

Resonating Bodies

An artist's enquiry into sympathies between the audible and the material.

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I hereby declare that the work in this dissertation and the work presented in the accompanying portfolio have been carried out by myself except as otherwise specified.

Signed,

Dawn Scarfe

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Abstract

This thesis uses sounding objects to explore interactions and affinities between the audible and the material. Throughout, the emphasis is on first hand, practical engagement with resonating bodies. Antiquated acoustic instruments are re-examined, generating personal conjectures and creative explorations. The author submits herself to “therapy” with the sound of the glass harmonica, inspired by controversial physician Franz Anton Mesmer (1734-1815). Helmholtz resonators (*circa* 1863) are re-made and given new hearings. The proposition that sound can provoke predictable responses from both inanimate and sentient bodies is considered through these encounters. Particular attention is given to interferences, “spillings and minglings” (Connor, 2001) between the senses, and the dynamic between the senses and the imagination.

Seven key artworks featuring resonating bodies are employed as case studies. These include *Lenses* (2008), *Carillon* (2008-9) and *Listening Glasses* (2009). The case studies are used to approach contested notions of voice, presence, absence, authorial intention, interactivity, audience participation, and other terms implicated in contemporary debates regarding the use of sound in art. The focus on resonance, in the sense of re-sounding, is carried through into the dissemination of art installations, performances and critical reflection by the author. Works are developed, then re-thought and re-formulated in relation to specific art, music and academic contexts in the UK and mainland Europe. Installations become performances and *vice versa*. Exhibitions, papers and presentations are regarded not as “receptacle[s] of the artist’s vision” (Bourriaud 2002) marking the end point of the creative process, but rather as opportunities to mobilise and test ideas through new frames of reference. Most significantly, the author uses this thesis to consolidate an art practice, and an orientation towards the world that is grounded in reflexivity and the impulse to remain attentive to the detail of her own sensory experiences.

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Selected Exhibitions, ♦ Performances ♦ and Presentations ♦

- 11.12.10–20.02.11 ♦ *Lenses*, 'TONSPUR_expanded: Der Lautsprecher,' quartier21 / MuseumsQuartier, Vienna, Austria. <<http://expanded.tonspur.at/>>*
- 23.08.10–27.11.10 ♦ *Do You Hear What I Hear?* 'TONSPUR 36,' quartier21 / MuseumsQuartier, Vienna, Austria. <http://www.tonspur.at/w_36.html>
- 23.09–25.09.10 ♦ *Through the Listening Glasses*, 'Sound Acts,' University of Aarhus, Denmark. <<http://soundacts.au.dk/en/programme/>>
- 10.06–12.06.10 ♦ *Through the Listening Glasses*, 'EMS at The Shunt,' London.
- 29.10.09 ◇ *Sounding Bodies*, Akademie der Bildenden Künste, Vienna, Austria.
- 02.12–24.02.09 ♦ *Listening Glasses*, 'The Grand Plasto-Baader-Books,' KALEID, London. <<http://www.kaleiditions.com/eshop/kaleid-exhibitions/future-exhibitions/58-the-grand-plasto-baader-book>>
- 25.07–15.08.09 ♦ *Listening Glasses*, 'Sound Escapes,' Space Studios, London. <<http://www.electraproductions.com/projects/2009/soundescapes/overview.shtml>>
- 03.08–04.08.09 ♦ David Tudor's *Rainforest IV*, Area 10 Project Space, London. <<http://www.area10.info/modules/magazine/article.php?articleid=86>>
- 20.05.09 ◇ *Carillon* (with Mel Gough), 'Re-think Re-use Re-make,' Bios, Athens, Greece. <<http://www.bios.gr/events/142/>>
- 01.04.09 ◇ *Carillon* (with Mel Gough), Café Oto, London. <<http://www.loudspkr.org/2008.html>>
- 15.02.08 ◇ *Carillon* (with Mel Gough), Café Oto, London. <<http://www.cafeoto.co.uk/programme/SundaysattheOto5.shtm>>
- 14.11.08 ◇ *Aural Architectures*, 'Voices and Noises,' University of Helsinki, Finland. <<http://filosofia.fi/node/4004>>
- 10.11.08 ◇ *Aural Architectures*, Digital Studios, Goldsmiths, University of London.
- 20.09–16.11.08 ♦ *Lenses*, 'Sound:Space,' South Hill Park, Bracknell.
- 09.10.08 ◇ *Carillon and Lenses Live* (with Mel Gough and Jane Dickson), 176 Zabłudowicz Collection, London.
- 30.09.08 ◇ *Carillon* (with Mel Gough), Beldam Gallery, London.
- 21.09.08 ◇ *Carillon* (with Mel Gough), Café Oto, London.
- 20.09.08 ♦ *Lenses*, '27 | 57,' broadcast by Rough Diamond Productions for SirenFM 107.3 in Lincoln and ArtinLiverpool FM for Liverpool Biennial.
- 14.07–30.09.08 ♦ *Lenses*, 'Essense,' Beldam Gallery, London.
- 04.07–06.07.08 ♦ *Lenses*, 'Sonic Arts Expo,' Lighthouse Media Centre, Brighton.
- 13.03–16.03.08 ♦ *Lenses*, 'Sightsonic' International Festival of Visual Arts, York. <<http://music.york.ac.uk/sightsonic/archive/2008/aplat.html>>

*All websites in this list accessed 12th October 2011.

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Introduction

Previous practice

My interest in sound developed during my undergraduate studies in fine art at Oxford Brookes University (2000-2003). I began to wonder whether listening could inform my thinking in distinctive ways and if attending to the audible might afford new ways of imagining aspects of the environment around me. Listening in a park to the sound of the wind in the trees, I considered how the sound seemed to meet my ears from all directions. The transience and dynamic nature of the sound fascinated me, as at some moments I felt consumed by it and at others outside of it.

I became interested in how my impressions of my environment changed over time, and began to make time based artworks to explore my observations. I wondered if solar and lunar cycles could be perceived as rhythms despite their long duration and explored different ways of apprehending and mapping them. In the performance / action *You Are Here* (2002)¹ I worked with collaborator Jane Ricketts to trace sun and moon shadows cast by lampposts, trees and our own figures with chalk and flour, repeating this action periodically to mark changes in the length of the shadows.

Watching particles of dust illuminated in a beam of light between my curtains I became interested in the way that my breath, or slight movements of my hand could disturb the atmosphere, causing the dust to move in a turbulent manner. Motivated by these observations I made *Interlocutor* (2002) a sound and light installation / performance. One visitor at a time was invited to enter a large unlit space with black walls, ceiling and floor. Once they had closed the door behind them a circle of blue light slowly faded to full luminosity accompanied by an electronic tone at a fixed pitch. Hidden in the dark and armed with a theremin² I waited for the visitor to step into the light and then changed the pitch and tremolo of the sound according to the speed and nature of their movements, to render the disturbances in the illuminated air audible. After a few minutes the light and sound faded out and the visitor left the space.

After *Interlocutor* I began to use sound to heighten the atmosphere of particular environments. I aimed to use sound to emphasise the character of specific spaces, such as the sombre, subterranean qualities of St Edmund Hall Crypt, Oxford (*Emersion*, 2003)³ and the bright, tall and circular nature of the Radcliffe Observatory tower, Oxford (*Rounds*, 2005).⁴ My working process involved spending time listening to the spaces, moving through them, documenting the sounds I imagined as well as heard there, and testing the acoustics with my voice. Choreographing the movements of the audience, how they would enter, stand or sit, pass through and exit, was as important to the work as the spatial distribution of the sound introduced into the space.

¹ Dawn Scarfe and Jane Ricketts *You Are Here* (2002), site specific drawings exhibited as part of 'Vain Live Art,' various locations, Oxford, 13th June 2002.

² The theremin is an electronic instrument that is played, not through touch, but by varying the proximity of the hand to the antennae (pitch) and loop (volume).

³ Dawn Scarfe, *Emersion* (2003), sound installation at St Edmund Hall Crypt, Oxford, 14th-19th June 2003. <<http://www.dawnscarfe.co.uk/work/emersion>> accessed 31st May 2011.

⁴ Dawn Scarfe, *Rounds* (2005), performance at the Radcliffe Observatory, Green College, Oxford, 26th and 30th April 2005, commissioned by Ovada. <<http://www.dawnscarfe.co.uk/work/rounds>> accessed 23rd May 2010.

Through my Masters study in composition at Goldsmiths, University of London (2005-6), I used sound to draw attention to movement in environments. The installation *Tree Music* (2006)⁵ played sound from speakers hanging from the branches of a tree. It allowed the motion of the branches in the wind to modify the sound through the Doppler shift⁶ as the speakers swung back and forth. Inspired by the concept of automatic instruments, I constructed an Aeolian harp⁷ and listened to it as counterpoint to the world outside my window. I was interested in how the wind affected the strings of the harp at close range, and the sound of planes in the distance.⁸

I identified with other artists whose work used sound to address the environment in which it was encountered. These artists included Robin Minard, whose sound installations aimed to modify the ambience of a place or make the structure of a room appear fluid and changeable (in his terms the “conditioning of space” and the “articulation of space”) (1996, 14-22); Max Eastley, whose sound sculptures such as *Aerophones*⁹ produced bleak wailing sounds which seemed to enhance the austerity of the windy coastal landscapes in which they were placed; and Janet Cardiff, whose audio walks such as *The Missing Voice: Case Study B* (1999)¹⁰ aimed to confuse the participant’s sense of which sounds were live, reproduced or imagined. Cardiff believed that portable audio players such as the Walkman could create a “cyborg relationship with the [participant] so that they’re in different worlds at once” (2001, 24). What interested me in these varied practices was the manner in which sound was used to alter listeners’ impressions of their surrounding environment.

Methods: re-thinking and re-making

Reflecting on the work I developed between 2002-6, I identified emergent concerns that have continued to drive my subsequent artistic practice. Dominant issues included how listening might influence our sense of our surroundings, and how sound can be used to alter the atmosphere of particular environments. I recognised a propensity in my work towards the condition of immersion, the desire to position myself and an audience in the flux of sound. I was interested in the qualities attributed to sound such as shape, density and mood, and wanted to employ sound to heighten or trick the senses, presenting it in such a way that listeners weren’t sure whether it was heard or imagined. In order to develop these concerns I embarked on this practice led PhD thesis, using my practice to generate the research questions that guided the thesis as a whole.

A strategy I employed throughout the research process was to seek out opportunities to re-configure and re-present my work¹¹ in different circumstances. This involved giving papers at academic

⁵ Dawn Scarfe, *Tree Music* (2006), ‘ARTE SONoro,’ Jardin del Observatorio de la Colina de las Cinecias, Madrid, Spain, 23rd April-13th June 2010, and The Quad, Goldsmiths University of London, 30th July 2006. <<http://www.dawnscarfe.co.uk/work/tree-music>> accessed 23rd May 2011.

⁶ “Doppler shift: The change in pitch of a sound heard by a listener when the source and observer are in relative motion to each other. As the observer and sound source come together, the perceived pitch is higher than that of the source when stationary, and as they move apart it is lower” Truax, 1999: *Handbook for Acoustic Ecology* <http://www.sfu.ca/sonic-studio/handbook/Doppler_Effect.html> accessed 11th August 2011.

⁷ An Aeolian harp is a string instrument sounded by the wind. It is discussed in more detail on p. 75.

⁸ These recordings were developed into an eight-channel composition named *Air Traffic* (2006) see <<http://www.dawnscarfe.co.uk/work/air-traffic>> accessed 23rd May 2011.

⁹ Eastley’s *Aerophones* feature in the first few minutes of the video ‘Max Eastly[sic]-Sound Sculptures & Improvisation’ <http://www.youtube.com/watch?v=9UALk5Zp0F8&feature=player_embedded> accessed 6th April 2011.

¹⁰ For an introduction to Cardiff’s *The Missing Voice: Case Study B* (1999) see <http://www.cardiffmiller.com/artworks/walks/missing_voice.html> accessed 6th April 2011.

¹¹ In using the term “work” here I refer to the art practice and written analysis that, taken together, constitute my research.

conferences and seminars in the UK and mainland Europe, as well as exhibiting and performing the work on multiple occasions to art and music audiences.¹² This was not merely an attempt to disseminate my ideas to a wider public. More importantly, it was an exercise in testing and re-thinking the work in relation to specific situations. I considered the context and manner in which my work was encountered to be integral to the meaning of the work, and regarded each presentation as both a form of critical reflection and an opportunity to gain new insight.

Most of the discourse concerning the history and theory of sound in art tends to prioritise the activities of twentieth century practitioners such as Luigi Russolo, Pierre Schaeffer, and most prominently of all, John Cage (see Kahn (2001a)¹³ Licht (2007)¹⁴ and Kelley (2011)).¹⁵ This is the canon against which art practice that engages with sound is generally measured. In this thesis I re-animate outmoded musical instruments and relics from the history of acoustic science in order to experience and interpret them in new ways. The figures that dominate my research include Franz Anton Mesmer, Ernst Florens Chladni, Johann Wilhelm Ritter and Hermann von Helmholtz. My interest in these individuals centres on their engagement with resonating objects, the relatively simple technical means they used to test their theories, and the ways in which their own bodies were implicated in their practice. I employ some of the instruments they used in their work (or approximations of them) such as wine glasses, vibrating metals, and glass resonators, in order to inhabit and perform their theories about the relationship between form and sound, and between the sensible and the intelligible. I then test the relevance of these ideas to contemporary debates about the use of sound in art.

Two approaches to contemporary art and art criticism influenced my strategy of making use of existing artefacts and presenting, reflecting on and re-configuring constituent elements of my own work. In his publication *Postproduction* Nicolas Bourriaud identifies the DJ and programmer as icons of a “new cultural landscape” characterised by the sampling, re-editing and recycling of existing cultural forms (2002a, 7). He suggests that this new situation coincides with a “profound transformation” of the status of art, which evolves from its traditional role as “receptacle of the artist’s vision” marking the end point of the creative process, to a stimulus for activity comparable to a musical score, blurring distinctions between reception and practice (2002a, 14). There are limits to how far I feel it is possible to use Bourriaud’s position to illuminate my practice,¹⁶ but the general premise that the meaning of existing artefacts, artworks and theories can be mobilised by new frames of reference is adopted throughout this thesis.

The strategy of re-thinking my work from different perspectives was also informed by Jane Rendell’s concept of “site-writing” (2010, 18). Rendell addresses the spatial terms of reference that relate the critic to the work (of art or theory). Rather than considering the work as being “under” critique, she

¹² See p. 5 for a list of events/exhibitions, dates and venues.

¹³ “John Cage appears throughout the book and is the subject of an entire section. He would occupy a central position within any discussion of sound art in this century because of the importance and influence across the arts of his music, writings and ideas about sound throughout his long and prolific career” (Kahn, 2001a, 13).

¹⁴ “Sound art’s roots can be found in the experimental work of Italian Futurism, Dada, and later the Fluxus group in the early to mid-twentieth century. Perhaps the greatest advance in the genre, however, came with the work of the American composer and artist John Cage in the 1960s” (Licht, 2007, book jacket).

¹⁵ “[The first section] begins with manifestos by two of the most referenced figures in the field of an expanded musical practice, Luigi Russolo and John Cage. [...] Another significant figure is the French composer and musicologist Pierre Schaeffer [...]” (Kelley, 2011, 15).

¹⁶ I use Bishop’s critique of Bourriaud to highlight these limitations pp. 80-81, 92.

proposes writing from alternative positions such as those that relate the critic “to” the work or that “use” the work (2010, 7, 20). In exploring multiple spatial configurations of the critic-work relationship Rendell challenges the assumption that knowledge is generated from a critical distance: an isolated, stationary point of view situated in the eternal present. The insight I gleaned from Rendell’s approach was to embrace opportunities to reconsider the subject and form of my work through different circumstances, and to reflect on the varied ways in which the work has been arranged and encountered. In doing so I draw from my own accounts and experiences, as well as those of other people.

Resonating bodies

A latent interest in my earlier work was how sound appeared to animate things and I started my research by addressing this notion specifically. I began by thinking and working on a small scale, asking why sounding objects seemed to project a more dynamic or life-like character than silent ones. One of the ways in which I explored this idea was to play sound into household objects with a sine tone generator and small loudspeaker.¹⁷ Holding the speaker above the bowl of a wine glass and raising and lowering the pitch of the sine tone, I noticed that the glass seemed to amplify some pitches more than others. After testing the sound of the glass by tapping it, I found that the sine tones closest in pitch to the sound of the glass tended to provoke the loudest response from it. I was intrigued by this subtle sonic reaction and how it seemed to bring the glass to life: it appeared to sound of its own accord as if it could hear itself.

The harmonic phenomenon of resonance¹⁸ and the practice of resonating bodies became the focus of my research. I developed installations and performances that used sound to re-sound bodies. The ambiguous term “bodies” in the title of this thesis refers to sonorous objects such as acoustic instruments used in my work. It also alludes to the human bodies implicated in the production and reception of sound. My interest in resonance is as an agent of exchange, moving across the tangible and ephemeral, suggesting correspondences between the material and audible, and challenging distinctions between the sentient and insensible.

Outline of chapters

The three chapters are structured chronologically according to seven key artworks I developed¹⁹ as case studies during the course of my research. Short introductions to the case studies are given at the start of each chapter. The issues presented by the case studies are then considered in relation to relevant aesthetic and historical topics, including my interpretation of work by other artists. Along with resonance, notions of voice, presence, absence, authorial intention and audience participation emerge as dominant concerns explored through all the chapters. The various iterations of the case studies and responses from people who experienced them are reflected on in the final section of each chapter.

Chapter 1: The Influence of Sound begins by introducing the first and second case studies, both named *Lenses* (2008). One is a sound installation and the other a performance. Both versions of *Lenses*

¹⁷ This exploration is discussed again on p. 29.

¹⁸ See p. 16 for an introduction to sympathetic resonance and why it is used in my work.

¹⁹ All of the case studies are new artworks I developed during the course of my research with the exception of David Tudor’s *Rainforest IV* (1973) which I helped to re-create in Peckham, London, July 2009.

use electronically reproduced sound to resonate a collection of wine glasses. After considering the phenomenon of acoustic resonance and how it compares to notions of voice and sound in general, the main body of the opening section focuses on ideas about how sound might physically affect listening bodies, and how different sonic sensibilities are reflected in the waxing and waning popularity of the musical glasses²⁰ over the course of the eighteenth and early nineteenth centuries. One core issue that unites the material in this chapter is the question of how the imagination might be harnessed to heighten the senses.

Chapter 2: Voicing and Vivifying uses *Carillon* (2008-9) a performance with “guitar-cymbals”²¹ as the third case study. This section surveys how sound has been employed along with electricity to animate physical bodies, modelling the enigmatic processes of biological vitality and sentience. It considers the impact of Chladni’s sound figures (*Klangfiguren*) and the practice of galvanism on intellectual discourse involving Johann Wolfgang von Goethe and Ritter. It traces the themes and concerns of this discourse through to an interpretation of the fourth case study, David Tudor’s sonic environment *Rainforest IV* (1973)²² which I helped to construct and perform a version of in Peckham, London (2009).²³

Chapter 3: Enlightened Ears reflects on the fifth, sixth and seventh case studies which all incorporate *Listening Glasses*: models of acoustic tools named Helmholtz resonators originally used for the scientific analysis of sound. I produced a new series of differently tuned glasses in 2009 and used them to listen to ambient sound. This final chapter explores the insight the glasses can offer into the processes of listening and hearing, and how distinctions between music and noise are made. The theories and practices of scientist Hermann von Helmholtz and acoustic ecologist R. Murray Schafer are used to trace the shifting territories of music and noise and to survey how listening can be employed to enchant or disenchant us with the sound of our environment.

The **Conclusion** draws together key concerns that have been raised through the different case studies, highlights the relationship between research and practice in my work and outlines the core principles I have consolidated throughout this thesis which continue to define my position as an artist.

²⁰ This instrument (and family of instruments) is introduced on p. 18.

²¹ For an explanation of how the “guitar-cymbal” is constructed see p. 37.

²² For more on *Rainforest IV* (1973) see pp. 37, 46.

²³ For dates and venue details see p. 5.

1. The Influence of Sound

Case study 1: Lenses (2008)

Sound installation, duration 15-55min

Lenses is a multi-speaker installation conceived for realisation in “white cube” art gallery spaces. It uses a range of wine glasses as “lenses” to modify sound. The glasses are collected from thrift shops, friends and pubs. They are arranged into a group of between twelve and twenty-four (depending on the size of the exhibition space). Each glass must be a different pitch from the others, and during the selection process the glasses are organised in descending order according to their pitch. Each glass is sounded by rubbing a moist finger around the rim²⁴ for approximately twenty seconds, and recorded with a stereo microphone positioned just above the bowl of the glass. The glasses are then arranged in a pattern across a wall. Small speakers hang over the rims, outside the bowls of the glasses. A soundtrack compiled from the recordings plays through every speaker, but each glass resonates²⁵ most powerfully in response to the recording of its own signature sound, which it gently modifies through acoustic amplification. The composition of the soundtrack is based on a grid-like score, which follows a “change ringing” technique devised by English church bell-ringers.²⁶ Directional lighting is used to create shadows of the glasses against the wall.

Case study 2: Lenses (2008)

Live performance, duration 15min

This performance, like the *Lenses* installation, uses a range of wine glasses to modify sound. It was commissioned for 176 Zabłudowicz Collection, a contemporary gallery in a former Methodist church. Jane Dickson, Mel Gough and myself perform the work. We each stand in front of a table of wine glasses. Opposite us on a balcony are three white columns (one facing each player). On each column a set of wine glasses has been mounted, each with a speaker hanging over the rim. The glasses on the players’ tables have been tuned with water to match the pitch of the glasses on the columns. The players rub the rims of the glasses to sound them, following a grid-like score. A contact microphone on the players’ tables picks up the sound of their glasses and plays it out of the loudspeakers on the column. Because of the tuning, the glasses on the column are encouraged to resonate in response to the sound from the loudspeakers. Directional lighting is used to create shadows around the glasses and players.

²⁴ The “stick-slip” method is explained in more detail on p. 17.

²⁵ For an introduction to sympathetic resonance see p. 16.

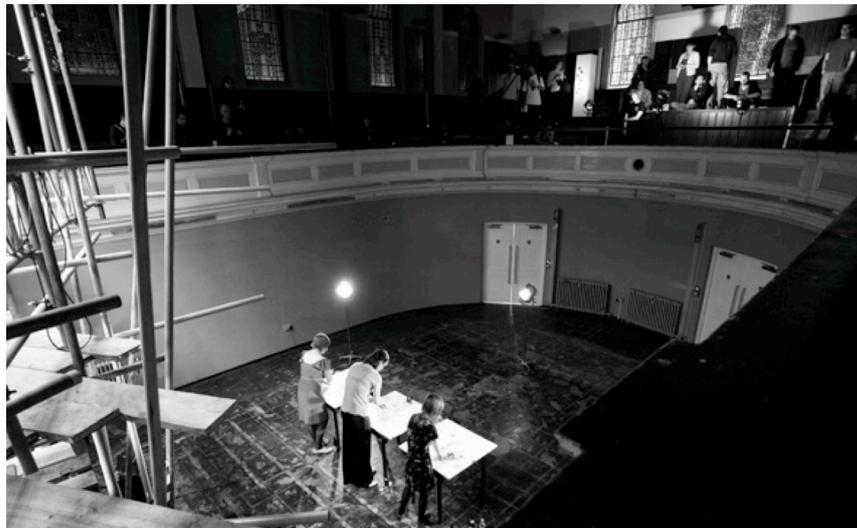
²⁶ “Change ringing” is explained in more detail on p. 32.



1



2



3

Figure 1. *Lenses* installation, quartier21/MuseumsQuartier, Vienna, Austria. Photo: Dawn Scarfe 2010.
 Figure 2. *Lenses* performance, 176 Zabłudowicz Collection, London. Photo: Justin Beber 2008.
 Figure 3. *Lenses* performance, 176 Zabłudowicz Collection, London. Photo: Justin Beber 2008.

Bodies and sound

What could be the motivation for attempting to force a sound back into its issuing body? *Lenses* presents different kinds of phenomena, solid objects including glasses and loudspeakers, and more ephemeral qualities such as sound (reproduced by loudspeakers and acoustically amplified by glasses) and light (spotlights reflected through glasses). It is my intention in *Lenses* and in this first chapter to explore the sympathies we infer between sound and material objects, asking:

Might residues of the concrete properties of sounding materials (their shape, thickness, smoothness, volume, density) be heard in their sound?

How does what we hear relate to the phenomena being sounded?

What is the role of our imagination in the act of perceiving?

Sound is generally referred to as an attribute of objects, but it might more accurately be described as an event or process, as Steven Connor suggests:

[D]espite all our instincts to the contrary, there are no sound objects. We say, hearing a sound, that is a siren, or, that is the sea, but objects are only the occasions for sound, never their origins. And there is no sound that is the sound of one object alone. All sounds are the result of collisions, abrasions, impingements or minglings of objects. ([2005] 2011, 135)

This is the paradox of sound, an immaterial phenomenon usually spoken of in terms of physical objects or concepts. Perhaps because of this tendency to speak of sound as matter, studies of sound tend to emphasise its disembodied nature. Peter Szendy describes sound as the “oscillation by which matter severs itself from its materiality” (2008b). Helmholtz explains it in terms of “undulatory motions” and “gentle blows” proceeding from vibrating bodies, usually conducted to our ear through the atmosphere ([1877] 1954, 9, 36).

To describe how sound seems to move through the air, Connor offers the metaphor that sound “spreads and leaks, like odour” ([2005] 2011, 129). For an odour to reach our nose however, molecules from a fragrant body travel through the air to meet it.²⁷ Helmholtz feels it is important to recognise that sound propagates differently to odour. No particle is shed from a sounding body to touch our ear directly:

[I]n daily experience sound at first seems to be some agent, which is constantly advancing through the air, and propagating itself further and further. We must, however, here distinguish between the motion of individual particles of air—which takes place periodically backwards and forwards within very narrow limits—and the propagation of the sonorous tremor. The latter is constantly advancing by the constant attraction of fresh particles into the sphere of tremor [...] Round the spot struck there forms a little ring of wave, which, advancing equally in all directions, expands to a constantly increasing circle [...]. (1954, 9)

²⁷ The air “allows us to smell, as the molecules that excite our olfactory receptors are diffused in it” (Ingold, 2011, 22).

Following Helmholtz then, sound is clearly something other than the trembling bodies that produce it. Jonathan Sterne recognised that Helmholtz's work posited sound as an "effect that can be reproduced, rather than something that is tethered to a specific and local cause" (2003, 65).²⁸ How are we to reconcile this technical understanding of sound with our sense of its tangible material causes? And what about that specific instance of sound, the voice?

Like sounds, voices are understood to emanate from bodies. What distinguishes the notion of voice from a more general conception of sound is often described in terms of a "grain" from the issuing body, as in Roland Barthes' frequently cited notion of the "grain of the voice:"

[I]ts aim is not the clarity of messages ... [but rather, it searches for] the pulsional incidents, the language lined with flesh, a text where we can hear the grain of the throat, the patina of the consonants, the voluptuousness of the vowels, a whole carnal stereophony: the articulation of the body [...]. (1976, 66)

Machines, musical instruments and other non-human things are also said to have voices that contain traits of their physical bodies:

The desire for sound reproducing devices to capture the true world as it was and transmit it perfectly was, thus, tempered by the knowledge that the apparatus had its own grain; the supposedly mute machines had many voices of their own. (Sterne, 2003, 274)

The use of the term "grain" indicates that the voice appears to contain palpable impressions, traces even, of its bodily source. Moreover, the voice would seem to communicate something of the presentness and proximity of the body, as Connor suggests: "the voice is at once immaterial—it is energy and not substance—and full of the sense of the body's presence (its warmth, elasticity and sensitivity)" (2000, 41). However, at the same time the dispersal of the voice signals its expulsion and otherness from the body. Connor likens the voice to the navel as "the enactment both of severance and continuity between self and other" (2000, 388). He uses the term "split condition" to describe this ambiguous nature of the voice, and cites the discomfort people can experience in listening to their own recorded voice as its commonest proof (2000, 7).

The effects of sound reproducing devices are often expressed in ominous language. Connor suggests that they pose a "decorporealizing threat" (2000, 388). In 1969²⁹ Schafer coined the deliberately provocative term "schizophonia" to dramatise the "aberrational effect" he identified in the "split between an original sound and its electroacoustic reproduction" (1977, 273). So what is it about this technology that serves to highlight and extend the already disembodied nature of sound and the voice in particular?

From Schafer's perspective, acoustic, or in his terms "original sounds" are "tied to the mechanisms that produce them" in specific times and places, whereas reproduced sounds are "copies" that can be

²⁸ See p. 62 for a longer discussion of the implications of understanding sound as a reproducible effect.

²⁹ I use the second edition of *The New Soundscape* (1974). The first edition (in which the term "schizophonia" was introduced) was published in 1969. For more on schizophonia see p. 71.

restated in entirely new contexts (1977, 273). As isolated fragments, recorded sounds can be repeated at varying volumes and in all manner of places, re-routed through surrogate bodies.³⁰ Schafer's anxiety arises from the notion that recorded sounds lose their proximity to the bodies that gave rise to them and the specific moment in time they were produced. He claims that through sound reproduction, "the binding relationship between a sound and a person making it has been dissolved" and as a result, the capacity of listeners to "feel" sound within their own bodies is diminished (1974, 47). He argues that, prior to the possibility of sound reproduction, there was a "correspondence between the physiological activity of producing a sound and the psychological qualities we attribute to it." He continues:

I would say this has helped us to feel into the depths of sounds with our muscles and nerves. And since we produce these sounds with our bodies we have an instinctive sympathetic feeling when others produce them [...]. Today there is no relationship between turning the volume dial on your radio up or down and the state of affairs that results. (1974, 47)

For Schafer then, sounds are "torn"³¹ from the living bodies that issued them through the process of recoding and reproduction, and this rupture threatens to impoverish our experience of sound. Sterne³² identifies a tendency, most acute in early users of sound recording technology, to regard the reproduced voice as a "resonant tomb, offering the exteriority of the voice with none of its interior self-awareness" (2003, 290).

What happens then if we sound an object, record the sound, and play it back into the object with a loudspeaker? Would this overcome or exacerbate the "decorporealizing threat"³³ of the technology? One effect I observed when performing this exercise with a wine glass was that the glass would resonate in response to its recorded sound.³⁴ I became interested in whether resonance could evoke something of an "interior self-awareness"³⁵ in the sounding body that Sterne links to the notion of the unmediated voice.

Helmholtz describes resonance in vocal terms. In the second edition of his major study on acoustics he uses *Mittönen*³⁶ to denote resonance and explains that it arises when the oscillations of one sounding body "call into action"³⁷ the oscillations of another (1865, 61). The phrase "call into action" suggests a form of acoustic communication is taking place. If we were to witness one body sounding in response to the call of another, we might presume that the two were engaging in a form of conversation. In this way resonance could be understood to link sound to vocal qualities and imply sentience.

³⁰ Schafer declares: "Modern life has been ventriloquised" through sound reproduction technology (1974, 44).

³¹ Schafer suggests that in the process of recording sounds are "torn from their natural sockets" (1974, 44).

³² For Sterne's criticism of Schafer's valorisation of live, unmediated sound see p. 71.

³³ Connor (2000, 388) first cited p. 15.

³⁴ I describe the context of this experiment in more detail on p. 29.

³⁵ Sterne (2003, 290) first cited in previous paragraph.

³⁶ Interestingly, the term is comprised of the words "with sound": *mit* [with] *tönen* [sound].

³⁷ Helmholtz uses the verb *rufen* [to call] (1865, 61). For Alexander Ellis' translation "call into action" see (1954, 36).

Resonance occurs when a sound and sounding body oscillate at the same (or very similar) frequencies.³⁸ This condition extends the notion of call and response, and connotes accord or agreement between sound and the resonating body. In the second English edition of Helmholtz's work, Alexander Ellis translates *Mittönen* as "sympathetic resonance." By association with the word sympathetic, resonance would seem to speak to us, (at least as a metaphor for) common feeling between two sentient beings. Jean-Luc Nancy takes this sentiment further by linking resonance to consciousness, comparing the re-sounding that occurs in resonance to perception, in the sense that both involve a "return to self":

"Self" is never anything but *to self, in self or for self*: it is never anything but a return, a reminder, a relationship, a transfer, and at the bottom of all this reversion an original generative repetition by which the *to self* occurs. [...] Resonance is inside of the sound itself: a sound is its own echo chamber, just as it is its own timbre, its overtones and what is called its colour. [...] A sonorous body that is struck *returns* the blow by the sound that is the vibration of the blow itself. Sound is at the same time *struck* (pinched, rubbed, breathed, etc.), *returned* and *heard* [...] it makes itself heard [...] it *listens to itself*. (Nancy, 2008, x)

The idea that a resonant body listens to itself, once again, implies sentience. Such associations of resonating bodies which relate to concepts of voice, sensation, and other characteristics of living beings are explored in *Lenses* and through the subsequent case studies that structure this thesis. Can resonance be understood to bring matter to life? Or might our experience of resonating bodies point us towards the dynamic nature of the world we live in? Tim Ingold suggests that it is important to distinguish between these two positions: "Bringing things to life, [...] is a matter not of adding to them a sprinkling of agency but of restoring them to the generative fluxes of the world [...] in which they came into being and continue to subsist" (2011, 29). I feel that the latter approach is a more fitting reflection of how (and why) resonance is brought into play in my work and throughout this thesis.

Musical glasses

[I]f you strike strait across the Glass, it occasions an [*sic*] harsh and unpleasing Tone [...]. In order to produce the Tone clearly and properly from the smaller treble Glasses, the Ball of the middle Fingers, or the prominent Part between the first and second Joint, being wet, must be flatly, and regularly moved, in a circular Motion, on the Top of the Glasses [...]. (Ford, 1761 in King, 1945-6, 104)

I think there is something very charming about the sound of glass vessels played by the fingers, as instructed by Anne Ford (above) in one of the first published guides to playing the musical glasses (King, 1945-6, 103). This action is known as the "stick-slip" method, because at the point of contact the glass rim moves with the finger, before slipping back into its original position (Rossing, 2000, 186). Bowed strings (on instruments such as the violin) act in a similar manner, sticking and slipping

³⁸ A body might also resonate in response to frequencies that are close to its own, as explained by the following definition of resonance: "As the frequency of the stimulus [sound] closely approaches that of the system [body], oscillation occurs, which reaches a maximum amplitude at the natural resonant frequency" Truax, 1999: *Handbook for Acoustic Ecology* <<http://www.sfu.ca/sonic-studio/handbook/Resonance.html>> accessed 7th August 2011.

as bow moves across them.³⁹ In my experience, playing wine glasses in this way can provoke curious reactions from observers. Whilst testing out the sounds of different glasses in a second-hand shop⁴⁰ on the Chatsworth Road in east London, one of the attendants asked me how I was making the “magic” sound, and suggested that I visit again to bring them good luck. The sound is often described in unearthly terms such as “ethereal tinkles” (Khazam, 2011a, 71).⁴¹ I began my thesis with the intention of exploring the qualities attributed to sound, and I was intrigued by the way in which the sound of rubbed glass could consistently evoke mysterious, airy substances and dreamlike states.

I began to collect accounts describing the sound of glass instruments⁴² played with the stick-slip method. I included references to three different types of instrument from the same family: the musical glasses (also named the glass harp), the armonica, (sometimes called the glass harmonica) and the verrophone (see Figures 4 and 5).⁴³ What connects these instruments is that each is usually sounded by moistened fingers moving over the round rims of a series of open-ended glass vessels. As a result, all three instruments tend to produce a similar quality of sound. The musical glasses are collections of glass vessels arranged according to pitch. The glasses are either of different sizes or tuned with water, and usually fixed to a table. The armonica, invented by Benjamin Franklin in 1761,⁴⁴ consists of a series of tuned glass goblets fixed on a spindle, which is rotated by a foot pedal. The glass verrophone invented in 1983 by Sascha Reckert,⁴⁵ is made of different lengths of open-ended glass cylinders. In the following section, I use the general term “musical glasses” to describe this family of instruments and the quality of sound they share.

Gerald and Christa Schönfeldinger of the Wiener Glasharmonika Duo regularly perform in mainland Europe on all three instruments. Recent press reviews on their website attribute fantastical qualities to their sound:

[T]wo glass music artists announced the performance of an eerie eventide dance, and it became apparent that old glass instruments can also produce modern fantasies. (Sächsische Zeitung)

[T]he atmosphere was mysterious and ungraspable, almost otherworldly, filled with dreamlike shadings. A major, absolutely compelling success! (Kronezeitung)

Whatever the Schönfeldingers play -and they do so with glittering perfection -the hearers are filled with a sense of joy both earthly and ethereal. (Nordbayrischer Kurier)⁴⁶

³⁹ Both processes are explained in greater detail by Rossing (2000, 186).

⁴⁰ Un-named second-hand shop, 32 Chatsworth Road, London, E5 0LP.

⁴¹ Rahma Khazam uses the term “ethereal tinkles” to describe the sound of *Lenses* (2011a, 71).

⁴² For an indication of the variety of glass musical instruments invented, see Rossing (2000, 182-191).

⁴³ p. 19.

⁴⁴ King acknowledges that the precise date of the invention has been contested, but suggests 1761 as the most reasonable estimate (1945-6, 107).

⁴⁵ Reckert is also credited with being a “current-day builder of glass armonicars” in ‘About the Instruments: Verrophone,’ *Wiener Glasharmonika Duo* <http://www.glasharmonika.at/html/e_instrumente_ver.htm> accessed 21st February 2011.

⁴⁶ All quotes taken from the *Wiener Glasharmonika Duo* website: <http://glasharmonika.at/html/e_presse.htm> accessed 12th September 2010.



4



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Figure 4. Wiener Glasharmonika Duo. Right, Christa Schönfeldinger on the Armonica. Left, Gerald Schönfeldinger on the verrophone <http://www.oho.at/upload/images/70791_glasharmonika-duo-07.jpg> accessed 19th August 2011.

Figure 5. Anna and Arkadiusz Szafraniec, Glass Duo (Poland) on the musical glasses <http://www.austinpolsishsociety.org/images/musical_glasses.jpg> accessed 19th August 2011.

I attended one of the duo's concerts at the opulent Schloss Halbturn in Burgenland, Austria⁴⁷ and found the experience both surreal and captivating. The performance room had intricately decorated white walls, mirrors and tall windows with a view to manicured gardens outside. The programme combined music written or adapted for the glass instruments such as Edvard Greig's *Småtroll (Puck, 1901)*⁴⁸ with readings such as 'Dedication' from Goethe's *Faust* (1808).⁴⁹ The references to magic spells, moonlit nights and phantoms emerging from the mist created a mysterious atmosphere, which the sound of the armonica and verrophone seemed to heighten.

Although the musical glasses and glass harmonica continue to be performed, historical studies by Alec Hyatt King (1945-6) and Heather Hadlock (2000) suggest that the instruments reached the height of their popularity and notoriety in the late eighteenth and early nineteenth centuries. King himself seemed enchanted with the sound of the musical glasses. He claimed to have been held "spell-bound" at a concert of the (again) "ethereal" music and described the sound of the instrument in terms of its "pure, thrilling tones" (1945-6, 119-20, 111). The accounts he collects from the late eighteenth century reflect on the mysterious and airy nature of the sound in more dramatic terms:

[T]he Tones of the MUSICAL GLASSES are, from their Similitude, more like the human Voice, than any musical Instrument [...] and perhaps, the only [...] from which you hear the Effect without cause. (Ford, 1761 in King, 1945-6, 105)

No instrument that I know has so celestial a tone. I thought it was a cherubim in a box. (Gray, 1761 in King, 1945-6, 106)

King makes the assertion that romantic poets such as Goethe and Schiller found profound meaning in the tones of the glass harmonica:

The long-drawn and delicately exciting sound, seeming to emerge from infinite space may almost have been said to anticipate part of the romantic ideal. [...] In its sustained tones Goethe detected *das Herzblut der Welt* [the lifeblood of the world]. (1945-6, 114)

If the reflections of Karl Leopold Röllig are to be believed, the effects of the instrument were both fantastic and dangerous:

Its tones could reconcile quarrelling friends; restore fainting men to consciousness; make women faint; send a dog into convulsions; make a sleeping girl wake screaming through a chord of the diminished seventh, and even cause the death of one very young. (Röllig, 1797 in King, 1945-6, 114)⁵⁰

King reported that the glass harmonica had been banned by the police in a number of German towns due to concerns about its unusual and sometimes harmful effects (1945-6, 114). He

⁴⁷ The particular programme was 'Goethe & Humoristisches' performed at Schloss Halbturn in Burgenland, Austria 7th August 2010.

⁴⁸ Quoted in the programme as *Smartrold - Der Kobold* [the Goblin], adapted by the Schönfeldingers from Grieg's *Lyric Pieces* (7) for piano, Book 10, Op. 71 No 3.

⁴⁹ The reading was in German. For an English version of the first paragraph of 'Dedication' see Appendix 1 p. 99.

⁵⁰ First published under Röllig, Karl Leopold 1787: *Über die Harmonika, ein Fragment* (Berlin).

added that the instrument was believed to have ruined the nerves of a number of prominent players such as Marianne Davies.⁵¹ In an effort to pin down the cause of these reputed ill effects, Kurt Sachs theorised that the “irritating permanence of extremely high partials”⁵² and the “continuous contact of sensitive fingers with the vibrating bowls” could have a “deranging effect on the nerves of the player” (Sachs, 1943 in King 1945-6, 114). As a result, in the late eighteenth century, attempts were made to engineer bows and pads to play the glasses,⁵³ but King judges that these failed to produce the same quality of sound achieved with the fingers:

[T]he peculiarly piercing sweetness of the harmonica did depend on [the] direct contact and varying pressure [of the fingers], for which no mechanical substitute was really adequate, even though it made for easier execution. (1945-6, 115)

What I find compelling about this statement, and the supposed cause of the instrument’s ill effects, is that the allure of the sound is linked to the manner in which it was evoked: the contact of the player’s fingertips on the edges of the vibrating glasses. Franklin identifies the role of touch in producing the unique tones of the glass harmonica:

[I]ts tones are incomparably sweet beyond those of any other; that they may be swelled and softened at pleasure by stronger or weaker pressures of the finger [...]. (Franklin [1762] 1838, 250)

Hadlock affirms that touch was an important aspect of the glass harmonica’s sound. However she suggests that it did not simply convey a sense of touch but rather the simultaneous presence and absence of the player’s finger:

[U]nder each note one hears the pull and scrape of a finger stroke against the glass disk. More precisely, one could say that the sound breaks down into two constituent parts, with the scrape “underneath” and the pure sound “above,” as each tone separates into material trace and abstract tone. [...] Only the soprano register escapes the percussive undertone, sounding clear and flutelike. Thus the armonica is not simply “bodiless”; rather it makes audible the process of spirit transcending body, the sublimation of rough, corporealized sound into ideal (feminine) voice. (2000, 510)

There are two elements in this statement that are pertinent to my work with musical glasses. The first is the assertion of a “solid link” between the sound of the glass harmonica and notions of female musicianship. Hadlock claims that the glass harmonica was “represented as a ‘sister’ and even as a physical extension of the woman performer” (2000, 508). She believes that it was regarded as the perfect instrument for women to play as it required restraint rather than virtuosity, promoted a certain poise and delicacy deemed ladylike, and its modest volume was suited to domestic contexts:

⁵¹ According to King, Davies won great renown touring Europe with the armonica between 1768-71. He asserts that it was “well established” that the instrument “ruined” her nerves (1945-6, 109, 114).

⁵² “Partial” tones are discussed in more detail on p. 60.

⁵³ King suggests that experimenters included Mazzuchi (who employed bows) and Frick (who used pads) (1945-6, 115).

[T]he armonica, requiring the most minimal motion, promised pure sound that would call attention neither to the sonorous material nor to the body that acts upon it. The erasure of both performer and instrument made this the ideal medium for women's music. (2000, 509)⁵⁴

These notions of female musicianship are discussed in the latter part of this chapter in relation to my performances with Mel Gough and Jane Dickson.⁵⁵ The other issue Hadlock raises in her analysis is that the sound of rubbed glass alludes to both the presence and absence of the performer. She perceives an audible trace of the player in the "scraping" sound caused by the finger on the edge of the glass, distinct from the "pure" tone produced by the resonating glass. *Lenses* explores the simultaneous presence and absence of the player in the sound of rubbed glass.⁵⁶

Returning to the reputed effects of the sound of the musical glasses, which include its capacity to induce varied mental states of ecstasy, serenity and neurosis, I want to explore how this sound was thought to be sensed by the listeners at the time. I am interested in the idea that listeners were somehow arrested by the sound, as if it acted on their senses in a way they were helpless to control. I will survey the work of German physician Franz Anton Mesmer (1734-1815) to gain insight into prevailing notions of sensation and sensibility through the period in which the glasses were supposed to have their most outlandish consequences, in the eighteenth and early nineteenth centuries.

Mesmerism

Mesmer was a keen player of the glass harmonica,⁵⁷ but he is remembered primarily for his controversial therapeutic practice. He attempted to tackle various disorders including amaurosis⁵⁸ by manipulating a mysterious ethereal "fluid" named "animal magnetism" (Mesmer, 1779).⁵⁹ Mesmer believed that this universal substance ebbed and flowed⁶⁰ between cosmic and human bodies. He claimed that it had a direct and immediate influence on the nerves,⁶¹ and that ill health resulted from the disruption of its regular circulation through the body.⁶² Riskin suggests that Mesmer understood the magnetic fluid to be the "medium of sensibility" (2002, 209), conveyed into the body from the surrounding world.

Mesmer aimed to restore the health and wellbeing of his afflicted patients by channelling the flow of animal magnetism through their bodies using the touch of his hands and metal rods such as the "mesmeric wand" (Riskin, 2002, 201). During a mesmeric exchange, the magnetic "currents" flowing through Mesmer's body and that of his patients were supposedly combined in a "harmonic manner" (Stafford, 1991, 454). The implication here is that the bodies oscillate in unison like sympathetically

⁵⁴ Hadlock explains how the armonica was hailed as a "supremely feminine" instrument and that its "sweet" and "modest" tones inspired analogies with female voices and souls (2000, 509-538).

⁵⁵ See p. 35.

⁵⁶ See pp. 29, 34.

⁵⁷ See Kerner (1856, 202-3) and Appendix 2, p. 99.

⁵⁸ My translation, cited as *goutte-sereine* in Mesmer (1779, 40).

⁵⁹ *Magnétisme Animal* in Mesmer (1779).

⁶⁰ *Flux & reflux* in Mesmer (1779, 6).

⁶¹ In Mesmer: "[...] s'insinuant dans la substance des nerfs, qu'il les affecte immédiatement" (1779, 76).

⁶² Mesmer claimed that Maria-Theresia von Paradis suffered from a blockage in the flow of magnetic fluid through her head, which caused her blindness. See Riskin (2002, 40).

resonating⁶³ instruments. However this was not a gentle or relaxing process. Patients were put into a state of crisis, described as “an emotional escalation often resembling a fit, with limbs shaking and fainting, which sometimes forced the removal of a patient to a padded room until he or she calmed down” (Gallo and Finger, 2000, 337).

Mesmer compared the attracting and repelling powers of the magnetic fluid to the more familiar physical effects of electric charges and magnetic poles.⁶⁴ He believed that the fluid could travel through a vacuum⁶⁵ and influence materials as well as animate bodies. He proposed that it could be “intensified and reflected by mirrors, like light” and “communicated, propagated and intensified by sound” (1779, 78).⁶⁶ An extraordinary talent attributed to Mesmer was that he could stream the fluid directly “from his finger and [direct it into] the body of any person without being obstructed by walls or any other obstacles” (Lopez, 1988 in Gallo and Finger, 2000, 337).

As both the fingers and sound were understood to direct and facilitate the flow of animal magnetism, it should perhaps not be surprising that Mesmer incorporated the sound of the glass harmonica into his therapeutic sessions. By some accounts it was used as little more than background music, played from a distant room in order to introduce a relaxed atmosphere. King claimed there could be “little doubt that Mesmer used his mastery of the highly emotional tones of the harmonica to induce a receptive state into his patients” (1945-6, 110).⁶⁷ However, a report from Dr. Le Roux suggests that the instrument was employed to administer Mesmer’s treatment directly:

After several turns around the room, Mr. Mesmer unbuttoned the patient's shirt and, moving back somewhat, placed his finger against the part affected. My friend felt a tickling pain. Mr. Mesmer then moved his finger perpendicularly across his abdomen and chest, and the pain followed the finger exactly. He then asked the patient to extend his index finger and pointed his own finger toward it at a distance of three or four steps, whereupon my friend felt an electric tingling at the tip of his finger, which penetrated the whole finger toward the palm. Mr. Mesmer then seated him near the harmonica; he had hardly begun to play when my friend was affected emotionally, trembled, lost his breath, changed color [*sic*], and felt pulled toward the floor. (Dr. Le Roux, 1778-9 in Gallo and Finger, 2000, 337)

This particular anecdote suggests a stronger link between the supposed “powers” of the sound of the musical glasses and animal magnetism, in that both are believed to touch the nerves directly, provoking an automatic response from listeners, as Hadlock proposes:

⁶³ For my introduction to the term sympathetic resonance see p. 16.

⁶⁴ “9°: Il se manifeste particulièrement dans le corps humain, des propriétés analogues à celles de l’Aimant; on y distingue des pôles également divers & opposés, qui peuvent être communiqués, changés, détruits & renforcés [...]” (Mesmer, 1779, 76).

⁶⁵ “2°: [...]Je souffrir aucun vuide [...]. 14°: Son action a lieu à une distance éloignée, sans le secours d’aucun corps intermédiaire” (Mesmer, 1779, 74, 78).

⁶⁶ “15°: Elle est augmentée & réfléchie par les glaces, comme la lumière. 16°: Elle est communiquée, propagée & augmentée par le son” (Mesmer, 1779, 78).

⁶⁷ Similarly, Hadlock suggests that the armonica’s sound “made patients more receptive to magnetic treatment and actually stirred up the atmosphere, making it more conductive” (2000, 529).

Like the armonica's music, the Mesmerist seemed to touch directly on the nerves, provoking a physical response (screams, fits, etc.) with barely perceptible gestures and distant passes. (2000, 529)

Mesmer was a notorious figure with as many detractors as admirers. He had been forced to flee Vienna in a scandal over the legitimacy of his practice, and after settling in Paris the French government appointed a royal commission (including Franklin, the inventor of the glass harmonica) to examine whether Mesmer's treatments were genuinely effective (Riskin, 2002, 209). In 1784 it concluded that any supposedly beneficial effects associated with Mesmer's methods had nothing to do with his manipulation of animal magnetism. It asserted that the ethereal fluid did not exist and that the spectacularly dramatic convulsions and blackouts his clients often exhibited were aroused through powers of suggestion, or more precisely, through Mesmer's ability to engage the imagination of his patients (Riskin, 2002, 220). Following this indictment Mesmer was forced into exile and obscurity.

Riskin emphasises the significance of the ruling. She suggests that it highlights "the prior elevation of feeling as the basis of both natural knowledge and social union" which defined the "age of sensibility" (2002, 190). She describes how the excessive outpouring of emotion Mesmer encouraged was premised on an assumed immediate connection between mind and world and "the ultimate authority of feeling" (2002, 209). Riskin argues that the commission's work undermined the prevailing principle that sensations issued in direct response to a world outside of the mind, proposing instead that sensations could be evoked through mental activity, and that people might be manipulated by charlatans such as Mesmer, with the capacity to charm their minds and deceive their senses (2002, 224).

Hadlock asserts that "the armonica came to be guilty by association with morally suspect mesmeric therapies" (2000, 534). However, she believes that the way the musical glasses fell out of favour over the same period as Mesmer's fall from grace could be seen as symptomatic of a broader shift in cultural beliefs and values. Hadlock suggests that the demise of the musical glasses reflected changing ideas about the aesthetic appreciation of music which took hold over the course of the Enlightenment. She argues the "very range, timbre, and tone quality" of the glass harmonica epitomised "the now-suspect feminine culture of sensibility against which musical Romanticism was defining itself" (2000, 538). Referring again to the sound of the instrument, Hadlock claims:

The immediacy of its effect on the listener—its ability to produce a spontaneous sensuous response—made it the perfect instrument for the "age of sensibility." Yet that same immediacy raised doubts about the intellectual and aesthetic status of the armonica's music, for its "automatic" effect on listeners could be discounted as a mere mechanical response to a physical stimulus. (2000, 509)

Hadlock cites Samuel Taylor Coleridge to evidence a growing aversion to the "immediacy" of the glass harmonica's sound:

The body of the sound ... or that effect which is derived from the materials, encroaches too far on the effect from the proportions of the notes, or that which is given to music by the mind. (Coleridge, 1809 in Hadlock, 2000, 537)

Here we have an assertion from Coleridge that the appreciation of music should be concerned with the relationships between the notes rather than the material or timbral characteristics of an instrument's sound. He makes the distinction that the "proportions of the notes" are given to music by the mind, so the suggestion is that "the body of the sound"—the qualities of its voice—are grasped by something other than this, perhaps the nerves and/or the unconscious. Coleridge feels that if the sense of the material is too prominent in the sound, it will inhibit the intellectual appreciation of the tonal structure of a musical work. This is the first example I will cite of a drive to separate musical concerns from acoustic or sonic ones. This thread will be explored later through Helmholtz's efforts to distinguish musical tones from noises⁶⁸ and Salomé Voegelin's attempts to listen to musical works "for the sound they make rather than their musical organization" (2010, 8).⁶⁹

Like Coleridge, Helmholtz took the view that the glass harmonica was not a "real musical instrument" ([1877] 1954, 289). He claimed the "glass harmonicon" was poorly suited to playing melodies because its sound was deficient in partial tones,⁷⁰ as opposed to the piano, which was rich in these sonic details and so had more body and depth to its sound. Helmholtz concluded that melodies rendered on instruments like the glass harmonica are "mere outlines [...] decidedly without the immediate impression on the senses which gives music its charm" (1954, 290).

According to Helmholtz then, the sound of musical glasses retained nothing of the immediate sensual and emotional force perceived by earlier generations of listeners. However I do not want to suggest that advances in the scientific understanding of sound directly influenced judgements about which instruments were deemed more suitable for the practice of music than others. I indicate in Chapter 3 that Helmholtz's disputed theory of hearing was unpopular with practising musicians of his day and served to complicate rather than simplify ideas about the role of body and mind in sensing and making sense of sound.⁷¹ What interests me is the notion that the glass harmonica could be so highly regarded in the eighteenth and early nineteenth centuries, and then fall into disrepute and relative obscurity. I am intrigued by the extent to which the qualities of the musical glasses could be said to reside in their sound, rather the imagination of the listener and the contexts in which they were employed.

Hörkur: Im Strom der Töne [Listening Treatment: In the Stream of Sounds]⁷²

On the 24th August 2010, I went to meet Gerald and Christa Schönfeldinger of the Wiener Glasharmonika Duo, who now live in a remote village in Burgenland, Austria. My aim was to find out more about their passion for glass instruments, discuss the possibility of working together at some point in the future, and to exchange ideas about the kind of music Mesmer might have played

⁶⁸ See Chapter 3 p. 57.

⁶⁹ See p. 91.

⁷⁰ See p. 60 for more on partial tones.

⁷¹ See p. 65.

⁷² My translation of the title of an email I received from the Schönfeldingers (dated 17th January 2011) announcing one of their first public healing sessions, held on the 5th March 2011 in Pottenstein, Austria.

on the glass harmonica.⁷³ I got the impression that the Schönfeldingers used their glass instruments for therapy sessions from browsing their website,⁷⁴ and I was curious to know what these sessions might entail. I didn't expect that they would offer to practise their *Hörkur* on me during my visit. When they did, I gladly, (if a little nervously) agreed to participate.

The Schönfeldingers have a diagram of different areas of the body, which they describe as operating "like chakras." They propose that these different regions of the body correspond to, and so can be manipulated by particular musical tones. So depending on the specific ailment of the patient, a musical tone is chosen for their treatment.⁷⁵ The duo follow guidance from Sonja Wittholm, a health and spiritual healing consultant,⁷⁶ and cite Mesmer as an inspiration for their practice.

The Schönfeldingers begin their sessions by asking participants (in this case just me) to sit on a chair, close their eyes, and relax. Christa and Gerald then take up their positions behind their respective instruments, the glass harmonica and verrophone. After a minute or so of silence they begin to play what they refer to as the "*Grund* [foundation] *tone g.*" This is sounded for about five minutes, sometimes in unison, sometimes at a different octave, tempo, and duration. Christa Schönfeldinger occasionally accompanies her playing with a very quiet, almost imperceptible singing at the same pitch.⁷⁷ Following the sounding of the *Grund tone* there is a long silence, which varies from one minute to over five minutes. The particular "healing" tone is played, again for about five minutes, then after another long silence, the *Grund tone* is sounded to end the session.

I was sceptical about the idea that there could be any automatic relationship between a particular musical tone and specific areas or organs of my body, and doubted that I could benefit from the session in the way that the Schönfeldingers intended. However, listening to them play one tone for a sustained period of time did have peculiar effects. Not really relaxing ones, or ones that I perceived to be affecting the desired region of my body. Towards the end of the *Grund tone* being played, and in the long silence that followed, I thought that I could feel a movement of the tone itself in the room, a reasonably slow oscillation (at the rate of relaxed breathing) from one side to the other. This was combined, once I had opened my eyes with some subtle effects on my vision, again a kind of slow oscillation in which the overall hue alternated between green and red. I also noticed a very low sound, perhaps a difference tone,⁷⁸ much lower than that which the Schönfeldingers had been

⁷³ Accounts of what Mesmer played on the glass harmonica are scarce. From Kerner (1856, 202-3), I gathered that Mesmer tended to play after dusk, improvising, and sometimes singing very quietly, see Appendix 2 p. 99 for the relevant extract in German.

⁷⁴ At the time of my visit the only indication of the *Hörkur* practice was a heading on the navigation bar of the Schönfeldingers' website entitled *GLAS UND THERAPIE*. This has since been expanded to a section named *HÖRKUR* complete with testimonials from participants under *Erfahrungsberichte* <<http://www.glasharmonika.at/html/seminar.htm>> accessed 13th May 2011.

⁷⁵ When asked whether I had any health problems, I replied that I had recently suffered from a bad back. The Schönfeldingers explained that they relied on Wittholm to advise them on the most appropriate tones to play for specific ailments, as at the time they were still relatively new to the practice and had not tried it on many people. In the absence of Wittholm's guidance they chose the tone *f* estimating that this corresponded to the approximate area of my lower back.

⁷⁶ Wittholm's practice encompasses *Seelenberatung* which translates literally as "soul consulting," but is perhaps better understood in terms of spiritual healing <<http://www.wittholm.info/>> accessed 13th February 2011.

⁷⁷ Christa Schönfeldinger told me that this technique was inspired by Mesmer's reputed tendency to accompany his glass harmonica playing with soft singing, as stated in Kerner (1856, 202-3) see Appendix 2, p. 99.

⁷⁸ "Difference Tone: When two tones are sounded simultaneously, other tones can sometimes be heard, the frequency of one of which is the difference between the frequencies of the two tones being sounded" Truax, 1999: *Handbook for Acoustic Ecology* <http://www.sfu.ca/sonic-studio/handbook/Difference_Tone.html> accessed 5th June 2010.

playing, which added to a feeling of pressure on both sides of my head, by the temples. Christa Schönfeldinger had warned me that the process could be “hard work” and I certainly felt strained by the end of it.

This was not the only time I had felt my senses responding strangely to sound. The first occasion I remember something similar happening was at a performance of Alvin Lucier’s *Wave Songs for Solo Soprano* (1997) at Tate Modern in 2005.⁷⁹ The programme notes describe the main concept of the piece: “the singer sings against the oscillator tones creating audible beats—bumps of sound as the sound waves coincide” (Open Sound Systems, 2005). In this instance I also experienced a kind of disorientating pulsing in my vision. I felt slightly anxious about this unexpected and involuntary response to the sound, which quickened my pulse and made me very conscious of my breathing.

On the rare occasions that sound arrests my body in such a way, it takes me by surprise as I have subjected myself to many sonic artworks over the years that have claimed to give rise to particular bodily effects, which I have either failed to perceive or have not felt significantly moved by. Kaffe Matthews’ *Sonic Bed Laboratory* (2005)⁸⁰ consisted of a mattress boxed in by vertical wooden panels around its edge. Twelve speakers were distributed through the bed, positioned under the mattress and in the panels at the side. The exhibition guide promised that visitors would become “physically affected” by the work, which used an “architectural map of the human body and the frequencies it is tuned to as its score” (Her Noise, 2005). A “bioresonance practitioner” had given Matthews “combinations of frequencies that are known to have particular effects [on the body] in certain combinations” (Matthews in Dzuverovic and Neset, 2005, 47). Matthews spoke about her fascination with the idea that each organ of the body could produce distinctive frequencies, referring to a healthy body as “harmonious” and an unhealthy one, “discordant.”⁸¹ Laying in the soft bed, I found the muffled, mostly bassy vibrations emanating from different parts of the mattress vaguely soothing, but I didn’t feel that any of the frequencies were particularly “in tune” with areas of my body, or that they manipulated my sense of my body in a remarkable way. The work gave rise to a feeling of subdued relaxation, similar I imagined, to using an electronic massage pad. Matthews has since used the *Sonic Bed* as a kind of “jukebox”⁸² to play compositions by other artists, such as Eliane Radigue.⁸³

I found the experience of laying on Bernhard Leitners’ *Ton-Liedge* [Sound Chair] (1975) more intriguing.⁸⁴ Four speakers were embedded in the base of a reclining wooden chair with cushioned panels. An ascending and descending tone moved in a pendular motion from one end to the other. Reclining on the chair, I began to meditate on the gentle movement of the sound under my body, rocking back and forth from my head to toes and back again, giving rise to a feeling of buoyancy.

⁷⁹ Part of ‘Open Sound Systems’ at Tate Modern, London, 16th September 2005, curated by Seth Kim-Cohen. See <http://www.tate.org.uk/intermediaart/alvin_lucier.shtm> accessed 12th September 2010.

⁸⁰ There have been many versions of Matthews’ *Sonic Bed*. The one I refer to here was installed at the ‘Her Noise’ exhibition, South London Gallery, 10th November-18th December 2005, curated by Electra.

⁸¹ Matthews added that she did not want to make “healing furniture,” but rather “to explore the possibility of using the body map and its energy as a source for music making” (Matthews in Dzuverovic and Neset, 2005, 47).

⁸² This term suggested by John Drever in conversation with author, June 2011.

⁸³ *Sonic Bed* was exhibited at Rich Mix, London 14th-24th June 2011 playing *Transmortem – Transmortem and Omnht* as part of the Eliane Radigue retrospective programmed by Sound and Music <<http://www.soundandmusic.org/thesampler/event/2011/06/sonic-bed-kaffe-matthews-rich-mix>> accessed 7th August 2011.

⁸⁴ I first encountered *Ton-Liedge* as part of the ‘See This Sound’ exhibition, Lentos Kunstmuseum Linz, 28th August 2009-10th January 2010.

Leitner's concern was not to tune into the supposed tonality of certain areas of the body, but rather to explore how the space of the body can be experienced through sound: "how subjective space is constituted within an acoustic framework" (Linke, [1986] 2008, 80). The rise and fall of the tone and the movement of the sound seemed in sympathy with the rate of relaxed breathing. Listening on Leitner's chair I became more aware of the space between my head and my toes as the sound moved across it.

Reflecting on these different experiences of having sound administered to my body, I have become more suspicious of the notion that specific musical tones might evoke predictable physical or emotional responses in listeners, and I have no enthusiasm for pursuing the idea of the presumed automatic or universal effects of sound in my own work. I am concerned with using resonance as a model of perception to pose the question of how we encounter the world around us, and to encourage reflection on how imagination and sensation might interact.

I feel that claiming to use tones that cure ailments or send listeners into a frenzy posits people as passive, helpless individuals easily manipulated by outside forces. In contrast, with regards my own work, I seek to encourage a degree of reflexivity on the part of the listener. What interests me in the model of resonating bodies is not that they are simply reactive, but rather the notion that they are active. Recalling Nancy's description, a resonating body "makes itself heard [...] it *listens to itself*."⁸⁵ This is not to suggest that a form of intelligence resides within the resonating object, but rather to encourage a responsive mode of engagement from the perceiver who, to paraphrase Ingold, is concurrently aware of changes in themselves and the object of their perception within the wider context of the environment. Ingold describes this form of responsiveness as "a kind of sensory participation, a coupling of the movements of one's attention to the movement of aspects of the world" (2000, 99).⁸⁶ This is grounded in the principle that "the world is not an external domain of objects that I look *at*, or do things *to*, but is rather going on, or undergoing continuous generation, within me and around me" (2000, 108).

Making Lenses

According to King, the practice of assembling drinking vessels in some order with the intention of sounding them is ancient and has been dated to the thirteenth century (1945-6, 98). He claimed the earliest recorded European reference to the musical glasses appeared in Gaffurio's⁸⁷ *Theorica Musicae* (Milan, 1492), which features a woodcut print depicting their use in a Pythagorean experiment.⁸⁸ King tells us that, around this time the instrument was used as a quasi-scientific toy or novel amusement for social gatherings.⁸⁹ The illustrations by Ford and Gaffurio (Figures 6 and 7)⁹⁰ show how collections of musical glasses are scaled in ascending or descending order, according to size of the bowl (Ford) or their being tuned with measured amounts of water (Gaffurio). I find this need to organise drinking vessels into some logical formation based on their pitch very curious. I began the *Lenses* project with the aim of doing exactly that. However I didn't have a prior notion of what the

⁸⁵ Nancy (2008, x) first cited p. 17.

⁸⁶ See also Ingold (1999, 582).

⁸⁷ King uses "Gaffurio" (1945-6, 99) whereas Gouk uses "Gaffurio" (1999, 279).

⁸⁸ See Figure 7 p. 30.

⁸⁹ King suggests that the musical glasses were frequently used as "an adjunct to convivial entertainment" (1945-6, 99).

⁹⁰ See p. 30.

pitches of the glasses should be, or consider tuning them with water. I just wanted to gather together an ensemble in which each glass was audibly distinct from the others in terms of its pitch.

I began to experiment with the sound of wine glasses around eight years ago. At the time there weren't any other musical instruments in my flat, and I liked how the glasses in the cupboard could be fashioned into an instrument when they weren't being used to drink out of. I preferred to play them by rubbing the rims with moistened fingers⁹¹ as this produces a sustained, ringing sound. However, it found it frustrating that I could only play two at once, because I only have two hands. I attempted to overcome this problem in the past by sampling the sound of the glasses and looping it through a guitar pedal, or by playing with other people. However, for a long time I had wanted to devise another way of sounding glasses, so that many could be heard at once without the assistance of a number of players.

As referenced in the Introduction,⁹² I had become interested in the idea that sounding objects seemed to project a more dynamic or life-like character than silent objects. To explore this notion I tapped and struck various household items to make them sound, and then began to use a function generator kit and small loudspeaker to play sine tones into them. Holding a speaker above the bowl of a wine glass, I found that at certain pitches, the volume and sonority of the sine tone would become enhanced through the acoustic resonance of the glass.⁹³ After knocking the glass I deduced that it sounded most loudly in response to sine tones that matched its own pitch. It was as if the glass was sounding of its own accord. I was keen to explore this effect further, and I experimented with playing the glasses using my fingers (the stick-slip⁹⁴ method), recording the sound, and then playing the recordings into the glasses with loudspeakers.

I could have continued to use sine tones matched to the pitch of the glasses to provoke sympathetic resonance, but I chose not to, as I found it more interesting to work with the distinctive sound of each glass as it was rubbed and made to oscillate. In 1986 electroacoustic composer Denis Smalley coined the term "spectro-morphology" to describe "the dynamic shaping of the pitch-spectrum of a sound or sound structure" (1996, 78). He suggests that listeners get a sense of the kind of gesture used to create a sound by its "spectral behaviour," or how its loudness, pitch and texture vary over time (1996, 88). I wanted to record the grating sound of friction which initiates the resonance of the glass, and the slippage in the pull-push motion of the finger on the rim, because I felt that these details would refer back to the act of my playing and elicit my presence. The notion that qualities of touch might be inferred through sound intrigued me before I had read Hadlock's study, but her careful analysis of how the sound of rubbed glass separates out into the sound of the finger "underneath" and the pure tone from the glass "above"⁹⁵ led me to reflect on the audible difference between the resonance of the glass and the sound of me playing it. I wanted to work with the simultaneous presence and absence of the player in the sound of rubbed glass.

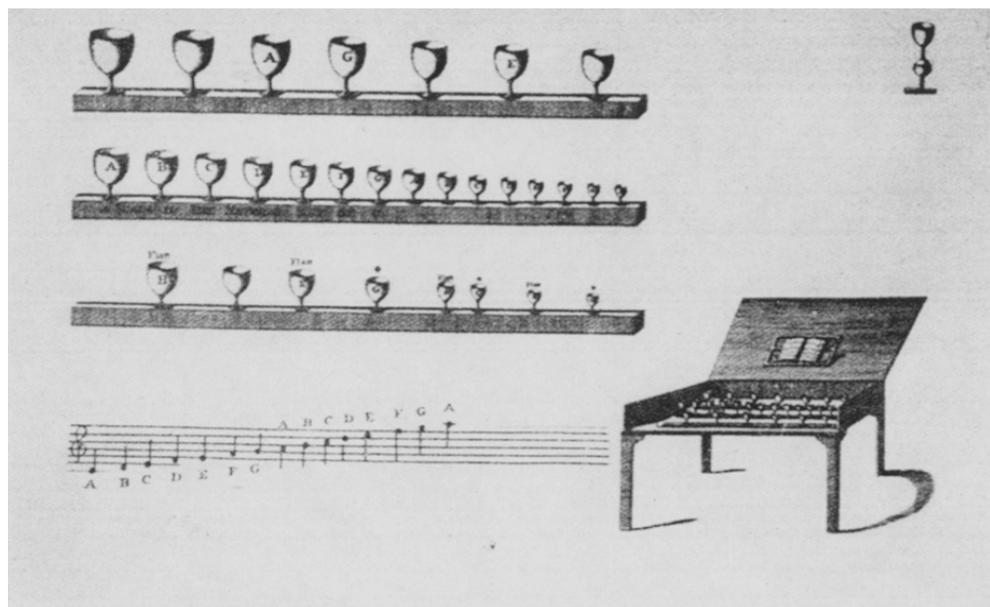
⁹¹ For an introduction to the stick-slip method see p. 17.

⁹² See p. 10.

⁹³ Images of this experiment are provided in Case study 1: *Lenses* installation, Disc 1.

⁹⁴ For an introduction to the stick-slip method see p. 17.

⁹⁵ See Hadlock (2000, 510), first cited p. 21.



6



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Figure 6. Illustration from Ford, *Instructions for Playing on the Musical Glasses* (London, 1761) in King (1945-6, 105).

Figure 7. Woodcut from Gaffurio's *Theorica Musicae* (Milan, 1492) in Gallo and Finger (2000, 327).

Another reason I chose to work with recordings of glasses rather than sine tones, was that I was intrigued by the idea of returning a recorded sound to the body that produced it. I wondered whether this would exacerbate or lessen the “schizophonic”⁹⁶ or “decorporealizing threat”⁹⁷ of sound reproduction technology. Instead of the recorded sound being isolated, “split”⁹⁸ or removed from the glass that issued it, rendering the reproduced sound, in Sterne’s terms a “resonant tomb,”⁹⁹ *Lenses* presents the glass and the speaker playing its recorded sound close together, prompting the glass to resonate and re-sound its own voice. The prominent position of the speaker, placed directly in front of the glass, could be considered to challenge the assumption that speakers should be used as “vanishing mediators” (Sterne, 2003, 218). However, this specific issue is more pertinent to my interpretation of Tudor’s *Rainforest IV* in the next chapter.¹⁰⁰ With *Lenses* I was most interested in my feeling that the act of retuning an audio recording to its “source” was a perverse thing to do.

Although artist Brian Catling does not refer specifically to loudspeakers in his discussion of “artificial others” (2009, 84) and life mimicking machines, loudspeakers could be regarded as relevant to this discourse, particularly when made to reproduce the sound of a recorded voice. Catling draws from Masahiro Mori’s concept of the “uncanny valley,” to suggest that anthropomorphic machines engender very different responses from observers, depending on how closely they are thought to approximate to the humans they imitate (Mori, 1970 in Catling, 2009, 91). Catling explains: “Where the machine almost resembles humanity, the sympathy of the onlooker ceases, and revulsion takes its place” (2009, 91).

This strand of Catling’s thinking seemed evident in an untitled performance of his that I witnessed at Alma Enterprises in 2007,¹⁰¹ which dealt with the artifice of the performance “prop” rather than of any specific technological device. I found this performance deeply disturbing. Catling appeared to be dressed in the style of an opera singer, and rested dejectedly against the wall. He repeatedly sang the refrain; “Falling in love again, never wanted to,”¹⁰² whilst extracting sections of watermelon in the shape of a heart from his own chest and (apparently) from the chests of audience members, before devouring them in a grotesque manner. The watermelon obviously was not a heart but had just enough of the red colour, slippery consistency, and squelchy sound of a heart to make me really worried that it was, and that he would try and gorge himself on mine next. I realised this was entirely irrational but this didn’t stop me from being extremely anxious about the prospect.

What I gleaned from Catling’s performance was that familiar or ordinary materials can, in a fetishistic way, be invested with strange and threatening qualities. Catling suggests that the act of revealing the artifice of machines (or life-like props) can heighten our sense of their mysteriousness and intensity:

⁹⁶ See pp. 15, 71.

⁹⁷ Connor (2000, 388) first cited p. 15.

⁹⁸ The notion of a “split” refers to Schafer’s term “schizophonia” discussed on pp. 15, 71.

⁹⁹ Sterne (2003, 290) first cited p. 16.

¹⁰⁰ See p. 49.

¹⁰¹ The performance was part of ‘It’s just bread’ at Alma Enterprises, London, Saturday 31st March, 2007 <<http://www.almaenterprises.com/itsjustbread.html>> accessed 12th June 2010.

¹⁰² From the song *Falling in Love Again (Can’t Help It)*, most famously rendered by Marlene Dietrich in the film *The Blue Angel* (1930).

When a machine copies or attempts human movement, thought or life, its artificiality often helps add to the wonder of its conceit. There is nothing wrong in being shown the cogs, wheels, springs and levers inside a machine. They do not remove the illusion, but help to create it. The very act of revealing intensifies the phenomena. (2000, 84)

By placing the glasses, speakers and recorded sound together in *Lenses*, I wanted to make the processes behind the construction of the work explicit, and to address the mysterious exchanges that take place between the material and ephemeral in the process of sounding bodies, recording them and re-producing their sound.

Artist Aura Satz expresses a desire to haunt or imbue objects with a sense of presence. Her films *Automamusic* (2007-8) and *Sound Seam* (2010) explore out-dated music making technologies such as player pianos and gramophones. Satz is interested in how these machines might be regarded as “secondary bodies we can project into, or be inhabited by, almost like some kind of possession” (Satz, 2010). She explains that her work tries to “inhabit the tension of sounds that are pried apart from their source through reproduction, but somehow remain latched onto a material body” (Satz, 2010). I hope that *Lenses* explores this same tension by awkwardly positioning recorded sound back together with the instrument (the glass) that produced it.

Once I had recorded the sound of each glass, I sought an appropriate method for structuring the playback of the recordings. Walking past a church in my neighbourhood, which happens to be a “major centre” for bell ringing (St John at Hackney, 2011), I became intrigued by the methods the ringers used to structure the tolling of the bells, and arranged an introductory ringing session with “Tower Captain,” Stephen Jakeman. I was impressed by the elegant rules used to structure “change ringing,” which can be outlined as follows:

(a) [E]ach bell sounds once in each row; (b) no bell may move more than one position at each change / row; (c) no row is repeated; and (d) the ringing begins and ends in Rounds. (The North American Guild of Change Ringers, 2011)

I decided to base the arrangement of my glass recordings on this method. I constructed a grid according to change ringing rules,¹⁰³ then arranged the recordings in a sound-editing programme using the grid as a score. The glasses sound in descending order (from highest to lowest pitch) at the beginning and at the end of the resulting soundtrack. In between there is a measured progression through different glass combinations. The change ringing system appealed to me because it offered a way of working systematically through the different sounds I had collected. I wanted to employ a gradual process to make it easy for a listener to get a sense of the structure and how the piece would evolve over time. For twenty-four glasses the length of the resulting soundtrack was just short of one hour long.

¹⁰³ For scores see Case study 1: *Lenses* installation, Disc 1.

Lenses is a multi-speaker, but not a multi-channel¹⁰⁴ installation. The same sound plays through each speaker, as I was interested to discover whether a glass might respond the sound of one of its neighbour's voices as well as its own. The glasses are positioned on a vertical surface, at something approximating to adult ear height, to enable people to listen closely to them for the subtle effects of resonance. By displaying the glasses in a series to I found it easier to get a sense of their relative size, shape and sound. The glasses are arranged in ascending order in terms of pitch, so the form of the work borrows from conventional models of the musical glasses, shifted from a horizontal tabletop to a vertical wall. I was aware that positioning the modular elements (glasses and speakers) in a regular pattern referenced the form of a minimalist installation.¹⁰⁵ I wanted to encourage this association as I saw it as a way of soliciting a particular manner of engagement from the audience, cultivated by minimalist artworks since the '60's.

Claire Bishop argues that the two main effects of minimalist art were to heighten awareness of the relationship between the artwork and the space in which it is situated, and to draw attention to the process of perceiving the work, which is marked by duration, like theatre (2005, 51-3). Bishop claims that these effects issue a "call to the beholder," a call that addresses their literal presence, asking them to reflect on "the contingent and contextual nature of their sensory perception in relation to their surroundings" (2005, 60). I wanted to encourage observers of *Lenses* to question how their impressions of the work changed over time, whether a particular glass resonated more loudly in response to particular parts of the soundtrack, and how listening from different positions, far away and in close proximity to the glasses, might impact upon what they hear.

Whilst considering the relevance and desirability of the minimalist aesthetic, I was drawn to two specific works by Robert Morris, *Box with the Sound of its Own Making (Box)* and *Column*, both from 1961. *Box* is an installation consisting of a wooden box displayed on a plinth. The box contains a tape player hidden within it that plays back a sound recording of the box being constructed. *Column* (a wooden column) was shown in the context of a concert,¹⁰⁶ in which it appeared to perform on stage. It stood on its narrow end for three and a half minutes, before falling on to its long side, and remaining there for another three and a half minutes. Morris, concealed off-stage, caused the box to fall by pulling on a string he had attached to it. Seth Kim-Cohen draws upon these two works to argue for a reading that extends beyond the "form and the phenomenological percept" of the material elements and towards the "terms of relations" they engage (2009, 69, 66). In other words, away from the "essentialism" usually associated with minimalism and towards the notion of a conceptual art practice.

Kim-Cohen claims that through the physical movement employed in *Column* and the sound played in *Box* "performativity, experiential duration, temporal form, memory and anticipation [are introduced] into the sculptural encounter" (2009, 69). I would add to this that the movement in *Column* and the sound in *Box* suggest the presence of the artist, though the artist remains invisible. In

¹⁰⁴ In sound reproduction, the term "channel" is used to describe a discrete path for the transmission of an audio signal. "Multi-channel" denotes that a number of distinct signals are sent to different speakers. See Truax, 1999: *Handbook for Acoustic Ecology* <<http://www.sfu.ca/sonic-studio/handbook/Channel.html>> accessed 10th August 2011.

¹⁰⁵ Claire Bishop suggests that minimalism's "literalism" is achieved through its "non expressive" use of materials and emphasis on "reduced and simple forms" (2005, 51-3).

¹⁰⁶ Organised by La Monte Young at the Living Theater in New York, 5th February 1962. As described in Kim-Cohen (2009, 69).

the *Lenses* installation my presence as the maker and performer of the work, though audible, is not visible. I was interested in this act of part-concealment and to what extent it resulted in a sense of the work playing itself, or of being haunted by an unseen presence.

Exhibiting *Lenses*

The first realisation of *Lenses* at *Sightsonic* York, (2008) was the least successful. As the designated exhibition space was a listed building I was not permitted to fix anything directly onto the wall. The organisers proposed that I work with a cubicle built out of “exhibition boards,” which effectively sectioned off the work from the rest of the room creating a space within a space. I was concerned that this added an unnecessary aspect to the installation, however I chose to show the work regardless. I used *Sightsonic* as an opportunity to present *Lenses* at an early, experimental stage, and to get valuable feedback from participating artists and the “artists platform” panel, which helped to improve the form of the work for future exhibitions.

Many of the artists exhibiting at *Sightsonic* told me that they found the sound produced by *Lenses* peculiar. Simon Whetham and Daniel Rodrigo called it “eerie,” and Mike Markus claimed that it was “perfectly suited” to my personality, by which I suspect he was referring to my slightly nervous disposition. I was pleased that the sound of the installation was received in this way, as I hoped that the sinister character of the sound might help to convey a sense of glasses being haunted by their own recorded voices. Members of the artists platform panel, curators Jamie Wyld and Sorcha Carey, gave constructive criticism about the overall cleanliness of the presentation, asking whether the amount of visible audio cable could be minimised, and whether the small written labels (denoting the pitch of the glasses) were necessary, which prompted me to remove or conceal these features in future realisations of the piece.

Sightsonic proved to be a very useful testing ground for *Lenses*. In subsequent exhibitions the glasses were fixed to a plasterboard panel mounted directly onto the wall, the majority of cables and wires were hidden and directional lighting was used to create shadows around the glasses. For different installations I tended to use a different combination of glasses, out of interest in how this would vary the soundtrack, and to adapt the work to the area of available wall space. I relied on the same methods for structuring the playback of the recordings and arranging the visual presentation. I think that the most successful versions of the installation were at Beldam Gallery and South Hill Park,¹⁰⁷ as on these occasions I had complete control over the form of the work and the exhibition spaces were calm and quiet, allowing for careful and close listening.

One of the most insightful comments I received concerning the experience of *Lenses* came from artist Isabela Castelan.¹⁰⁸ Encountering the *Lenses* installation at the Beldam Gallery, she told me that she felt the sound of the work enabled her to perceive the quality of the glass as a material more sensitively, and that the effect became stronger the closer she stood in relation to the glasses. She felt that the sound was extending the physical properties of the glasses beyond their material borders into the surrounding space, and claimed she could feel these qualities through the skin on her face.¹⁰⁹

¹⁰⁷ See p. 5 for list of exhibition dates.

¹⁰⁸ Isabela Castelan exhibited her work *Telephonica* as part of the group show ‘Essense,’ Beldam Gallery, 14th July-30th September 2008.

¹⁰⁹ Details of conversation verified by email correspondence, 19th October 2009.

The notion that sound could somehow invest the glasses with more of a physical, tangible presence than they have as mute objects was an idea that I had wanted to explore from the outset, so it was interesting that Castelan picked up on this so strongly.

Performing *Lenses*

I was invited to present the installation in the form of a performance at 176 Zabludowicz Collection, London. A live re-working appealed to me as I saw it as a way of experimenting with my visibility as a player and performer. It gave me an opportunity to incorporate the act of playing directly into the scene of the work, to see how this changed the experience of it. For the performance two sets of glasses were necessary, one to be played and another to be resonated. The played-glasses were selected to be as identical as possible to the resonated-glasses, and if necessary tuned with water to the same pitch. The sound of the played-glasses was picked up by contact microphones and relayed to speakers on the columns to resonate the other set of glasses.

176 Zabludowicz Collection is housed in a former Methodist Church dating from the nineteenth century. Its spaces have more character than the more ubiquitous white cube style of gallery. The largest space, formerly the nave, retains an upper balcony that I wanted to make use of in the performance. Considering the scale of this space I thought that it would be appropriate to have three performers, so I invited Mel Gough and Jane Dickson to join me in playing the piece. The decision to perform as an all female group was intentional as was I was intrigued by Hadlock's assertion that, in the eighteenth century the musical glasses were conceived as a "physical extension of the woman performer."¹¹⁰ I was intrigued to find out whether a contemporary audience would sense some form of sympathy between the female performers and their glass instruments. I considered loaning glass dresses for the performers to wear,¹¹¹ but the designer I contacted, Diana Dias-Leão, explained that her pieces were too fragile to be worn. In the end Dickson, Gough and myself made a collective decision to wear more conventional, fabric dresses.

The score we used was based on the grid system I had developed for the *Lenses* installation, but we each took a different path through the grid, working in slightly different systematic ways.¹¹² The resonated-glasses were mounted onto vertical columns standing at the end of the upper gallery, and the performers were positioned in the lower gallery. Directional lighting was used on the three performers and the three columns to draw attention to the relationship between them, hopefully helping to convey the notion that we were transmitting our sounds (and something of ourselves) across the space in order to prompt the glasses on the other side to resonate.

The most frequent theme in the feedback I received from friends and gallery visitors after the performance was to do with the sense of "femaleness"¹¹³ they associated the glasses and their sound. I had not anticipated how much this would dominate responses to the work. I found it intriguing that such associations identified in eighteenth century thought (Hadlock, 2000)¹¹⁴ should be present

¹¹⁰ Hadlock (2000, 508) first cited p. 21.

¹¹¹ For an image of one of Dias-Leão's glass dress creations see <<http://www.dudley.gov.uk/EasysiteWeb/getresource.axd?AssetID=4956&type=full&servicetype=Inline>> accessed 11th August 2011.

¹¹² See Case study 2: *Lenses* performance, Disc 1 for documentation of the scores.

¹¹³ This particular term was used by friend and artist Gili Tal in email correspondence dated 12th March 2009.

¹¹⁴ This aspect of Hadlock's work was first introduced p. 21.

in the mind of a contemporary audience. This idea of working with (and against) some of the gendered associations of musical instruments was one that I took through into the performance *Carillon*, discussed in the next section.

2. Voice and Vivification

Case study 3: Carillon (2008-9)¹¹⁵

Performance with “guitar-cymbals,” duration *circa* 20 min.

Carillon is an improvised performance characterised by the sound of a “guitar-cymbal.” This hybrid instrument is constructed by playing the sound of an electric guitar through a small speaker resting on the edge of a cymbal. The guitar strings are tuned to the cymbal and a contact microphone clipped onto the edge of the cymbal picks up the resulting sound. The performers employ a range of implements such as violin bows, metal rods, copper wire and paintbrushes to excite the guitar strings and explore different accents in the sound.

Case study 4: David Tudor’s Rainforest IV (1973)¹¹⁶

Sound installation and performance, duration indeterminate.

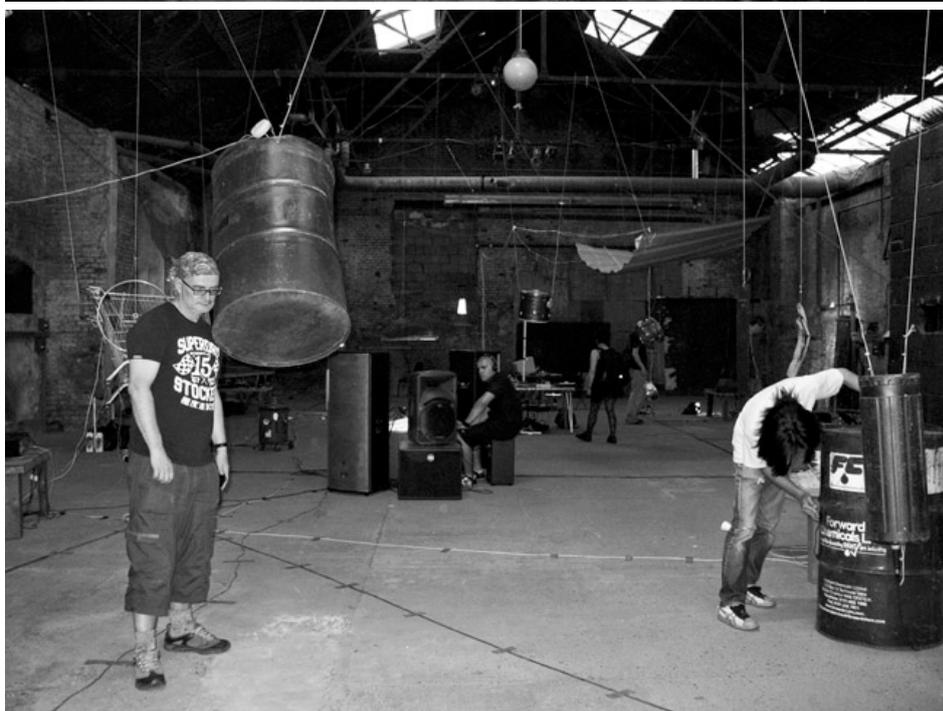
Tudor’s sonic environment *Rainforest* has a number of versions. This case study refers specifically to version “IV” (1973) in which transducers are used to drive electronically produced sound through a range of salvaged items, such as oil drums and paint cans, which are suspended from the ceiling of an installation space. The sound played through the transducers is tuned to what Tudor refers to as the “resonant nodes” of the object (Tudor, 1988). Contact microphones placed on the object are used to play the sound of one object into another or out to an amplified loudspeaker system. Each participating artist or musician selects, installs, tunes into and sounds their own object. Audience members are encouraged, where possible, to get inside the objects and listen to their local sound, feel the vibrations through their teeth or skin, and to wander around the space to listen from different positions.

¹¹⁵ See Figure 8 p. 38.

¹¹⁶ See Figure 9 p. 38.



8



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Figure 8. *Carillon*, 176 Zabłudowicz Collection, London. Photo: Luke Saunders 2008.
 Figure 9. *Rainforest IV*, Area 10 Project Space, London. Photo: Dawn Scarfe 2009.

Touching through sound

Like *Lenses*, *Carillon* plays audio into objects with the aim of sounding them from the inside out through resonance. With *Carillon* I was interested in using the tactile tuning pegs and strings of an electric guitar to tune into the resonant tones of a cymbal. I was intrigued by the notion of transferring my touch through sound, and using this sound to explore the invisible structure inside the cymbal.

The structures and processes inside bodies, though usually concealed from vision, can be imagined through sound. This next section explores how musical and acoustic instruments have been used to reify activity occurring inside the human body such as sensation. The purpose is to expand on the life-like attributes of resonating bodies identified in the first chapter, which include voice and sentience,¹¹⁷ and to discuss how these qualities are presented in Tudor's *Rainforest IV* (1973).

Musical models of the body and its processes

Carillon:

A set of stationary, tuned bronze bells played by a carillonneur or carillonist (Fr. carillonneur; Dutch beiaardier; Ger. Glockenspieler) using a baton keyboard (stokkenklavier). [...] Each key on the keyboard is attached to a flexible steel wire (the "keyboard wire") which is pulled down when the key is struck. A lever rotating about its axis converts the vertical motion of the keyboard wire into the horizontal motion of a second wire, known as the clapper wire. This wire pulls the clapper to the inner wall of the bell, which is chimed. The force with which the key is struck affects the speed of the clapper, determining the attack and volume of sound produced. (Rombouts, 2011)

Descartes' theories regarding the physiology of the body, set out in *Traité de l'Homme* [Treatise on Man] (1632)¹¹⁸ were informed by his dissection of human and animal parts. He reasoned that the sensory processes of the body operated according to mechanical principles. He compared the nervous system to a "*cloche*" [or carillon] (1677, 25). In this analogy nerve filaments resemble bell chords, attached to sensory organs at one end and to the brain at the other, as Kassler explains:

[To] account for nervous function, Descartes resorted to a carillon [...]. When the sensory organs are excited by external stimuli, they cause a slight pull on the filaments which, at the same instant, open the orifices in the brain and permit the animal spirits to flow through hollow nerve pipes toward the muscles. Thus a twofold function of animal spirits. First, they enable the mind (animus, soul) to interact with the body; then, they inflate the muscles to which the spirits are carried by the nerves. (1995, 44)

Penelope Gouk identifies a tendency amongst seventeenth century thinkers to conceptualise hidden forces governing the body in terms of musical instruments and the processes by which they sound:

[I]deas about bodily harmony were commonplace in the early seventeenth century. Of these the most important were that the body and soul are constructed according to the same

¹¹⁷ See Chapter 1, p. 16.

¹¹⁸ Written in 1632. Published in 1677: *L'Homme de Rene Descartes et la Formation du Foetus*, second edition (Paris: Girard).

harmonic principles, that they are also connected by a vital medium or spirit, and that musical instruments can be used as analogies for body parts and systems (2002, 239).

Gouk traces the origin of such ideas to the tradition of natural magic in which “the motions and powers of the heavens were first characterized in a way which made them manipulable” (1999, 267). She claims that the notion of a “harmonically constructed cosmos in which the same mathematical laws govern many different powers operating throughout the universe” was the “most powerful feature of the neo-Pythagorean tradition” (1999, 267). She refers to the illustrations of Robert Fludd (1574- 1637), as manifestations of this idea, particularly the *Divine Monochord* (1617), which is used by Schafer to represent the “tuning of the world” (see Figure 15).¹¹⁹

Gouk claims that this tradition of thinking was evident in Isaac Newton’s mathematical explanation for the transmission of sound (published in *Philosophiæ Naturalis Principia Mathematica*, 1687). She points to how the calculations set out in this work were based on Newton’s visualisation of “the air being made up of particles which oscillate backwards and forwards like tiny pendulums, each one obeying the laws of simple harmonic motion” (1999, 250). However, she also identifies a fundamental difference in the way in which musical models were used over the course of the seventeenth century, contrasting Fludd and Newton:

In Fludd’s [...] system of universal harmony, the musical metaphor dominates because it serves as the principal means of structuring and knowing the world. Moreover, Fludd clearly regarded the *practice* of music as a fruitful step towards philosophical knowledge and divine illumination. In Newton’s scheme, music plays no such privileged role [...]. Instead, his interest in music is purely structural; it serves as a means of grasping higher philosophical truths which are expressed through words and mathematics. (1999, 267)

I find the idea that natural philosophers developed understandings of nature through their observations of musical and harmonic instruments¹²⁰ quite fascinating. I will pick up on this thread again with Helmholtz’s use of the piano and resonators to develop and communicate his theory of hearing.¹²¹ It is the way in which the instruments are substituted for sentient bodies that really intrigues me and feeds into my work with resonating objects. The other, more disturbing feature of this kind of practice is the intention to make the processes of the body not only comprehensible, but ultimately, manipulable.

Another interesting feature I found in Gouk’s work was the suggestion that sympathetic resonance had played a “central role” in the theory of natural magic and occult practices since antiquity, and then became an “integral part” of the new discipline of experimental philosophy that emerged during the scientific revolution over the sixteenth and eighteenth centuries (2002, 224). Focussing her research on the work of Newton and members of the Royal Society, London, she concluded that “musical sympathy came to serve as a model for other hidden forces in nature, most notably gravity and magnetism” (2002, 224). It is with Gouk’s observations in mind, that I will examine how

¹¹⁹ See p. 72.

¹²⁰ I am referring here to Newton’s pendulum, which is a harmonic oscillator.

¹²¹ See Chapter 3 starting p. 57.

Chladni's *Klangfiguren* (Figure 10)¹²² inspired theories about the shared character of sound, electricity and other invisible forces, and the effects these might have on the human body.

The *Klangfiguren* for which Chladni is best known, were anticipated by Robert Hooke of the Royal Society London, who demonstrated (from 1671-83) that if glass plates or bowls containing sand were set into vibration with the strokes of a violin bow, patterns emerged in the sand tracing the structure's movement and the way it was made to resonate (Gouk, 1999, 219). Chladni was intrigued by how plates of glass or metal produced differently pitched sounds depending on where they were held and struck (1830, xiii).¹²³ He regarded the different pitches as evidence that distinct rates of vibration emerged from different parts of the plates' structure (1830, 50).¹²⁴ In order to visualise these oscillations, he adapted methods used in experiments to render electrical patterns visible:

The experiments on electric figures, formed by a plate of resin covered with sand, discovered and published by Litchenburg (in the Memoirs of the Royal Society at Gottingen), made me presume that the different vibratory motions of a sonorous plate ought to offer different appearances, if a little sand or other similar matter was strewed on their surface [...]. (Chladni, 1821, 171)¹²⁵

The way Chladni appropriated the form of an electrical experiment for the analysis of sound hints at the commerce between concepts of sound and electricity. He produced his first *Klangfiguren* (in 1785) by setting round glass and metal plates into vibration with a violin bow, and scattering sand on the surface of the plates to trace the resulting vibrations (1830, xiv). Szendy identified a "revolution" in Chladni's work, in that he studied a range of sounding bodies rather than restricting his acoustic research to the string of the monochord and its harmonic divisions. According to Szendy, the monochord had been "the basis of acoustic theory and calculation since Greek antiquity" (2008a, 25). Chladni's move towards the "irregularities" and "inharmonic and irrational relationships" in the sound of various bodies signalled, for Szendy, the "modernity" of his thinking (2008a, 25).

Szendy claims that Goethe was inspired by Chladni's work to develop a "dynamical rather than arithmetical" theory about the major and minor scales in music and their effects on the human body (2008b, 25). He quotes a letter to Christian Heinrich Schlosser dated 1815, in which Goethe describes his idea of "tone monads" that provoke corresponding movements and feelings in the listener:

[A]s the major tone arises from the expansion of the monad, so it exerts the same effect on human nature, driving it into the object, towards activity, towards the periphery. And it is similar in the minor tone; since the latter springs from the contraction of the monad, it contracts itself as well, in a concentrated fashion, and drives into the subject, and knows how to discover the last refuge in which one's dearest melancholy loves to hide. (Goethe, 1815 in Szendy, 2008a, 25)¹²⁶

¹²² See p. 43.

¹²³ For Smyth's translation see Chladni (1821, 171).

¹²⁴ For Smyth's translation see Chladni (1821, 176).

¹²⁵ For German see Chladni (1830, xiv).

¹²⁶ Quoted in German by Szendy, translated by Nicholas Walker in email correspondence, 21st July 2009.

Goethe's "tone monad" theory reflects a fundamental trait in his ideas about nature, the principle of dynamic oscillation between polarities. This underpinned his thoughts not only on the behaviour of electricity and sound, but of all observable phenomena:

True observers of nature, however they may differ in opinion in other respects, will agree that all which presents itself as appearance, all that we meet with as phenomenon, must either indicate an original division which is capable of union, or an original unity which admits of division [...]. To divide the united, to unite the divided, is the life of nature; this is the eternal systole and diastole, the eternal collapsion and expansion, the inspiration and expiration of the world in which we live and move. ([1810] 1967, 293-294)

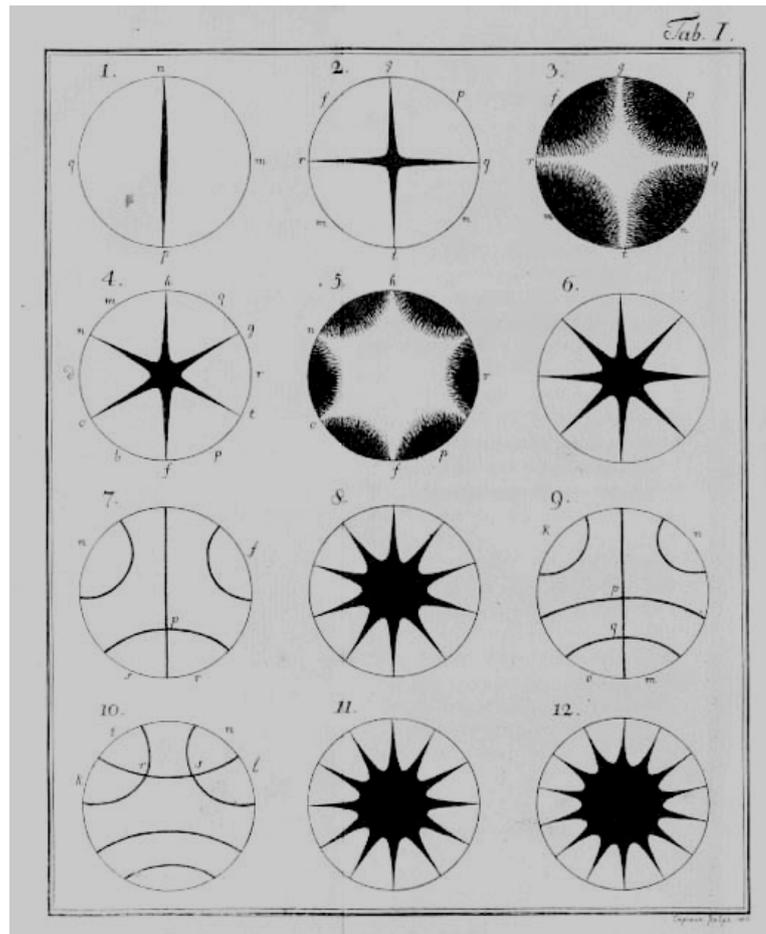
Szedy points to the more sinister applications of Goethe's tone monad theory: "what is at stake, here, is already the in-out motion of an impulse that music creates in an experimentally controlled way, in order to subject the subject" (2008a, 26). Referencing Stanley Kubrick's film, *A Clockwork Orange* (1971) in which the main character Alex is subjected to brainwashing treatment, Szedy introduces the menacing notion of a "subject plate" through which musical impulses might be driven, in order to provoke predictable physical and emotional responses. He claims that Goethe's tone monad hypothesis "could be seen as the first step towards the experimentalization of sound effects and affects, towards a biopolitical musicotherapy of the passions" (2008a, 26). In light of the territory covered by the previous chapter, we might identify a similar tendency in the work of Mesmer and contemporary sound healing practices,¹²⁷ under the guise of compassionate therapy rather than outright manipulation. The next section will expand on the interplay between concepts of the sonic and the electric, to explore how both were implicated in scientific experiments that aimed to mimic and make intelligible the mysterious properties that vivify and animate bodies.

Galvanism and audification

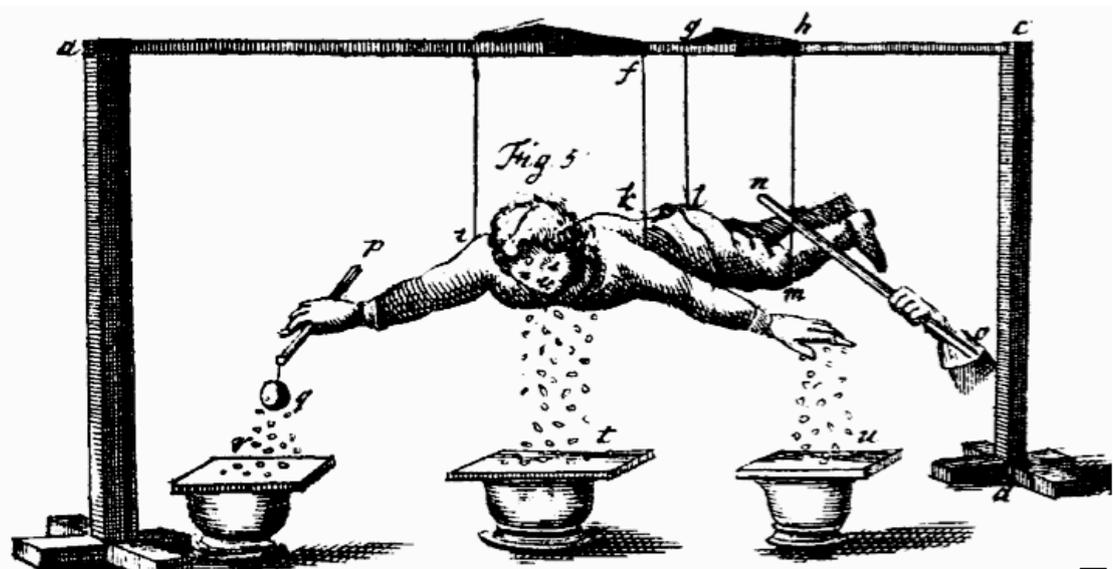
Eighteenth century experimenters devised spectacular ways of testing and exhibiting the capacity of the human body to conduct electricity. The form of these experiments often dramatised sensual processes and alluded to magical or supernatural forces. Steven Gray (1666-1736) suspended small boys from a wooden frame with silk threads, in a scene suggestive of the gallows used for public executions (see Figure 11).¹²⁸ Gray proceeded to electrically charge the boys, and demonstrate how small pieces of paper and brass leaf would be attracted to their fingertips (Elsenaar and Scha, 2002, 17). Antoine Nollet (1700-1770) electrified up to 180 people at once, requiring his subjects to hold hands to form lengthy human chains. He performed this exercise with a band of Carthusian monks and is claimed to have induced an "ecstatic state" into the collective (Zielinski, 2006, 165). Georg Matthias Bose (1710- 1761) devised a way of generating the effect of a corona, using an electric charge and ionisation to illuminate the silhouette of a person in blue light, evocative of the manner in which saints were depicted in paintings (Elsenaar and Scha, 2002, 18). Bose also devised the *Electrical Kiss* experiment, where men were invited to kiss electrically charged women standing on insulating platforms (Elsenaar and Scha, 2002, 18). These various displays indicate the enthusiasm with which the electric charge was harnessed over the eighteenth century to represent supernatural, sensual and emotional processes.

¹²⁷ See Chapter 1 from p. 22.

¹²⁸ p. 43.



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Figure 10. *Klangfiguren* from Chladni (1787, Tab I).

Figure 11. An experiment by Stephen Gray (1730) from Elsenaar and Scha (2002, 18).

Luigi Galvani (1737-1798) believed an electric force was responsible for movement in human and animal bodies. He theorised that an innate nervous fluid named “animal electricity” animated muscle fibres.¹²⁹ His notorious experiments of the 1780’s involved sending electric charges into the nerves of dissected frogs legs, producing a contraction of the muscles and the effect of a kick. Public demonstrations of galvanic effects occurred in England with Giovanni Aldini (Galvani’s nephew) practising on the corpse of a murderer in London, 1803, and Charles Sylvester using the body of a sheep in York, 1805 (Elliott, 2008, 218). The objective was to apply electric charges to dead bodies in order to provoke life-like motions such as winking and chewing, as well as strange and macabre facial contortions. After witnessing one of Aldini’s experiments with a severed dog’s head, an observer commented:

The jaws open, the teeth chatter, the eyes roll in their sockets; and if reason did not stop the fired imagination, one would almost believe that the animal is suffering and alive again.
(Elsenaar and Scha, 2002, 23)

This reflection indicates that the grotesque mechanical movements of flesh driven by electric charges played on concepts of resuscitation or resurrection and the instinctive feeling that moving bodies are living bodies.

Whilst investigating the theatrical ways in which forces were driven through bodies to speculate on the causes of animation, I was particularly drawn to practices that explored the dynamic between the audible, the electric, and the senses and motors of the body. Julius Althus’ publication of 1866 documented the use of galvanism and “faradisation”¹³⁰ in medical practice to treat disorders such as loss of voice.¹³¹ Strangely, in Althus’ experience, the condition of “aphonia” or “loss of power” in the vocal cords appears to have only affected women, and mostly those who were unmarried and under 30 years of age (1866, 151). Althus found that the application of the “interrupted current” to the throat immediately restored the voice to its full strength in the majority of cases (1866, 153). In 1881 Julius Bernstein created the *Muskeltelephon*, which used the technique of “audification” to study electric currents present in the muscles. He made the muscles into transducers, attaching a microphone to one end and a speaker to the other. Bernstein documented the effects of his experiments using musical terminology, identifying particular musical pitches produced such as *e’* and *f’* (Dombois, 2008, 41-44).

Ritter (1776 -1810) conducted dangerous experiments on his own body, exposing himself to the strongest electrical current he could endure (Zielinski, 2006, 175). He “married” parts of himself to positive and negative electrodes, including eyes, ears tongue and “the organs of procreation” (Erlmann, 2010, 191-2), in order to explore his concept of the body as a “bipolar electrical system” (Zielinski, 2006, 175). He claimed that galvanic experiments on the ear produced different musical tones depending on the metals used and the precise configuration of the components:

¹²⁹ Elsenaar and Scha explain that Galvani had not discovered an innate charge in the muscle but rather “the electric potential of metal junctions” (2002, 22).

¹³⁰ Althus defined “faradisation” as an “interrupted” current as opposed to the “continuous” galvanic current. He explained that both had distinct effects and uses (1866, 8).

¹³¹ For a number of intriguing case studies see Althus (1866, 151-3, 166).

[A] galvanic circuit between the left earlobe connected to the silver end of the battery and the right hand connected to the zinc side resulted in a [...] tone situated somewhere between $g \#'$ and a' . And when the polarities were reversed, and the earlobe was connected to the zinc and right hand to the silver, Ritter heard an f' . (Erlmann, 2010, 192)

In a similar way to Goethe, Ritter identified oscillation as a fundamental principle of life, claiming: *Aller Sinnempfindung liegt Oscillation zum Grunde* [oscillation is the foundation of all sensation] ([1803] 1920, XXXII). Like Goethe, he looked for characteristics that united the magnetic, electrical, chemical, and organic: aspects of nature previously thought to be independent of each other.¹³² He was enthralled by Chladni's *Klangfiguren*, believing them to be *Feuerschrift* (Ritter, [1810] 1969, 227), which has been interpreted as "writing in the fire," "fire path[s]" and "primal, scriptural images of sound."¹³³ Ritter wondered how *Klangfiguren* might be apprehended "internally" asking, "is not every act of seeing with the inner eye a form of listening, and hearing a seeing from and through the inside?" (Ritter in Erlmann, 2010, 192). What I find particularly compelling about Ritter is his extensive, subjective exploration of internal effects and interferences between the senses. Erlmann claims that Ritter believed sensations to result from "different degrees of galvanic disturbance":

[T]he commonly made distinction between sound and light in reality is only a difference in the way an identical galvanic disturbance affects the ear and the eye. (Erlmann, 2010, 196)

The proposition that sensory organs reflect the state of the nerves themselves, rather than the phenomena that stimulate them, foreshadows Johannes Müller's law of the "specific energies of sense" which I examine in more detail in relation to Helmholtz's theory of hearing in Chapter 3.¹³⁴ Ritter's suggestion that perceptions involve a "mix" of inner and outer, conscious and unconscious impulses also evokes the blend of "reason and resonance"¹³⁵ that Erlmann identifies in Helmholtz's work. Ritter distinguishes between the "external, listening ear" and "the more inner, feeling ear." He elaborates:

[E]very sound, as we commonly perceive it, is really a mix, in different proportions, of tone and sound (or noise). [...] Tones are no longer a matter of the external ear; one does not hear them as one hears any other thing; we ourselves are the string that, set into motion, perceives its own sound from inside to inside; perceives itself. By contrast, sound, noise or whatever else one may call it, are a matter of the external ear; [...] one hears that it exists, but we barely enter into an intimate relationship with it; it passes as it arrived. (Ritter in Erlmann, 2010, 198-9)

Ritter's use of his own body as a laboratory ultimately destroyed his health and led to his untimely death at the age of thirty-three (Zielinski, 2006, 172). However I find the principle of experimenting with one's own perceptions very inspiring. My practice aims to explore ways in which different senses meet or overlap, and how the imagination might be stimulated to heighten our perceptions. In

¹³² Erlmann suggests that Ritter regarded nature as a "coherent whole, with Volta's electric pile being but one element in a long chain joining the organic and inorganic" (2010, 191).

¹³³ Translations from Szendy (2008, 21), Erlmann (2010, 194), and Adorno, (1934) from 'Die Form der Schallplatte' trans. Szendy (2008, 22).

¹³⁴ See p. 61.

¹³⁵ See p. 65.

pursuing these concerns, I aim to use my own sensory experiences in a reflexive way. The manner in which Ingold distinguishes anthropological modes of enquiry from scientific ones can help to elucidate my approach. He asserts:

Anthropological experiments require no elaborate instruments that would deputise for the investigator, allowing the latter to hide behind the scenes and thereby maintain the illusion of absence that underwrites the claim to objectivity. Nor do they require any laboratory within which to craft a simulacrum of the world designed to highlight only those variables that are the subject of the investigation. Rather they place the investigator, in person, right in the midst of things. In terms of scientific protocols, these experiments break all the rules. (2011. 15-16)

I find Ritter fascinating because, like him, I aim to use my practice as a means of putting myself “in the midst of things.” The significance of this strategy, and its impact on my work is re-examined in the Conclusion.¹³⁶

The various practices I have surveyed in this chapter indicate that between the eighteenth and nineteenth centuries sound and electricity were driven through fleshy bodies to model and attempt to understand the enigmatic causes of biological animation and vitality. Natural philosophers interpreted and used the audible and electric (often interchangeably) as signs of life. With Tudor’s *Rainforest IV* and my work *Carillon* I explore how the sonic, electric and sentient overlap in the imagination.¹³⁷ Might the practice of using sound to resonate bodies appear to transform inert matter into living bodies, in a manner reminiscent of the galvanic demonstrations of the eighteenth century? Or have advances in the scientific understanding of biological and physical processes undermined the mysterious nature of bodies that appear to move or sound of their own accord?

Connor suggests that the achievements of natural philosophers such as Helmholtz in “emptying out [...] sensation and perception into mechanical processes” (2000, 362) did not lead, as might be expected, to a de-mystification of the voice. Instead, he argues that in the mid nineteenth century, the idea of the voice appeared to take on “motive or animating principle of life itself, whether identified with blood, animal spirits or electricity” (2000, 334):

The understanding of voice as bodily mechanism does not signify the simple materialization or disenchantment of the voice. On the contrary the magical mechanism of the voice began to mediate [...] between the ideas of matter and magic (Connor, 2000, 334).

The next section investigates how Tudor exploits the vivifying properties of sound, electricity and the voice to breathe new life into mundane, discarded objects.

¹³⁶ See p. 92.

¹³⁷ This notion is supported by Gouk’s assertion that sympathetic resonance took on associations with other invisible forces such as electricity and magnetism, see p. 40. It also relates to Erik Davis’ use of the term “the electromagnetic imaginary” to refer to “the mythic, animistic, and just plain weird cultural dimensions of electricity and electromagnetism” ([1999] 2002, 15).

***Rainforest IV* (1973)**

Artist Bill Viola gave the following account of how Tudor first introduced him to the mechanics of *Rainforest IV* in 1973:

As the oscillator swept the pure tone slowly up through the audible sound spectrum, the object would vibrate and physically rattle, giving off a loud, complex array of sound frequencies, or otherwise fall still and quietly reproduce only the originally pure sound source. [...] We were informed that the louder events were the result of resonant nodes latent in that particular [object] and that all physical objects had them. (Viola, 2004, 49)

In *Rainforest IV* sound is used as an impulse to vibrate inanimate objects and make them produce their own acoustic voices. I think that reasonable comparisons can be made to Galvani and Aldini's practice of using electricity to provoke movement in dead human and animal bodies, Gray's display of electrically charged boys suspended from silk threads, and the medical application of electric current to the throat to restore the powers of the voice.¹³⁸ This section will explore how Tudor resonates objects with sound to imbue them with sentient qualities.

Viola proposes that Tudor used electricity and sound as a means of bringing materials to life. Describing Tudor's work with electronics he claims that the components "became animated by the electricity coursing through them" and were "transformed into a living, pulsing system" (2004, 54).¹³⁹ Viola cites resonance as a key feature of Tudor's practice, emphasising the appeal of its "autonomous" nature and its interaction with the insides of matter:

[R]esonance is the condition whereby a tiny input autonomously cascades into a much larger output. It occurs when a small vibration interacts with the internal structure of a material and greatly increases in intensity [...]. (2004, 54-55)

Viola's comments suggest that Tudor used electricity, sound and resonance to infuse objects with life-like qualities. Other statements by Viola and Tudor indicate that the practice of animating objects with sound reflected their more profound thoughts on the nature of organic life and interactions between spiritual and material realms. Viola revealed that Tudor's guidance led him to discover "sound as a dynamic life force" (2004, 53). In the process of developing *Rainforest*, Viola began to identify similarities in the sound and organisation of natural, animal and electronic systems:

The exotic birds and frogs on Tudor's tapes sounded a lot like some of the abstract electronic bleeps and whoops I had been struggling with. The resonant properties of the found objects we were using functioned much in the same way as audio modulators and filters of the electronic synthesizer [...]. The world inside of electronic circuits and the world outside in forests and rivers were revealing their common forms and underlying principles. (2004, 52)

The notion that the same "underlying principles" might govern electricity, sound and movement in the nature is reminiscent of Goethe and Ritter's assertions that dynamic oscillation between

¹³⁸ These experiments were introduced in the previous section. See pp. 42-44.

¹³⁹ Viola's observation was a response to untitled performance by Tudor, but is intended to represent his attitude towards electronics in general, and so is relevant to this interpretation of *Rainforest IV*.

polarities forms an essential characteristic of the observable world (an idea introduced in the previous section).¹⁴⁰ This connection to Goethe's ideas seems to be more than mere coincidence, as Viola (2004), Kahn (2001b), Cameron and Rogalsky (2006) have referenced Tudor's "dedication"¹⁴¹ to Rudolf Steiner's "anthroposophy,"¹⁴² a philosophy indebted to Goethe's work. Cameron and Rogalsky note that Tudor became a member of the Anthroposophical Society of America in 1957,¹⁴³ Viola discloses that Tudor made a pilgrimage to the Goetheanum School for Spiritual Science in Dornach, Switzerland (2004, 51), and Kahn reckons that the philosophy was "on a par with music" in terms of its importance in Tudor's life (Kahn, email correspondence, 3rd August 2008).

In the light of this insight into Tudor's ideology, *Rainforest's* concern with living, metamorphosing sonic systems could be interpreted as a reflection of one of the central tenets of Steiner's thought, that dynamic, transformative processes in nature correspond the movement and activity of the human spirit (Steiner, 2006, 56). According to Michael Howard, the concept of an "outer, physical" and an "inner, soul-spiritual" reality was fundamental to Steiner's thought (Steiner and Howard, 1998, 24). Steiner believed that "living into" or consciously feeling the "inner qualities" of sensory impressions (such as the apparent warmth or coldness of a colour) was a means of overcoming the apparent dualism of the outer and inner worlds (1998, 23-24). He refers to the spiritual realm as a "world of softening, expanding, buoying-up that counteracts the hardening, contracting and weighing down of the purely physical" (1998, 10). Adhering to these principles, Tudor would regard the process of resonating objects not merely as a means of producing life-like qualities in them, but as a way of exploring the dynamic language of the human spirit through them.¹⁴⁴

Another feature of Steiner's teaching was the notion that creative activity did not originate solely within the individual, but rather from an "actual world of spirit" (1998, 10). In keeping with this sentiment, *Rainforest IV* is a collaborative piece described by Viola as being "self instructive" as its "essential parameters are intuitively self evident to the performer" (2004, 50). Tudor left it to the performers to choose their own object, and to "get a feeling for what kind of [sonic] material to send through it" (Tudor, 1995). Furthermore, Tudor described the objects themselves as having their own agency, advising performers: "The object should teach you what it wants to hear" as if it had its own preferences (Tudor, 1995). This perspective seems to have been shared by critics such as Tom Johnson, who noted:

Of course the objects were all wired to tape recorders and sound synthesizing equipment, but it was the objects themselves which took on the greatest significance. In a way they were the performers, because it was they, after all, that were actually producing the acoustical sounds we were hearing. Each object had its own distinct voice. The wine barrel, for example, seemed happiest with low frequencies, and as one might expect, he added a deep

¹⁴⁰ See p. 42.

¹⁴¹ Kahn, email correspondence, 3rd August 2008: "Tudor was resolute in his dedication to 'spiritual science' (aka Steiner's anthroposophy), which he put on a par with music (much to the angst of his wife M. C. Richards, who was hoping for a trinity of sorts), but Tudor was tight-lipped about the particulars of his influence. My [unpublished paper, 2001] was thus a speculation on what he could find in anthroposophy about sound and music [...]."

¹⁴² For an introduction to the principles of Anthroposophy see <http://www.goetheanum.org/hochschule.html?&L=1> accessed 24th February 2011.

¹⁴³ Cameron and Rogalsky (2006, 916, citing Kahn, 2001b, unpublished).

¹⁴⁴ This element of Steiner's ideology evokes Ingold's notion of "restoring [things] to the generative fluxes of the world" (2011, 29) see p. 17.

echo to all his sounds. The little plastic lawn sprinkler turned out to be a squawky fellow, who resonated much louder than anyone his size ought to. (Johnson, 1989, 94)¹⁴⁵

Tudor and Johnson's habit of describing *Rainforest IV* objects as anthropomorphic characters with their own unique voices substantiates the notion introduced in Chapter 1, that resonating objects exhibit qualities associated with living human bodies.¹⁴⁶ Picking up on Connor's point that the concept of voice implies the physical presence of the sounding body,¹⁴⁷ Tudor makes the following assertion:

[In] *Rainforest IV* [...] the objects that the sounds are sent through are very large so that they have their own presence in space. I mean, they actually sound locally in the space where they're hanging as well as being supplemented by a loudspeaker system. (Tudor, 1988)

Here Tudor distinguishes between the sounding objects driven by transducers and the loudspeaker monitors. He implies that the sounding objects have presence in the space, whereas the loudspeakers do not. This sentiment reflects Sterne's assertion that the difference between a musical instrument and a sound reproducing device is that "the former is supposed to shape sound, the latter to reflect it" (2003, 258). Musical instruments are assumed to have their own voice and presence in space whereas loudspeakers are not. Tudor confronts this distinction by declaring that, in *Rainforest IV* "the loudspeaker should have a voice which was unique and not just an instrument of reproduction, but as an instrument unto itself" (Tudor, 1988). Using the term "loudspeaker" here Tudor is referring to the sounding objects. He regarded the transducers and objects they were fixed to as loudspeakers. He wanted each of these object-speakers to be recognised as having their own idiosyncratic voices. But why should attending to the individual sonic character of speakers be important for Tudor?

One possible interpretation is that Tudor sought to undermine the conventional way in which loudspeakers are regarded, or rather disregarded. Sterne claims that fidelity is the standard by which sound reproducing technologies such as the speaker are valued. He presents a critique of this attitude, arguing that the perfect loudspeaker would "obliterate itself in achieving its end" (2003, 282). He asserts that:

Conventional accounts of sound fidelity often invite us to think of reproduced sound as a mediation of "live" sounds, such as face-to-face speech or musical performance, either extending or debasing them in the process. Within a philosophy of mediation, sound fidelity offers a kind of gold standard: it is the measure of sound-reproduction technologies' product against a fictitious external reality. From this perspective, the technology enabling the reproduction of sound thus mediates because it conditions the possibility of reproduction, but, ideally, it is supposed to be a "vanishing" mediator—rendering the relation as transparent, as if it were not there. Inasmuch as its mediation can be detected, there is a loss of fidelity or a loss of being [...]. (2003, 218)

¹⁴⁵ From a review dated 26th July 1973.

¹⁴⁶ See Chapter 1 from p. 16.

¹⁴⁷ See Chapter 1 p. 15.

Sterne argues against the “false idol” of fidelity because he believes that it “posit[s] sound reproduction as a failure, a sham, and a debasement of a more fundamental live presence” (2003, 286). He suggests that the condition of immediate self-presence is brought about by the possibility of reproduction: “authenticity and presence only become issues when there is something to which we can compare them” (2003, 220). With *Rainforest* Tudor appears to have been interested in the opposite of fidelity. Driscoll and Rogalsky locate the “sonic identity” of a *Rainforest* object in its “(in)fidelity,” in the sonic characteristics of the object, the transducer and pickup (2004, 25). They propose that Tudor intended to invert the assumed relationship between loudspeaker and signal:

One didn’t have to think of the generation of electronic music from signal source to the reproducing output, but one, instead, might as well just start from the other end and go back and arrive at a signal source. (2004, 25)

Of course, it could also be contended that Tudor’s emphasis on the unique resonances of the loudspeaker ultimately upholds the notion of fidelity as the value of sound reproduction technology. *Rainforest IV* might be seen as a consequence of the “desire for a slice of reality coming through the diaphragm of the machine” (Sterne, 2003, 274). Perhaps Tudor felt that the “schizophonic”¹⁴⁸ nature of reproduced sound posed a “decorporealizing threat.”¹⁴⁹ By using loudspeakers as instrumental voices, Tudor may well have been striving to realise the condition Sterne describes, to make the loudspeaker “obliterate itself in achieving its end.”¹⁵⁰

Having worked on a realisation of *Rainforest IV* in 2009,¹⁵¹ I feel that the piece presents the voice as an emergent, negotiable quality. The acoustic characteristics of the objects influence the kind of sonic material the performers play through them to evoke their resonant voices, but these sounds can be re-tuned, adapted and augmented according to the whim of the performers. The contact microphone on the object is intended to pick up its sound and send it into other objects or to a centralised loudspeaker system. Tudor describes how the sound picked up from the contact microphone is a “different kind of sound” to the acoustic “local” sound of the object. He explained his interest in re-distributing voices through the installation:

It becomes like a reflection and it makes, I thought, quite a harmonious and beautiful atmosphere, because wherever you move in the room, you have reminiscences of something you have heard at some other point in the space. (Tudor, 1988)

Although *Rainforest*’s voices emerge through material objects, I think that Tudor was not so much concerned with tying voices to a “specific and local cause,”¹⁵² as with exploring the way that voices might manifest through alternative bodies, in various combinations, in a process of transformation. An aspect of *Rainforest IV* that I enjoy is that it presents no privileged point from which to listen. Audience members can wander freely through the installation space, listening close to the objects, touching them, or turning their attention to the collective sound. Notions of signal, foreground, background, live and reproduced are continually negotiated through the listener, as well as the

¹⁴⁸ Schafer (1974, 43-47) first cited p. 15.

¹⁴⁹ Connor (2000, 388) first cited p. 15.

¹⁵⁰ Sterne (2003, 282) first cited p. 49.

¹⁵¹ See p. 5 for date and venue details.

¹⁵² Sterne (2003, 65) first cited p. 15.

players who sound the objects. I think that *Rainforest* is successful in issuing a “call to the beholder”¹⁵³ asking them to be aware of their own perceptual processes and how these shape their impressions of the work over time. I sought to encourage a similar manner of engagement with my installations *Lenses* and *Listening Glasses*.

Carillon

Carillon stemmed from my work on *Lenses* and *Rainforest IV*, but this section outlines the particular lines of enquiry that gave *Carillon* a distinctive form and purpose. I first attempted to use the sound of an electric guitar to send a cymbal into sympathetic resonance as a means of demonstrating the mechanics of Tudor’s *Rainforest* to myself with the instruments I had at my disposal. The “guitar-cymbal” was constructed by playing the sound of an electric guitar through a small loudspeaker positioned on the edge of a cymbal. Using this technique I found it very difficult to make the cymbal sound the air around it (a requirement of a *Rainforest IV* object). However, I found that a contact microphone placed on the edge of a cymbal would pick up its inner, structure-borne sound very well. Through my experiments I became intrigued by the notion of manipulating the tuning pegs and strings of the guitar in a tactile fashion to prompt the hidden, inner structure of the cymbal to resonate. It was the thought of using sound to “touch” the intangible space inside the cymbal that interested me.

Chladni’s work inspired the form of *Carillon* in many ways, but most references are oblique rather than literal. The cymbal, for me, alluded to the circular metal plates Chladni had used to produce the sound figures. His technique of using a violin bow to set the plates into vibration influenced my use of a bow to sound the strings of the guitar, which in turn sounded the cymbal. Intrigued by Szendy’s observation that the monochord and Chladni’s resonating plates represented two very different approaches to understanding acoustics and nature,¹⁵⁴ I began to associate the guitar strings with the monochord, which made prospect of combining the sound of the guitar (monochord) and cymbal (Chladni plate) more enticing.

Most of all, it was Chladni’s descriptions of the inner vibrations of sonorous bodies that influenced *Carillon*. His account of how different parts of a body produced different speeds of vibrations (and therefore sounds of a different pitch¹⁵⁵) gave me (a person who enjoys sounding things) an incentive to explore the range of resonant tones I could find within a cymbal. His attention to the inharmonic relationships¹⁵⁶ present in vibrating plates influenced my desire to explore the “dense fog of enharmonic partials”¹⁵⁷ in a cymbal, tuning into them individually. His thoughts on timbre or quality of tone were also influential:

[Timbre] seems to depend on the rigidity or tenacity of the bodies and the quality of the matter which is used to put them in motion [...]. The difference of quality of tone seems to be caused by a little noise mixed with the appreciable sound: for example, in a melody which is heard, besides the vibrations of the air, the friction of this fluid on the organs of the voice; on the violin, besides the vibrations of the strings, we hear the friction of the bow on

¹⁵³ Bishop (2005, 60) first cited p. 33.

¹⁵⁴ Szendy (2008a, 25) first cited p. 41.

¹⁵⁵ Chladni (1830, xiii) first cited p. 41.

¹⁵⁶ Szendy (2008a, 25) first cited p. 41.

¹⁵⁷ Reid (2002). For a more in depth discussion of partial tones, see p. 60.

the strings, &c. Perhaps the different kinds of noise and quality of sound consist in the unequal motions of the smallest parts of the body [...]. (Chladni, 1821, 171)

I found the level of detail in Chladni's writing compelling because it dealt with how traces of material objects (sonorous bodies and the agents that excite them) might be inferred through listening, a subject I had become interested in through *Lenses* and my research into the sound of the musical glasses.¹⁵⁸ With *Carillon*, I wanted to explore differences in the quality of sound produced by the guitar-cymbal; how the stroke of a violin bow along the ridged strings of the guitar would inflect the sound differently to the stroke of a finger, a paintbrush, or a coil of copper wire. As well as varying the materials used to excite the strings, I wanted to employ a range of different gestures. My experience as an amateur viola player meant that I was aware of how subtle differences in the position, pressure and speed of a bow against a string could produce remarkably diverse sounds. Using various objects I investigated the effects of percussive and sustained, gentle and forceful contact with the strings.

Chladni's concern with timbre was evident in the musical instruments he invented. The *Euphon* (1789-90) comprised of a series of glass rods, sounded by rubbing with moistened fingers. The name of the instrument was intended to refer to its *angenehmen Klang* [pleasant sound] (Chladni, 1830, xv). Chladni was so enchanted by the thought of the sound this instrument would produce, he confessed to playing and hearing it many times in his dreams before the instrument itself was realised (1830, xv). He was inspired to make the *Clavicylinder* (1799-80), as he desired an instrument with a sensitive keyboard that would allow the player to *fortdauer* [prolong] sound with the nuances of *anwachsen* [crescendo] and *abnehmen* [diminuendo] according to the pressure of the fingers on the keys (1830, xvi).¹⁵⁹ Chladni seems to have been motivated by the thought of how the expression of the player could be transferred, through the touch of their fingers, to the quality of the sound. This is another element I had considered in relation to *Lenses*¹⁶⁰ and was keen to explore further with *Carillon*.

According to Myles W. Jackson, Chladni was something of an "anti-elitist," seeking to engage amateurs with his instruments rather than musical "virtuosos" whom he criticised for allowing "speed of playing" to take priority over the "quality of sound" produced (Jackson, 2006, 44). This emphasis on the quality of sound puts Chladni at odds with Coleridge, who felt that the appreciation of music should depend upon the "proportions of the notes"¹⁶¹ and not the timbre of sound.

My prior experiences of "non-virtuoso" music making fed into *Carillon's* improvised quality. I had previously invited Malcolm Atkins, Jem Finer, Dominic Lash and Jonny McHugh to collaborate on *Rounds* (2005-7).¹⁶² These were durational performances of between one and three hours, in which the emphasis was on the sustained sound of the musical glasses. Other instruments (including the hurdy gurdy and double bass) added accents and nuances to the "bed" of sound created by glasses. The focus was on making slight variations in quality of sound rather than perfecting any pre-determined

¹⁵⁸ See Chapter 1 from p. 21.

¹⁵⁹ "Ein Hauptbestreben von mir war, ein Tastaturinstrument zu erfinden, auf welchem man jeden Ton nach Belieben fort dauern und durch mehr oder weniger Druck anwachsen oder abnehmen lassen könnte" (1830, xvi).

¹⁶⁰ See p. 29.

¹⁶¹ Coleridge (1809) in Hadlock (2000, 537) first cited p. 25. Contrasting notions of what should distinguish music from sound are discussed pp. 62, 69, 91.

¹⁶² Dawn Scarfe *Rounds* (2005-7). Collaboration with Malcolm Atkins, Jem Finer, Dominic Lash and Jonny McHugh see <<http://www.dawnscarfe.co.uk/work/rounds>> accessed 2nd May 2011.

melodic structure. In a similar respect, *Carillon* used the sound of the guitar-cymbal as its “score.” The priority was to explore the timbre of its sound in detail.

My interest in an improvised approach to performing was renewed by my participation in Marina Rosenfeld’s *Sheer Frost Orchestra* (2006).¹⁶³ I joined an “all-female 17 electric guitar ensemble” (Electra, 2006) using nail polish bottles to excite the strings of the guitar according to the instructions given in a graphic score. Rosenfeld selected players by virtue of their interest in the project, and no previous musical experience was necessary. She prioritised “the immediacy of new experience [...] over virtuosity or the kind of standardisation of skills and technique that is the essence of conservatory or ‘classical’ musical education” (Rosenfeld in Dzuverovic and Neset, 2005, 23). For the participants, the social activity of meeting and rehearsing the piece was as important as performing the work in front of an audience. Kim-Cohen observed:

The primacy of the performance over rehearsal is destabilised by the social aspects of the rehearsal sessions. Virtuosity is disarmed by the unconventional playing technique that privileges spontaneity and idiosyncrasy over practiced craft. (2009, 249)

Having enjoyed being part of Rosenfeld’s unconventional orchestra, I was keen to develop my guitar-cymbal work in collaboration with at least one other person as a means of sharing my practice and opening it up to new influences. I had found producing *Lenses* and embarking on full-time PhD research to be a largely solitary exercise. A friend invited me to perform at Café Oto¹⁶⁴ and this was an incentive for me to seek out a collaborator to work on the guitar-cymbal project. I approached Mel Gough, whom I had met at Goldsmiths, University of London in 2005, because we shared many interests. Gough had studied the tuning strategies and the “corporeal” instruments of Harry Parch (Gough, 2005), and I had been very intrigued by her solo performance *Small Sounds Up Close* (2005) with canned air, sand, Velcro and contact microphones.

As with the *Lenses* performance, my decision to work with a female accomplice on *Carillon* was not incidental. I was mindful of Hadlock’s assertion that, in the eighteenth century women were generally regarded as musical amateurs, expected to demonstrate restraint and poise whilst performing.¹⁶⁵ I wondered whether similar assumptions might still be brought to bear on musical performances by women, even in the context of “experimental” music. My awareness of these issues had been fostered through my involvement with Rosenfeld’s orchestra, which confronted notions of gender and virtuosity in a light-hearted way. In *Sheer Frost Orchestra* the guitar, an emblem of in Rosenfeld’s terms “almost comic masculinity” (Dzuverovic and Neset, 2005, 27), is laid on its back on the floor and tapped rather delicately by women using cosmetic implements as percussive tools. For *Carillon*, I positioned the guitar-cymbal on the floor in a similar fashion, as I wanted to avoid connotations of rock and metal style posturing. On a more expedient point, I found it easier to play that way too.

¹⁶³ Marina Rosenfeld, *Sheer Frost Orchestra (Cage Version, 2006)* Tate Modern, London, Sunday 28th May, curated by Electra.

¹⁶⁴ Jonny McHugh curated an evening of performances at Café Oto, 21st September 2008. <<http://www.cafeoto.co.uk/programme/oceans.shtm>> accessed 23rd May 2011.

¹⁶⁵ First discussed Chapter 1 p. 21.

Before joining Rosenfeld's *Sheer Frost Orchestra* I worried that her work might be playing on the idea of femininity and re-enforcing some of its less desirable associations, with the nail polish suggesting a concern with cosmetics, and the emphasis on amateur performers linking women specifically to being incompetent musicians.¹⁶⁶ However, the experience of being in a line of women playing electric guitars made me realise that there is something distinctive about the presence of women. *Sheer Frost Orchestra* encouraged me to acknowledge that being female is part of my identity, and something I should consider when performing my own work in public, for the impact it might have on people's responses to my work.

During the first practices with Gough, I demonstrated the guitar-cymbal set up and explained the quality of sounds I was interested in pursuing. We listened to recordings of the object-speakers in Tudor's *Rainforest IV* (1981, LP) and Javanese court gamelan (Nonesuch Explorer, [1971] 2003, CD), as at the time I was fascinated by the resonant and inharmonic sound of metallophones and bronze gongs. Gough engineered a synthesizer-cymbal in order to explore how the cymbal would respond to sweeping sine waves. We met regularly to play together, always recording the results and listening to them back over again, discussing the positive and negative aspects of our efforts. Once we had settled on the basic instrumentation (two guitar-cymbals, and one synthesizer-cymbal), we worked hard to refine the structure and dynamics of our performance. We set ourselves certain guidelines, such as one person taking the "lead" whilst the other decided whether to support or subvert whatever was being played, and *vice-versa*. We were both keen that these strategies were not too prescriptive. We wanted to keep the piece intuitive, so that we might hear and learn new things each time it was performed.

The set-up gradually became more sophisticated, for example with better cymbals and larger Fender guitar amplifiers rather than small practice ones, but there was still an element of chaos to the piece which Gough and I both liked. Sometimes the tenuous nature of the instrumentation would backfire. A missing bit of Blu-Tack between the speaker and the cymbal would make the difference between a gong-like ring and a rattle, but this helped to focus our attention and energies whilst performing.

One of the recurring features of the performance was the process of tuning into the cymbal. We did this at the beginning of the piece and then periodically throughout (as opposed to the conventional musical practice of tuning the instruments beforehand). We would bend the pitch of the guitar strings in and out of the resonant response range of the cymbal, in an attempt to convey the sense of the cymbal having its own preferences. We decided that arranging our instruments on the floor, and sitting on the floor to perform would lend itself to a more relaxed atmosphere and give the audience a better view of how the materials were connected up. It was important that this aspect of the work was transparent. Being on the floor worked against what we felt to be a tendency in a particular strand of improvised music, whereby people sit almost motionless behind tables with laptops and various other box-like electronics.

In calling the work *Carillon*, we hoped to allude to the quality of sound we were striving for: inharmonic, metallic and sonorous. On a personal level, I was interested in the hybrid nature of the

¹⁶⁶ Associations between women and poor musicianship were identified by Hadlock as prevalent in the eighteenth century (2000, 509-538) first cited p. 21.

carillon as an instrument, how the keyboard mechanism activated the bells allowing the carillonist to vary the loudness of the bell tone according to the force applied to the key.¹⁶⁷ I felt this was in keeping with the amalgamated nature of our guitar-cymbal set up, and my original concern with using one instrument to sound another. Neither of us liked the idea of being referred to as a “duo,” despite this being commonplace in the improvising circuit we were venturing into. We felt that the term put an emphasis on the people rather than the work, and we wanted *Carillon* to have its own identity and purpose.

The initial invitation to perform at Café Oto, an east London performance venue associated with the improvised music scene, meant that the form of *Carillon* was oriented towards this setting. It is often said that improvised music is open to amateurs as well as seasoned performers, a “genuinely democratic realm full of cooperation, coexistence and intersubjective exchange” (Cox and Warner 2004, 251-2). For this reason we found it rather surprising that Richard Pinnell, an Oxford based critic of “the improvised and experimental music world,”¹⁶⁸ should post a review of our set at Oto which focussed almost entirely on the novelty of our age and gender and how (in his opinion) we were “new” to this particular field:

[I]t was great to see two young (and female) performers get up in front of a 60 or 70 strong audience and play like this. If I’m honest the music left a lot to be desired, but it was certainly very much their own, quite individual music and hopefully given time they will grow into seasoned musicians I can sing the praises of. (Pinnell, 2008)

I felt that Pinnell’s statement revealed how notions of professional “musicianship” can come in to play in this supposedly anti-elitist arena. I also found it quite astonishing that our age and gender should have been such a dominant part of Pinnell’s experience, implicitly linked to our apparent “inexperience” in his view. This sentiment seemed remarkably reminiscent of Hadlock’s assertions about the status of women in music during the eighteenth century.¹⁶⁹ In another part of his review Pinnell suggested: “The presence of a lot of younger players on the bill [...] meant that the audience was also very young, and remarkably female.” I struggle to understand why the notion of women listening to improvised music should be in any way “remarkable.” However I hope that our appearance in this field at least helped to challenge such a perspective. Other members of the audience seemed more appreciative of what we were trying to achieve with *Carillon*, and we were invited back to play the same piece at Café Oto on two subsequent occasions.¹⁷⁰

Carillon was performed in art galleries, arts centres and experimental music venues,¹⁷¹ which suggests that the subject matter had some appeal to both art and music audiences. Due to the time it took to set up our hybrid instruments, and the delicate nature of some of the connections amongst the electronic components, we found that it was preferable to perform it in the context of art galleries, where there would generally be more time and space to set-up in.

¹⁶⁷ For a description of the mechanics of the carillon see p. 39.

¹⁶⁸ From Pinnell’s biography <http://www.thewatchfulear.com/?page_id=2> accessed 6th August 2011.

¹⁶⁹ See Hadlock (2000, 509-538) first cited p. 21.

¹⁷⁰ For performance dates see p. 5.

¹⁷¹ For performance dates and venues see p. 5.

The main value of *Carillon* for me was the process of practising and performing with Gough, listening and responding to each other during the performance (with the instruments) and afterwards in dialogue. However I was never really convinced by the way in which we were engaging with the audience, asking them to sit back, listen and observe us play from a distance. I felt that their experience wasn't as rich as ours because we enjoyed the physical exploration of the instruments, the tactility of the different tools and how subtly different gestures would inflect the sound. I wanted to move on from the more conventional model of performance we were using, and think about how some of *Carillon's* underlying motivations, such as the use of sounding instruments as models of sentient bodies, might be explored in alternative situations and circumstances. *Carillon* was very much about exploring the sound of objects, and I was keen to return to the issue that had dominated my earlier work: how we form our impressions of our environment and the ways in which listening can be used to modify these impressions.

Chapter 3. Enlightened Ears.

Case study 5: Listening Glasses (2009)¹⁷²

Sound installation with glass sculptures

Listening Glasses are hollow spheres of glass with a small funnel-like opening at one side, which is inserted into the ear and a circular aperture at the other, which is exposed to the air. Each glass is tuned to a particular musical tone,¹⁷³ and acoustically amplifies this tone through sympathetic resonance.¹⁷⁴ Using such a glass, a listener can discover a musical tone in sound that might otherwise have been too quiet to be noticeable.

The design of the *Listening Glasses* emulates nineteenth century acoustic tools named Helmholtz resonators. Helmholtz revealed that he had used glass resonators to listen for musical tones in the sound of his environment ([1877] 1954, 44). Fascinated by the thought of trying this exercise myself, I produced a new series of resonators. The installation *Listening Glasses* was commissioned for the exhibition 'Sound Escapes' (2009).¹⁷⁵ The work consisted of five differently tuned glass resonators on a mahogany stand. Accompanying paraphernalia included sterile speculums, cloth gloves and a small leaflet,¹⁷⁶ which invited gallery visitors to use the glasses to listen for musical tones in the sound of other works featured in the exhibition, as well as in ambient environmental sound.

¹⁷² See Figure 12 p. 59 and Case study 5: *Listening Glasses*, Disc 1, for further documentation.

¹⁷³ I use the term "tone" throughout this chapter because it is frequently employed in Helmholtz (1954). I understand it to denote, in accordance with Truax's description: "A single sound of definite, recognizable pitch. It also refers to the sonority or the quality of timbre of a particular sound or sounding instrument" Truax, 1999: *Handbook for Acoustic Ecology* <<http://www.sfu.ca/sonic-studio/handbook/Tone.html>> accessed 18th August 2011. It is also worth noting here the difference between "frequency" which represents the number of times a sound wave oscillates within a given period, and "pitch" which, as Ellis explains, is the subjective sense of frequency (Helmholtz, 1954, 11).

¹⁷⁴ An introduction to the phenomenon of sympathetic resonance, and its anthropomorphic characteristics most pertinent to this thesis is given on p. 16. For Helmholtz's definition of the term see 1954, 36.

¹⁷⁵ 'Sound Escapes,' Space Studios, London, 25th July to 15th August 2009. For press release see:

<<http://www.electra-productions.com/projects/2009/soundescapes/overview.shtml>> accessed 23rd May 2011.

¹⁷⁶ Images of this leaflet are provided as part of Case study 5: *Listening Glasses*, Disc 1.

Case study 6: Through the Listening Glasses, (2010)¹⁷⁷

Audio for headphones, duration 14min.

This work documents my search for the tones of the *Listening Glasses* in “the whistling of the wind, the rumbling of carriage wheels [and] the splashing of water” ([1877] 1954, 44) as Helmholtz claimed to have done. I took a series of glasses outside and recorded my investigations using binaural (in ear) microphones. Initially developed as a means of documenting the effects of the *Listening Glasses*, the recordings have since been exhibited as an installation¹⁷⁸ accompanied by two leaflets, one in the “voice” of Helmholtz,¹⁷⁹ another giving a short introduction to the aims of the piece.¹⁸⁰ Headphones must be used to listen to the work.

Case study 7: Do You Hear What I Hear? (2010)¹⁸¹

Eight-channel¹⁸² sound installation for TONSPUR,¹⁸³ quartier21/MuseumsQuartier, Vienna, Austria, duration not specified.

A mysterious Aeolian sound emanates from the TONSPUR_passage, its tonal range shifting gradually over time. The audio was collected in an experiment: a search for musical tones in the sound of a road, inspired by Helmholtz’s act of listening to “the rumbling of carriage wheels”¹⁸⁴ through his resonators. I positioned eight differently tuned *Listening Glasses* by the side of a road, placed a small microphone inside each one and made eight simultaneous recordings. The differently tuned streams of audio were played through the eight speakers in the TONSPUR_passage, and the diffusion varied continuously throughout the duration of the exhibition (23rd August to the 27th November 2010).

¹⁷⁷ See image on p. 59 and Case study 6: *Through the Listening Glasses*, Disc 1, for further documentation.

¹⁷⁸ See p. 5 for places and dates exhibited. A CD featuring *Through the Listening Glasses* accompanied Scarfe, 2010, 43–6.

¹⁷⁹ This was the same design of leaflet produced for the *Listening Glasses* installation, described on p. 81 and documented as part of Case study 5: *Listening Glasses*, Disc 1.

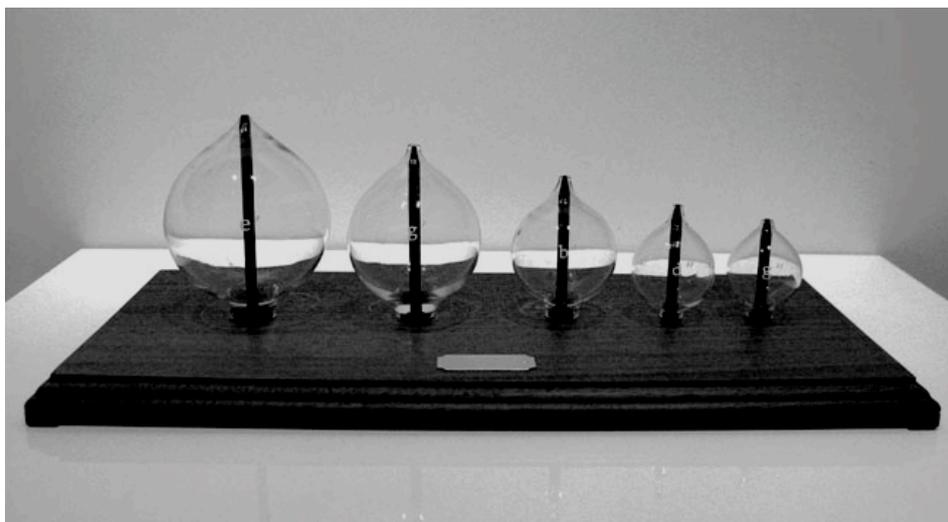
¹⁸⁰ See Case study 6: *Through the Listening Glasses*, Disc 1, for documentation.

¹⁸¹ See Figure 14 p. 59.

¹⁸² The notion of an audio “channel” is explored on p. 33.

¹⁸³ TONSPUR is a programme of sound works curated by Georg Weckwerth and Peter Szely at quartier21 / MuseumsQuartier, Vienna since 2003 <http://www.tonspur.at/w_36_en.html> accessed 1st June 2011.

¹⁸⁴ Helmholtz (1954, 44) first cited in previous paragraph.



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Figure 12. *Listening Glasses*. Photo: Dawn Scarfe 2009.

Figure 13. *Through the Listening Glasses*, South Mill Fields, London. Photo: Luke Saunders 2010.

Figure 14. *Do You Hear What I Hear?* TONSPUR_passage, Vienna, Austria. Photo: Dawn Scarfe 2010.

Re-hearing Helmholtz resonators

This third chapter focuses on the works I produced between 2009-10 using Helmholtz resonators. I spotted an illustration of a glass resonator in Helmholtz's study on acoustics,¹⁸⁵ and was intrigued by the thought that this delicate spherical vessel might momentarily "catch" partial tones from the air, amplifying them and allowing them to be heard. An anecdote about how the resonators were (mis)used by Helmholtz fascinated me. As well as employing the tools to identify specific partial tones in the sound of musical instruments, Helmholtz directed the resonators towards sound outside of his laboratory such as "the whistling of the wind, the rumbling of carriage wheels [and] the splashing of water."¹⁸⁶ The gesture seemed playful and suggested Helmholtz had taken pleasure in a peculiar form of aural detective work. It led me to wonder what could be appealing about discovering particular musical tones in the sound of the environment. I was curious to find out how the resonators might direct listening, and whether or not they could foster a more sensitive awareness of tonal details in sound. Inspired by these notions I set about producing a new series of resonators.

Hearwear

To inform my development and use of the resonators, I wanted to understand how the instruments related to Helmholtz's theory of hearing and how he used them to distinguish between noises and musical tones. This next section explores how these issues are presented in Helmholtz's study *On the Sensations of Tone as a Physiological Basis for the Theory of Music* ([1877] 1954). Following the work of Ohm and Fourier,¹⁸⁷ Helmholtz asserted that many sounds which appear to originate from one source, such as a single note on the piano, are actually "compound tones" which consist of a number of "partial tones."¹⁸⁸ Partial tones had been intuited by musicians, but their subtlety meant they were often dismissed as figments of the imagination.¹⁸⁹ Helmholtz set out to prove the objective existence¹⁹⁰ of partial tones, because he believed that our ability to hear them could help to reveal how the inner ear functioned.

The main principle underpinning Helmholtz's theory of hearing was sympathetic resonance.¹⁹¹ He hypothesised that the inner ear generated sensation when auditory nerves vibrated in sympathy with oscillations in the air. He claimed that individual auditory nerves "decomposed" or "resolved" wave forms into their simplest constituent partial tones, acting according to the same mechanical laws exhibited by "the sympathetic vibration of elastic bodies" (1954, 128, 49). In a manner reminiscent of Descartes and natural philosophers of an earlier generation,¹⁹² Helmholtz employed acoustic instruments to develop and model his theory of hearing. He used the piano to illustrate the processes he believed to be at work in the inner ear:

¹⁸⁵ It was Figure 16a that I was particularly drawn to for its translucent spherical design. Figure 16b illustrates an alternative, opaque tubular design, see Helmholtz (1954, 43).

¹⁸⁶ Helmholtz (1954, 44) first cited p. 58.

¹⁸⁷ Helmholtz outlines the relevance of Ohm and Fourier's work to his theory of hearing (1954, 33-34).

¹⁸⁸ For Helmholtz's definition of "compound" and "partial" tones see 1954 (22-23). Partial tones are discussed in more detail on p. 60.

¹⁸⁹ Helmholtz remarked that in his experience, musicians were "inclined to think" of partial tones as "an illusion of the ear" (1954, 48). This notion is discussed by Erlmann (2010, 224).

¹⁹⁰ The issue as to whether these tones were apprehended consciously or otherwise is considered on p. 65.

¹⁹¹ For an introduction to the phenomenon of sympathetic resonance, and its anthropomorphic characteristics most pertinent to this thesis, see p. 16.

¹⁹² See Chapter 2 from p. 39 for examples of other natural philosophers using the musical instruments to model bodily processes.

Gently touch one of the keys of a pianoforte without striking the string, so as to raise the damper only, and then sing a note of the corresponding pitch forcibly directing the voice against the strings of the instrument. On ceasing to sing, the note will be echoed back from the piano. (1954, 38)

Helmholtz claimed this effect was dependent on “the same law” as the sensation of partial tones in the ear:

The end of every fibre of the auditory nerve is connected with small elastic parts, [like the piano] which we cannot but assume to be set into sympathetic vibration by the waves of sound. (1954, 129)

Julia Kursell suggests this metaphor worked in two ways; Helmholtz “perceived the piano to be a reconstruction of the ear” and likewise, theorised the ear’s functioning on the design of the piano (Kursell, 2005, 95-6).

Brown points to how Helmholtz’s resonators display the same amplifying effect of “any [musical] instrument comprising a resonant sound box and [...] aperture: an acoustic guitar for instance” (2010, 151).¹⁹³ Like the piano, the resonators can be regarded as acoustic models that represent Helmholtz’s theory of hearing:

When a compound musical tone or chord is presented to the ear, all those elastic bodies [nerve fibres, like resonators] will be excited, which have a proper pitch corresponding to the various individual simple tones contained within the whole mass of tones [...]. Physiologically it should be observed that the present assumption reduces sensations which differ qualitatively according to pitch and quality of tone, to a difference in the nerve fibres excited. (1954, 148)

Helmholtz’s assertion that our sense of the quality of a sound (with regards to its pitch and timbre) can be “reduced” to the stimulation of particular nerves, is evocative of Ritter’s hypothesis that a single impulse can affect different organs of sense in disparate ways, discussed in the previous chapter.¹⁹⁴ Helmholtz compared his own theory to Johannes Müller’s law of the “specific energies of sense” which postulated that sensations arise from the state of the nerves, rather than the external phenomena that might excite them (1954, 148). To elucidate this idea, Helmholtz likened the nerves to telegraph wires, describing how both carry signals that produce different effects depending on the type of apparatus wired into the receiving end (1954, 149). This notion implies that the senses we use to engage with the world might be radically manipulated. Jonathan Crary suggests that Helmholtz was interested in “exchangeability” between the senses: “the body’s indifference to the sources of its experience, and its capacity for multiple connections with other agencies and machines” (1992, 94). The notion of specific energies of sense, applied specifically to the faculty of hearing, raises the possibility of reconfiguring the audible, using technology to transform unpleasant sound into music to our ears.

¹⁹³ Brown also offers a very detailed account of the physical processes involved in Helmholtz (or cavity) resonance. See Appendix 3 p. 100 for extract.

¹⁹⁴ See p. 45.

Helmholtz considered the different kinds of sensation the ear gives rise to, and identified musical tones and noises as two possible extremes. He described musical tones as “simple [and] regular” in contrast to noises, which he characterised as: “irregularly mixed up and [...] tumbled about in confusion” (1954, 8). This is not to say he believed that noises and musical tones were unrelated. On the contrary, his work showed how one “extreme” could be synthesised or refined from the other. Resonators could be used to help the ear identify musical tones in noise (1954, 7), and tones from a musical instrument could be fused into noise:

[W]e can easily compound noises out of musical tones, as, for example, by simultaneously striking all the keys contained in one or two octaves of the pianoforte. (1954, 8)

From this practice of processing noise into music and *vice versa*, a logical development would be technologies that manipulate what we hear. Like Crary, Sterne argues that because Helmholtz conceived of sound as an effect produced in the ear, the actual source of the sound became “irrelevant”: “if you can get the same reaction in the nerve, you create the same sensation” (2005, 65).¹⁹⁵ Sterne judges this aspect of Helmholtz’s work to be significant, in that it prepared the ground for the development of sound reproduction technology (2005, 65). As an extension of this notion, by designing resonators that functioned as prosthetic listening tools, Helmholtz could be credited with inventing a rudimentary form of “hearwear:” devices that modify the audible according to personal preferences.

‘Hearwear: the future of hearing’ was chosen as the title of an exhibition at the V&A Museum in London, which featured intriguing gadgets such as *The Beauty of Inner Space* by Ross Lovegrove: “designed to cancel out the noise pollution of everyday life and to amplify sounds we would like to hear” (Hearwear, 2005-6). Writing in 2009, Max Dixon speculated on the invention of advanced hearing systems that might give us greater creative control over the audible:

Mobile phones may increasingly converge with iPods and worn or semi-implanted personal computing to offer us more choice over how we experience incoming sounds. Perhaps we will choose to augment certain sound signals, such as the higher pitches of birds. Perhaps ambient-responsive generative compositions, perhaps just an intelligent earplug, will learn our soundscape¹⁹⁶ preferences. (2009, 5)

It would seem then, that the idea of modifying or rewiring our sensations through technology continues to provoke new inventions and fantasies. But the more problematic question raised by Müller’s theory of the specific energies of sense, is to what extent can our sensory impressions be considered reasonable interpretations of reality? How might this issue impact on the methods scientists and artists use to approach the “outside world”?¹⁹⁷ In order to try and find Helmholtz’s perspective on this issue I will now go deeper into the details of his theory of hearing and its relationship to the practice of music.

¹⁹⁵ Sterne’s assertion that sound is an “effect that can be reproduced, rather than something that is tethered to a specific and local cause” (2003, 65) was introduced p. 15.

¹⁹⁶ See p. 79 for a discussion of the term “soundscape.”

¹⁹⁷ This term is borrowed from Helmholtz, who contrasts *Aussenwelt* [the outside world] with *subjectiven Erscheinungen* [subjective impressions] (1863, 101-102).

Helmholtz on music

A key aim of Helmholtz's work on acoustics was to establish "a physiological foundation for theory of music."¹⁹⁸ He recognised three distinct approaches to acoustics: "physical" (dealing with the vibrations which act as the stimulus for sensation), "physiological" (dealing with the activity occurring within the ear itself, giving rise to sensation) and "psychological" (the processes by which sensations result in mental constructs of external phenomena, as in perceptions) (1954, 4). He argued that a scientific understanding of the functioning of the ear was particularly relevant to the theory of music:

[I]t is precisely the physiological part in especial—the theory of the sensations of hearing—to which the theory of music has to look for the foundation of its structure. (1954, 4)

Helmholtz believed that the mechanisms at work in the inner ear guided the development of musical principles. This related to his assertion that the inner ear resolved sound into its constituent partial tones.¹⁹⁹ He claimed that the relationship between the partial tones determined the "musical quality" or timbre of a sound, and insisted that only instruments that produced harmonic upper partial tones had "a really musical quality" to their sound (1954, 74). This led him to declare that the sound produced by the glass harmonica was thin, insubstantial and unmusical due to its lack of harmonic upper partial tones.²⁰⁰

The principle that the ear reduces waveforms to their simplest constituents also underpinned Helmholtz's account of the sensation of musical intervals. The basic premise was that consonant intervals arise from the "undisturbed coexistence of sound" (1954, 181). Following Euler,²⁰¹ Helmholtz argued that the degree of harmoniousness of an interval was dependent upon "the ratios of the periods of vibration which characterise the intervals" and that the smaller the ratio, the more "pleasing" and "perfect" the consonances (1954, 230). These assumptions led Helmholtz to argue that the Western standard of twelve-tone equal tempered tuning, which involves complex ratios (such as 635:504 for a major third²⁰²) resulted in "imperfect consonances" which "threatened to lord it over the natural requirements of the ear" (1954, 207, 327).

Helmholtz's enthusiasm for the unconventional just intonation system was not matched by that of the majority of musicians and commentators on musical practice of his era, as the following review indicates:

Some of [Helmholtz's] experiments require not only very delicate instruments, but a special training of the sense of hearing; a sense liable, perhaps more than any other, to subjective illusions, and for that reason alone such experiments are better out of the hands of musicians. The decision of musico-acoustical questions must be left wholly to cool-headed specialists, who possess the requisite knowledge and apparatus, and are not likely to hear certain intervals which at the moment may not be in existence, or to sacrifice the purity of

¹⁹⁸ As the title of his publication suggests (Helmholtz, 1954).

¹⁹⁹ See p. 60.

²⁰⁰ Helmholtz (1954, 289-90) first cited Chapter 1 p. 25.

²⁰¹ Helmholtz explains Euler's perspective as follows: "the human mind had a peculiar pleasure in simple ratios, because it could better understand them and comprehend their bearings" (1954, 15).

²⁰² From a table comparing intervals in perfect, equal and Pythagorean temperaments (1954, 313).

science to technical mystifications and individual desires. [...] Years ago Mr Ellis expressed the opinion that Helmholtz had “sounded the death knell of equal temperament”; and now, in 1885, Mr Ellis’s second edition naturally suggests the questions—How is it that the knell is still sounding? How is it yet that the funeral procession does not move, and that our defunct friend is not yet formally consigned to the tomb? (*The Musical Times and Singing Class Circular*, 1886, 481-2)

Helmholtz himself would seem to be aware of the limits of bringing the results of scientific enquiry to bear on musical practice:

[T]he system of Scales Modes and Harmonic Tissues does not rest solely upon inalterable natural laws but is also, at least partly, the result of esthetical principles, which have already changed, and will still further change, with the progressive development of humanity. (1954, 235)

However, his acknowledgement that aesthetic principles are subject to variation and development did not lessen his conviction that they related at the most fundamental level to the processes at work in the ear. He wrote that whilst the mechanisms of the ear might not have been consciously understood by generations of musicians and composers, their physiological features had guided their instinctive preferences for pleasing harmonic structures (1954, 235). He pointed to similarities between the structure of constituent partial tones in compound tones, and the individual musical tones used to form chords, suggesting that sympathies between these arrangements arose through an “unconscious sense of resemblance” intuited by musicians. He likens this “unconscious sense” to our capacity to infer shared facial characteristics amongst family members of a different age and sex (1954, 369-70). Erlmann points to the paradox in this idea that musicians had made seemingly rational choices based on unconscious “tonal affinities” (2010, 264).

The faith Helmholtz placed in his own discerning ears has been identified by David Pantalony as symptomatic of the status of music in the scientific culture of the time. He proposes, “Helmholtz, [Rudolph] König, and many of their contemporaries were all amateur musicians who believed that their good ears were an asset to their experiments” (2005, 82).²⁰³ Ironically, Pantalony describes how Helmholtz’s theories regarding the objectivity of combination tones came under fire from König, the instrument maker responsible for “buil[ding] Helmholtz’s ideas into apparatus” (2005, 57). König claimed that the tools Helmholtz used to make his observations contained too many “unwanted” partial tones for the results to be accurate and objective. Directly contradicting Helmholtz, König argued that combination tones were subjective, arising through the act of perception (Pantalony, 2005, 72).

Helmholtz devoted much thought to the relationship between artistic and scientific practice. He acknowledged that art was “another way, besides that of science, to acquire insight into the complicated workings of nature” ([1892] 1971, 481). Dani Hallet suggests that Helmholtz recognised intuition as an important aspect of the early stages of both artistic and scientific enquiry (2009, 185). But whilst Helmholtz believed that “tentative exploration or the play of imagination” (1954, 235) was

²⁰³ See also Jackson (2006).

to be celebrated in art, he felt science should pursue a path of rigorous, evidence-based research and remove all “arbitrary” elements in the process of developing natural laws (1954, 234). His acoustic investigations were limited to the “elementary musical art” of scales and harmony (1954, 366) and did not extend to complete musical works, as he believed the latter would be dominated by complex psychological motives over more easily quantifiable physiological processes and structures. However, Helmholtz entertained the “alluring” thought that future scientific research might “explain the wonders of great art, and learn the utterances and various affectations of the mind” (1954, 371). Once again, it is possible to identify in this sentiment something of Goethe’s notion of “tone monads,”²⁰⁴ Mesmer’s magnetic therapy,²⁰⁵ and Szendy’s vision of experimentally controlled “subject plates”²⁰⁶ whose nerves and emotions might be manipulated and dominated.

Erlmann points to the complex interweaving of science and aesthetics in Helmholtz’s work, and uses this as evidence of Goethe’s influence on his ideology (2010, 248). He claims that Helmholtz’s theory of knowledge became marked over the course of his career by “a dwindling trust in the fallibility of scientific reason and the concomitant acceptance of aesthetic modes of induction as equal partners in a search for truth” (2010, 250). Erlmann finds discrepancies in Helmholtz’s theories by contrasting the four different editions of his study on acoustics. He argues that Helmholtz reconfigures and sometimes blurs relationships between consciousness and sensation, reason and resonance (2010, 252). One of the inconsistencies he points to is that Helmholtz appears to have changed his mind about whether hearing individual partial tones should be regarded as “mere” sensation, or a more conceptually rigorous act of making sense of the audible (2010, 236-7). Erlmann suggests that the physical labyrinth of the inner ear and difficulties in distinguishing between conscious and unconscious modes of hearing and listening led Helmholtz to reach ambiguous conclusions about the processes involved in perception, characterised by such notions as “thought without consciousness” (2010, 252). Erlmann makes a convincing case that Helmholtz’s weighty tome on acoustics “needs to be rediscovered as a major document of the mounting crisis of modern rationality and aurality during the second half of the nineteenth century” (2010, 220).

I had been drawn to Helmholtz’s act of using the resonators to listen to aspects of his environment because it seemed intuitive and playful, even “slightly potty,”²⁰⁷ and not at all how I expected an eminent scientist such as him to behave. Helmholtz seemed to place himself, in Ingold’s terms, “in the midst of things” and to “break all the rules”²⁰⁸ of scientific protocol in the process. His act alluded to the idea of hidden harmony in nature, and of a desire to find meaning in the sound of the air in a similar way in which the Aeolian harp was put to use by nineteenth century romantic poets.²⁰⁹ I liked to think that whilst using a resonator Helmholtz’s ear led him astray, calling him to the “whistling of the wind”²¹⁰ when he was studying the sound of the piano. My projects with the resonators were driven by my interest in his diversion from the quantitative study of partial tones in the sound of musical instruments towards the more whimsical and speculative activity of engaging with quotidian sounds of his environment.

²⁰⁴ First cited p. 41.

²⁰⁵ First cited p. 22.

²⁰⁶ Szendy (2008a, 26) first cited p. 42.

²⁰⁷ Michael Hampton remarked that Helmholtz’s act demonstrated “a slightly potty yet feline sensitivity to the world of sound” (2010, 27).

²⁰⁸ Quotes from Ingold (2011 15-16) first cited p. 46.

²⁰⁹ The Aeolian harp is discussed in more detail p. 75.

²¹⁰ Helmholtz (1954, 44) first cited p. 58.

I have pointed to how Helmholtz's advocacy of the just intonation tuning system met with indifference on the part of musicians of his time.²¹¹ But there is evidence to suggest that Helmholtz's acoustic work influenced subsequent generations of artists. Harry Partch made repeated references to Helmholtz's work through his investigation into unconventional tuning systems.²¹² Russolo ([1916] 1986, 37-9) and Schafer (1974, 14-17) challenged Helmholtz's distinction between noise and music²¹³ based on the criteria of irregular and regular oscillations. However, it seems reasonable to suggest that Helmholtz's demonstration of the relationship between noise and music, the ways in which one could be derived from the other, and his act of discovering tones in "the whistling of the wind, the rumbling of carriage wheels [and] the splashing of water"²¹⁴ anticipated both Russolo and Schafer's aim of finding music in the sound of the urban environment:

Let us cross a large modern capital with our ears more sensitive than our eyes. We will delight in distinguishing the eddying of water, of air or gas in metal pipes, the muttering of motors that breathe and pulse with indisputable animality. (Russolo, [1916] 1986, 25-6)

I am going to treat the world as a macrocosmic musical composition. (Schafer, 1977, 5)

Holmes argues that the impact of Helmholtz's work extended to the most radical aspects of Cage's practice. He claims that Cage mounted a challenge to the definition of music based, in part, on his understanding that compound tones could be analysed into their constituent partials. Paraphrasing Cage, Holmes elaborates:

Because all sounds are composed of the same primary components and because music is sound, then it must follow that all sounds can be defined as being musical. (2008, 177)

I believe that reconsidering Helmholtz's work on acoustics, regardless of how convincing we might ultimately find it, can help us come to a sharper awareness of the distinctions we choose to make between music and noise, how we listen, and how listening feeds into our impressions of the world. In the following section I will focus on Helmholtz's act of finding musical detail in the sound of the environment and explore the grounds for the appeal of such an activity. Is the notion of using a resonator to listen to the sound around us a liberating or oppressive one? Would it open listeners' ears to tonal details in the world of the audible or limit and restrict what they might hear? I will use the work of Schafer, credited with founding the "interdiscipline"²¹⁵ of acoustic ecology to gain some perspective on these questions.

²¹¹ See p. 64.

²¹² See for example Partch (1979, 144-5).

²¹³ See p. 62 for Helmholtz's distinctions between music and noise.

²¹⁴ Helmholtz (1954, 44) first cited p. 58.

²¹⁵ Schafer's term (1977, 3-4).

Music in the sound of the environment

Without the co-operation of the trees the wind would be helpless to rustle. Without the assistance of the pebbles, the brooks would not bubble. Sounds of the past, including many of those produced by nature and all those produced by animals and humans, were produced by the give-and-take circumstances of the living environment. One may call this acoustic ecology. In other words they depended on environmental feedback to give them their precise tone and character. (Schafer, 1974, 69)

This notion of a reciprocal relationship between a listener and the sound of their environment is central to Schafer's concept of acoustic ecology. He argued that our capacity to appreciate and to live in harmony with the sound around us rested on our ability to compare it to the sound we produce with our own bodies, for example with our voices, footsteps or breathing (1977, 207). Schafer believed that this principle was threatened by the "ruthless and unecological" noise of motors and industry that had come to dominate modern urban life (1977, 69). A sense of urgency and foreboding underpinned his tone as he described the "imperialistic spread" of noise into "every corner of man's life," and asserted that the sound of the environment had reached "an apex of vulgarity" with the potential to cause "universal deafness" (1977, 3). He warned:

When, as today, environmental sound reaches such proportions that human vocal sounds are masked or overwhelmed, we have produced an inhuman environment. When sounds are forced on the ear which may endanger it physically or debilitate it psychologically, we have produced an inhuman environment. (1977: 207)

Schafer could not stress enough what he perceived to be the danger of excessive levels of noise. He claimed "extremely loud noises seem to glut the brain's sensation-receiving capacity making it impossible for the human being to function" (1974, 25). To emphasise the potential of sound to harm, he cited an article by Max Gunther²¹⁶ describing experiments in military laboratories with sound of "destructive" and "deadly intensities":

The biologist has brought a white rat into the room in a small cage. [...] The biologist lifts the cage into the sound field. The rat stiffens, rises up to the full stretch of his legs, arches his back, opens his mouth wide and falls over. He is dead. An autopsy will reveal that he had died of instant overheating and a massive case of the bends. There are bubbles in his veins and internal organs. (Gunther in Schafer, 1974, 25)

One of the initial goals of acoustic ecology was to study the physical and behavioural effects of the acoustic environment on its inhabitants (1977, 271). Schafer felt that musicians should play a key role in attending to, regulating and protecting citizens from oppressive levels of environmental noise. He considered music to act as a barometer of aural habits and perceptions, asserting that:

Music moves into concert halls when it can no longer be effectively heard out of doors. [...] The string quartet and urban pandemonium are historically contemporaneous. (1977, 103)

²¹⁶ Originally published in 1967: 'The Sonics Boom' *Playboy Magazine* vol. 14 no. 5 pp. 82-83.

Schafer argued that concert music, designed to be heard within the insulating walls of the concert hall, signalled disengagement and disenchantment with the sound of the external environment (1977, 103). For this reason, he found inspiration in experimental music of the twentieth century, such as John Cage's *4'33''* (1952).²¹⁷ He felt such work invigorated music by breaking down the barriers that came between the "containers we call compositions and concert halls" and the sound of the environment (1977, 5). He claimed: "when John Cage opens the door of the concert hall and encourages the street noises to intersect his compositions he ventilates the art of music" (1974, 1). In the light of the precedent set by Cage, Schafer declared:

Today all sounds belong to a continuous field of possibilities lying *within the comprehensive dominion of music*. Behold the new orchestra: the sonic universe! And the musicians: anyone and anything that sounds! (1977, 5)

The proposal that music is latent in all sound would seem liberating. It implies that "anyone" can be a composer, and that the intention to listen transforms the heard into a musical composition (1974, 18). However, Schafer's model of acoustic ecology set out clear standards for how the environment shouldn't sound. At the same time as Schafer asks us to open our ears to the sounds around us, he also urges us to take responsibility for them, to promote those that are desirable, and to "rage" against those that are "ugly, boring or simply unnecessary" (1974, 4, 57). He cites power saws, "electrified kitchen gadgetry," motors and "airplanes" as most offensive to the ears (1974, 57-8). So, inherent in Schafer's call to attend to the sound of the environment is a drive to silence what he feels to be its less attractive features:

We must seek a way to make environmental acoustics a *positive [sic]* study programme. Which sounds do we want to preserve, encourage, multiply? When we know this, the boring or destructive sounds will be conspicuous enough and *we will know why we must eliminate them* [emphasis mine]. (1977, 4)

Schafer used the term "acoustic design" to describe a means of "adjudicating" and "improving" the quality of environmental sound (1977, 237-8). This involved applying some of the aesthetic paradigms associated with the appreciation of concert music in listening to the sounds of the environment, such as attending to rhythms and tempi, relationships between frequency, time and intensity, continuity and interruption, foreground and background, signal and noise (1977, 155, 226). Guided by such concerns, Schafer described acoustic design as the "orchestration" of environmental sound and believed that the task was best suited to musicians. He aspired to foster "beautifully modulated and balanced soundscapes"²¹⁸ such as we have in great musical compositions" (1977, 237) and like Helmholtz, he equated being a musician with having a "good" ear (1977, 155).

Privileging the educated musical ear and using it to identify and "eliminate" offensive sounds from the environment would seem to be a rather authoritarian and oppressive project. Connor points to the paradox of Schafer's position, "a valuing in [Schafer's] soundscape of something like the very

²¹⁷ Schafer describes the work as follows: "In Cage's *4'33'' Silence* we hear only the sounds external to the composition itself, which is merely one protracted caesura" (1977, 5).

²¹⁸ See p. 79 for a discussion of the term "soundscape."

principles of separation and distinctness of which the traditional quarantining of music might be an expression" (2006, 3). It is not Schafer's objective of silencing or arranging particular sounds that provokes the most controversy, but rather the very idea of listening to ambient environmental sound as music. Artists such as Dan Lander have expressed their aversion to such a practice, arguing that "[t]he imposition of a 'musical template' onto the sounds that otherwise, in a day to day context, have meanings other than musical ones, leads us to a dead end conclusion: all sound is music" ([1990] 2011, 64). Kahn takes a similar position, describing the strategy of "attracting everything toward a pair of musical ears" as a "nagging categorical imperialism" that "imagines sounds having nothing to do with humans as music" (2001a, 195-7) and inhibits alternative interpretations of sound:

To musicalize sound is just fine from a musical perspective, but from the standpoint of an artistic practice of sound, in which all the material attributes of a sound, including the materiality of its signification, are taken into account, musicalization is a reductive operation, a limited response to the potential of the material. ([1993] 2011, 31)

In a similar way, Voegelin seeks to disentangle and separate musical concerns from "sonic" ones:

To impose any framework and expectation on to what I hear in this stillness negates the opportunity to listen. To discover the musical in the sounds of this hushed environment destroys the audible. (2010, 86)

Concerns about judging quotidian sound by musical standards would seem to be driven by a particular model of musical listening. Voegelin relies on Hegel's notion of "pure apprehension" to characterise such listening. She proposes: "Apprehending listening is the listening of a trained musician who hears, immediately, what he expects within the rules of a (harmonic) system" (2010, 53). She argues that musical listening is visual listening, a "listening for" the names of sounds and chords, and their organisation in a score, read in a linear fashion. Voegelin suggests that this manner of listening attends to visual references rather than the "sound as heard." She believes the tendency to *listen for* is not limited to musical listening, but extends to "the discussion of sounds by their object" (2010, 53).

I am not a professional musician, so I can only try to imagine the concept of musical listening that Voegelin, Kahn and Lander wish to protect sound from. However, I do wonder whether this model of listening could ever be realised in the way that Voegelin describes. I don't think that listening can be limited to the identification of a single message or relationship in sound, and in this respect I think David Dunn's perspective is more convincing:

The meaning of music cannot be found within the mere structure of notes and/or their semiotic referents. There is no point to point correspondence of communicative intent and reception, and the extent to which there could be, would be a commentary on its triviality. For myself, the familiar information theory model of emotional and expressive communication through music has become untenable. Even though I probably never did accept it, I now consider it to be an extreme case of [...] misplaced concreteness. (1997-8, 77)

Whether or not the act of finding musical qualities in environmental sound can be interpreted as a revelation or an imposition depends on how we choose to define the scope of music, and how we understand the process of listening in general. I will return to the impact of these issues on my practice in the Conclusion.²¹⁹ Leaving aside the specific matter of musical listening for the moment, I want to pursue the grounds for the novelty or appeal of simply attending to the sound of the environment. Schafer suggested that this was something modern societies failed to do. He argued that our ears needed to be nurtured with a talent for “clairaudience” or “clean hearing” (1977, 11):

[M]ultitudes of citizens (preferably children) needed to be exposed to ear cleaning exercises in order to improve the sonological competence of total societies, and [...] if such an aural culture should be achieved, the problem of noise pollution would disappear. (1977, 181)

Here Schafer conflates the ability to analyse and discriminate between aspects of the audible with notions of social responsibility and progress. His logic is that the process of cultivating discerning ears results in a more harmonious society. Eric Leigh Schmidt and Sterne have identified the drive for the improvement and refinement of listening as crucial to the idea of the rational modern citizen. In Schmidt’s account of how listening was implicated in the Enlightenment, he suggests that scepticism towards the audible (and the senses in general) was encouraged due to the belief that it would enhance the validity of knowledge (2000, 26). In Sterne’s study of the “cultural origins of sound reproduction,”²²⁰ he uses the term “audile technique” to describe how modern methods of listening have been developed in the service of rationality (2003, 93). He claims that such techniques of listening are “foundational to modern modes of knowledge, culture and social organization” (2003, 2). Following the insights of Sterne and Schmidt, perhaps the allure of attending to the sound of the environment is down in part to extant Enlightenment values that encourage citizens to reflect on and question what they hear. However, this notion on its own would not explain why listening analytically seems like a novel or unusual thing to do in the context of the environment. The detail of Sterne’s proposition may have some bearing on this issue.

Sterne argues that a constitutive element of “audile technique” was the “individuation of the listener” (2003, 158). He claims that modern listening devices (particularly stethoscopes, headphones and telephones) helped to construct auditory space as a private, interior sphere:

Not only was hearing [...] separated from the proximal auditory environment, but the act of communication itself was [...] separated from the surrounding physical environment. (2003, 158)

This chimes with Schafer’s observation that amplified music and headphones express “the desire to experience individuation... aloneness... disengagement” (1977, 96). Sterne suggests that the notion of private auditory space took hold as a general principle over the course nineteenth century, to the extent that it applied to occasions of collective listening in places such as opera and concert halls. He describes how growing bourgeois audiences, previously thought to be noisy and unruly, gradually

²¹⁹ See p. 91.

²²⁰ Full title: *The Audible Past: Cultural Origins of Sound Reproduction* (2003).

adopted the principle that silence should be observed in order to uphold the individual “right” to private auditory space (2003, 160-1).

Nancy makes a similar proposition. He traces the etymology of *écoute* [to listen] in order to highlight the many ways in which the term has been associated with a secretive practice:

After it had designated a person who listens (who spies), the word *écoute* came to designate a place where one could listen in secret. *Être aux écoutes*, “to listen in, to eavesdrop,” consisted first in being in a concealed place where you could surprise a conversation or a confession. *Être à l’écoute*, “to be tuned in, to be listening” was in the vocabulary of military espionage before it returned, through broadcasting, to the public space, while still remaining, in the context of the telephone, an affair of confidences or stolen secrets. (2007, 4)

From the perspective of Sterne and Nancy, acts of mediated listening and “listening in,” are both associated to some degree with privacy and inconspicuousness. The act of listening through a resonator could be considered to be mediated (by the glass), and a way of listening in to previously undetectable tonal details in sound. Perhaps this is one reason why holding a glass to the ear and making visible the normally discreet act of listening seems an unconventional thing to do in a shared public space. Sterne believes that an effect of “audile technique” was to promote “physical distance and epistemological and social mediation” (2003, 138). If this is the case then we may not usually expect mediated listening to be directed towards the immediate acoustic environment.

Issues of mediation and distance were of great concern to Schafer. As outlined in the first chapter,²²¹ Schafer used the term “schizophonia” to describe “the split between an original sound and its electroacoustic reproduction.”²²² He believed that “schizophonic” sounds had become so pervasive by the mid twentieth century that live or “natural” sounds were “becoming increasingly unnatural” to listen to, whereas “machine made substitutes [were] providing the operative signals directing modern life” (1977, 91). The tendency to valorise live, unmediated sound has been critiqued by Sterne (as discussed in Chapter 2).²²³ Sterne’s contention is that the possibility of immediate self-presence is brought into play by the invention of sound reproduction technology. He identifies the preoccupation with original and unmediated sound as having its roots in an “audiovisual litany:” a way of thinking grounded in Christian “religious dogma,” which privileges hearing and speech as the primary means of communing with God (2003, 16). Might the appeal of identifying musical detail in the sound of the environment have something to do with this notion? The following section will use Schafer to explore the dynamic between the celestial, natural, audible, and musical beginning with his assertion that “God was a first-rate acoustical engineer” (1977, 207).

²²¹ Schafer’s term “schizophonia” was first introduced p.15.

²²² Schafer (1977, 273) first cited p.15.

²²³ See p. 49.

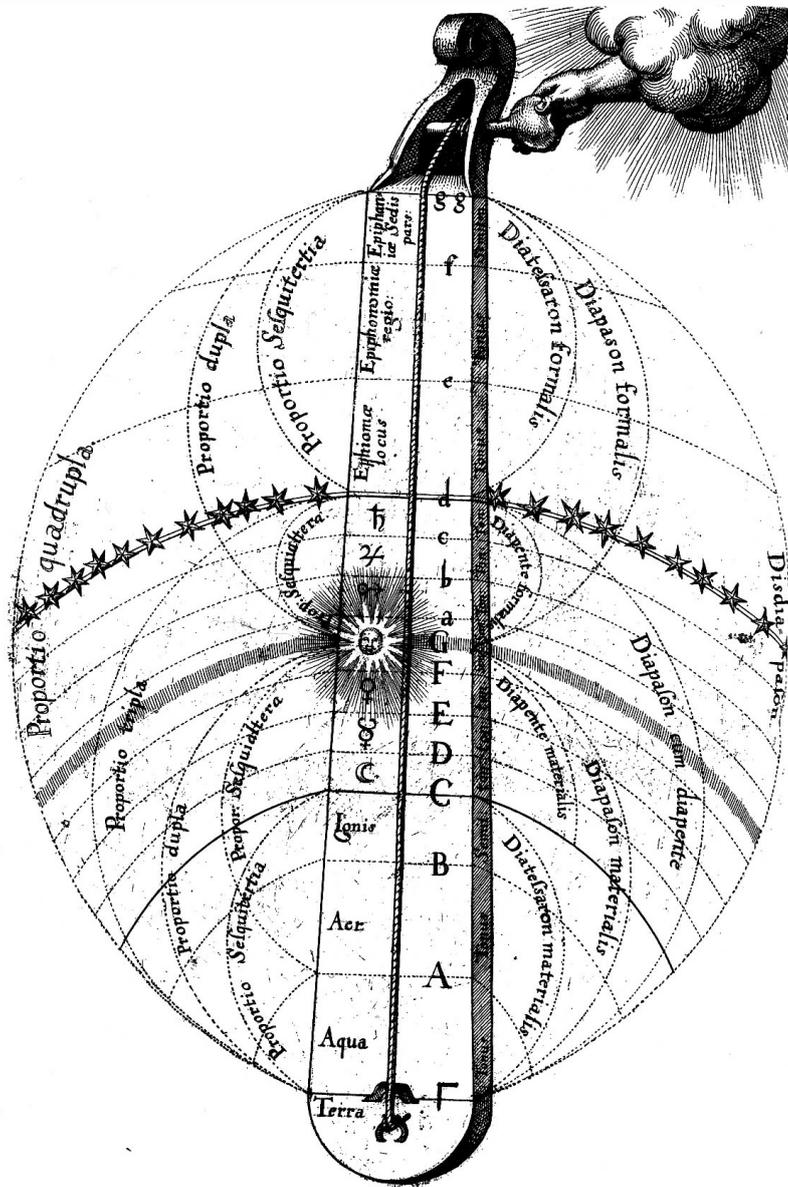


Figure 15. Fludd's *Divine Monochord* in Gouk (1999, 146) and Schafer (1974, 56 and 1977, ii). Originally published in Fludd's *Utriusque Cosmi Historia* (1617).

Nature and divine acoustic design

The earth forms the body of an instrument across which strings are stretched and tuned by a divine hand. We must try again to find the secret of that tuning. (Schafer, 1977, 6)

Schafer believes that Fludd's *Divine Monochord* (1617)²²⁴ "illustrates the continuing desire of man to find harmony in his environment" (1974, 56). According to Schafer this desire extends back to Apollonian and Pythagorean principles:

[T]he Apollonian [...] is external sound, God-sent to remind us of the harmony of the universe. In the Apollonian view music is exact, serene, mathematical, associated with transcendental visions of Utopia and the Harmony of the Spheres [...] It is the basis of Pythagoras' speculations [...] as well as Schoenberg's twelve note method of composition. Its methods of exposition are number theories. It seeks to harmonize the world through acoustic design. (1977, 6)

In an effort to re-enchant us with the sounds of our environment, Schafer invokes the mystic notion of divine harmony, a celestial music audible in the realm of the spirits, achieved through the transcendental practice of silent meditation (1977, 252, 262). He describes such a moment when a sufficiently "attuned soul" (1977, 10) might experience such music:

[T]he whole body opens out to become an ear. [...] Then perfection is achieved. The secret hieroglyph of the Universe is revealed. Number becomes audible and flows down filling the receiver with tones and light. (1977, 262)

Schafer uses the "Harmony of the Spheres" myth as evidence that ancient civilisations sought some "prime unity" or "tonal centre" to measure sound against (1977, 98-9). He makes a comparison with Indian drone music, through which one sound is sustained for the duration of piece and all other sounds played refer to it. Extending this idea further, he claims that the installation of the alternating current in villages, towns and cities through the "Electric Revolution" inadvertently established the first "international tonal centres" by virtue of the audible resonant harmonics produced by electric devices "from lights and amplifiers to generators" (1977, 99). After plotting the tones heard at night from street lighting, signs and generators in the Swedish village of Skurv, Schafer was "surprised to find that together they produced a G-sharp major triad" (1977, 99). For Schafer, the motivation to identify specific, sustained tones in the environment is part of a human spiritual quest to seek resonance between the earth and the cosmos. The glass spheres of the resonators could be used to pursue this ideal. They establish a reference tone against which to measure quotidian sound, enabling the user to discover previously unnoticed tonal sympathies and to speculate on occulted signs of a mysterious design.

It is generally assumed that Helmholtz resonance was employed by our ancient ancestors to evoke supernatural presences, those of the dead and of the divine. Brown explores how cavities in the walls of Stone Age burial chambers have been found to amplify the voice at specific frequencies. He describes the effect of Helmholtz resonance in general as:

²²⁴ See Figure 15 p. 72. This image was first discussed in Chapter 2, p. 40.

[V]aguely alchemistic: the amount of resonance that seems to resonate within or emanate from the chamber seems to be more than what was put in: the effect exceeds the cause, apparently, so it might well be tempting to infer some supernatural force at work. (2010, 152)²²⁵

Schafer noted how a cavity, “shaped like a big Helmholtz resonator,” had been worked into the construction of a Neolithic cave in Malta. He claimed that it resonated with the sound of a deep male voice, filling the space (which he assumed to be a shrine or oracle chamber) with a ringing, “awe-inspiring” sound (1977, 217-8). Following the work of acoustic archaeologist Steven Waller, Blesser and Salter suggest that early humans believed echoes heard in caves to be “the sounds or even voices of spirits beyond the cave wall” (2007, 75). It seems that the capacity of acoustic devices such as Helmholtz resonators to amplify and dramatise sound made them particularly suited for use in rituals to summon or simulate the supernatural.

On the basis of arguments by Sterne and Schmidt, I have suggested that attentive listening was encouraged during the Enlightenment in order to promote scepticism towards the audible.²²⁶ Schmidt argues that a specific goal of the “enlightened” ear was to challenge the notion that sonic messages might be received from the supernatural. He documents how listening tools such as trumpets and tubes were put to use by natural philosophers to undermine the superstition that divine voices could emerge from religious sites and icons:

[S]taged modern oracles encouraged auditors to be both detached and amused; they invited listeners to acquire the habits of perceptual suspicion and impartial judgement that allowed penetration of the illusions of disembodied, revelatory voices. (2000, 122)

Schmidt asserts that natural philosophers went to great lengths to demystify a commonly held belief that the sound of thunder was the voice of God. According to Schmidt, explanations of the physical forces that produced the sound were pursued with tenacity, and as a result:

[A]ny emotional power that thunder continued to have for the literati was aestheticized, made an aspect of the sublime, comparable in imaginative force to the roar of a waterfall, not the voice of God. (2000, 123)

In Schafer though, there remains a strong connection between the sound of the “natural” environment, and the idea of divine revelation. He employs a passage from Goethe to express the notion that sounds of nature might bring us closer to God:

When I hear the humming of the little world among the [grass] stalks, and am near the countless indescribable forms of the worms and insects, then I feel the presence of the Almighty [...]. (Goethe in Schafer, 1977, 44)

²²⁵ Brown also offers a very detailed account of the physical processes involved in Helmholtz (or cavity) resonance. See Appendix 3 p. 100 for extract.

²²⁶ See p. 70.

According to Schafer, a prime concern of the acoustic designer should be to cultivate places where nature might speak “with its own authentic voices” (1977, 246-7). He names such places “soniferous gardens” and issues the following guidelines towards their realisation:

Water, wind, birds, wood and stone [...] are the natural materials which like the trees and shrubs should be organically moulded and shaped to bring forth their most characteristic harmonies [...]. A garden may also be a place of human artefacts [...], but they must harmonize with their natural surroundings, indeed appear to have grown out of them. Thus, if synthetic sounds are introduced to the soniferous garden, they should be sympathetic vibrations of the garden’s original notes. (1977, 247)

Following these specifications it is plausible to imagine a system of Helmholtz resonators incorporated into Schafer’s acoustically designed garden, in the form of partially concealed caves, chambers or other, smaller spherical orifices in trees, amplifying resonant tones produced by water or birds. Schafer devotes a section of his ideal garden to “the spirit of the wind” describing how chimes of glass, shell or bamboo could be used to give the wind “an additional voice” (1977, 251). He writes of the virtues of the Aeolian harp, an instrument designed to allow the wind to excite and sound the strings, and references its privileged status within the romantic tradition (1977, 250).

As an unpredictable and sensitive instrument, with the capacity to listen and respond to nature rather than to fragment and abstract it, theorists Hankins and Silverman have described the Aeolian harp as serving “the needs and purposes of the romantic quest for the harmony of nature” (1995, 87). Being automatic instruments, responsive to movement in the air, Helmholtz’s acoustic resonators share some of the characteristics of the Aeolian harp. The following account would seem to describe how the resonators function:

[A]s light shews [*sic*] no particular colour but by means of some other intervening body to separate and modify its rays; so the air yields no particular musical tone without the assistance of some sonorous body to separate its parts and put them into a vibratory motion. (Jones, 1781, 341)

However, this is a statement from English theologian and natural philosopher William Jones of Nayland, theorising how the wind harp generated sound. He believed that the harp acted as a “prism” for sound, “refracting” the wind to reveal musical tones latent in the air. He asserted: “music is in air as colours are in the light” (1781, 341). Jones’ theory was debated at the time and has since been disproved,²²⁷ but it nevertheless serves to demonstrate how the resonators might compare to the Aeolian harp, in that both inspire fantasies about sonorous qualities inherent in the air. Around the time of Jones’ publication, the Aeolian harp was as much a source of inspiration for romantic poets as practitioners of the emerging science of acoustics. Hankins and Silverman highlight how instruments such as the Aeolian harp were used to serve distinctly different ideologies:

²²⁷ Hankins and Silverman describe the sound of the Aeolian harp as being generated when “[a]ir flowing past the cylindrical string produces eddies that drive the string from side to side” (2000, 98).

These two different treatments of the Aeolian harp represent two different versions of natural “science” and two different ways in which instruments can be used to comprehend the physical world. (2000, 93)

In the same way that the Aeolian harp can elicit different meanings when used by romantic poets or natural philosophers, the resonators can be employed in circumstances as diverse as the acoustician’s laboratory and Schafer’s “soniferous garden.” Through this chapter I have explored how listening tools and practices have been employed to disenchant²²⁸ and re-enchant²²⁹ people with the sound of their environment. I think that part of the appeal of Helmholtz’s act of using the resonators is that it seems to do both at once. It manages to provoke references to both rational, scientific experiment and a mystical desire to find meaning in the sounds of the natural world. It suggests a yearning for resonance with the environment, whilst at the same time employing tools that represent something of the “emotional distance” and “objective”²³⁰ nature of the scientific method.

Listening through glasses

It seems that surviving glass resonators (as opposed to brass ones) are rare. I contacted museums in London,²³¹ Oxford²³² and Cambridge,²³³ and only the Whipple Museum in Cambridge had a lone glass resonator remaining in their collection. I made an appointment with Josh Nall of the Whipple Museum to visit this relic. I was guided into the basement and advised to wear cloth gloves before touching the resonator. A little nervous of dropping the delicate glass instrument, I placed it in my ear and listened. The room was very quiet and nothing too remarkable could be heard except a very soft drone from the glass. Slightly disappointed, I made an utterance, similar to “ohh” and remarkably, that sound prompted the glass to resonate and produce a strong tone which tickled my ear. The glass was unmarked and so had no indication as to which tone it had been calibrated to. I was intrigued by this experience but also a little frustrated that I wasn’t allowed to take the resonator outside to explore the sounds out there with it.

Because I couldn’t find a set of existing glass resonators, I resolved to make a series of my own using measurements set out by Helmholtz (1954, 373) and the expertise of scientific glassblower, John Cowley. By adapting a standard glass beaker, we produced a prototype resonator, calibrated to the tone *d*.²³⁴ Keen to try it out, I put it to my ear whilst walking across a park between Cowley’s workshop and my flat. Again, there wasn’t a great deal to be heard. The sound entering my open and unobstructed ear seemed much the same as that reaching my “glass ear.”²³⁵ In environments such as parks where the ambient sound level is generally quiet, I learnt that I would need to be patient to hear any strong resonance from the glass. I did hear an atmosphere, Aeolian in character,

²²⁸ Discussed p. 70.

²²⁹ Discussed p. 73.

²³⁰ For an analysis of “the history of [scientific] objectivity and its alternatives” see Daston and Galison, *Objectivity* (2010, 10).

²³¹ The Science Museum, London.

²³² Museum of the History of Science, Oxford.

²³³ The Whipple Museum of the History of Science, Cambridge.

²³⁴ The tuning of the glasses was estimated rather than engineered with any great precision. We worked from Helmholtz’s table of measurements (1954, 373), which lists the diameter and aperture of the spheres and their corresponding tones. If a glass was too sharp or flat, we adjusted the pitch by changing the size of the aperture. The first ‘test’ glass was made according to the following specifications, sent by email to John Cowley, 3rd June 2009: “thickness of glass: 1.5mm, diameter of the large opening: 14 mm, height of the spout: 11mm, diameter of the small opening: 7mm, diameter of the sphere: 50mm.”

²³⁵ Helmholtz recommended closing off one ear to enable concentration on the sound of the resonator in the other ear (1954, 43). I decided to leave one ear open so that I could compare the sound received by my two ears.

which gave rise to the feeling of being in a glassy tunnel. The longer I listened, the more I felt drawn into the atmosphere of the glass. I later came across a discussion of the term “atmo-sphere” which pointed to the literal meaning of “ball of vapour” (Brown, 2010, 143). I felt that the spherical glasses encapsulated this notion. They also seemed to represent the roundness of sound, another sentiment expressed by Brown: “the theatre of sound is round because individual earshot is spherical and because sound ripples outwards on all fronts” (2010, 7).

Listening through the resonator in the park, I occasionally heard a faint trembling tone from the glass, or clicks and pops as my shoe caught stones in the grass. Then a plane passed by and at a certain point in its trajectory its sound caused the glass to resonate loudly. This had the strange effect of making the plane seem much closer than it had been, even though it was moving away from me. So I had found a *d'* in sound from a plane, but what did I feel I had achieved through this activity? There was some appeal in detecting a tone in an unlikely sound, but what I enjoyed most was the process of waiting for the glass to respond. I couldn't predict which sound events would produce interesting resonances, so I had to wander around and wait for sounds to happen. I found it to be a strangely relaxing exercise. When I developed more glasses to work with, I attempted listening through two differently tuned glasses at once, which was a more intense experience. It was the sound of an impossible space. I felt trapped inside two glassy tunnels at once, one bigger than the other. I had the feeling that I was listening through alien ears.

Using one or two glasses to direct my ears, I became more aware of processes of listening and hearing and how they interacted, how the feeling of being immersed in the sensation of the audible blended with the desire to isolate and make sense of its various aspects, such as what had caused a particular sound, whether I should be alarmed by it, whether it was pleasant to listen to or not. I had thought that the glasses would make me listen analytically, focused on the occurrence of one tone and how other sounds related to it. Instead I became more aware of how listening is distracted at the same time as it is directed. Listening through a glass, though guided towards a particular tone, my ears remained open to the unknown and the unexpected. Amongst other things, my attention was drawn to the high pitched hisses from car wheels, distant voices reflecting off high brick walls, and the deep bassy groan of the 242 double-decker bus. I became more conscious of the way that I could listen to several things simultaneously, each with varying degrees of awareness.

Using the resonators in an open environment raised the questions, what am I listening for, and what am I hearing? Catherine Laws came close to the articulating the effect of the glasses in her feedback on my article for *Performance Research* (Scarfe, 2010). Regarding Helmholtz's act of listening to the sounds of his environment, she asked:

[C]ouldn't one argue [...] that Helmholtz might be seen as opposed to Schafer (or Cage, equally), in that rather than wanting us to open our ears to sound and listen more carefully and openly to all that is truly around us, the glasses immediately filter this, limiting our listening? [...] I get the impression that you'd argue otherwise; that despite their focusing, we have to listen more openly in order to make the comparison between environmental sound and what the glasses filter from it.²³⁶

²³⁶ Catherine Laws, email correspondence, 14th April 2010.

Rather than leading us to listen more openly, I think the glasses can make us more conscious of how listening involves directing our attention to specific details in the audible. The glasses suggest that listening entails framing, or abstracting from the audible. They also help to reveal how easily our ears can lead our thoughts astray; how in the process of listening our attention is often diverted to the next unexpected sonic event. There is a paradox in using a device (a glass) to frame sound and listening in order to draw attention to the notion that listening can only be guided rather than directed, and that sounds cannot be solidified into objects. But I think that the glasses achieve this ambiguous objective because of their “barely there” transparent glass form. They subtly augment the audible, but do not silence it or amplify it too loudly, and they react spontaneously to unpredictable fluctuations in ambient sound.

To show how the barely there-ness of the resonating glasses was important to my work, I will contrast the form of *Listening Glasses* to Liminal’s²³⁷ planned²³⁸ sound installation *The Cochlea Unwound*. I discovered Liminal’s project after I had exhibited my first installation with the resonators²³⁹ and was struck by the shared concerns of our work. Both *The Cochlea Unwound* and *Listening Glasses* use acoustic devices to augment sounds already present in an environment, and claim to present a “listening aid” that might encourage reflection on the act of listening. However, real differences emerge in the form of the works. For *The Cochlea Unwound*, Liminal intend to place a series of opaque steel²⁴⁰ cylinders (in their terms a “sonic crystal array”) in a block formation in front of Diglis Weir, Worcester (Prior, 2010, 95-102). The purpose of the cylinders is to “attenuate or accentuate certain frequency bands” present in the sound of the weir (2010, 99). They do not act as resonators, but rather as “barriers around which the sound-waves are redirected and should be as inert as possible.”²⁴¹ David Prior (of Liminal) suggests that:

The Cochlea Unwound challenges expectations of what might constitute a piece of music by adding nothing new to the existing soundscape but rather offering new ways of listening to what is already there. (2010, 102)

My feeling is that the “adding nothing new” concern may be compromised by the large scale, stationary structure Liminal plan to place in front of the weir, which is likely to have a notable visual impact on the environment as well as altering the sonic character of that particular site.

The distinction I am making here can be elucidated by an examination of the term “soundscape” Schafer defines soundscape as “[t]he sonic environment,” which he takes to refer to both “actual environments, or to abstract constructions such as musical compositions” (1977, 274-5). Connor suggests that Schafer conceives of soundscapes as if they were physical objects “which have an actual existence, which may be preserved or, sometimes, recaptured from the past.” Connor proposes that it would be more accurate to describe soundscapes as “phenomenological rather than

²³⁷ Liminal define themselves as “a partnership between architect Francis Crow and sound artist and composer David Prior” <<http://www.liminal.org.uk/>> accessed 7th October 2011.

²³⁸ At the time of writing *The Cochlea Unwound* project is in development. I have based my reflections on the prototypes, visualisations and descriptions in Prior (2010, 95-102).

²³⁹ ‘Sound Escapes,’ Space, London, 25th July-15th August 2009.

²⁴⁰ Prior suggested corten steel would be used if the project were to get the required funding. Email correspondence, 4th July 2011.

²⁴¹ Prior, email correspondence, 4th July 2011.

natural objects, that are brought into being by acts of listening, which they themselves also reciprocally bring into being” (2006, 11). In a similar way, Ingold argues that the concept of soundscape itself indicates a misrepresentation of the experience of listening, and that the “place confinement” the term suggests “is a form of deafness” (2008, 12). By emphasising the portability of the glasses and their use as delicate (and slightly invasive) prosthetic tools placed in the ear of the listener, rather than monuments positioned at a distance from the observer, I hoped to engage with the embodied nature of listening and the transience of sound. In my work with the glasses I hoped to create experiences that emphasised, in Law’s terms:

[T]he messy reality of listening: the collision of the sensual impact of sound with the perceptual impulse to order and make sense, the conjunction of personal listening history with the sound encountered in the moment, the muddle of subjectivity and objectivity.
(Laws, 2010, 2)

The resonators appealed to me because I thought they could be used to invite contemplation on the act of listening, without dominating either the audible or visual features of particular environments. Pantalony remarks on how Helmholtz “referred to the resonators as a ‘crutch,’ because they were mechanical replacements for the attentive powers of the well-trained ear” (Pantalony, 2005, 60). The notion that the resonators were tools was important to me. I wanted to use the glasses in fleeting interventions rather than developing them into large scale, permanent structures. This was a matter of finding the most appropriate form to address my concern with how our impressions of our surroundings are negotiable rather than fixed. I had been inspired by the way that Ritter and Helmholtz had implicated and manipulated their sensations through their experiments, and I wanted to use the resonators to explore my own listening.

Three artworks with resonators

To date, I have made three different artworks with glass resonators: *Listening Glasses* (2009) a sculptural installation that invited visitors to use a series of resonators; *Through the Listening Glasses* (2010) a composition for headphones that documented my attempts to seek out the tones of a number of glasses in specific sounds, and *Do You Hear What I Hear?* (2010) an eight-channel composition for a public passageway that used recordings of different glasses placed by the side of a road. The divergent forms of the work are a consequence of the specific issues I wanted to explore, and the exhibiting opportunities available to me at the time. They indicate that I seek to frame my work in a way that solicits a particular mode of engagement from the audience, one that is appropriate to the themes of the work and its specific context. I will now discuss the ideas and principles that informed the development of each piece.

Listening Glasses (2009)

The installation *Listening Glasses* was the first piece I exhibited with glass resonators. I was invited by curators Irene Revell and Angus Carlyle to contribute to a group exhibition named 'Sound Escapes.' The exhibition was initially described as relating to an interdisciplinary academic research project titled 'Positive Soundscapes'²⁴² which explored "the positive elements of soundscapes in urban settings."²⁴³ The themes of the exhibition were outlined as being:

[W]orks that emerge out of a listening process that challenges what counts as positive; work[s] that understand the auditory world in a more inquisitive way, indeed an interrogation of what even counts as sound. (Revell, email correspondence, 30th April 2009)

Helmholtz's act of using resonators to listen for musical tones in the sound of his environment seemed to relate strongly to all of these concerns, and so I proposed working with this idea for the exhibition.

Before the opportunity arose to participate in 'Sound Escapes,' I had envisaged making a series of new resonators and using them in a workshop context, taking small groups of people out into the urban environment to listen with them. Considering appropriate ways of contributing to the exhibition, I thought about how it was likely to sound, look and feel. Revell informed me that the other pieces included "fair amount of wall based work (and noisier sound based work)" (Revell, email correspondence, 12th May 2009). I was already familiar with the gallery space, and knew there was a courtyard and a busy road outside of it. I reasoned that there would be enough sound in and around the gallery already to allow the glasses to resonate of their own accord, so I decided to provide a series of resonators and to invite visitors to use the tools themselves. There were risks in this strategy, such as the glasses might be dropped and broken, and people might be disappointed if they found nothing obvious to listen to in a particular moment.

I could have provided a tone generator to instantly demonstrate the way in which the glasses resonated. However, this would neglect Helmholtz's act of directing the glasses towards his immediate environment, which raised provocative questions about how we might distinguish music from sound in general, and what kind of sounds could be regarded as positive. I decided that the work should offer visitors the challenge of seeking correspondences between the sound of the glasses, and whatever sounds were audible. I chose to leave it to the people who engaged with the glasses to decide which sounds were worth listening to.

I invited the audiences' literal interaction as I felt that this was the best way of asking them to attend to their listening. However, I was mindful of Bishop's criticism of art that privileged audience participation over authorial intention. Bishop identified a "project-based laboratory tendency" in work produced in the 1990's. She described the features of this kind of art as "open-ended, interactive, and resistant to closure, often appearing to be 'work-in-progress' rather than a completed object" (2004, 52). She felt that this practice emerged from a misreading of the poststructuralist

²⁴² An overview of the project is provided at the following address: 'Positive Soundscapes' <http://www.positivesoundscapes.org/project_overview> accessed 18th January 2011.

²⁴³ Revell, email correspondence, 30th April 2009.

principles set out by authors such as Barthes (*The Death of the Author*, 1967)²⁴⁴ and Umberto Eco (*The Open Work*, 1962). Bishop claimed that whilst these texts had celebrated the notion that *interpretations* of artworks were “open to continual reassessment,” “laboratory tendency” artists made works in which the *form* appeared unfinished or “in perpetual flux” (2004, 52-3).

Bishop was particularly critical of Bourriaud, as she identified him as the “leading theorist” of laboratory tendency art through his texts *Postproduction* (2002a) and *Relational Aesthetics* (2002b). Referencing Rirkrit Tiravanija’s work, Bourriaud claimed that “encounters are more important than the individuals who compose them” (2002a, 43). Bishop questioned this notion that the act of involving participants in the physical realisation of a work should be considered a virtue in itself:

There is a common belief that reduced authorial status is more “democratic” and “ethical” than an artist imposing their vision or will on a group of participants. I think we can question all of these assumptions. ([2006b] 2008, 206)

Bishop sought to remind artists that acts of reflection and contemplation are valid and significant modes of audience participation. She urged artists to take responsibility for the quality of engagement their work offered. Mindful of Bishop’s concerns, I was careful to guide the audiences’ involvement with *Listening Glasses*. I tried to emulate the form of Helmholtz’s resonators as sensitively as possible, to make it clear that they were not my own inventions, and to ensure their historical context remained evident. I worked with John Cowley to base the design of new resonators on Helmholtz’s descriptions and measurements,²⁴⁵ and on my encounter with the glass in the store at The Whipple Museum, Cambridge.²⁴⁶ With technician Hoagy Dunnel I produced a mahogany stand mimicking the one I had seen at the Whipple museum, with chamfered edging, and a small silver tag engraved with Cowley’s name.

Although I considered attention to certain historical details important, I manipulated others to emphasise how the act of listening to the immediate environment had become the main focus of the work. I re-named the resonators *Listening Glasses* and produced a pamphlet in the “voice” of Helmholtz, inviting visitors to listen through the glasses to ambient sounds, such as other works in the exhibition and traffic outside of the gallery. I took considerable liberties with Helmholtz’s (1954) text, combining fragments from different sections, adding some embellishments of my own, and putting an unrepresentative emphasis on his act of taking the resonators outside. Michael Hampton described my approach as a “*joco-serioso*” light remixing of Helmholtz’s work (2010, 27).

I provided artefacts that referenced what I imagined to be laboratory conditions, such as protective cloth gloves, sterile wipes, and speculums to encourage people to use the glasses carefully, and to give the impression that they were undertaking an experiment. The pamphlet instructed people to don the gloves and to insert a speculum into their ear before listening through a glass. These procedural details were intended to make the normally inconspicuous process of listening theatrical, visible, and reflexive. Watching other people use the glasses I noticed that some became quite self-conscious. The posture of the listener gave a visual clue as to what they may be listening to, so I

²⁴⁴ Published in Barthes (1977, 142–148).

²⁴⁵ See footnote p. 76 for a description of this process.

²⁴⁶ See p. 76 for more details of my visit.

think people were mindful of being seen to be listening in a particular way. Some gallery visitors liked to watch others in the process of using the glasses. Artist Holly Rumble “particularly enjoyed the delicacy and ritual with which [the glasses] were handled by the public” (Rumble, 2009).

Although I found it interesting to use the glasses in the gallery and to inspect the sound of other works with them, I preferred my experience of using them outside, in and around my local neighbourhood. I felt much freer when I wasn’t in the gallery to experiment with different glasses, to wander around and spend long amounts of time listening. I think that *The Listening Glasses* piece succeeded in making its users more aware of how they listened, and in demonstrating the principle of resonance,²⁴⁷ but I wanted to make more work that documented my own experiences of listening through the glasses, and conveyed more of a sense of a listening journey.

Through the Listening Glasses (2010)

My motivation to listen through the glasses had originally been triggered by the thought of listening to the same kind of sound that Helmholtz directed his ear towards, specifically “the whistling of the wind, the rumbling of carriage wheels [and] the splashing of water.”²⁴⁸ I felt that these particular sounds warranted careful investigation. Once I had made new resonators I went on a series of missions to seek the out similar sounds. I chose to record these explorations as a means of documenting the process. I then developed these recordings into audio work for headphones named *Through the Listening Glasses*.

After researching Helmholtz’s theory of hearing,²⁴⁹ I came to envisage the resonators as large-scale models of (what Helmholtz believed to be) the processes at work in the inner ear. Using my reconstructions of the resonators, I began to associate them with Helmholtz’s ears, and with listening in the same way as he did. I became intrigued by two possibilities. The first was to deliberately seek out convenient sounds in my neighbourhood that approximated the wind, water and traffic sounds he described. This appealed to me as I wondered how the glasses, based on a nineteenth century design, would resonate in a contemporary urban environment. I listened to rain, a weir, water fountains, and the sound of the wind moving through tree branches. All of these sounds could be found in the vicinity of my flat in Hackney, London. As a substitute for the “rumbling of carriage wheels”²⁵⁰ I listened by the side of roads.

The other impulse I had was to get as close as I reasonably could to the same kind of sounds Helmholtz described. The statement that had triggered my interest in the resonators didn’t offer too much detail about the places in which Helmholtz listened.²⁵¹ However, in another section of his book Helmholtz offered more specific clues to the locations: “the rattling of a carriage over granite paving stones, the splashing or seething of a waterfall [...], the rustling of leaves in a wood” (1954, 7). I had these descriptions in mind when seeking out places to listen through the glasses. I made another

²⁴⁷ Rumble remarked that she found the installation to be “a really simple demonstration of resonance” (Rumble, 2008).

²⁴⁸ Helmholtz (1954, 44) first cited p. 58.

²⁴⁹ See p. 60.

²⁵⁰ Helmholtz (1954, 44) first cited p. 58.

²⁵¹ I am referring here to “the whistling of the wind, the rumbling of carriage wheels [and] the splashing of water” (1954, 44) first cited p. 58.

series of recordings in Vienna, Austria, where there are a large number of horse drawn carriages that taxi tourists around the city, and a number of woods to explore.

I chose to record my listening excursions with “binaural” in ear microphones, and to specify that the audio should be played back on headphones, as a way of ensuring the sounds that I had recorded in my ears, met the ears of the listener in a tangible as well as audible fashion. I developed a system of recording, starting with one microphone in each ear. I would then take a microphone out and put it inside a resonator, before placing the resonator in my ear, and after a minute or so changing to another resonator.

Listening back to the recordings through headphones, I found that the sound of the microphones being squeezed into the entrance of the ear canal, and in through the neck of the resonators produced a peculiar sensation that something was being inserted into my ear. I kept these sounds in the final edits as I felt that this uncomfortable sensation reflected the slightly invasive procedure of placing the glasses in the ear. The microphone sound also pointed to the artifice of recording. I regarded it as a device to reveal myself as the agency making the work. In this respect I was inspired by Luc Ferrari’s strategy of *musique anecdotique* (Ferrari, 1996, 101), which aimed to acknowledge the recordist, putting them: “inside the process and recognising him [or her] as a person” (Ferrari, 1998). I wanted the listener to appreciate my efforts to seek out the tones of the resonators, and have a sense of the process involved without using a vocal narrative.

I produced short texts to accompany the recordings as another way of emphasising my role in making them, and to describe what had motivated me to undertake them. Wherever the recordings have been exhibited,²⁵² I displayed headphones at a desk, alongside reading material²⁵³ to introduce the resonators and to explain the aim of my recording project. It was important for me that the audio was understood in context, as my attempt to hear sounds in the same way as Helmholtz was the inspiration for the piece, and I wanted to reference some of the historical detail that continued to fascinate me.

Do You Hear What I Hear? (2010)

The resonators for the *Listening Glasses* installation were developed as a series of five differently tuned pieces. Since exhibiting the work I had wondered how it might be possible to listen to more than two glasses at once, as if I had more than two ears. König’s apparatus for the visual analysis of sound, a single instrument that incorporated a scaled series of resonators (Figure 16),²⁵⁴ prompted me to think about how I might combine the sound of multiple glasses. I thought about designing a network of tubes to link the smaller openings of a number of glasses to one main tube, the end of which could be inserted into one of my ears. However, I reasoned that this would be a rather cumbersome thing to construct and carry around. An easier way to try out this idea would be to put microphones inside multiple glasses, connect them to a monitoring or recording device, and listen to them simultaneously.

²⁵² See p. 5 for exhibition dates and venues.

²⁵³ As mentioned on p. 58, the reading material consisted of the same design of leaflet produced for the *Listening Glasses* installation, described on p. 81 and documented as part of Case study 5: *Listening Glasses*, Disc 1. The other element was an A4 sheet outlining the aims of the piece, documented in Case study 6: *Through the Listening Glasses*, Disc 1.

²⁵⁴ p. 85.

Whilst thinking through these options, I received an invitation from curator Georg Weckwerth to make a sound piece for the “TONSPUR_passage,”²⁵⁵ an archway within a wider series of public squares which make up MuseumsQuartier (MQ) Vienna. The MQ complex faces on to a loud and busy road, but the inner squares are relatively sheltered and quiet. The TONSPUR set up is non-negotiable, artists must work with eight speakers arranged in fixed positions on the walls. The passageway is partially open to the elements, and traversed by a fairly constant stream of pedestrians. I wanted to introduce a sound into the passage which appeared to move through it like a breeze. Having recorded the sound of road traffic through the resonators before, I knew that it produced a sound evocative of a windy tunnel, so I chose to make a road the subject of my multi-channel recording experiment for TONSPUR.

I placed eight differently tuned resonators by the side of a road and inserted a small microphone into each one to pick up eight streams or channels of sound. My first idea was to play back the recordings with each channel of audio allocated to a different speaker in the passage, so that listeners would be able to walk through and hear distinctly tuned streams emitting from particular locations. However, when testing this idea in the passage I found that the position of the speakers overhead, combined with the natural reverberation of the arched space made it difficult for listeners to detect the separation of the channels and their distribution through the space. I resolved to move the streams of audio around the eight speakers, to combine them in varying ways, manipulating both the tonal range of the sound and the position of each channel. I found that this gave a more spatially dynamic feel to the piece, which helped to evoke the feeling of wind moving through the passageway. I used a matrix system in the editing programme AudioMulch to structure the diffusion. I specified that the piece should be played constantly for the allowed time (10am-8pm daily) as this would give the impression of an atmosphere rather than a timed event with a definite beginning and ending.

Weckwerth asked me to produce a series of seven A0 size posters related to the piece, to be displayed in the passageway. I used this as an opportunity to outline some of the ideas that had inspired the work, and to help make the processes involved in its production more explicit. An obvious choice was Helmholtz’s illustration of a glass resonator, which I had used before in the *Listening Glasses* pamphlets. In addition to this, I took photographs of the *Listening Glasses* against the backdrop of busy roads. To supplement these images, I considered using prints and diagrams that related in a more abstract way to the concerns of the piece. One of these was the frontispiece to Gaffurio’s *Practica Musicae* (1496), which refers to the “Harmony of the Spheres”²⁵⁶ myth (see Figure 17).²⁵⁷ It shows a series of eight spheres representing celestial bodies such as Venus and the Sun on the right-hand side. These correspond to eight spheres on the left-hand side that depict, according to James Haar, eight Muses arranged according to a musical scale (Haar, 1974, 13). To me, this image seemed to convey the notion that individual planets were in sympathetic resonance with individual muses. Because of my work with the *Listening Glasses*, I imagined the different spheres as ears of different listeners, each resonating with a particular tone.²⁵⁸ Although I didn’t show this illustration,

²⁵⁵ TONSPUR is a programme of sound works curated by Georg Weckwerth and Peter Szely at quartier21 / MuseumsQuartier, Vienna since 2003 <<http://www.tonspur.at/index2.html>> accessed 15th May 2011.

²⁵⁶ See p. 73 for a discussion of Schafer’s use of the myth.

²⁵⁷ p. 85.

²⁵⁸ This was due to my eccentric association of the resonators with Helmholtz’s ears, see p. 82.

its form influenced the diagram I created to show how the recordings were made with eight differently sized *Listening Glasses* by the side of a road.²⁵⁹

For another poster I appropriated a diagram of Empedocles' theory of perception (Zielinski, 2006, 51), this time maintaining clear references to the source. According to Zielinski, Empedocles (*circa* 490–430 BC) theorised that all living things were surrounded by a fine porous film or skin. These pores were invisible and of different shapes, which corresponded to different sensory modes. Passing around and through the pores were a "constant stream of effluences" (2006, 43). If the effluences of two "organs" (for example the organ of what is heard and the organ of the listener) were "in sympathy," reciprocal contact was made which resulted in sensation, in this case, hearing. The sympathetically resonating porous orbs in Zielinski's diagram seemed to me to anticipate the form of Helmholtz's translucent glass resonators. I was intrigued by Empedocles' notion that both the organ of what is perceived, and the perceiver, engage in reciprocal contact. This seemed to chime with Ingold's notion of "sensory participation"²⁶⁰ which continued to inspire my practice, as I explain in more detail in the Conclusion.

²⁵⁹ See Case study 7: *Do You Hear What I Hear*, Disc 1 for documentation.

²⁶⁰ Ingold (2000, 99) first cited p. 28.

Conclusion

The aim of this thesis has been to explore sympathies between the audible and the material through art practice. I have developed seven artworks as case studies which have guided my reflections and analysis. All the case studies have used sound to resonate objects, prompting them to produce acoustic voices. With these works my aim was not to conflate sound and matter, attempt to “precipitate”²⁶¹ sound into solid form, or to tie voices to a “specific and local cause.”²⁶² My main concern was to use sounding bodies to address listening bodies, in the sense of Sterne’s assertion that “the sounding or listening subject is coterminous with a sounding or listening body” (2003, 346). I have explored how objects that appear to produce their own sound compare to living, sentient bodies. I have investigated how the process of sounding transforms our impressions of (formerly mute) objects, from being rigid and stable to dynamic and life-like. I have suggested that resonating bodies demonstrate an interplay between sound and material form, which can fuel conjectures on the reach and limits of living bodies, and how we sense their presence and absence.

Crossing thresholds

With *Lenses* and *Carillon*, I explored how sound could move through and resound in the fabric of material objects such as wine glasses and cymbals, conveying something of their inner density and structure, which could be inferred through attentive listening. I considered how the bodily qualities of objects appeared to move beyond their physical borders in their sound. I described the capacity of listeners to project themselves into the matter and form of sounding objects, for instance, how Chladni imagined the differently pitched sounds produced by a metal plate to emerge from particular parts of its structure,²⁶³ and how Castelan could “feel” the material of the glass in *Lenses* through the skin on her face.²⁶⁴ I have found that listening can enable us to enter into material structures on the smallest of scales, from the inside out, and in multiple places at once.

Listening Glasses brought impressions of scale, distance and detail into play with resonating tools that re-sounded partial tones in the air which would otherwise have been too quiet to be noticeable (or deemed worthy of notice). The amplifying effects of the glasses made particular sounds seem closer than they would otherwise have been,²⁶⁵ and helped listeners to discover tonal sympathies in the varied sounds of their environment. Using the glasses heightened my awareness of the airy “*atmosphere* (ball of vapour)”²⁶⁶ through which we generally encounter sound, by encapsulating a sample of it in a translucent glass membrane.

The phenomenon of resonance has been the significant impulse linking all of the case studies in this thesis. The works employed resonance to occupy sonorous bodies, to evoke their voices, and to sound inside and outside of them. Hannah Schwegler gave an account of what she judged to be my

²⁶¹ This expression is borrowed from Connor’s discussion of “sound sculpture.” He suggests that such art forms present “a commerce between sound and shape, whether in the form of a shaping of time, or [...] a kind of precipitation of sound in form” ([2005] 2011, 136).

²⁶² Sterne (2003, 65) first cited p. 15.

²⁶³ See p. 41.

²⁶⁴ See p. 34.

²⁶⁵ See p. 77.

²⁶⁶ This definition of atmosphere is taken from ‘The Aesthetics of Atmosphere’ in Brown (2010, 143) first cited p. 77.

interest in resonance:

[R]esonance is also the sympathetic vibrating or resonating of a body with its environment. The outside, the environment, reverberates within the body. Resonance is a reference point, the link, the *in-between* between a vibrating body and the surrounding sound. Bodies are made to vibrate in that they pick up resonance. [Quoting Nancy, 2007, 14] "To listen is to enter that spatiality by which, *at the same time*, I am penetrated." (Schwegler, 2010, 4)

Schwegler indicates that resonance was used in *Do You Hear What I Hear?* to address the act of sensation; suggesting a responsiveness (in the resonant glass and in the listener) to the stimulus of sound. She implies that resonance involves a transgression of physical and spatial thresholds, and that we might imagine listening to be a means of inhabiting spaces; tiny dense areas inside of sounding objects and the environments that surround us.

Palpable bodies

The voice generally is understood to be issued by a living, material body and to carry a "grain"²⁶⁷ or palpable trace of this body, along with a suggestion of its proximity. By departing from its body and dissipating into the air, it signals entropy and mortality. Using Connor (2000), Sterne (2003) and Schafer (1974) I have explored how the process of recording and replaying the recorded voice is understood to pose a "decorporealizing threat"²⁶⁸ by definitively "severing"²⁶⁹ the voice from its proximity to its body, creating an isolated sonic fragment that can be manipulated and reproduced through loudspeakers. I have examined how this relates to the concept of the loudspeaker as "vanishing mediator"²⁷⁰ without a body or a presence of its own. Despite being a tangible object with unique sonic characteristics, the loudspeaker is generally used as a "window to an imaginary space" (Lansky in Weckwerth, 2010). It is regarded not as a sounding body but as a neutral conduit through which virtual voices and spaces speak. My analysis of *Rainforest IV* suggested that Tudor attempted to tackle such assumptions by foregrounding the individual sonic character of loudspeakers.

Whilst developing my case studies, I found that acoustic bodies could be used as a means of re-sounding through resonance, but that these sounding objects carried very different associations to loudspeakers. I confronted these differences through the installation *Lenses*. This work considered how sound, when channelled through an acoustic object to provoke its resonance, seemed to heighten the presence of the object. By "returning" a recorded sound to the glass that was sounded to produce it, *Lenses* explored how sound might re-occupy bodies, in a manner evocative of possession²⁷¹ or resuscitation.²⁷² The *Listening Glasses* I developed use the same principle of cavity resonance that Brown and Schafer believe was employed to elicit the voices of spirits in ancient burial chambers.²⁷³ I noted how sounding bodies can seem to be expressive bodies with their own distinct character and agency, and how artworks such as Tudor's *Rainforest IV* encourage such sentiments.

²⁶⁷ See p. 15.

²⁶⁸ Connor (2000, 388) first cited p. 15.

²⁶⁹ See Schafer's definition of "schizophonia" discussed pp. 15, 71.

²⁷⁰ Sterne (2003, 218) see p. 49.

²⁷¹ Suggested by Satz (2010) see p. 32.

²⁷² In a manner reminiscent of Aldini's electrical experiments, see p. 44.

²⁷³ See p. 73.

Sound affects

My analysis highlighted how sounding bodies such as musical and acoustic instruments have been used to represent the human body, its animation and sentience. This idea was explored through Descartes' carillon as an analogy for the nervous system²⁷⁴ and Helmholtz's piano and resonators as models of the inner ear.²⁷⁵ I have reflected on ways in which the sonic and electric converge in the imagination, and how both have been driven through material bodies to evoke living processes and attributes. Through Ritter²⁷⁶ and Bernstein²⁷⁷ I considered how musical tones have been interpreted as signs of activity in the nervous system. Using Althus I noted how galvanism was used to restore the voices of the female victims of aphonia.²⁷⁸ Through Schafer I explored the potential of intense levels of sound to harm, and even to be used as a lethal weapon.²⁷⁹

Across three chapters I traced how the concept of resonance has been employed from the Pythagorean tradition and Fludd's illustrations²⁸⁰ to the work of Mesmer, Tudor and Schafer to suggest mystical correspondences between material and spiritual realms. The notion that particular sounds exert a mysterious power over the human body continues to be exploited by alternative therapy practitioners and artists promising to "re-tune" the body and spirit with musical tones or specific combinations of frequencies. I have pointed to the sinister applications of such an idea, notably through Szendy's concept of "subject plates,"²⁸¹ manipulated by sound to feel predictable emotional responses. However, through subjecting my own body to audible treatments, such as Matthews' *Sonic Bed*²⁸² and the Schönfeldingers' *Hörkur* inspired by Mesmer,²⁸³ I have come to be sceptical of the proposition that human bodies, senses and emotions might respond in "automatic" and wholly predictable ways to specific musical tones or harmonic structures. I feel that such ideas and practices posit listeners as passive individuals. In my own work, I aim to address participants as active agents with the capacity to respond in unique and creative ways. I hope to heighten their sense of self-awareness rather than diminish it.²⁸⁴

I have considered ways in which the belief in resonance between macrocosm and microcosm has been challenged, for example with the Mesmer ruling which posited that sensations could be aroused through the imagination, and did not necessarily issue a direct response to a world outside of the mind.²⁸⁵ This notion was then examined through the work of Ritter,²⁸⁶ Helmholtz and Müller,²⁸⁷ which suggested that hearing reflects only the state of the auditory nerves, and therefore may not correspond to an "external" agency or reality. Ritter in particular, supposed that the most profound sensations were self-affectations, "inner tones" distinct from sounds heard by the ear. I suggested that theories such as Müller's "specific energies of sense" advocate a "rewiring" of the senses, a sentiment which is embodied by inventions such as prosthetic listening tools that offer to pleasure

²⁷⁴ See p. 39.

²⁷⁵ See p. 61.

²⁷⁶ See p. 44.

²⁷⁷ See p. 44.

²⁷⁸ See p. 44.

²⁷⁹ See p. 67.

²⁸⁰ See Figure 15 p. 72.

²⁸¹ See p. 42.

²⁸² See p. 27.

²⁸³ See p. 25.

²⁸⁴ See closing paragraph, p. 92 for more on this sentiment.

²⁸⁵ See p. 24.

²⁸⁶ See p. 44.

²⁸⁷ See p. 61.

the ear or allow their users to manipulate ambient environmental sound according to personal preference.²⁸⁸

My work is concerned with how a sense of the material can be evoked through the audible. I look for sympathies between different sensory modes and how one might be used to enrich and transform another. I aim to encourage what Connor refers to as “spillings and minglings” between the senses; exploring how dominant senses can be “shadowed and interpreted” by others ([2001] 2004, 154). Connor suggests that touch interlaces with sound in a different way to the visual. He describes how it “accompanies, mimics, performs sound, rather than translating or defining it” ([2001] 2004, 154). I used recorded sound in *Lenses* rather than sine tones as I was specifically interested in the traces of the contact of the finger in the sound of rubbed glass. The appeal of the “guitar-cymbal” was that it engineered a means of touching through sound, resonating the inner substance of the cymbal with the sound produced by tactile guitar strings and articles of varying textures used to excite them. The *Listening Glasses* were handled by the audience and inserted into their ears. I found that the resonance of the glass would tickle my ear, and recorded my own listening experiments with the glasses through binaural microphones to maintain this contact with the ear. My interest in the material is primarily in the tangible and how our sense of touch can be elicited through sound.

Rahma Khazam proposed that the ‘TONSPUR_expanded’ exhibition in which I participated “contravened the principle of the separation of the spatial and time-based arts.” She suggested that “[a]mong the most interesting works in the show were those that assigned length, shape and other ‘visual’ attributes to sound.” She felt that *Lenses* “invit[ed] the visitor to reflect on the relationship between shape, size and sound” (Khazam, 2011b, 13). This invitation was not to determine a cause and effect relationship between a sound and its assumed visual source, but rather to consider the palpable presences produced through listening, the unseen agents derived through sound that relate to our experience of texture, depth, temperature and movement. Connor describes these manifestations in terms of “vocalic bodies” or “voice-bodies”: compensatory “imaginary but determinate form[s]” given to sound (Connor, 2000, 35-6, 157). All of the works in this thesis have sought to provoke reflection on the dynamic bodies we sense in sound.

Sound and music

The above subheading references the name of a UK based arts organisation which seeks to promote “contemporary music and sound art” (Sound and Music, 2011). This thesis has pursued the question of why there might be a need to stake out distinct territories for sound art and music. The first chapter considered numerous historic accounts in which the sound of the musical glasses was thought to operate directly on the senses and emotions of listeners. This brought me to Coleridge’s assertion that the melodic and harmonic structure of a musical work was appreciated by the rational mind, implying that the timbral or material qualities of a sound were apprehended more instinctively, by the senses. This was the first instance in which I identified a drive to distinguish “rational” musical concerns from “visceral” sonic ones.²⁸⁹

²⁸⁸ See p. 62.

²⁸⁹ See p. 25.

I traced this notion through the work of Chladni²⁹⁰ and Helmholtz.²⁹¹ The third chapter used Schafer's work to point to the ethical issues of listening to all sound as music. I explored why Schafer has been accused of "imperialism" in seeking to "orchestrate" the sound of the environment according to musical principles. This thesis indicates that I have no interest in attempting to limit my engagement with sounds to musical concepts alone, or in seeking to dominate the sound of any environment by shaping it into a musical composition as if it were a soundscape-object.²⁹² However, I have concluded that the tendency of artists, critics and theorists (such as Lander and Voegelin) to promote a sound art practice that insists on bracketing out musical concerns, is equally as territorial and as potentially limiting as Cage and Schafer's desire to direct all sound towards "a pair of musical ears."²⁹³ I have suggested that the impulse to isolate sonic concerns from musical ones emerges from a narrow definition of musical listening; one which misrepresents the experience of listening in general.

Coleridge and Voegelin's characterisation of musical listening as "rational" prompted me to explore the difficulties Helmholtz had in distinguishing between rational and instinctive aspects of listening and hearing. I was not concerned with labelling particular aspects of hearing as conscious or otherwise, but rather in broaching the complexity of the process; how hearing and listening involve multiple levels of activity and awareness. I pointed to Erlmann's observation that Helmholtz reconfigured the relationship between "reason and resonance," most notably with his thoughts on how partial tones were apprehended.²⁹⁴ I developed *Listening Glasses* calibrated to musical tones and marked these on their surface, but my aim in doing so was not simply to label particular sounds as "music." I regarded the *Listening Glasses* as devices to direct the ear of the listener towards their surrounding environment to explore the "messy reality" (Laws, 2010, 2) of listening. To quote Warren Burt, I used the glasses to engage with:

[H]ow the metaphorical fugue of our consciousness works on several levels at once, and how one can, given the right conditions, direct and guide that consciousness in order to enhance the experience of our listenings to the world. (Burt, 2009, 5)

Participation

Throughout this thesis I have used antiquated acoustic objects, or approximations of them, to approach the theories of figures such as Mesmer, Chladni and Helmholtz by sounding and listening to their associated relics. This method relates to Bourriaud's concept of "postproduction,"²⁹⁵ in that it engages with cultural artefacts, not as monuments to established theories, but as a means of generating personal conjectures and new insight. The process of sounding and listening invites participation, as Voegelin suggests:

The critic of sound is invited to consider the dynamic of perception rather than the monument of its materiality. He does not conclude the story but keeps on narrating and enters rather than observes cultural production. (2010, 100)

²⁹⁰ See p. 52.

²⁹¹ See pp. 25, 62.

²⁹² See p. 78.

²⁹³ Kahn (2001a, 197) first cited p. 69.

²⁹⁴ See p. 65.

²⁹⁵ Bourriaud (2002a) first cited p. 9.

However, I do not expect to solicit this kind of involvement from the people who encounter my work simply by using the medium of sound. I have explored the way that minimalist art sought to emphasise the audience's perceptual processes and the durational aspect of their experience. I emulated the form of minimalist installation in *Lenses* to encourage precisely this reflexive mode of engagement from the audience. I played on some of the historical details of the resonators: circumstantial, visual and theoretical, to provoke interest in the audible elements of the *Listening Glasses* series.²⁹⁶ My concern with guiding the audience's experience was renewed through Bishop's criticism of "laboratory tendency" art practice.²⁹⁷ Whilst I acknowledge and welcome the freedom of the audience to engage with my work on their own terms, and encourage their feedback as means of developing and evaluating it, I take responsibility as the artist to direct their involvement in a manner appropriate to my specific aims and interests. The way I experimented with installation and performance in *Lenses* and how I used the *Listening Glasses* as sculptural tools and filters through which to record, evidences this flexible approach to the form of my work and my willingness to adapt my ideas to make the most of particular contextual circumstances.

A key aspect of my approach to this thesis has been to generate questions through art practice and to put ideas into practise. This method has been inspired by Rendell's efforts to "use" artworks and concepts rather than to "relate to" them (2010, 241). Rendell suggests that using work involves a form of destruction which allows the work to exist "in a different place" (2010, 242). Schwegler regards the interplay between research and practice as a significant feature of my work:

It is enriching to follow Dawn Scarfe's activities as both an artist and a researcher. It is important for me to emphasize the simultaneity, because that is what makes her works so stimulating. On the one hand the searching, the research and the questions, which she then poses, on the other hand, in an artistic, an aesthetic context. (2010, 1)

As well as highlighting the relationship between theory and practice in my work, Schwegler's statement points to what I have worked towards throughout the development of this thesis, to involve myself and others in a form of sensory participation a "coupling of the movements of one's attention to the movement of aspects of the world."²⁹⁸ I have sought to encourage a mode of engagement that is reflexive and sensitive. It corresponds to Nancy's characterisation of a resonating body as one that "listens to itself"²⁹⁹ and his description of the act of sensation as "feeling-oneself-feel [*se-sentir-sentir*]" (Nancy, 2007, 8). I hope to continue to adopt this approach towards artworks, artifacts and theories, but more importantly as an orientation towards the world, and one that continues to shape my ongoing practice.

²⁹⁶ Namely *Listening Glasses* (2009), *Through the Listening Glasses* (2010) and *Do You Hear What I Hear?* (2010).

²⁹⁷ See p. 80.

²⁹⁸ Ingold (2000, 99 and 1999, 582) first cited p. 28.

²⁹⁹ Nancy (2008, x) first cited p. 17.

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Appendix 1

Opening paragraph, 'Dedication' from Goethe's *Faust*³⁰⁰

Once more I sense uncertain shapes appearing,
 Dimly perceived in days of youth long past.
 Now in my heart I feel the moment nearing
 When I can hold these phantom figures fast.
 The haze and mist that swallowed them is clearing,
 They gather round me, bodied forth at last.
 Within me a youthful passion surges
 As from a magic spell their throng emerges.

([1808] 2007, 3)

Appendix 2

Kerner on how Mesmer played the armonica:

Von Mesmer's Spiele auf der Glasharmonika erzählte [Dr. Karl Christian] Wolfart in Erinnerung feines Aufenthaltes zu Frauenfeld bei Mesmer Folgendes: „Als ich in Frauenfeld war, hatte Mesmer die Gewohnheit, nach Tische, wenn er erst ein wenig geruht hatte, gegen Abend, so wie die Dämmerung anhub, seine geliebte Harmonika zu spielen, — wie Alles an und in ihm harmonisch erschien. So wie sein Spiel sich mehr und mehr belebte, die Töne inniger seine berührende Hand hervorzog, sang er immer leise dazu und leitete gleichsam das Spiel der Finger mit den Modulationen der Stimme, die noch im höchsten Alter ein angenehmer Tenor war. So kam freilich in sein Spiel die Seele, es kam ein solcher Gesang in diese Musik der Sphären, wie ich ihn nie wieder gehört habe. Auch will ich den Umstand berühren, daß Mesmer in Paris genau mit dem großen Tondichter Gluck bekannt war, diesen oft durch das Spiel seiner Harmonika begeisterte und ihm das Versprechen geben mußte, niemals anders als so, nämlich blos phantasierend, ohne Noten und künstliche Stückchen diese Tonglocken zu berühren.“

(1856, 202-3)

Key points from this description. Mesmer plays the glass harmonica in the evening after dusk [*Dämmerung*]. To accompany his playing he sang softly [*sang er immer leise*] in the range of a Tenor.³⁰¹ His playing apparently evoked the "Harmony of the Spheres"³⁰² [*Musik der Sphären*]. Mesmer's playing was improvised, not referring to any score or musical structure [*ohne Noten und künstliche Stückchen*].

³⁰⁰ Included in the Wiener Glasharmonika Duo's programme, 'Goethe & Humoristisches' performed at Schloss Halbturn in Burgenland, Austria 7th August 2010. See p. 20.

³⁰¹ This detail inspired Christa Schönfeldinger to sing during the *Hörkur* process see p. 26.

³⁰² For my account of how Schafer uses the "Harmony of the Spheres" myth see p. 73.

Appendix 3

Brown's description of Helmholtz resonance

Helmholtz resonance is responsible for the surprisingly loud sound that is made when air is blown across the mouth of a bottle. The act of blowing causes the air to vibrate in the bottleneck, producing an audible tone. This action sends patterned shockwaves into the volume of the main "jar" portion of the bottle. Air is elastic (or bouncy) and the waves rebound, combining their peaks at the fundamental standing wave frequency of the bottle, which has the effect of energising or amplifying the sound which is forced back out of the bottleneck as seemingly amplified tone. The audible pitch produced is dependent on the relationship between the size of the cavity to the size of the aperture.

(2010, 151)

Appendix 4

Guide to additional documentation

Disc 1 documents all the case studies used in this thesis. It is in HTML format and is optimised for the latest versions of internet browsers Firefox, Chrome and Safari.

How to use: Open the index page with your browser (ideally one of the three mentioned above). Select the case study you wish to view from the index list.

The first audio extract should begin to play automatically. The scroll or "scrubber bar" (image below) represents the entire duration of the extract, allowing you to select different parts of it.³⁰³

play / stop

00:00 / 54:05



Audio: Dawn Scarfe 2010

The images can be viewed "small" or "big," in slideshow or static modes. The slideshow will begin automatically, and can be stopped by using the next button (image below) or by selecting a particular image from the list.

slideshow>next>big>

Photo: Rubin Starset 2011

Disc 2 features a select number of audio files in their original format (only mp3 and ogg files are used for the HTML documentation).

³⁰³ This feature may be disabled should you attempt to view in an alternative browser.