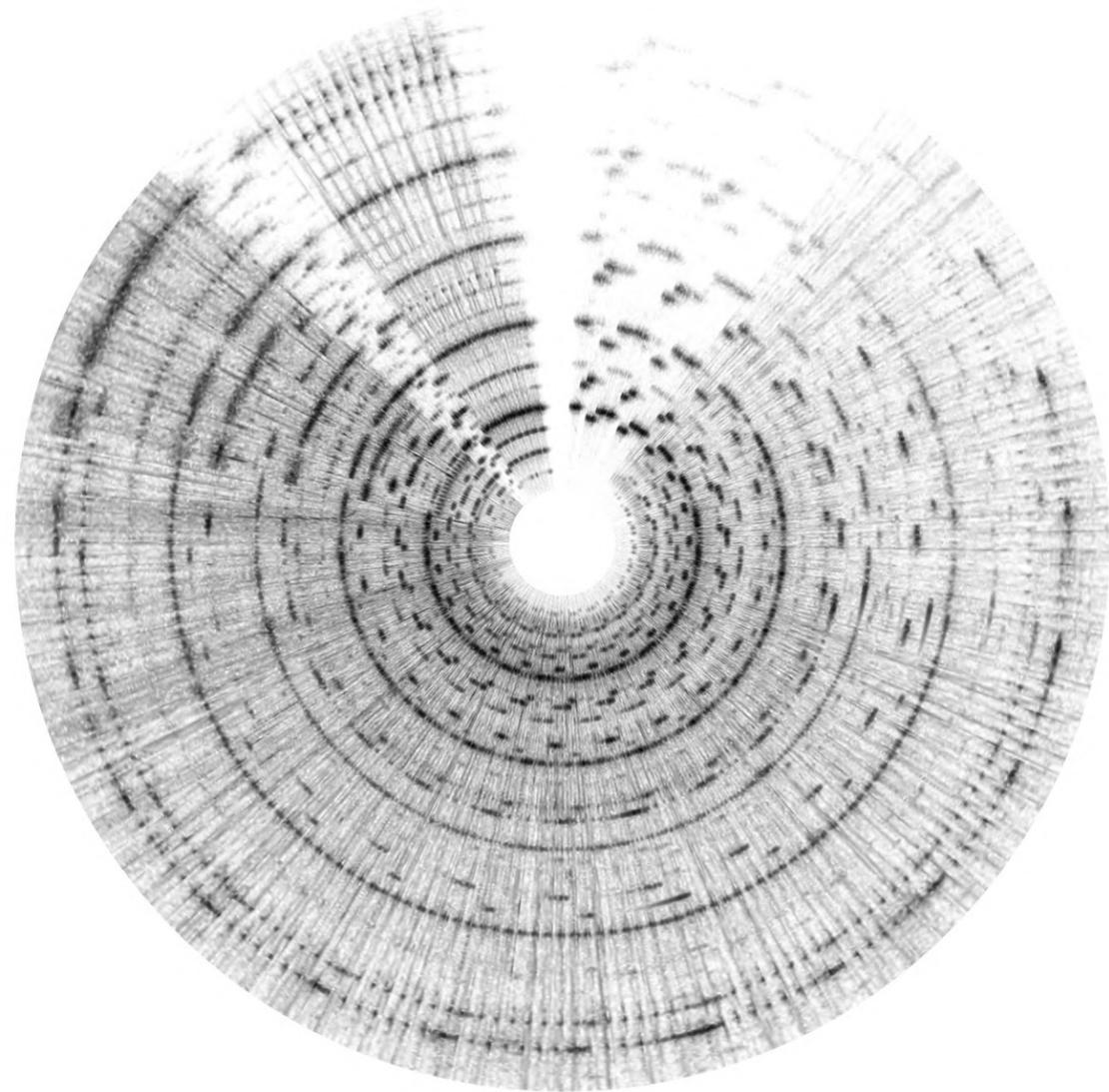
"The Fairie Round (Galliard No. 3)"
Composed by Anthony Holborne & Performed by David Munroe
3/2 Timing over 96 beats

▶ ■ || ▶▶
4.2.5



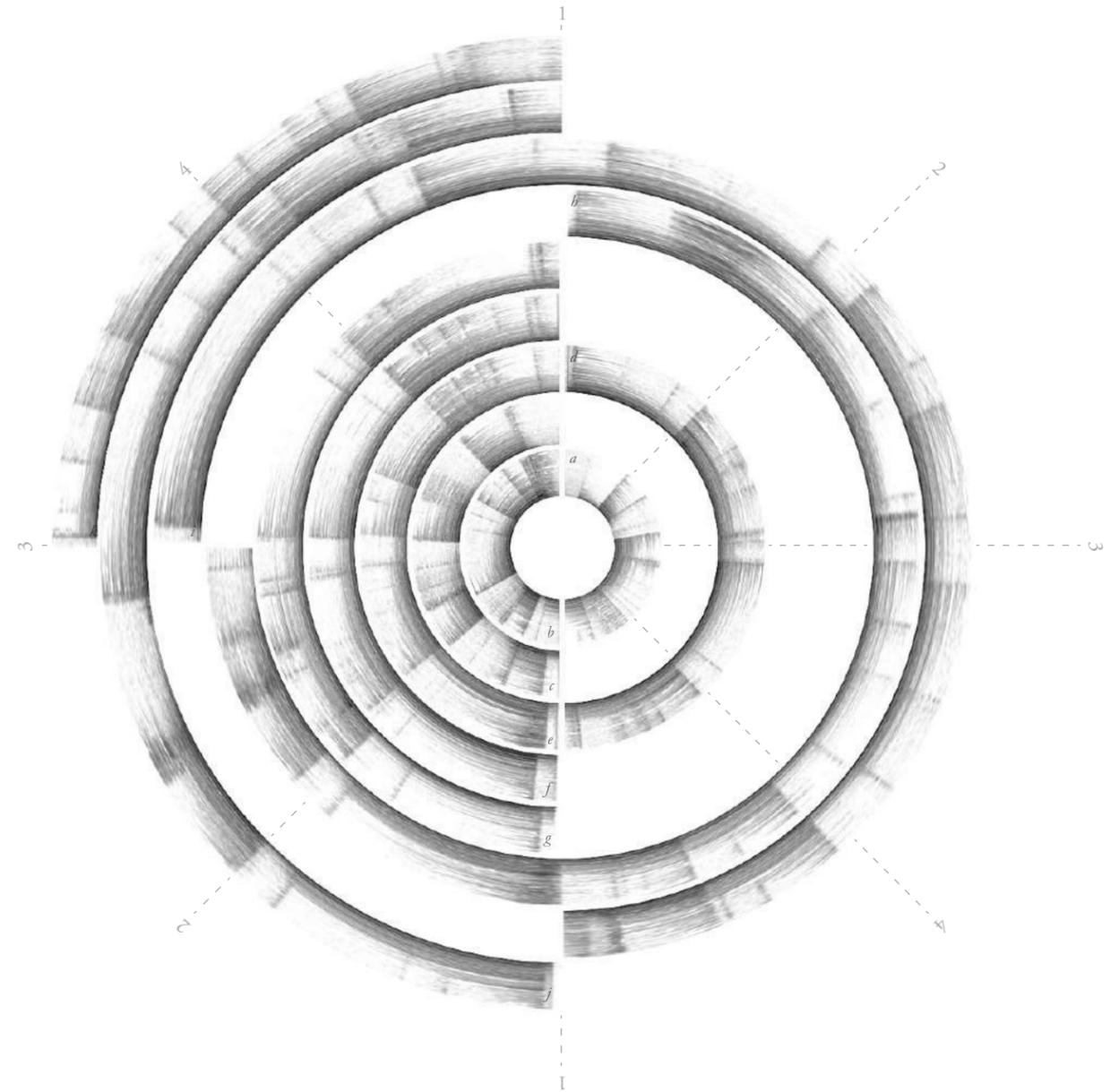
Metal Bowls in the Rain
Field Recording by Author
2:00

▶ ■ || ▶▶
4.2.6



"You Are Loved"
 Composed by Four Tet
 6:09

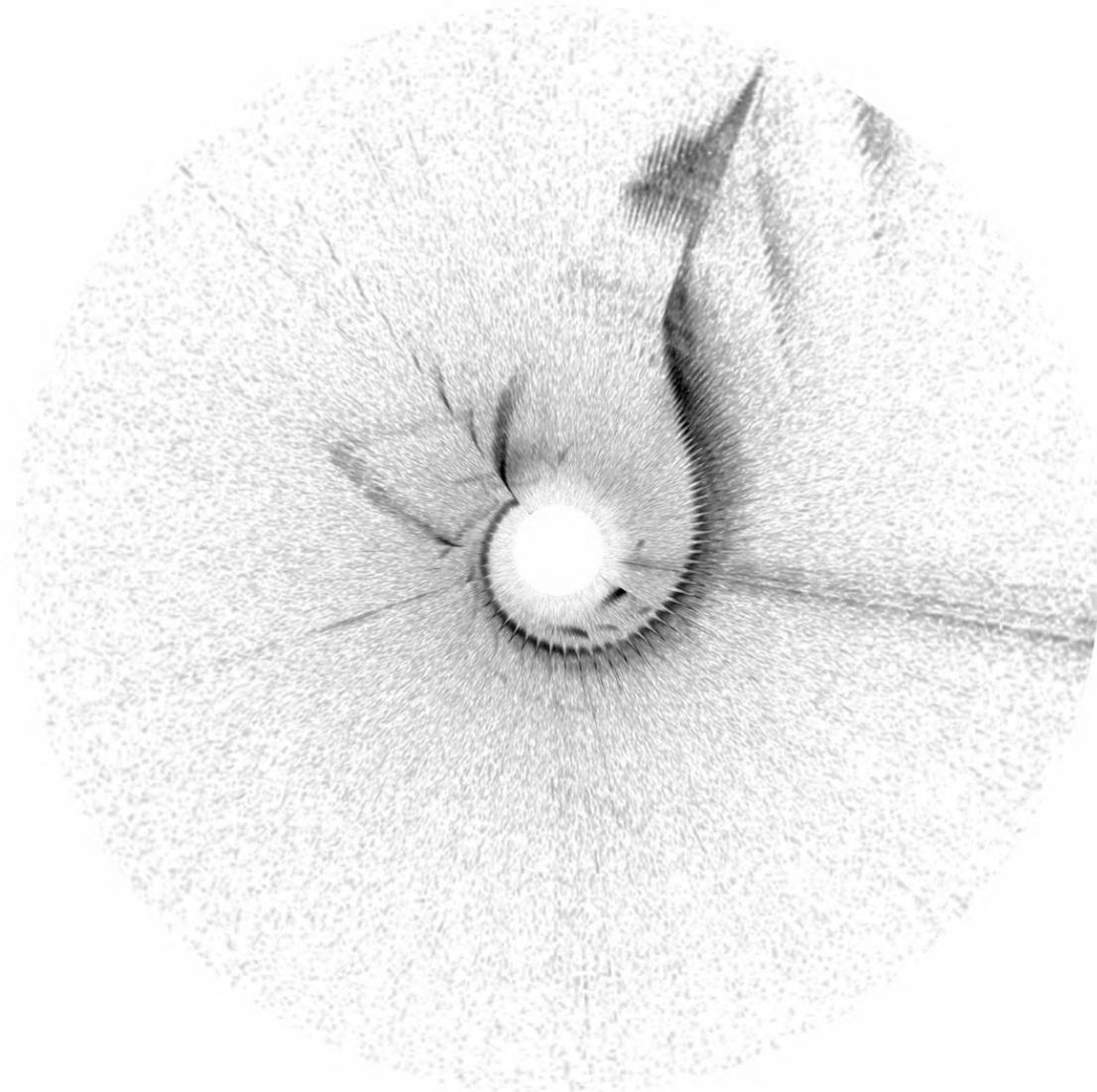
▶ ■ || ▶▶
 4.2.7



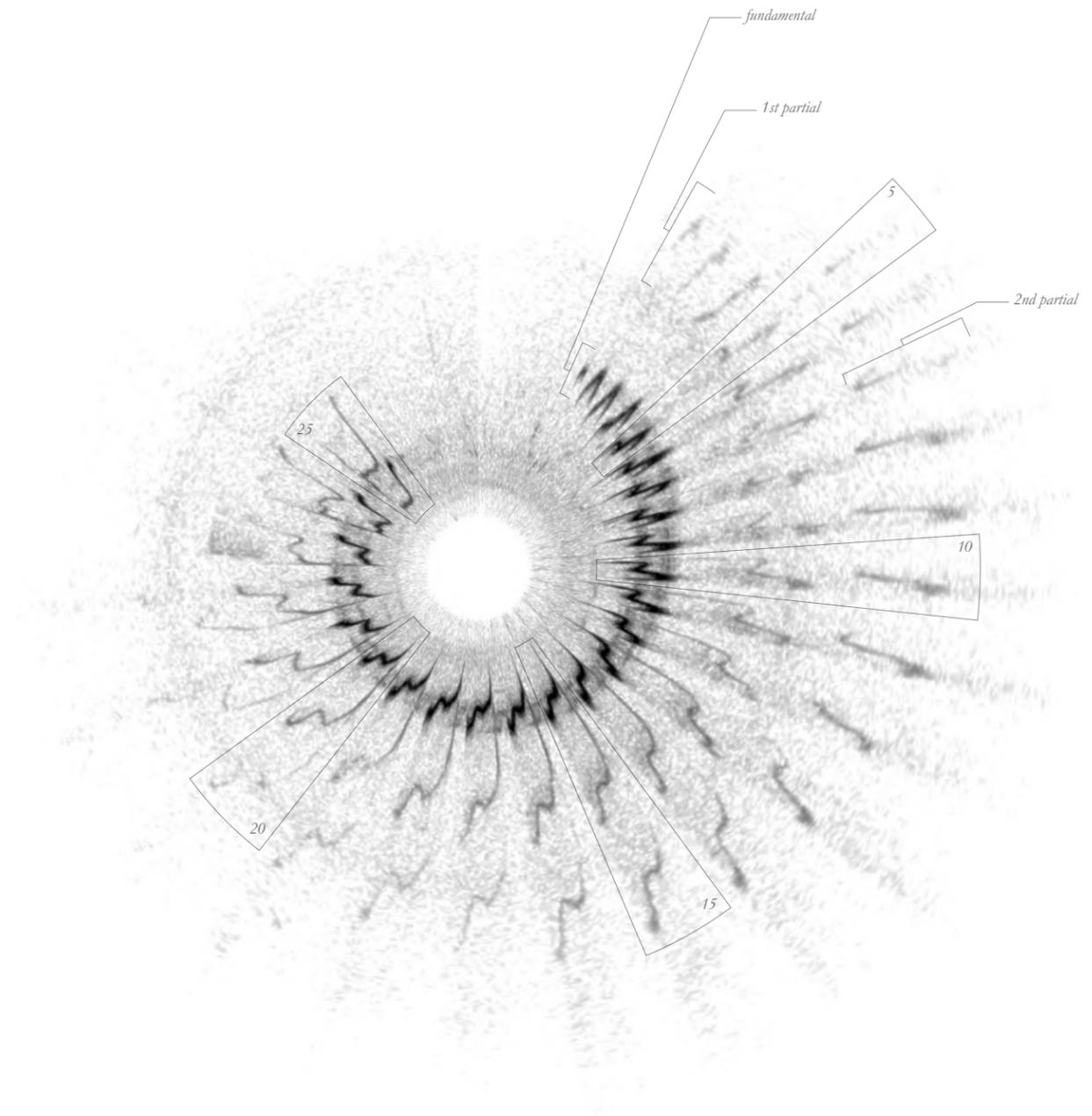
"Guitar Elements"
 Author's Composition
 4/4 Timing over 72 beats

▶ ■ || ▶▶
 4.2.8

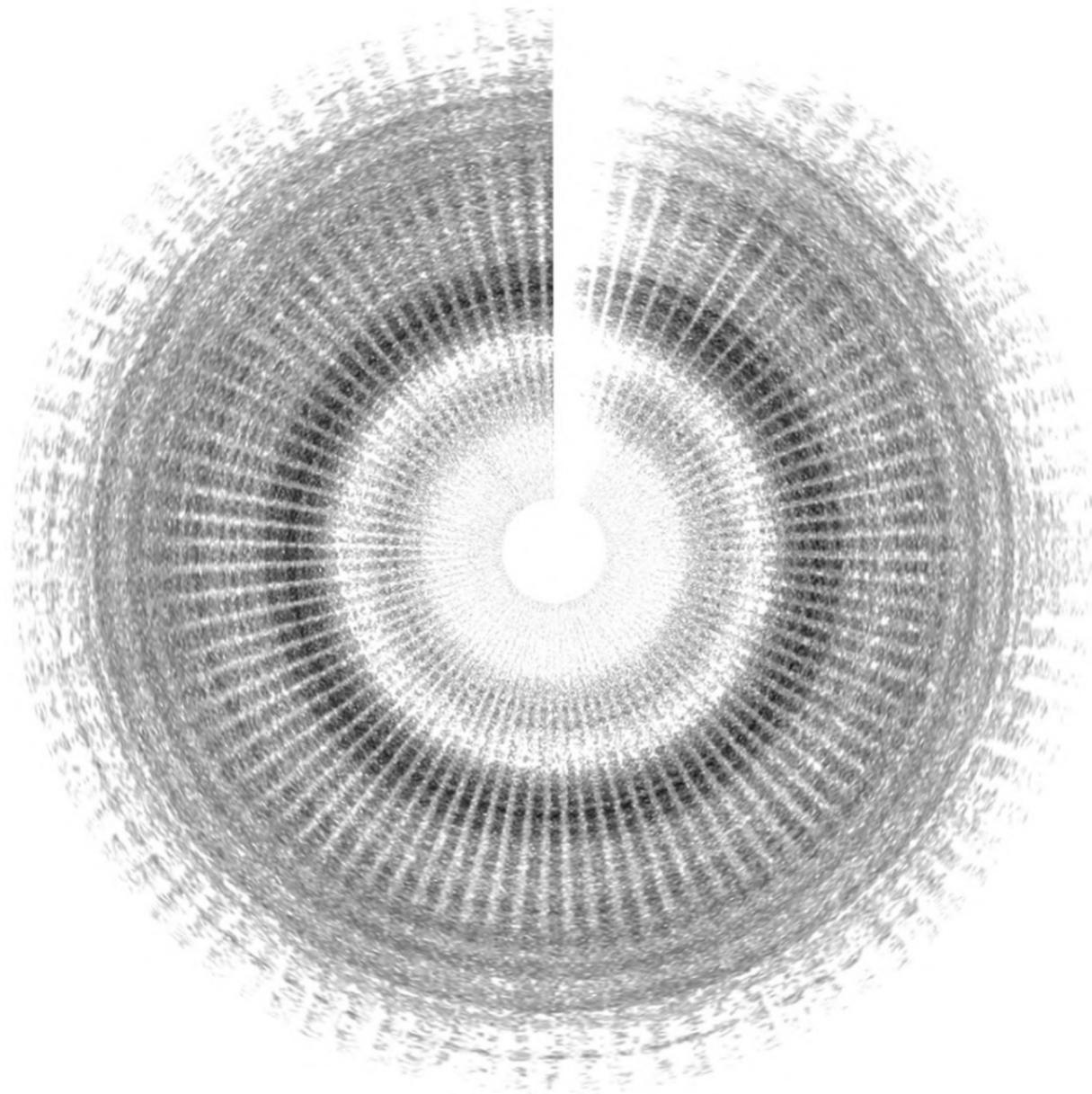
pattern: a b a c a b
 d e d f d g
 b
 i j i k



Bearded Seal
Cornell Lab of Ornithology
57s
▶ ■ || ▶▶
4.2.9



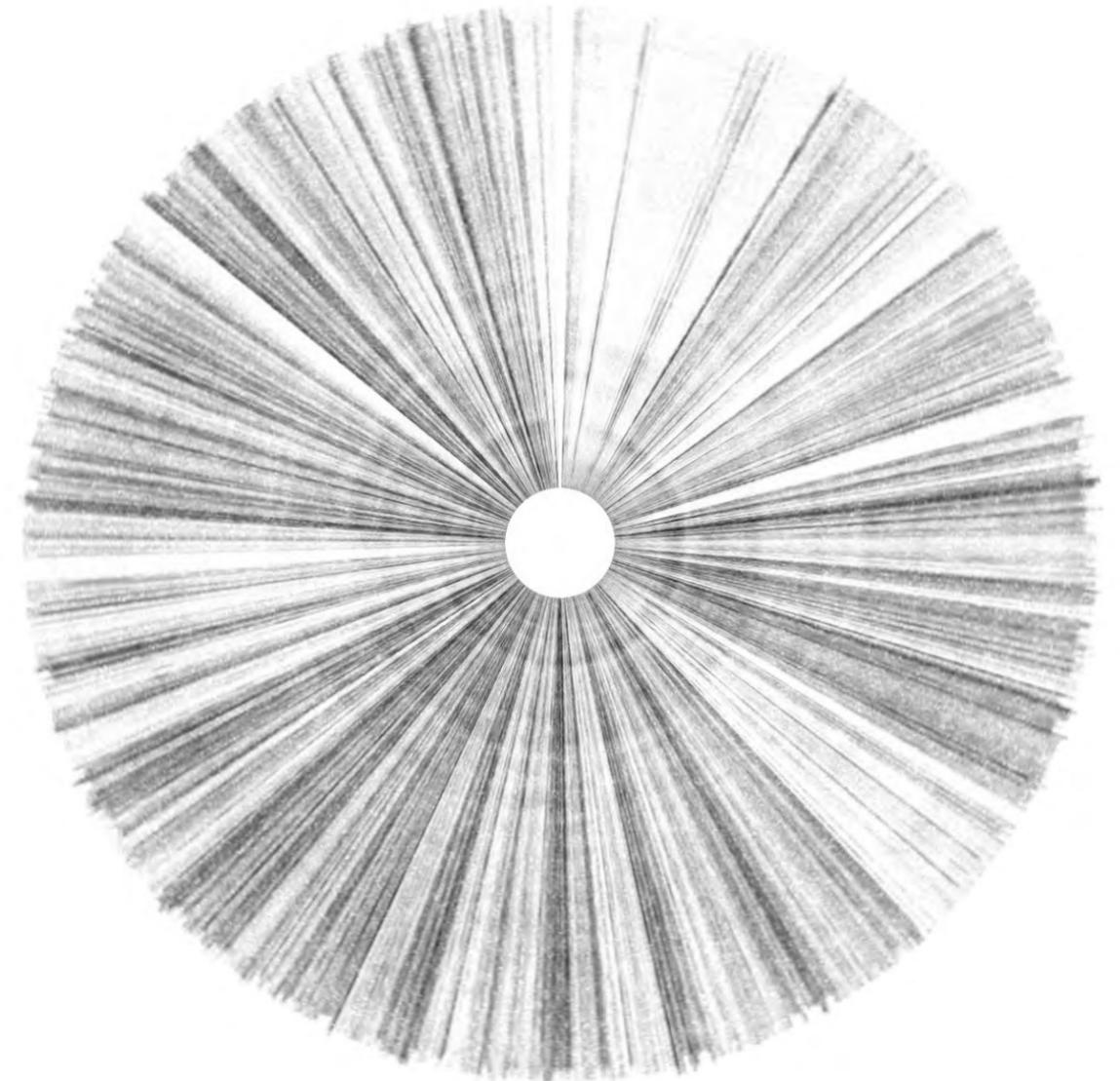
Canyon Wren
Cornell Lab of Ornithology
6s
▶ ■ || ▶▶
4.2.10



Cicadas Chirping
Sounds of Nature's YouTube channel
15s



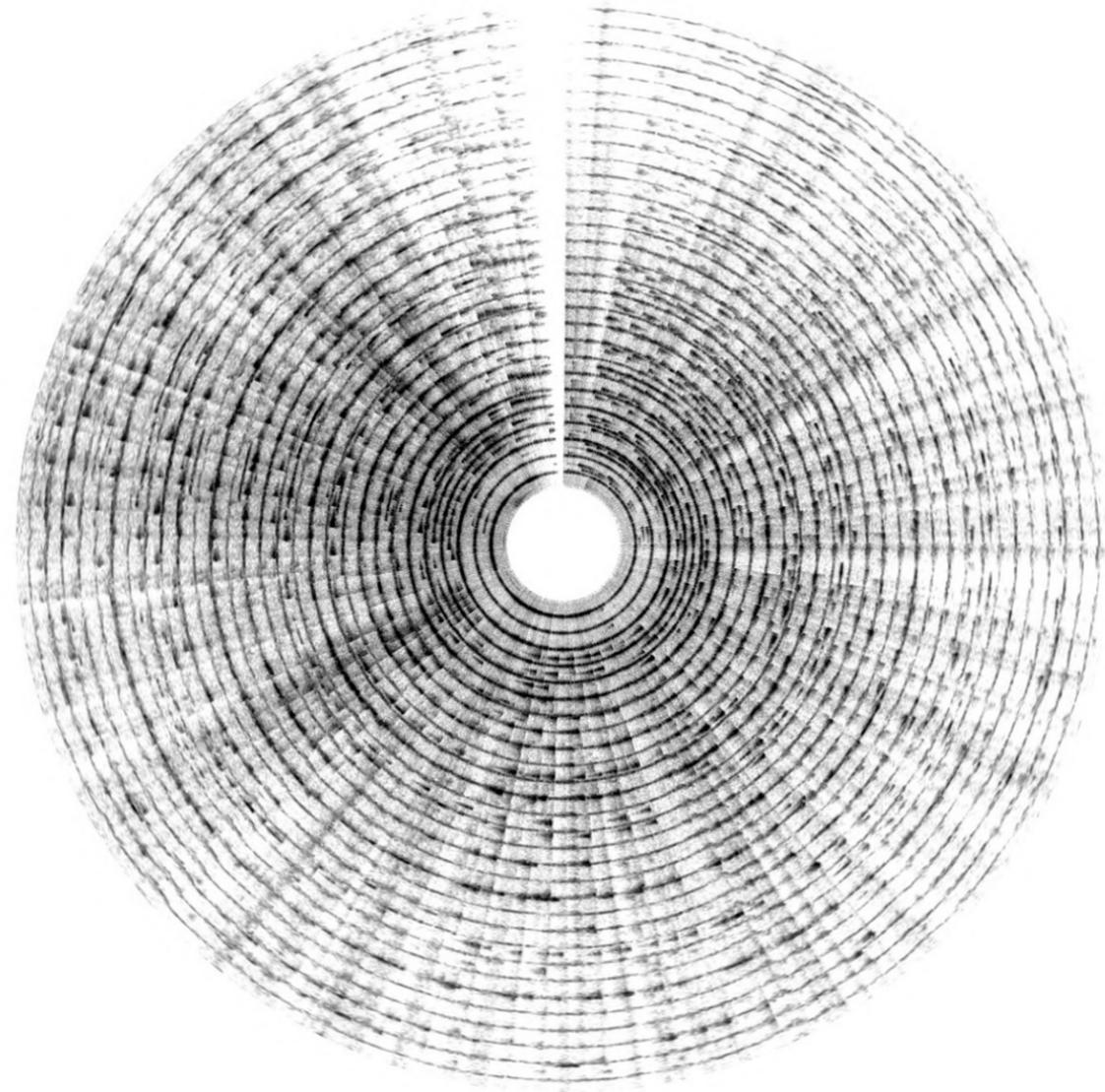
4.2.11



Walking on Ice
Field Recording by Anders Östberg
25s



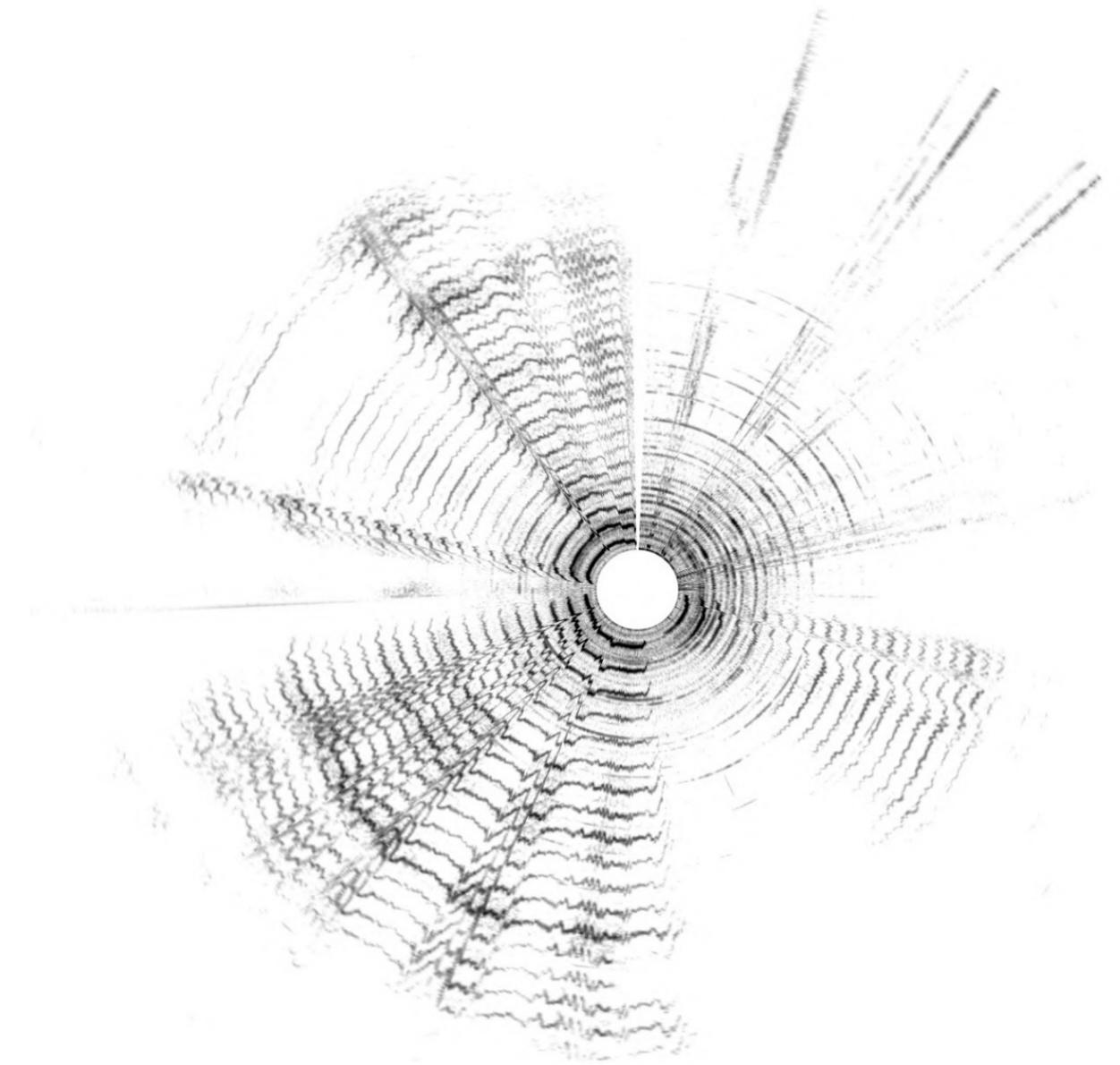
4.2.12



"Tone"
Composed by Deep Listening Band in the Dan Harpole Cistern
17:41



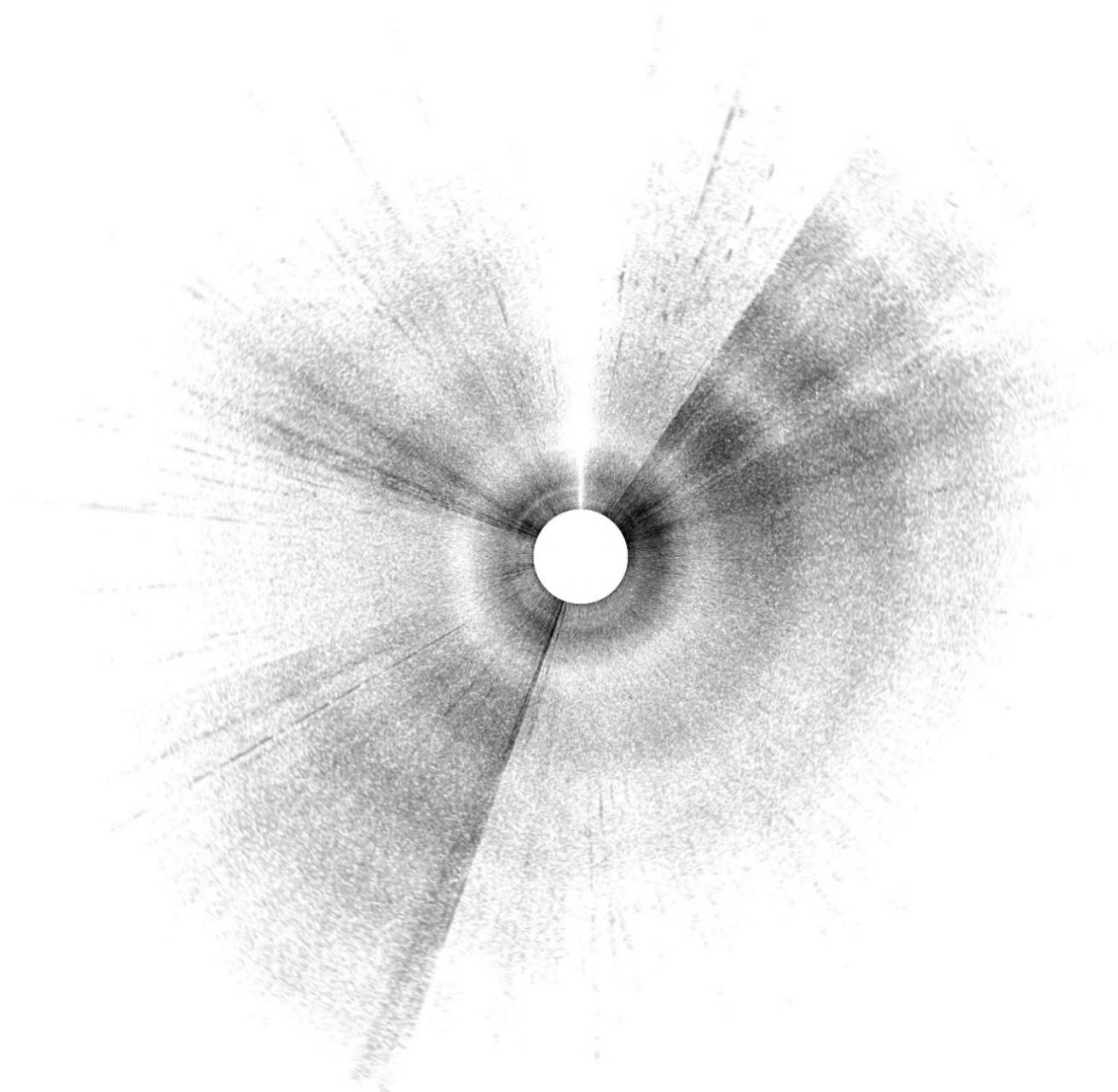
4.2.13



Human Voice Humming
sung by author over "Siren" by Deep Listening Band
1:15



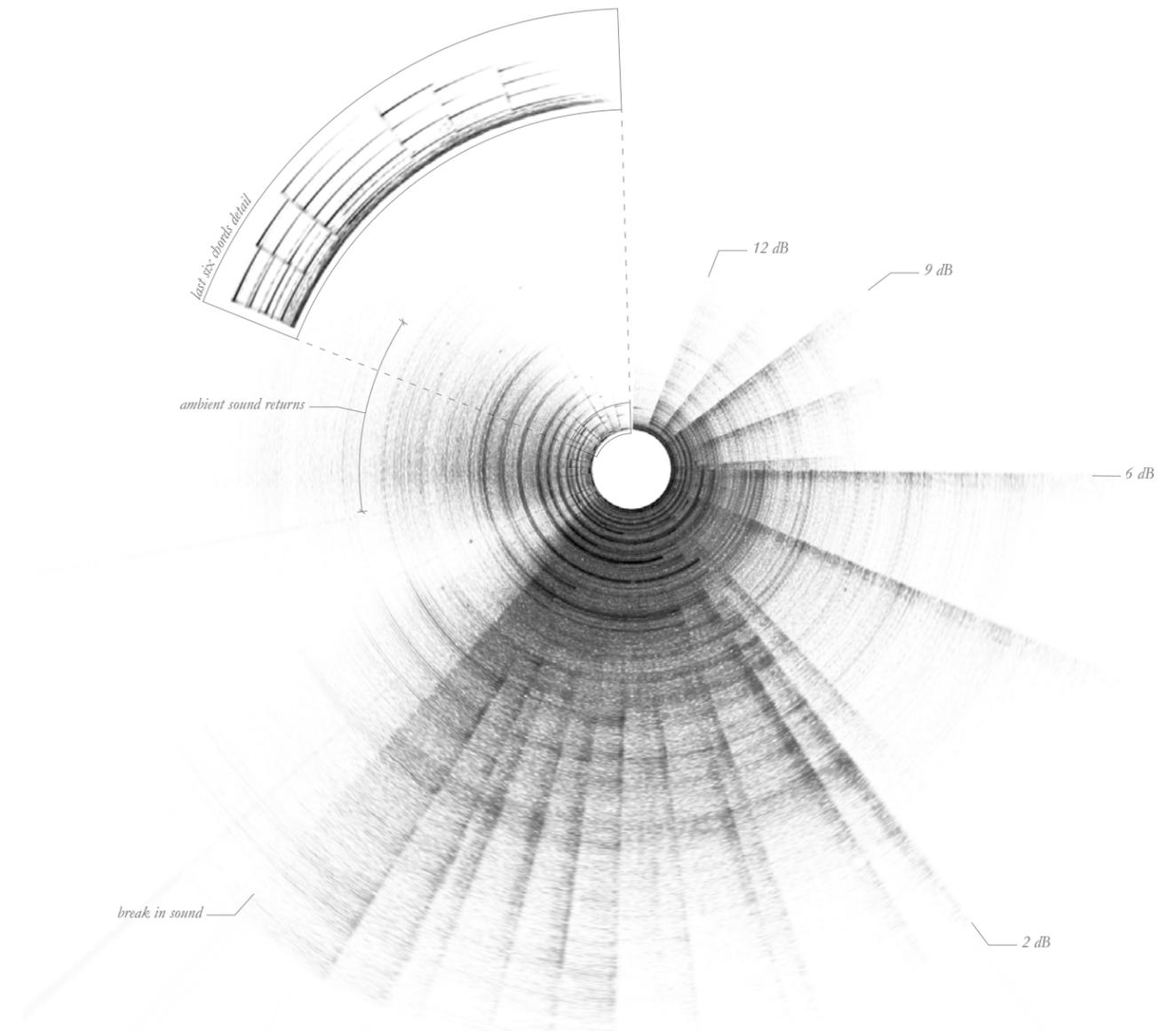
4.2.14



Glacier Calvings and Fractures
Field Recording by H. Lentfer, Margerie Glacier, Glacier Bay, Alaska
46s



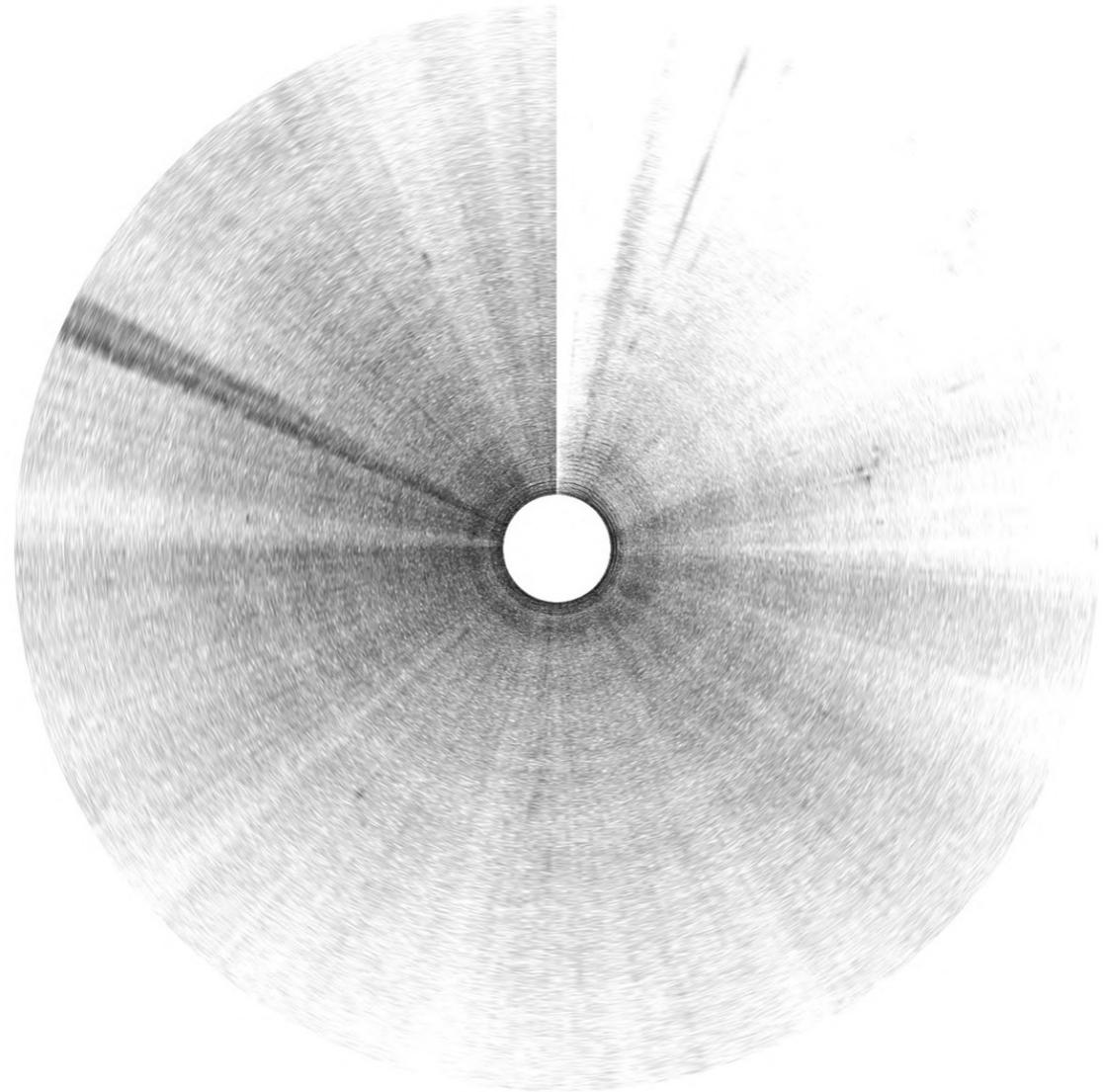
4.2.15



“Angklung Rising”
Author’s Composition
2:05



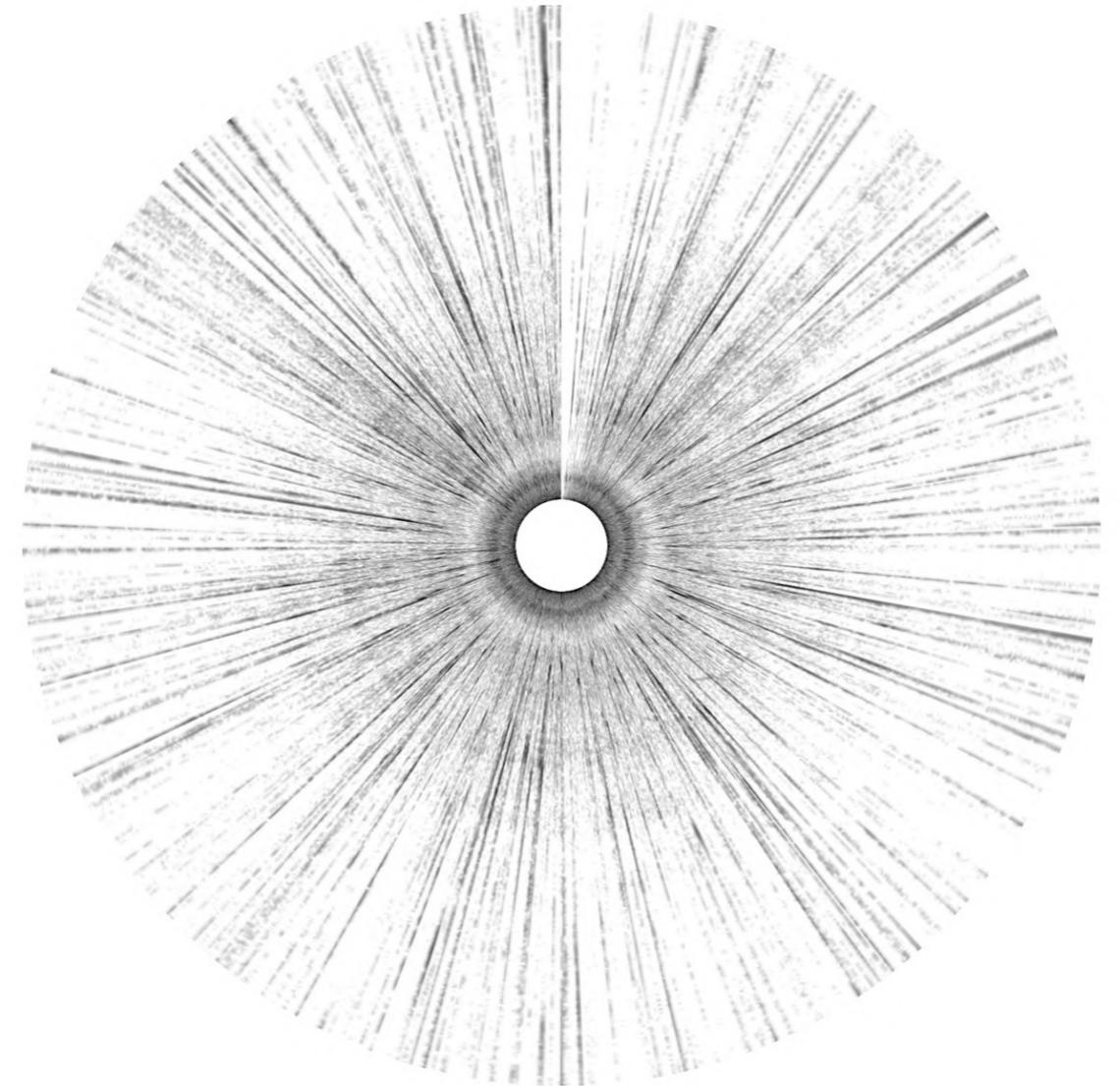
4.2.16



Boat through Ice
Field Recording by Cedric Peyronnet
49s



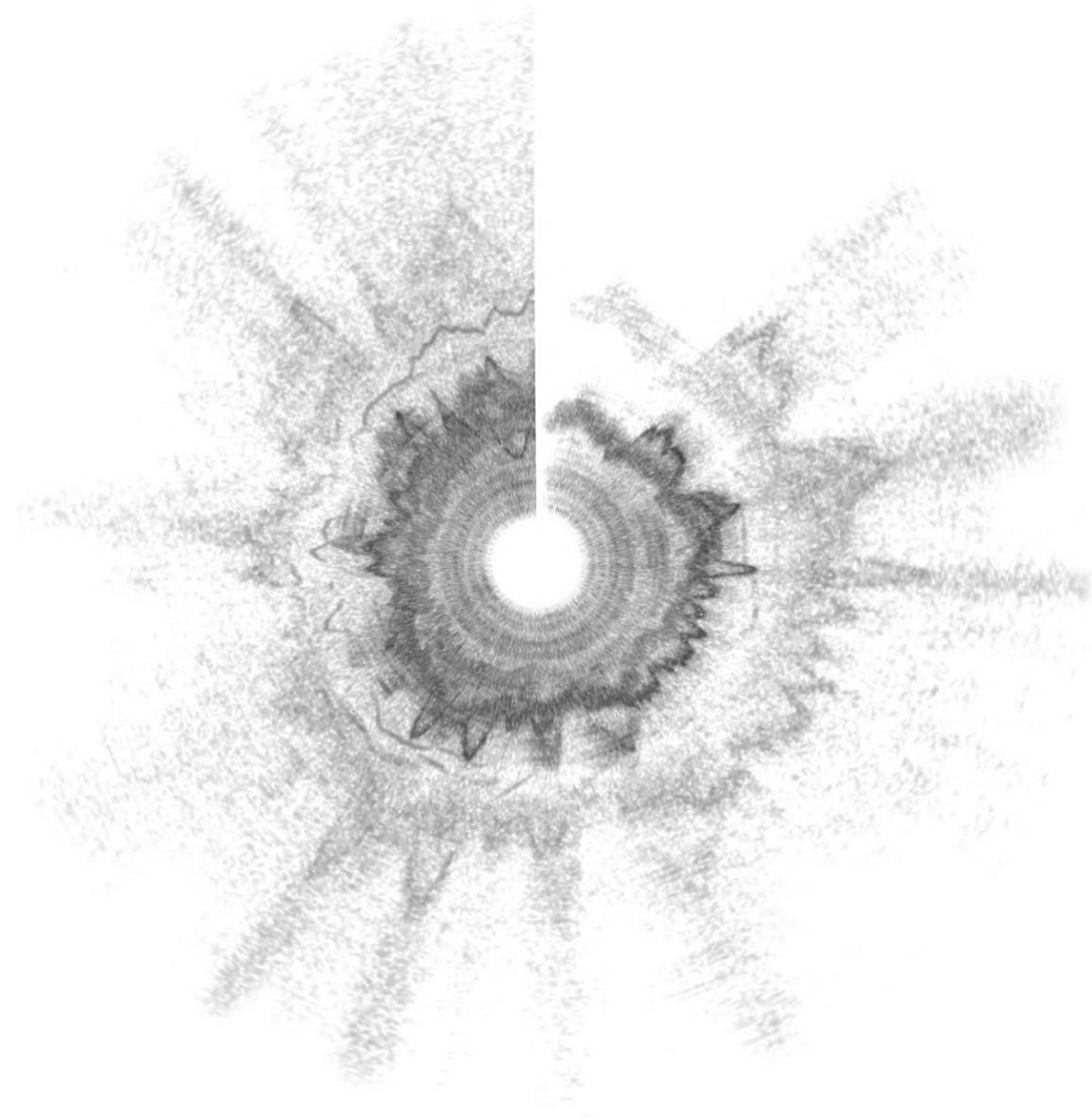
4.2.17



Glacier Ice on the Beach
Field Recording by H. Lentfer, Glacier Bay, Alaska
2:04



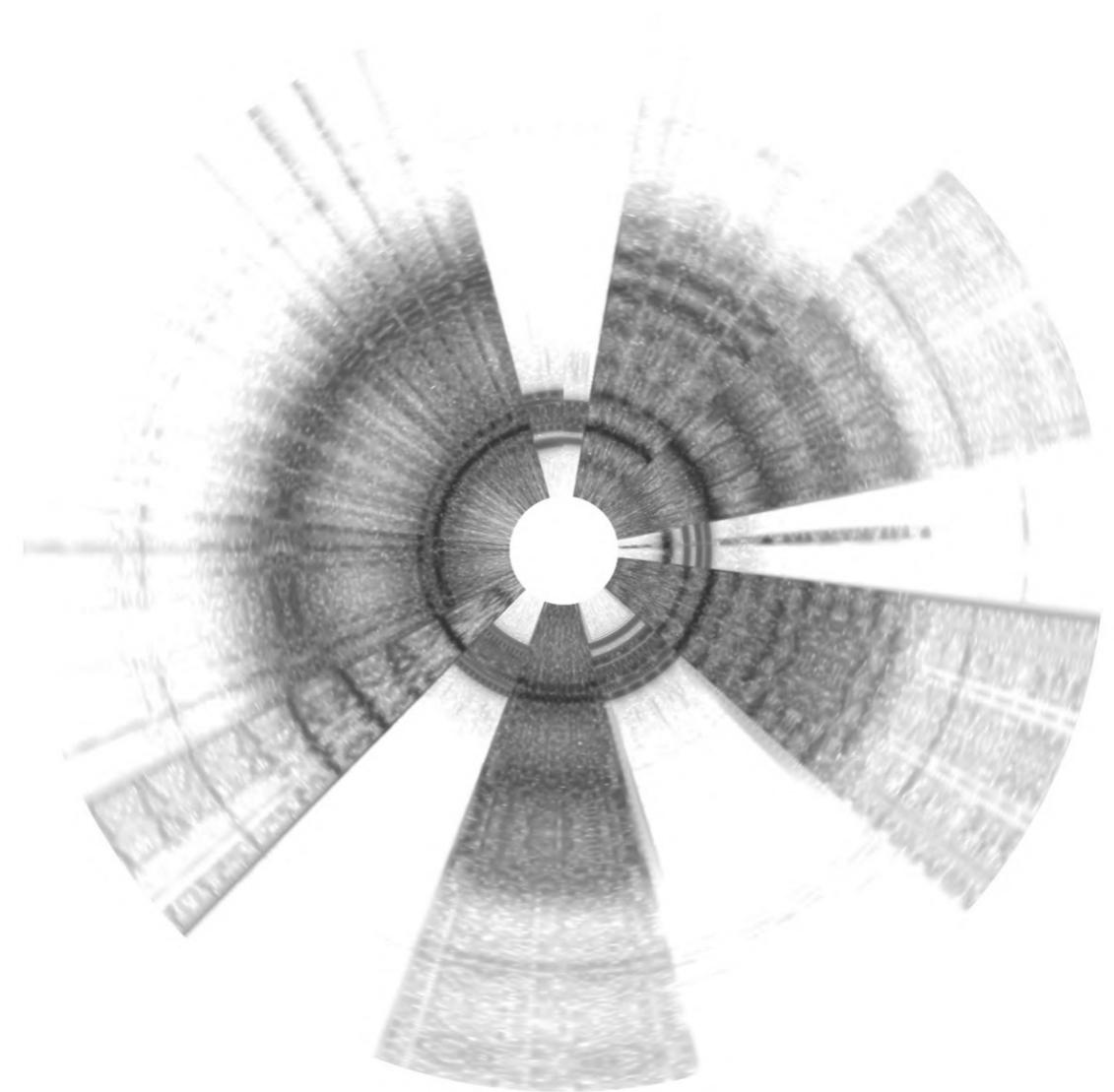
4.2.18



Wind Howling
Andree81's YouTube channel
50s



4.2.19



Wind over the Surface of the Ross Ice Shelf
Seismic Sensor Field Recording by Julien Chaput, Antarctica
42s (sped up ~1200 times to make audible)



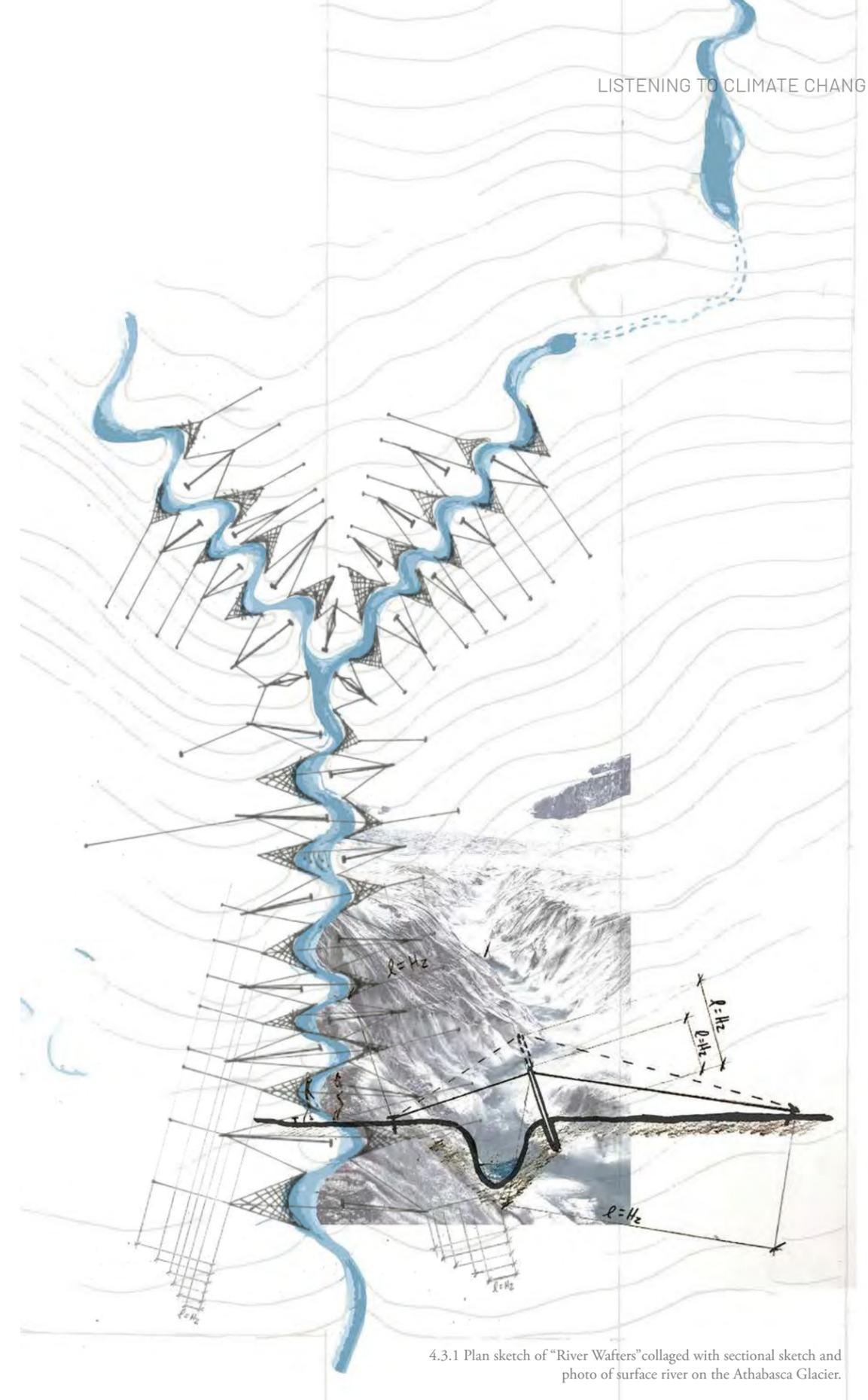
4.2.20

4.3 Imagined Sonic Interactions

This series intends to generate speculative sonic interactions between humans and non-humans. These drawings begin with a field recording of something non-human which has been translated into a linear spectrogram. White geometric shapes are then overlaid on top of the spectrograms in Adobe Illustrator, muting those areas. The added drawings indicate some kind of human interaction with that soundscape (i.e. how humans would be affecting the soundscape through architectural means). The overlaid spectrograms are then fed into Photosounder, a software that translates visual spectrograms back into sound. The listener will notice the sound of each augmentation is distorted significantly. The distortion is an artifact from the process of translating the original sound file into a spectrogram, augmenting it, and re-translating the spectrogram back into sound, resulting in information-loss.

These drawings use augmented sounds to generate architectural imagination. Although this method can be further explored, one imagined architecture this process generates is a series of “river wafers,” or undulating walls, whose undulations can be manipulated by adjusting the cables holding them in place (fig. 4.3.1).

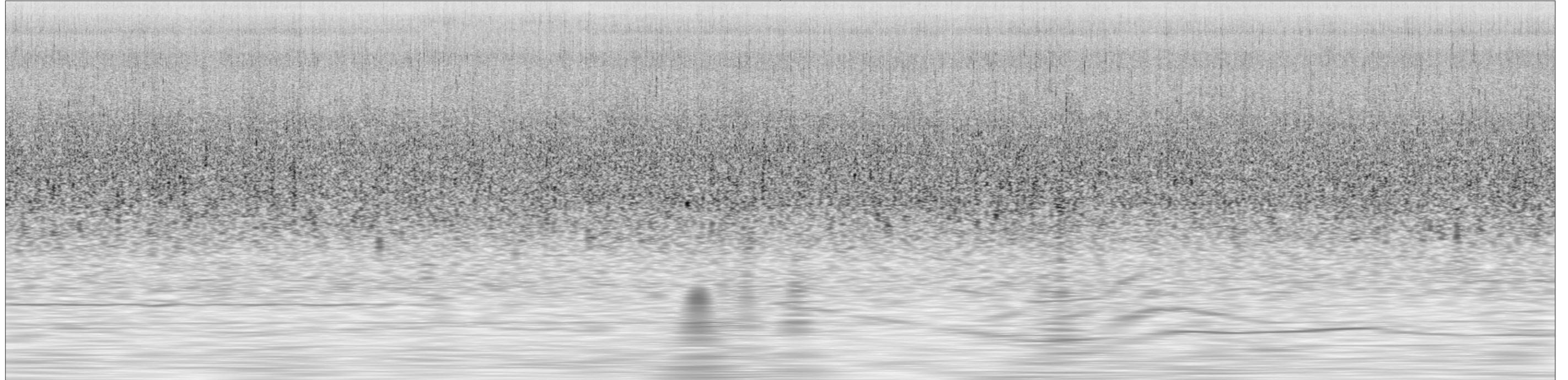
As a drawing method, overlaying “human logics” on non-human sounds is a relatively simple process. This is because the overlays are drawn irrespectively of the sounds they effect. In *Domesticating the Unfamiliar* and *Defamiliarizing the Domestic*, I am considering how the relationship in this series of drawings can be reversed, or at least more balanced: How can non-human patterns guide and effect human logics of drawing and of engaging sonic space?



4.3.1 Plan sketch of “River Wafers” collaged with sectional sketch and photo of surface river on the Athabasca Glacier.

HUMAN LOGICS & THE SOUNDSCAPE: RIVER INTERACTIONS

4.3.2 Original Recording: Flowing Surface River at Athabasca Glacier, AB



0s

1:36m

4.3.3 Human Logic Overlay 1: "Gradual Muffling"

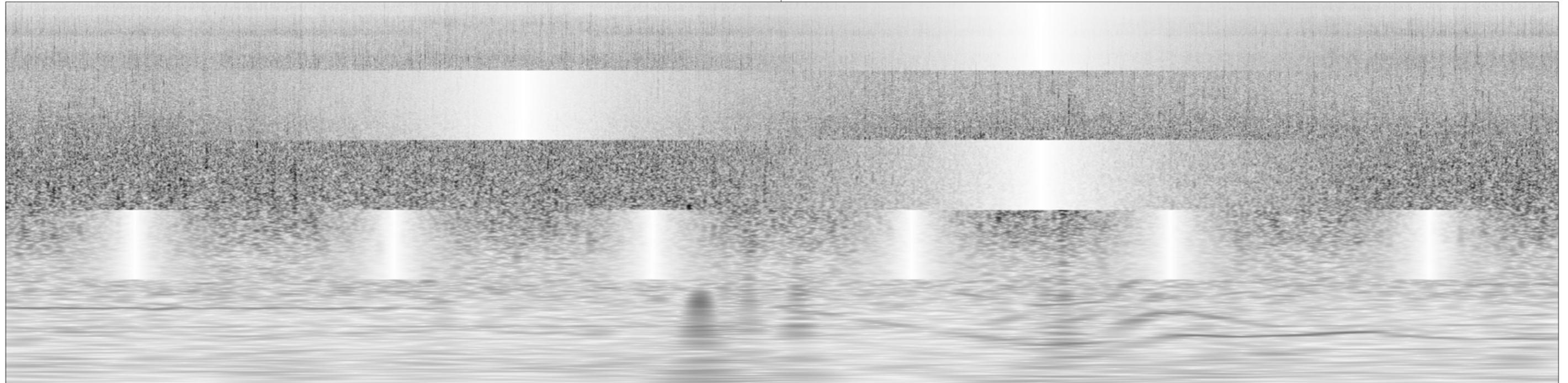


0s

1:36m

HUMAN LOGICS & THE SOUNDSCAPE: RIVER INTERACTIONS

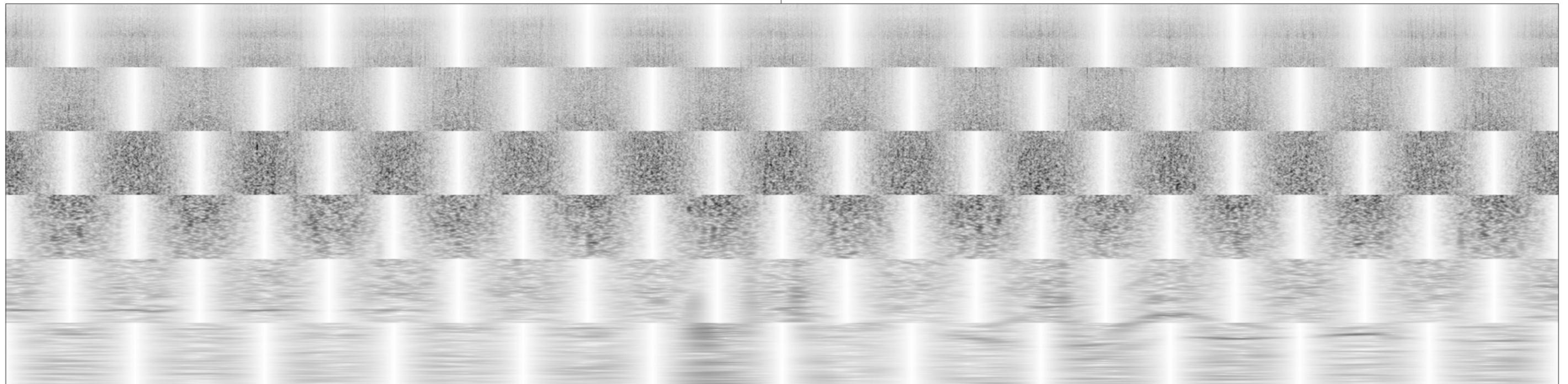
4.3.4 Human Logic Overlay 2: "Acoustic Bandwidth Emphasizing"



0s

1:36m

4.3.5 Human Logic Overlay 3: "Acoustic Bandwidth Emphasizing"

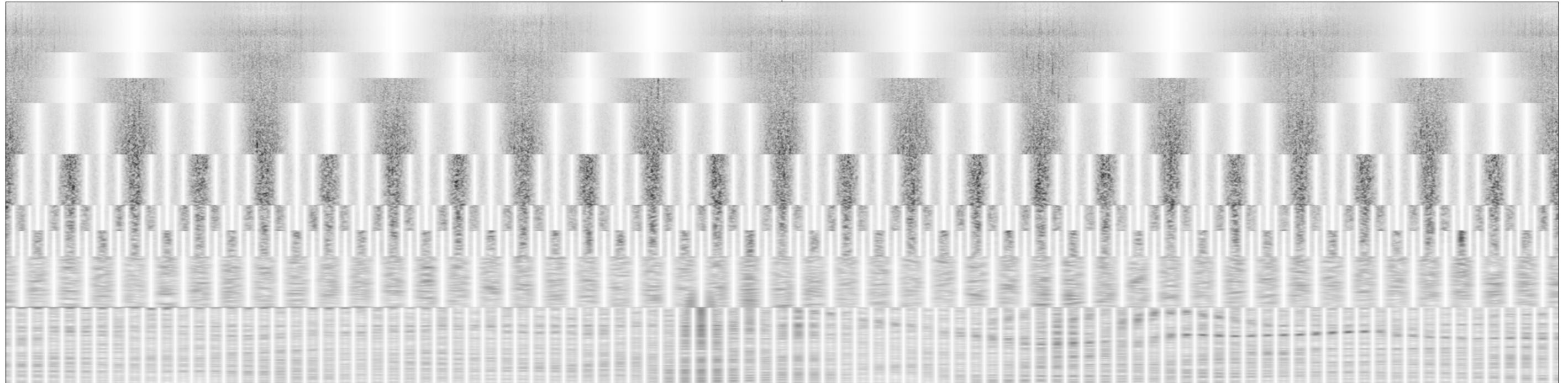


0s

1:36m

HUMAN LOGICS & THE SOUNDSCAPE: RIVER INTERACTIONS

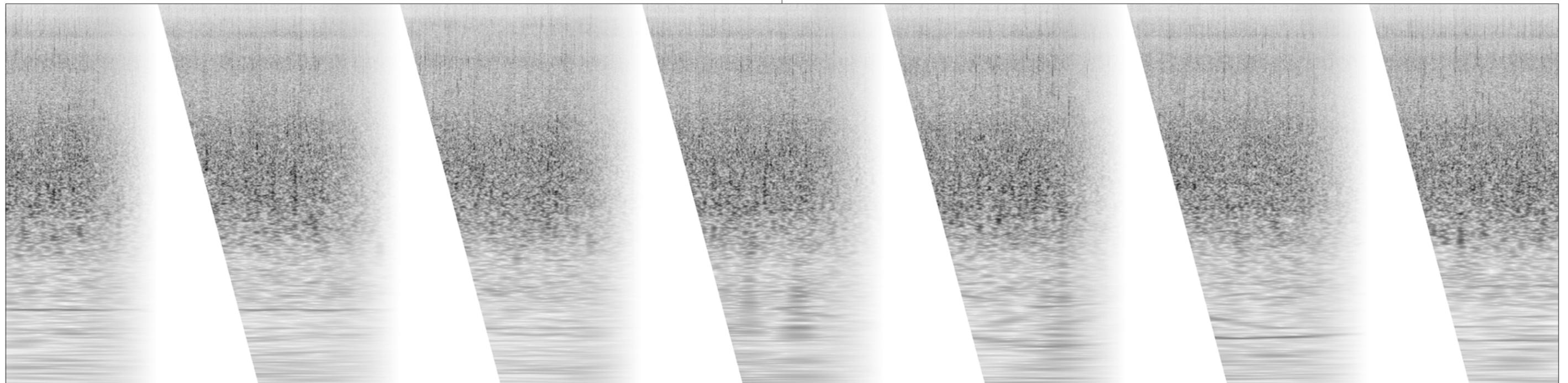
4.3.6 Human Logic Overlay 4: "Acoustic Bandwidth Emphasizing"



0s

1:36m

4.3.7 Human Logic Overlay 5: "Muffling + Reopening"

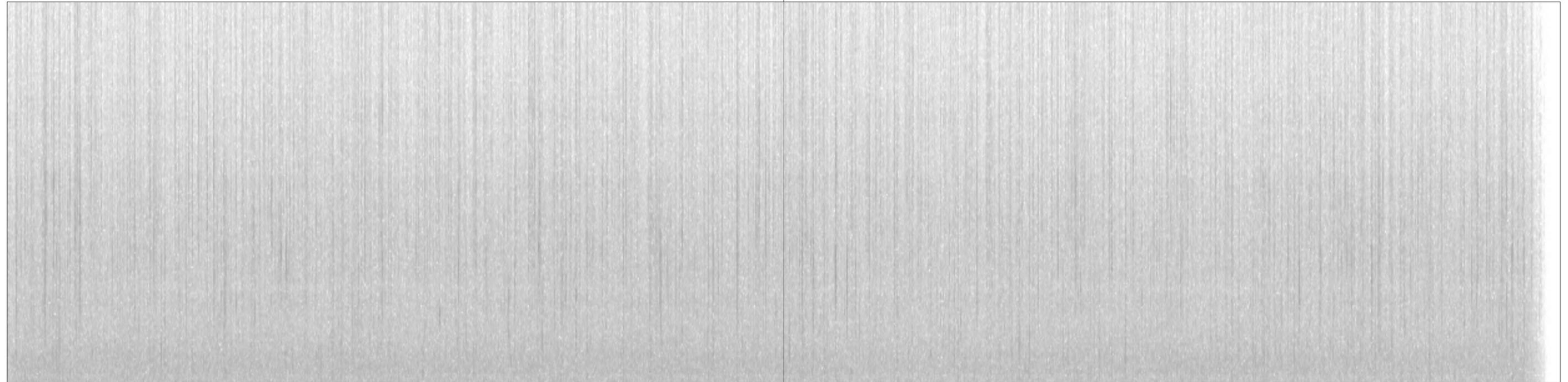


0s

1:36m

HUMAN LOGICS & THE SOUNDSCAPE: RAIN INTERACTIONS

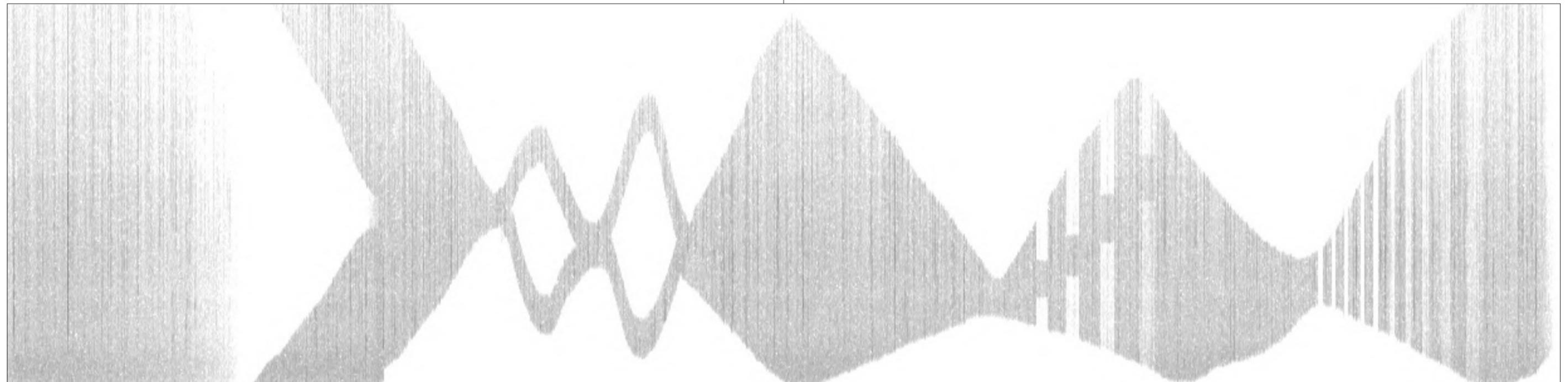
4.3.8 Original Recording: Rain Field Recording by Sound Jay



0s

1:00m

4.3.9 Human Logic Overlay 6: "Acoustic Bandwidth Emphasizing"

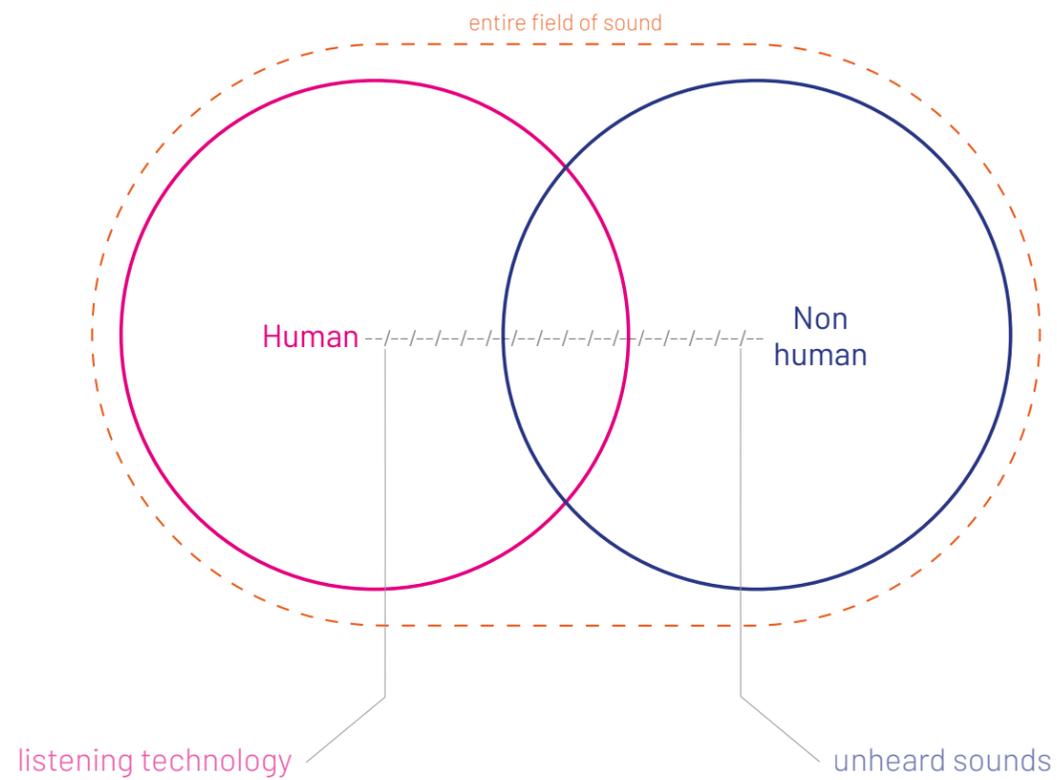


0s

1:00m

4.4 Listening Questions

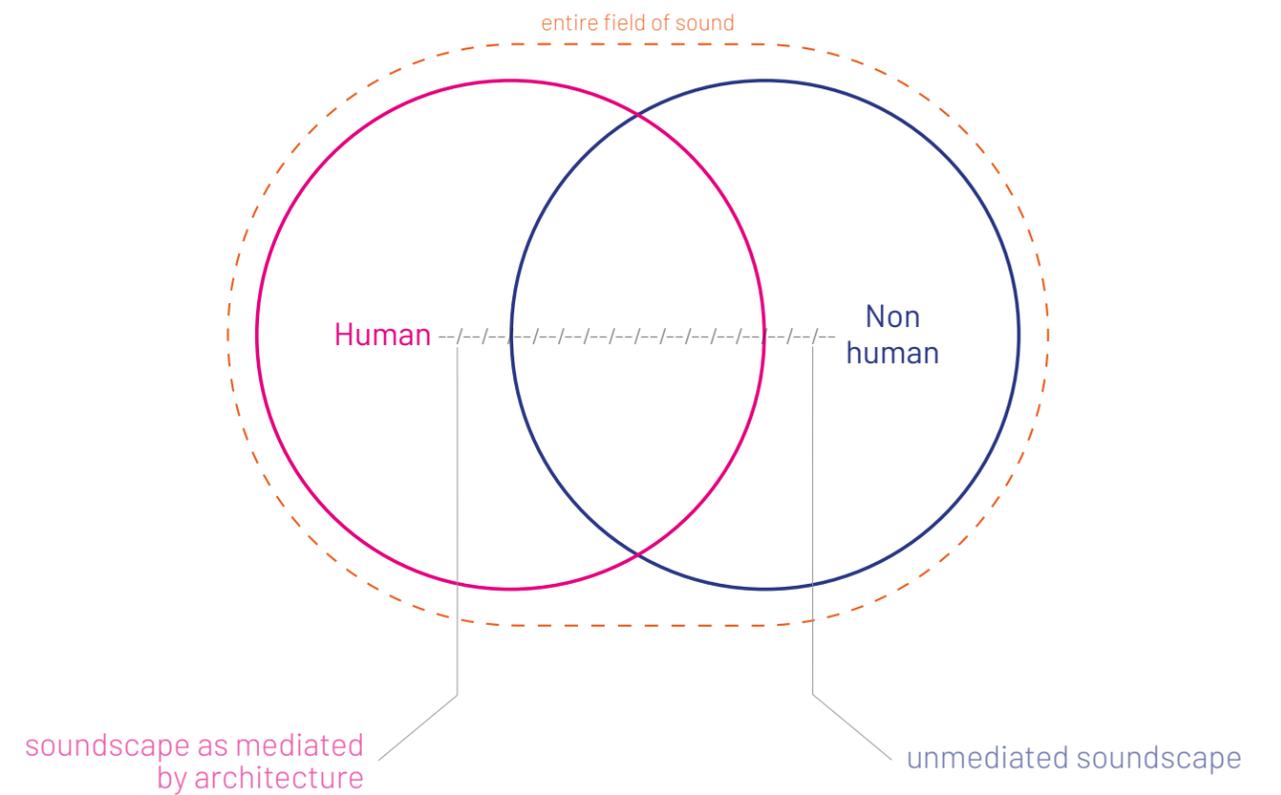
The following diagrams and questions are intended to provide a framework for assessing the instrument designs and recording practices in chapters six and seven:



Listening Question 1

How can architecture act as a technology that enables the perception of unheard sonic informations within a soundscape?

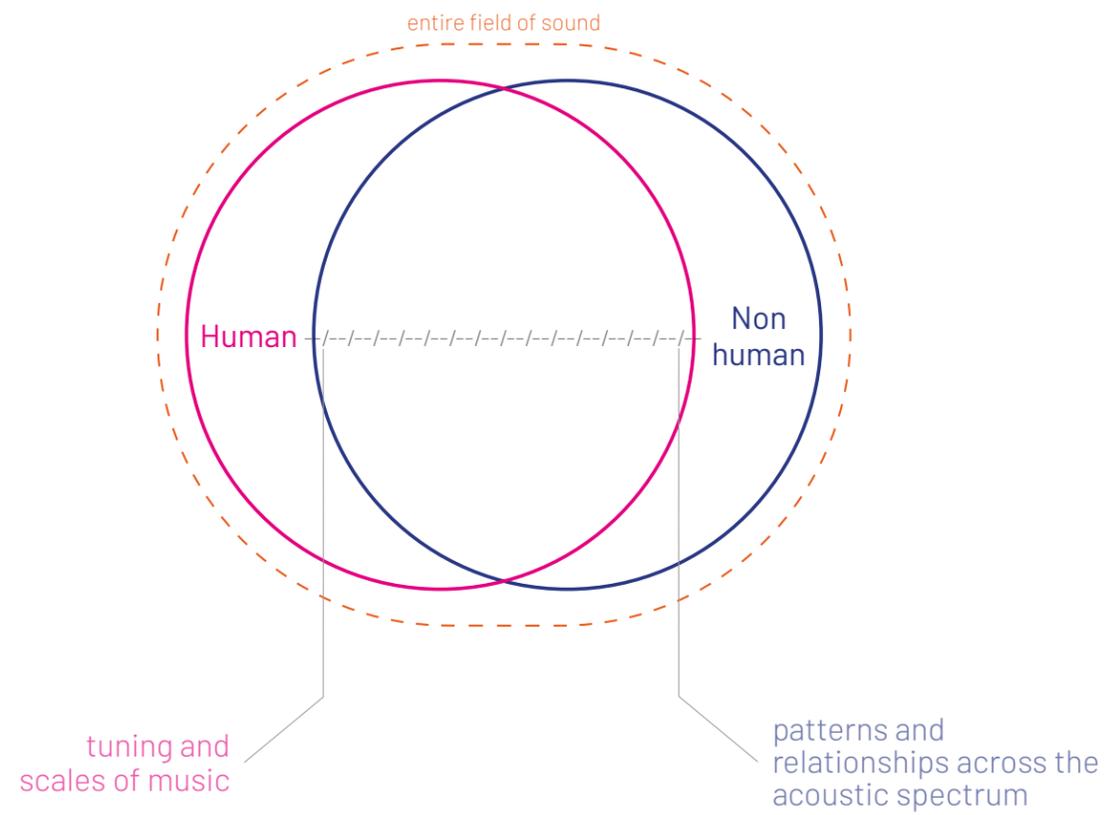
4.4.1



Listening Question 2

To what degree can human architectures augment existing elements of the soundscape? How can environmental phenomenon, in turn, augment human architectures?

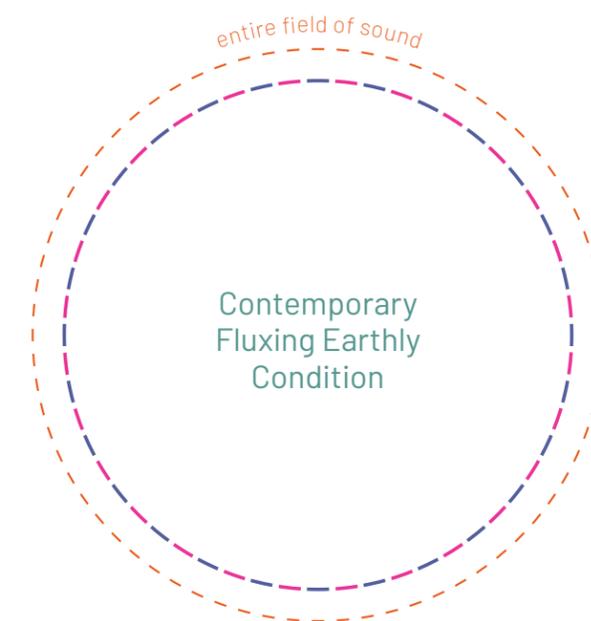
4.4.2



Listening Question 3

To what degree do human systems of tuning impose upon the soundscape? To what degree do non-human patterns and relationships "tune" the human?

4.4.3



Listening Question 4

How can listening engage a more-than-human mode of attention that decenters the human in a time such as the "Anthropocene"?

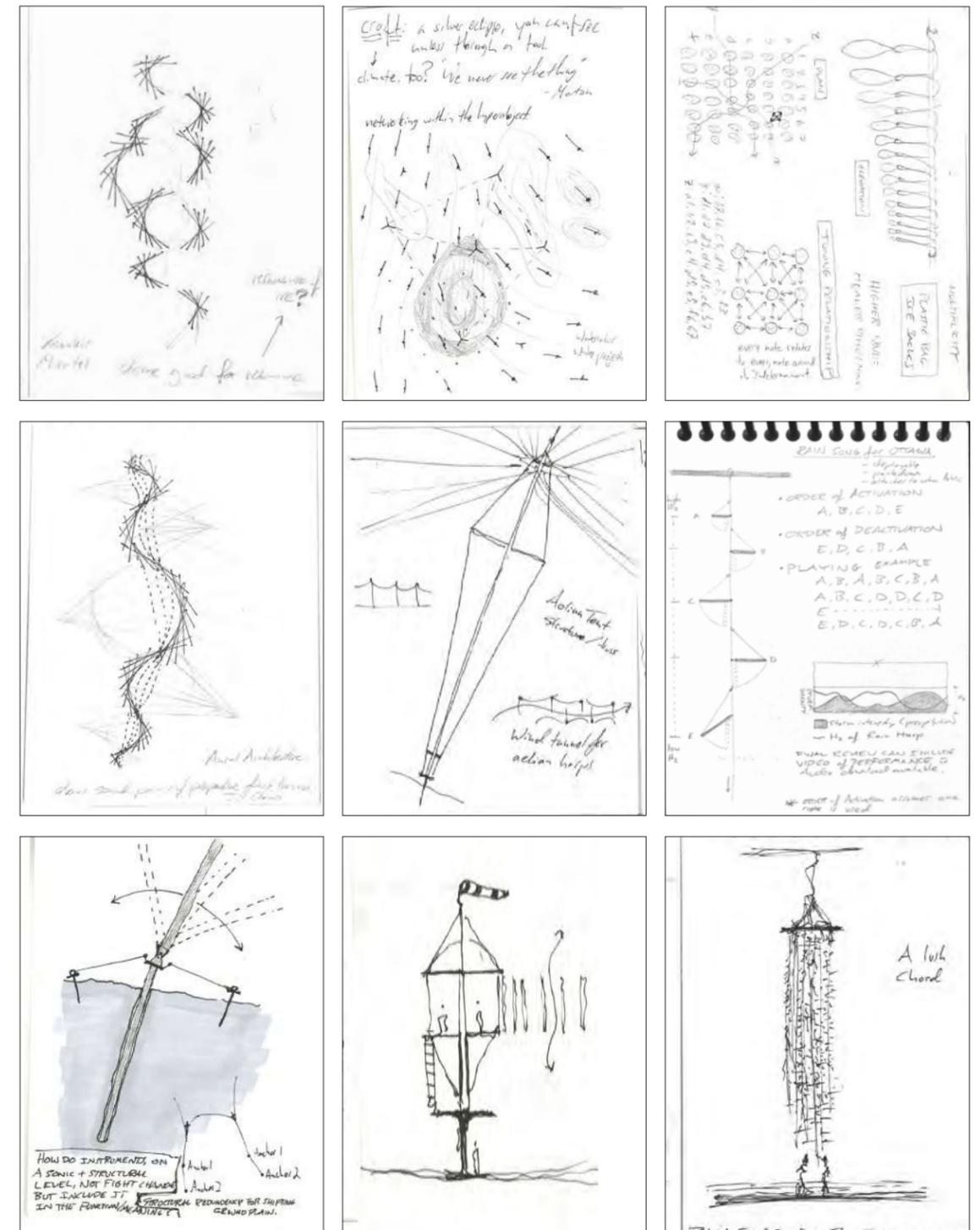
4.4.4

CHAPTER 5: DOMESTICATING THE UNFAMILIAR:
SPECULATIVE ATTUNEMENTS

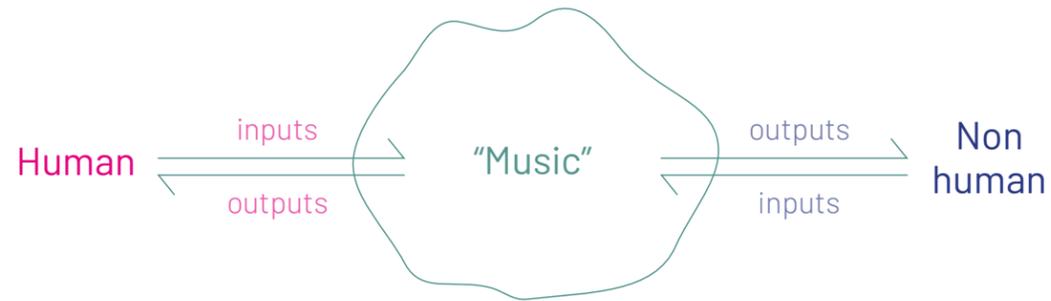
In the post-Cartesian, ecological world view that is now emerging, the self is no longer isolated and self-contained but relational and interdependent. What are the implications for art born of these changes in our notions of selfhood? Art that is rooted in a “listening” self rather than in a disembodied eye challenges the isolationist thinking of our culture because it focuses not so much on individuals but on the way they interact.”

-Suzi Gablik, “Connective Aesthetics”

How can listening engage a more-than-human mode of attention that decenters the human in a time such as the “Anthropocene”?⁶ This chapter is dedicated to the design of environmentally-activated instruments, or *listening devices*, intended to bring the unfamiliar sounds of climate change into human awareness and attention. The instruments themselves are situated primarily at the Athabasca Glacier, and are intended to provide an interface between the human and the non-human, enabling a transfer of information and sonic languages, ultimately repatterning what is traditionally considered to be “music” (fig. 5.0.2). As mentioned earlier, non-human patterns may affect and refine human perceptions as well as the way we think. Here, the listening devices and their sounds are a medium of attunement through which to inform and nurture ecological relationships.



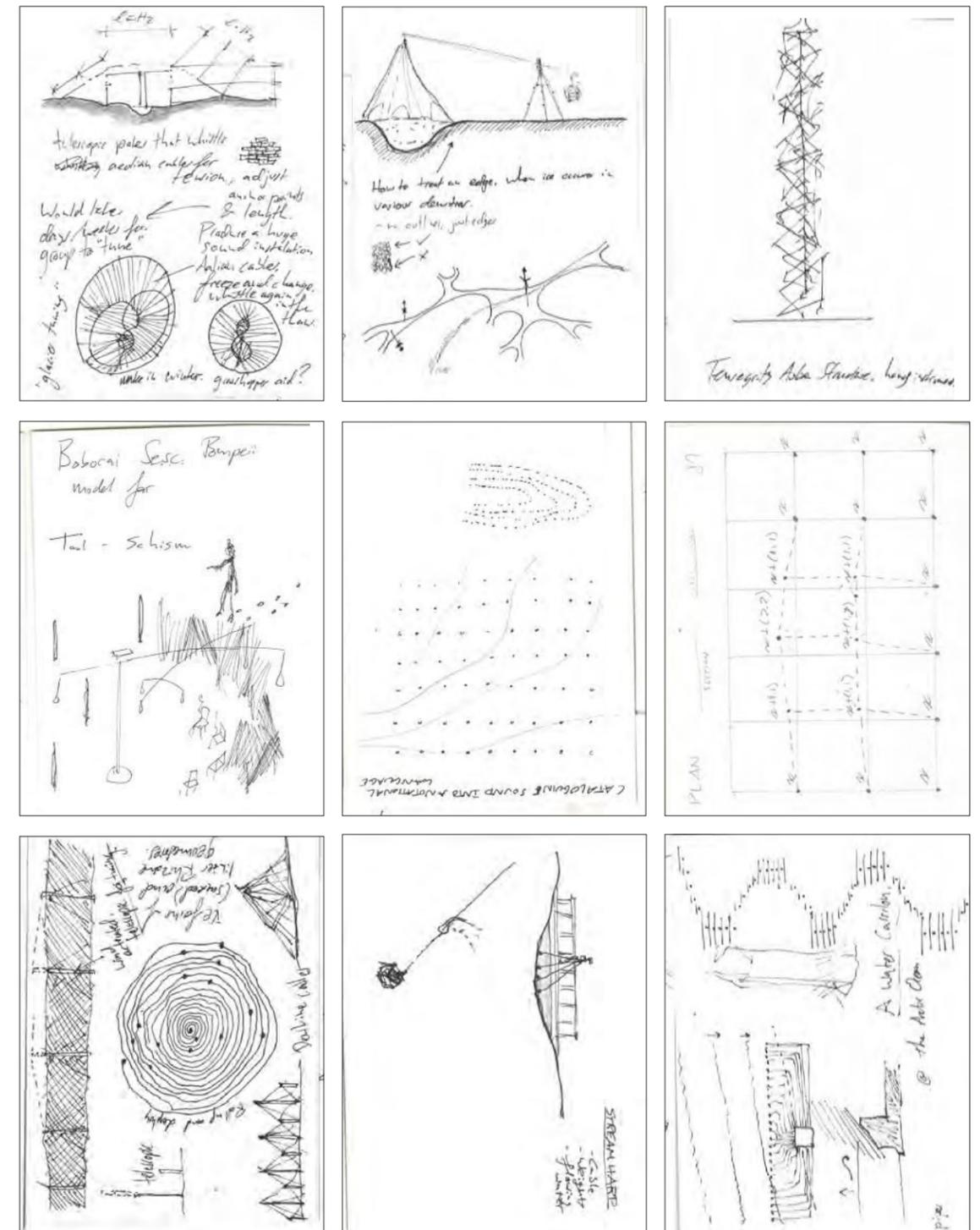
5.0.1 Various instrument ideas



5.0.2 Based off a diagram by Ken Yeang, this diagram describes a human-to-non-human interface as enabled through listening devices.

Amongst the various thumbnail sketches (right), the instruments brought to a higher level of design development have four parts to their drawing and making: (1) sketches, (2) an *instructional* perspectival section describing use, (3) an *active* plan or section describing what environmental phenomenon are affecting the instrument and the resulting sound isobel map, and (4) an *architectural duration score* that speculates on the sounds themselves that the instrument might produce. The combination of these drawing types intend to probe how humans might relate to climate through listening devices. As described below, listening devices:

1. Provide parameters, but are indeterminant in their outcomes.
2. Involve deployable instruments that become immersive testing grounds, where the non-human climate is as much an active participant as the human.

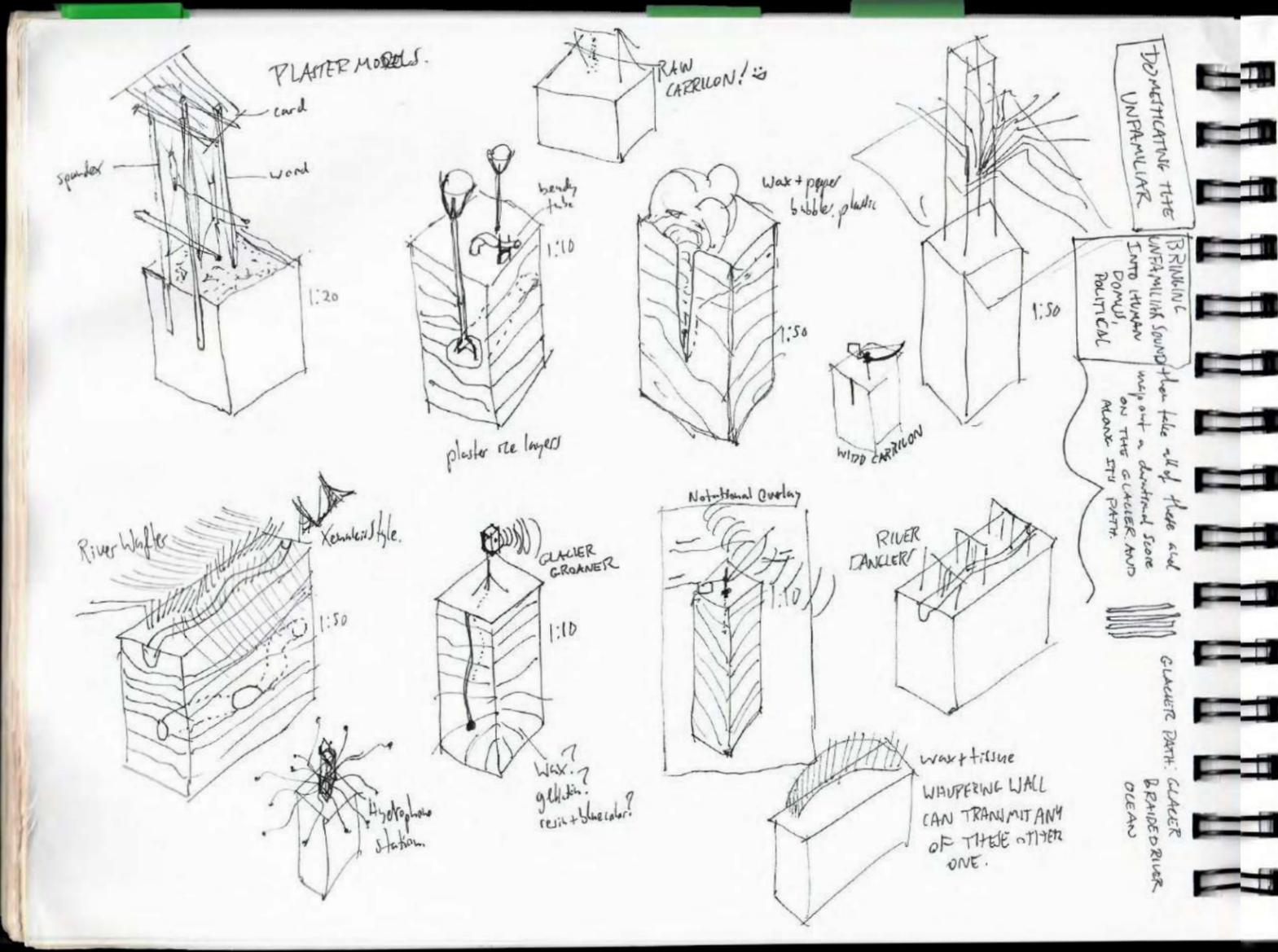


5.0.3 Various instrument ideas

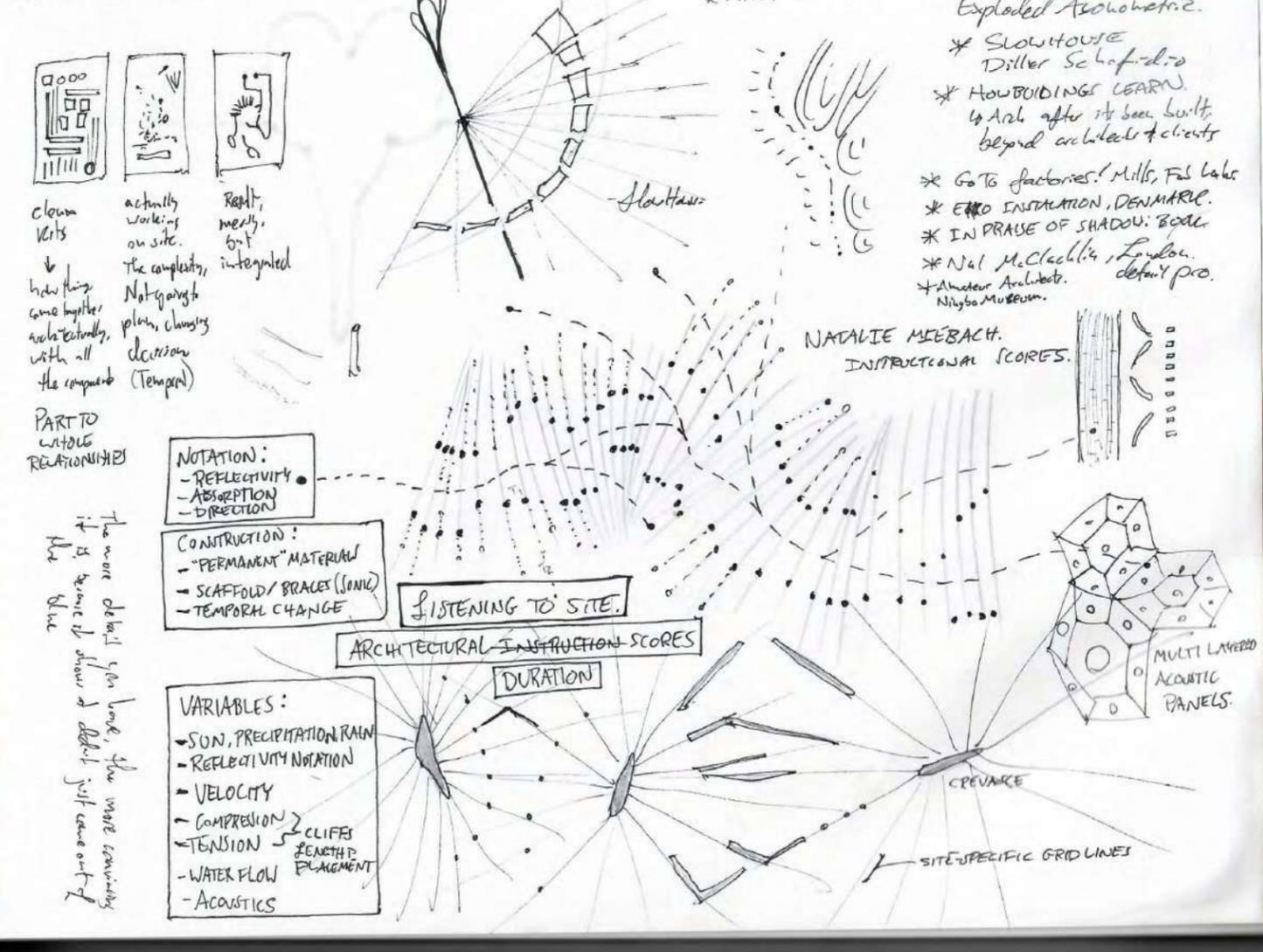
Instruments

“In order to design for movement a whole new system of conceptualizing must be undertaken. Our present system of design and planning are inevitably limited by or techniques of conceptualizing and our methods of symbolizing ideas. We know only how to delineate static objects, and so is all we do.”

-Laurence Halprin



INSTRUCTIONAL SCORES

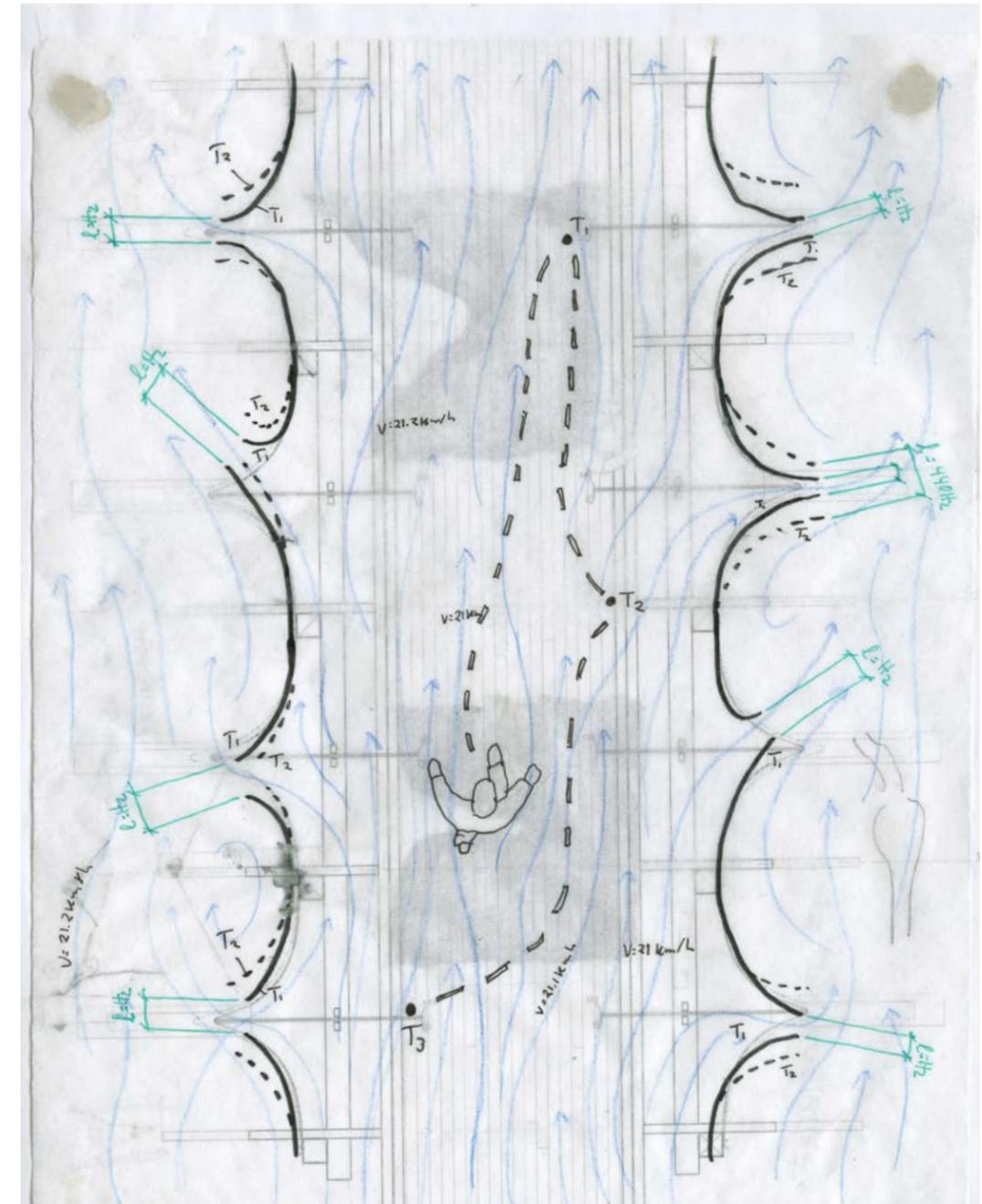
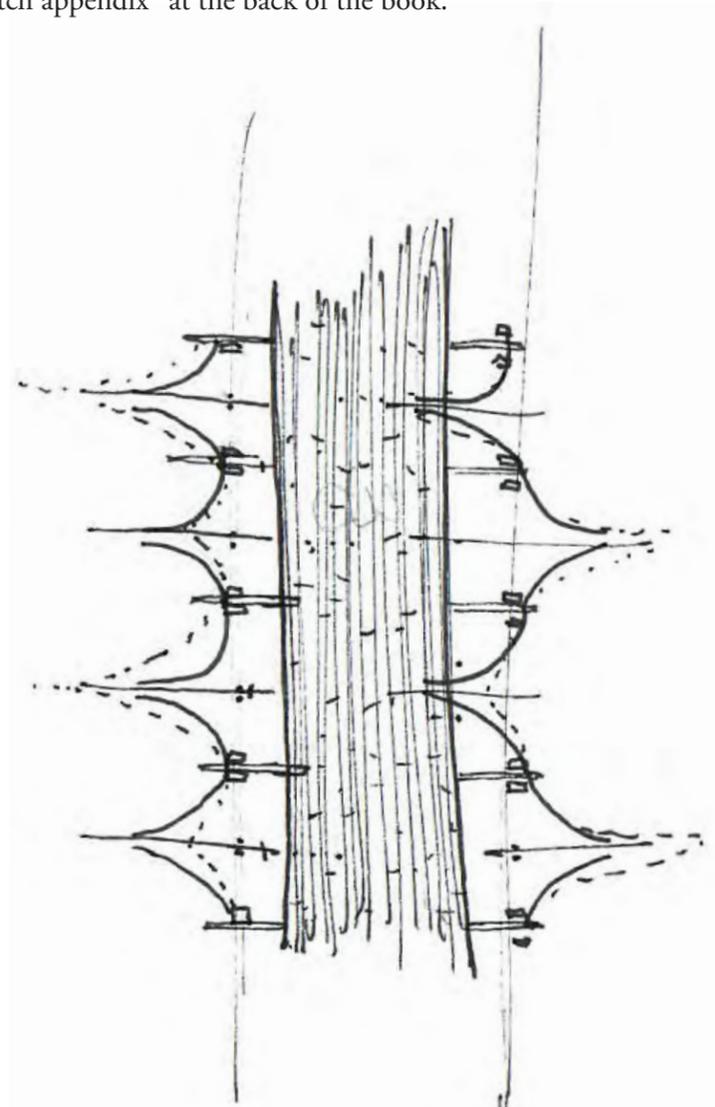


5.0.5 Various instrument ideas for interacting with the glacier, drawn as sectional axonometrics.

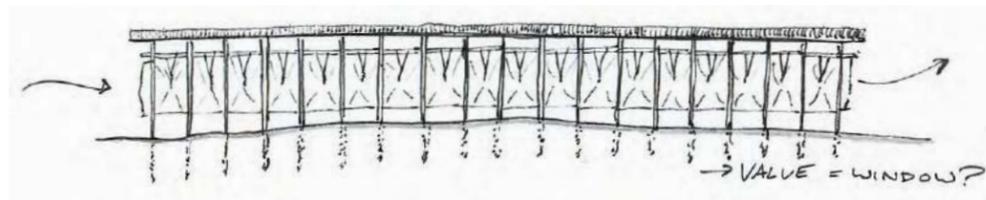
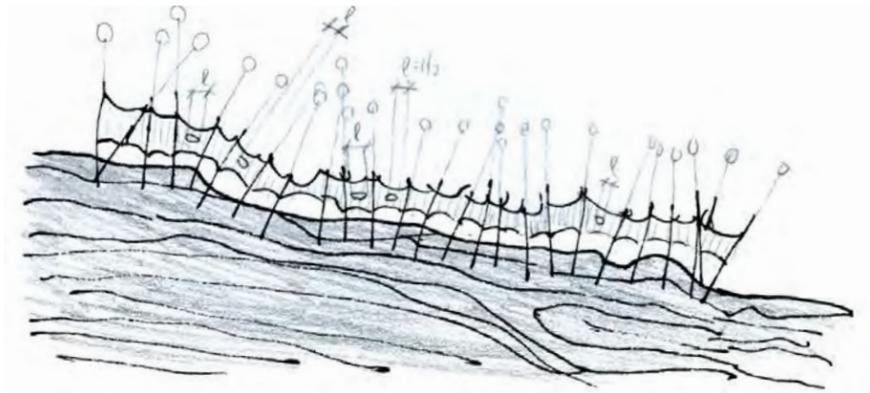
5.0.6 Sketch ideas of “Listening to Site: Architectural Duration Scores” considers variables of environmental phenomenon, site specificity, and a notational language of showing architectural movement over time.

Glacier Accordion

The drawing method for developing and communicating listening devices (sketches, *instructional* drawing, *active* drawing, and *architectural duration score*) is tested here on an instrument called the "Glacier Accordion". Other less developed instrument ideas are included in a "sketch appendix" at the back of the book.



5.0.7 (left) and 5.0.8 (above):
Various process sketches.

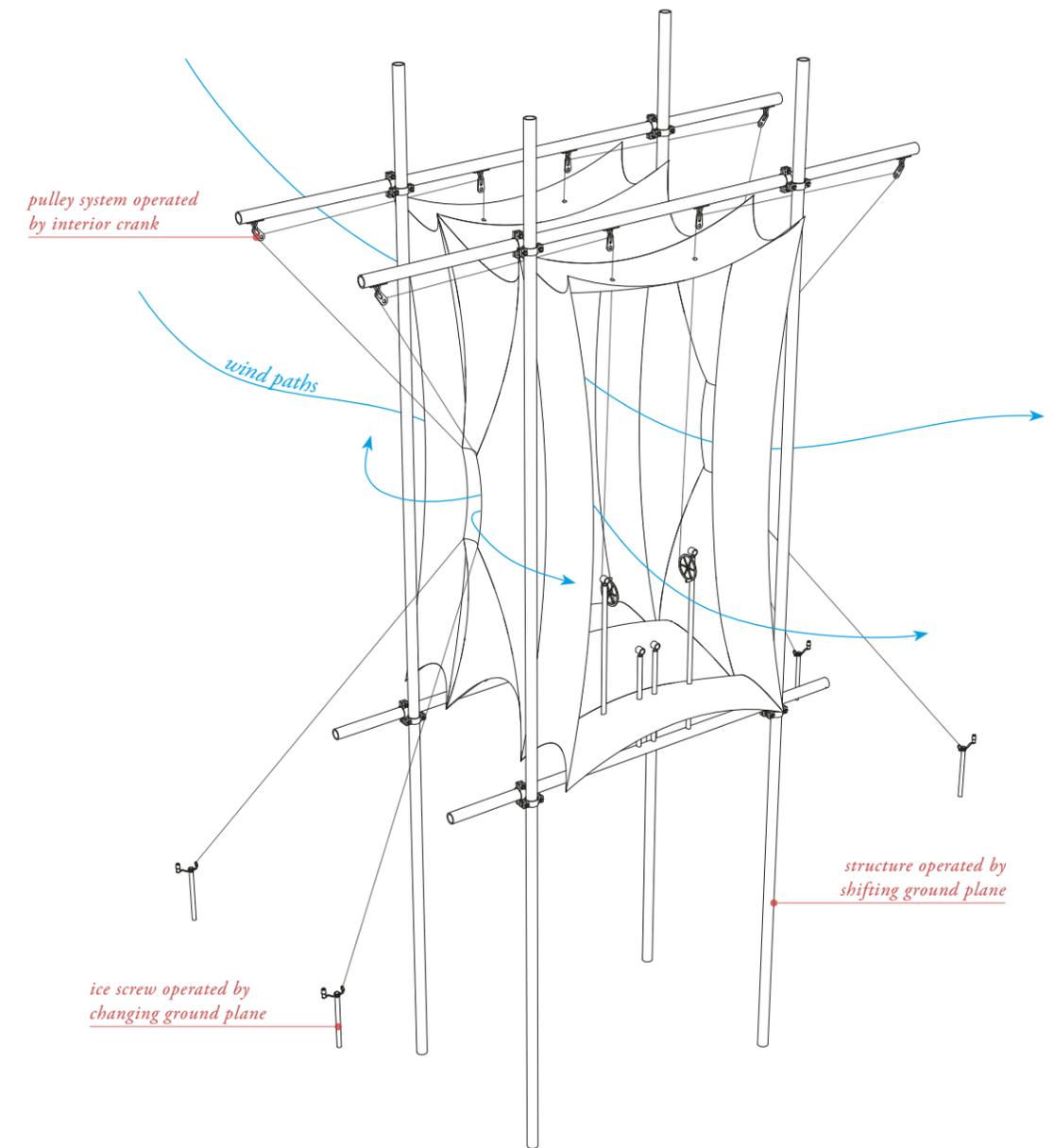


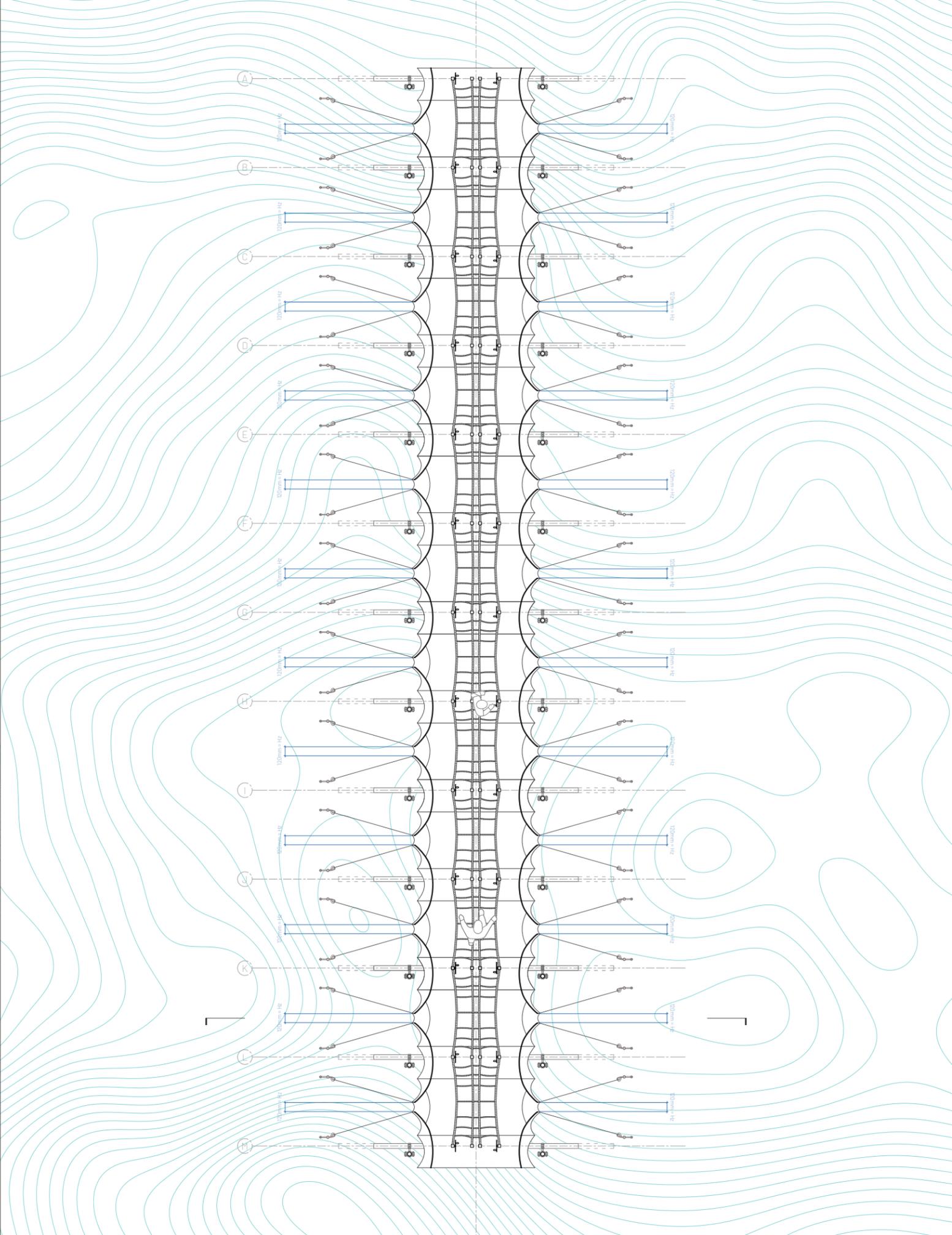
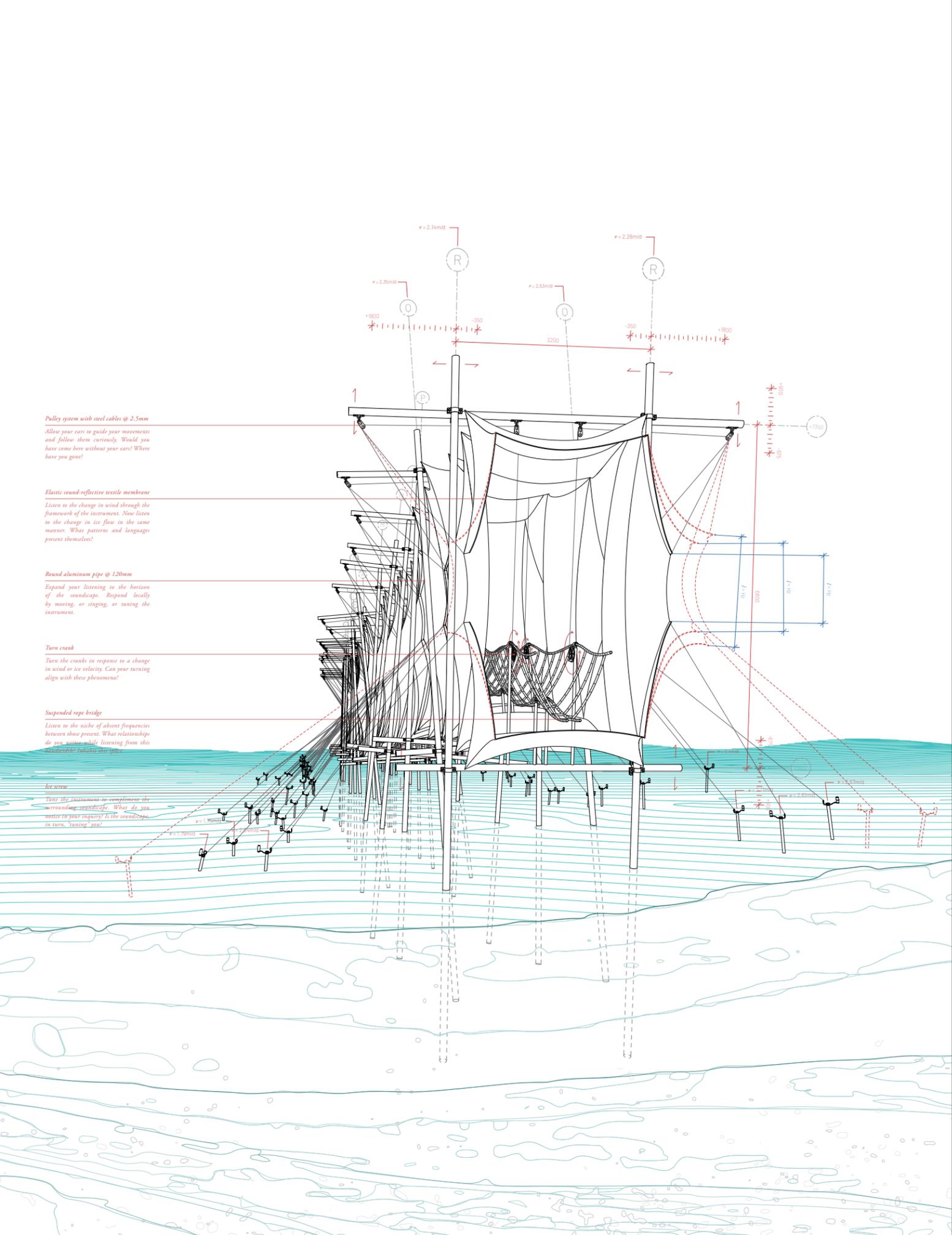
5.0.9 and 5.0.10 (above):
Process sketches.

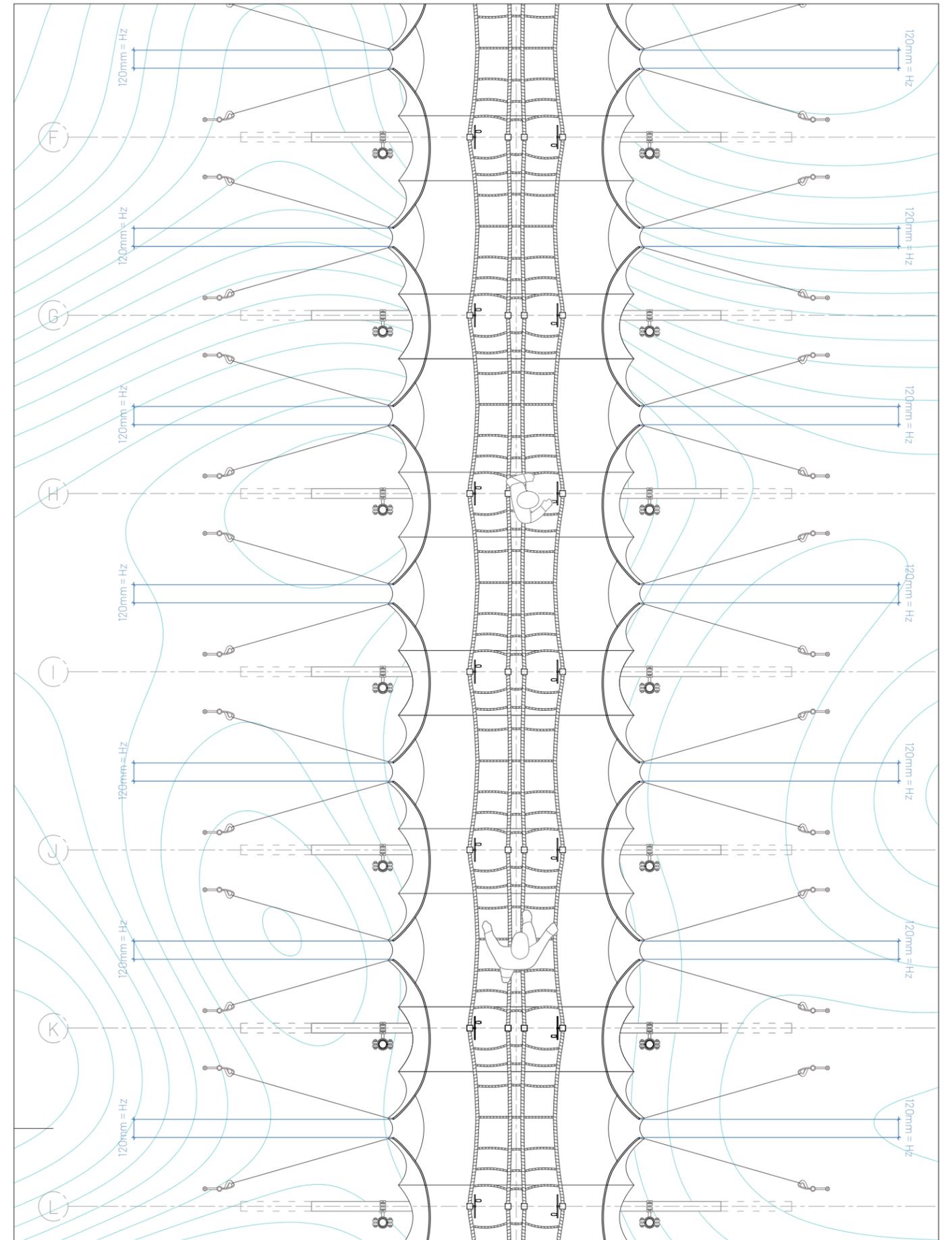
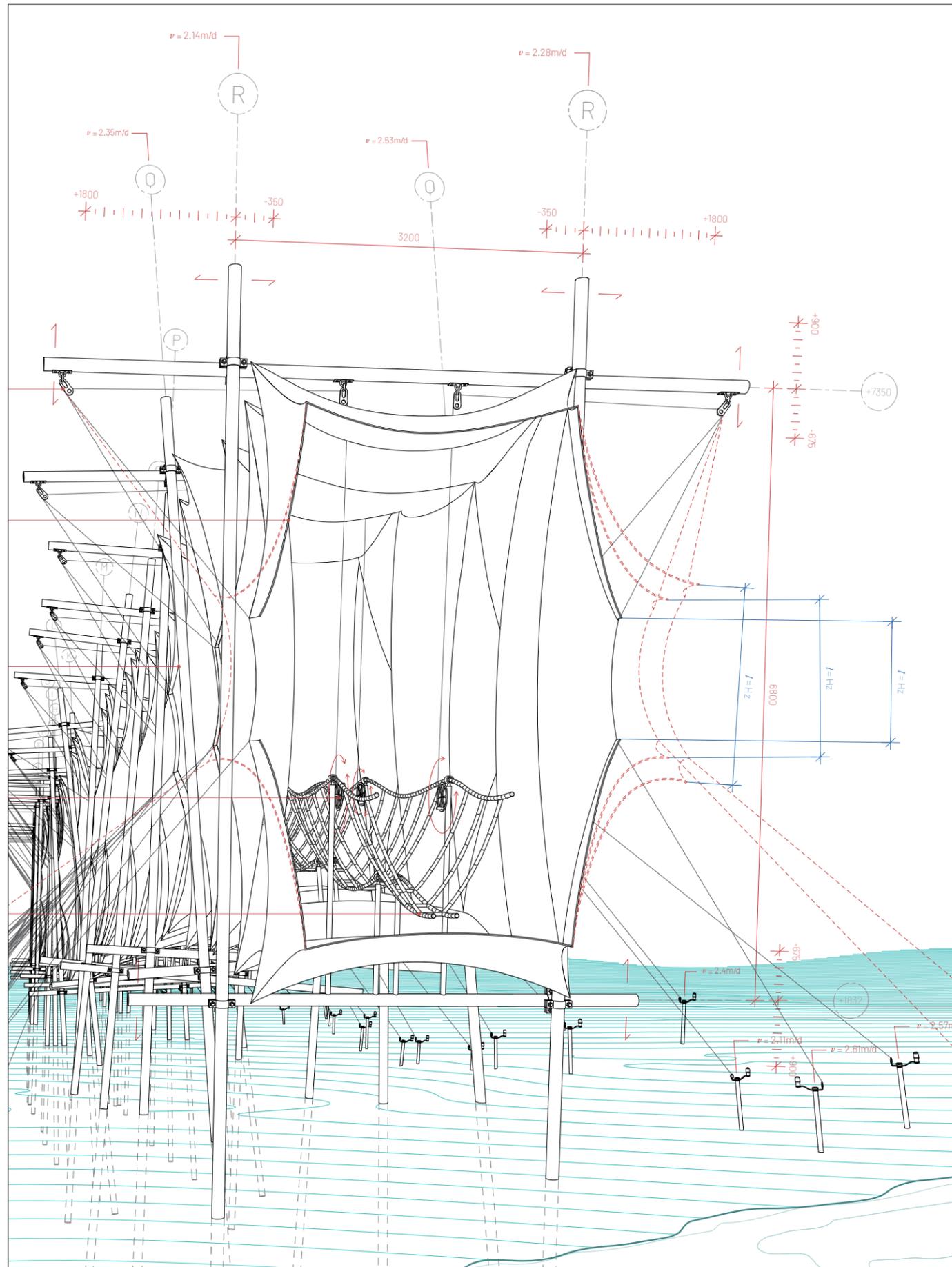
5.0.11 (right):
Process drawing of Glacier Accordion module, membrane operability and wind interaction.

5.0.12 (left-hand side of next pages):
Instructional perspectival section of the Glacier Accordion. This drawing describes operability of the accordion by both humans (operating turn cranks) and the glacier (operating ice screws and aluminum structural posts). Added notations in brown and blue show structure variability, membrane augmentation over time, notations of ice velocity and notation of tuning.

5.0.13 (right-hand side of next pages):
Active plan of the Glacier Accordion. This drawing describes the Glacier Accordion's original position and its changing position in response to the glacier's changing ground plane. Additionally, this drawing shows what active forces (in this case wind) are acting upon the instrument and producing sound. (Note: change of position, wind paths, and isobel map not yet drawn).







Pulley system with steel cables @ 2.5mm

Allow your ears to guide your movements and follow them curiously. Would you have come here without your ears? Where have you gone?

Elastic sound-reflective textile membrane

Listen to the change in wind through the framework of the instrument. Now listen to the change in ice flow in the same manner. What patterns and languages present themselves?

Round aluminum pipe @ 120mm

Expand your listening to the horizon of the soundscape. Respond locally by moving, or singing, or tuning the instrument.

Turn crank

Turn the cranks in response to a change in wind or ice velocity. Can your turning align with these phenomena?

Suspended rope bridge

Listen to the niche of absent frequencies between those present. What relationships do you notice while listening from this bandwidth? Inhabit this space.

Ice screw

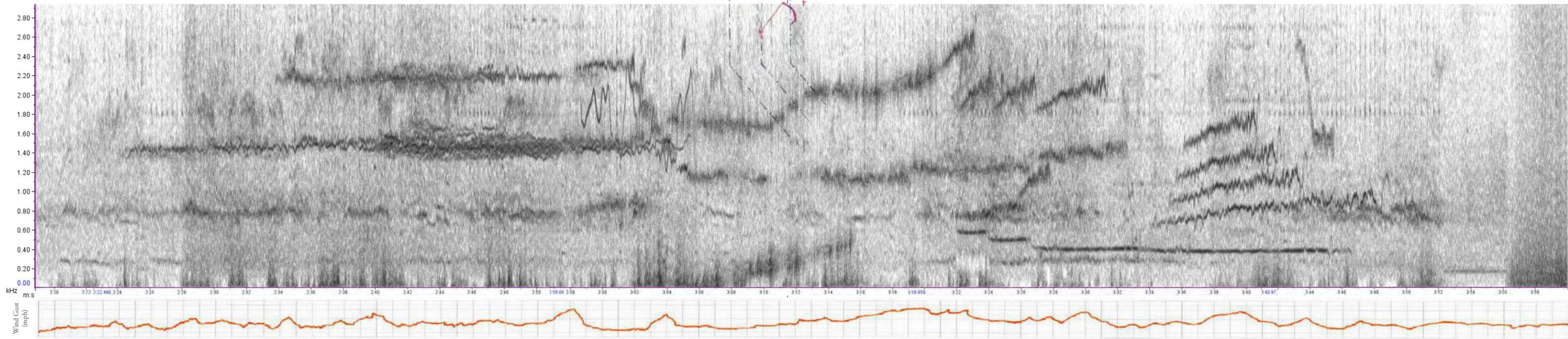
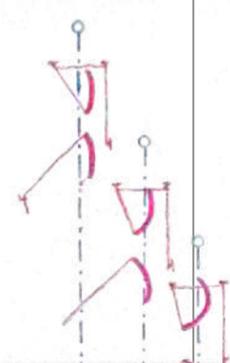
Tune the instrument to compliment the surrounding soundscape. What do you notice in your inquiry? Is the soundscape, in turn, "tuning" you?

Instructional detail callouts with added instruction scores intended to guide sonic awareness and interaction.

Listening is a process that occurs at varying speeds. It can be like a bolt of lightning – all at once in the moment – or it can consist of intuitive guesses and thoughtful references to past experience. Raw listening, however, has no past or future. It is the roots of the moment. It has the potential of instantaneously changing the listener forever.”

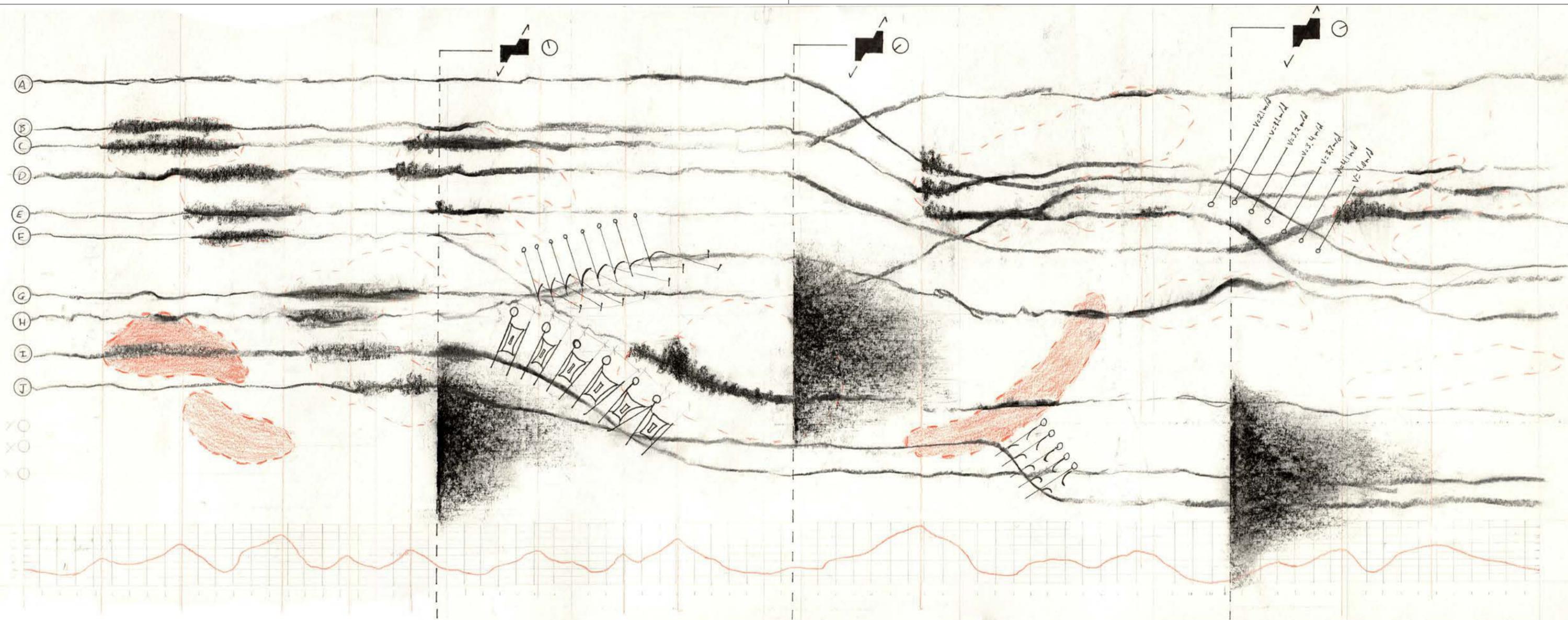
*-Pauline Oliveros, *Deep Listening: A Composer's Sound Practice**

ARCHITECTURAL DURATION SCORE: GLACIER ACCORDION



5.0.14 This *architectural duration score* combines a notational language of sound, environmental phenomena and architectural use to consider each simultaneously as well as in relation to each other. It's sound is a collage of various augmented field recordings of boat's sails sounding in the wind. Like the *Imagined Sonic Interactions* in Chapter 4.3, this method of drawing with sound, environmental phenomena and architectural notation can be useful in generating architectural imagination before designing the architecture itself. (Note: drawing not yet fully annotated with architectural operability and glacier operability).

ARCHITECTURAL DURATION SCORE: GLACIER ACCORDION + ICE MIC

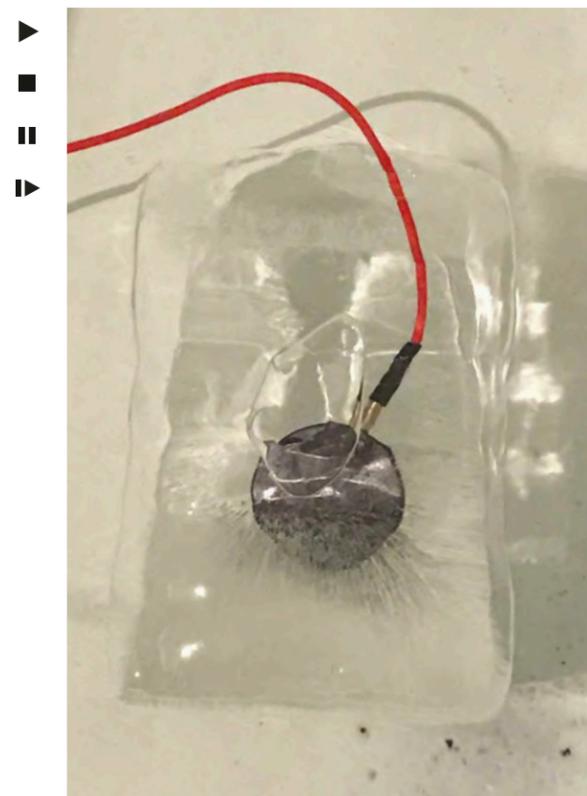


5.0.15 This *architectural duration score* begins to consider the glacier accordion interacting with an "ice mic," an additional instrument not yet designed that transports a glacier's internal groans to the surface (large black portions). The two instruments interact with each other, the wind, and ice movements.

CHAPTER 6: DEFAMILIARIZING THE DOMESTIC: PERSONAL ATTUNEMENTS

“Compassion and understanding comes from listening impartially to the whole spacetime continuum of sound, not just what one is presently concerned about. In this way, discovery and exploration can take place. New fields of thought can be opened and the individual may be expanded and find opportunity to connect in new ways to communities of interest. Practice enhances openness.”

–Pauline Oliveros, *Deep Listening: A Composer’s Sound Practice*



6.0.1 Hydrophone frozen into ice, then placed in water.

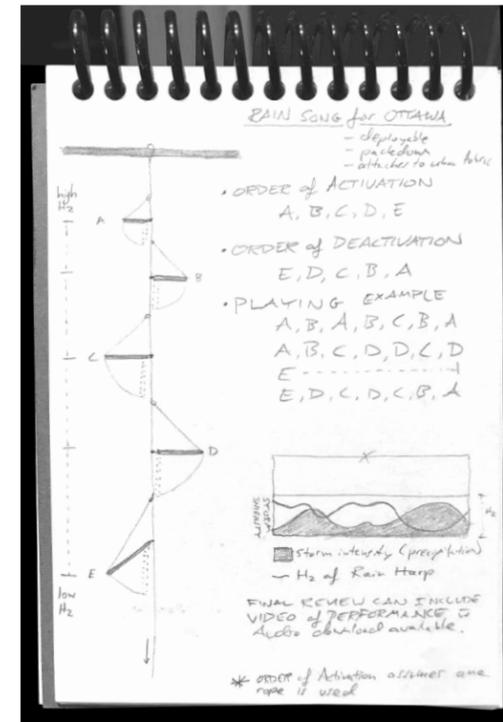
As much as bringing unfamiliar sounds of the ‘non-human’ into the human sphere is important in order to raise awareness, *Defamiliarizing the Domestic: Personal Attunements*, the second portion of thesis design and research is dedicated to the ideas that “nature” and “ecology” are not only relevant “over there” at the glacier. Human existence is inherently ecological and so is the built environment. As Timothy Morton reflects on his own experience of climate change, “I do not access hyperobjects [Morton’s conceptual term for climate change] across a distance, through some transparent medium. Hyperobjects are here, right here in my social and experiential space.”⁹ This chapter is intended to counter *Domesticating the Unfamiliar* by generating ways to listen to climate change in domestic space, positing that climate change can be heard anywhere within its volume. By developing my own attunement to climate change, this chapter also aims to provide an experiential knowledge that the rest of the thesis then speculates on.

Joanne Zylinska writes, “The Anthropocene is not to be sensed only, or even primarily, on a visual level: we literally breathe it, day in, day out. The Anthropocene can therefore also be tasted, smelled, walked through, touched, and heard. We could thus go so far as to say that we already sense the Anthropocene before we can come to terms with it; this is the case even if we ignore or deny it.”¹⁰ A goal of this thesis is to provide ways of sensing what is already the case:¹¹ a phenomenon so total in its surrounding us that we don’t know we are in it; so total in its permeation *through* us that we don’t know we are *of* it.

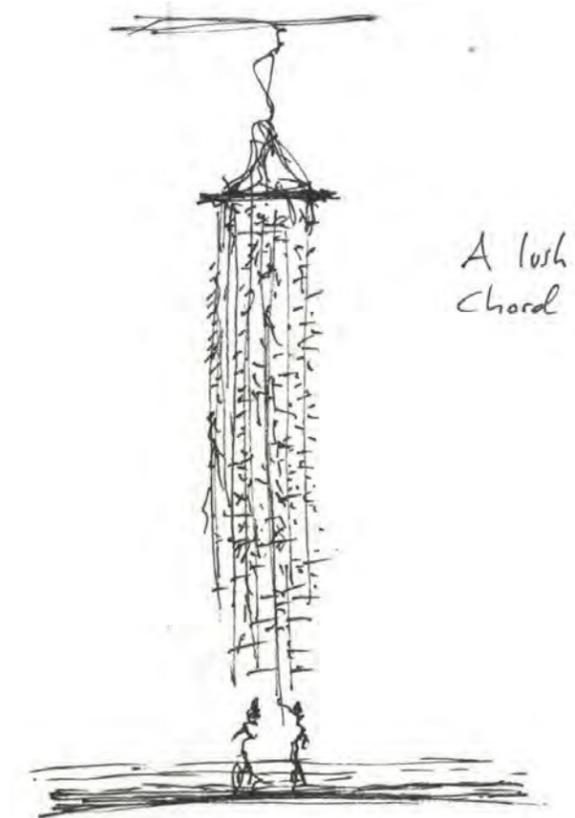
Defamiliarizing the Domestic uses constructed instruments as well as a daily practice of listening to make the engagement of domestic space less habitual and more embodied. In doing so, the resource-

intensive practices of domestic and urban life may lose the invisibility their familiarity reinforces. Instruments and practices of listening aim to help myself and others ask questions like, “how do the pipes in my kitchen affect the rivers of a glacier hundreds of kilometers away?” The two waters are not immediately connected, but somewhere along the webby hydrological mesh of the earth, the two phenomena inflect upon each other.

It seems common to get caught in an unproductive spiral of guilt and worry when asking these types of questions. Yuval Noah Harari writes, “A global world puts unprecedented pressure on our personal conduct and morality. Each of us is ensnared within numerous all-encompassing spiderwebs, which on the one hand restrict our movements but on the other transmit our tiniest jiggle to faraway destinations.”¹² Being made aware of the consequences of one’s action can be a disturbing realization; however, an ethic of listening as well as an inviting architecture for listening may provide friendlier and more compassionate modes of entering into heightened awareness. Although out of scope for this thesis, I am imagining different ways of distorting or bringing attention to sounds that are taken for granted in domestic space. One of those imaginings is a “Rain Carillon”, an instrument prototyped for Ottawa’s increasing, and predicted to continue increasing, rainfall. This instrument amplifies and distorts what is already the case, and could be multiplied into a larger structure that invites users to celebrate rain, and to come into contact with climate change through the framework of a rain’s celebration (fig. 6.0.2 and 6.0.3). Additionally, ‘listening’ is being practiced and recorded through a one-month long daily practice. This daily practice is included below after the Rain Carillon.



6.0.2 Sketch of “Rain Song for Ottawa”. The Rain Carillon is activated by pulling a draw string from below, activating the lower tones first. Pulling the string gradually activates the higher tones, forming a lush chord. It is hypothesized that a users engagement of the instrument ebbs and flows with rain intensity.



6.0.3 Sketch for a public rain structure. If developed further, multiple chords could be developed in harmony or disharmony with each other.

Rain Carillon



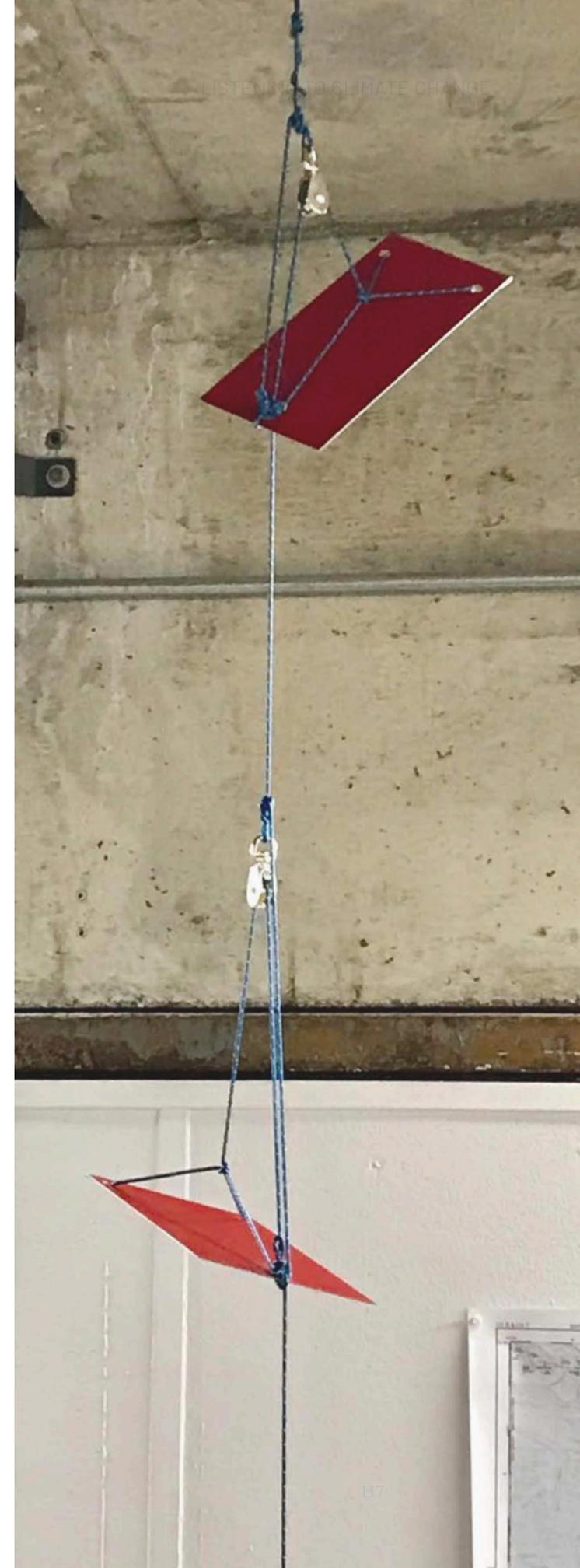
6.0.4 Rain Carillon packs down flat for transport and deployability.



6.0.5 (above):
Once a panel is activated, this stopper ceases its activation, transferring the pull's tension to the next panel.

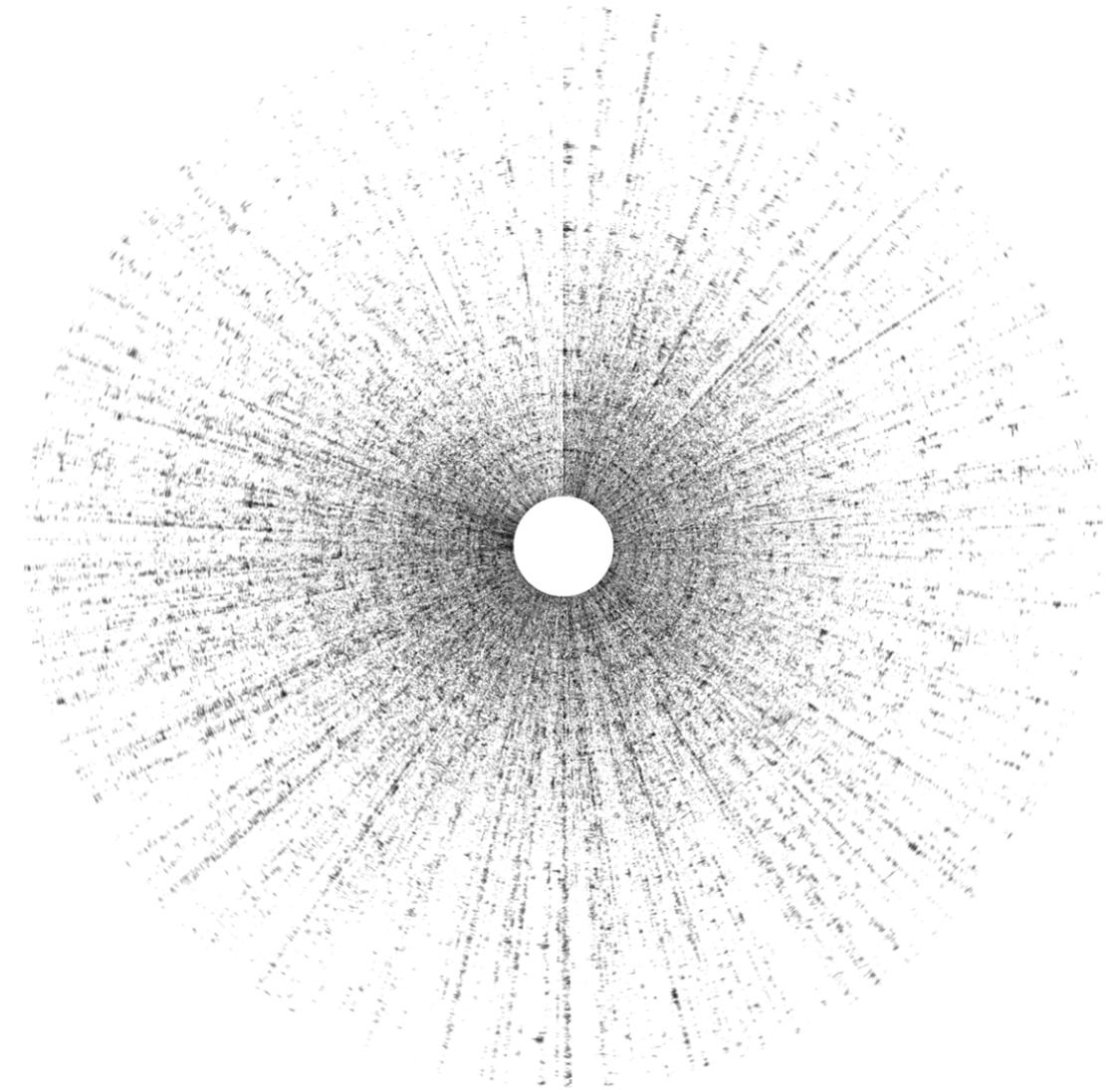


6.0.7 (above):
Study of latex as an alternative material.





6.0.8 Views of Rain Carillon during use.

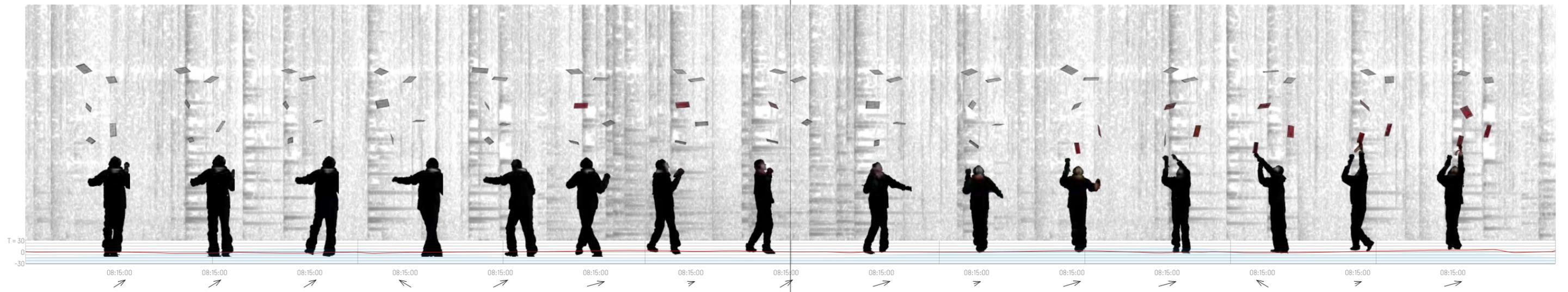
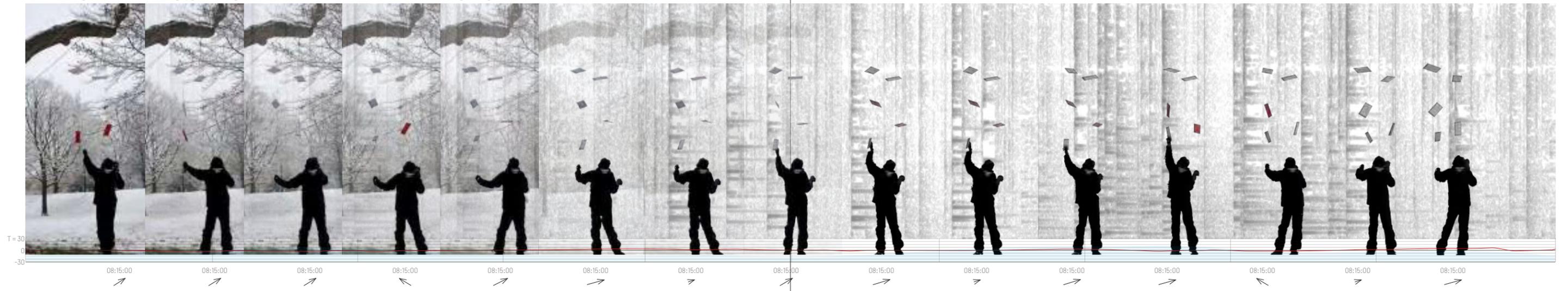


Rain Carillon (number of panels multiplied)
Speculative Audio Collage made from various Field Recordings
0:00



6.0.9

6.0.10 Testing a time-based drawing type that aligns environmental metrics with instrument use and spectrogram.



6.1 Listening as Daily Practice

Natalie S. Loveless' third talk of her *Sensing the Anthropocene* series, "Listening as Ethic; Walking as Method: Daily Practice and Art/Life Intervention," describes the "instruction score," which sees the everyday experience of life as a foundation for artistic form. This is done simply by recontextualizing daily activities as such; by labeling them as art.¹³ "With the instruction score," she describes, "the frame of art is mobilized to reorient habitual modes of being."¹⁴ In the same way a musical score invites musicians to interpret graphic symbols and translate them into sonic form, or a construction drawing guides builders in the "performance" of construction, the instruction score calls participants to perform any action as guided, under the presupposition that this act, as a form, is art. Yoko Ono's *Cut Piece* (1965) for example, instructs members of the audience to walk on stage and cut a small piece of clothing off of her, which they can then keep. Later in the performance, audience members are invited to begin doing the same with each other.¹⁵

Loveless adapts the instruction score into one of daily practice, that is, a score that is repeated every day over a long period of time. "Action A Day (Maternal Prescriptions)" was part of her three-year long daily practice entitled *Maternal Ecologies*. This was a "trimester-long web-based project that used the language of performance art to recast the maternal everyday."¹⁶ She along with five mothers from three different countries performed "the ecologies of care that texture everyday (maternal) life" daily for three months.¹⁷ The instruction score she sent out to collaborating mothers follows:

Action A Day (Maternal Prescriptions) (2010):

*I send you a performance action from my experience of daily life (e.g., "listen to baby's breath," "watch baby sucking on finger," "observe the rise and fall of breath," or whatever action I want to bring the attention of "performance" to that day). You do the same for me. I perform as many actions as are sent to me, and if none are sent, I only perform my child's action. Each day's action(s) will be documented both in video and still-form with my smartphone and uploaded to a blog we will share for the duration of the performance.*¹⁸

Loveless' attention to maternal actions is a decided practice of awareness towards the moments of daily life that are so easily lost to time. She explains that in the second daily practice of *Maternal Ecologies*, a performance focused on her child's "firsts," "a central side effect of this 210-day project was to pull me into a differently attuned temporality. Despite the progressive and anxiety-laden developmental drive of the language of "firsts" in Western parenting culture, instead of grounding me in the attainable future, the project of finding firsts in everything re-attuned me to the complex texture of a shifting present." During her talk, she drew upon this experience and put forth the idea that daily practice may be an effective means of attuning oneself to climatic realities.

I started my own daily practice on the walk home after her talk, listening carefully to the sounds of my footsteps as they compressed the snow that had fallen a few hours earlier. I was startled by the amount of variance the sounds my boots and the snow produced, realizing a level of complexity I was not attuned to. Three days later I attended my

weekly seminar class, *Deep Listening Intensive 1*, an online course given by instructors who trained under Deep Listening's founder, Pauline Oliveros. Oliveros developed a multitude of "sonic mediations" over the course of her life, and our homework that week was to practice "Open Field":

Open Field (1980):

*When a sight, sound, movement, or place attracts your attention during your daily life, consider that moment an "art experience." Find a way to record an impression of this momentary "art experience" using any appropriate means or media. Share these experiences with each other and make them available to others.*¹⁹

Having just begun my own daily practice three days prior, I decided to use this opportunity to write my own instruction score to formalize the few experiences I had in daily practice:

Listening to Water (2019):

Each day, listen to water in any of its forms, liquid or crystalline ice. Listen for one or more minutes while recording and write down something about the sound you've become aware of that you weren't of before listening. In addition, take a photo of what produced the sound and describe through text the spatial acoustics that articulated the sound.

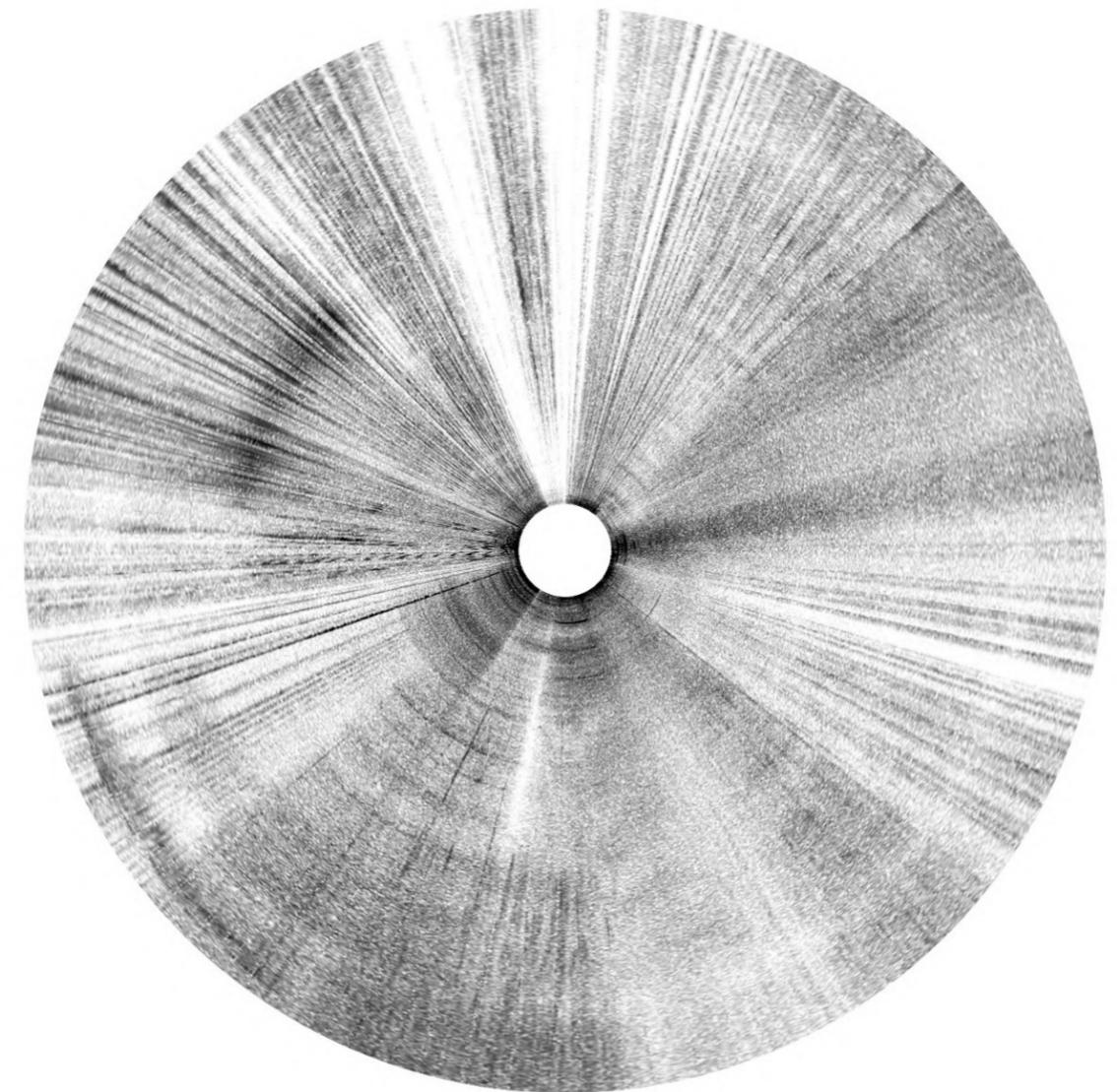
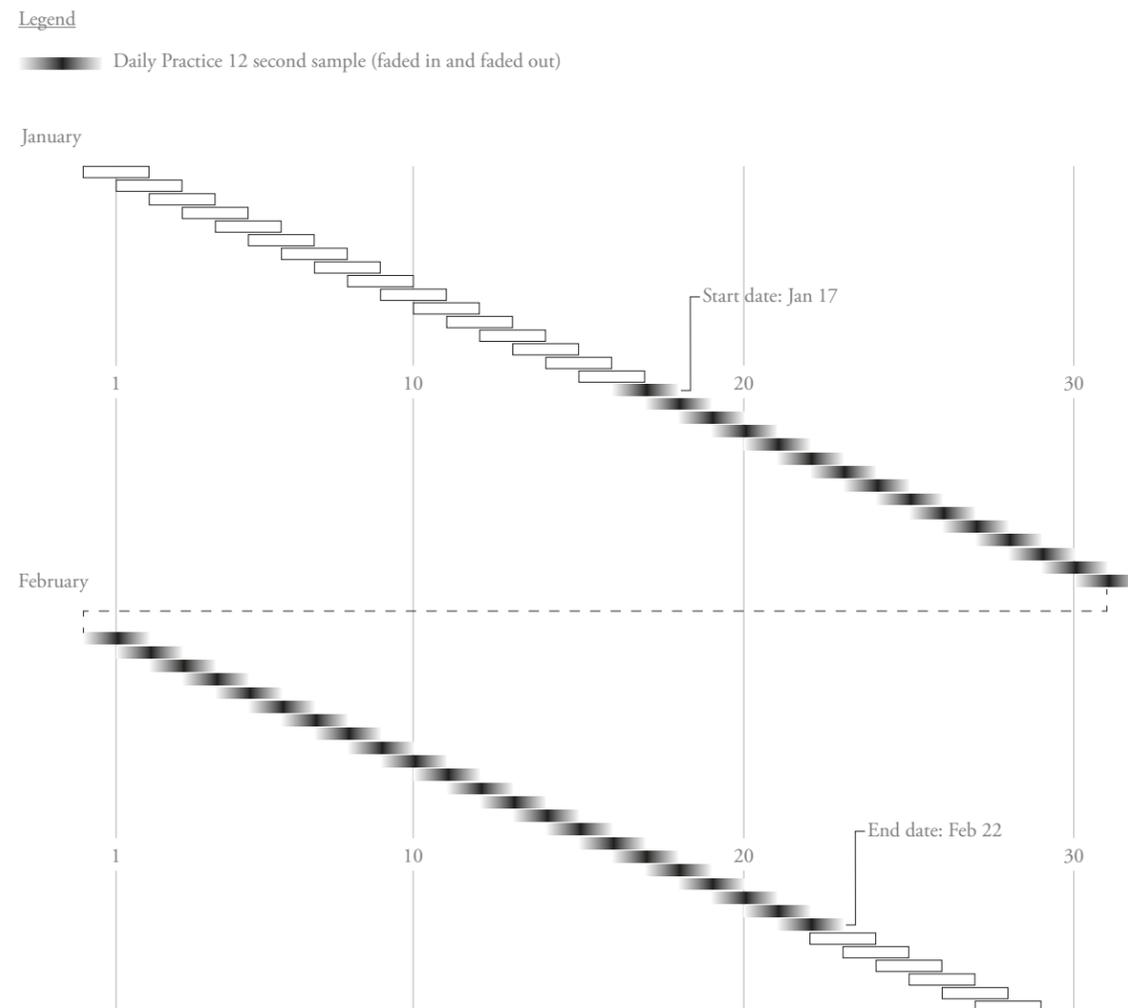
I practiced this score for one month, labeling it as thesis research. The score is designed to heighten the performer's awareness of their environment, particularly of water, given my interest in the Athabasca Glacier. As guided by *Deep Listening*, the "form" of each day's practice

was the act of listening itself, that is, *how* one listens. These small sonic doses follow Oliveros' emphasis on an impartial listening, that is, accepting the sounds *as they are*, not as one wants them to be.²⁰ This mode of listening is viewed as a productive means of understanding one's environment for what it truly is, a prerequisite to actively and effectively improving it. Listening here is "dying" in Scranton's sense of "letting go." Having experienced Loveless' notion of the "value of dailyness," this slow and gradual transition towards awareness and acceptance of my environment, of *feeling* it more fully through sound, provides testimony to architecture's value in inviting others to do the same.

When playing sounds from the *Listening to Water* daily practice pages that follow, I invite listeners to, as TJ Szewczak describes their experience in *Deep Listening*, "feel around in all of the crevices and peaks that speckle the surface of any sound or soundscape."²¹

6.2 Timeline of Daily Practice

The following diagram shows a timeline of daily practice recordings. Each recording is twelve seconds long and fades into the next. On the right is a polar spectrogram of this compilation. The longer sample of each daily practice can be heard on the pages that follow.



Compilation of Daily Practice Recordings
Author's Composition
1:42



6.2.1

6.2.2

Jan 17, 8:44 pm

"walking in snow"



sound: The higher and louder tones of each foot step are always in sync with a more subtle "creaking" rhythm as pressure shifts on the snow.

space: Sounds don't last long and are heard very crisply. Highly absorptive ground plain, very little reverberation.

Jan 18, 11:50 am

"washing bread knife in kitchen sink"

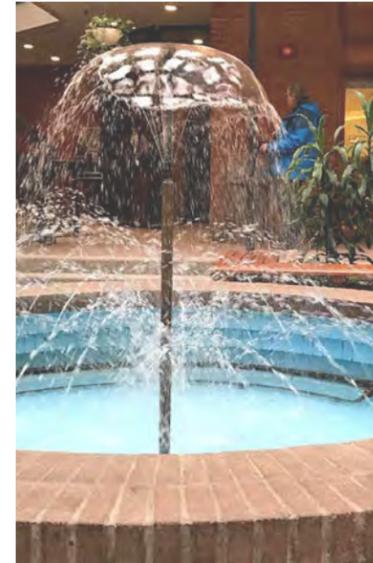


sound: after turning the sink off, many small drops fall down a highly reverberant drainage pipe.

space: the sink bowl "pingy" and clear while drops falling down the drain are highly reverberant, articulated by the length and width of pipe.

Jan 19, 12:11 pm

"sitting by indoor fountain"

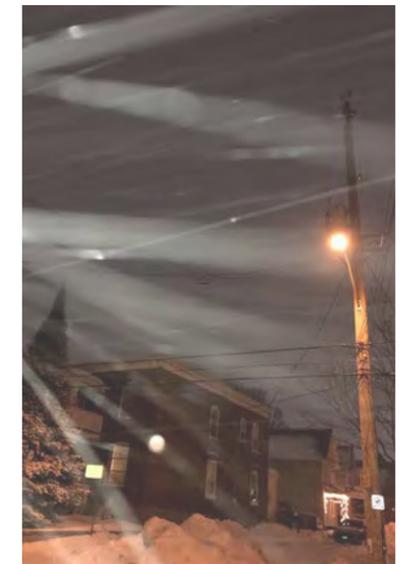


sound: The general "fuzz" or effect of the fountain is composed of many short tones at many different frequencies. Water sounds blend with surrounding voices.

space: Smooth interior surfaces make for a highly reverberant space. Volume increases dramatically once ears move beyond fountain's interior ledge.

Jan 20, 6:52 pm

"snowflakes on hood of jacket"

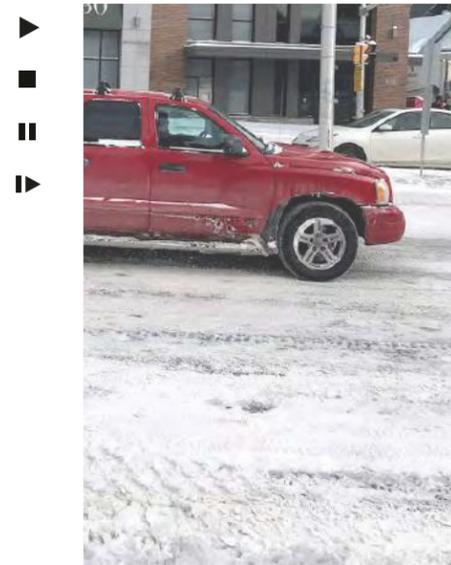


sound: Very tiny specs of sound (microphone not sensitive enough to pick up) like radio static. Sounds can be close together in time but silence is never longer than 2 seconds or so.

space: Sound too quiet to be heard when walking or when cars go. Soundscape very quiet due to blanket of fresh and very dry puffy snow. Snowflakes in the air are also absorbing sound.

Jan 21, 1:05 pm

"fresh snow at an intersection"



sound: Compressed snow creeks as tires moves over it in unison with the rev of the engine. Creaking becomes a different sound when cars speed up.

space: Wind is shaking many loose pieces of metal around me. Intensity of sound transitions from left ear to right as cars move by.

Jan 22, 10:40 am

"washing lampshade"

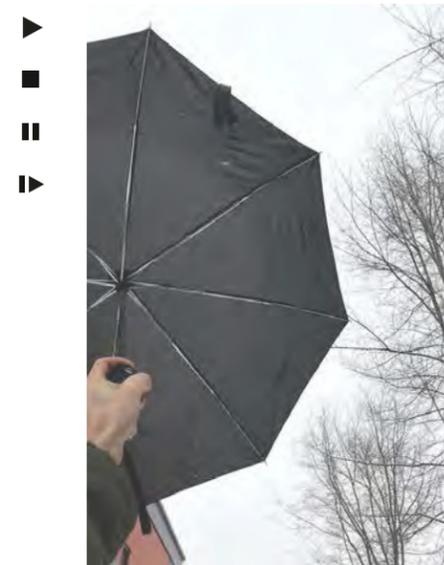


sound: Low and high pitch plopping as water drops back down into pot.

space: Both the pot and the lamp shade become resonators, sound shoots right back up at me like at the fountain.

Jan 23, 10:56 am

"snowflakes on umbrella"

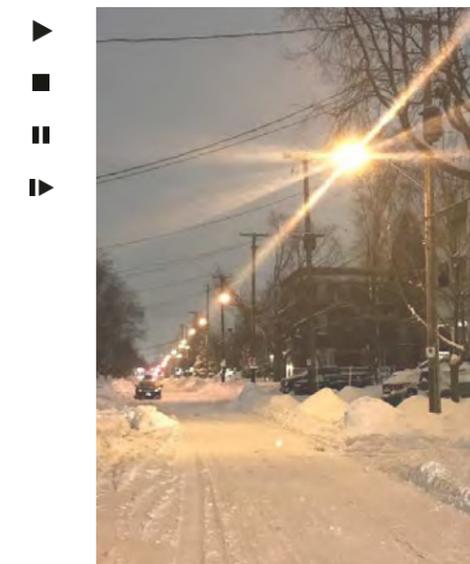


sound: Small grains of sound gradually intensify and gain individual definition as my listening adjusts to their subtleties.

space: A long narrow alleyway with reflective walls and a snowy ground plain. Sounds of cars and trucks enter the alleyway from both directions, becoming a counterpoint to the tiny specks of snow sound.

Jan 24, 10:35 pm

"quiet lumpy street"



sound: Not listening to water flowing and moving, but to how quiet the street is after hours of heavy snowfall from the day before.

space: Ground surface became increasingly absorptive and undulated as the snow was moved around by plows throughout the day. Spatially and acoustically very unique, so much light and so little sound transmission.

Jan 25, 00:00 am

"Kaia in the snow"



sound: A gradient between a hard crunch and a softer brush as Kaia's paws pass through a hard top layer of ice to fluffy snow below.

space: The top crust of ice becomes a membrane for sound to travel slightly across. The powder below has very low reverberation.

Jan 26, 00:00 am

"washing machine"



sound: breaks in the constant machine sound allow a subtle trickle of the water supply tube to be heard.

space: swish of water much more audible when lid of the machine is open.

Jan 27, 00:00 am

"snow on umbrella 2"



sound: Static like on Jan 20, but much more rapid. Comes down in billowy densities of sound grains in sync with the wind.

space: As gusts of wind roll by, sounds transition from front of umbrella to back, making for an audible read of spatial phenomena.

Jan 28, 00:00 am

"pouring carbonated water"



sound: fast and short micro-melodies can be found as bubbles surface in sequence. Some resemble each other, making an almost fugue-like morphology of melodies.

space: Bottle becomes a resonator. After closing its lid, the air still squeaked its way through whatever crack it could find.

Jan 29, 00:00 am

"shower"



sound: many elements make up the bathroom soundscape: high pitch forcing of water through shower head, water hitting the plastic floor, a subtle low-pitch rumbling of water hitting my body heard heard internally.

space: Sound events are stretched out in time by the highly reflective bathroom tiles and porcelain, blending together.

Jan 30, 00:00 am

"chirping bubbles in boiling water"



sound: Small chirps repeat, a second series joins in polyphony. Sounds like a live audio mixing of bird calls.

space: Because the sound is so quiet in relation to the sound of vents, one needs to put their ear right up to the pot.

Jan 31, 00:00 am

"spraying fern with spray bottle"

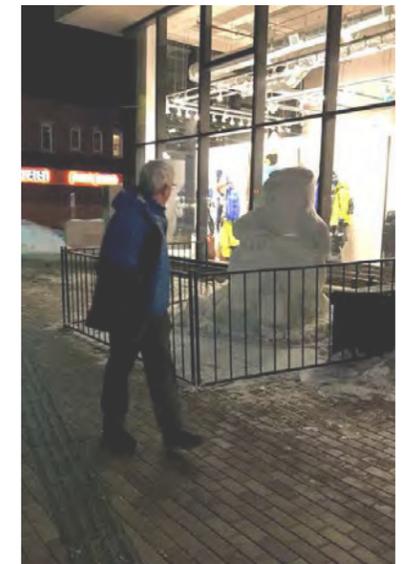


sound: A soft "mist" of small sound grains follow a gentle click of the sprayer's lever. Very difficult to discern the end of the sound of spraying, sound has blurry "edge".

space: "Edge" of sound is further blurred by the highly reflective bathroom tiles and porcelain.

Feb 01, 00:00 am

"pedestrians posing with beaver snow sculpture"



sound: melody of voices and laughter over lap in response to each other.

space: People's comments towards the beaver come in and out of perception as they pass by range of microphone and of ears.

END NOTES – PT. 2: A MORE-THAN-HUMAN MUSIC

1. Jim Nollman, "Playing Music with Animals," *Interspecies*. 2010. Accessed February 24, 2019. <http://www.interspecies.com/pages/animalmusic.html>.
2. David Rothenburg, "Bug Music: David Rothenberg's Insect Choir." *Vimeo*. June 21, 2013. Accessed February 25, 2019. <https://vimeo.com/68859004>.
3. Sven Sterken, "Music as an Art of Space: Interactions between Music and Architecture in the Work of Iannis Xenakis," in *Resonance: Essays on the Intersection of Music and Architecture*, ed. Mikesch W. Muecke and Miriam S. Zach (Ames: Culicidae Architectural Press, 2011), 26-7.
4. *Ibid.*, 24.
5. *Ibid.*, 43.
6. The term "Anthropocene" is put in quotations because of its still tentative usage as the most accurate and ecologically productive way of conceptualizing the current geologic epoch. I use it here for clarity, but other terms can be considered in addition to, or instead of, the "Anthropocene".
7. M. Beth L. Dempster, *A Self-organizing Systems Perspective on Planning for Sustainability*, Master's thesis, University of Waterloo, 1998, v.
8. Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016), 8.
9. Timothy Morton., *Hyperobjects: Philosophy and Ecology after the End of the World* (Minneapolis: University of Minnesota Press, 2014), 27.
10. Joanne Zylinska, *The End of Man: A Feminist Counterapocalypse* (Minn.: The University of Minnesota Press, 2018), 47.
11. This idea comes from Timothy Morton's notion of what the goal of meditation is, that is, "getting used to what is already the case." Timothy Morton, "Being Ecological | Lecture by philosopher Timothy Morton." *Radbound Reflects*. March 24, 2018. Accessed March 3, 2019. <https://www.youtube.com/watch?v=Yv4W4M8Z8VQ>.
12. Yuval Noah Harari, *21 Lessons for the 21st Century* (Toronto: Signal, an imprint of McClelland & Stewart, a division of Penguin Random House Canada Limited), xvi.
13. Natalie S Loveless. "Sensing the Anthropocene III: Listening as Ethic; Walking as Method: Daily Practice and Art/Life Intervention." Lecture, Event from the *Centre for Sensory Studies*, Montréal, January 17, 2019.
14. *Ibid.*, in "Listening as Ethic; Walking as Method: Daily Practice and Art/Life Intervention," Loveless describes the instruction score (an art form that emerged out of the Fluxus movement of the 1960's and 70's) which emphasizes artistic process over finished form, and that sees the everyday experience of life as a grounds for artistic form. The talk ended with an open dialogue with what it means to sense our environments, and how art as daily practice may play a role in attuning oneself to their surroundings.
15. Yoko Ono, "Yoko Ono: Cut Piece," *MOMA Learning*. n.d. Accessed January 20, 2019. https://www.moma.org/learn/moma_learning/yoko-ono-cut-piece-1964/.
16. Natalie S. Loveless, "Maternal Ecologies: A Story in Three Parts," in *Performing Motherhood: Artistic, Activist, and Everyday Enactments*, ed/ Amber E. Kinser, Kryn Freehling-Burton and Terri Hawkes (Bradford: Demeter Press, 2014), 151.
17. *Ibid.*, 152.
18. *Ibid.*, 154.
19. Pauline Oliveros, *Deep Listening: A Composer's Sound Practice* (Lincoln: iUniverse, Inc., 2005), 46.
20. This notion of accepting things as they are is very present in the lecture videos played at Vipassana retreats by S.N. Goenka, and is synonymous with Morton's notion that meditation is way of "getting used to what is already the case."
21. TJ Szewczak, "Posten Kill," in *Deep Listening: A Composer's Sound Practice*, by Pauline Oliveros (Lincoln: iUniverse, Inc., 2005), 64.

FUTURE PROJECTIONS

Rediscover communication.

-lyric from "Schism" by Tool

The final defense included a question and discussion about the potential value of using the *Atlas of Endangered Glaciers* to prompt emotional responses that could then stimulate climate discussion and discourse. Although this might be a necessary first step, the disembodied eye the atlas engages also risks promoting a state of *watching* rather than *acting*.

In considering Loveless' framework which differentiates between art *on ecology* and art that is *formed ecologically*, this work is *on ecology* and should ethically be paired or explored in tandem with works that foster and nurture responsiveness in those engaging the project. In future explorations of the various experiments and methods tested in this book, I will continue to consider the distinction Loveless poses. I may continue to develop both projects *on ecology* and projects *formed ecologically* in tandem, while also contemplating which experiments and methods are most effective in listening to climate change, specifically, which projects act to produce the greatest amount of philosophical and behavioural change, both in myself and in those who wish to engage the work. Ultimately, I am most interested in how architecture can be designed in such a way that it listens to its site by being inclusive to non-human entities and phenomena, and how this kind of architecture can promote a state of listening in human-dwellers, enabling modes of *listening to* or *reading* the environment.

Methodologically, I intend to continue testing the *Architectural Duration Score* as a means of generating an architectural imagination that is inclusive to both humans and non-humans. As well, and more simply, I intend to continue practicing listening as an ethic towards environmental issues, change and conflict, attuning myself to the physical and cultural entity called "climate change".



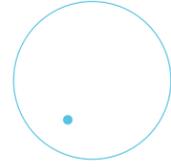
Thesis defense - work hung in situ.

APPENDIX

The following pages are a working template developed for the *Atlas of Endangered Glaciers* discussed in *Icons for Global Warming* (Chapter 1.3). The atlas was abandoned partway through the thesis-year for what was felt to be a more effective means of stimulating philosophical and behavioural change, that is, *listening devices* and their associated practices. The *Atlas of Endangered Glaciers*, however, may still have some value and relevance in raising awareness of global warming, and may be developed further in future work.

ATHABASCA

N 36 ° 18'51.743" E 028 ° 05'44.154"
Colombia Icefield, Alberta, Canada



Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations.

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Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations.



STATUS
Retreating



ICE CAP
Info



TOTAL SURFACE AREA
Info



LENGTH
Info



WIDEST POINT
Info



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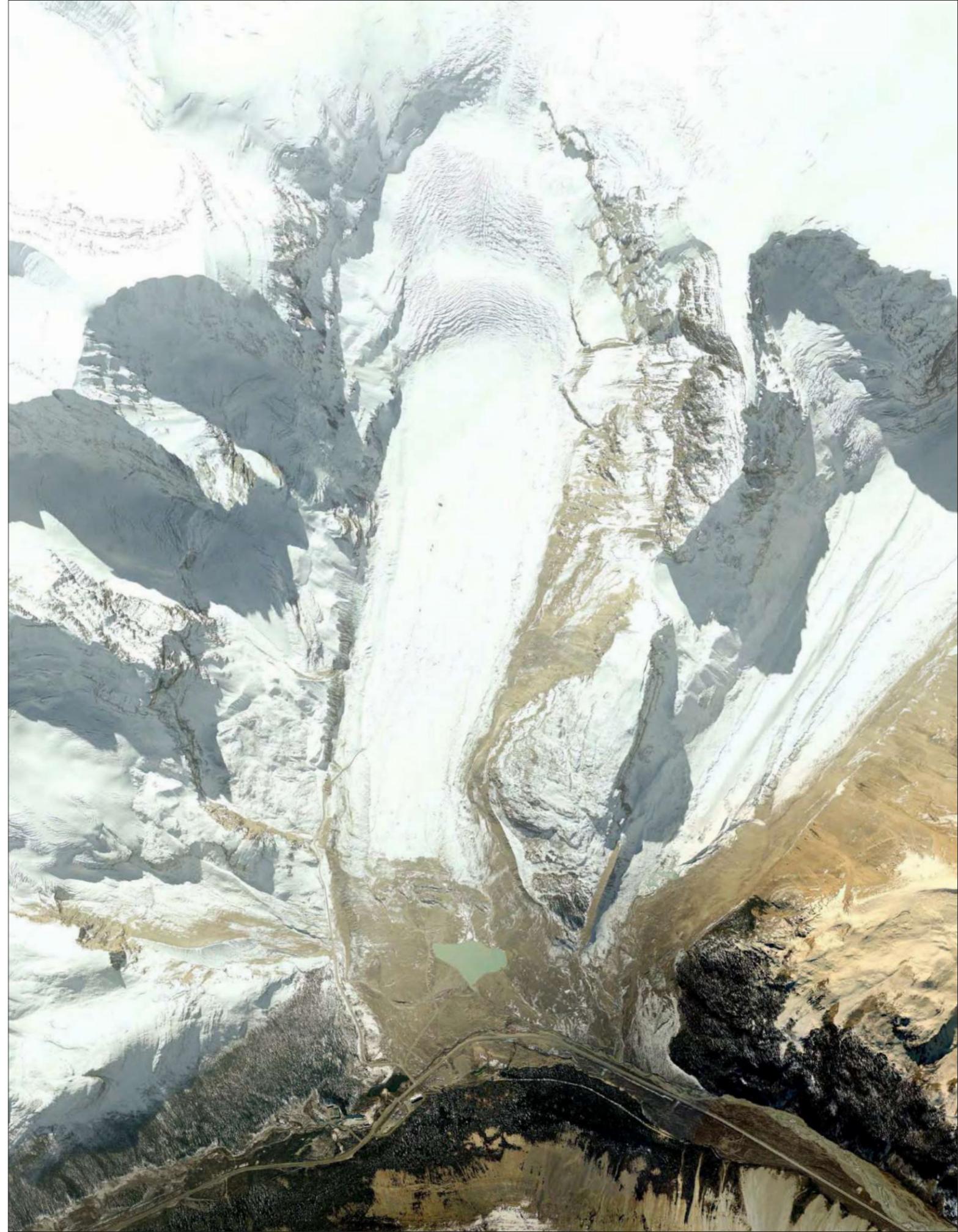
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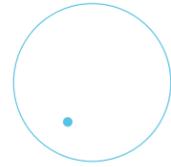


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BERING

N 36 ° 18'51.743" E 028 ° 05'44.154"
Bagley Icefield, Alaska, USA



Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations.

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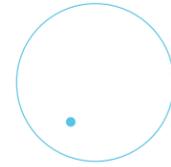


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THERI KANG

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Bhutan



Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations.

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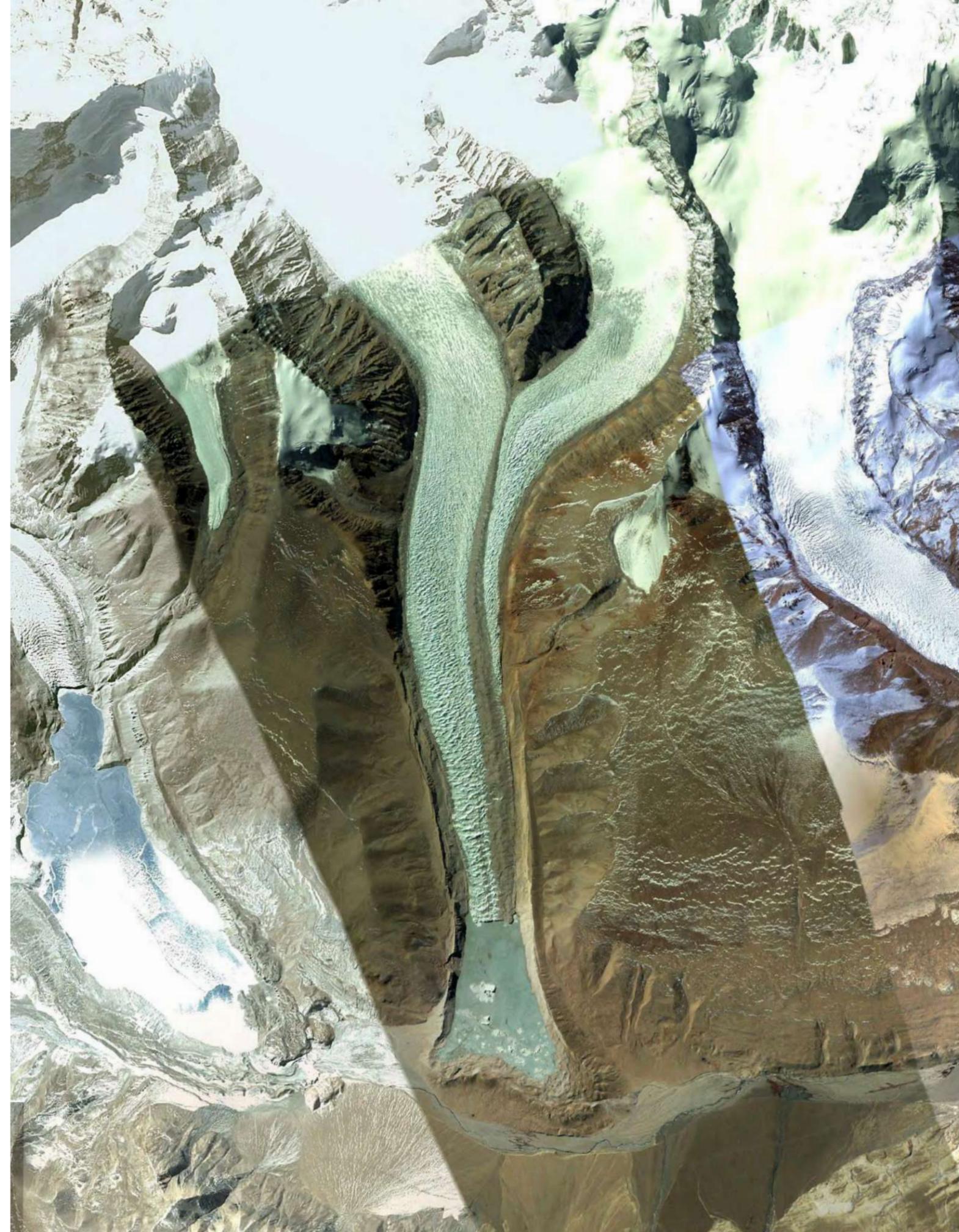
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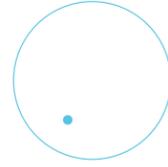


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HELHEIM

N 36 ° 18'51.743" E 028 ° 05'44.154"
Sermerssoq, Greenland



Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations.

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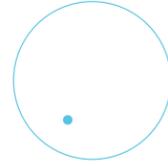


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FURTWÄNGLER

N 36 ° 18'51.743" E 028 ° 05'44.154"
Mt. Kilimanjaro, Tanzania



Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations. Describe specific attributes of the glacier and its ecological relation to neighboring water-bodies, as well as human and non-human populations.

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STATUS
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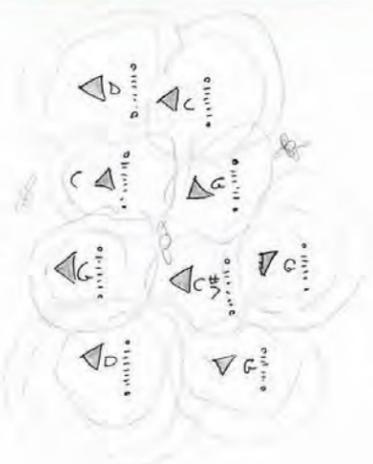
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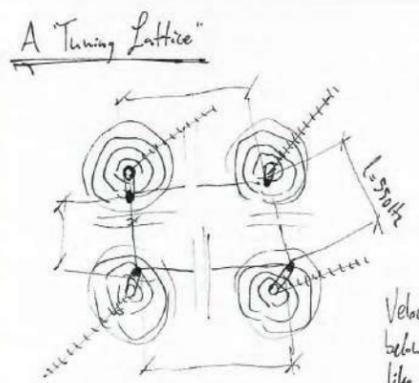
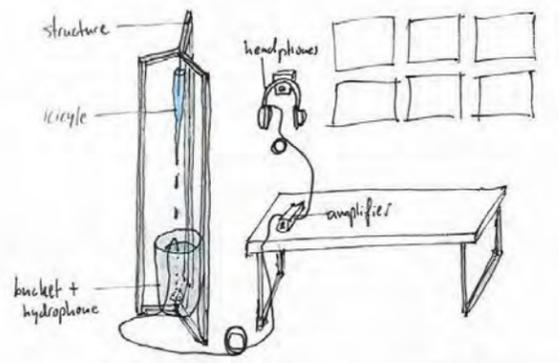
SKETCH APPENDIX

The following pages are a series of *listening device* ideas sketched over the duration of the thesis-year. Each attempts to collaborate with a particular environmental phenomena and begins to consider the sonic result of this collaboration.

Additionally, a series of *architectural duration score* sketches continue after the listening devices. Each was generated somewhat differently, and is intended to generate architectural imagination before or during the design of an architectural assemblage. They are incomplete drawings, and will be developed further in future work.

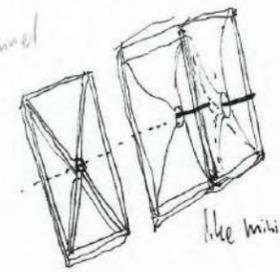
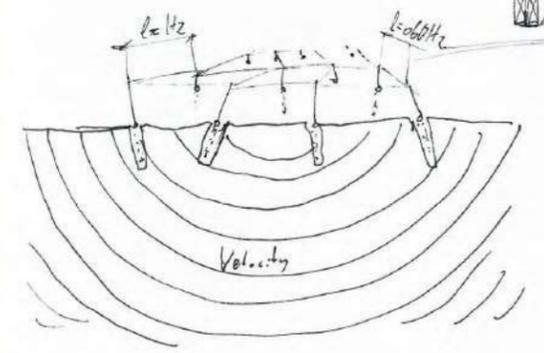


ICICLE DRIPPER:
DEFAMILIARIZING THE DOMESTIC

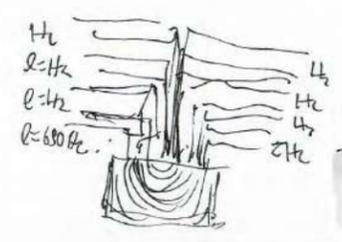
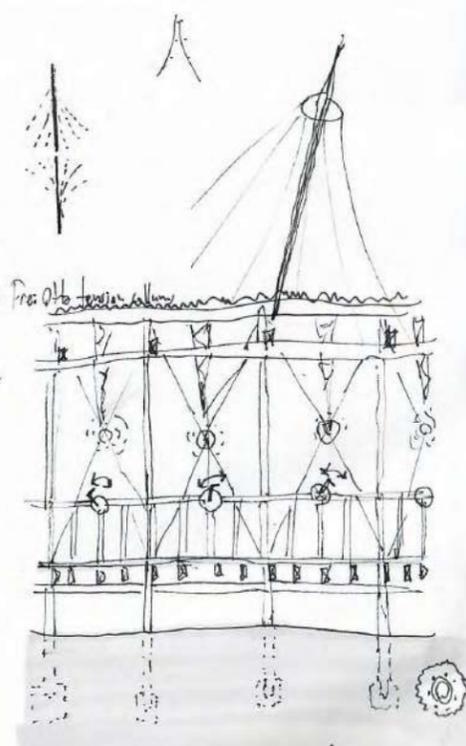


ARCHITECTURAL DURATION SCORES
DURATIONAL ARCHITECTURE SCORES

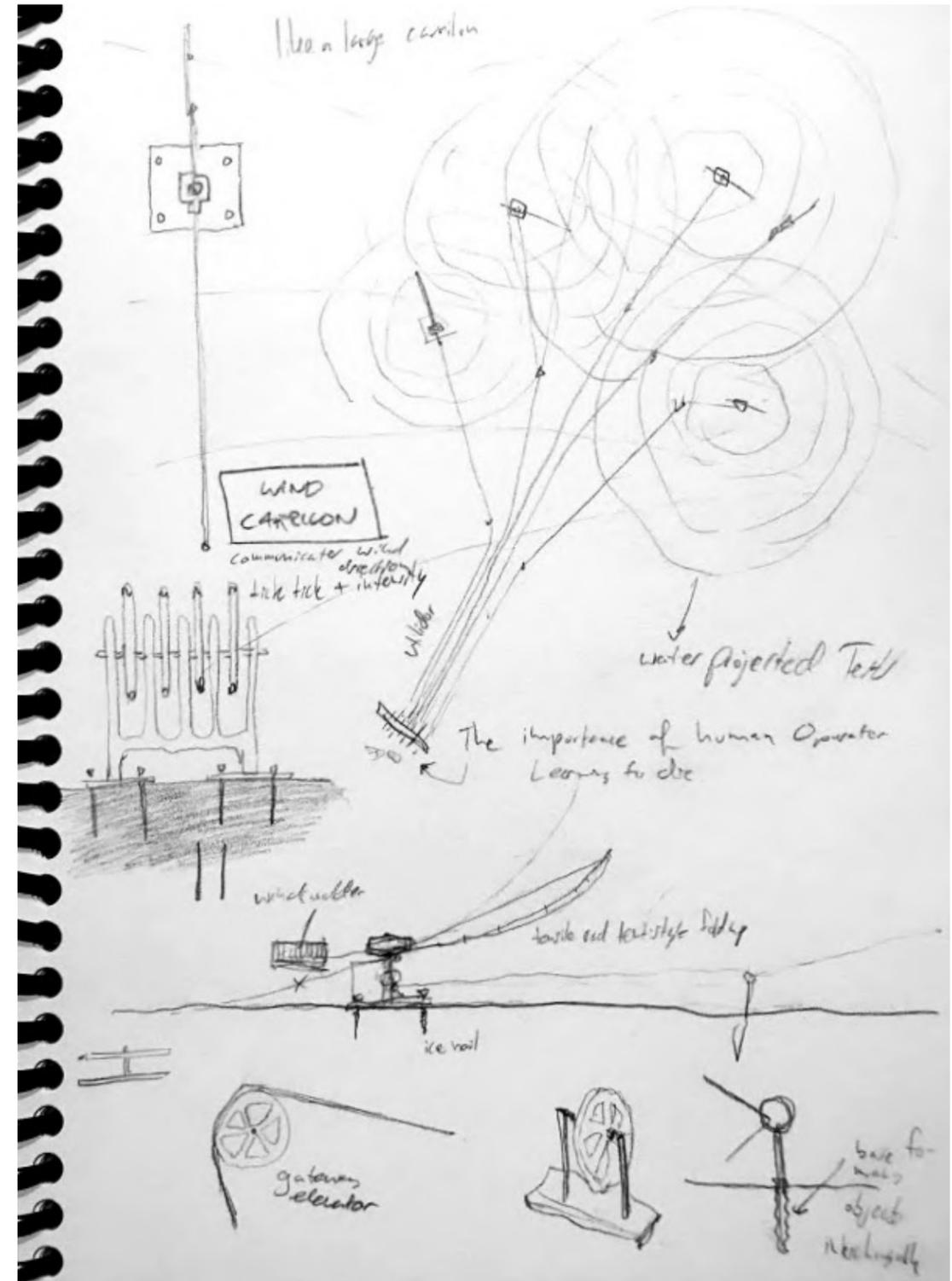
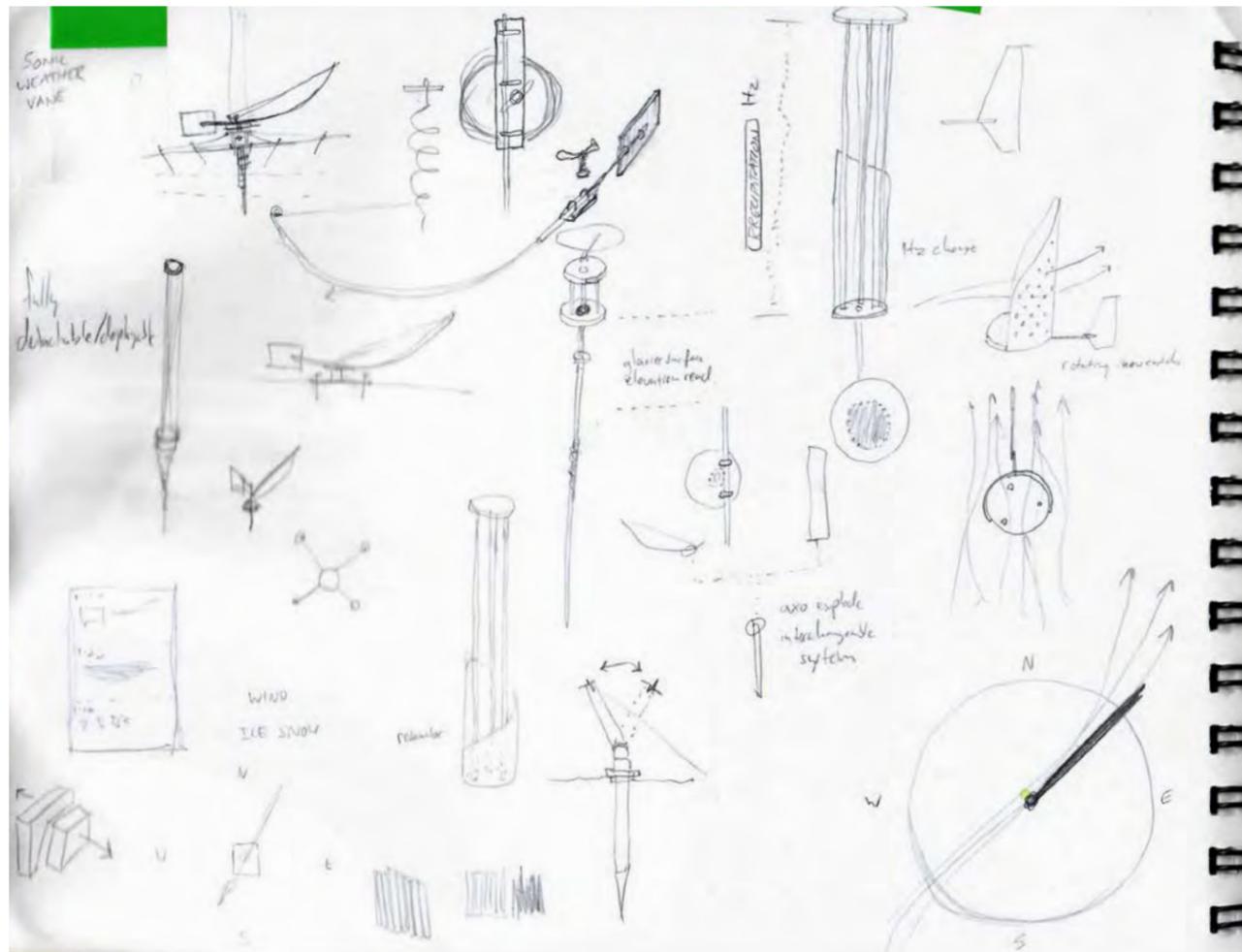
+ Wind Tunnel

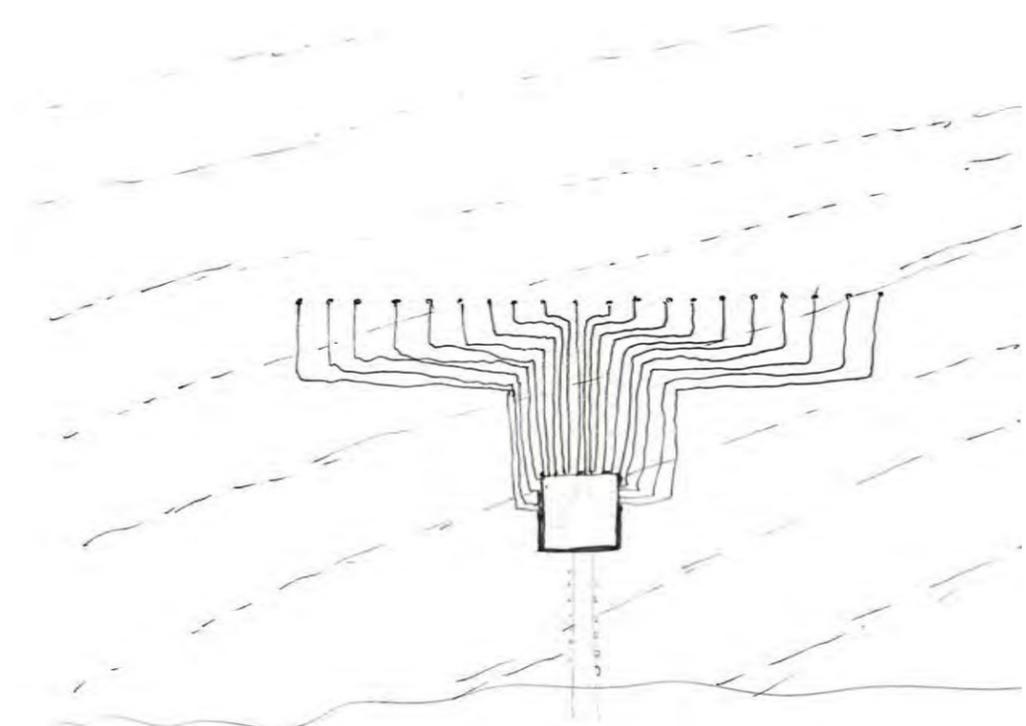
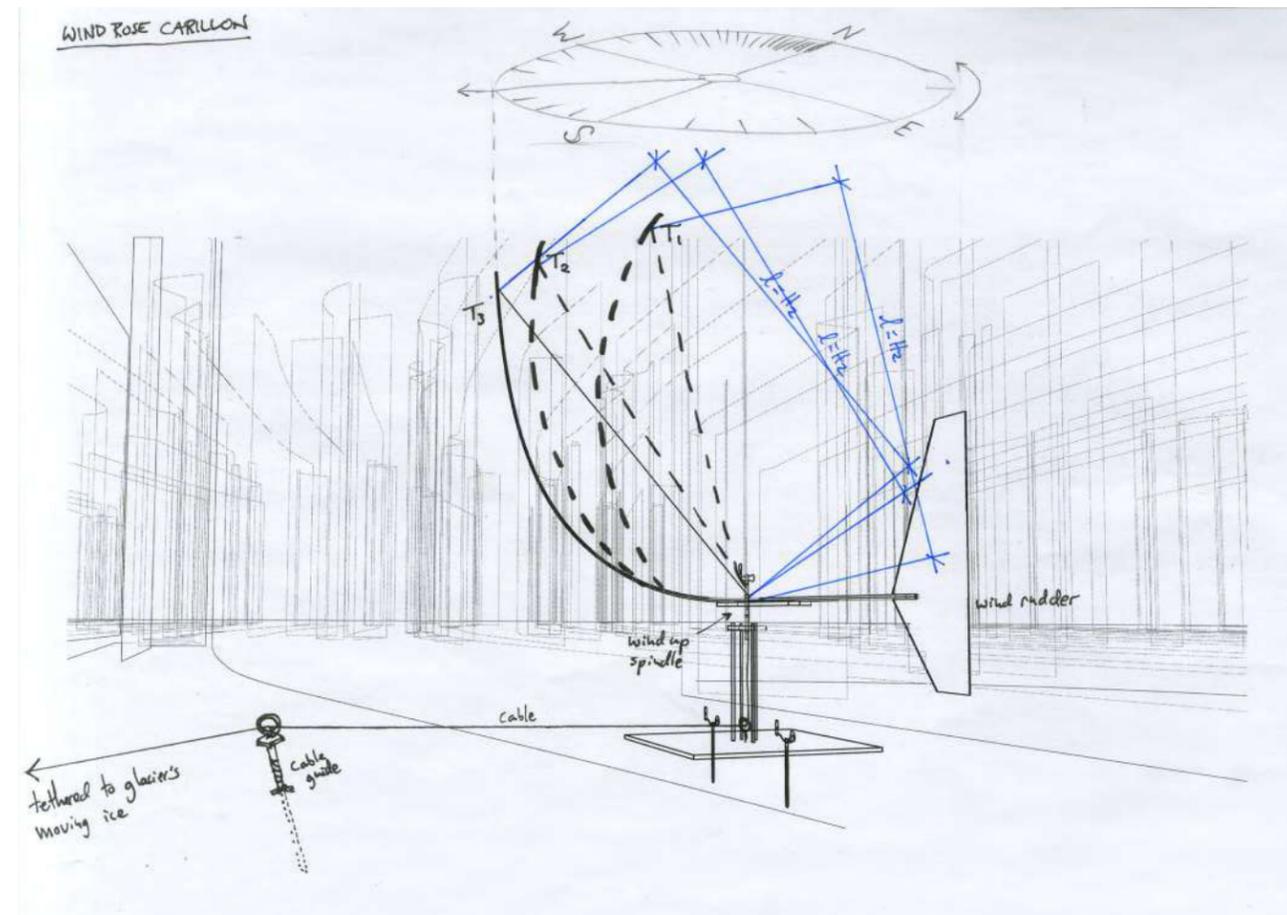
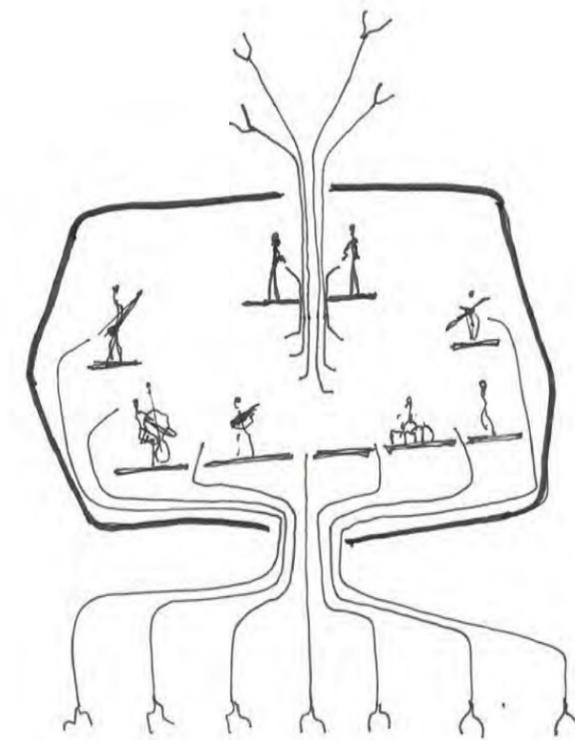
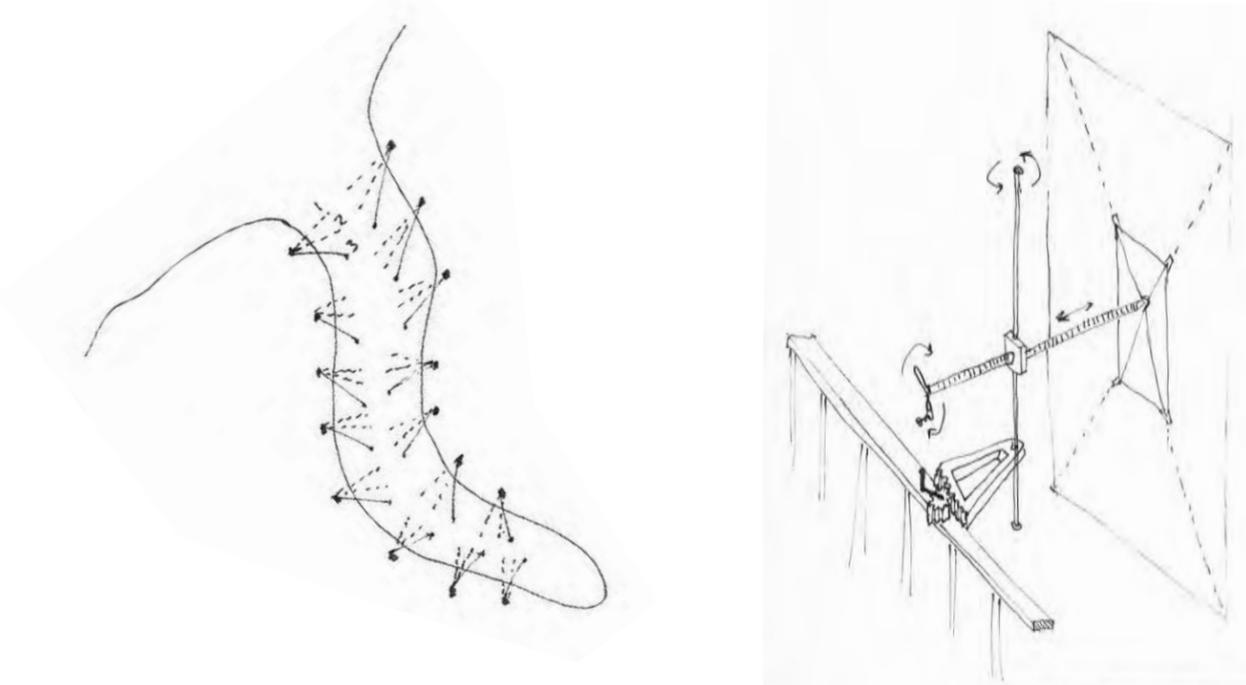


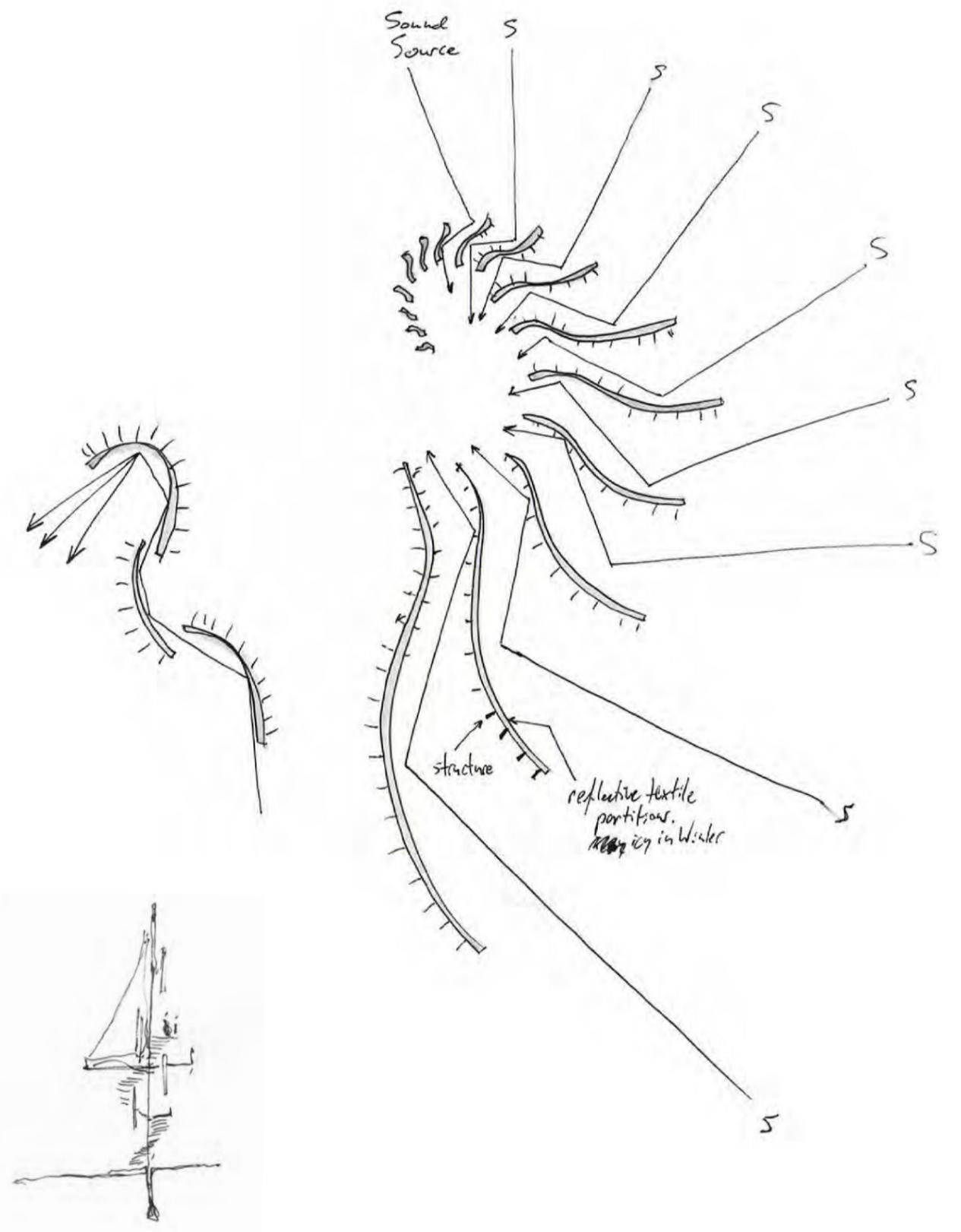
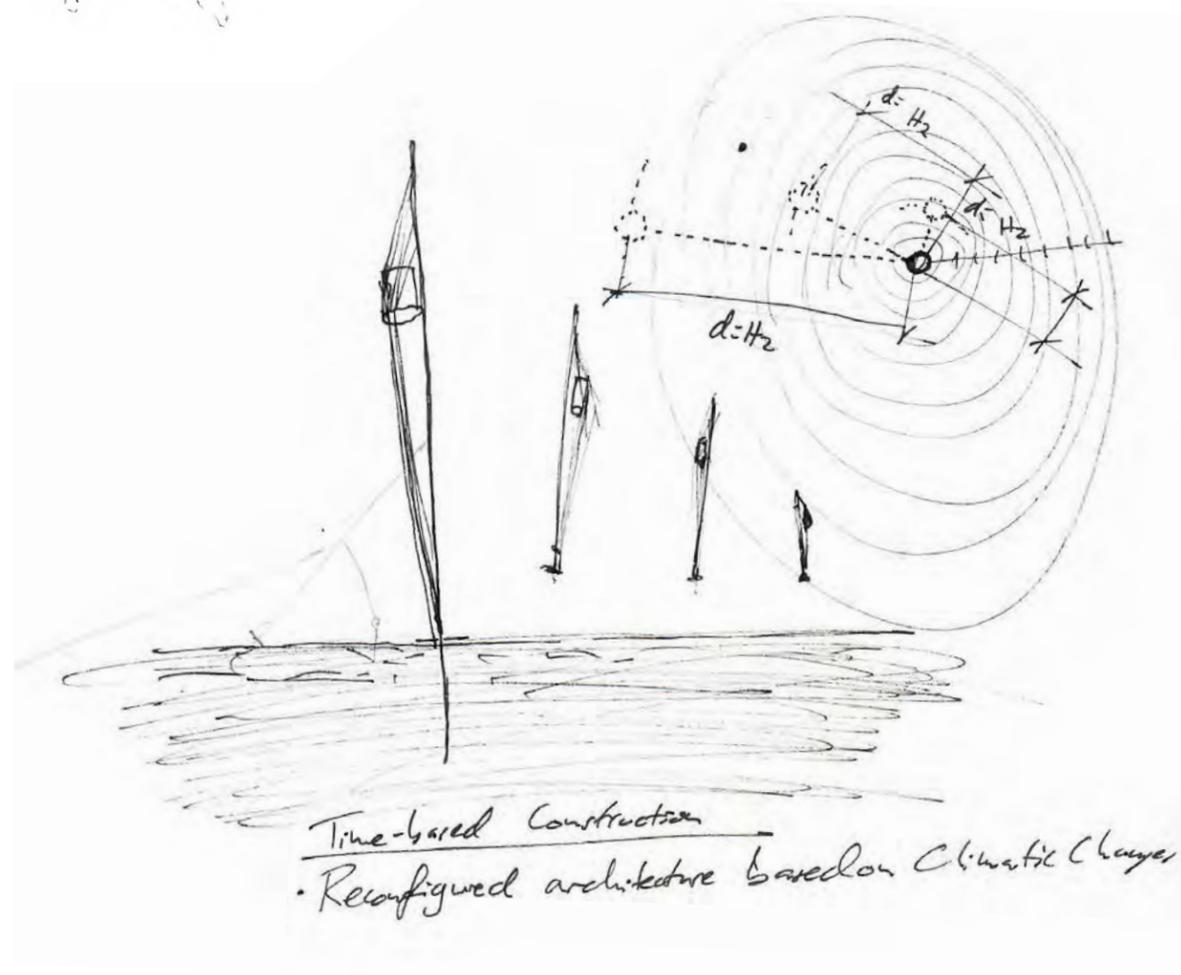
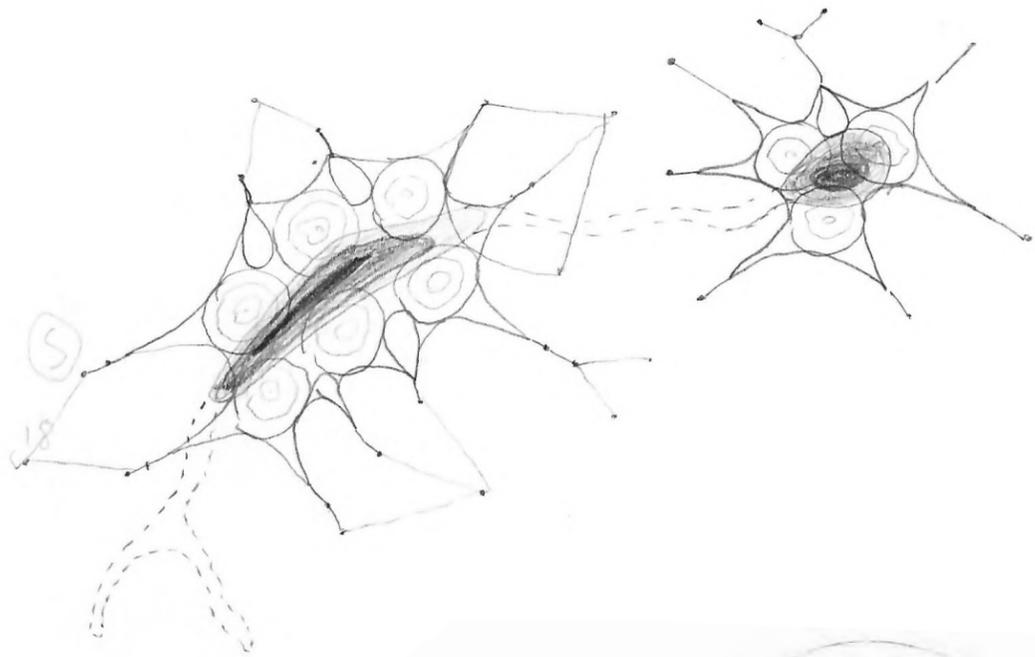
like mini Pro 01b

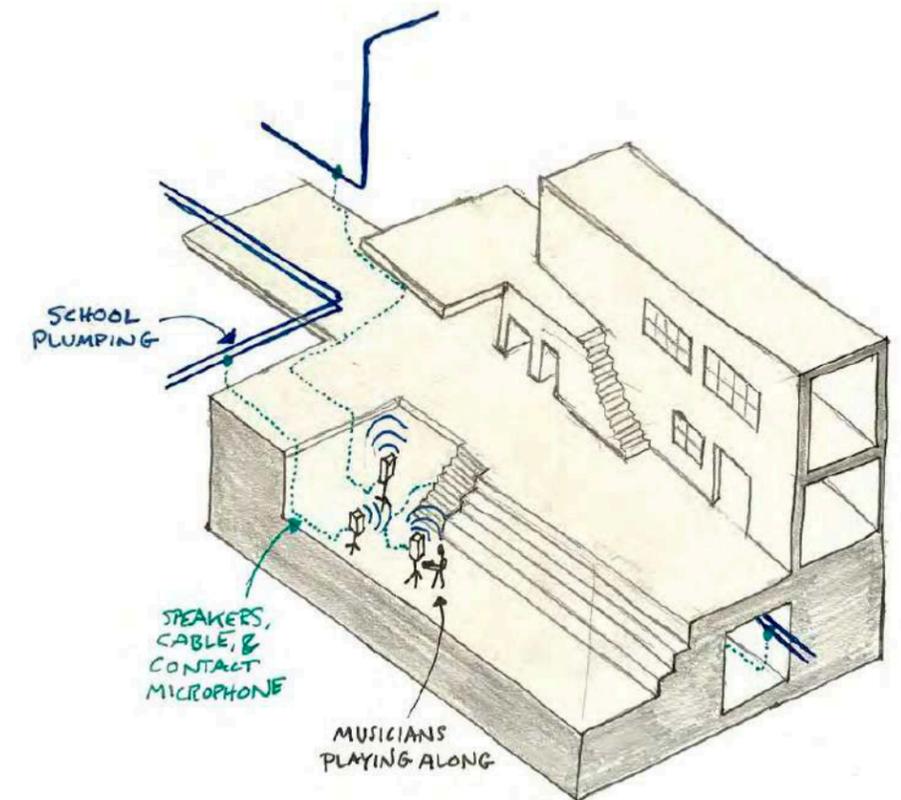
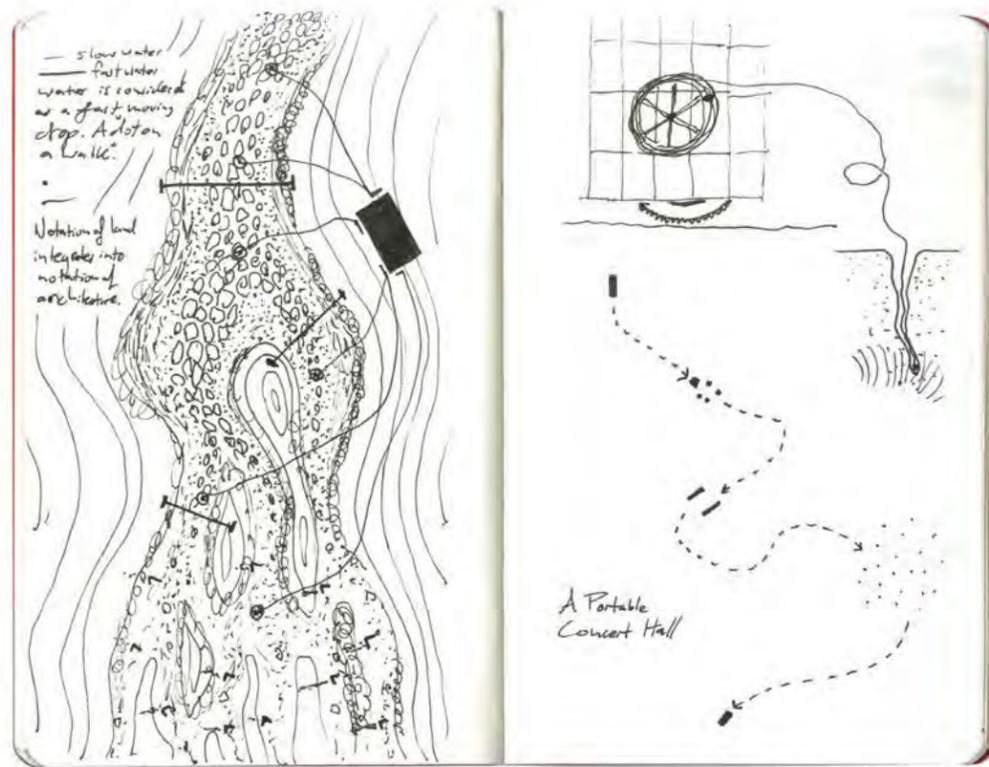
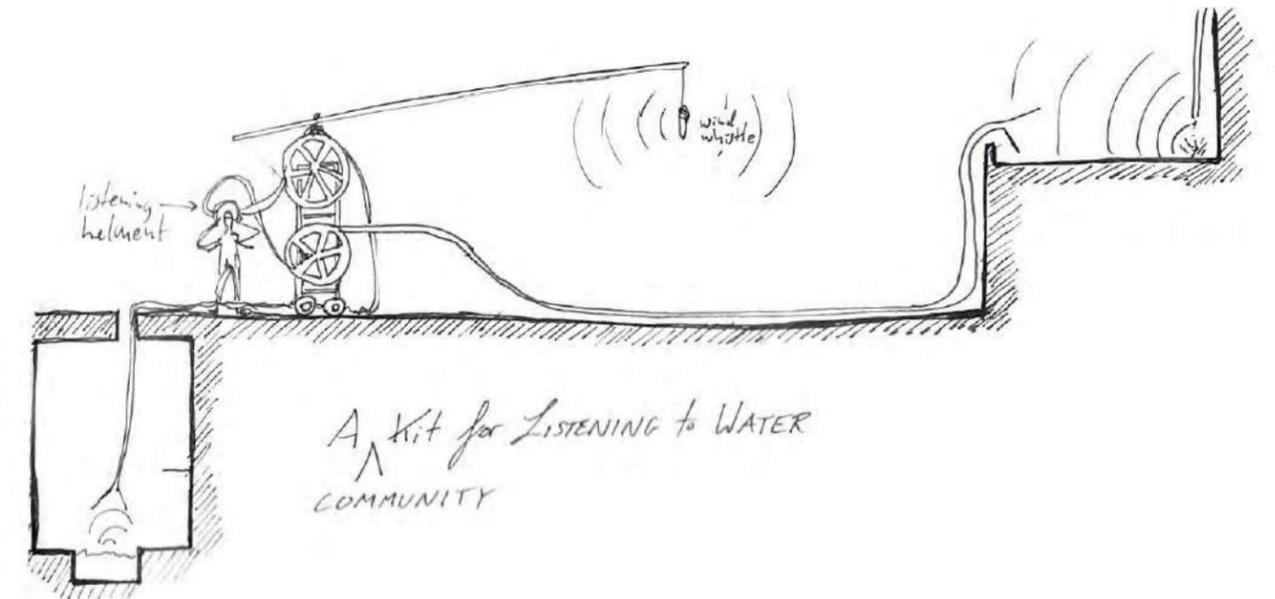
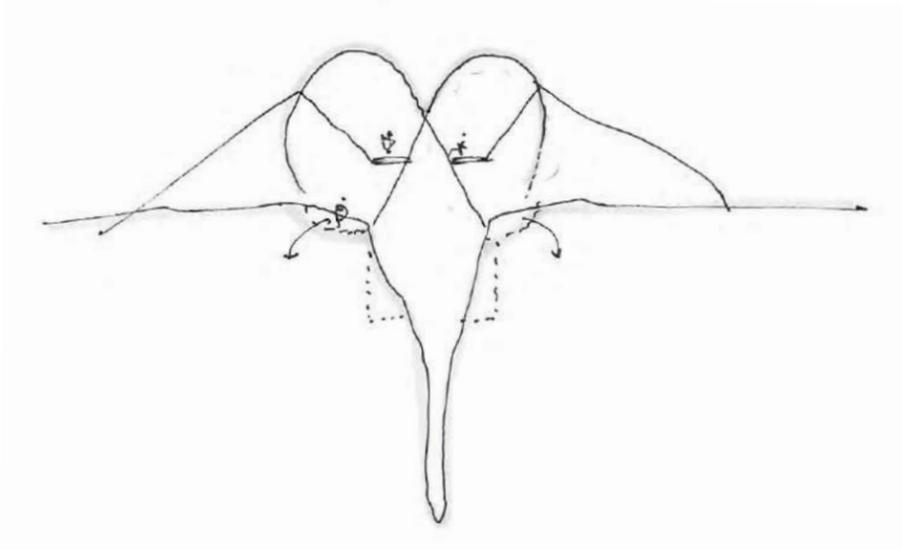


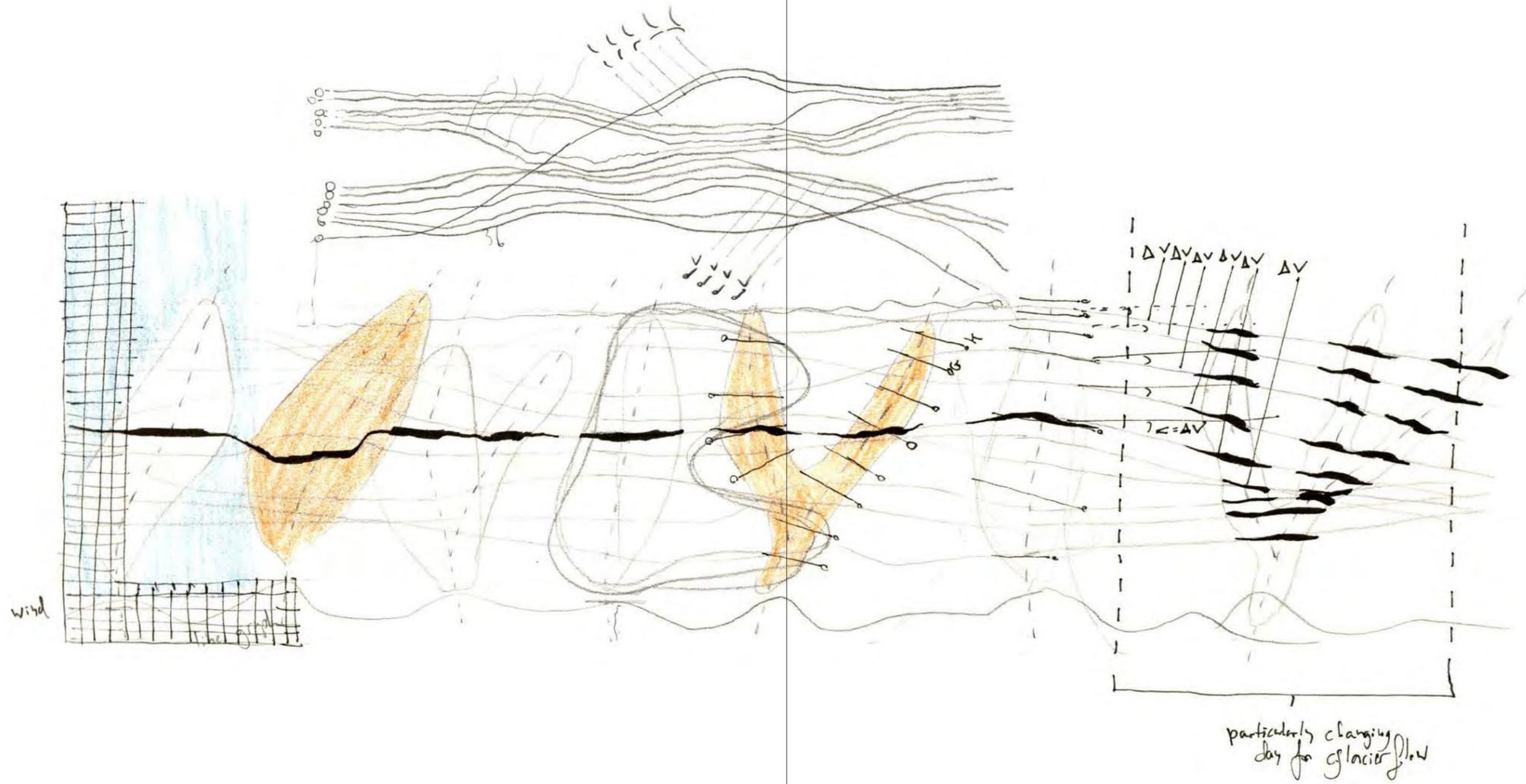
of stairs
of tubes

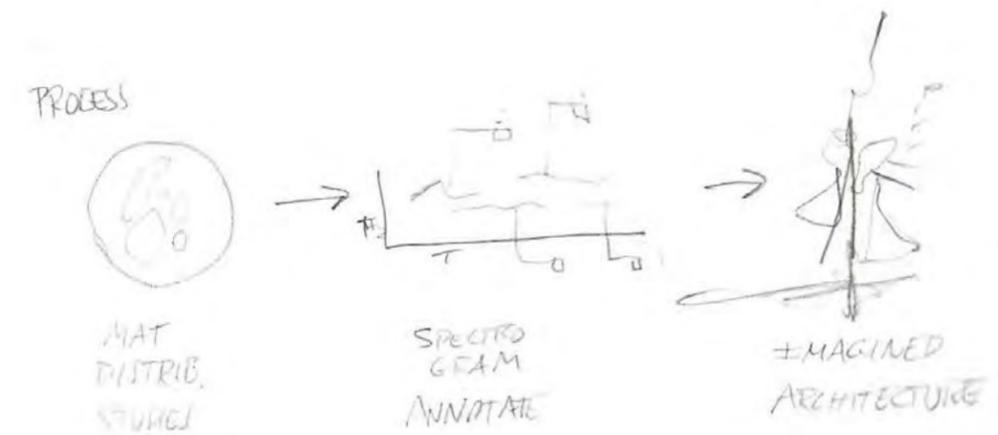
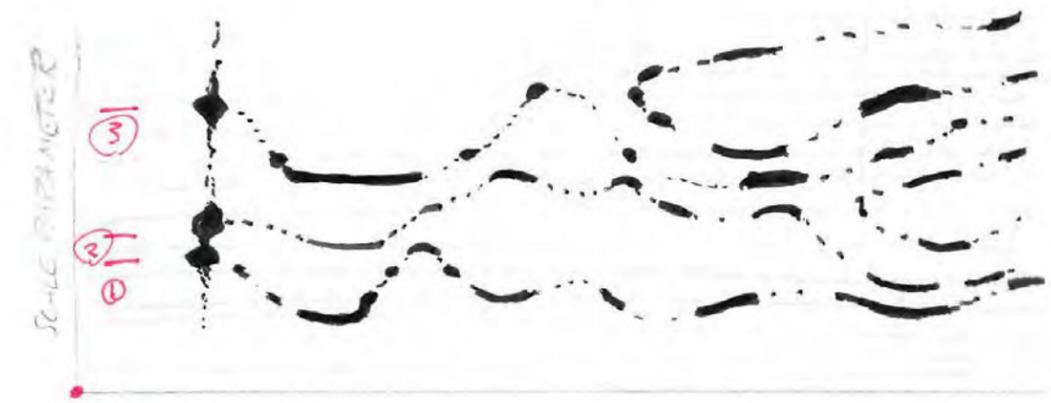
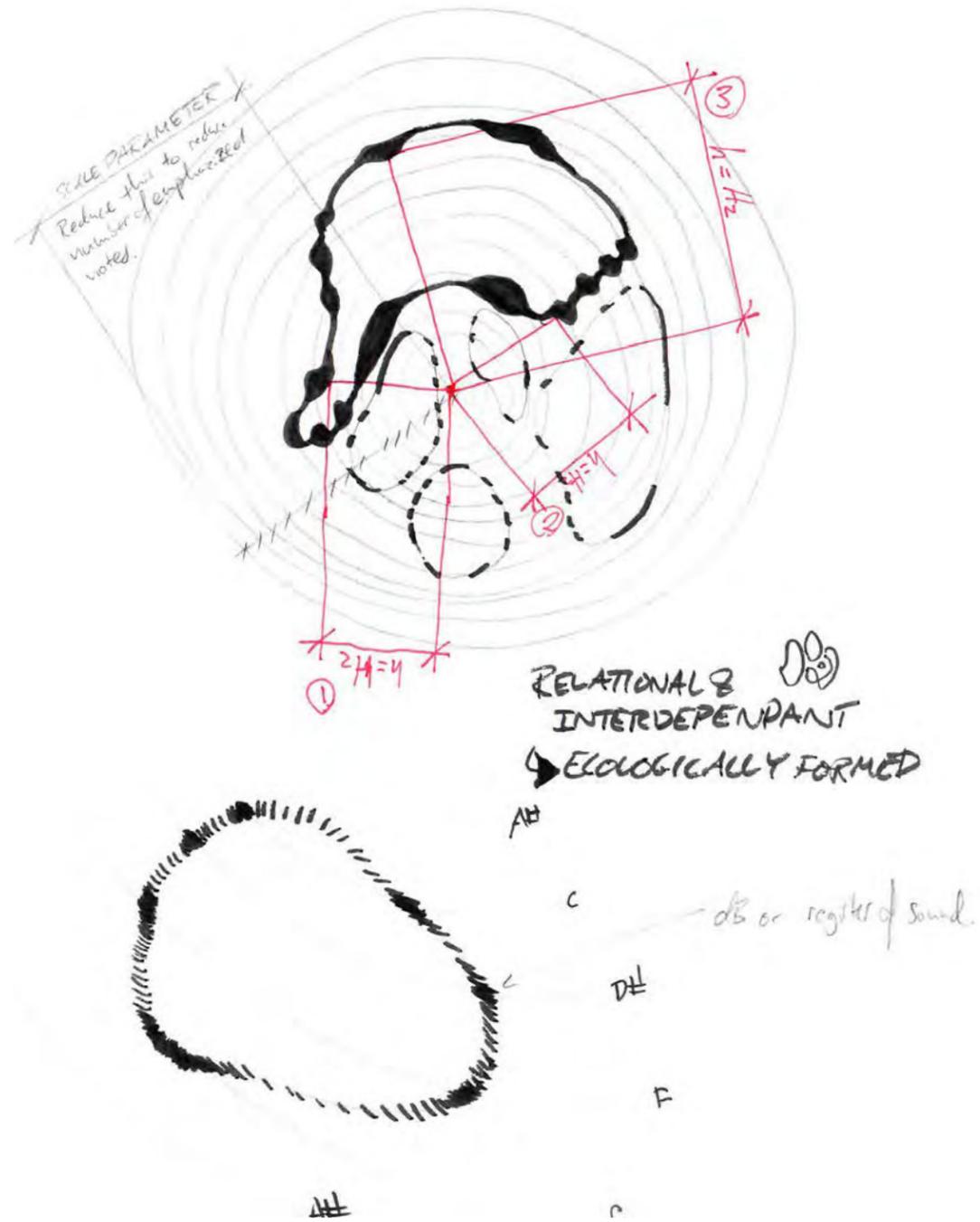


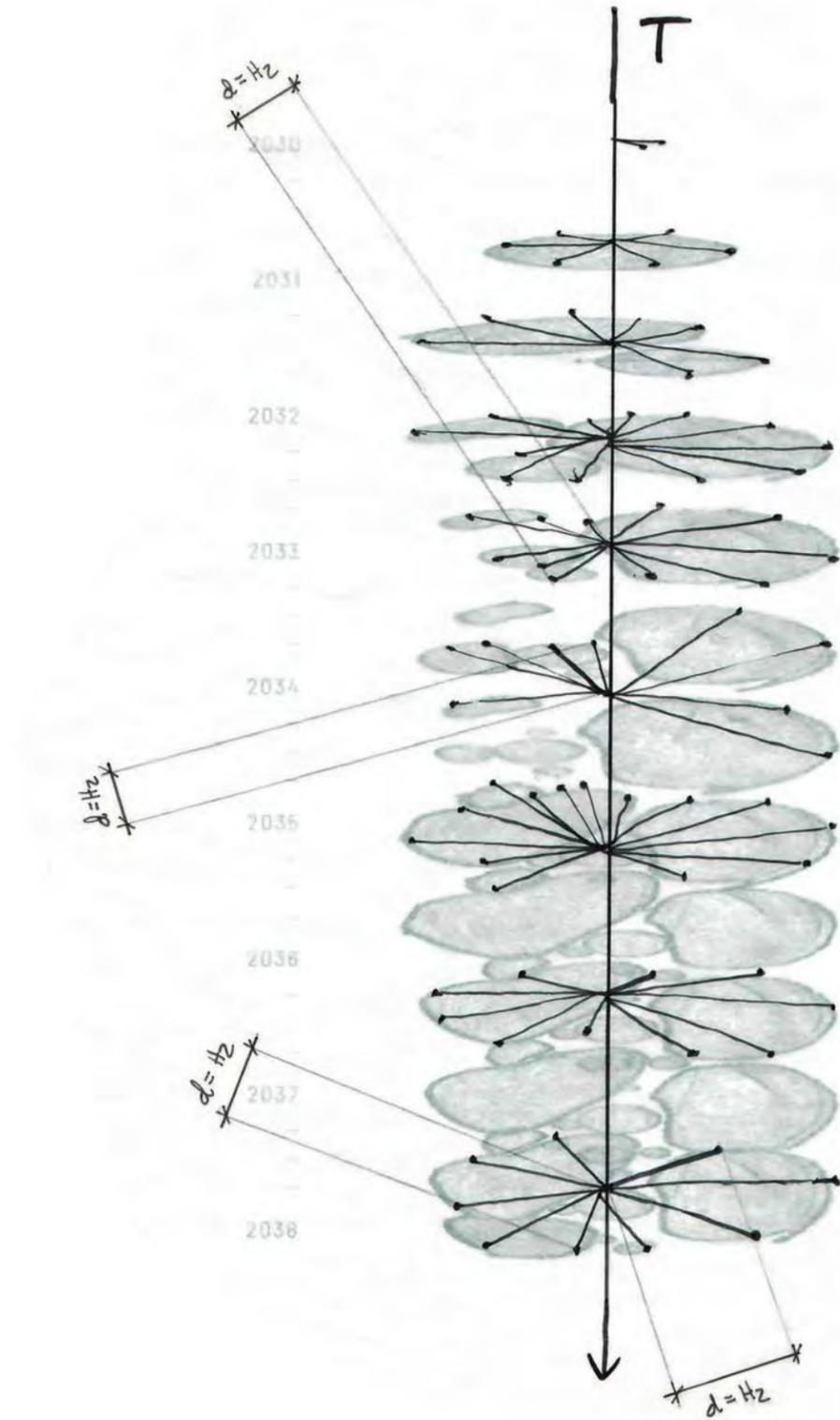
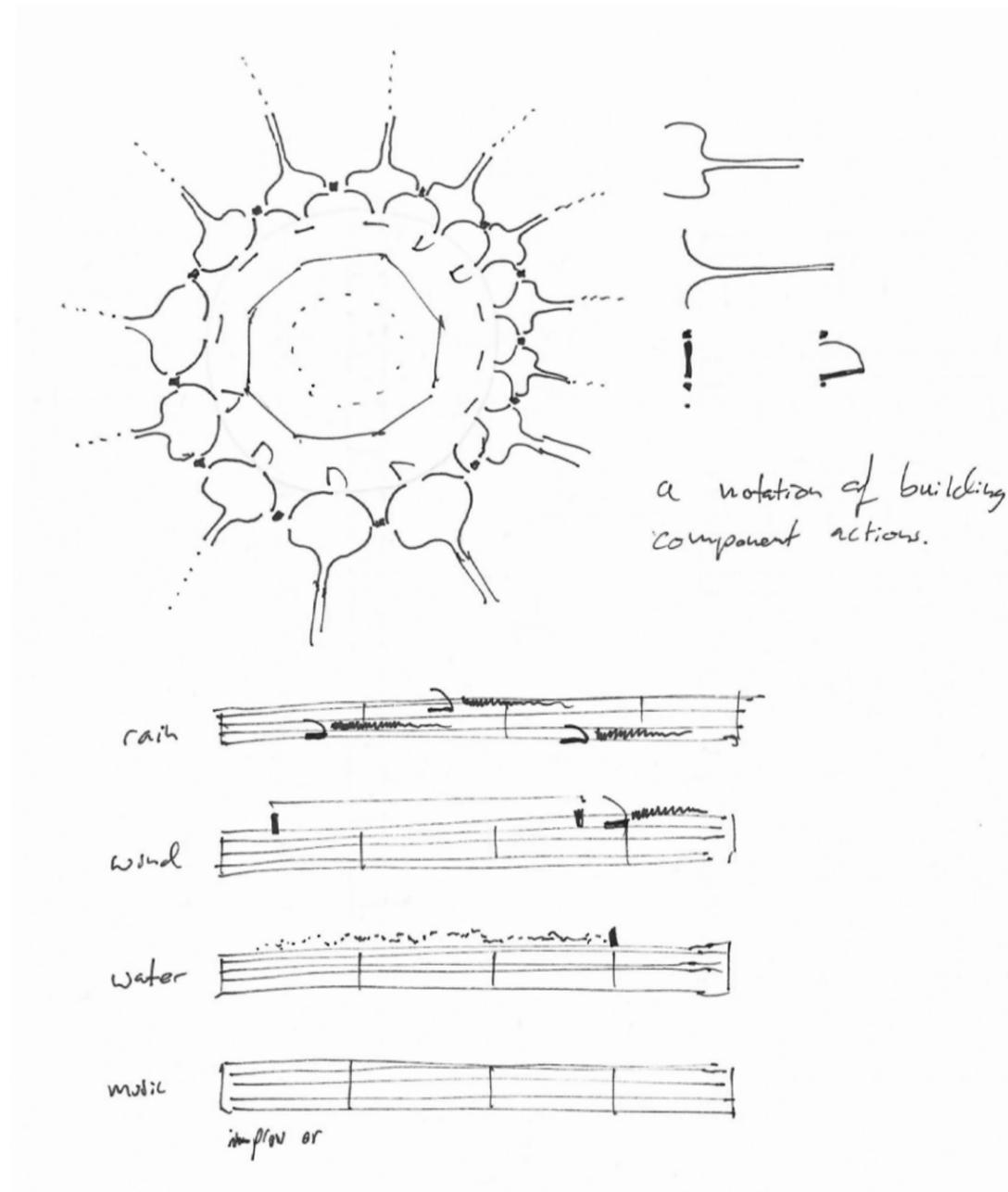












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