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Sound Work: Composition as Critical Technical Practice

Edited by Jonathan Impett

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SOUND WORK

COMPOSITION AS CRITICAL TECHNICAL PRACTICE

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Appendix

Online Materials

As further reference to chapters 2 (Rosenboom), 4 (Warde), 5 (Brown), 9 (Romero), 11 (Fantechi), and 14 (Alessandrini and Zhu) in this book, an online repository of multimedia files was created to enhance the reading of the relevant chapters. The material is hosted on the website of the Orpheus Instituut, Ghent. These examples, which should be viewed in connection with a reading of the relevant articles, may all be accessed under the URL: https://orpheusinstituut.be/en/sound-work-media-repository.

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The Impossibility of Material Foundations

Scott McLaughlin
University of Leeds, UK

My sound work is composing for the material indeterminacy of continuous sounds. These terms will come up a lot in this chapter, so an explanation will be useful. By *material* I mean the physicality of the instrument, the way it makes sound and the breadth of sounds that it makes; this assumes also avoiding traditional dichotomies between "musical" and "non-musical" sounds, and instead treating the instrument in a more ecological way where all sounds have validity and the relationship between sounds (how they change, how they stabilise and destabilise) is primary, though some may have priority in creating structure in musical pieces. By *indeterminacy* I'm aligning my work with the tradition of experimental music following John Cage. However, rather than using dice or the I Ching, I use the unstable and unpredictable elements of the instrument's materiality to suggest different paths as the piece unfolds. This allows the "material agency," the material preferences or "will" of the instrument, to have an impact on how the piece unfolds, and to guide the player. Because these pieces require the player to respond in real time to an unpredictable instrument, the term *contingent* will also feature as the situation of the player working-with and responding-to[1] the sometimes unpredictable instrument. Lastly, for materiality and indeterminacy to have time to act, and for the relationship between player and instrument to be a continuous feeding-back of actions and energy, the focus here is on continuous sounds—where energy continuously excites an object into vibration, such as bowed objects, blown instruments,[2] guitar/microphone feedback, and so on. Composing "for" material indeterminacy involves setting up musical material and scoring such that live performance involves the unfolding of decisions made through both human agency and material agency, and the emergence of structure in performance: because there are different ways the piece might unfold due to the unpredictable material agency of the instrument, the pieces are composed such that whatever emerges in performance can become the focus of the piece, creating an audible structure. The work here begins (and continues) with a very close relationship

1 These terms are deliberately hyphenated to reflect the conjoinedness of player and instrument in this reading.

2 Both blown and bowed instruments are not perfectly continuous because the continuity of the sound is broken (or at least seriously perturbed) when taking a breath or changing bow direction. However, within each breath or bow the system is continuous, and resonances may carry over to influence what comes after the breath/bow change, all of which is the focus of this practice. This is explicitly in opposition to the attack-based model of much music (and its notation) that takes the piano as the basic model of sound production, an attack-decay model where continuity of sound is functionally irrelevant.

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with the instrument in order to learn its behaviours, especially those unstable zones of sound production that are contingent but not chaotic to the point of unmanageability. Once the right behaviours have been studied (usually by playing the instrument myself), the work is twofold: (1) building an open-form performance system (usually in text or diagrammatic form) where structure can emerge from the interaction of embodied techniques of performance, score-based rules/instructions/principles, and the indeterminate materiality of the instrument; and (2) working with an experienced performer to ensure that the piece is built on universal phenomena of the instrument, not simply by-products of my own untrained technique.

My concern with contingency found a touchstone in Philip Agre's proposal for critical technical practice (CTP) as not "seeking foundations" but instead "embrac[ing] the impossibility of foundations, guiding itself by a continually unfolding awareness of its own workings as a historically specific practice" (1997, 23). In my sound work, Agre's practice resonates strongly with the performance-based revealing of emergent forking paths and networked structures inherent in the materiality of the performer-instrument (which can treated as a single system, an "assemblage"). The culture of music and its instruments is a complex balance between rich and lively materials and the controlling technique of the performer—the entrenching of musical systems (notes, tunings, harmonies, rhythms, etc.) and capture of material liveliness in reified instrumental technique (how a player controls the instrument into producing culturally desired tone colours), but also the vibrant embodied skills and imagination of the player that pushes against received ideas. Perhaps a musical CTP can take materiality as its entry point to a continual unfolding where the imposed *logos* of Western musical systems become subsumed in Donna Haraway's "speculative fabulation of 'Terrapolis,'" an "*n*-dimensional niche space for multispecies becoming-with. . . . a chimera of materials, languages, histories. . . . mak[ing] space for unexpected companions" (2016, 11).

This chapter discusses my compositional practice in a mix of modes in an attempt not to disentangle but to further entwine the strands of compositional thought. Elements under discussion—both alone in sections of singular focus and composited and "composted" together (Haraway 2016, 32)—include: technical description of material and compositional elements; poetic and phenomenal description of engagement with materials; and the enrolling of concepts from philosophy both to permeate the "doing" and to drive practice-based enquiry. The first half of the chapter outlines the main ideas in relation to work for prepared bowed strings, while the remainder of the chapter unfolds the same ideas and methods in the context of works for clarinet.

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First, some concepts should be outlined that are central to all this work.

Phase-space:[3] This term is borrowed from physics where it is used prominently in dynamical systems theory (chaos theory) to represent all possible states of a system, and usually visualised in relation to important parameters relative to their orders of freedom. Phase-space often includes features prominent in the dynamics of the space, known as attractors. Both simple and complex attractors delineate areas of attraction, including stable states (such as simple attractors like the final resting point of a pendulum), or in continuous systems it can also capture patterns and metastable states; that is, complex attractors that are only stable under highly specific conditions, and that might shift relative to the initial conditions of the system. This sound work thinks through the player-instrument assemblage in terms of phase-space, as a multidimensional topology of energy in a space of flows and resistances. The work happens mostly in the boundaries of this space, where the instrument becomes like a cybernetic black box: knowable only by parsing the inputs and outputs, the performative feedback and the phenomenal reading of productive paths as they emerge.

Recursivity: To make use of phase-space (all the possible behaviours of the instrument) and the contingencies of its unstable boundary spaces, this sound work recursively explores the same space to reveal the variety of different paths. The same musical phrases or gestures are repeated over and over, knowing that their instability will lead to different versions emerging. Often, the same things will result in many cases, but other less-likely things will also emerge, revealing a sense of the material's preferences and the stronger and weaker paths that emerge through these contingent repetitions. Over time, the performance becomes a structure of the interaction between the respective weight of paths through contingency, and the productive tensions encoded in the score that specify which paths are to be preferred by the player. In some pieces this recursive looping is strict; as in Alvin Lucier's "scanning" pieces, this allows the material phenomena to be foregrounded, limiting human agency in the process. In most of the pieces, though, the recursivity is loose, and often given to the player to enact when the performance offers rich spaces to explore. However, this is not simply a tool to maximise the richness of contingency; in the player-instrument assemblage the continuously updating knowledge is a mycelial thread that strengthens the connection between player and instrument, entwining them further in a singular performance instance of an open work. As Yuk Hui describes it: "Recursivity is not mere mechanical repetition; it is characterized by the looping movement of returning to itself in order to determine itself, while every movement is open to contingency, which in turn determines its singularity" (2019, 4).

3 While in physics this term is not normally hyphenated, I have chosen to hyphenate it here for ease of communication, and to avoid confusion with discussions of physical space.

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How does composition happen?

First, prepare the cello. Take the preparation and place it on the string in an arbitrary place. Begin to bow, gliding, pushing, gently probing for boundaries, changes of state and hints of new terrain that may lie just out of hearing. Also, mirages, resonances that exist only as a consequence of where I am right now, coupled to this unfolding moment, and collapsing as soon as I try to move out of this space, to change. Action proceeds all at once in and out of focus: offering the cello the resources for change; listening to what the instrument says, in the foreground and the background; feeling with the bow and body and moving to support, to accommodate, or to thwart; learning the instrument's behaviours from within the feedback loop of cello-string-bow-body; categorising and classifying behaviours as features on an instrumental topology; filtering, selecting, and hierarchising to make a dynamic map of tensions and openings, stabilities and instabilities updated continuously through selective reinforcement inside the performative loop. As performance unfolds, the map becomes the territory of composition (for a while at least), and real material forces are abstracted into a mental model of relationships. The instrument is put down and tentative steps towards diagramming and score building begin.

Sometime years ago I absorbed an idea that lodged in my mind in a fundamental way. It was when I was reading lots about chaos theory and cellular automata (Conway's Game of Life, of course). I forget the detail, but what stuck was a description of a space that was largely sterile and predictable but for a single meandering thread of life running across it (life occurs in the cracks . . .). This thread meandered and forked its way across the space, unwilling to settle into the ultimate stability of zero or infinity. Instead it roiled with patterns and repetitions, spiralling off at times, splitting, rejoining, dying out, and starting again in a new way, a fizzing, splitting edge where the potential for change overwhelmed forces of constraint. At the core of the thread was a chasm, like the endless enfolding edges in a fractal, a space where repetition and variation furled and unfurled into each other to create . . . well, just to create. The chasm is not a void, though it may pragmatically become one at some point, its function is precisely not in emptiness but in vitality. Philip Agre's line about "embrac[ing] the impossibility of foundations" resonates vibrantly with this image as an injunction to follow the repetitions of the practice as they continuously reveal, not to untangle them but to become-with them, to "become humus," "not Homo, not Anthropos, we are compost" as Donna Haraway puts it (2016, 40, 55).

In my compositional practice, the instrument becomes the space where I seek such threads, and in this chapter I'll outline the form they take and how composition happens around them. The key idea is what I have come to call *material indeterminacy*, a compositional strategy of using the contingencies of an instrument to balance the agency of the performer and the agency of the instrument (see McLaughlin, forthcoming). Here, indeterminacy is an inherent property of the instrument, the lively space between the chasm of total

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unpredictability and the plateaus of stable sound—where the player can be, in anthropologist Tim Ingold's terms, a "wayfarer" (2007, 15) in the space of the instrument, where the possibility for forking paths is always present in the unfolding moment of performance, and where composition encourages following these paths while always searching for points to recognise and acknowledge recursion.

As I sit with the cello, I bow. Each time I begin again the bow movement, I'm listening for stability and also for potentials: resonance here and now, and resonances on the horizon. Each time the bow movement begins, there's a transience, a perturbance of the vibrational system that opens a door to change. The system may stay in place, or it may step over that boundary. Resonant systems are hysteretic. Like a metal that when bent returns to its shape, the resonance is materially entrained; it wants to stay in its groove as long as conditions are favourable. But the sudden transient movement of the bow changing direction is a perturbance that always wants to refigure.

Waves. Water sloshing and spilling over a boundary. I hold a bowl of water, gently swirling it, trying to find a balance where each swirl brings the water just up to the edge. On each swirl perhaps it will go just enough over the edge to break the meniscus, flow out, change its path. Perhaps the meniscus will hold. If it does break, a new path is opened up; then on the next swirl as the wave builds again, does it push over the edge again? Does the water remember? Will it push the same way or is the swirl's rhythmic sameness only an illusion that imperceptible differences of force define which path is taken. Do I have two states: one where the water stays in the bowl and one where it escapes? Or, do I have two families of states? In one family, water pushes over the bowl edge. Perhaps it dribbles down the side or perhaps it splashes out into the air. But those are extremes; more likely, the gentle movement of hands will give the swirl a stability that affords variation on only the smallest scale. The compositional art here is in finding and maintaining the balance point where material indeterminacy comes into play, where material agency can tack the system towards one course or the other. How small is the space in which my oscillations vary?

Moving with the bowl, I fix into a rhythm that both directs the water to this side of the boundary and is always slightly too much, always becoming. The water gently sloshes over the edge of the bowl, more or less the same way each time, pouring down the side to the ground, never demonstrative, but always with a rhythm that is both lively and predictable. My rhythm fixes on the impossibility of finding that perfect balance of fifty-fifty chance that any given cycle will break the meniscus, the truly aleatoric. But in aiming for this, I know that what I will actually reach is the chaotic, a tidal movement between motions of slightly-too-much and slightly-too-little, where each testing of the meniscus is decided by knife-edge materialities beyond my intentional control.

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Composition here is an arrangement of forces and techniques to produce relationships in time. The forces are the intra-action[4] of player and instrument, and techniques are those relationships recast as forms of knowledge that allow productive engagement. When John Cage, late in his career, wrote his "music of contingency" pieces, he used the sloshing of water inside a conch shell as an instrument so that he could have improvisational activity without improvisational style, to avoid improvisers imposing their musical history on his piece by replacing their familiar instrument with an unfamiliar object. For Cage, this would allow the players to be purely responsive, free of the baggage of style. In my music, I need the players to know the contingencies of their instrument, precisely so they can find and sustain those metastabilities[5] where material indeterminacy can come to the fore. My water vignette is analogous to my instrumental compositions. The player knows the water and the bowl, he or she knows there is a meniscus and the feel of the water's weight in the bowl that guides the rhythm of movement. The player develops a technique of knowing the materiality of the instrument, knowing its behaviours and edges and how it communicates these, its thingliness. These techniques are in a constant state of becoming because the composition always pushes the player to the next level by asking him or her to find stabilities and instabilities. Each stability emerges from a former instability. The metastable is continuously turning over new possibilities both because the material is infinitely rich and because the material and the player and the environment are entwined and constantly changing.

The behaviours and affordances of liquid water provide a productive analogue for thinking about the materiality of instruments. On the cello, the bow moves back and forth, not unlike the water. Also like the water, the cycle of back and forth is not smooth, the transitions perturb the system. The cello departs from the water in several ways, but key to this is the training of the cellist,[6] a player with many years of embodied techniques and sedimented agency attuned to his or her instrument.[7] While the prepared cello will challenge traditional cello technique, it is not completely alien, requiring more a shift of expectation than treating it as a new instrument. The player builds on his or her existing techniques of bow control to work with the system so that the perturbation is productive. The cello preparation is a circular ring that connects two adjacent strings (without touching the

4 Intra-action is Karen Barad's term for "the mutual constitution of entangled agencies . . . the notion of intra-action recognizes that distinct agencies do not precede, but rather emerge through, their intra-actions" (2007, 33).

5 *Metastability* is a stable state that is not the ground state. For example, a spinning coin is a series of metastable states, held in place by the energy of spinning, which as the energy ebbs away will finally reach the ground state of complete stop. In rare cases the coin may stop spinning while still on its edge: arguably either a rare unstable ground-state, or another type of metastable state. In instruments, metastable sounds are often found by accident, sometimes they can be repeated or a technique developed to repeat them, or sometimes they remain elusive.

6 Tragically (perhaps), the practice of swirling water in a bowl is not something we have a cultural tradition of technical training for.

7 For more on *sedimented agency* see Spatz (2015, 50).

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fingerboard),[8] coupling their vibrations into an interference pattern that varies from single pitches to noisy multiphonics. As the player's familiarity grows, he or she can quickly attune embodied skills to the tasks prescribed by the score: following behaviours, locating edges, surfing the contours of metastabilities, and being-with the instrument in what Donna Haraway calls "ongoingness," the continuity of things in relationship with one another and life.

As I move the bow and the transient subsides into stable periodic pitch, that resonance is a sonic version of what I describe above as the "slightly-under" of the moving water-in-bowl. Sound too has a meniscus, a surface tension pressed by resonance. Resonance is the hysteresis of the system, holding the just-now-previous pitch in the material vibration and smoothing the way for that same pitch to happen again, while impeding unrelated pitches.[9] That meniscus of resonance is where the system is, where it's stable, and where it wants to stay. But as the bow changes direction again there can be just enough energy in the transient to break that meniscus, to push it over the edge to something else, one of several possible elsewheres. The bow movement can be leaned towards just-too-much in different components of sound, all of which have boundaries open to exploration, such as: transitions within a harmonic series from one partial to another; transitions between voiced and unvoiced sound, across the boundary where the bow's stick-slip action is enough to produce periodic vibration; or transition between monophonic and multiphonic sounds.

In the fractal image, magnification at the boundary reveals different-but-the-same structures as the equation traverses scales of self-similarity. Here, Agre's "impossibility of foundations" maps across to the mantra of chaos theory where systems continuously diverge due to "sensitive dependence on initial conditions" (Weisstein 2021). Repetition in a metastable space is the impossibility of foundations: each boundary opens up space for new stabilities and instabilities, and each repetition both stabilises and opens another possibility for new instabilities to explore. The phase-space of the cello is incredibly complex, with many variables being coupled to one another in non-linear ways, and the player's embodied skills are the result of training that mostly seeks to avoid the unpredictable and metastable.

On the prepared cello, the left hand is rarely used (see below for exceptions) and due to the interference of the coupled strings, a wide variety of sound can be produced by bowing in different places and in different ways. Here is the way that I break down the cello behaviours, searching for boundaries and stabilities both in the string segment (the physical space between the bridge and the preparation) and through varied approaches to bow technique: the bow is the transducer of movement and the human is the site of feedback between sensing and acting. The following description proceeds from "first bowing,"

8 This is because touching the fingerboard would ground the vibration, stopping the string; essentially it is a double-stop at that point on the strings. By allowing the ring to float, the strings are coupled in such a way to create four string segments (two strings, each one partitioned in two by the ring) all of which are excited when any one of them is bowed.

9 That is, very close pitches and pitches low in the same harmonic series—and near to a favourable formant—tend to be strongly related and may be promoted by the resonance, with others being impeded.

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when an experienced cellist is encountering the system initially, through levels of increasing familiarity.

- On first bowing, begin with the boundary between noise and pitch. This is a highly porous boundary where various forms of coloured "pitchy" noise can be produced, but it is characterised by a definite bump when the boundary is crossed from noise to pitch; as the resonance floods in there is a sudden appearance of pitch, which is sometimes very obtrusive. This boundary is not specific to the prepared cello, but the behaviour is amplified here by the unpredictable resonances arising from interferences.
- Once pitches start to emerge, notice that there are fundamentals[10] and non-fundamentals. The string segment can be divided into a mid-segment and two end segments. The mid-segment tends to produce fundamental pitches corresponding to the length of that segment, while the end segments also produce these but are easily pushed into producing harmonics. At the bridge end (sul ponticello playing), as expected these are usually harmonics of the fundamental; however, at the preparation end (sul tasto) these can be harmonics or also be subharmonics derived from string interference: when bowing on or very near to the preparation itself, subharmonics are almost unavoidable.
- Bow-direction: The mid-segment has an unusual boundary where up and down bow strokes produce two different fundamentals. This odd behaviour, once it is "found" by isolating the correct bow technique, is completely consistent in pitch terms; it produces the same two pitches, usually only a few semitones apart. The behaviour is unpredictable and difficult to isolate: once found it can usually be maintained for a while, but if lost it may be hard to retrieve. This behaviour seems to be suppressed by strong non-fundamentals in the end segments, and is less prevalent there.
- Bow-speed/pressure: The baseline speed and pressure for the prepared cello is slow and light; a *pp–ppp* technique works best for me. There is a loose boundary where faster bowing and greater pressure tends to produce harmonics (when playing towards the bridge), and multiphonics when playing in the mid-segment or towards the preparation.
- Monophonic and multiphonic: The general tendency (especially on shorter segments where the preparation is near the end of the fingerboard) is for a constant low-level multiphonic sound where one or more resonances sit behind the prominent monophonic percept; these resonances are perceived separately. With higher pressure this can fuse into a single multiphonic percept. As well as the obvious boundary of multiphonic fusion, there is a more productive boundary in trying to find states (in the phase-space) where single pitches can be isolated.

10 Of course with rigorous acoustic analysis it may turn out that these are in fact not fundamentals but actually partials of a low interference tone; but without recourse to that level of analysis I will use *fundamental* because that's what they sound like, and they mostly match the pitch of the equivalent fingered string segment.

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- Modifying the system using the left hand: The preparation connects and intersects two adjacent strings to make four string segments coupled into a system. By bowing one string, energy travels through the system recursively to create a single vibration through complex mutual filtering across the four string segments. The left hand can then be applied to modify this system in a variety of ways: stopping a string will shorten one string segment and alter the resonance; stopping with a glissando acts like a subtle filter sweep of interference; harmonic pressure on a segment has a similar effect but interacts with light sul ponticello bowing more; and muting the segment completely removes a component of the overall sound that can allow for focusing on remaining components.

The behaviours above indicate the initial and subsequent levels of exploration of the system, and the basis for compositional thought; both thought-in-action and "offline" thought. Placing the preparation at different positions on the string produces the same behaviours generally but alters the specific performative response. Continued exploration of the system reproduces these boundaries at more fragile levels, but always with the possibility of phenomena emerging in metastable states: as an example, my 2015 piece for violin and electronics (*The Endless Mobility of Listening*) is based on a bowing technique that results in indeterminate harmonics emerging from a drone, these harmonics tended on the whole to be low-order partials (5th, 7th, 9th, maybe 11th or 13th) but at any moment in the performance there was always the possibility of statistically unlikely partials (17th, 19th, even a 23rd in one Canadian performance) emerging. To return briefly to water swirling in a bowl, the compositional questions are about phenomena that can be explored in performance through their emergence in relation to tightly defined contingencies. The score sets up edges and boundaries in relation to physical phenomena, which when explored can lead in various different directions.

This is the beginnings of a compositional material that can lead to multiple different pieces across an ontological spectrum from the representational (reifying the sound phenomena as fixed entities represented through notation and subsequently recreated in performance) to the performative (guiding the player into structured intra-action with instrumental materiality in open-ended performance).[11] My recent music has tended almost exclusively towards the performative, which focuses the compositional act less on the fixed sequencing of events and more on creating open networks of contingencies. This is not to propose a bare dichotomy of open versus closed (which would not stand up to much scrutiny), more to make the point that the site of composition is shifted into a different stratum. Here the compositional thought is primarily about where the contingency lies in the instrument's phase-space (an easy place to reach or a hard place?), how open it is (what is the range of likely and unlikely outcomes?), what the ratio of stable to unstable spaces is, how they are connected, and whether there are fixed beginning and end points.

11 A key influence on my thinking on performative ontology is from philosophy of science (see Pickering 1995).

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All these questions are part of the construction of a labyrinth where decisions happen performatively across the combined agencies of the player-instrument assemblage.

This at least is the ideal: material things have their own limits. While a fractal is infinitely emergent, an instrument eventually reaches physical limits where the interaction of bow and string can go no further; thus, part of the compositional process is a question of the richness of the system, the possibilities for variation in recursion. This decision is tied in some ways to the technical question of whether the phenomena in question are of an order of contingency that is within the window of human perception and action—for example, avoiding phenomena that happen too quickly for a human to react to in performance, or that are too low or high-frequency to be meaningfully parsed as pitches.

As an example of one composition that has emerged so far as an instantiation of this technique, I turn to my piece *The whole is encountered by going further into the parts* (2019–20) for contrabass prepared with string-coupling rings, which was written for Christopher Williams. While my research was initially on prepared cello, the ideas transferred quite readily to bass, with Christopher as an ideal collaborator due to his experience as an improviser and with open forms and open notation in experimental music (see Williams 2016). The piece is a text score, outlining a performance technique (interaction with the behaviours of the prepared instrument) and an open formal scheme defined around the interaction of performance technique and the contingent materiality of the instrument. The piece also uses a physical meditation as part of the rehearsal process—more on this later. This is the opening of the score:

> This piece is built on cycles of repetition and change driven by feedback between player and instrument. An instrument made unstable by preparations that pass energy from one string into its neighbor, creating interference patterns that the player enters into.
>
> Cycles happen at many scales.
>
> > Event-level cycles of slowly bowing back and forth to reveal stable sounds; drones of single pitches or pitch-timbre-complexes, or repeating patterns of pitches that emerge from interference.
> >
> > Phrase-level cycles of stability and instability as drones and patterns are disrupted by small but constant change.
> >
> > Section-level cycles of changing environments. Moving between strings differently prepared, and living now in the consequences of a previous cycle's activity. (McLaughlin 2020)

Compositionally speaking, this sets up the different levels of player agency and contingency (as material agency) (see McLaughlin, forthcoming) as both points and strata of decision-making in performance. In the score, event-level cycles are mostly human-agentic as the player chooses materials to work with, while the material may specify exactly what happens in that space. The player, instead of controlling the instrument works "with" the particular instrumental state

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or behaviour that emerges, aiming for a state but being responsive to contingencies, the nature of which may influence the player to stay or move on. Here the player and the material can both make decisions about ongoingness. For example, will the player decide to step out of a material that is too stable (or too unstable, depending on what the score directs), or will the material refuse to be what the player wants, forcing a change? The score directs the player to find stabilities at this level, which are then put in tension at the next level. Above this, phrase-level cycles are largely material-agentic, with the player following a quasi-mechanistic process of making small incremental changes to find tipping points where the material breaks into a new state. The stable states of the phrase-level pattern are moved across the topology of the instrumental phase-space until they hit a boundary. Being-with and ongoingness are still active and present in the form of what Haraway calls response-ability (2016, 28), which, translated into this context, I posit as the player being aware of and responsive to where the instrument wants to go. The player is always present and attentive to the instrument for the aural and haptic cues that there may be other spaces to move to, snakes and ladders in the contrabass phase-space.

At the macro-structural section-level, the response-ability (Haraway's pun on "responsibility" that places the weight of the word on our actions, our response) outlined above steps a little back from "being-with" the instrument so that the player can make human decisions to sculpt the shape of interactions across the piece, to choose what aspects of the piece the player wishes to be "with." The score outlines options for "transitions" and "interventions" as structural gambits. Interventions are high-level variations in texture, such as adding pizzicato open strings as an internal accompaniment, or going against the main method of the piece by sustaining a single sound without change for a long time. Transitions are part of the main method of ongoingness of variation and repetition in the piece by starting again. Transitions begin the form of event and phrase cycles again in a new and different materiality, where the same initial conditions might produce different outcomes. Transitions mostly involve the player making changes that the instrument could not change on its own, such as crossfading (through a double-stop) to bowing a different string, or moving the preparation to a different point on the string. Unlike phrase-level movement across the phase-space, which is looking for a tipping point to respond to, transitions are a complete reset of the performative space where the player must re-enter being-with a new instrument. Of course, over both the micro-time of a single performance and the macro-time of a lifetime's practice, the player comes to know the instrument behaviours; but the compositional artifice that I strive to get right is that the piece will always offer new interactions, a richness where contingency and response-ability work in tandem. Like our relationships with animals and friends, we are always in a process of getting to know.

This takes my commentary on this piece full circle, back to the epistemology of practice and bringing the player into the world of the piece. The score contains instructions for technique and the application of that technique in structuring contingency. Additionally, there is a rehearsal technique described

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for engaging with the piece away from the instrument. The player is asked to engage in a simple practice of drawing:

> As part of the practice-regime, make drawings of cycles. On a large sheet of paper, draw a continuous line that moves in overlapping circles. Each new circle should pass through the first one at the same point. Now try again but crossing the first circle at two or more points. Keep drawing continuously until knots emerge, stable points in the wayfaring curves, responding to the constraints of rules and materiality unfolding in time. (McLaughlin 2020)

Figure 7.1.

Over many years of engaging with materiality, my notational practice has vacillated between approaches that place the weight of communication on different mediums. I think I am only now starting to find what works for me. Initially I often relied on instructional text to tell the player what to do (and what not to do), but this usually needed me to demonstrate to clear up misunderstanding that lay below the level of prescribed actions. Symbolic and graphic approaches offered more intuitive paths for the player but often at the expense of clarity. More recent pieces have been more successful by combining instructional and poetic text that afford both clarity and the sensuous connection to the materiality at the core of the piece. The inclusion of a separate-but-connected physical practice in this piece sets up an analogy for the piece in a different medium, an additional path to connecting the player, instrument, and score that roots the piece in a practice of doing, without closing down interpretations.

This approach is indebted to similar approaches, such as those of Jennifer Walshe and Cassandra Miller. Walshe's *THIS IS WHY PEOPLE O.D. ON PILLS* (2004) asks the player to "learn to skateboard, however primitively" in preparation for the piece; however, the piece itself does not involve skateboarding (quoted in d'Heudieres 2015). Performer Louis d'Heudieres describes this as a way of changing perception that resonates entirely with my line drawing:

Figure 7.1. Excerpt from *The whole is encountered by going further into the parts*, for contrabass prepared with string-coupling rings (McLaughlin 2020).

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> the activity itself requires you to engage differently with the environment around you. An incline is no longer just an incline; it's an opportunity. A strip of smooth tarmac has a certain feel; a cobbled alley isn't going to be particularly pleasant; wood is fast, rubber is slow, grass is an injury-safe sanctuary for practising ollies. You go around spotting these different zones where different types of movement and behaviour are possible, earmarking that spot for speed, or that one for smoothness, or that one for attempting a trick. (d'Heudieres 2015)

This concept of "opportunity" is key in responsive performance where contingencies in the instrument become pathways not simply to new sounds, but new structural connections.

In Cassandra Miller's recent work she uses a form of embodied practice in her composition that she refers to as "automatic singing." The technique references Robert Ashley's "automatic writing" as a method of distancing and opening up intuition in a context of "mimicking and transformation" (Miller 2018, 38). Miller describes it as:

> listening (in headphones) to a recording while attempting to sing-along to that recording in real time, often while distracted by a mental task such as a body-scan meditation. The resulting audio is then recorded, holding the potential for further soundings and listenings. . . . I am making an utterance that is unique to myself on that day at that time, and with the new knowledge learned in each previous iteration. To sing "along" does not imply copying, quoting, or stealing, but instead implies a togetherness, an accord, an attunement; a listening, an empathetic physical response, and—originating from that response—a participating, an expressing alongside. (Miller 2018, 37–39)

Miller's technique, while superficially different to my own, is strongly connected as an embodied act that relies on the performer attuning him- or herself in a space of constraint and contingency to produce new knowledge by moving recursively, repeating the same movements in an unstable space—composition as a series of decision paths through a network of ideas and materialities that mutually constrain and constitute themselves.

The remainder of this chapter will transpose the ideas discussed above onto composition for clarinet, where the same concerns apply but unfold in a different way due to differences between the instruments.

String instruments are fairly predictable in that they produce a reliable harmonic series with indeterminacies largely relegated to extremes of sound production, to the extent that I needed to use preparations to make the instrument more inharmonic and increase the size and richness of the contingent space. Clarinets are in some ways the opposite of this since they are inherently inharmonic and contingent, with indeterminacies lurking just outside the edge of even the best player's technique. No preparations are needed for the clarinet,[12] but the shift in technical expectations for the clarinettist is arguably steeper than that of the cellist; since clarinet technique needs to work harder to avoid contingencies, working those contingencies back into performance

12 Though I have done some experiments in this area with clarinettist Heather Roche, the results of which will be disseminated as part of the Garden of Forking Paths project in 2021.

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technique is more difficult. In terms of the compositional work outlined above, the two instruments are similar because they afford sound production that is continuous and also continuously alterable. Additionally, both afford multiple simultaneous resonances that can interact, but the instruments tend to produce a low number of simultaneous resonances, making them manageable and traversable yet still rich. The cello preparation couples across two strings to produce (usually) two strong resonances and related harmonics; it also produces the subharmonic, but this is mostly only active at one end of the segment and doesn't seem to interact strongly. Similarly, the clarinet tends to favour multiphonics where two strong resonances interact, and like the cello preparation there is a more-or-less traceable path between these resonances as separate but entwined, and as completely fused. My recent research on the Garden of Forking Paths project[13] aims to bring to light the technical mechanics underpinning these clarinet phenomena in ways that composers and performers can better understand the systems and their indeterminacies.

How does composition happen on the clarinet? In this case I will present two cases with different initial conditions.

Starting with the known: Play long and slow a standard monophonic fingering on the clarinet such as the chalumeau register C4 (transposed). Play the note long, and listen inside to its spectrum, bringing individual strong partials into perception: be "co-present" with the sound (Manning and Massumi 2014, 5). Using the standard techniques of overblowing, play through the available harmonics of the fingering. All the work here is done by the mouth as a complex interaction of variables in what I will call production technique—an umbrella term for the variable-system that includes embouchure position/pressure/bite, tongue position, breath speed/pressure/angle, throat-tuning, and so on—and the specific position of all these variables required to produce each harmonic is a point (of varying narrowness) on the phase-space of the clarinet. In learning these techniques, the clarinettist learns to separate these points to be confident in technique—performative security in knowing that you won't land between the points and make an error. **Now, as gently as possible, tack away from the stable point until something else emerges, and stabilise the two as a multiphonic. Explore between these points to find new points and strata of interaction, different levels of balance and imbalance.** Each new breath breaks the system and perturbs the delicate setting of the body's parameters; but equally, each new breath and resetting reinforces the technique of finding that point. Begin again on a stable tone, sustained and steady. **Gently slide a finger off any hole—as slightly as possible, and without altering any other parameters. Listen for change. Don't compensate pre-emptively. Allow resonances to slosh towards the edge of the spectrum; concentrate on the meniscus. Whether change is fast or slow, support where the instrument wants to go. Try again. Alter the movement of the finger and the focus of production. Where do stabilities and instabilities emerge?** What is the terrain of the phase-space here, and there, and between? What can be known and learned and sedimented, and what will always be contingent?

13 See https://forkingpaths.leeds.ac.uk/.

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Starting with the unknown: Invent a fingering (or distort a known fingering) and excite the air column. There are compositional decisions here: to blow as though this was a chalumeau pitch or an altissimo? To apply a known bodily configuration of production technique to an unknown topology is to begin in alienation. **Listen and be with the instrument in sounding. Follow and support emerging resonances. Push into different corners of the phase-space with embodied techniques.** Move across the continua of the terrain, not teleporting from point to point. **Establish the stable points, the key features of the topology. Now start again with a change to the fingering, enter again a new world.**

The relationships here are the same as in the bass piece: materiality, agency, contingency, emergence, and structure all interact at different levels. Composition begins with understanding materiality as behaviours, structuring these as topological relationships, and scoring a schema for emergent structure by productive constraining and aligning of relationships. Macro-structural alterations, like the transitions in the bass piece and the change of fingerings—whether discrete or continuous—create new resonant topologies to explore, effectively resetting the piece. Phrase-level activities can include the process of slowly opening a hole, which can be controlled slowly over several breaths to explore that space. However, slow processes of change are much more difficult in the embouchure and airstream because (a) these mechanisms are internal, knowable only through feel and muscle memory (which requires extended time to build-up), and (b) retaking breath (or circular breathing) is difficult to do without perturbing the system in some way, so the exploration can only happen within a single breath in most cases. This difficulty is easily flipped into an opportunity for compositional structuring by continually parsing, over a sequence of breaths, the same approximate point in phase-space. Such a recursive process produces a range of emergent sounds but with a high probability of revealing many variations on a small set of different outputs; hence, structure is emergent from recursion.

At the event-level, the clarinettist learns the phase-space of the instrument through performative exploration moving between stabilities and instabilities, where the latter are a state of continuous becoming. The player's awareness of the self and the instrument as an assemblage is what Erin Manning and Brian Massumi (2014, 4) refer to as a "dance of attention": "the holding pattern of an immersive, almost unidentifiable set of forces that modulate the event in the immediateness of its coming to expression. Attention not to, but with and toward, in and around." They continue: "A dance of attention is not attentiveness of the human to the environment but attentiveness of the environment to its own flowering, at the very limit where experience and imagination, immediacy and cross-checking, overlap. It is the making-felt of a co-compositional force that does not yet seek to distinguish between human and nonhuman, subject and object, emphasising instead an immediacy of mutual action, an associated milieu of their emergent relation" (ibid., 6). Here, the clarinet and the player are themselves the environment, continuously attentive and immediate. The compositional act is in structuring the potentials and resistances that allow that "co-compositional force" to emerge.

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The known fingerings of the clarinet—that is, the core set of fingerings commonly taught, and augmented by individual players' accreted knowledge—and their associated production techniques always offer stable outputs, while deviation from this limited set opens up unpredictable terrain. As previously mentioned, the known spaces of the clarinet are rigorously embedded techniques of the body, while unexplored spaces, lacking this rigorous embedding, are liable to rapid failure if resonances are paired with incompatible production techniques and vice versa. The clarinet is a good example of Deleuze and Guattari's "smooth" and "striated" spaces in action. The known fingerings are striated by the "state," the external system of tempered pitch and uniform timbre imposed by musical convention, and thus "limited by the order of that plane to preset paths between fixed and identifiable points" (Massumi 1987, xiii). The expansive network of not-known fingerings is the smooth space of nomadism, "projective" and "topological" (Deleuze and Guattari 1987, 361), where "space is occupied without being counted," without measurement or grid, only emergent relations (362).[14] This is Deleuze and Guattari's "problem" space, "affective and . . . inseparable from the metamorphoses, generations, and creations within [performance] itself" (362). Productive wayfaring by the player-instrument assemblage in this space requires both the striation of the score and the dance of attention. Composition here corrals forces to be "mutually constitutive"—what Andrew Pickering describes as the "quality of interplay between the state and the nomad" (2009, 160). "The nomad supplies a transformative dynamic, upsetting state formations, which are then reconstituted on a new basis, only to be nomadically disrupted again, and so on. The state adapts to the nomad" (ibid.).

To return to Agre, his "impossibility of foundations" is here transposed into the performative by composing for the player to continuously dig further into the contingent materiality of the instrument as a way of curating emergent structure. The sound work moves erratically between thinking with instruments to instrumentalising their territories as a State of states whose only purpose is to fall apart in unfolding becoming-with: an insistent tendency towards what Cornelius Cardew colourfully characterises as a commitment to "a music which is going wild again" (quoted in Piekut 2014, 774). By beginning with the material phenomena of the instrument, and asking the player to engage by recursively stretching his or her embodied techniques into pure *physis*, can critique be embedded in composition? My hope for this follows Andrew Pickering's performative ontology of the "mangle," that "the world becomes sufficiently full of explicitly and self-consciously decentered practices and their products that an ontology of becoming becomes the natural ontological attitude" (2008, 9).

14 [Deleuze and Guattari here paraphrase Boulez (1963, 95–107; 1971, 85–94); the phrase in quotation marks is Deleuze and Guattari's adjusted quotation of Boulez (1963, 107; 1971, 94).—Ed.]

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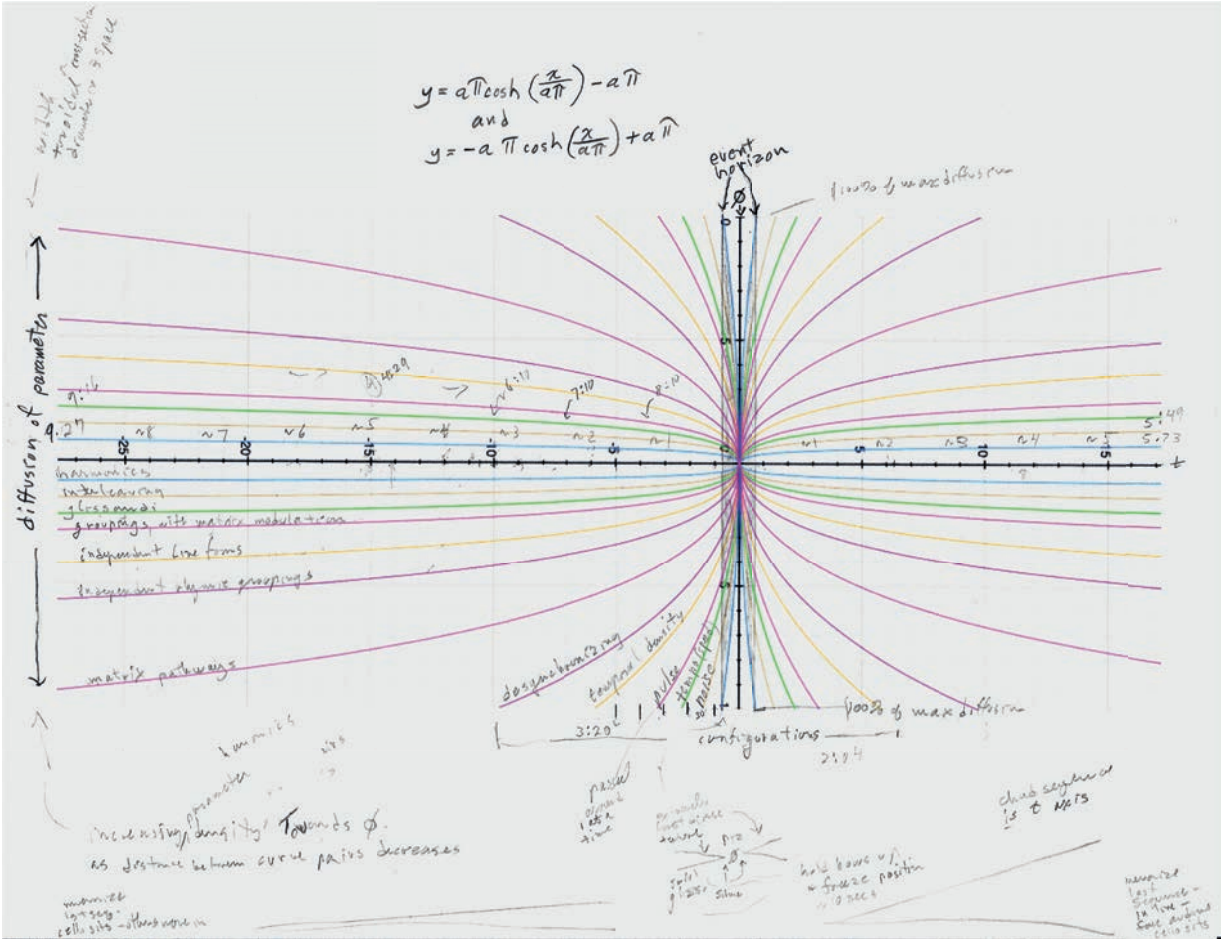

Plate 2.1.

Plate 2.1. Page from composer's sketches showing how rotated catenaries outline the diffuseness of compositional parameters, event horizons marked by silence and frozen motion, and the Ø point where one time ends and another begins.

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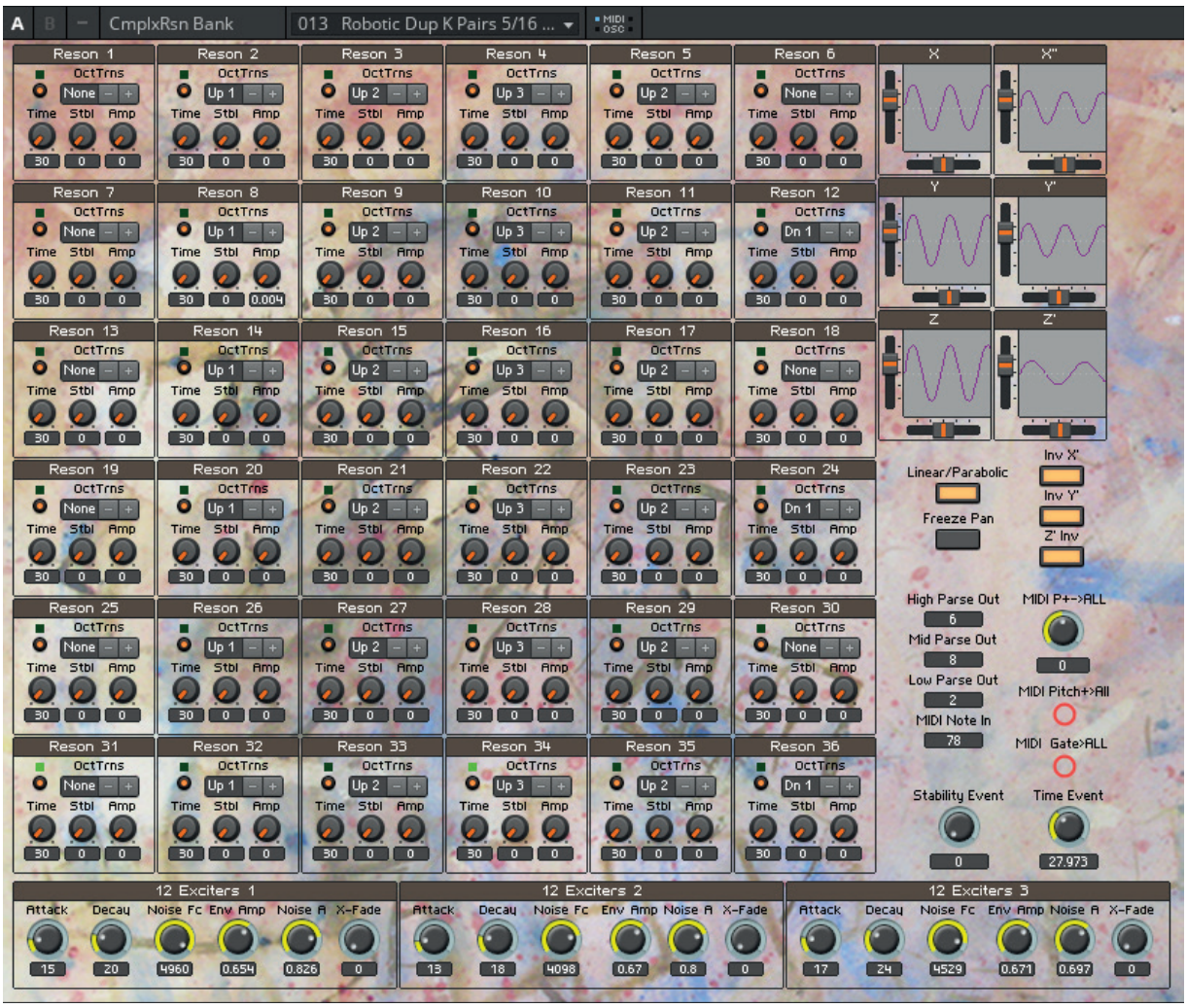

Plate 2.2.

Plate 2.2. Control surface for the complex resonator bank used in *Earth Encomium* and *Nothingness is Unstable*, programmed with Reaktor software.

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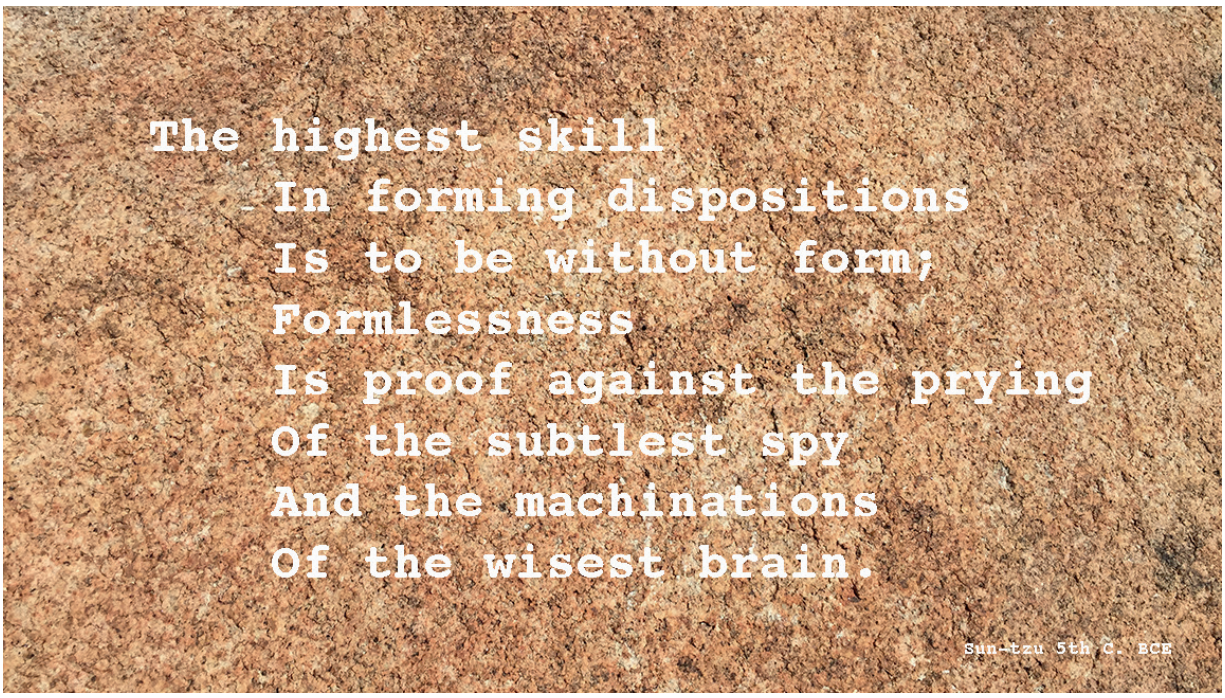

Plate 2.3.

Plate 2.3. The penultimate projected during performances of *Earth Encomium* with *Nothingness is Unstable*.

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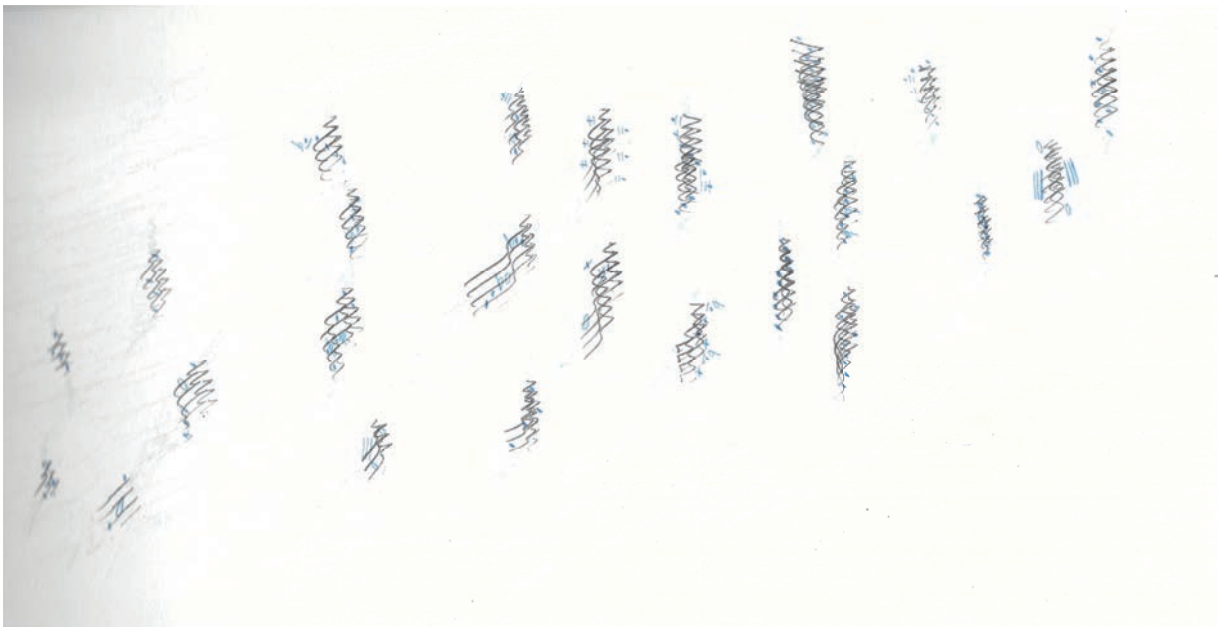

Plate 2.4a.

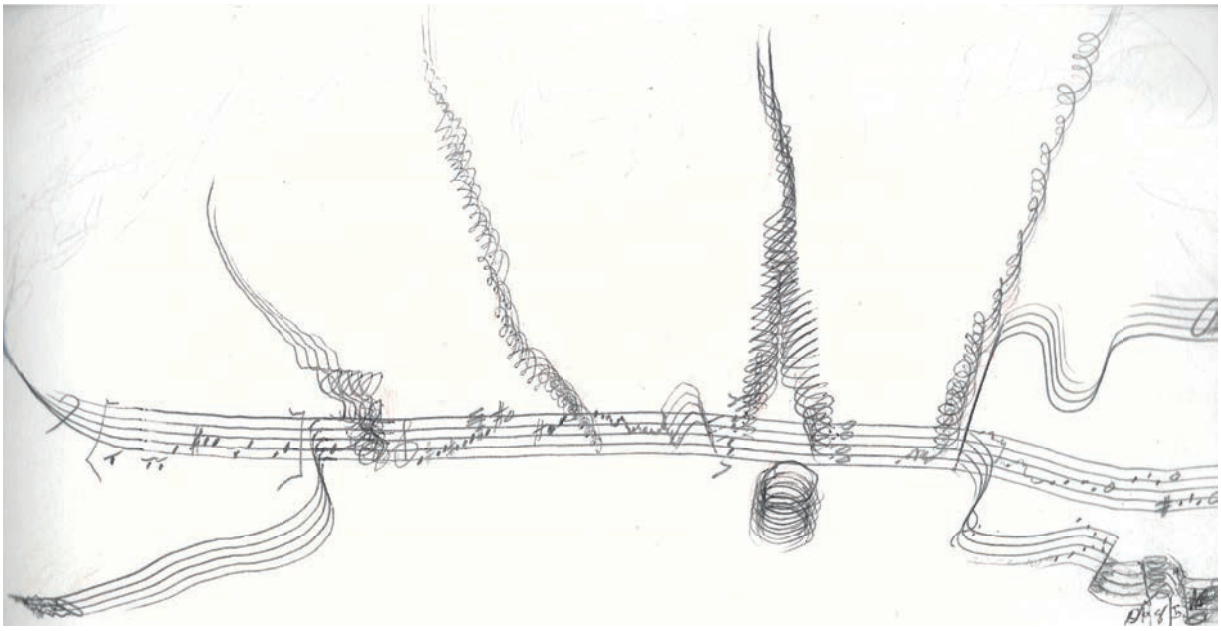

Plate 2.4b.

Plate 2.4a–c. Drawings from my book *Natural Scores* also used in *Choose Your Universe* performances.

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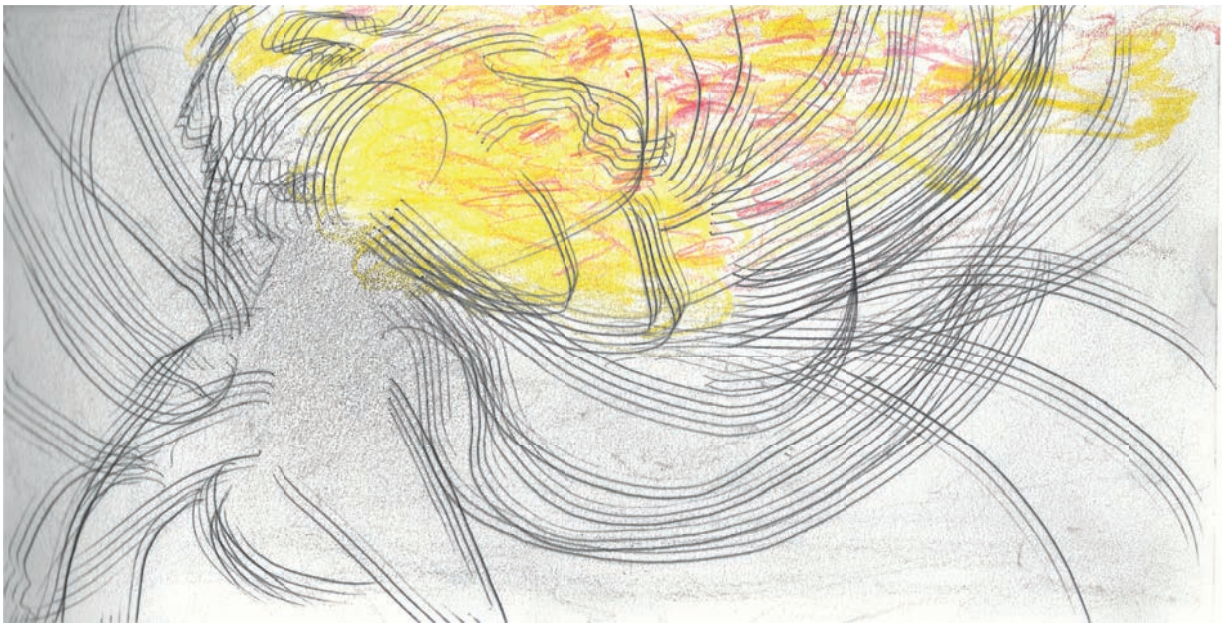

Plate 2.4c.

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Plate 2.5.

Plate 2.5. Control surface for the software developed for performances of *The Experiment*, written in Reaktor. This version accommodates four audience members at one time, who were brought into a limousine where the performances took place. A separate concert version of *The Experiment* has also been created, which permits various kinds of expanded presentations.

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Plate 2.6a.

Plate 2.6a–f. Images from *Swarming Intelligence Carnival*: preparations taking place in the Lotus Pond, participants getting ready, three performance snapshots from ground level, and a computer control and performance station.

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Plate 2.6b.

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Plate 2.6c.

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Plate 2.6d.

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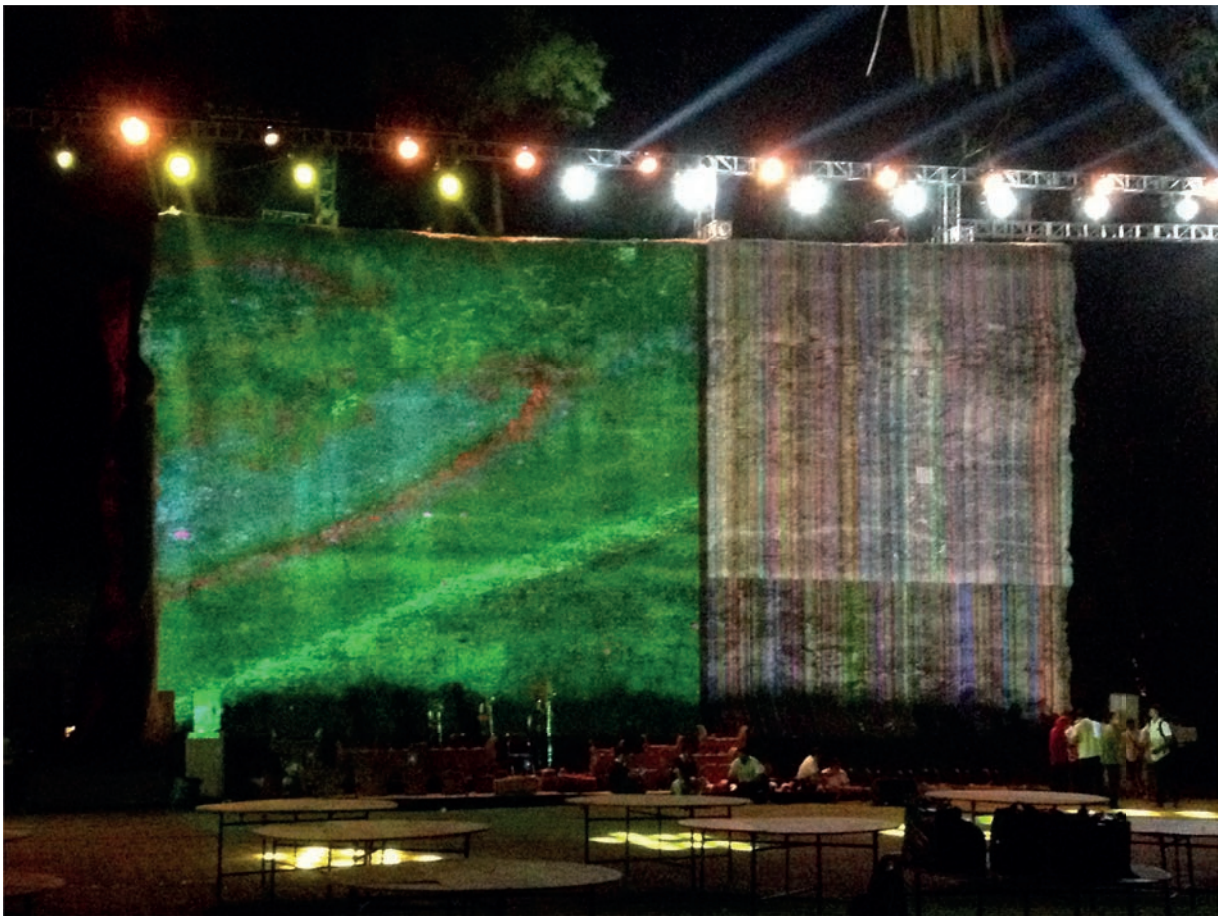

Plate 2.6e.

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Plate 2.6f.

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Plate 16.1.

Plate 16.2a.

Plate 16.1. Set-up of *Rave Séance* with a circular arrangement of five tables and the laser projection in the middle (photo: Katja Goljat).

Plate 16.2a–b. Audience members interacting with the performance of *Rave Séance* via illuminated buttons (photos: Katja Goljat).

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Plate 16.2b.

Plate 16.3.

Plate 16.3. View of the net-art part of *Why Frets?* (photo by the author).

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Plate 16.4.

Plate 16.5.

Plate 16.4. An audience member using a tablet to generate augmented reality (photo: nmzMedia).

Plate 16.5. Arrangement of the space of *Anna & Marie* with the violinists in playing positions and no audience members (photo: nmzMedia).

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Plate 16.6.

Plate 16.7.

Plate 16.6. Audience members listening to the narrative using earpieces during the installation phase (photo by the author).

Plate 16.7. Hot plates with beeswax were used in *Anna & Marie* in order to create a subtle odour of melted wax throughout the venue (photo by the author).

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