Murmur

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Certificate Of Authorship/Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student

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I am, of course, responsible for any and all mistakes, misrepresentations and omissions.

Note: The sections of this thesis addressing digital sound has been developed from work I completed for my Honours thesis which has since been published in another form in my paper ‘Digital Sound: On Technology, Infidelity & Potentiality’.

Once long ago Narcissus was fascinated by seeing himself. In a smooth and calm water, either which was not moving, or which flowed unified and untroubled. Mirror of the waters, morose masturbation of the subject, repetition and death. Narcissus drowned in his reproduction, in his double and his mime, when his face met the image of his face. Drowning, smothering, in adequation. Let that water, then, be murky or rough, so that the face and the body cannot be seen in the reflection of the waters (Serres 2000, p.155).

- Michel Serres

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Abstract

Murmur is an effort to learn from sound. Here I examine the study of sound from early explanations of sound based on the metaphor of a wave on the surface of a body of water, to research into its existence as a physical phenomenon during the Enlightenment, the invention of phonography and the resultant commodification of sound, the *auditory turn* and beyond. Establishing a history of sound based on the many voices that comprise the murmur of sound itself, I critique the myths, each dominated by particular ideas, images and technologies, that have shaped the individual characteristics attributed to sound today. I analyse the influence of tropes such as the image of a stone thrown into water as a model for the passage of sound through a medium, the notion that any sound is reducible to individual frequencies and the suggestion that sound recordings can offer fidelity to an *original* source. I listen to the cacophony. I offer an account of sound that approaches it as a multiplicity that is individuated in a variety of ways. I hear sound as murmur.

Introduction

The echo is a particularly evocative sound. Hearing your own echo is like looking into a mirror. Often people speak of how an important event echoes through history. It is common to discuss how something echoes something else. However, despite its significance, the echo is redundant, a reflection, a link to the past. The echo is a trail into the murmur of history.

The redundancy of the echo is, literally, an overflowing, like that of the face of a wave. A little repetition is needed in order to find meaning but too much can lead to collapse. A few echoes can lead to the source but too many and all that is heard is murmur. All of a sudden the murmur of sound is everywhere and it is impossible to discern its path.

Generally a murmur is considered to be low, indistinct and heard at a distance. Once a sound, perhaps the echo of a voice, is approached it is apprehended, separated, individuated, from the surrounding murmur. Alternatively a murmur may eventually build to a deafening noise. Still, there is always murmur.

Murmur is a useful archetype of sound – experiential and conceptual, meaningful and full of noise, it reflects sound as it heard and as it has been theorised and it contains all other archetypes.

A History, Mythology and Philosophy of Sound

Murmur is a critical survey of sound theory. It is a textual analysis, based in sound studies, which presents a history, mythology and philosophy of sound. It argues sound is multiple. Just like murmur the text is discursive rather than dialectical or univocal. It is not a chronological account but one that follows the winding tributaries of ideas that have influenced understandings of sound. Intertwining historical and contemporary voices, it simultaneously tells a story of the study of sound, critiques that study and is itself a part of it. Speculative in tone, expansive in scope and self-reflexive, it is written in a murmurous voice that is intertwined with and composed of many others.

Ernst Cassirer writes that ‘it is not by its history that the mythology of a nation is determined but, conversely, its history is determined by its mythology – or rather the mythology of a people does not *determine* but *is* its fate, its destiny as decreed from

the very beginning (Cassirer 1955, p.5). This is an aphorism that could equally be applied to sound and indeed it is echoed by Michel Serres. Myths, for Serres, offer a rich source of inspiration. He argues that 'history trickles down from them as from a spring' (Serres 2009, p.51). He claims 'we know that myth is so good and so productive when it comes to anticipating our social sciences that it can sometimes be more knowledgeable than our sciences themselves and that our sciences, in return, so full of myths, can be in the dark' (Serres 2009, p.114). Ultimately, for Serres, 'myth as much as history poses all the questions and gives all the answers, so that they define a curious object, differently viewable from every site' (Serres 2009, p.51).

Since it was focused on in its own right, distinct from music and the voice, sound has been defined as an *object* of study by those seeking to know it. Across centuries of research sound has been placed in a variety of sites and explained according to the guiding principles of various disciplines of philosophy, science and the arts. Therefore, sound, when individuated, is a cultural artefact that has been formed from a history of study that has been guided greatly by a number of myths, based on the influence of particular ideas, images and technologies. However, such approaches necessarily address only specific aspects of its existence. Sound challenges many of the assumptions of academic thought that are inscribed in its history and there is much to learn both about and from it, particularly when it is approached as murmur.

Defining Sound

Attempts to write about sound frequently define it by locating it in a particular place. In early accounts of sound the surface of a pond into which a stone was thrown served metaphorically as such a place. Subsequently, physics located sound in pressure waves before physiologists heard sound in the ear, the auditory nerve or brain and inventors *inscribed* sound into wax cylinders and more recent media.

Initially, fundamental ideas related to the passage of sound were developed based on study of the voice, music and acoustics. The work completed in this time formed the foundations for the scientific theories developed throughout the eighteenth century and for the invention of sound recording and other related technologies in the late nineteenth and early twentieth centuries. It wasn't until the mid-twentieth century that the guiding impact of the arts on sound theory became evident in phenomenological theories of listening and, more recently still, post-structuralist accounts of sound.

Given the changes that the definition of sound has undergone throughout history the notion of the *horizon* of sound is an important one. Along with attempts to locate sound, the history of the study of sound has been characterised by attempts to establish the horizon of sound – the point at which sound begins and ends. Consequently, any definition of sound, and by extension its ontology, is fundamentally based in the selection of the location of that horizon, which I think is most usefully understood as the threshold of audibility, but instead of framing sound we must trace its lines of flight.

Sound is something that is constituted by the establishing, negotiating, and, quite regularly, moving of borders around sound and not sound that has taken place. Ultimately, the focus on a horizon of sound and associated visual metaphors does not adequately explain the activities, knowledge and relationships held in constellation when sound is discussed. However, in many ways a conceptual approach, as has been offered more recently, offers just one more location, albeit an intellectual omnipresent one, in which to locate sound.

All the knowledge that has been developed about sound, theories that explain sound, contribute to its existence. Sound is nothing more than a functional abstraction. Sound involves waves, ears, materiality, perception, subjectivity and experience, along with much more, but it is greater than the sum of its parts. Its transmission can be measured, its pitch divided into individual frequencies and its volume graphed but it is not merely physical. It can be heard, seen and even felt and yet it is not just sensible. It can be conceived, thought and discussed and yet it is not just intellectual. There is barely a language to discuss sound. Just as Frances Dyson writes, '"Sound" – the term itself – is already abstracted: there is sound, inasmuch as there is atmosphere; like a dense fog, it disappears when approached, falling beyond discourse as it settles within the skin' (Dyson 2009, p.4). Many of those that have turned their attention to sound have attempted to clear the fog so that they may see but I wish instead to listen through the fog.

Developing an Interdisciplinary Approach to Sound

I am attempting here to write about sound without claiming to be able to, at least too closely or absolutely, define it. To define something is to delimit it, to mark its boundaries, ultimately to bring it to an end. Sound has inspired me to attempt to break free of such ways of thinking and find a new approach. I am particularly influenced by Serres and his belief that:

> It is the function of the philosopher, the care and passion of the philosopher to protect to the utmost the possible, he tends the possible like a small child, he broods over it like a newborn babe, he is the guardian of the seed. The philosopher is the shepherd who tends the mixed flock of possibles on the highlands, heavy ewes and shuddering bulls, the philosopher is a gardener, he crosses and multiplies varieties, he safeguards the vastness of the old-growth forest, he is on the watch for the inclemency of the elements, a carrier of new seasons of history and of duration, fat cows and lean cows, the philosopher is the shepherd of multiplicities (Serres 2009, p.23).

Adopting such an approach, the hearing of sound I offer here is designed not to explain sound but to provide an account of it that opens new possibilities. I regard sound as multiple and dynamic rather than as a *thing* that can, or should, be strictly defined so as to avoid attempting to hold it too rigidly in place.

In his book *Hermes: Literature, Science, Philosophy*, conspicuously named for the messenger of the Gods within Greek mythology, who is also a guide to the Underworld and the patron saint of those that cross borders, Serres claims that 'hearing is our heroic opening to trouble and diffusion; other receptors assure us of order or, if they no longer give or receive, close immediately' (Serres 1982b, p.126). He refers here to the fact that sound is not ordered, instead it always chaotic – individual sounds flow in and out of one another – and therefore hearing opens the individual to the multiple.

Where possible, I will endeavour to critique the cultural perspective from which I write with mention of alternatives. For example, I have been influenced by the remarkable importance placed on listening and sound in the Dreaming of Australian Indigenous peoples. This emphasis is demonstrated by Ros Moriarty's articulation of the 'pathway gouged by a metaphorical river of intricate knowledge and wisdom' when writing about her husband's people, from around the Gulf of Carpentaria, in *Listening to Country: A journey to the heart of what it means to belong*:

> The Yanyuwa call it *anyngkarrinjarra ki-awarawu*, 'listening to country'. It is a time and place to sit down, absorb, reflect, see how things really are in the place you come from. A place in the mind, a place with family, or a physical place where the mind is freed (Moriarty 2010, p.7).

I find it telling that cultures as much as 40,000 years old, reputedly the oldest continuing cultures in the world, think about their place, or country, in such ways. It is

an example of how listening necessitates interest, that is, an involvement and presence. Still, I've limited the scope of this work to the academic study of sound from Greek philosophy onwards, both to make it manageable and because that is the tradition in which I myself work.

It is important to realise that, as Jonathan Sterne points out, 'at its core the phenomenon of sound and the history of sound rest at the in-between point of culture and nature' (Sterne 2003, p.10). He has written a thought provoking paper, 'Being 'In the True' of Sound Studies', in which he argues:

> One of the main methodological problems for people who do interdisciplinary research is that different disciplines speak of the same phenomenon as if it were two or more totally different things. It is not a question of each discipline only being able to claim partial knowledge of an artifact, of relative degrees of truth, or of progress from one mistaken paradigm to a truer one. It is a case of incommensurable assumptions and worldviews simultaneously existing and producing useful knowledge. Many of the central concepts in sound studies carry some degree of this problem with them, since many fields can at once lay claim to knowledge of sound, hearing, listening, or even just vibrations or signals. No single discipline can claim a monopoly of knowledge over what any of these terms means, and certainly sound studies, as an emergent formation in the human sciences, is no exception (Sterne 2008, p.163).

Although my work is interdisciplinary in the sense that it draws on the work of a number of different disciplines, it is still disciplined in that it is situated within the, admittedly broad and at times disparate, field of sound studies and is grounded in the analysis of accepted scholarly research into sound. As Sterne outlines, no single one of the disciplines on which I draw that address sound can lay claim to theirs being the only truth about sound but, importantly, the same applies to my work. *Murmur* presents only one possible history, mythology and philosophy of sound.

I have researched the history of the study of sound in the arts, sciences and philosophy in an attempt to *listen* to the emergence of sound as it is known today. I have done this not to somehow define the essence or nature of sound but in the hope that I may elucidate how my understanding of sound has been formed and present some of my own thoughts on how to think about and learn from sound. It is necessary given the interdisciplinary nature of the field to draw from a wide variety of sources in any attempt at engaging with sound. Sterne claims that as scholars focused on sound 'we have the difficult task of breaking down the intellectual ghetto walls surrounding

those practices long associated with sound: speech, music, acoustic design, soundscape studies, studies of sound technologies and media, deaf studies' (Sterne 2003, p.348). This is precisely what I will attempt, offering an account of the history of the study of sound across a variety of disciplines in order to approach it in all its complexity.

There are many voices in any text and that is certainly the case here. My argument is based not just on my voice but also on the voices of others – it is an articulation of an ongoing discussion as much as a claim. There are times when I rely on the voices of others to support my own, times when several voices are in conversation and perhaps even times when I get lost in the clamor but, most importantly, my voice is expressed in a murmur that is comprised of many voices and is in many ways itself constituted by those voices. Sound studies is itself based upon the accumulation of knowledge about sound and so to offer an effective approach to sound in a contemporary context it is necessary to traverse the history of its study. I approach sound as cultural and so draw on a great range of sources, including first hand accounts of research, histories, critiques, and even hearsay, to establish sound as being, historically as well as contemporaneously, contested and multiple, to present sound as murmur.

Sound Studies

There have been a number of histories written in the last decade chronicling the role of sound in the arts, including, but not limited to, Douglas Kahn's *Noise Water Meat: A History of Sound in the Arts*, Brandon LaBelle's *Background Noise: Perspectives on Sound Art,* Alan Licht's *Sound Art: Beyond Music, Between Categories,* and anthologies such as Michael Bull's *The Auditory Culture Reader* and Christoph Cox's *Audio Culture*. Each of these texts, to varying degrees, document the cultural evidence of shifts in the role and conception of sound in contemporary culture, but none investigate the shifts themselves, the reasons behind them and their implications. Similarly, there are a number of excellent histories of acoustics, such as Frederick Vinton Hunt's *Origins in Acoustics*, and Robert T Beyer's *Sounds of Our Times: Two Hundred Years of Acoustics*, but none of these go beyond their authors' interest in the science of such histories.

Fortunately in the last decade there have been a number of thought provoking texts written, all of which fit into the broad field of sound studies, such as Jonathan Sterne's *The Audible Past*, Peter Blamey's *Sine Waves and Simple Acoustic Phenomena in Experimental Music*, Frances Dyson's *Sounding New Media: Immersion and*

Embodiment in Arts and Culture and Seth Kim-Cohen's *In the Blink of an Ear: Towards a Non-Cochlear Sonic Art*, which have addressed some of the issues I attempt to grapple with here and I have drawn on them all a great deal. However, none of them offer a comprehensive account of sound as multiple. In addition, although older, Jacques Attali's *Noise: The Political Economy of Music*, R. Murray Schafer's *The Soundscape: Our Sonic Environment and the Tuning of the World* and Don Ihde's *Listening and Voice: A Phenomenology of Sound* have proved invaluable to my work.

It is perhaps Sterne's *The Audible Past* that offers the most direct investigation of the history of sound. In the book, Sterne looks to transducers, essentially anything that 'turns sound into something else and something else back into sound', as the basis of a history of the audible and, to some extent, sound because, in his own words, 'it is a history of attempts to manipulate, transform, and shape sound' (Sterne 2003, p.28). He traces the audibility of sound from the human ear to technologies of sound reproduction and manipulation and beyond. Interested not in reaching a particular definition or ontology of sound but in transduction as the site of the emergence of sound, he suggests that 'it is not the breaking down of borders of sound and not-sound that should fascinate us but rather the continuous constitution and transformation of the two' (Sterne 2003, p.337). Although his approach serves as the central theme for a very interesting and well-written history, Sterne's reliance on transduction to ground that history amidst the multiplicity of sound is a maneuver that I find, while productive, leaves a number of intractable problems. Particularly, those raised by the way in which contemporary understandings of sound must be considered, at least in part, the result of the murmur of a cultural history, as I will explore further.

LaBelle rightly argues in his *Background Noise: Perspectives on Sound Art*, a good example of the many texts detailing sound practice in the arts that have emerged in recent years, that 'it seems that the "auditory turn" may define the present by pointing toward the future' and 'what this future may bring we might detect in sound's own current dynamic, which seems to both intensify sound's specificity while widening its ephemeral circumference, making it ever more concrete while expanding its immaterial flow' (LaBelle 2006, p.297). His approach to sound as *associative*, as outlined in his recent book *Acoustic Territories: Sound Culture and Everyday Life*, is an important step in the shift currently underway to new understandings of sound that avoid approaching it as a thing (LaBelle 2010,p.xix). LaBelle's ear is rigorously tuned to the social dimensions of sound and so he does not attempt a broader theory of sound as I do here but nonetheless I find his work fits very well with my own.

Kim-Cohen, meanwhile, is concerned specifically with the conceptual aspect of sound and argues for a 'non-cochlear sonic art' that 'seeks to replace the solidity of *objet sonore*, of sound-in-itself, with the discursiveness of a conceptual sonic practice' (Kim-Cohen 2009, p.217). This too is an important step. However, it is one that I believe does not define a new area of sonic practice so much as offer an explanation of strands of artistic practice that have been around for decades but to date remain under and ineffectively theorised.

Dyson, in her book *Sounding New Media: Immersion and Embodiment in Arts and Culture*, offers some of the most insightful thoughts about sound I have read. However, ultimately hers is a project focused on developing conceptual frameworks and language appropriate to discussions around new media and is not concertedly focused on sound. Still, she is one of the few working broadly in the field of sound studies who offers an approach to sound as multiple and the deft complexity of her treatment of sound is impressive. Also, she makes an important point worth keeping in mind while traversing *Murmur*, 'although sound as a material acoustic medium provides an opening to an alternate metaphysics, it does not in itself constitute that metaphysics, and it would be a mistake to conflate sound, or even the larger sphere of aurality, with the alterity it points to' (Dyson 2009, p.5).

Despite the dramatic increase in scholarly writing focused on sound in the last few decades it has been in contemporary philosophy, in particular in Gilles Deleuze & Felix Guattari's *A Thousand Plateaus: Capitalism and Schizophrenia* and Michel Serres's texts *Genesis*, *The Parasite*, *The Five Senses: A Philosophy of Mingled Bodies* and *Hermes: Literature, Science, Philosophy,* that I have found the greatest inspiration for my work. Sound has influenced a great deal of contemporary and particularly European philosophy precisely because it challenges the very assumptions of the academic tradition and now, strangely enough, it is that philosophy – particular philosophies of multiplicity such at that of Serres – which offers the most useful means with which to approach it.

Murmur

Most early knowledge about sound came from the applied acoustics of the ancient Greeks. Indeed it was Greek philosophy that established the academic tradition itself. Although their study was largely focused on the voice and music rather than sound, it nonetheless provided significant insights. *Chapter 1 – Tremors: Voices, Music & Acoustics*, traces the tremors of the prehistory of the study of sound from the work of

the Greeks to the birth of modern acoustics, including discussion of the interruption of scholasticism, the resulting importance of scholarly contributions from the Islamic world, the developments of the Renaissance and the early steps toward the disciplines of modern science.

Along the way it outlines the significance of the voice as the first, and to this day a prevailing, idealised instance of sound. The Greeks built impressive outdoor theatres capable at once of accommodating crowds of literally thousands of people and ensuring that even those furthest from the stage could hear the players' voices clearly without electrical amplification. This was achieved by means of the acoustic design of the structures, which reinforced the voices from the stage while filtering out the surrounding noise, allowing the attention of audiences to be completely on that of the meaningful sound of the voice.

Also, the role of music in shaping the development of mathematical explanations of sound was vital and is covered in detail, from Pythagoras of Samos's work developing the mathematical ratios that have become the basis of the twelve-tone system of musical tuning, to the research of Galileo Galilee and Marin Mersenne into vibrating strings. Included is an exploration of Pythagoras's use of his mathematical ratios to develop a theory of 'the music of the spheres' and its association with religious conceptions of the Word and harmony.

Central to the chapter is a sustained account of the use of the visual metaphor of the ripples that result when a stone is thrown into water that is credited as originating in the words of Chrysippus of Soli. The image of sound as a wave, or tremor, on the surface of a body of water was the earliest recorded definition of sound and has rippled over the centuries, remaining influential to this day. It was refined by Leonardo da Vinci in his writing about the *tremors* of sound and solidified by the work of Ernst Florens Friedrich Chladni using glass plates and bows to create wave patterns in sand.

Eventually the image of sound as a wave became the basis for the scientific theory of sound and in particular the work of Hermann von Helmholtz. *Chapter 2 – Theory: Instrumentation, Visualisation & Science* focuses on the application of scientific method to research into sound and the dominance of scientific disciplines over the study of sound during and immediately following the Enlightenment. After Georg Ohm published his laws of acoustics, applying Joseph Fourier's heat equations, Helmholtz developed a theory of the sine tone, a single frequency, as the simplest unit of all sound and explained it using the wave metaphor.

The visualisation of sound was of primary importance to scientists. It allowed sound to be observed, measured and studied. Although, the experiments conducted were still largely applied in nature and focused chiefly on the study of vibration as the cause of sound. Sound was located in waves which themselves where held still as evidence to be witnessed.

Importantly, Helmholtz employed in his experiments a calm body of water safe from the noisiness of the waves of the sea – reinforcing the notion of sound as meaningful and distinct from the noise of the world. Sound, therefore, was considered not only material but also meaningful and the sine tone was installed as the new ideal instance of sound, considered even more pure than the voice. However, Serres argues that 'pure and simple forms are neither that simple or that pure' and this is certainly true of Helmholtz's sine tone, as I will explain (Serres 1982a, p.96).

Helmholtz was focused on sensations of tone and so his work, along with that of a number of others, led to increased importance being placed on perception and sound being located in the ear as often as the wave, which itself had come to be considered divisible into individual frequencies, perfect mathematical units of sound. In fact, Helmholtz, although since proved wrong, believed that the human ear contains a hair for each frequency in the audible range and it was that theory which led to his other work.

Just as the work of scientists developing theories of sound involved quelling noise in order to focus on discrete, idealised instances of sound, during the nineteenth century, a time of greatly increased noise in cities due to the Industrial Revolution, there were increasing efforts to silence the public and move music indoors into privatized acoustic space. Concert halls became more and more common, and were gradually constructed specifically to offer quiet spaces for the performance of music safe from the noise outside, providing increasingly ideal conditions for the encouragement of attentive listening and silencing of audiences. Alongside that development, anti-noise legislation spread around the world, among other things regulating the, previously common, playing of music in public spaces.

Chapter 3 – Phonography: Technology, Infidelity & Commodity concentrates on the invention of sound reproduction technologies in the mid to late nineteenth century, the *high fidelity* recording as a further idealised instance of sound and the commodification of sound. After sound became, to some extent, privatised when music was increasingly shifted into the private space of the concert hall, it was phonographic technologies that made sound ownable, a commodity, by recording it and thus locating it, reified, on

physical media. Transduction allowed sound to be turned into something else and, when desired, back into sound, so that it could be stored.

Among other things, the mechanical reproduction of sound severed individual sounds from their perceived sources, making them both *schizophonic* and *schizochronic*, as I will discuss in more detail. One effect of this has been the disembodiment of the voice, increasing its reach. Along with this there has emerged a kind of *panaurality* in which the potential reach of individual sounds and, more importantly, hearing has become global. However, despite the rhetoric suggesting the *high fidelity* of phonography, technologies are most conspicuous in their infidelity and, as I will explain, the notion that a recording somehow represents let along can maintain some kind of fidelity to an *original* is complicated and problematic.

The chapter details how early examples of phonography were developed for a variety of reasons. In fact, some of the earliest known phonographic technologies could not even reproduce sound. Instead, they were, literally, sound writing technologies and nothing more. It was only when Thomas Edison, often cited as the father of phonography, developed his phonograph that sound became mechanically reproducible. He imagined a great many uses for his technology but importantly thought its use should be *democratic* in that amateurs would be able to make and listen to their own recordings. His machine could initially produce only one recording at a time, which itself could not be copied, and so it was not until later developments that sound recordings could be mass reproduced. However, once those developments had taken place *democratic* uses of the technology were pushed aside by the emergence of the music industry, as Jacques Attali analyses in detail and I will explore further, demarcating music as something produced by professionals for consumers to listen to in the privacy of their own home. It was not until the early twentieth century that theorists such as Laszlo Moholy-Nagy began to imagine the creative possibilities of such technologies and it would be some years before artists utilised them in such ways. Nevertheless, eventually uses of sound technologies proliferated in the twentieth century, in the arts as well as in other industries and, alarming but perhaps unsurprisingly, in warfare as sound, and even *unsound* outside the spectrum audible to humans, was made available as a resource.

Following these developments, it has been the arts that have led critical discourse around sound. Although work continues in the sciences, the scientific theory of sound remains largely as it was articulated during the nineteenth century. *Chapter 4 – Listening: Phenomenology, Sense & Experienc*e documents and analyses the artistic

and philosophical interest in listening that emerged in the latter half of the twentieth century.

As I detail, it was only when Pierre Schaeffer instigated *musique concrète* in the late nineteen forties that that the arts began to experiment specifically with sound, rather than the voice or music. Drawing on phenomenology and its focus on sensation as bodily experience, he theorised the *objet sonore*, or sound object, creating yet another, although admitted quite flexible, ideal sound.

His work paralleled that of John Cage, who famously called for composers to 'let sounds be themselves', implicitly suggesting, as did Schaeffer, the, to my mind erroneous, notion that individual sounds have an essence. Also, Cage developed from his interest in *all sound*, demonstrated in his well known piece *4'33"*, a theory of *always sound* based on his belief that there is no such thing as silence, purportedly developed following a visit to an anechoic chamber. This, however, is complicated by his extensive use of silencing in his compositional practice and fails to recognise the possibility of multiple silences. As I will argue, silence is not merely the absence of sound. Instead, it is itself contingent and multiple.

These important figures were followed by R. Murray Schafer who, in his book *Our Sonic Environment and The Soundscape: The Tuning of the World* defined and mapped out the field of acoustic ecology. He demonstrates very well the increased focus on listening that has gradually emerged in theory, as well as a clearly anti-noise sentiment, such as is now increasingly common. His claim that 'hearing is a way of touching at a distance', as I will explore, articulates accurately the experience of sound as bodily, which has since been explored by a number of theorists, introducing the body as yet another site or, perhaps more accurately, medium of sound (Schafer 1994, p.11).

It has only been in the last twenty to thirty years, following the work of Schaeffer, Cage, Schafer and others, that sound studies as emerged as a discipline. However, despite frequent complaints about the opto-centric culture of modern society it is now a vibrant area of study and one that, as I have stated, has gathered pace in the last decade. Along with the work of artists exploring sound, sound theorists have often based their work on that of contemporary philosophers, who are themselves increasingly influenced by sound.

Chapter 5 – Murmur: Haecceity, Difference & Noise details the work of contemporary philosophers of multiplicity, such as Michel Serres, Gilles Deleuze and Felix Guattari;

themselves inspired by sound, and uses it to develop a philosophy of sound based on the history of its study and the mythology around it. Along the way it analyses digital sound as a contemporary example of sound and contextualizes and analyses recent discourse around sound and related sonic philosophies, all of which are intimately entangled with the approach I take here. I argue, as I have already claimed, that murmur is a useful archetype of sound, precisely because it is not ideal. Unlike the voice, music or a *high fidelity* recording, it is not defined or pure but plural and noisy. It is continuous but spatially dispersed. It is has conceptual, perceptual and social dimensions.

Although it is my contention that sound exists in multiplicity, it is nonetheless individuated. Originally referring to the particulars, discrete qualities, properties or characteristics, that give something singularity or thisness, *haecceity* is a term that has been adopted by Deleuze and Guattari to describe a 'mode of individuation very different from that of a person, subject, thing or substance' that exists entirely as 'relations of movement and rest between molecules or particles' or 'capacities to affect and be affected' (Deleuze & Guattari 1987, p.261). One example of a haecceity is a season; it does not exist in a specific location but is defined by particular characteristics that are held together in a constellation that is identifiable. Sound can be individuated as just such a haecceity – assigned many characteristics but lacking specific location or manifestation. More commonly, sound exists as a cultural artefact that is defined as a *thing* by different disciplines using a number of definitions. However, these maneuvers deny the fact that there is not one sound but many sounds, all of which are intimately bound up with noise, such that sound is multiple, impure and resistant to definition.

Deleuze and Guattari theorise the refrain or *ritournelle* in the chapter '1837: Of The Refrain' of their book *A Thousand Plateaus: Capitalism and Schizophrenia*. When writing the refrain, Deleuze and Guattari are referring to the musical concept of a refrain, a repetition or thematic re-statement, a motif perhaps. 'A child in the dark, gripped with fear, comforts himself by singing under his breath', they write (Deleuze & Guattari 1987, p.310-350). Definitions of sound that individuate it are just such refrains and I will explore those that have dominated scholarship around sound as well as their repetition and restatement, the redundancy that gives them meaning, to the point they break up into noise.

Deleuze argues in *Difference and Repetition* that 'every object, every thing must see its own identity swallowed up in difference, each being no more than a difference between differences' and this applies to sound (Deleuze 1994, p.56). But, as I have

said, it is not so simple as defining sound as different to silence, or noise for that matter, instead it is that sound is better understood with an approach to ontology that emphasises difference rather than discrete identity.

It is the work of Serres that I rely upon most here. He has developed a philosophy of multiplicity based on a metaphysics of noise, which he outlines most fully in his book *Genesis*. He uses a wave metaphor such as that which, as I will explain, has been so pivotal in explaining sound but, rather than seek a perfectly formed wave on a calm, flat pond, he is interested in the tumult that results from the immense swell of waves in the sea. He traces the lineage of the word noise to nausea, seasickness (Serres 2009, p.13).

Importantly, specific instances of noise as unwanted or loud sound are for Serres nothing more than localised approximations of a greater *noise*, a kind of chaos that exists as a space of potential, which is inaccessible. For him, 'history is in the midst of these hazy midsts, commonly lived, uneasily thought, it is, as it happens, information neither total nor null, without a clear cut boundary between observer and observed (Serres 2009, p.6-7). Sound, in this way, exists on backdrop of noise and is itself suffused with noise.

Murmur is sound that is multiple and noisy. When thought using Serres's metaphysics it challenges the academic metaphysical tradition's identification of the real with a stabilised unitary being. While it can be individuated, it nonetheless possesses *multivocity,* unlike established archetypes of sound such as the voice, sine tone and high fidelity recording. The notion that univocity is somehow fundamental to being, although increasingly criticised in contemporary philosophy and problematic when applied to sound, has been highly influential throughout the development of the study of sound and remains influential in sound studies. It is, therefore, necessary to hear sound in new ways, using archetypes such as murmur in order to address its multiplicity.

Sound undermines many assumptions of the metaphysics, epistemology and philosophy inscribed in its history. As a result, it has led me to alternate metaphysics that emphasise presence, difference and multiplicity. Here I demonstrate just some possibilities of what can be learnt from sound.

Instead of being defined by physical properties, sound is a *haecceity*, a thisness or singularity, with disparate characteristics such as those of a season or an hour. Although it can be explained as a wave with length and height, frequency and

amplitude, perceptible by the human ear and brain, is divisible into the simplex of the sine tone and can be inscribed into a material form, at the same time it exists in many other ways.

The tremors of sound can be found in ancient research into the voice, music and acoustics. It is in excavating this history that the most enduring and influential thoughts about sound can be found. Discoveries that would later be made as a result of the development of the sciences during the enlightenment period, technological advances in the nineteenth century, philosophical shifts in the twentieth century and even in the rise of the arts as a forum for experimentation with sound are all in some way attributable to the prehistory of the study of sound.

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Chapter 1

Tremors: Voices, Music and Acoustics

> Hearing occurs when the air between that which sounds and that which hears is struck, thus undulating spherically and falling upon the ears, as the water in a reservoir undulates in circles from a stone thrown into it (Hunt 1978, p.23-24).
>
> - Chrysippus of Soli

Interest in the study of sound is most commonly traced back as far as 500 BCE to the work of ancient Greek philosophers. There is evidence that as early as 3000 BCE the Chinese had already developed a scale based on the knotted articulation of positions of overtones on the ancient instrument the *guqin* and that a great deal of musical theory in the Indian philosophical tradition dates to at least the time of the Greeks themselves. However, it is the Greeks who are responsible for laying the foundation upon which the modern study of sound would be built. In particular they are responsible for establishing the fundamentals of acoustics, the mathematical expression of musical harmony and even rudimentary versions of the wave theory of sound.

For a period of almost two thousand years after the time of the Greeks, basic ideas related to the passage of sound were developed based on study of the voice, music and acoustics and the use of empirical knowledge and analogies that were employed in antiquity. The work completed in this time formed the foundations for the scientific theories developed during the eighteenth and nineteenth centuries and even the subsequent development of sound recording and other related technologies in the late nineteenth and early twentieth centuries.

The Greek philosopher Chrysippus is credited with first describing the movement of sounds through the air, using the metaphor of the waves that result when a stone is cast into water. This represents perhaps the original and certainly the most enduring example of the influence of the Greeks on the study of sound. It is an analogy which

has been so often repeated that whatever its origins the influence it has had on the development of thought around sound cannot be underestimated. Given their enduring influence, it is perhaps not surprising that the dominance of certain images, ideas and technologies has been clear since the work of the Greeks and the metaphor of sound as a wave rippling across the surface of water is the most important of these.

Leonardo da Vinci was perhaps the most significant figure of the Renaissance to continue the study of sound initiated by the Greeks after the dominance of scholasticism largely halted that study in the Middle Ages. He made extensive use of the wave metaphor. He also anticipated the discovery of resonance, studied echoes and even provided the basic model for modern sonar techniques, laying the foundation for the research that would follow as the sciences gathered momentum (Hunt 1978, p.76). Subsequently, Galileo and Mersenne refined the musical ratios that had been developed by the Greeks and perpetuated by early Christian liturgical music. They developed mathematical equations by studying vibrating strings. This furthered the development of theories of 'musical' sound as distinct from the noise of the world and initiated the dominance of physics in the study of sound that would lead to the development of modern acoustics. It is the work of Chladni bowing glass plates covered in sand that is now seen as the defining moment in the birth of acoustics as a distinct discipline. However, if this is the case then it is as a moment that solidified the work of others, such as Robert Hooke, whose own experiments with flour covered plates predated Chladni's, and Joseph Sauveur, who is responsible for coining the term *acoustics*, as well as solidifying sound itself in his gesture to render it visible and, therefore, knowable.

It is in the study of the voice, music and, eventually, acoustics that sound was gradually constructed from the noise of the world. In the theatres of ancient Greece the audience was focused on the voice of players with the design of the structure itself attenuating all other noise. In the development of harmony and the well-tempered scale, music was separated from all other noise and, eventually, the emergence of acoustics as a distinct discipline served to further the distinction of sound from noise as something meaningful, understandable and controllable.

Tracing the Voice

Actors in Greek tragedies spoke through masks called *persona*, literally 'by-sound', allowing the communication of their character by voice alone and so relying on the audibility of the players to the entire audience (Ihde 1976, p.15). The efforts of the Greeks to ensure that the players could be clearly heard laid the foundations of acoustics. The art of theatre was central to the culture of ancient Greece and, as a result, the theatres constructed throughout the period were of immense scale so as to accommodate the large audiences that the popular art form attracted. Greek amphitheatres held as many as 15,000 people and were constructed so as to allow all patrons to hear the actors on stage without amplification, vital before modern technologies such as microphones and loudspeakers and given the centrality of the voice to the art form. Imagining a venue of such a size in which those on stage could be heard, un-amplified, in even the furthest reaches of the seating is, even by today's standards, difficult and yet this is precisely what the Greeks achieved.

Marcus Vitruvius Pollio, a Roman architect, described the design of Greek theatres using the analogy of a stone cast into water. He thought the important factor was the theatre's slope, designed to trace the voice as it rose up the theatre's tiers of seating. In an articulation of Chrysippus's description of sound 'undulating spherically', he explained that 'on the surface of water the circles move horizontally, while the voice at once advances horizontally and mounts upward, step by step' (Vitruvius 1999, p.66).

The Hellenic theatre at Epidaurus is an excellent example of such architecture. Designed in the fourth century BCE by Polykleitos the Younger, it remains one of the world's great acoustic achievements as it allows the un-amplified voice of an actor situated on the proscenium to be heard with almost perfect intelligibility regardless of the seating of audience members (Declercq & Dekeyser 2007, p.2011). Exactly which aspects of the design of the theatre allowed such acoustic qualities has largely remained a mystery in the centuries since. In fact, for some time it was speculated that the *persona* might have directed the voice of the performers and so contributed to the clarity of performances in the theatres. Other explanations for the phenomenon have included the rhythm of Hellenistic poems of the period and even the strength of the wind running through such spaces (Declercq & Dekeyser 2007, p.212).

In 2007 Nico F. Declercq and his team at the Georgia Institute of Technology completed research into the acoustic of the amphitheatre at Epidaurus, discovering that the tiered limestone seating acts as a series of acoustic traps which filter out frequencies below 500 Hz while also conveying higher frequencies toward the

audience, creating a flow in the architectural design that allows voices to be carried clearly from the proscenium to even the furthest rows of seating (Chao 2007). As well as filtering out the fundamental tones of the human voice, which is in the range of 85-155 Hz for men and 165-255 Hz for women, the acoustic effect of the seating also removes background noise that would have been present in the theatre, such as that of the audience as well as the wind and other incidental sounds. Consequently, with the audible frequency spectrum cleared of such interference, the human nervous system and brain are able to reconstruct the fundamental tone or each actor's voice from the available high frequencies through the effect of virtual pitch (Declercq & Dekeyser 2007, p.2020).

It is likely that the Greeks, and indeed the Romans and others that followed, did not themselves fully understand the method behind such an accomplishment as later amphitheatres were constructed with seats made of timber or other materials rather than the limestone used so well at Epidaurus. However, despite the apparent absence of the involvement of theoretical understanding in their successful design, the amphitheatres remain nonetheless an exceptional achievement of early acoustics.

The efforts to develop an acoustic effect in Greek theatres was focused on the task of maintaining the audibility of the voice and, in particular, only the voices of the players on the stage, to the exclusion of all else. The construction of the theatre at Epidaurus removed the unwanted noise of the wind and the crowd, leaving only the sound of the actors' voices. Apart from the importance of Greek architecture in the development of modern acoustics this demonstrates the elevation of the voice above all other sound, which was perceived as noise. However, this was only the case when the voice was disembodied by the *persona* because, as Frances Dyson writes, 'the voice has had to undergo a prior refinement – the transmission of sound into speech – utterance into language. In this process, a metaphysical filter has been engineered, allowing sound – as an abstraction – to occupy both natural and cultural realms simultaneously, and turning the voice into an instrument – separate from the body and the world in which it speaks' (Dyson 2009, p.8). Dyson argues that 'while generally associated with the production of language (the cornerstone of intellectual life), the sound of the voice also adheres to a truth supposedly beyond language, revealing the physical and emotional state of the speaker as being, for instance, in a state of anger, nervousness, mirth, congestion or psychosis' (Dyson 2009, p.8). She continues, 'meaning and rationality are never fully grounded in the voice' – onomatopoeia, rumour and cacophony are examples (Dyson 2009, p.8). Therefore, only when utterance was interpreted as speech, meaningful language disembodied and separated from the world, did it become of worthy of transmission for the Greeks.

The use of the *persona* and the development of an acoustic in Greek theatres specifically to allow transmission of the voices of the players alone represents not only the gradual development of a distinction between meaningful and useful sound, as exemplified by the voice, and unwanted noise but also, importantly, signals both the emergence of technologies to transmit sound and the beginnings of modern notions of listening as an activity focused on giving attention to specific sounds and their sources.

Weighing a Blacksmith's Hammer

The philosophers of ancient Greece played a significant role in the development of musical theory as well as sound theory. In particular, the mathematician Pythagoras and his followers who 'lost faith in the senses as a criterion for judgment' and 'sought to interpret all phenomena as manifestations of mathematics' (Hunt 1978, p.11). Mirroring the use of the *persona* by players in the Greek theatre, Pythagoras is known to have lectured from behind a screen. He would allow only the *mathematikoi*, disciples who had already spent years devoted to his teachings and observed a ritual of silence known as *echemythia*, to see his figure and work with him directly, referring to less advanced students as *akousmatikoi*. It is this practice that is the basis of the modern acousmatic tradition in experimental music and accompanying notion that sounds can be heard in themselves more clearly when removed from their context.

In the fifth century BCE Pythagoras developed his theory of tuning based on mathematical ratios. He thought that music should be made more harmonious, an attempt to fight the chaos of dissonant sound not dissimilar to the Greek amphitheatre builder's efforts make the voice of the players in their theatres audible above the background noise around them. It is believed that Pythagoras first developed his theory listening to the sound of a blacksmith striking an anvil and realising that the weight of the hammer was relevant to the sound it produced. Subsequent study into tones, such as that undertaken by Hermann von Helmholtz and, which is explored later in this work, would be based on this discovery.

Listening from the Cave

Plato's allegory of the cave from *The Republic* is arguably one of the most cited texts in the academic philosophical tradition. It illustrates the basic metaphysics and epistemology of his philosophy – a belief in universal forms inaccessible to human experience – and its repetition, by empiricists and idealists alike, has contributed significantly to the development of the 'natural standpoint', theorised by Edmund Husserl as a commonly held view, which has dominated the academic tradition, that *things* materially exist and properties emanate from them. It involves a fictional conversation in which Socrates likens human experience of the world to that of a group of people who have lived all theirs lives chained in a cave facing a blank wall. The only visual experience the people have of the world is the shadows they see projected on the wall as a result of things passing in front of a fire behind them and so those shadows form their reality.

> Behold! human beings living in a underground den, which has a mouth open towards the light and reaching all along the den; here they have been from their childhood, and have their legs and necks chained so that they cannot move, and can only see before them, being prevented by the chains from turning round their heads. Above and behind them a fire is blazing at a distance, and between the fire and the prisoners there is a raised way; and you will see, if you look, a low wall built along the way, like the screen which marionette players have in front of them, over which they show the puppets.
>
> I see.
>
> And do you see, I said, men passing along the wall carrying all sorts of vessels, and statues and figures of animals made of wood and stone and various materials, which appear over the wall? Some of them are talking, others silent.
>
> You have shown me a strange image, and they are strange prisoners.
>
> Like ourselves, I replied; and they see only their own shadows, or the shadows of one another, which the fire throws on the opposite wall of the cave?
>
> True, he said; how could they see anything but the shadows if they were never allowed to move their heads?

> And of the objects which are being carried in like manner they would only see the shadows?
>
> Yes, he said.
>
> And if they were able to converse with one another, would they not suppose that they were naming what was actually before them?
>
> Very true.
>
> And suppose further that the prison had an echo which came from the other side, would they not be sure to fancy when one of the passers-by spoke that the voice which they heard came from the passing shadow?
>
> No question, he replied.
>
> To them, I said, the truth would be literally nothing but the shadows of the images (Plato 427-347BC, Book VII).

Following the teachings of Socrates, Plato uses the allegory to argue an idealist belief in a world of universal forms inaccessible to experience in the same way that the things seen as shadows themselves were inaccessible to the people chained in a cave. The focus on the existence of *things*, which in turn treats phenomena as mere effects, demonstrated in the allegory dominated philosophy until the work of Husserl and the phenomenologists. Furthermore, it continues to influence popular understandings of the world. All of which is relevant here because, as I will show, sound fits uneasily in any philosophy that assumes that the world is principally made up of things – it is many ways indivisible, unbounded, and fills space. Demonstrating the point, Edmund Carpenter and Marshal McLuhan argue in 'Acoustic Space' from *Explorations in Communication: An Anthology*:

> We suppress or ignore much of the world as visually given in order to locate and identify *objects* in three dimensions. It is the objects which compel our attention and orient our behavior; space becomes merely that which must be traversed in getting to or from them. It exists between them, but they define it. Without them you have empty space…The essential feature of sound, however, is not its location, but that it *be*, that it fill space (Carpenter & McLuhan 1970, p.67).

Admittedly, Plato argued that face-to-face conversation, rather than writing, was the best way to philosophise as it offers each thinker the chance to answer questions and explain himself. He even wrote about the way in which the people chained to a wall in a cave all their lives would have attributed echoes they heard as having come from the shadows they saw in front of them. However, his focus was on the shadows and the visual representation of the world they offered and this too has continued. Carpenter and McLuhan elaborate:

> In our society…to be real, a thing must be visible and preferably constant. We trust the eye, not the ear. Not since Aristotle assured his *readers* that the sense of sight was "above all others" the one to be trusted, have we accorded sound a primarily role. "Seeing is believing (Carpenter & McLuhan 1970, p.65)."

Just as Don Ihde argues, academic discourse has been dominated by the visual, a '*worldview*', and 'this visualism may be taken as a symptomatology of the history of thought' such that 'the use and often metaphorical development of vision becomes a variable that can be traced through various periods and high points of intellectual history to show how thinking under the influence of this variable takes shape' (Ihde 1976, p.6). He claims that one of factors involved in this has been 'an implicit *reduction to vision* whose roots stem from the classic period of Greek philosophical thought' but 'its source lies not so much in a purposeful reduction of experience to the visual as in the glory of vision that already lay at the center of Greek reality' (Ihde 1976, p.6-7). Ihde cites Theodor Thass Thiemann's explanation that:

> The Greek thinking was conceived in the world of light, in the Apollonian visual world…The Greek language expresses this identification of 'seeing' and 'knowing' by a verb which means in the present *eidomai*, 'appear,' 'shine,' and in the past *oida*, 'I know,' properly, 'I saw'. Thus the Greek 'knows' what he has 'seen' (Ihde 1976, p.6-7).

Despite this, there is a strong history of pre-Socratic philosophy that approached reality as based in change and flux, which is now often forgotten. Drawing attention to historical examples of such ideas, Marshall McLuhan argues, in *Visual and Acoustic Spaces*, that for 'the mountain Greek', among others, 'the world was multicentered and reverberating…Acoustic imagination dwelt in the ebb and flow, the *logos*' (McLuhan 2004, p.68).

One philosopher in particular who emphasised change as the foundation of reality was Heraclitus. Although little is known about him and his life, it seems he lived around

535-475 BCE. He is most well know for the aphorism ‘you cannot step twice into the same river, for other waters and yet others go ever flowing on’, along with quotes such as ‘everything flows and nothing abides; everything gives way and nothing stays fixed’ and ‘it is in changing that things find repose’ (Danielson 2000, p.13). Generally this is thought to refer to the fact that although a river is understood as a discrete thing with a specific location and existence it is in fact nothing more than the movement of water. He was a philosopher interested in flux and mutability and so offers an interesting entry point to alternative metaphysics that better accommodate sound, Although, I must mention that even he has been quoted as having argued that ‘eyes are more accurate witnesses than ears’ (Wheelwright 1966). It is in his work that there is precedent for the recent philosophy of multiplicity on which I will rely later, such as that of Michel Serres.

The Music of the Spheres

Although most of Pythagoras’s work is still respected today, one theory that is now largely set aside is his theory of a ‘music of the spheres’. Built on his belief that the universe was underpinned entirely by mathematical principles and equations, Pythagoras theorised that the planets and stars move according to mathematical ratios corresponding to musical notes and so produce a symphony, a ‘bringing together of sound’ in its Greek etymology. Building on Pythagoras’s initial concept, Anicius Manlius Severinus Boëthius presented the three branches of the medieval concept of *musica* in *De Musica*, published around 500 AD, as being the music of the spheres, *musica universalis*, the music of man, *musica humana*, and the music of instruments, *musica instrumentalis* (Caldwell 1981, p.145). Musica universalis, which literally means ‘music of the universe’, is an ancient philosophical concept that suggests the proportions of the movements of the Sun, Moon, and planets create a kind of music and it this belief to which Pythagoras referred in his theory. It is, as I will explore, an idea that is related to religious notions of harmony, an idea that recurs throughout history and is referred to in many literary works, including Dante’s *The Divine Comedy* and Shakespeare’s *The Merchant of Venice*.

Scientifically the ‘harmony of the spheres’ was disproved as a theory when the ‘bell-in-a-vacuum’ experiment, well known to many from high school physics classes, was first described in 1615. Gianfrancesco Sagredo suspended a bell in a glass vessel from within which the air had been removed and observed that when he moved the bell it made no sound (Beyer 1999, p.4). It was with this experiment that scientific evidence was discovered to confirm that sound requires a medium through which to pass, rendering the notion of a ‘music of the spheres’ in the vacuum of space untenable

(Hunt 1978, p.122-118). However, the idea of a 'music of the spheres' is powerful and, whatever its scientific value, a theory that has been common in a variety of forms in the centuries since, particularly in connection with various spiritual beliefs. It presents a key idea from which to analyse the role of religion in the development of such ideas in the Middle Ages.

The Word

The music of the spheres is often considered synonymous with the religious notion of a vibration that flows through all creation. In the Christian tradition this is referred to as the Word and John's Gospel places it as the originating principle – 'In the Beginning was the Word and the Word was with God, and the Word was God' (John 1:1, King James Version). It is also synonymous with the ancient Sanskrit word Shabd, which appears throughout Hindu Yogic tradition and is now translated as 'sound' or 'speech', and the Kalam-I-Qadim, which refers to the Islamic concept of an 'ancient sound'. Don Ihde starts his book *Listening and Voice: Phenomenologies of Sound* with the passage:

> The beginning of man is in the midst of *word*. And the center of word is in breath and sound, in listening and speaking. In the ancient mythologies the word for soul was often related to the word for breath. In the biblical myth of the Creation, God breathes life into Adam, and the breath is both life and word. Today mythical thought is still repeated in many other ways. We know that we live immersed in a vast but invisible ocean of air that surrounds us and permeates us and without which our life must necessarily escape us…but in the words about breath there lurk ancient significances by which we take in the haleness or health of the air that for the ancients was spirit. From breath and the submersion in air also comes *in-spire*, "to take in spirit", and on a final *ex-halation* we ex-(s)pire, and the spirit leaves us without life. Thus still with us, hidden in language is something of the ontology of Anaximenes who, concerning the air, thought, "As our souls, being air, hold us together, so breath and air embrace the entire universe." But the air that is breathed is not neutral or lifeless, for it has life in *sound* and *voice*. Its sound ranges from the barely or not-at-all noticed background of our own breathing to the noise of the world and the singing of word and song among humans (Ihde 1976, p.3).

According to R. Murray Schafer the music of the spheres represents 'eternal perfection' and 'when the Indian yogi attains a state of liberation from the senses, he

hears the *anāhata*, the "unstruck" sound' (Schafer 1994, p.261). He explains the *anāhata*, or unstruck, as 'a vibration of the ether, which cannot be perceived by men but is the basis of all manifestation' (Schafer 1994, p.260). Schafer argues that all the sounds heard are imperfect – distorted in transmission and reception – and so the only sound he considers perfect is silence and 'all sound aspires to the condition of silence, to the eternal life of the Music of the Spheres' (Schafer 1994, p.262).

Sound has inspired many such mystical claims but all rely on a similar notion of underlying universal harmony. I find this to be nothing more than a premise of faith, if an understandable one. Schafer wisely points out that there is distortion in all sounds heard, which makes the notion of perfect or pure sound problematic. However, his belief in the 'music of the spheres' is at best a poetic reference to the silence of space as one of potential and at worst seriously misguided for it suggests an ordered, harmonious, vibration to the universe that I find incredible.

Scholasticism and its Silence

The theatres and academy of ancient Greece may have been the birthplace of acoustics but it was over two thousand years before the field was defined and serious advances made. Principally this interruption can be understood as being due to the dominance of medieval scholasticism in academia, the pedagogical methodology used by academics in medieval times to justify orthodoxy and, in particular Christian theology. Frederick Vinton Hunt argues in his book *Origins in Acoustics* that 'the rise and decline of medieval scholasticism carried the pure rationalism of Greek natural philosophy through a full cycle of change before free scientific inquiry was reinstated in the West at the culmination of the Renaissance' (Hunt 1978, p.45). The rise of Christianity in the West and Islam in the Middle East would result in a profound change, leading, as Hunt notes, to 'a fundamental clash between religious faith and the objectivity of scientific rationalism' because 'one is tacit and invariable, the other is dynamic and committed to change; yet each is responsive to deeply felt human needs' (Hunt 1978, p.45). Hunt adds 'the responsibility for fusing these inhomogeneous convictions fell then (as it still does) on the shoulders of teachers and scholars, and their attempts to achieve a synthesis of sacred and profane sciences were a dominant feature of the scholasticism that flourished almost universally during medieval times' (Hunt 1978, p.45).

Scientific study continued in the Muslim world to some extent during the dominance of scholasticism, such as in the work of Khalìl Ibn Ahmad, Al Kindì and Al-Fàràbì,

although there seemed to be little theoretical development of the thought of the Greeks (Hunt 1978, p.47-49). During the tenth century there was a secret society called the Ikhwàn al-Safà, or the Brethren of Purity, established at Basra, who collaborated on writings dealing with the philosophy and natural science known at the time, including the harmony of the celestial spheres and even a three dimensional development of the image of the wave as a model for the propagation of sound (Hunt 1978, p.56-57). Muslim science of this period reached its peak in the late tenth and early eleventh century with the work of a number of notable thinkers. Most interesting is Ibn Sinà, whose writings on sound and music were the result of some of the earliest deliberate experimentation in acoustical science and included the earliest measurement of the difference threshold for pitch change (Hunt 1978, p.57-59). Importantly, Hunt notes that Islamic scientists not only adopted the physical sciences of the Greeks but experimented further with them such that 'a clarified, if not augmented, version of the Greek's acoustical tradition was conserved in Islam for retransmission – "on the wings of song," as it were – to the West' (Hunt 1978, p.47).

There was some continuity in the development of acoustics more generally during this time and that was through the study of music which, in the words of Hunt, 'was assured a continuing place in the scholastic sun by virtue of its role as a part of the classical quadrivium' and so 'educators, philosophers, encylopedists, and commentators alike had perforce to deal with music and the evolution of musical science' (Hunt 1978, p.46). In the eleventh century A little known German monk named Theophilus wrote *Diversarum atrium Schedula*, in which he detailed the method of construction of organs and organ pipes and explained procedures for casting bells and cymbals. He demonstrated a knowledge of the importance of weight in achieving desired tones based on the work of Pythagoras and therefore his work demonstrates at least some degree of continuation of acoustical theory in the Christian tradition of the time (Hunt 1978, p.61). Meanwhile, Safì al-Dìn, who is credited as the last and perhaps the greatest of the Arab musical theorists of this age, made a particularly notable contribution to the theory of music, and incidentally, acoustics, in the thirteenth century. His *Kitàb al-Adwàr*, or Book of Musical Modes, thought to have been written in 1252, proposed a melodic system based on the division of the octave into sixteen intervals, out of which could be formed a great deal of eight note scales that fit closely to what is now known as *just* intonation (Hunt 1978, p.69).

Gradually the stewardship of natural science, and with it acoustics and musical theory, shifted back to the West (Hunt 1978, p.62). However, it was not until the Renaissance that significant attention would again be conferred on the sciences and, as a result, musical theory and acoustics. Important steps had already been taken towards the

emergence of acoustics as a distinct discipline and, despite the delay, scholasticism and applied knowledge eventually made way for the rise of the sciences. Significantly it was the image of a stone thrown into water as an analogy for the passage of sound that would preserve the ideas of the Greeks most successfully. Almost two thousand years later and with very little development in the intervening period it was some of the most important thinkers in history who further developed the study of sound.

Religious Harmony

The influence of religion on early history of the study of sound wasn't limited to the silence it imposed on the sciences. In fact the use of sound as a means of communication was very important to the church and its power and reach. Consequently, religious sounds were dominant in everyday life. R. Murray Schafer writes about the importance of sound in the church:

> The most salient sound signal in the Christian community is the church bell. In a very real sense it defines the community, for the parish is an acoustic space, circumscribed by the range of the church bell. The church bell is a centripetal sound; it attracts and unifies the community in a social sense, just as it draws man and God together (Schafer 1994, p.53-54).

Similarly, in the Islamic world the call to prayer functions to create an acoustic territory around a mosque, a territory within which all are related to the mosque and each other by the sound of the calls to prayer. Although, the possibility of multiple churches or mosques competing must of course be considered. Along the same lines, Ros Moriarty writes about how in the country of the indigenous Yanyuwa people of the Gulf of Carpentaria in Australia there is a traditional role of 'loudspeaker' (Moriarty 2010, p.95).

> Loudspeakers would address clan groups settling down for the night, and again when they woke in the morning. Sometimes it was to suggest when to move on, where food would be and what ceremony would happen soon. Other times it was to publicly air a problem or grievance, and find a solution. If conflict couldn't be resolved, a formal fight might be organised. One traditional fighting ground of the Yanyuwa later became a football pitch. Loudspeaking stopped when bush camps where replaced by houses, because voices were blocked out by walls (Moriarty 2010, p.95).

Furthermore, Schafer notes that 'the interior of the church, too, reverberated with the most spectacular acoustic events, for to this place man brought not only his voice, raised in song, but also the loudest machine he had till then produced – the organ. And it was designed to make the deity listen' (Schafer 1994, p.52).

The use of music in the church had far reaching effects on the development of secular music for centuries and as a result the development of a scientific theory of sound. Early Christian liturgical music was based on the harmony of tuning systems developed in ancient Greece and influenced greatly the development of classical music. Gregorian chants, which are monophonic and were generally taught using the *viva voce* method, dominated until the eleventh century, after which polyphonic music developed throughout the late Middle Ages and into the Renaissance leading up to what is now known as the common practice period, which in turn is divided into the Baroque, Classical and Romantic eras. Harmony is a dominant feature in all these musics and, indeed, wouldn't be challenged as central feature of music until the twentieth century. Although, it is important to realise that the nature of harmony changed, from describing the relationship of one note to the next, monophony, to the relationship between two or more notes at the same time, polyphony. Jacques Attali argues that 'this explains the fundamental political importance of music as a demonstration that an ideal order, the true image offered by elemental religion, is possible':

> To those who availed themselves of it, music made harmony audible. It made people believe in the legitimacy of the existing order: how could an order that brought such wonderful music into the world not be the one desired by God and required by science? (Attali 2006, p.61).

Although there was little belief in the music of the spheres as a reality, rather than a metaphor, its underlying suggestion that there is a governing harmony, both to music and to life, was accepted and to this day remains an important aspect of much religious doctrine. Indeed, as Attali quotes from Serres 'the word *harmony* sweeps its semantic zone with precision: number, artifact, well-being, language and world' (Attali 2006, p.61). However, eventually modern theorisation of harmony would be born in which 'the idea was no longer to conceptualise music as a naturally ordered whole, but to impose upon it the reign of reason and the scientific representation of the world: harmonic order is not naturally assured by the existence of God', rather 'it has to be constructed by science, willed by man' (Attali 2006, p.60). Although he contradicts himself in his attempt to establish absolutes with his claims, Attali offers a further interesting insight when he argues:

> Music, from the very beginning transected by two conceptions of harmony, one linked to nature, the other to science, was the first field in which the scientific determinations of the concept would prevail; political economy would be its final victory. Of course, music has been conceptualized as a science as far back as the day Pythagoras supposedly heard fourths and fifths in the pounding of a blacksmith. But, simulacrum of the sacrifice in its most basic form, of the natural ritualization of the channelization of violence, it was first theorised in its relation with nature. Originally, the idea of harmony was rooted in the ideas of order through the endowment of noise with form…Harmony is thus the operator of a compromise between natural forms of noise and the emergence of a conflictual order, of a code that gives meaning to noise, of a field in the imaginary and a limit of violence (Attali 2006, p.59-60).

Approaching this with more clarity, Serres argues that 'music is saturated with the reversible' (Serres 2000, p.154). He is interested in the definition of meaning from noise, a project that would in many ways define the rise of the sciences and in particular the scientific theory of sound. He hears vibrating strings and ringing bronze as vortices, a mass of whirling air or water, and suggests that in Pythagoras's legendary work 'arithmetic was born from music' (Serres 2000, p.154).

Waves of Sound

Chrysippus is credited, as I have mentioned above, with being the first to explain the passage of sound with the analogy of a wave in water. He argued that 'hearing occurs when the air between that which sounds and that which hears is struck, thus undulating spherically and falling upon the ears, as the water in a reservoir undulates in circles from a stone thrown into it' (Hunt 1978, p.23-24). This concept has been used repeatedly throughout the history of acoustics, from the architectural theory of Vitruvius to the theories of Leonardo da Vinci and the experiments undertaken by Helmholtz and John Tyndall in the nineteenth century, when it formed the basis for much early research into sound itself. It remains to this day a central aspect of ontologies of sound and perhaps the single best example of the empirical symbolism that dominated the early study of sound.

Vitruvius extended the work of Chrysippus with his description of the acoustic function of Greek theatres in his *Ten Books on Architecture*. Interested in the passage of the

voice in such theatres, he explored the idea that sound travels in three dimensions rather than the two dimensions of a ripple on the surface of water. He wrote:

> The voice is a flowing breath of air, and perceptible to the hearing by its touch. It moves by the endless formation of circles, just as endlessly expanding circles of waves are made in standing water if a stone is thrown into it. These travel outward from the centre as far as they can, until some local constriction stands in their way, or some other obstacle that prevents the waves from completing their patterns. In the same way the voice makes circular motions; however on the surface of water the circles move horizontally, while the voice at once advances horizontally and mounts upward, step by step (Vitruvius 1999, p.66).

The ideas of the ancient Greeks related to acoustics were perhaps best collected and summarised in the writings of Boëthius in the eleventh century, although there are suggestions that he was merely translating and repeated Nicomachus's *The Introduction* and Ptolemy's *Harmonics* (Caldwell 1981, p.139). Whatever the merits of that contention, he wrote that 'in the case of sounds something of the sort takes place as when a stone is thrown out and falls into a pool or other calm water' such that 'when the air is struck and produces a sound, it impels other air next to it and in a certain way sets a rounded wave of air in motion, and is thus dispersed and strikes simultaneously the hearing of all who are standing around' (Boëthius 1948, p.189).

During the Renaissance 'in the West the ear gave way to the eye as the most important gatherer of information' and the wave theory of sound began to be developed further to a significant extent (Schafer 1994, p.10). However, the prose of Geoffrey Chaucer provides an excellent example of how the image of ripples on the surface of water as an analogy for the passage of sound was preserved in the intervening centuries. He wrote in his famous text *The House of Fame*:

Soun is noght but air y-broken,

And every speche that is spoken,

Loud of privee, foul or fair,

In his substance is but air;

For as flaumbe is but lighted smoke,

Right so soun is air y-broke….

And right thus every word, y-wis,

That loude or privee spoken is,

Moveth first an air aboute,

And of this moving, out of doute,

Another air anoon is meved,

As I have of the water preved,

The every circle causeth another…

Now have I told, if thou have minde,

How speche of soun, of pure kinde,

Enclyned is upward to meve;

This, mayst thou fele, wel I preve (Chaucer 1393, p.35).

The notebooks of Leonardo da Vinci contain a great many references to the study of sound and, in particular, the image of a stone cast into water as an analogy for its action. He anticipated Galileo's discovery of sympathetic resonance, recognised from his study of echoes that wave motions of sound have a finite velocity of propagation and even provided the basic model for modern sonar techniques (Hunt 1978, p.76).

Interestingly, as Hunt noted, 'he seems not to have leaned very heavily on the teaching of the ancients, however, if he had indeed been exposed to any; instead he made for himself careful studies of the propagation of waves on water and was led independently to regard these and sound waves as similar phenomena' (Hunt 1978, p.76).

According to Martin Kemp, da Vinci conceived the circular movements of sound to be 'a series of successive 'tremors' rather than linear movements of actual material' (Kemp 2006, p.114). He noted that 'tremors from different sources crossing the same space will mingle yet remain discrete and separately discernible, as revealed by the manner in which people can simultaneously see more than one light source and distinguish more than one source of sound, just as the circular ripples from two stones thrown into water intersect yet retain their geometrical integrity' (Kemp 2006, p.114). Leonardo claimed in his notebooks that 'just as a stone flung into the water becomes the centre and cause of many circles, and as sound diffuses itself in circles in the air; so any object, placed in the luminous atmosphere, diffuses itself in circles, and fills the surrounding air with infinite images of itself' (da Vinci 1977, p.203).

The analogy of ripples on the surface of water continued to be used to explain the wave action of sound for several hundred years after the work of da Vinci and, in time, became vital to the development of the scientific theory of sound in the eighteenth century. It exerted a great deal of influence over the work of Lord Rayleigh, Helmholtz and Tyndall. Immediately, however, it was eschewed in favour of the centuries old focus on harmony and the even more ancient technology of the vibrating string.

Vibrating Strings

Arguably the vibrating string dates to the very origins of music, as is suggested by the antiquity of instruments such as the *guqin* mentioned earlier. Strings feature prominently in the work of Pythagoras and remain the basis of a great number of contemporary musical instruments (Beyer 1999, p.13). Galileo and Mersenne independently discovered the laws of vibrating strings in the seventeenth century and used their deductions based on observations of the *waves* of motion visible in the movement of such strings to elaborate theories of the passage of sound. It was from there that the wave theory of sound, based on the metaphor of the ripples on the surface of a pond, began to gather momentum. Galileo argued that the vibrations of a sonorous body spread through the air to produce waves that bring to the tympanum of the ear a stimulus that the mind interprets as sound. Mersenne, meanwhile, is credited

with discovering that the pitch of a sound was determined by the frequency of the oscillations of the wave.

Galileo noticed that when he scraped a chisel over the surface of a metal plate it would sometimes vibrate in such a way as to produce a 'musical' sound and that when this happened 'there would appear on the surface of the plate a series of fine, parallel, regularly-spaced tool marks' (Hunt 1978, p.82). This was, it would seem, a very early example of the practice of the inscription of sound, and is an important step in carving musical sound and specifically its *tone* from the noise of the world. Almost simultaneously, in 1628 Mersenne published his *Traite de L'Harmonie Universelle*, seemingly titled in reference to the 'harmony of the spheres'. Although that treatise contained little original thought itself, the text eventually lead to later papers which detailed his study of string harmonics and finally to his 'great encyclopedic' *Harmonie Universelle*, which would formally appear in 1636 (Hunt 1978, p.83). Concerning the apparent simultaneity of the work of Galileo and Mersenne on vibrating strings, Hunt argues:

> Mersenne's interest in the vibration of musical strings was closely related to his studies of the pendulum and probably preceded them chronologically. Galileo's *Discorsi*, in which he summarized his analysis of vibrating strings, appeared two years after Mersenne's 1636 publications, but it is reasonably certain that Galileo's work on strings preceded Mersenne's. It is equally certain, however, that Mersenne attacked this problem from a fresh viewpoint, as evidenced by the fact that his experimental approach was entirely novel and introduced into the field of mechanics for the first time the quantitative use of scale-model experiments (Hunt 1978, p.90).

It is interesting to note that Mersenne initially followed the established course of using ratios to express the movement of his vibrating strings but made his greatest contribution when he eventually went further and attempted to specify the actual number of vibrations made by a string in a second when sounded in unison with a specific musical note (Hunt 1978, p.90). In effect he was attempting to establish the frequency, that is the number of vibrations per second, of the musical note, which he was the first to do in such a way. There were significant limitations on his method but nevertheless the intention was evident. Although his own calculations and attempts at standardisation were somewhat unreliable, he suggested that the calculation of frequencies of vibration of musical notes offered the opportunity to create a convenient and reproducible standard of pitch (Hunt 1978, p.94). It would not be for several hundred years, and not until Euler's renewal of the suggestion, that the median pitch of

A would be established as 440Hz but Mersenne's contribution was nonetheless insightful.

Mersenne is also known for having attempted to address the problem of establishing the speed of sound. He based his studies on the amount of time taken between a sound and its echo from a reflective surface over a known distance. After establishing the distance from such a surface at which one must stand in order to discern a clear echo, he set about a multitude of experiments, perhaps among his first of an acoustical nature, using the voice as the source of sound and timing echoes produced by a range of syllables, repeated in a variety of different locations. He also conducted tests on the speed of sound using gun blasts, which yielded wildly different results. Although his experiments were quite crude and imprecise, and produced conflicting results, the basic method was fundamentally appropriate, and his result of 319 metres per second deviates less than 10% from the accepted speed of sound in air at normal temperatures of 343 metres a second (Hunt 1978, p.95-100). Not only does this demonstrate his success in quantifying sound but the increasing prevalence of mathematics in the study of sound.

There were a great number of experiments attempting to establish the speed of sound following Mersenne. However, little progress was made until the work of Newton with attention seeming to shift to learning more about the propagation of sound rather than obtaining greater accuracy in results (Hunt 1978, p.111). Eventually, Isaac Newton published the *Philosophiae Naturalis Principia Mathematica* in 1687, in which he stated his three universal laws of motion (Hunt 1978, p.145). It was in this work that he presented the first analytical determination of the speed of sound in air. Newton did this before most of the development of thermodynamics and so did not account properly for the effect of the temperature of the air but otherwise his calculations were correct.

It is clear that at that point the transmission of sound in waves had become a somewhat widely known and accepted idea. Daniel Bernoulli was a Dutch-Swiss mathematician and perhaps the most gifted of three brother mathematicians in the Bernoulli family, sons of Johann Bernoulli (Hunt 1978, p.148). He is remembered particularly for his applications of mathematics to mechanics and for his pioneering work in probability and statistics. Following the work of Galileo and Mersenne, it was Bernoulli, as well as mathematicians such as Leonard Euler, who took the tools of analytical geometry and calculus developed by Newton, Gottfried Wilhelm Leibniz and even his own father Johan Bernoulli, among others, and applied them to physical problems, paving the way for the experimentation and theories of Fourier and others in

the eighteenth century (Hunt 1978, p.147-148). Among other work, he pointed out for the first time the possibility of resolving a compound motion into motions of translation.

The vibrating strings of Galileo and Mersenne provide an important link between the applied interest in the transmission of the voice and beauty of music of the ancients and the more directed research of modern acoustics. Their pioneering contribution cannot be underestimated. Through them the work of ancient Greek architects building theatres to 'trace the voice as it rose', the work of Pythagoras developing harmony in music and the metaphor of a stone thrown into water as a way of understanding the movement of sound would come together in the beginnings of a formalised wave theory of sound, including, for the first time, calculable estimations of the frequency of those waves. Friedrich Kittler argues:

> Intervals and chords…were ratios, that is, fractions made up of integers. The length of a string (especially on a monochord) was subdivided and the fractions, to which Pythagoras gave the proud name *logoi*, resulted in octaves, fifths, fourths and so on…The nineteenth century's concept of frequency breaks with all this. The measure of length is replaced by time as an independent variable. It is a physical time removed from the meters and rhythms of music… references can also be established to link musical intervals and acoustic frequencies, but they only testify to the distance between two discourses. In frequency curves the simple proportions of Pythagorean music turn into irrational, that is, logarithmic, functions (Kittler 1999, p.24).

It is true that the simple understanding of sound's passage as a wave had been considerably improved, the ratios Pythagoras had developed had been, to some extent, replaced with exact integers. However, although the power and details of mathematics quickly obscured the more practical knowledge of the Greeks, this mathematical understanding was nonetheless based on the work of ancients such as Chrysippus, Pythagoras and Vitruvius. Nevertheless, despite the reliance on empirical methods evident in the work of Mersenne and Galileo and the dominance of the wave metaphor in research into the passage of sound, which would continue well into the nineteenth century, the beginnings of the influence of inscription, mechanics and physics on the study of sound are clear.

Drawing with Sand

Ernst Florens Friedrich Chladni's work visualising sound at the turn of the nineteenth century is now frequently cited as the beginning of modern acoustics. Even though his efforts followed the pioneering work of Joseph Sauveur – perhaps a more important figure in modern acoustics – as well as others such as Robert Hooke and John Shore, Chladni's contribution is significant. He felt that the musical theory of the times lacked scientific, and particularly, mathematical rigor and so turned his attention to acoustics, creating his striking *Chladni Figures* by spreading sand over glass plates before running a violin bow against their edges (Sterne 2003, p.44). This vibrated the plates so as to leave patterns in the sand corresponding to the mechanical waves created (Sterne 2003, p.44). It is almost certain that he was aware of earlier experiments conducted by Hooke however it is Chladni who utilised this discovery for further research. Mary D. Waller argues that:

> The originality of Chladni's experiments depends upon the double circumstance that he employed the bow to excite his plates, and used the best powder for sonic frequencies, namely 'fine' sand, which for his purpose did not need to be graded, to obtain his nodal figures (Waller 1961, p.xvii).

However, that originality remains in question because in 1680 Hooke observed the nodal patterns associated with the modes of vibration of glass plates by running a bow along the edge of a glass plate covered with flour. Hooke's work was fundamental to the development of modern acoustics but is now much less frequently cited than that of Chladni. Shortly after this, in 1711, John Shore invented the tuning fork. It was this invention, more than perhaps any other from this period, that was not only a harbinger of the *musical* focus, driven by mathematical systems, that would guide the new scientific field of acoustics for more than a hundred years afterwards but would be literally instrumental in some of that research (Miller 1916, p.29).

Moreover, Joseph Sauveur is given credit for coining the French term *acoustique*, derived from the Greek *ακουστός* or 'able to be heard' from which the word acoustics is, in turn, taken in the English language. Interested in establishing a *sons fixe*, or absolutely frequency, he was responsible for developing the method of finding the pitch of a musical note by observing the frequency of its vibrations, as well as advancing the investigation of musical sound and establishment of a fixed musical scale (Scherchen 1950, p.15).

Although it is important to note the work of Hooke, Shore and Sauveur, Chladni is now seen as the progenitor of the fertile period of development of the field of acoustics and, subsequently, the theory of sound, which followed in the nineteenth century. It was only after the popularisation of Chladni's work that sound was for the first time able to be seen, fixed in time, and hence studied far more closely than ever before. Acoustics had been formally established as an independent academic discipline that, drawing on the work of a great variety of thinkers stretching back to the Greeks, would provide the foundation for further developments in the study of sound.

The *tremors* of sound that are to be found in ancient research into the voice, music and acoustics have created some of the most powerful ideas of sound that exist today and it is in their development that the most important foundations of scientific theories of sound were formed. However, as Dyson writes, 'the desonorization of the voice, the containment of sound and its exclusion from what counts as knowledge, parallel and penetrate the development of ocular-centrism – of a metaphysics grounded in the visible and material presence of the static and enduring object' such that 'immateriality, invisibility and ephemerality become ontological orphans' and 'defined as the attributes of a "thing," rather than things themselves, they are cast into the shadowy cauls of multiplicity' (Dyson 2009, p.21).

Despite the significance of their discoveries Greek philosophers commonly believed the sensible to be 'unstable and therefore unknowable' and developed an epistemology where 'objects of knowledge are ideal, subsistent, immaterial forms that embody eternal order, intelligibility and meaning' and 'ontology and epistemology are united via the being of the object, and the knowledge of this being is given through the sense of sight and touch' (Dyson 2009, p.21). It is perhaps unsurprising to note that 'sound and the speaking voice are banished from this ontological elite, not because of their sonority, but because of what sonority represents – impermanence, instability, change and becoming' (Dyson 2009, p.21). Only with the development of inscription mechanics and physics would sound become knowable and so the comparatively obvious conclusions of the Greeks would, having been preserved for thousands of years, become the basis of the more advanced theories of the nineteenth century.

It is at least somewhat understandable that the discoveries before the development of the scientific theory of sound took many centuries. There were certainly some missed opportunities along the way because, as Hunt argues, 'the commentators and historians who repeated the legend of Pythagoras and the hammers could so easily have contributed to the store of knowledge in their own time had they only repeated the simple experiment of listening to some hammers and then weighing them' (Hunt 1978, p.41).

It is interesting to note that the scientific investigation of sound, which would soon proliferate, was based on the visualisation of sound as a practice that rendered sound static and observable. It was only after sound could be *seen* that scientists came to believe that it was *truly* knowable. Acoustics developed as an independent discipline of note soon afterwards. However before that could happen some great leaps had to be made in other sciences. In particular, as Hunt points out, 'mechanics, heat, and electricity had to come of age first before any comparable progress in understanding could be made in the field of sound' (Hunt 1978, p.142). This demonstrates how the study of sound has always been an interdisciplinary field that draws on other knowledge to fuel its discoveries. Nevertheless, it was to be offered intellectual substance for the development of a scientific theory of sound at the beginning of the nineteenth century, as the enlightenment spread and there were significant advances in the physical sciences.

The Greeks understood sound quite well and applied their knowledge pragmatically. Following the interruption imposed by scholasticism, the science of sound was expanded upon during the Renaissance, leading to huge developments in understanding of just how sound *works*. It is telling that the great theatre at Epidaurus filtered out the murmur of the crowd in favour of the stable, distinct and ideal, but faceless, voice of a performer wearing a *persona*. At the beginning of the eighteenth century acoustics became a distinct field of study in its own right and with it the powers of rational thought and emergent disciplines such as inscription, mechanics and physics became dominant. Scientists began to develop theories of sound, moving beyond the applied knowledge that dominated previous inquiry and gradually making significant changes to how sound was regarded, increasingly distinguishing it from noise and defining it in its own right. Nevertheless the influence of the Greeks would remain. The dominance of certain images, ideas and technologies in the study of sound that was clear from the earliest work of the Greeks would continue in the development of new instruments, techniques of visualisation and fields of knowledge that would expand audibility and the horizon of sound further still and result in the redefinition of sound itself.

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Chapter 2
Theory: Instruments, Visualisation and Science

> The sensation of sound is a thing *sui generis*, not comparable with any of our other sensations. No one can express the relation between a sound and a colour or a smell. Directly or indirectly, all questions connected with the subject must come for decision to the ear, as the organ of hearing; and from it there can be no appeal. But we are not therefore to infer that all acoustical investigations are conducted with the unassisted ear. When once we have discovered the physical phenomena which constitute the foundation of sound, our explorations are in great measure transferred to another field lying within the dominion of the principles of Mechanics (Strutt 1945, p.1).
>
> - Lord Rayleigh

Despite the ideas of the ancient Greeks and other investigations in the intervening years, it was only with the development of modern acoustics and subsequently phonography in the nineteenth century that sound became subject to direct investigation. In much the same way as there was an *Enlightenment* there was also an *Ensoniment* such that, as Jonathan Sterne notes, 'between about 1750 and 1925, sound itself became an object and a domain of thought and practice, where it had previously been conceptualised in terms of particular idealized instances like voice or music' and 'hearing was reconstructed as a physiological process' (Sterne 2003, p.2). The study of sound in that period was dominated by attempts by scientists to define sound, to render it visible and thus to make it knowable through the application of a range of ideas, images and technologies. This was a process that involved the invention of new instrumentation that could isolate, transmit and amplify sound; new techniques of visualisation to render sound observable, static and knowable; the development of a theory of sound based in physics; the gradual separation of meaningful sound from the noise of the world; and finally the adoption of the pure and simple form of the tone as the basic unit of sound and hearing. The rise of the sciences led to a new age in which sound was conceived in a way that was previously unimaginable. Sound emerged from the evanescent, impermanent and changeable to

become a subject of study, a phenomenon that could be described, measured and reproduced.

Douglas Kahn argues that inscription loosened the reliance of acoustics on music in the late eighteenth and nineteenth century, changing the physics and cosmology of sound, precisely because it made sound visible, static and observable (Kahn 2001, p.74). However, the influence of music and, in particular the primacy of harmony nonetheless remained strong, influencing thinking about sound. For example, the application of Fourier's heat equations to sound and the resulting dominance of the understanding of the sine tone as literally the fundamental of sound, the archetypal example of sound as inherently *meaningful* and thus distinct from noise.

The development of new scientific instrumentation and visualisation technologies, underpinned by the emergent field of mechanics, led to a new theory of sound that was strongly related to early physiological theories of hearing and modern notions of attention. Although perhaps not as well recorded, the Enlightenment had just as significant an influence on approaches to sound as to anything else. The development of new instrumentation led to the possibility of visual representations of sound and, with the application of the new science of mechanics to the action of sound, to the distinction of the tuneful, of *tones*, from noise, and also to models of the physiology of hearing. Simultaneously, there was a proliferation of dedicated listening spaces such as concert halls and a corresponding silencing of public space. All of the various advances made in the nineteenth century, while undeniably crucial to the advancement of the study of sound, demonstrated the way in which particular ideas, images and technologies have influenced that study, making sound observable, visible and knowable in a way it had never been before.

Vibration

It would seem that early attempts to visualise sound all demonstrated an interest in vibration. Beyer notes that it is evident that there is almost a complete absence of mathematics in Chladni's *Die Akustik*, published in 1802 (Beyer 1999, p.2). From that observation he suggests that at the beginning of the nineteenth century acoustics was a discipline based on observations and descriptions of vibration (Beyer 1999, p.2). Initially these vibrations were most commonly the result of music of some sort because, as Beyer points out:

> In 1800, the available means for the production of sound were the human voice, musical instruments, cannons and other explosive devices, and natural phenomena such as animal sounds, thunder, etc. It is not surprising, therefore, that Chladni (and others of the time) used music as the basis on which to build almost all acoustics. When dealing with vibrating strings, they were concerned with stringed musical instruments. Vibrating air columns were of interest because of organ pipes, and also various musical horns, while stretched membranes were related to drums. Almost every subject in Chladni's text is studied from the point of view of music (Beyer 1999, p.9).

I suspect that music served most commonly as the source of vibrations for study because, due to a focus on harmony, it produced regular waves of sound that were not viewed as too noisy. However, the invention of the tuning fork by John Shore offered those who followed Chladni, such as Thomas Young and Jules Antoine Lissajous, an alternative sound source for their experiments. Sound was beginning to be distinguished from the noise of the world and with the tuning fork as a test subject could be heard in its *pure* form without the need of music or the voice.

It is clear that at the time of the pioneers of visual sound, in the early nineteenth century, vibration was relied upon as a means for creating sound and so seen as the embodiment of sound and it remains a powerful image. For example, in the early twentieth century Hans Jenny, as Peter Blamey writes, 'pioneered the field of 'Cymatics' (from Greek *kyma*, wave) which he described as the study of the effects of vibration – and considered the visualising of sound as a key method of giving "tangible expression" to the phenomenology of vibration' (Blamey 2008, p.208). He 'posited that periodic phenomena underpinned human existence, and were evident at every level of being, matter and area of investigation' (Blamey 2008, p.208).

Jonathan Sterne argues 'sound is a little piece of the vibrating world' and in so doing demonstrates the influence that the notion of vibration as the basis of sound has, to at least some extent, been retained to this day (Sterne 2003, p.11). Similarly, Brandon LaBelle argues:

> Sounds are generated by vibrating objects and materials, and they in turn generate, through a sort of reciprocal exchange, further vibrations as they come to touch material surfaces. Vibration is then a primary basis of sound, a fundamental material event perpetuating the movement of sounds and extending, as an elaborate network, the collective elemental force of auditory events (LaBelle 2010, p.134).

This idea is developed further by Steve Goodman in his book *Sonic Warfare: Sound, Affect and the Ecology of Fear,* in which he argues for an ontology of vibrational force. He, quite rightly to my mind, argues that 'sound comes to the rescue of thought rather than the inverse' but continues, 'forcing it to vibrate, loosening up its organised or petrified body' (Goodman 2010, p.82). Explaining his position, he claims:

> The vibrational ontology begins with some simple premises. If we subtract human perception, everything moves. Anything static is only so at the level of perceptibility. At the molecular or quantum level, everything is in motion, is vibrating. Equally, objecthood, that which gives an entity duration in time, makes it endure, is an event irrelevant of human perception. All that is required is that an entity be felt an object by another entity. All entities are potential media that can feel or whose vibrations can be felt by other entities (Goodman 2010, p.83).

He points out that such an ontology should not be misconceived as a 'naïve physicalism in which all vibrational affect can be reduced scientifically' (Goodman 2010, p.82). Nonetheless, Goodman's theory remains inspired by the figure of vibration and as so is limited by it.

The relationship of vibration to sound is not so clear. Dyson questions whether vibration is the correct figure for reading sound and wonders whether sound can be more usefully thought of with a metaphysics based on a chart plotted between axis of singular and multiplicity (Dyson 2009, p.78-79). She also notes, quite rightly, that vibration connotes an Ur state that is seen to resist theorisation and at the same time offer a grounding site (Dyson 2009, p.160). Along similar lines, Serres argues that:

> Vibration of a vibrating string, or the vibration of a column of air, these are movements that turn back upon themselves. Acoustics as a whole is just the reversible. This is perfectly general: every sound, every signal is in the domain of periodicity. Thus of the repetitive, of reversibility. The measure that ceaselessly repeats, rhythm, these are returns (Serres 2000, p.151).

Although vibration has come to be seen as the material representation of sound on which visual sound relies, based on the *tremors* so many saw on the surface of water and in the experiments of the scientists of the Enlightenment, there were several antecedent systems for the visual representation of sound: musical notation and, earliest of all, writing. Each of these involves an arbitrary semiotic system that denotes

the use of specific sounds but cannot represent any given sound or make it available for study in the manner in which science made possible. The practice of writing, at least in English and most other European languages, developed the convention of indicating progression with movement from left to right and top to bottom. Subsequently musical notation adopted and augmented that approach with a vertical staff indicating pitch, low sounds represented in degrees below an accepted centre and high sounds above. Although, as R. Murray Schafer points out, 'the matter is largely arbitrary, for while it is customary to point out that there are solid cosmological reasons for such a convention in that shrill sounds like those of birds come from the air while deep sounds come from the earth, thunder does not speak with a soprano voice, the mouse is not a baritone or the rattlesnake a timpanist' (Schafer 1994, p.124). In any case, these conventions became the basis for the reading of visual systems for representing sound.

Visual Sound

The *Chladni Figures*, as a development of the visual of *tremors* of sound on the surface of a body of water, furthered the evolution of the visualisation of sound by replacing the fleeting and noisy waves on the surface of water with static patterns in sand. Well documented in Matt Woolman's *Sonic Graphics: Seeing Sound*, the visualisation of sound has since been an active area of both artistic and scientific research (Woolman 2000, p.1). Winston E Kock asks:

> Why should we wish to "see" sound? What do we expect to gain by visually portraying a phenomenon that we have always perceived so effectively with our ears? An early maxim states that seeing is believing, and the history of science progress is replete with the efforts of experimenters to reduce the observation of physical happenings and measurements to something that can be seen (Kock 1971, p.vii).

The provenance of the visualisation of sound can be traced back for centuries. It is evident in the work of Leonardo da Vinci, Galileo Galilee, Robert Hooke and Ernst Chladni, as I have mentioned, and would be investigated further in the work of a number of prominent scientists over the next two hundred years.

The development of new instruments and technologies in the nineteenth century led in turn to significant developments in the visualisation of sound. Perhaps most significantly, following Chladni's efforts to visualise the vibrations of resonating plates and developing the same line of thought employed by Thomas Young to inscribe those vibrations, the French mathematician Jules Antoine Lissajous developed a method to project vibrations onto a screen for analysis. The *Lissajous Apparatus*, as it was called, which used a complex setup involving a tuning fork, several mirrors and a screen, produced an image, commonly know as a *Lissajous Figure*. By shining a light into a mirror attached to a vibrating tuning fork the light would be reflected into another mirror attached to a perpendicular vibrating tuning fork, which would in turn reflect the light onto a screen. The apparatus in this way described the complex harmonic motion, as perpendicular waves, of the vibrations produced by the tuning forks.

Just as Schafer argues, 'sounds resisted graphic representation for a long time and while we take it for granted that sounds may be described visually, the convention is recent, is by no means universal and…is in many ways dangerous and inappropriate' (Schafer 1994, p.123). Nevertheless, one obvious precedent to the scientific visualisation of sound, as I have mentioned, was the visualisation and, indeed, materialization and commodification of music in the score. As Attali points out, 'the introduction of bar lines in musical notion, of thoroughbass and equal temperament, made music the representation of a constructed, reasoned order, a consolation for the absence of natural rationality' (Attali 2006, p.61).

Techniques of sound visualisation proliferated at an astonishing rate in the nineteenth century and became important tools in the development of a scientific theory of sound but, as Schafer notes, 'while the science of acoustics has advanced greatly since the eighteenth century, the listening abilities of average mortals have not shown corresponding improvement' (Schafer 1994, p.128). Although the visualisation of sound has produced useful knowledge and continues to do so, to some extent it has diverted people from listening to sound. Despite the ontological continuity offered by the figure of the vibration, scientific visual projections of sound are 'arbitrary and fictitious' and should not be seen to truthfully represent a knowable sound any more than musical notation or writing (Schafer 1994, p.127). Visualisations of sound are necessarily gross simplifications of something that is very complex and so, while useful, should not be seen to present sound completely. Fundamentally, most academic metaphysics has come to privilege the visual, as is demonstrated by attempts to create a visual sound, and a fresh approach to sound is necessary.

Attempts to Describe Sound

Generally it is accepted as a truism within traditional academic metaphysics that 'seeing is believing'. People do not trust that which they cannot 'see for themselves' and hearing – hearsay – is considered unreliable, the domain of rumour and speculation. Schafer puts it well when he writes that 'sounds cannot be known the way sights can be known' (Schafer 2003, p.67). He argues that viewing things side by side allows people to place them in comparison with one another and so 'sights are knowable' while 'sounding is active and generative', 'sights are nouns' and 'sounds are verbs' (Schafer 2003, p.67). However, today people still tend to discuss sights as things, or nouns, and to describe sounds using adjectives, recognizing them only as effects, rather than discussing their action with verbs. Roland Barthes argues, similarly, in his essay 'The Grain of the Voice' that language's interpretation of music is based on 'the poorest of linguistic categories: the adjective':

> The adjective is inevitable: this music is *this*, this execution is *that*. No doubt the moment we turn an art into a subject (for an article, for a conversation) there is nothing left but to give it predicates; in the case of music, however, such predication unfailingly takes the most facile and trivial form, the epithet (Barthes 1977, p.179).

Writing about music, as the most popular and predominate form of writing about sound in the contemporary world, is indicative of the way sound is written about more generally. It is in this way, with the use of the epithet, that sound is continually defined as a real and existent *thing* with characteristics that can be observed and described.

Often theorists suggest this is representative of a value judgment that does not deem sounds worthy of the same stasis as that which people can see. Instead I believe that it is because the fundamentals of accepted academic metaphysics remain unsuitable for understanding, let alone writing about, sound.

Demonstrating the historical lack of appropriate language to describe sound, and in keeping with its basis in writing, the 'theoretical vocabulary of music' adopted visual terms such as '*high, low, ascending, descending* (all referring to pitch); *horizontal, position, interval* and *inversion* (referring to melody); *vertical, open, closed, thick* and *thin* (referring to harmony); and *contrary* and *oblique* (referring to *counterpoint* – which is itself a visual term)' and these conventions have, in the most part, been absorbed by the sciences and indeed all disciplines engaged with sound (Schafer 1994, p.124).

This is more than a linguistic quibble. The lack of adequate terminology to describe sound either theoretically or popularly hampers understanding of sound and points to a much deeper epistemological problem. In academic studies, sound has been understood as a *thing*, demonstrated by the noun used to name it, in order to be able to more easily regard it as something that exists. Consequently, it has been described through metaphors that assist understanding but ultimately prove inadequate. This failure extends to the scientific explanations developed from the ancient Greeks through acoustics to modern wave theory. The scientific models oversimplify and omit important dimensions. Schafer explains:

> For sounds to be given exact physical description in space, a technology had to be worked out by which basic parameters could be recognized and measured in exact, quantitative scales. These parameters were time, frequency and amplitude or intensity. The fact that these three parameters have been identified as in some sense basic should not lead us to believe that this is the *only conceivable* method by which a total description of the behavior of sound should be possible (Schafer 1994, p.124-125).

The adoption of these parameters as the somehow natural measurements of sound is arbitrary and, as Schafer claims, each is in constant interaction with the others as they are perceived; 'for instance, intensity can influence time perceptions (a loud note will sound longer than a soft one), frequency will affect intensity perceptions (a high note will sound louder that a low one of the same strength) and time will affect intensity (a note of the same strength will appear to grow weaker over time) – to give just a few examples of interaction' and 'the problems between acoustics and psychoacoustics may never be clarified so long as the 3-D acoustic image continues to be regarded as an inviolably accurate model of a sound event' (Schafer 1994, p.124-125). Arguing along similar lines, Dyson claims that the characteristics of hearing 'rattle the foundations of Western metaphysics and Western culture generally, by questioning the status of the object and the subject, simultaneously' (Dyson 2009, p.4).

> In this respect, sound's "vocabulary" and ontology are serious matters, since any vocabulary begins (and possibly ends) with the near impossibility of approaching sound as an object without first disentangling it from the visualist metaphysics within which it is named (Dyson 2009, p.28).

Ultimately she, I think rightly, claims 'because of this, the aural has been muted, idealized, ignored, and silenced by the very words used to describe it' (Dyson 2009, p.4). I live in a society that is built upon a body of knowledge about the world that itself

rests on an opto-centric metaphysics, which privileges that which is *seen*. This is articulated in language, which in turn has influenced how people think and express themselves, such that it is common for people to speak of their *observations* and *point of view*.

Instrumentation

The early nineteenth century was a time of great experimentation in Europe as new scientific disciplines looked to empirical research as a means of testing various hypotheses. It is in this period that the ancestors of many of the technologies used to amplify and record sound to this day can be found. One of the most interesting was French physician Rene Laennec's invention, the stethoscope, which predated and played an important role in the development of technologies such as the phonograph, radio and the telephone. Laennec 'discovered that a tube of rolled paper applied to the chest of a patient could amplify the sound of her heart' and recorded his discovery in 1816 (Sterne 2003, p.101). As recounted by Sterne, he wrote:

> I rolled a quire of paper into a kind of cylinder and applied one end of it to the region of the heart and the other to my ear, and was not a little surprised and pleased to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear. From this moment I imagined that the circumstance might furnish means for enabling us to ascertain the character, not only of the action of the heart, but of every species of sound produced by the action of all the thoracic viscera…With this conviction, I forthwith commenced at the Hospital Necker a series of observations, which have been continued to the present time (Sterne 2003, p.101-102).

Listening to the heart, known as auscultation, was already common at the time but it was always immediate – that is unmediated – and Laennec coined the phrase mediate auscultation, which means indirect listening, to describe his new method. Although the typical design now recognised as a stethoscope came later with the work of others, the term itself was his. The word stethoscope is formed from *stethos*, or chest, and *skopos*, which is commonly believed to mean examination but in fact has its far more specific origin in the word *skeptomai*, a strictly visual term that means to scope or mark with the eye. This is somewhat ironic given the purpose of the invention and a further example of the dominance of visual language at the time. Importantly, Jonathan Sterne notes that 'the development of the stethoscope coincided with the development of new

theories of sense perception based on a 'separation of the senses'' (Sterne 2003, p.110). According to Thomas Dormandy in his book *Moments of Truth* there exists a number of different stories about how the idea for a stethoscope first occurred to Laennec and while 'all or none of them may be true' what is known is that, as his reflected above, while Laennec described it he never claimed to be its physical inventor (Dormandy 2003, p.103-104).

Scientist and inventor Charles Wheatstone undertook many experiments on the transmission of sound and, as Brian Bowers details in his book *Sir Charles Wheatstone FRS 1802-1875,* eventually these experiments were adapted for public demonstration (Bowers 2001, p.8). According to reports from several London journals in 1821, he exhibited his first, known as the *Enchanted Lyre*, in the shop his father owned in Pall Mall. He enjoyed constructing words and the invention's more technical name, *Acoucryptophone*, is derived from Greek and means literally 'hearing a hidden sound'. It consisted of a large lyre – with horns bent towards the floor and metallic discs on each side of its body, hanging from the ceiling of the shop and visible to visitors, which was encircled by a ring supported by three rods, possibly hollow tubes – which ran to the floor. The trick lay in the fact the instrument was suspended by a brass wire which ran through the ceiling and was connecting to the sounding boards of a harp, piano and dulcimer in a room above so that performers could play the instruments and the vibrations would run down to the lyre's horns, giving the impression that it was indeed enchanted (Bowers 2001, p.8).

He later developed this work and demonstrated his *Diaphonicon*, which was a 'horizontal sound conductor running between rooms' that he used to transmit both voice and music (Bowers 2001, p.9). In 1827, Wheatstone presented his *Kaleidophone*, a machine consisting of a metal rod fixed at one end and with a reflector at the other that would reflect a spot of candlelight in regular patterns in the air when the rod was made to vibrate (Bowers 2001, p.22). Around the same time, he devised a basic instrument for amplifying quiet sound which he called a *microphone*, again using metal rods to convey the vibrations but this time in much the same fashion as a stethoscope, and it is possible he did so without knowledge of Laennec's previous work (Bowers 2001, p.25). Although it is perhaps easy to dismiss Wheatstone's inventions as little more than parlour tricks, he demonstrated a highly developed knowledge of acoustics and, while his inventions have not remained in use to this day as is the case with the stethoscope, the imaginative reach that he displayed in developing a *microphone* well before the technology known today was invented is significant.

Meanwhile, it was Thomas Young, before even the work of Wheatstone, who, in 1807, invented what is now credited as the first method for the inscription of sound, his *phonautograph*, which employed a stylus attached to a tuning fork that moved around a wax coated revolving drum (Schafer 1994, p.125). All these inventions demonstrate the rapid development of the sciences in the nineteenth century and the accompanying techniques of empirical research and instrumentation.

The development of instruments such as the *microphone*, *telephone* and *phonautograph*, all of which would be usurped by their contemporary namesakes within the next century, demonstrates a move by the sciences to render sound material, visible and knowable, to transmit and record sound and so, ultimately, to control it. Douglas Kahn, as I have mentioned, sees this as a dramatic shift in the physics and cosmology of sound which had its roots in the work of Ernst Chladni and, although there had been attempts to visualise sound previously including the ubiquitous image of a stone thrown into water, he believes that with it 'the ability to make the invisible visible and to hold the time of sound still entered into a new phase' (Kahn 2001, p.74). Sound had been severed from linear time and made static, to be studied in depth and detail for the first time.

The Physiology of the Ear

The invention of instruments such as the stethoscope coincided with the development of 'new theories of sense perception based on a "separation of the senses"' and with that came interest in hearing and the physiology of ear (Sterne 2003, p.110). In his treatise *On Sound,* John Tyndall had explained how people hear, following an account of the motion of sound as it is 'conveyed from particle to particle through the air', that 'the particles which fill the cavity of the ear are finally driven against *the tympanic membrane*, which is stretched across the passage leading from the external air toward the brain' and, as a result, 'this membrane, which closes outwardly the "drum" of the ear, is thrown into vibration, its motion is transmitted to the end of the auditory nerve, and afterward along that nerve to the brain, where the vibrations are turned into sound' (Tyndall 1867, p.33-34).

Decades earlier physiologist Johannes Müller wrote that 'without the organ of hearing with its vital endowments, there would be no such thing as sound in the world, but merely vibrations' and this became a fact recognised by the scientists leading the study of sound (Müller 1843, p.714). However, building on the work of physiologists such as Peter Degravers and Charles Bell, Müller had also realised that other senses

could perceive vibration and this was something that was not recognised by those that followed for some time (Sterne 2003, p.59). It was with his discoveries as well as the work of other physiologists of the time that perception, inevitably human, came to be included in definitions of sound. It is now broadly accepted that, as Sterne uses as a basis of his research:

> Sound is a very particular perception of vibrations. You can take the sound out of the human, but you can take the human out of the sound only through an exercise in imagination**…**My point is that human beings reside at the center of any meaningful definition of sound…as part of a larger physical phenomenon of vibration, sound is a product of the human senses and not a thing in the world apart from humans. Sound is a little piece of the vibrating world' (Sterne 2003, p.11).

Importantly, as Don Ihde argues 'there is an essential sense in which *my hearing of myself is distinct from all other forms of hearing*' (Ihde 1976, p.138). He notes, 'I do not hear myself as others hear me nor do they hear me as I hear myself' and so 'when I speak, if I attend to the entire bodily sense of speaking, I feel my voice resonate through at least the upper part of my body…I feel my whole head "sounding" in what I take for granted to be sonoric resonance' (Ihde 1976, p.138). Necessarily this means that people hear themselves in a unique way. Further, due to the action of the apparatus of the middle ear, including but not limited to the ossicles – commonly known as the hammer, anvil and stirrup – on the ear drum, it can quite literally be argued that ears are not passive organs but instrumental in hearing themselves.

Above and beyond the work of others from his time it was Hermann von Helmholtz who was most influential in the development of theories of auditory perception in the nineteenth century (Sterne 2003, p.62). He synthesized the approach of the physiologists with that of his fellow scientists. Put simply, 'Helmholtz argued that the tiny hairs inside the cochlea were like the strings of a piano, each tuned to perceive a particular frequency' (Sterne 2003, p.66). As a result, 'because sounds are made of a range of frequencies, Helmholtz reasoned that it would be possible to synthesize almost any sound' (Sterne 2003, p.65). He believed that 'frequencies are frequencies' and 'sounds are *effects*', sound happens within the ear itself and 'the cause is irrelevant' (Sterne 2003, p.65). Helmholtz had been a student of Johannes Müller and so it is not surprising that his approach to sound as an effect emphasises the importance of perception and in particular hearing in any useful definition of sound. However, more than just arguing that the mechanism of hearing involves the reception of the individual frequencies he believed make up sound he, perhaps unwittingly,

introduced the idea that people listen, indeed pay attention, to particular, individual, sounds and in so doing consciously or unconsciously tune out *noise* (Blamey 2008, p.30). Indeed the root of the word *tune* is *tone* and so to *attune* hearing is to bring a self into consonance with the fundamental tone of a sound. Attempting to explain the difference between noises and musical tones, Helmholtz wrote that 'the soughing, howling, and whistling of the wind, the splashing of water, the rolling rumbling of carriages, are examples of the first kind, and the tones of all musical instruments of the second' and that while 'noises and musical sounds may certainly intermingle in very various degrees' he believed that 'the sensation of a musical tone is due to a rapid periodic motion of the sonorous body; the sensation of a noise to non-periodic motion' (Helmholtz 1954, p.7-8). It is, therefore, the rhythm of musical tones that makes them meaningful: there is in them a regular and recognizable pattern that can be discerned, evaluated and understood.

The Scientific Theory of Sound

The work of Lord Rayleigh (John William Strutt), Tyndall and Helmholtz came to define the field of acoustics in the late nineteenth century (Blamey 2008, p.33). All of these men were instrumental in developing the scientific theory which is still relied on today for some of the most useful knowledge about sound. However, it can certainly be said that Helmholtz was the innovator of the three, the other two refining and collating his knowledge along with that of others and extending upon it rather than making their own leaps, and it is he who is of the most interest to this study.

In 1843 Ohm asserted his laws of acoustics which argued – using Fourier's series of equations developed to account for heat transfer which when published in 1822 had shown that any finite periodic motion can be mathematically reduced to a series of component simple periodic motions – that all sounds can be represented as complex periodic waveforms (Blamey 2008, p.27-28). Applying Fourier's theorem, Ohm posited that sounds are reducible to the individual frequencies, or tones, of which they are composed and which ears discern when they hear sound (Blamey 2008, p.27-29). Subsequently in his *On The Sensations of Tone as a Physiological Basis for the Theory of Music,* first published in 1863, Helmholtz, following Ohm, developed a theory of the sine tone as the basis of sound and used it to construct a theory of hearing and sound based in perception. Illustrating the continued influence of the image, he used the Greeks' analogy of a stone cast into water in the introduction to the seminal text, describing how:

> Round the spot struck there forms a little ring of wave, which, advancing equally in all directions, expands to a constantly increasing circle. Corresponding to this ring of wave sound also proceeds in the air from the excited point and advances in all directions as far as the limits of the mass of air extend. The process in the air is essentially identical with that on the surface of the water (Helmholtz 1954, p.9).

Significantly, he was 'compelled to rid his study of noise from the outset' and directed his readers away from the noisy waterways of the world and instead to the specific image of stone dropped into a calm body water (Kahn 2001, p.79). Despite his strict adherence to the principles of science and in particular mathematics and physics, he was interested only in 'musical sound' and specifically the tone as the basis of all sound.

The work of Tyndall and Strutt extended Helmholtz's theories and those of others to sounds in general and exhibited a greater willingness to include real world examples, such as Tyndall's experience on a boat in Cowes Harbour. In his book *On Sound*, which was first published in 1867, he notes that while in a rowboat on the harbour he noticed how 'every wave and every ripple asserted its right of place, and retained its individual existence, amid the crowd of other motions which agitated the water' (Tyndall 1867, p.255). Nevertheless, the wording of all these accounts on the similarity between wave action on the surface of water and the transmission of sound demonstrates that, as Peter Blamey notes in his thesis *Sine Waves and Simple Acoustic Phenomena in Experimental Music*, 'charting the progression of the water-based examples reveals a process of quelling some of the perceived 'noisiness' of water hidden inside the wave metaphor for sound, redirecting it towards a depiction of sound more in line with the prescriptions of musical sound' (Blamey 2008, p.54).

Lord Rayleigh published his own book titled *The Theory of Sound* in 1877, owing a significant debt to both Tyndall and Helmholtz. By that time the dominance of physics in the study of sound and hence, its definition, was complete and, as he wrote, had established laws to which 'sensations of the ear cannot but conform' (Strutt 1945, p.1). According to Strutt, like Helmholtz and Tyndall, 'sounds may be classed as musical and unmusical; the former for convenience may be called *notes* and the latter *noises'* (Strutt 1945, p.4). More significantly, as I have included in the quote at the beginning of this chapter, he argued that 'the sensation of sound is a thing *sui generis*, not comparable with any of our other sensations' (Strutt 1945, p.1).

Background Noise

The work of Helmholtz had by the end of the nineteenth century become the dominant force in the development of the scientific study of sound and thus his emphasis on the sine tone, musical sound or signal at the expense of noise was itself perpetuated. As Blamey observes, 'in examining the course of experimentation into sound in the late nineteenth century, it is possible to trace a progressive 'drying out' of the aqueous metaphors that had provided so much of the initial descriptions for the behaviour of sound and definitions of noise' and, ironically, it would be the progressive refinement of liquid examples and metaphors of wave action that would aid the conflation of the concept of a sound wave into that of the abstract sine wave and complex periodic waveform, and in turn lead to practices for the abatement and removal of noise' (Blamey 2008, p.51). He notes:

> The sine tone played a role in the desire amongst nineteenth century acousticians to confirm ideas about the regular and even nature of musical sound. The reductive effects of Fourier analysis, combined with both a discourse of regularity and experimental technique, formed a strategy for taming any unruly behaviour found in the natural and aqueous metaphors used to describe musical sound. In transforming the sound wave into a complex periodic waveform through procedures of visualisation, Fourier analysis effectively separated orderly and desirable musical sound from the noisy and quotidian sounds of the world. This was accompanied by a shift from descriptions and observations of wave patterns and wave motion, to demonstrations of isolated wave action that attempted to quell the watery aspects of wave motion and its associated splashy noisiness (Blamey 2008, p.62).

Nonetheless, although Helmholtz held that the difference between sound and noise is quite profound there were those whose opinion differed. Lord Rayleigh for one believed that while noise could not be used to make music at times the accumulated sounds of music could produce noise. He argued that 'the extreme cases will raise no dispute; every one recognises the difference between the note of a pianoforte and the creaking of a shoe. But it is not so easy to draw the line of separation. In the first place few notes are free from all unmusical accompaniment. With organ pipes especially, the hissing of the wind as it escapes at the mouth may be heard beside the proper note of the pipe' (Strutt 1945, p.4).

Pivotal to the dismissal of unwanted noise was the conception of figure and ground. Developed in perspective painting and applied to the study of sound, the figure-ground relationship guides perception. Just as Schafer argues 'signals are foreground sound and they are listened to continuously' such that 'in the terms of the psychologist they are figure rather than ground' (Schafer 1994, p.10). Necessarily this positions all other sound as the ground, as noise.

Adopting this construction, Michel Serres traces the word noise to its Latin root nausea, literally seasickness. He suggests that 'background noise may well be the ground of our being', arguing that 'it is at the boundaries of physics, and physics is bathed in it, it lies under the cuttings of all phenomena, a proteus taking on any shape, the matter and flesh of manifestations' (Serres 2009, p.13-14). He believes that:

> We are surrounded by noise. And this noise is inextinguishable. It is outside – it is the world itself – and it is inside, produced by our living body. We are in the noises of the world, we cannot close our door to their reception, and we evolve, rolling in this incalculable swell. We are hot, burning with life; and the hearths of this temporary ecstasy send out a truceless tumult from their innumerable functions. If these sources are stilled, death is there in the form of flat waves. Flat for recording, flat for closed ears. In the beginning is the noise; the noise never stops. It is our apperception of chaos, our apprehension of disorder, our only link to the scattered distribution of things (Serres 1982b, p.126).

This approach lends a flexible way in which to think about sound. It articulates the way in which sound has been defined in relation to noise as much as silence. According to Serres 'the code avoids entropy for the time of memory' and 'meaning is formed by noise, a rare and improbable miracle, then it drifts, at its own tempo, towards noise. Space-time of flickering and decline. The signals of the universe blink from the depths of the cloud' (Serres 2000, p.138 & 150). He notes, 'I hear without clear frontiers, without divining an isolated source, hearing is better at integrating that analysing, the ear knows how to lose track. By the ear, of course, I hear: temple, drum, pavilion, but also my entire body and the whole of my skin' (Serres 2009, p.6).

Sensations of Tone

The sine wave, or simple tone, as it is variously known, continues to be considered to be the basic unit of which all sounds are composed, in much the same way as a variety of other fundamental measures in science. However, beyond the extent to which people see a gram as the basic unit of weight or the litre as the basic unit of volume, they generally see the sine wave as not only indivisible but also somehow pure and free of the interference of noise. This is despite the fact that when graphed using the two dimensional Cartesian coordinate system a sine curve, as an abstract mathematical expression, at any individual point expresses only one value on the y-axis but is infinite in both directions on the x-axis (Blamey 2008, p.38). Blamey writes:

> Given that it seeks to describe the composition of sound through the interactions of sine waves, Fourier analysis has to contend with infinity along two axes. As already mentioned, the first of these is the horizontal infinity of sine curves. The second is the chain of successively shortening sine and cosine waveforms arranged vertically along the positive arm of the y-axis. This ascending movement is anchored by the waveform with the lowest frequency of the series, designated the fundamental. To move from the mathematical abstraction of the Cartesian plane to the exigencies of an actual sound in space and time requires an examination of these apparent infinities, as defining a given musical sound of finite duration through a series of infinitely sounding components is problematical (Blamey 2008, p.39).

As Blamey suggests, using Aristotle's theory around potential and actual infinitives, although it is possible to view a sine function as shown on a Cartesian graph as an actual infinite, a sine tone can only be considered a potential infinitive, and even then only if somehow in some ideal situation it could continue indefinitely, because 'any real world sine tone sound would necessarily be of finite duration' (Blamey 2008, p.39). Even if people accept it as a theory that 'works' there exists no example of such purity in the audible world. In fact, as Schafer writes, it is impossible to hear a perfect sine wave because:

> For man, the perfectly pure and mathematically defined sound exists as a theoretical concept only…Distortion results the moment a sound is produced, for the sounding object first has to overcome its own inertia to be set in motion, and in doing this little imperfections creep into the transmitted sound. The same thing is true of our ears. For the ear to begin vibrating, it too has first to overcome its own inertia, and accordingly it too introduces more distortions (Schafer 1994, p.261-262).

Serres, interested in how people retreat to constructions such as the sine tone when faced with the chaos or noise in the world, argues that 'pure and simple forms are neither that simple or that pure; they are no longer complete, theoretical knowns, things seen and known without residue, but rather theoretical, objective unknowns infinitely folded into one another, enormous virtualities of noemes, like the stones and the objects of the world, like our stone constructions and our wrought objects' (Serres 1982a, p.96). He argues:

> We are as little sure of the one as the multiple. We've never hit upon the truly atomic, ultimate, indivisible terms that were not themselves, once again, composite. Not in the pure sciences and not in the worldly ones. The bottom always falls out of the quest for the elementary. The irreducibly individual recedes like the horizon, as our analysis advances (Serres 2009, p.3).

Blamey applies this to the figure of the sine, which he describes using the words of Serres as an *aporia*, and argues that there are 'residual meanings excluded from the formulation of sine waves in both science and musicology' and that 'these residues, mostly empirical in nature, destabilise conceptions of the sine wave as a simplex – as an exemplar of artistic, acoustic or even metaphysical purity' (Blamey 2008, p.5&262).

Despite the conflation involved in its conception, the sine tone had a central role in the development of a scientific theory of sound, based on a definition of sound that excludes noise, in the nineteenth century. Its influence is still felt in modern notions of attention and its effect on listening, popular expectations of music and contemporary beliefs about the nature of sound. Perhaps even more importantly, as Blamey recognises, the application of Fourier's equations to explain sound as complex periodic waveforms divisible into sine tones represented a shift in the study of sound from basing observation on the horizontal domain of time to an analysis of sound based on the vertical domain of frequency such that 'it effectively halted a transient phenomenon, and allowed for an analytical focus upon the material aspects of sound' (Blamey 2008, p.263-264). In turn this meant that sound was made not only static and

observable but two dimensional, broken down into vertically ordered sine and cosine functions, without depth (Blamey 2008, p.263-264). For the first time sound could be studied in detail according to scientific principles. It became a phenomenon that with the use of new instruments and techniques of visualisation, along with the scientific theory of sound as a complex period waveform subject to Fourier analysis, could not only be *seen* but also could be graphed and dissected.

Separating Acoustic Spaces

The development of amphitheatres and concert halls in the nineteenth century paralleled developments in the scientific study of sound. Thus 'the space of the auditory field became a form of private property, a space for the individual to inhabit alone' (Sterne 2003, p.160). Schafer argues that 'music moves into concert halls when it can no longer be effectively heard out of doors' and so attributes this shift to the Industrial Revolution (Schafer 1994, p.103). Indeed, he says 'there, behind padded walls, concentrated listening becomes possible' and so 'the string quartet and urban pandemonium are historically contemporaneous' (Schafer 1994, p.103). Supporting this argument, Emily Thompson notes in her book *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900-1933* that 'during the eighteenth and early nineteenth centuries, music in America was performed primarily by amateurs who made music for their own enjoyment' but:

> The phenomenon had already been under way for over a century in Europe. When Count Francesco Algarotti had petitioned for an acoustically controlled architecture in 1762, he pleaded as vehemently for a new attitude toward listening to accompany the sound. Algarotti longed for a rationally designed theater that would no longer constitute "a place destined for the reception of a tumultuous assembly, but as the meeting of a solemn audience." His desire to control sound was paired with an equally strong desire to control the behavior of the audience. Algarotti himself already constituted such a concerted listener, and he sought an architectural means to engender this attentive way of listening in all concertgoers (Thompson 2002, p.45-46).

Important here is the mention of desire. Concert halls and other acoustic structures did not create modern attentive listening but were instruments designed to achieve desired ends. Just as Thompson argues 'over the course of the next century, the transformation that Algarotti longed for would indeed occur' and 'urbanization, the decline of the aristocracy, the rise of the middle class, the romantic movement in arts

and letters, and the development of symphonic music are just some of the factors that contributed' (Thompson 2002, p.46-47). Mirroring the silencing of noise in the development of the scientific theory of sound was the silencing of audiences in the nineteenth century, as is recounted by James H. Johnson in regard to audiences in Paris in the eighteenth century in his book *Listening in Paris: A Cultural History* (Johnson 1995, p.59-60&p.171-172). As Sterne argues, 'where opera and concert audiences had been noisy and unruly, quieting down only for their favorite passages, they gradually became silent – individually contemplating the music that they had enshrined as autonomous art…this quieting has the effect of atomizing an audience into individual listeners…in "observing silence" we respect other people's "right" to enjoy the film without being bothered by noisy fellow audience members' (Sterne 2003, p.160). He explains, 'the premise behind the custom is that in movie theaters (and a variety of other places), people are entitled to their private acoustic space and that other are not entitled to violate it' (Sterne 2003, p.160). It was at this time that modern concern with privacy developed, a particular take on dealing with social difference amongst individuals.

Silencing the Public

It seems that for as long as people have lived together they have been disturbed by one another's noise. The murmur of the crowd has always made it difficult for the individual to be heard, or indeed to hear itself. Apparently, there is even graffiti on a wall in the ruins of the ancient city of Pompeii which calls for quiet (Rice 1906, p.552). Jacques Attali argues that 'before the Industrial Revolution, there existed no legislation for the suppression of noise and commotion' and 'the right to make noise was a natural right, an affirmation of each individuals autonomy' (Attali 2006, p.122-123). However, Schafer claims that:

> After art music moved indoors, street music became an object of increasing scorn, and a study of European noise abatement legislation between the sixteenth and nineteenth centuries shows how increasing amounts of it were directed against this activity…Early noise abatement legislation was selective and quantitative, contrasting with that of the modern era, which has begun to fix quantitative limits in decibels for all sounds. While most of the legislation of the past was directed against the human voice (or rather the rougher voices of the lower classes), no piece of European legislation was ever directed against the far larger sound – if objectively measured – of the church bell, nor against the equally loud machine which filled the church's inner vaults with music,

> sustaining the institution imperiously as the hub of community life – until its eventual displacement by the industrialized factory (Schafer 1994, p.66-67).

Gradually anti-noise legislation has spread around the world. According to Schafer the earliest example of a by-law relating to noise was passed by Julius Caesar in 44 BCE, a number of towns in England restricted blacksmiths to certain areas because of the noise they created, and two Acts of Parliament were passed to suppress street music during the reign of Elizabeth I (Schafer 1994, p.189-190). Interestingly, Thompson notes that:

> In 1853, Henry David Thoreau was awakened from his agrarian reverie at Walden Pond by the screaming whistle of a passing train. Yet, as he listened, Thoreau realized that it was not just the train that was passing, but also the old ways of life he was attempting to perpetuate. As Leo Marx has shown, Thoreau, Nathaniel Hawthorne, Ralph Waldo Emerson, and many other nineteenth-century American writers struggled with mixed emotions about the coming of industry. The steam whistle, which announced the arrival of both railroad and factory, constituted the acoustic signal of industrialization (Thompson 2002, p.120).

Schafer offers an excellent study of anti-noise legislation, including a number of informative statistics, in the chapter 'Noise' from his book *The Soundscape: Our Sonic Environment and the Tuning of the World* (Schafer 1994, p.181-202). Eventually the General Assembly of the International Music Council of UNESCO unanimously passed a resolution in Paris in October 1969 stating, 'we denounce unanimously the intolerable infringement of individual freedom and of the right of everyone to silence, because of the abusive use, in private and public places, of recorded or broadcast music' (Schafer 1994, p.97).

Anti-noise sentiment is now perhaps stronger than ever. The city in which I live as I write this, Melbourne, is right now exploring the possibility of a sensor network across the city to measure, or more accurately surveil, noise levels and requires performers, or buskers, who wish to perform in the Bourke St Mall in the city undertake an *audition* (Dowling 2010). Garret Keizer argues:

> Noise is a complex phenomenon that reveals our complexity as human beings. It is both easy and hard to define, objective and subjective, new as the latest gizmo and old as the most ancient myth. Its subjective aspects put us in touch

> with our prejudices, our fear of difference, our deep-seated need to be acknowledged. Its objective aspects put us in touch with our nature as physical beings. Our noisiest inventions, after all, have the common aim of reducing the restrictions of time and space, which are also the conditions of living in a body (Keizer 2010, p.243-244).

These are all points with which I can easily agree. However, like so many others, these realisations lead him to hear noise as a threat. He argues that 'in some ways our mechanised civilisation is at war with our bodies':

> Noise is often the sound of that battle. As noise affects our bodies, it also affects the body politic. Noise is political. It makes its first grand appearance in the *polis*, the city, just as politics do. Noise is political, first of all, because loudness is powerful. Noise is political because peace and quiet are forms of wealth, subject to the laws of supply and demand, and because how a society divvies up its wealth is a basic political question. Inherent in every "unwanted sound" produced by a human source lies the question: What kind of a society do we want? A society I don't want is one in which cruelty and gross injustice are superficially "subverted" by petty noise (Keizer 2010, p.243-244).

Noise is political and loudness is powerful, however not all noise is loud and while Keizer hears a threat to his body, or I suspect more accurately to his individuality, I hear something that challenges me to deal with those around me. This debate involves what Steve Goodman refers to as the politics of silence and noise. He writes of the politics of silence:

> The politics of silence often assumes a conservative guise and promotes itself as quasi-spiritual and nostalgic for a return to the natural. As such, it is often orientalized and romanticizes tranquility unviolated by the machines of technology, which have militarized the sonic and polluted the rural landscape with noise, polluted art with sonification, polluted the city with industry, polluted thought with distraction, polluted attention with marketing, deafens teenagers and so on. Its disposition is almost always reactionary. In a much less strong but more compelling aesthetic version, it sides with those lamenting the loss of dynamic range within the "loudness war" that currently rages concerning the overuse of compression in mastering techniques within sound engineering (Goodman 2010, p.191-192).

Arguments such as Keizer's are an example of Goodman's politics of silence. It is an approach that, as I will show, has been adopted by a number of artists and sound theorists. It is contrasted by the politics of noise, which I suppose goes some way to describing my own position. Goodman explains:

> The politics of noise, on the other hand, may become an excuse for relativism (one person's noise is another's music) or, in more militant mode, takes noise as a cultural weapon, as a shock to thought, as a shock to bourgeois complacency, as a shock to tradition, as a shock to the status quo. The various positions that can be grouped under this heading revolve around an array of definitions of noise, from unwanted sound, to deconstructive remainder, systemic excess, void, or disturbance through to acoustic definitions based on distribution of frequency and tagged by colors – white, pink, black and so on. Aesthetically, however, in the soundtrack to the politics of noise, its weapons often remained trapped within the claustrophobic confines of the dual (and usually white) history of rock music and avant-classical sound art (Goodman 2010, p.192).

Offering an explanation for the passionate arguments of both sides of the debate, LaBelle argues in his book *Acoustic Territories: Sound Culture and Everyday Life* that 'acoustic space is a disruptive spatiality' and 'policies in urban noise abatement increasingly reveal the degree to which acoustic space, and its ubiquitous impingement, is also difficult to control' as 'it sparks annoyance and outrage, while also affording important opportunities for dynamic sharing – *to know the other*' (LaBelle 2010, xxiii).

> For on one hand there is no denial as to the intensities with which noise interferes with personal health and environmental well being, while on the other hand noise may be heard as registering a particular vitality within the cultural and social sphere: noise brings with it the expressiveness of freedom, particularly when located on the street, in plain view, and within public space; it may feature as a communicational link by supporting the passage of often difficult or challenging messages; and in its unboundedness it both fulfills and problematises the sociality of architectural spaces by granting it dynamic movement and temporal energy (LaBelle 2010, xxiii).

He describes sound as 'an itinerant movement' that may create 'a relational space, a meeting point, diffuse and yet pointed; a private space that requires something between, an outside; a geography of intimacy that also incorporates the dynamics of interference, noise, transgression' (LaBelle 2010, p.xvi-xvii). As a result, he continues,

‘through lending to the thoughtful quest for more humane audible environments, silence paradoxically supplies the mechanics of social values with a vocabulary of control and constraint’ (LaBelle 2010, p.64).

Attempts to remove the noise of the world from meaningful sound, or perhaps more accurately to define sound itself as a signal distinct from noise characterised the study of sound in the nineteenth century. However noise simultaneously contains all the voices, music and signals on which attentions are focused and is, simultaneously, within all of them. Indeed, one person’s music or conversation, meaningful sound, may be another’s vexatious noise. Noise saturates the world and is inescapable, as Serres explains, because:

> There is noise in the subject, there is noise in the object. Meddling in the phenomenon, the receiver introduces a certain noise there, his own, for no-one can live without noise…There is noise in the observed, there is noise in the observer. In the transmitter and in the receiver, in the entire space of the channel. There is noise in beginning and appearing…in being and knowing, in the real and in the sign, already (Serres 2009, p.61).

Interestingly, Schafer traces the history of the definition or noise from its early reference to unwanted sound, to its definition as unmusical sound, the gradual acceptance of it as referring to any loud sound and, finally, its definition as disturbance in any signaling system (Schafer 1994, p,182). Moreover, he notes that the term has in fact been used to refer to ‘an agreeable or melodious sound’ as is the case in the writing of Chaucer and in the King James version of the Bible (Schafer 1994, p.182). Whatever feelings individuals have about noise, it seems its definition is the result of social change and the noise people heard during the Industrial Revolution is not necessarily the same as that which disturbed Helmholtz’s experiments or the unwanted sound people had previously recognised around them.

Just as the applied knowledge of the ancients was developed by the sciences into concrete theory, so too was their desire to clarify what they heard inherited and developed to the extent that sound came to be separated from noise. The Enlightenment brought with it new instruments, techniques of visualisation and scientific disciplines that offered new opportunities to investigate sound. The theory of sound developed by scientists represents a definition of sound as a perceived signal that is differentiated from the noise of the world.

The development of new instruments such as the stethoscope extended the practices of isolation, transmission and amplification of sound that were made possible by the knowledge of the ancient Greeks and demonstrated in the acoustics of their amphitheatres. These apparatuses, along with Young's phonautograph and more speculative technologies such as the *Enchanted Lyre*, laid the platform for modern technologies such as the telephone, radio and phonograph. New techniques of visualisation rendered sound observable, static and knowable in new ways. Perhaps most significantly of all, the work of scientists such as Helmholtz, Strutt and Tyndall and their development of a theory of sound based in physics changed the way sound is defined and, heavily influenced by image of the *pure* and simple form of the sine wave, lead to a shift in which sound went from being imagined as a wave caused by a stone thrown into a pond, river or the ocean to being seen as represented by a perfectly drawn chart of periodic waveform resulting from the application of a mathematic formula.

The scientific theory of sound that emerged in the nineteenth century, while undeniably crucial to the advancement of the study of sound and the development of the technologies of sound reproduction and manipulation that would soon make sound available like never before, demonstrated the way in which particular ideas, images and technologies have influenced the study of sound. It can be understood as an attempt to define sound ontologically by rendering it observable, visible, knowable and, hence, containable. As I have discussed, the scientific theory of sound, while useful, should not be assumed to explain sound completely. Although the development of new instrumentation allowed the isolation, transmission and amplification of sound, techniques of visualising sound made it observable and the resulting scientific theory of sound explained sound effectively as the perception of a complex periodic wave, the knowledge about sound accrued in the nineteenth century was based upon some questionable assumptions. In particular, that sound, defined as distinct from noise, is necessarily meaningful. Still, the stage was set for the invention of technologies to mechanically reproduce sound.

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Chapter 3
Phonography: Technology, Infidelity & Commodity

Au clair de la lune, Pierrot répondit…

- Unknown Author

Generally the inventor Thomas Edison is considered to be the father of recorded sound. However, it is a paternity claim that is dubious at best. A French man named Édouard Léon Scott de Martinville recorded the French folk song *Au Claire de Lune* on April 9 1860 using his invention the phonautograph, a full seventeen years before Edison would receive a patent for the phonograph in 1877 (Rosen 2008). He was a typesetter who was inspired to develop the invention while proof reading anatomical drawings of the human ear for a textbook on physics (Sterne 2003, p.35-36). He understood his invention as a machine to write sound (Sterne 2003, p.36). Attempting to establish a new form of direct writing that was not dependent on an alphabet or pictographic system, Scott developed his phonautograph to record sound as tracings on smoked glass with no method or intention to achieve its reproducibility. In fact, it is only with recent technological advances that his recordings have been made audible.

In a poetic analogue of the inventor's own pursuits, *Au Claire de Lune* tells the story of a 'likable harlequin' knocking on the doors of Pierrot and an unnamed brunette looking for a pen and a flame to write something down. The term phonography itself comes from the Greek words *phōnē*, meaning voice or sound, and *graphos*, or writing, and phonautograph extends this simply with the insertion of the root of *autos*, or self, an indication of the hopes its inventor held for his machine as one that would allow the development of an automatic stenography, that is an absolute written language (Sterne 2003, p.41). Scott was, therefore, focused on sound writing for preservation (Sterne 2003, p.45).

Although mention of Scott and his work serves to undermine the claim that Edison himself invented phonography and recorded sound, I mention it not to create a counter claim but to demonstrate that there were in fact a great number of inventors who attempted, and in various ways succeeded, in recording sound. In yet another early instance of an inventor interested in recording sound, Wilhelm Weber attached a pig's bristle to a tuning fork in an attempt to inscribe its vibrations as frequency curves on a piece of sooty glass (Kittler 1999, p.26). Furthermore, the phonograph is not the only sound technology for which the credit must be shared. Just as is the case with the phonograph the credit for and exact date of the invention of telephone and radio is disputed and both are technologies whose invention involved the work of many.

After the Enlightenment and the subsequent development of scientific practice, sound could be viewed as both visible and divisible and so, within the dominant metaphysics of the day, knowable to an extent that was unprecedented. Individuated examples of ideal sounds had been isolated, transmitted and amplified through acoustics and, subsequently, technologies such as the stethoscope, but the invention of the phonograph, telephone and radio extended that process a great deal. The effects of the invention of these technologies were so pervasive that they forever changed the way people think about sound, giving it a new ontology as a *thing* that is material, transportable and available, a commodity to be bought and sold at will.

More than perhaps any of the other ideas, images and technologies that I have discussed that have influenced the study of sound, the invention and use of phonography, or perhaps more accurately its conception, has altered completely the way people think about and work with sound. Geoffrey Batchen argues in his book *Burning with Desire: The Conception of Photography* that what he called the 'desire to photograph' preceded the invention of photography (Batchen 1999, p.100). It is the same with the phonograph. He examines a number of examples of what he describes as 'proto-photographers' and claims:

> Culture and nature, transience and fixity, space and time, subject and object – each example cited above articulates these opposing pairs in the same act of representation. From this epistemological dilemma also emerges the desire to photograph. At issue was not just the theorization and depiction of nature, landscape, reflection, or the passing of time but, more fundamentally, the nature of representation and the constitution of existence itself. It is yet further evidence that the period between about 1790 and 1839 was marked by a turbulent phase of scientific and philosophical speculation, of which photography was but one residual effect. Indeed the conjunction of frustrations

> and aspirations that I have characterized as a “desire to photograph” obviously long precedes, and extends well beyond, the announcement of a phonographic apparatus in 1839 (Batchen 1999, p.100).

Directly, in a way quite similar to that which Batchen describes in reference to photography, it can be argued that phonography was a result of a desire to write the voice. It is almost incidental that the technology allows people to record sound and so render sound material. Nonetheless the implications of this development have been enormous.

Jonathan Crary argues In his book *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* that the camera obscura functions as an *assemblage* in the history of understanding of vision, the development of the technology capturing the imagination of the public to such a degree that it was for a time seen as a model for understanding vision itself (Crary 1990, p.30-31). The development of phonography, likewise, functions as an assemblage in the history of understanding sound and hearing. Just as was the case with the camera obscura, the phonograph captured the imagination of the general public and as a result has had more influence on how people think about sound than any other technology. However, unlike the camera obscura, the phonograph did not influence developments in physiology. Instead it was an assemblage in that it was built from knowledge gathered in the study of hearing. Physiology was used not just as a model for the technology but quite literally as part of the apparatus in early designs.

This was demonstrated with the experiments that preceded the invention of the phonograph and telephone. Alexander Graham Bell and Clarence Blake developed a version of the phonautograph in 1874 which used a human ear as a transducer to turn speech into tracings on a piece of glass that had been blackened with smoke (Sterne 2003, p.31). This demonstrates that the body as technology was not just an inspiration for the development of the phonograph but quite literally remediated into it. It depicts the way in which previous scientific and specifically physiological studies of sound and hearing facilitated the invention of phonography, and the way in which the process of transduction offers a neat ontological line to draw from one to the other. Moreover, Bell, like Scott, was only interesting in writing sound, not reproducing it. In particular, he was interested in visible speech – a disturbing technique, apparently of some popularity at the time, for teaching the deaf to speak that involved a deaf person recording their own speech to compare to *ideal* recorded examples and thereby learn to speak without ever hearing themselves (Sterne 2003, p.37). Bell explained:

> My original skepticism concerning possible speech reading had one good result; it led me to devise an apparatus that might help children...a machine to hear for them, a machine that would render visible to the eyes of the deaf the vibrations of the air that affect our ears as sound (Sterne 2003, p.38).

The phonograph and subsequent technologies of sound reproduction and manipulation have had a great impact on conceptions of sound, changing its ontological character significantly, rendering it material, a commodity and even private property. Necessarily this has undermined acceptance of definitions that approach sound as a phenomenon. Instead the idea that sound is something that is heard has been extrapolated and is now considered in its broadest sense. Fundamental to this shift is the concept of transduction, remediated from the diaphragm of the ear to be used in machines, which have offered new sites in which to locate sound.

Generally it is thought that phonography allows sound to be recorded but actually it has changed the way it is thought about entirely. No longer are scholars limited to employing specific applied examples of sound such as the voice, a sine tone or music in their work – it is now possible to possess a *high fidelity* recording of any sound. Sound itself cannot therefore be merely a phenomenon or perception because it is reified in records, leading to a focus on individual sounds that are assigned an origin, meaning and value.

Transduction

All technologies of sound reproduction and manipulation involve the transduction of sound – that is, receiving sound and somehow transforming it into something else – and so do not actually record or transmit sound *per se* but instead simply transfer energy from one form to another and, potentially, back, at a different point or place in time – assuming that is that the sound is at some point heard played through a speaker. Although, admittedly, this is complicated by the fact it is possible to generate and store a *sound* digitally without any direct processes of transduction, or without any additional electronic ones beyond what a computer might already be performing anyway. This is due to the conflation of sound, signal, storage and phenomena that occurs with sound reproduction. The human perception of sound is necessarily mediated by the ear and physiology of hearing more broadly, as I will explore further later. However, the development of phonography and subsequent technologies of sound reproduction and manipulation have complicated that mediation further and

contributed to the reification of sound. There are now machines that can *hear* and so a much broader definition of perception must be employed.

Crary examines the history of perception in his book *Suspensions of Perception: Attention, Spectacle and Modern Culture*, and claims that 'once the empirical truth of vision was determined to lie in the body, vision (and similarly the other senses) could be annexed and controlled by external techniques of manipulation and stimulation' (Crary 1999, p.12). He continues:

> Within this vast project, an older model of sensation as something *belonging* to a subject became irrelevant. Sensation now had empirical significance only in terms of magnitudes that correspond to specific quantities of energy (e.g., light) on one hand and to measurable reaction times and other forms of performative behaviour on the other. It cannot be emphasized too strongly how, by the 1880s, the classical idea of sensation ceases to be a significant component in the cognitive picture of nature (Crary 1999, p.27).

Jonathan Sterne is particularly aware of this situation and, in attempt to offer an ontological grounding, traces the history of listening, and to some extent therefore sound, as a social process based in transduction in his book *The Audible Past*. He argues that 'sound reproduction technologies are artifacts of vast transformations in the fundamental nature of sound, the human ear, the faculty of hearing and practices of listening that occurred over the long nineteenth century' (Sterne 2003, p.2).

There is significant merit in his argument because, above all, it recognises the pervasive influence of phonography and related technologies. However, it is an extension of the focus on sound as vibration that is evident from the work of the ancient Greeks to the scientists of the Enlightenment and problematic in that it still attempts to locate sound in a series of discrete sites rather than deal with sound as a *thing* that has been constructed. His approach treats sound as a kind of vibration and hearing as a kind of transduction, and, in so doing, does not consider fully the perceptual, cultural and social dimensions of either.

Arguing the point, Frances Dyson believes that 'although Sterne's arguments must be separated from his larger claim, his focus on the vibrational qualities of sound reframes audio as acoustic; aurality as sound, removing sound from its media and cultural context, and placing it within the phenomenality that, as I have argued, is working within an epistemic system that defines "being" in the first place' (Dyson 2009, p.77). As she writes, 'if sound's integrity is eviscerated through recording, sound's materiality,

however, provides a firewall against complete atomization and this occurs, once again, through the figure of vibration, which is not confined to sound, but rather opens an expanded phenomenal field, wherein sound and the body can recover ground lost to reproduction, simulation and mediatization' (Dyson 2009, p.143). Basically, Dyson argues that to approach a history of listening and hence sound with a focus on transduction is too reductive, and I agree. It locates sound in a specific site rather than approaching it as existing inherently in multiplicity. Although the transduction of sound fits neatly in the history of the study of sound – following the tremors on the surface of a pool of water observed by the Greeks and the image of vibrational figures drawn in sand popularised in the scientific exploration of the Enlightenment – and offers a useful way to approach sound, it is ultimately an attempt to define sound ontologically within traditional academic metaphysics.

Schizophonia

Schafer argues that the principal effects of the development of the phonograph and the following 'electric revolution' on sound were actually 'the discovery of packaging and storage techniques for sound and the splitting of sounds from their original contexts', which he calls *schizophonia* (Schafer 1994, p.88). The word is comprised of the Greek prefix *schizo*, meaning split, and *phone*, which is Greek for voice, and so, as he explains, '*schizophonia* refers to the split between an original sound and its electroacoustical transmission or reproduction' (Schafer 1994, p.90). For Schafer 'the three most revolutionary sound mechanisms of the Electric Revolution were the telephone, the phonograph and the radio' because 'with the telephone and radio, sound was no longer tied to its original point in space' and 'with the phonograph It was released from its original point in time' (Schafer 1994, p.89). He believes that with these developments 'sounds have been torn from their natural sockets and given an amplified and independent existence' (Schafer 1994, p.90).

> Originally all sounds were originals. They occurred at one time in one place only. Sounds were then indissolubly tied to the mechanisms that produced them. The human voice traveled only as far as one could shout. Every sound was uncounterfeitable, unique. Sounds bore resemblances to one another, such as the phonemes which go to make up the repetition of a word, but they were not identical. Tests have shown that it is impossible for nature's most rational and calculating being to reproduce a single phoneme in his own name twice in the same manner (Schafer 1994, p.90).

Although Schafer's point is an important one, his use of the term original is problematic, as I will explain. Nonetheless, approached in this way phonography, telephony and radiophony create a situation in which sound, and specifically particular sounds, exist independent of their source, and so can now be considered in their own right, independent of their representative meaning in the world. However, because science claims that sound is a vibration that is caused and is in turn heard, the technologies themselves become the source. Paradoxically the severing of individual sounds from specific points in time and space makes people more aware of them as individual sounds. Depending on the approach taken, sound occurs in the time and place of transduction or becomes multiple and conceptual as much as actual.

Panaurality

Douglas Kahn argues that there is a Western history of 'mythic spaces' and that 'these spaces and quasi-spaces contained voices or music in perpetuity – sounds that continually sound, circulating within physical or social spheres, or that can be activated after having been recorded in matter or memory' (Kahn 2001, p.202). This is demonstrated by the House of Rumour from Ovid's *Metamorphoses:*

> There is a place at the centre of the World, between the zones of earth, sea, and sky, at the boundary of the three worlds. From here, whatever exists is seen, however far away, and every voice reaches listening ears. Rumour lives there, choosing a house for herself on a high mountain summit, adding innumerable entrances, a thousand openings, and no doors to bar the threshold. It is open night and day: and is all of sounding bronze. All rustles with noise, echoes, voices, and repeats what is heard. There is no peace within: no silence anywhere. Yet there is no clamour, only the subdued murmur of voices, like the waves of the sea, if you hear them far off, or like the sound of distant thunder when Jupiter makes the dark clouds rumble (Ovid 2000, Book XII:39-63).

Kahn continues, 'accompanying these sonic and phonic spaces of *all sound*, *all voices*, or *all* or *always sounding* is the capacity for panaurality to be invested within a single being or for other types of sensing ultimately to be manifested within sound' (Kahn 2001, p.202). Here he refers to Rumour's panaurality as something that is increasingly approached in the way human beings are able to hear and sound – the possibility of hearing and sounding globally.

Panaurality is a term that Kahn uses to refer quite literally to a hearing that is always and all encompassing in its range and which is, therefore, based in the idea of a theoretically omnipresent subject. He claims that 'between the sounds in perpetuity and panaurality is a process of negotiations called audibility and in turn at least one schism within audibility producing inaudibility' and 'the amplification of sounds into audibility and the amplification of hearing into panaurality' can be considered 'the prehistory of amplification' (Kahn 2001, p.202).

Disembodied Voices

Jacques Derrida is critical of the *phonocentrism* common to Western cultures – what he called the 'the common belief that there is an immediate and unmediated relationship between the mind, the voice, language, and the nature of the world' (Dyson 2009, p.95). He makes an important point, which I have already mentioned in pointing out the voice's status as an idealised example of sound and the validity of which is demonstrated by the situation created by the reproduction of the voice using phonographic technologies. Just as Dyson argues:

> Traditionally, the voice grounds the subject in presence, and here "presence" signifies both the temporal present and the "presentation to the senses," which Western ontology demands to attribute existence. Projected from the inside to outside, heard at the moment of utterance, the voice establishes a circuit between perception and intellection, between the thinking mind and the speaking body, between the interior and the exterior, and between the subject and the object (Dyson 2009, p.95-96).

However, phonography and other technologies of sound reproduction and manipulation facilitated changes in the way people relate to their voices and so to themselves. While people still hear themselves in a distinct way – through the bones in their skull – that grounds their voice in their head and, therefore, in a self with a specific place, it is now also possible for them to hear their voices disembodied from their selves. As Kahn and Whitehead argue:

> Phonographic deboning is, therefore, a machine-critique of Western metaphysics a century before Derrida's critique of Husserl, for it uproots an experiential centerpiece for sustaining notions of the presence of the voice – hearing oneself speak – and moves the selfsame voice from its sacrosanct

> location into the contaminating realms of writing, society and afterlife (Kahn & Whitehead 1992, p.93-94).

Importantly, the way in which the development of phonography and subsequent technologies of sound reproduction and manipulation has disembodied individuals' voices, allowing people to hear themselves as they do others, has had complicated results. Necessarily this problematises the standing of the voice as an articulation of self, particularly because it is common for people when hearing a recording of themselves, of their voice, to exclaims 'that's not me'. Despite this, the voice has nonetheless demonstrated tremendous resilience and as Dyson argues:

> As the first attribute to become disembodied through electronic transmission, the voice has anchored all other transmissions. From telephony, to television, to digital simulated environments, the familiarity of the voice blunts the sharp edges of telepresent culture, dampening the potential volatility of troubling questions concerning the self, existence, the real and the social. Sound disappears into the voice in the same way that the voice encloses and hides the technological means of transmission and reproduction…The importance of the voice in this respect cannot be underestimated. Why was it, for instance, that even though telephony radically disassociated the voice from the body and the speaker from their geographical presence, somehow, culturally, a person's denuded telephonic voice came to speak for their whole being? Likewise, how was it that while the audio recording automatically announced the voice or sound heard as being both absent and past, it was still heard as if it were present, occupying the same time and space as the listener? (Dyson 2009, p.8-9).

It is now possible to hear oneself as everything else and so humankind has achieved an omnipresence that, if it does not place humankind outside the world, leaves it in a no place such as that of The House of Rumour, lacking in specific presence but global and perhaps even universal in its reach.

Writing Sound for Reproduction and Preservation

Apart from Scott and his predecessor Weber, whom I mentioned earlier, Charles Cros, and Thomas Edison each played a significant role in the development of phonography. Described by Kittler as 'a Parisian writer, bohemian, inventor and absinthe drinker', and unable to afford to build the invention himself, Charles Cros deposited a sealed envelope containing an essay detailing 'with great technical elegance' the principles of

the phonograph in 1877 (Kittler 1999, p22). However, it was Edison who would become known as the inventor of the phonograph, due as much as anything to his ability to commercialise the technology. He had numerous ideas as to possible uses for the phonograph, including using it for letter writing and dictation, phonographic books for the blind, the teaching of elocution, the reproduction of music, family recordings, music boxes and toys, talking clocks, the preservation of languages, educational purposes, and for use in connection with the telephone (Sterne 2003, p.202).

All the inventors involved in the development of phonography had in common an interest in writing sound. The way in which a record is inscribed with *sound writing* is described by Theodor Adorno in his essay *The Form of the Phonograph Record* when he writes that, 'it is covered with curves, a delicately scribbled, utterly illegible writing' (Adorno 2002b, p.277). He argues that 'the possibility of inscribing music without it ever having sounded has simultaneously reified it in an even more inhuman manner and also brought it mysteriously closer to the character of writing and language' (Adorno 2002b, p.280). This demonstrates, even at a very early stage in his writing about phonography, Adorno's concern with the effect of the technology on music, one that has since been shared by a great number of theorists, and has proven wise, if perhaps overly pessimistic.

Jacques Attali is a Marxist and economist who has written extensively about the impact of phonography on music. Despite his criticism of the commodification of sound and the resulting music industry – in which phonography has played a large part – he notes in his book *Noise: The Political Economy of* Music that not only did Scott, Charles Cros and Thomas Edison all develop their inventions in attempts to write sound, to achieve a sort of 'automatic stenography', but in doing so 'emphasis was placed on *preservation* not mass *replication*' (Attali 2006, p.91).

> The phonograph was thus conceived as privileged vector for the dominant speech, as a tool reinforcing representative power and the entirety of its logic. No one foresaw the mass production of music: the dominant system only desired to preserve a recording of its representation of power, to preserve itself…The attempts to transcribe music into language or language into music reflect this will to construct a universal language operating on the same scale as the exchanges made necessary by colonial expansion: music, a flexible code, was dreamed of as an instrument of world unification, the language of the all mighty (Attali 2006, p.92).

The point that Attali is trying to make is that although phonography was initially developed as a democratic technology designed to allow people to *write* sound themselves it was nevertheless an invention that was the product of a powerful modern culture that sought in many respects to universalise itself. All this would change, however, when Emile Berliner developed the gramophone, a machine closely related to the phonograph, and in particular a model in 1888 that used rotating discs, like the vinyl played on a contemporary record player, rather than the wax cylinders that had been used to that point (Sterne 2003, p.203).

Understandably Adorno believed that 'the phonograph record is an object of that "daily need" which is the very antithesis of the humane and the artistic, since the latter cannot be repeated and turned on at will but remain tied to their place and time' (Adorno 2002b, p.278). He noted that 'records are possessed like photographs', explicating their function as a means of preservation (Adorno 2002b, p.278).

> The key to the proper understanding of the phonograph records ought to be provided by the comprehension of those technological developments that at one point transformed the drums of the mechanical music boxes and organs into the mechanism of the phonograph. If at some later point, instead of doing a "history of ideas", one were to read the state of the cultural spirit off of the sundial of human technology, then the prehistory of the gramophone could take on an importance that might eclipse that of many a famous composer. There is no doubt that, as music is removed by the phonograph record from the realm of live production and from the imperative of artistic activity and becomes petrified, it absorbs into itself, in this process of petrification, the very life that would otherwise vanish (Adorno 2002b, p.279).

The invention of the gramophone was followed by the development in the 1920s of electrical recording, better waxes for the records themselves, and the pickup, which allowed for amplified recording and playback, which in turn lead to more people adopting the technology and its increased use for playing music on radio and in public (Attali 2006, p.96). Thompson points out that development of electrical amplification, unsurprisingly, *amplified* the noise of the city, leading concerned citizens to push for further anti-noise legislation (Thompson 2002, p.117-118). However, at the same time 'Jazz musicians and avant-garde composers created new kinds of music directly inspired by the noises of the modern world' and 'by doing so they tested long-standing definitions of musical sound, and they challenged listeners to reevaluate their own distinctions between music and noise' (Thompson 2002, p.118-119). Indeed, this had already been demonstrated by the work of the Futurists in Italy and particularly in Luigi

Russolo's *The Art of Noises,* in which he proclaimed 'our ear is not satisfied and calls for ever greater acoustical emotions…each sound carries with it a tangle of sensations, already well know and exhausted, which predispose the listener to boredom, in spite of the efforts of all musical innovators' and so 'by selecting, coordinating, and controlling all the noises, we will enrich mankind with a new and unsuspected pleasure of the senses' (Russolo 1986, p.24-27). Thompson adds:

> The problem of noise was further amplified in the 1920s by the actions of acoustical experts. Like the musicians, these men constructed new means for defining and dealing with noise in the modern world. For the first time, scientists and engineers were able to measure noise with electroacoustical instruments, and with this ability to measure came a powerful sense of mastery and control. Acousticians were eager to step into the public realm, to display their tools, and to demonstrate their expertise as they battled the wayward sounds. Their unprecedented ability to quantify the noise of the modern city further heightened public awareness of the problem as well as expectation of its solution. That solution would prove elusive, however, as even the most technically proficient campaigns for noise abatement struggled to effect change within the public soundscape. By the end of the decade, urban dwellers were forced to retreat into private solutions to the problem of noise. Acoustical expertise was brought back indoors, and acousticians devoted themselves to the construction of soundproof buildings that offered refuge from the noise without (Thompson 2002, p.119).

Apart from the increasing importance of acoustic design, the electrical amplification of sound, along with technologies such as the telephone, phonograph and radio, allowed the creation of what Schafer terms 'sound walls' (Schafer 1994, p.96). In fact, he offers radio as the first example of a sound wall – 'enclosing the individual with the familiar and excluding the enemy' (Schafer 1994, p.93). He writes that 'modern man has discovered what might be called *audioanalgesia*, that is, the use of sound as a painkiller, a distraction to dispel distractions', even suggesting that the proliferation of such technique is the result of the lack of acoustic insulation in many modern buildings (Schafer 1994, p.95-96). For example, 'the Moozak [sic] industry deliberately chooses music that is nobody's favorite and subjects it to unvenomed and innocuous orchestrations in order to produce a wraparound of "pretty", designed to mask unpleasant distractions in a manner that corresponds to the attractive packages of modern merchandising to disguise frequently cheesy contents' (Schafer 1994, p.96). 'Walls used to exist to isolate sounds', he claims, but 'today sound walls exist to isolate' (Schafer 1994, p.96). More recent technologies that can easily be argued to

function in the same way include portable music players, stereo systems in cars and even televisions.

His Master's Voice

Apart from the shift from music as live performance and lived culture to available and often private entertainment that was facilitated by the development of the phonograph, there was a corresponding and significant change in the way people listened. As I have just mentioned, new technologies allowed people to distract themselves from the noise around them, but at the same time these technologies, to a large extent, were involved in developing notions of attentive listening. Often people now talk of the sea of information in which they live and, having all developed short attention spans, how they are easily distracted. However, Crary contends that 'modern distraction was *not* a disruption of stable or "natural" kinds of sustained, value-laden perception that had existed for centuries but was an *effect*, and in many cases a constituent element, of the many attempts to produce attentiveness in human subjects' and so 'if distraction emerges as a problem in the late nineteenth century, it is inseparable from the parallel construction of an attentive observer in various domains' (Crary 1999, p.50).

> Spectacle is not primarily concerned with *looking at* images but rather with the construction of conditions that individuate, immobilize, and separate subjects, even in a world in which mobility and circulation are ubiquitous. In this way attention becomes key to the operation of non-coercive forms of power. This is why it is not inappropriate to conflate seemingly different optical or technology objects: they are similarly about arrangements of bodies in space, techniques of isolation, cellurization, and above all separation. Spectacle is not an optics of power but an architecture. Television and the personal computer, even as they are now converging towards a single machinic functioning, are antinomadic procedures that fix and *striate* (Crary 1999, p.74-75).

He is arguing that contemporary notions of attention and models of subjective perception only emerged in the nineteenth century (Crary 1999, p.12). He uses a diagram of a telephonic listening room as an example of the 'technologies of separation' he argues supported modern notions of *attention*, and the same can be said of the role of the phonograph in recording individual sounds. Use of the technology trained people to listen to them attentively in *high fidelity* and the phonograph parlour offered an isolating environment in which one could pay *attention* (Crary 1999, p.75). Similarly, Schafer argues that 'the real depreciation of attention

came after the advent of the telephone' (Schafer 1994, p.93). Beyond even those examples, once phonography enabled sound to be recorded and manipulated it was not long before there were significant changes in the way people listen to sound.

Perhaps the best articulation of the attention commanded by phonography is the now well-known phrase 'His Master's Voice', which was originally used in advertising for a number of record companies and other businesses. It describes the logo that it accompanied, which featured a small dog listening intently to the horn of gramophone. Adorno, for one, believed that the image was 'the right emblem for the primordial affect which the gramophone stimulated and which perhaps even gave rise to the gramophone in the first place' (Adorno 2002a, p.274).

Interestingly, the slogan and image come from a painting by an Englishman named Francis Barraud (Taussig 1993, p.224). Apparently the artist had inherited a cylinder phonograph after his brother's death, along with some recordings of his brother's voice and his brother's dog named Nipper. Playing the cylinders he noticed the dog's reaction and decided to commit it to canvas (Taussig 1993, p.224). All of which is in keeping with Adorno's argument that:

> What the gramophone listener actually wants to hear is himself, and the artist merely offers him a substitute for the sounding image of his own person, which he would like to safeguard as a possession. The only reason he accords the record such value is because he himself could be just as well preserved. Most of the time records are virtual photographs of their owners, flattering photographs – ideologies (Adorno 2002a, p.274).

Although, it is important to remember that even before the phonograph became affordable enough to be a common sight in the every day home, phonograph parlours offered 'a place where commuters (perhaps awaiting a train or a trolley) could stop in for a short time, drop a coin in the slot of a phonograph, and listen to a short tune or sketch' (Sterne 2003, p.162). In doing so, the parlours demonstrated, following the concert hall, 'the construction of a private auditory space and the commodification of sound itself' (Sterne 2003, p.162).

Mimetic Responsibility and Technology's Infidelity

Initially phonographic equipment was commonly advertised for its *high fidelity* and the expectation of its function as a mimetic faculty, similar to that placed on photography, has been great. In particular, Thomas Edison's phonograph was marketed with various posters promoting its *high fidelity* character, one such poster showing a small boy taking an axe to a phonograph with the caption 'Looking For The Band' and proclamation that 'The Edison Phonograph' was 'The Acme of Realism' (Sterne 2003, p.264).

Phonographs were presented as capable of reproducing sounds in a manner so *real* that no one, man or beast, could differentiate between the recorded sound and the *original* sound itself. All of this, it seems, was evident to a very real extent to people of the day because Adorno himself wrote that:

> There is only one point at which the gramophone interferes with both the work and the interpretation. This occurs when the mechanical spring wears out. At this point the sound droops in chromatic weakness and the music bleakly plays itself out. Only when gramophonic reproduction breaks down are its objects transformed. Or else one removes the records and let's the spring run out in the dark (Adorno 2002a, p.275).

Nonetheless, as he acknowledges, it was and has always been to some extent possible to hear the technology, if only in its failure, and so the rhetoric is undermined by technology's infidelity. Also, with early phonographs and gramophones the signal to noise ratio was particularly low and so it was undeniably possible to perceive the mediation of the technology, even if audiences would perhaps unconsciously listen past such imperfections. There was and is always noise in the sounds of technology, a murmur that is suppressed as much as possible but which remains inescapable. Nevertheless the technology itself was and is expected to be inaudible and, as Sterne notes, 'inasmuch as its mediation can be detected, there is a loss of fidelity or a *loss of being* between original and copy' and 'in this philosophy of mediation, copies are debasements of the originals' (Sterne 2003, p.218).

Michael Taussig writes enthusiastically of the 'mimetic faculty' he saw in technologies of reproduction such as the phonograph in his book *Mimesis & Alterity: A Particular History of the Senses* (Taussig 1993, p.21). Particularly crucial to Taussig was the duality of mimesis as both a 'copying or imitation' and a more direct 'palpable, sensuous, connection' between bodies, as 'seeing something or hearing something is

to be in contact with that something…vibrating like sound, gleaming like light, copy blurs with contact at the heart of matter's sympathetic magic' (Taussig 1993, p.21&43). Taussig writes about the significance of the large amount of 'colonial photography', that is the use of the phonograph at so called frontiers, including Richard Marsh's search for 'white indians' and Robert Flaherty's images of Nanook of the North, and depictions of similar situations in films such as Werner Herzog's *Fitzcarraldo*, in which the titular character plays a recording for the tenor Enrico Caruso for the *savages* while going up river in the Amazon during the rubber boom of the early twentieth century. Instead of the effect of the phonograph or camera on 'the natives', Taussig is interested, in his own words, in 'the white man's fascination with their fascination with these mimetically capacious machines' (Taussig 1993, p.198). He argues that:

> What seems crucial about the fascination with the Other's fascination with the talking machine is the magic of mechanical reproduction itself. In the West this magic is inarticulable and is understood as the technological substance of civilized identity-formation. Neither the prospector filming in the early 1930s in the New Guinea highlands nor Fitzcarraldo in the jungles of the Upper Amazon in the early twentieth century could make a phonograph, or an electric lightbulb switch for that matter. Vis à vis the savage they are the masters of these wonders that, after the first shock waves of surprise upon their invention in the West, pass into the everyday. Yet these shocks rightly live on in the mysterious underbelly of the technology – to be eviscerated as "magic" in frontier rituals of technological supremacy. To take the talking machine to the jungle is to do more than impress the natives and therefore oneself with Western technology's power…it is to reinstall the mimetic faculty as mystery in the art of mechanical reproduction, reinvigorating the primitivism implicit in technology's wildest dreams, therewith creating a surfeit of mimetic power (Taussig 1993, p.207-208).

Moreover he argues that Westerners should remember 'the magic of sound-reproduction in their recent histories' and warns that 'once the mimetic has sprung into being, a terrifically ambiguous power is established; there is born the power to represent the world, yet that same power is a power to falsify, mask, pose' (Taussig 1993, p.208&p.42-43). He details how when Edison heard his voice played back to him singing 'Mary Had A Little Lamb' he was reportedly, according to his own words, taken aback. Taussig argues that '"taken aback" is a significant choice of words for this historic moment, a spontaneously fitting way of expressing (what Adorno called) the "shudder of mimesis" being taken back to childhood, back to primitivism' (Taussig 1993, p.210-211). Applying this argument to the RCA Victor logo of Nipper and the

gramophone, his interest stemming from its appropriation by Cuna women in their designs, he argues that 'the power of this world-class logo is the way it exploits the alleged primitivism of the mimetic faculty', rather than just because of its invocation of the idea of fidelity – 'the technology of reproduction triumphs over the dog but needs the dog's validation' (Taussig 1993, p.213&224). The image of Nipper's loyalty underlines the message of fidelity.

Although the fascination with phonographic technology demonstrated by colonial frontiersmen is significant, the use of such machines demonstrates at the same time sound's function as a coloniser. The way in which Fitzcarraldo plays opera while going up river creates a perimeter around the boat while simultaneously sending the opera singers' voices ahead into the jungle. Similarly, the use of Richard Wagner's 'The Ride of the Valkyries' by General Kilgore's men as they fly in for a helicopter attack in *Apocalypse Now* claims the territory ahead before their arrival as well as suggesting – at least to those familiar with the reference – the power of the squadron to be akin to that of the valkyries referenced in the piece's title – female figures in Norse mythology who are said to have, as is literally communicated in their name, decided who would die in battle. Often the colonising force of sound is more complicated, as is demonstrated in Paul Carter's investigation of the use of the cry *cooee* in Australia in his book *The Sound In Between: Voices, Space, Performance*. Cooee is a term that is used to attract attention if lost in the bush, of announcing one's presence and of seeking attention in hope of a reply (Carter 1992, p.27). Generally it is thought colonisers adopted the term from the country's Indigenous people, and there are records of settlers in Sydney hearing the calls from local Aborigines. However, even if it did originate from people of the Dharuk language from the area inland from Sydney, it was regarded by most Aboriginal people as a white term, according to a report written by Ernest Giles in 1889, and as such:

> "Cooee" might not bring the colonisers and the colonised closer together but, as a term of exclusively local origin, it served to bind the *colonists* together. Adopting it, genuine "currency" lads demonstrated their difference from mere new chums. In due course "Cooee" came to signify an Australian identity – a point underlined by the iconic status afforded it in 'Cooee to Australia', a World War 1 recruiting poster (Carter 1992, p.29).

Attempting to examine the reaction of scholars of the day such as Adorno and Walter Benjamin to the development and adoption of technologies of sound reproduction and manipulation in the late nineteenth and early twentieth centuries, Sterne argues that,

as they wrote, 'the problem of mechanical reproduction is central to understanding the shape of communication in the late nineteenth and early twentieth centuries' and so:

> For them the compelling problem of sound's reproducibility, like the reproduction of images, was its seeming abstraction from the social world even as it was manifested more dynamically within it. Other writers have offered even stronger claims for sound reproduction: it has been described as a "material foundation" of the changing senses of space and time at the turn of the twentieth century. Sound technologies are said to have amplified and extended sound and our sense of hearing across time and space (Sterne 2003, p.6).

Benjamin argues in *The Work of Art in the Age of Mechanical Reproduction* that while in principle individual works of art had always been reproducible, and indeed replicas of art works were and still are made for a host of reasons, the mechanical reproduction of a work of art was something new. It had only previously been achieved by the Greeks in the form of founding and stamping, and subsequently in extensions of those technologies such as woodcut graphic art and, most notably, the printing press. However, only comparatively recently with the development of lithography, and after that photography and the technical reproduction of sound, was the process easy enough to allow the speed and quantity of reproduction required for products to be available on the market both in large numbers and constantly changing forms (Benjamin 2008, p.3-4).

He believed that 'even with the most perfect reproduction, *one thing* stands out: the here and now of the work of art – its unique existence in the place where it is at this moment' (Benjamin 2008, p.5). He argues that the concept of authenticity is founded on the presence of an *original,* and while with manual reproduction the authority of the original was maintained, with the development of mechanical reproduction such authority was undermined (Benjamin 2008, p.6). This shift paved the way for the development of the manipulation of recordings to produce new work. In order for it to become possible for artists to approach the new technologies and the recordings made with them as potential source material available to manipulate as they pleased the *aura* of the work recorded had to be undermined, and the development of technologies of mechanical reproduction such as phonography had exactly that effect.

Generally, the rhetoric around the supposedly *hi-fi* nature of stereo equipment leads people to think about reproduced sound as a mediation of an *original*, live, sound. Sterne argues that as a result such sound is measured against a 'fictitious external reality' (Sterne 2003, p.218). Whether that *reality* is fictitious or genuine is open to

debate, but in either case it is imagined and does not necessarily represent accurately what was recorded. Principally the lack of a perceived authenticity in recordings is based on the distinction between recordings and *original* musical performances. However, as Sterne argues:

> To consider the products of reproduction – original and copy – separate from the process, even in a philosophical exercise, is to confuse a commercially useful representation of reproduction with the ontological character of reproduced sound itself. "Original" sounds are as much a product of the medium as are copies – reproduced sounds are not simply mediated versions of unmediated original sounds. Sound reproduction is a social process. The possibility of reproduction precedes the fact (Sterne 2003, p.219).

This is why Schafer's use of the term original is problematic. Technologies of sound reproduction and manipulation have indeed allowed identifiable sounds, which could equally be identified as unique sounds, to be distinctly separated from their initial sources – where previously they may have reached a considerable distance from their source but were nonetheless considered to emanate somehow from them – but this does not mean that all sounds prior to the development of sound recording were originals. Further complicating the issue, Dyson argues that 'the denial of difference between the source and the reproduced sound is an ontological claim, an assertion of ontological similitude, which has enabled audiophony to avert the kinds of discursive discriminations that are fundamental to media analysis' (Dyson 2009, p.77). According to Dyson, despite his argument above, 'by securing his theorization of sound in vibration and, following Helmholtz, treating sound as an "effect" ("frequencies are frequencies"), Sterne removes the cause – the source – of the sound from consideration', and 'placing sound within these acoustic and physical parameters ignores both the importance of locational hearing and (relatedly) the signifying aspects of sound' (Dyson 2009, p.78). Most importantly, she argues, as I have mentioned, that 'audiophony does not *reproduce* as much as *represent* sound' and yet 'as the product of a series of technological mediations, it is still very difficult to differentiate the recording from acoustic sound without using terms that imply an original, identifiable, and thus *singular* sonic event, an event that conforms to the visually based ontology, that sound theory is attempting to escape' (Dyson 2009, p.75).

The Potentialities of Phonography

Demonstrating the shift in attitudes that led to artists beginning to experiment with new technologies such as phonography, Laszlo Moholy-Nagy wrote a paper entitled 'New Form in Music: Potentialities of the Phonograph' in 1923 in which he argues, some years before any of his arguments would be realised, that 'the phonograph be transformed from an instrument of reproduction into one of production' (Moholy-Nagy 1985, p.291). He suggests methods such as the inscription of engravings directly into phonograph discs, use of the phonographic disc by composers for the 'immediate reproduction' of their work without the need for live musicians, and the use of the phonograph in live performance to develop a new form of music, all of which have been central to subsequent musical experimentation (Moholy-Nagy 1985, p.291). He extended and clarified this argument in *Painting Photography Film*, published in 1925, in which he posited:

> In the case of the gramophone the situation is as follows: the business of the gramophone to date has been to reproduce existing acoustical phenomena. The sound vibrations which have to be reproduced are scratched by a needle on a wax plate and later transposed back into sound from a pressing from that plate with the aid of a membrane. Expansion of the apparatus for productive purposes might make it possible for scratches to be made in the wax plate by the person himself without mechanical external agency; these would, when reproduced, give an effect of sound, which would offer without new instruments and without orchestra a new way of generating sound (new sounds which do not yet exist and new sound relationships) and thus help to bring about a change in the concept of music and in compositional possibilities (Moholy-Nagy 1967, p.31).

It was not, however, until the 1920s and early 1930s that the phonograph began to be actively experimented with as a source of *original* sound production. Caleb Kelly notes in his book *Cracked Media: The Sound of Malfunction* that:

> The phonograph was developed steadily over the next seventy years, including the replacement of the cylinder with flat shellac discs, allowing for multiple copies of recordings to be easily produced, the development of the vacuum tube, and electronic amplification and recording. It was not, however, until the 1920s and early 1930s that the phonograph began to be actively experimented with as a source of original sound production, rather than the playback of a recorded piece of sound (Kelly 2009, p.102-103).

Writing in 1934, Adorno argued that up until that point there had been no development of 'phonographic composers' (Adorno 2002b, p.278). However, composers in the 1920s and 1930s, such as John Cage, Percy Grainger, Paul Hindemith, Raymond Lyon, Darius Milhaud, Laszlo Moholy-Nagy, Ernest Toch and Edgard Varèse, explored the creative applications of the phonograph (Kelly 2009, p.103). The phonograph had already made the mass production of music possible but it would soon become an instrument in its own right, and perhaps it is in the work of artists such as these that the real democratic potential of the technology can be found, if not realised given their status as a cultural elite.

Offering a useful approach to the agency of technologies and the importance of experimentation with their possibilities, Martin Heidegger argues in his essay 'The Question Concerning Technology' that all technologies are part of a greater system of *Technology*. Heidegger suggests that the two most common definitions of technology, that 'Technology is a means to an end' and that 'Technology is a human activity', together can be seen as the instrumental view of Technology (Heidegger 1977, p.4-5). In his opinion such a view places technology as subservient to the human subject and so 'everything depends on our manipulating technology in the proper manner as a means' (Heidegger 1977, p.5). However, he is dissatisfied with the instrumental view of technology, concerned that 'so long as we represent technology as an instrument, we remain held fast in the will to master it' and argues:

> Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology (Heidegger 1977, p.4).

Having traced the modern *technology* back to the Greek *technikon* and, in turn, its root *techné,* which is related to *epistémé* and 'knowing in the widest sense', Heidegger arrived at a broader view of Technology as a kind of systematic treatment of an art or craft (Heidegger 1977, p.12-13). As Ursula Franklin comments:

> Technology is not the sum of the artifacts, of the wheels and gears, of the rails and electronic transmitters. Technology is a *system*. It entails far more than its individual material components. Technology involves organization, procedures, symbols, new words, equations, and, most of all, a mindset (Franklin 1992, p.12).

Technologies of sound reproduction and manipulation are an excellent example of the action of a system of Technology. As Sterne argues in his book *The Audible Past*, 'the possibility of reproduction precedes the fact' such that the effect of the technologies is not to allow the recording and manipulation of some sounds but rather to render all sound recordable, mutable and even, theoretically, synthesizable (Sterne 2003, p.219). Technology has facilitated great changes in how people relate to sound and, to an extent, the nature of sound itself.

Technologies are constructed from the parts of preceding technologies. In his paper 'Holes In The Head: Theatres of Operation For The Body In Pieces' Gregory Whitehead argues that 'successive generations of technology do not so much displace as *digest* each other' (Whitehead 1993, p.2). Writing specifically about radio, he claims that:

> Churning through several generations of media, such digestion is never complete: dissect a radio, and you will find the remains of a book; dissect the book, and you will find the remains of a larynx; dissect the larynx, and you will find the skeletal trace of a twitching finger, lighting a match and sending a telegram; take the prints from the finger, and there you will rediscover the origins of radio (Whitehead 1993, p.2).

Therefore, digital technologies, as the most recently developed phonographic technologies, along with those before them, do not exist independently of the other technologies that have preceded them but rather contain within them many of the preceding developments.

As I have mentioned, Schafer coined the term *schizophonia* to describe the contemporary situation in which 'sounds have been torn from their natural sockets', providing an explanation of the effect on the perception and conception of all sound that results from the introduction of technologically mediated sound (Schafer 1994, p.90). John Potts subsequently extended this notion in his article 'Schizochronia: Time In Digital Sound', explaining that digital technologies of sound reproduction and manipulation not only sever sounds from their initial sources but also from their initial

times, such that the contemporary concept of sound is not only schizophonic, but also *schizochronic* (Potts 1995, p.20). For instance, while 'all of the analogue audio techniques – cutting, fading, mixing, looping, delay, reversing – are honed with greater precision and control in the digital domain' digital technologies also complete a technological deconstruction of the notion of sound as tied to the progressive flow of time (Potts 1995, p.18-19). He argues that:

> In recording a sound, we preserve its flow in time. The recording represents a past sequence of time, which when played, returns to occupy the present. Any recording is a past waiting to return to the present. The replayed sound is ontologically distinct from the original, since it is a recorded version displaced in both time and space. Its return at a later time is a form of difference: the sound is marked by both the technological intervention and the displacement in time. Incorporating these markings of future difference, the sound once recorded is re-constituted: it is split across time, imbued with the potential of re-emergence in time (Potts 1995).

Instead of recording sound as a linear flow of signal, as is done in the grooves on a record or lengths of magnetic fields on analogue tape, time in digital editing is infinitely supple. Digital data is recorded as stores of binary information independent of existing constructions of time such as those produced by the motors of a turntable or reel-to-reel tape player. Therefore, Potts explains:

> Digital audio presents us with a range of paradoxes. Its high precision encourages non-linear editing, in which material can be retrieved and assembled in any order. Its mathematical nature offers an infinite number of choices in non-destructive editing. It is based on tiny slivers of frozen time, yet it offers inexhaustible means to explore the ambiguities and flux of time. These paradoxes proceed from its central concept, which comprises the greatest paradox. Its stuff is numerical information, yet that stuff is a non-stuff, manipulable to an unprecedented degree. Its binary language is brutally simple, but the ways it invites us to think and create are unfathomably complex (Potts 1995, p.19).

The use of digital technologies to record and manipulate sound focused originally on the replication of existing *musical* sounds – the possibilities of the digital used to sample and synthesize wind, string and percussion instruments. However, as Kahn argues, 'recent digital sound technology has made an expanded concept of instrument

unavoidable' and so digital sound has begun to be considered in its own right, confronting the unique situation presented by these technologies (Kahn 2005).

Significantly, digital technologies are the first technologies of sound reproduction and manipulation that in recording and storing sound do not create an overt, physically representative, or haptic, materiality such as occurs in the construction of the object of the vinyl record or cassette. Instead, digital technologies produce a potentiality that lacks any obvious tangible materiality, severing sound more severely from its putative existence as a phenomenon of vibrating particles or waves of pressure.

Digital sound is commonly theorized as dealing with sound at the level of the molecular, the miniature, or the granular. The reality of this, as Potts points out, is that, despite the flexibility offered by digital technologies, 'its principles are mathematical, its mode is extreme precision' (Potts 1995, p.18). Digital technologies impose a mathematical construction of sound divided into miniscule blocks, bits and samples.

Technologies of sound reproduction and manipulation aim for fidelity and yet they are most conspicuous in their infidelity. Arguably, the development of digital sound technologies has taken fidelity in sound to a level indistinguishable by human hearing. However, as with the technologies that have preceded them, the phonograph with its surface noise and magnetic tape with its noise floor and limited dynamic range, it is through their infidelities that digital technologies assert their presence. This interest in the fidelity of technological sound is misplaced, however, as it assumes a linear relationship between the phenomena of sound and its construction through Technology. Technologies of sound reproduction and manipulation do not exist simply to reproduce the *original* sounds of *reality*. Instead, as Sterne observes:

> Sound fidelity is a story that we tell ourselves to staple separate pieces of sonic reality together. The efficacy of sound reproduction as a technology or as a cultural practice is not in its keeping faith with a world wholly external to itself. On the contrary, sound reproduction – from its very beginnings – always implied social relations among people, machines, practices and sounds. The very concept of sound fidelity is a result of this conceptual and practical labor (Sterne 2003, p.219).

The technological mediation of sound has served to disrupt any notion of a singular sonic *reality*, bringing into doubt the existence of sound as a verifiably *real* phenomenon. Instead, the ability to technologically store, manipulate and produce sound re-posits sound as a constant flow of energy, repeatedly broken down,

interpreted and reconstructed and involving, as Sterne comments, 'social relations among people, machines, practices and sounds' (Sterne 2003, p.219). Sound is not just phenomenal. Any argument that technologies should achieve fidelity with an external phenomenal sound is undermined by the technologies themselves and their role in redefining all sound.

According Heidegger 'Technology is a way of revealing' or 'bringing forth' (Heidegger 1977, p.12). Furthermore, modern Technology is not just a 'revealing' but a 'challenging' in which all is rendered potential by a process of 'Gestell' or 'enframing' (Heidegger 1977, p.20). Heidegger argued that with modern Technology everything is made to be available, to be made potential; with modern Technology everything becomes the 'standing reserve' (Heidegger 1977, p.17). He found this to be a disturbing and negative trend of commodification and objectification. With the advent of digital technologies this process is more absolute than every before: all the world becoming what Mitchell Whitelaw describes as a *datasphere*, reducible to a binary system of ones and zeros (Whitelaw 2003, p.93).

The Commodification of Sound

The commodification of sound and emergence of a culture industry closely followed the development of phonography. Despite his questionable paternal status in relation to the technology, Edison remains, in Crary's opinion, 'a prominent sign of the transition to centralized corporate capitalism in the late nineteenth century' because he 'saw the marketplace in terms of how images, sounds, energy, or information could be reshaped into measurable and distributable commodities and how a social field of individual subjects could be arranged into increasingly separate and specialized units of consumption' (Crary 1999, p.31). Emile Berliner and his gramophone, which allowed the emergence of an industry around record production, also contributed greatly to this process. However, Sterne argues, quite rightly, that 'acoustic space had to be "ownable" before its contents could be bought and sold' (Sterne 2003, p.155). In fact, 'the construction of acoustic space as private space is in fact a pre-condition for the commodification of sound' (Sterne 2003, p.155). This is because commodity exchange presupposes private property and it was not only sound could be controlled that it could be owned and commodified.

Despite the influence of phonography, sound did not become a commodity until a market for it, in the form of recorded music, was created. Although a market for music in the form of sheet music, and for instruments to play it on, operated before the

existence of wax cylinders, that was a market for technology to allow people to play music themselves, albeit not their own, rather than one which marketed *high fidelity* recordings of music – an important distinction. Attali argues that a market for recorded music was produced by industry's colonisation of black music in the USA such that 'a music of revolt transformed into a repetitive commodity' (Attali 2006, p.103). He writes that 'in the slang of the black ghettos, "to jazz" and "to rock" both meant to make love…significantly, they were lived, festive acts; they became neuter commodities, cultural spectacles for solvent consumers' (Attali 2006, p.103). For him 'the gramophone seemed powerful and original because, since it *plugged into a stockpile playing on time and space*, it seemed to be a tool for the generalization of representation, a symbol for internationalization of social relations' (Attali 2006, p.95). Just as David Suisman explains in his book *Selling Sounds: The Commercial Revolution in American Music*:

> The manufacturers of player-pianos and phonographs stood at the forefront of early twentieth-century consumer marketing, and their most effective strategies drew on and expanded the association between music and "respectable" middle class identity. Indeed, the more adept the manufacturers became at promoting the value of music as cultural capital, the larger their markets grew. Their commercial strategies had paradoxical effects, however, in that they both reinforced and undermined existing cultural hierarchies. They also ushered in a new cultural order in which people became closer to music in some respects and more distanced from it in others. With player-piano rolls and phonograph records, it was possible to hear expert renditions of Beethoven of Verdi in the intimacy or one's own home, at any time. A person could listen to a cherished work over and over, studying and savoring all its complexities and nuances…Despite hopes that the enhanced availability of music would fuel musical training, in reality it often meant simply that the actual human labor of making music was now accomplished somewhere else, by specialists (Suisman 2009, p.91).

Attali argues that phonography was involved, as a technology that allows mechanical reproduction, in the creation of 'a radically new social and cultural space demolishing the earlier economic constructions of representation' (Attali 2006, p.95). He builds on Benjamin's ideas about mechanical reproduction and the shift that took place when machines were developed to automate previously manual reproduction and believes that the mechanical reproduction made possible by phonography has lead to a process of production that is characterised by repetition (Attali 2006, p.101-106). This is demonstrated in the following account documented by Suisman:

> "One afternoon, when I was watering flowers in the back yard, a boy in the street whistled a tune that I had not heard before," a typical jeremiad began. "The infliction of that tune on my unwilling ears [infuriated me], not only because of its offensive vulgarity, but because there was something in the nature of that mephitic air [that is, song] that made me feel certain I should hear it a thousand times during the summer. And my prophetic soul divined the truth. In the course of a week or two every boy in town was whistling that tune, every other man humming it, and every tenth woman playing it on the piano". The critic then recounted how the song "ravage[d] [sic] the country like an epidemic" (Suisman 2009, p.56).

Attali holds that while previously music had been a culture of representation it was changed forever by phonography and now the focus of the listener is as much on the fidelity of the recording as the music itself, so that 'sitting in front of his set, he behaves like a sound engineer, a judge of sounds' (Attali 2006, p.101-106). The result is that 'little by little, the very nature of music changes: the unforeseen and the risks of representation disappear in repetition…the new aesthetic of performance excludes error, hesitation, noise…it freezes the work out of the festival and the spectacle, it reconstructs it formally, manipulates it, makes it abstract perfection' (Attali 2006, p.101-106). Michel Serres argues in his text *The Parasite* that 'repetition is death', 'it is the fall into the similar, like the fixed identity of the too-well-known…but were truth and reality always prescribed, everything would be transformed into the sepulchral' (Serres 1982b, p.122). The dominance and power of phonography as a technology has changed the way people listen to sound and the very function of music in society such that it is now considered normal to repeatedly listen to music, to own it and to express individual identity with it.

> Fetishized as a commodity, music is illustrative of the evolution of our entire society: deritualize a social form, repress an activity of the body, specialize its practice, sell it as a spectacle, generalize its consumption, then see to it that it is stockpiled until it loses its meaning (Attali 2006, p.5).

Sound has become a commodity, most of all when used to make music, and as part of that shift now has financial value and can be owned (Attali 2006, p.37). People sell and consume it, listening with a mind to who will buy it (Attali 2006, p.37). For some time there was no regulation associated with the use of records, record companies and producers would distribute their releases freely to radio stations and people could play them in public. Soon writers, publishers, performers and, more than any of the others,

manufacturers attempted and succeeded in gaining control of who could play records and where, charging them for the privilege (Attali 2006, p.96). However, as Suisman notes:

> Looking back from the vantage point of the early twenty-first century, it is easy to see that in recent years the ground has been shifting, most notably in the erosion of the music industry's monopoly on the means of production. Beginning with the introduction of inexpensive four-track tape recorders and dramatically expanding with digitization, the Internet, and other computer technologies, the power to make, reproduce and distribute high quality sound recordings has ceased to reside exclusively with institutions possessing sizable capital and technical resources. The line between producer and consumer blurs when anyone with a high-speed Internet connection can download free digital editing software such as Audacity, broadcast over his or her own Internet "radio" station, and exchange files, copyrighted or otherwise, through decentralized peer-to-peer distribution networks (Suisman 2009, p.282).

It is unsurprising then that by the end of the Industrial Revolution it was the sounds of machines that echoed around the world, the church bell held a diminishing domain but popular music was, largely, moved off the streets. As Schafer has written, 'the association of Noise and power has never really been broken in the human imagination' and 'it descends from God, to the priest, to the industrialist, and more recently to the broadcaster and aviator' such that wherever it is allowed, there you will find power (Schafer 1994, p.76). This includes the military, a traditional site of power that has been at the forefront of technological development.

The Military and Politics of Frequency

It seems that technical advancement is at its fastest during times of war and so, given the global conflict over the last century, it is logical that once made available sound has been put to use as a military resource. There are a number of notable and now reasonably well-known examples of exactly this; including the Israeli air force using sonic booms as sound bombs over the Gaza strip in 2005; the *Squawk Box* which was used in Northern Ireland to disperse crowds by producing two ultrasonic frequencies which together produced an infrasonic frequency considered intolerable; and long-range acoustic devices used by the American military that create high frequency sound beams capable of producing 150 decibels to a range of 100 yards and are used to

disperse crowds (Goodman 2010, p.xiv & p.20-21). Employing a definition of noise as loud sound, Attali explains the basis of such sonic weapons, when he describes noise as a 'weapon of death' and notes that 'the ear, which transforms signals into impulses addressed to the brain, can be damaged, and even destroyed, when the frequency of sound exceeds 20,000 hertz, or when its intensity exceeds 80 decibels', although this of course depends on the individual and length of exposure (Attali 2006, p.27). However, while to varying extents the examples I have given all employ loud sounds, it is not sufficient to define noise as such and increasing military uses of sound do not rely on volume. Instead, increasingly they rely on frequency.

Steve Goodman, in his book *Sonic Warfare: Sound, Affect and the Ecology of Fear*, argues that what he calls the 'politics of noise' and 'politics of silence' are 'the typical limits to a politicized discussion of the sonic' and so 'locate the potential of sonic culture, its virtual future, in the physiologically or culturally inaudible' but these politics 'must be supplemented by a *politics of frequency*' (Goodman 2010, p.xvii&xx) .

> The problem of solely prioritizing the amplitude axis (between loudness and quietness) when considering the politics of sonic intensity is that usually it comes at the expense of a much more complex set of affective resonances distributed across the frequency spectrum…In other words, to a micropolitics of amplitude must be added a micropolitics of frequency (Goodman 2010, p.191-193).

Although there is a tendency, as I just demonstrated, when discussing military use of sound to think exclusively of its use as a weapon, initially and just as commonly it has been used a means of communication, such as Hitler's infamously successful use of the loudspeaker, surveillance and thus of defence. During the 1920s a series of sound mirrors were constructed along the English coast near Dover (Goodman 2010, p.37). Built from concrete, the structures, some of which are still standing today, were erected in attempt to *hear* approaching enemy aircraft. There were a few different designs, variously featuring concave, circular or otherwise curved surfaces and employing metal sound collectors connected by tubing to a stethoscope or microphones wired to a control room. A report in 1924 found the mirrors to be ten times more sensitive than the human ear (Goodman 2010, p.37). However, while attempts were made to place the mirrors in *silent* locations, ambient noise such as the wind was a significant problem (Goodman 2010, p.37).

Acoustic mirrors are themselves an important precursor to the other sonic military technologies that people would not usually class as weapons, such as the sonar and radar technologies developed and employed during World War II that used ultrasonic frequencies. In his book *Ultrasonics*, originally published in 1949, Benson Carlin defines ultrasonics as 'vibrational waves of a frequency above the hearing range of the normal ear' and adds that they have 'become of great important in recent years' (Carlin 1960, p.1). He details that 'frequencies of 10,000 to 100,000 cps [cycles per second] are used for industrial applications, sound ranging, submarine signaling, and communication' while 'those of 10,000 to 20,000,000 cps are used in testing materials for flaws, chemical treatment, medical therapy, etc' (Carlin 1960, p.1). Importantly, as is implied above, he notes that audible frequencies may sometimes be used for ultrasonic applications and ultrasonic frequencies are sometimes referred to as *sonic* (Carlin 1960). Goodman explains this complex situation by offering a definition of *unsound* as 'the not yet audible' and arguing that:

> The bandwidth of human audibility is a fold on the vibratory continuum of matter. With reference to military research into acoustic weaponry, this molecular backdrop will be mapped as a vibratory field into which the audible is implicated. On the frequency spectrum, bounding the thresholds of perceptible sound (above 20 hertz and below 20 kilohertz), where sonic perception becomes intermodal or defunct, lies infrasonic and ultrasonic wave phenomenon. The narrowband channel of the audible plunges into the murky depths of low-frequency infrasound and subbass, or constricts into the piercing high frequencies of ultrasound (Goodman 2010, p.9)

Friedrich Kittler goes so far as to argue, in *Gramophone Film Typewriter,* that all media are military in nature (Kittler 1999). Analyzing this claim, Goodman argues that 'the crucial issue here is not simply the erroneous claim that all technological media are invented by the military in periods of war, but rather how weaponry and logistic, tactical and strategic conditions serve to catalyze and pressure convergence, reconnection, and innovation in media and that all other cultural deployments serve merely to camouflage a militarization of the minutiae of urban existence' (Goodman 2010, p.32-33). He continues:

> In the mutating logistics of sonic perception, a general tendency in both research and deployments can be detected. The historical drift in the technical deployment of sonic force is marked by a number of parallel phase transitions: from the violence of high amplitude to inaudible or silent frequencies, from discipline and punishment to subtle control through modulation of affective

> tonality, from forcing behaviour to the distribution of "self control," from the messy and unmanageable to the highly directional and targetable, from exceptional deployments to ubiquitous fields or enclaves fortressed by sonic walls, and from music as pleasure to music as irritant. Importantly, this is not a successive history of stages; these modalities of sonic power coexist with each other, often literally in the battlefield (Goodman 2010, p.17).

In her article 'Sonic Assault to Massive Attack: Touch, Sound and Embodiment', Anne Cranny-Francis extends the notion of sound as a colonising force and argues that 'with the history of Waco, of the bombardment of Baghdad and now of Guantanamo Bay prisoners such as Haj Ali reporting the use of sonic torture it is crucial to recognize how sound is being used against individuals and communities to control and colonize them' (Cranny-Francis 2008). She claims that the colonization of hearing by sound 'destroys the individual's sense that s/he has any control of their body, leading to a sense of being dehumanized' (Cranny-Francis 2008). While it may seem that such sonic torture is not as brutal as other sonic weapons and that they in turn are preferable to other more lethal weaponry, accounts of soldiers suffering from shellshock should only be enough evidence of the power of sound to instill fear and, beyond that, deep psychological distress, and therefore the effects of such weapons can be considered nothing other than gravely serious. However, Cranny-Francis suggests somewhat optimistically that 'there are many other uses to which this deconstructive understanding of embodiment might be put, uses which focus on the ways in which this understanding of embodiment, of the relationship between touch and sound, of the relationship between individual and community might be used for purposes that are productive rather than destructive – to generate new understandings rather than to colonize and oppress' (Cranny-Francis 2008). Indeed, as Michel Serres claims, 'noise destroys and horrifies. But order and flat repetition are in the vicinity of death. Noise nourishes a new order. Organization, life and intelligent thought live between order and noise, between disorder and perfect harmony' (Serres 1982b, p.127). Still, as Goodman notes, 'as attention becomes the most highly prized commodity, the sonic war over affective tonality escalates' (Goodman 2010, p.194).

Gradually, after the success of commercial records following the Great Depression and the invention of the long playing record, along with the support of radio, the 'mass produced music' that was made possible by phonography created a culture industry that significantly changed the role of music and sound in society (Attali 2006, p.102). It is, for Attali, 'mass music for an anesthetized market' (Attali 2006, p.105).

> Mass music is thus a powerful factor in consumer integration, interclass leveling, cultural homogenization. It becomes a factor in centralization, cultural normalization and the disappearance of distinctive cultures. Beyond that, it is a means of silencing, a concrete example of commodities speaking in place of people, of the monologue of institutions. A certain usage of the transistor radio silences those who know how to sing; the record bought and/or listened to anesthetizes a part of the body; people stockpile the spectacle of abstract and too often ridiculous minstrels. But silencing requires general infiltration of this music, in addition to its purchase. Therefore, it has replaced natural background noise, invaded and even annulled the noise of machinery. …This situation is not new. After all, Haydn and Mozart's works were almost exclusively background music for an elite who valued them only as a symbol of power. But here power has extended its functions to all of society and music has become background noise for the masses. The music of channelization towards consumption. The music of worldwide repetition. Music for silencing (Attali 2006, p.111).

Phonography, a technology that had the potential to democratise communication, at least to some extent, has gradually become an instrument in the commodification of sound. It has shifted the way people listen to and think about sound. More than any other technology is has become emblematic of recorded sound and as such of sound that is material and available, sound that has become private property. Originally developed to allow a sort of automatic stenography, dreamt of as a democratic technology with a number of applications focused on preservation, the phonograph nonetheless was ultimately used for reproduction and has to a very large extent yielded a culture of repetition. Nevertheless, the severing of individual sounds from specific points in time and space explicates the multiplicity of sound.

Following the image of a ripple on the surface of water, which so powerfully articulated the wave theory of sound, and the work of physiologists and scientists during the Enlightenment that pinpointed sound as occurring when such a wave is perceived, sound has become, since the invention of phonography, unconsciously regarded as material and available, with attention now drawn to the significance of specific sounds. In reaction to this predicament, attempts to investigate the effect that phonography has had on the way we approach sound have often located sound in the process of transduction, the transition between sound and not sound, which is common to all technologies of sound reproduction and manipulation and, indeed, the ear. However, this is a simplification of a complex situation. Phonography has rendered sound schizophonic, emphasizing sound's existence as a multiplicity, and it is impossible to

adequately approach sound by assigning it a specific site at which it occurs. Instead we must turn to an approach to sound that eschews traditional academic epistemology.

Initially reproduced sounds were marketed for their *high fidelity* to *original* sounds. Subsequently, they were denigrated as inferior representations. Now they are just as commonly seen as ontologically identical. However, this approach is based in a epistemology in which the real or true is *seen*, not *heard*, to be that which is singular, discrete and identifiable from a particular epistemic viewpoint and does not account for sound's existence as an individuated cultural artefact. Just like so many developments in the history of the study of sound, theorisations of phonography's effect on sound all too often treat sound as a *thing* that can be located. It is only with the imagination of artists and others that its creative and democratic potential has been realised. More generally the phonograph has contributed to the development of modern notions of attention, allowed sound to be possessed as a marker of identity and, most importantly, laid the foundation for the commodification of sound as a resource. Over the last century sound has been made recordable and thus available but it has also been in that time that there has been a turn to listening and the aural.

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Chapter 4
Listening: Phenomenology, Sense & Experience

> Sound surrounds. Its phenomenal characteristics – the fact that it is invisible, intangible, ephemeral and vibrational – coordinate with the physiology of the ears, to create a perceptual experience profoundly different from the dominant sense of sight…Immersed in sound, the subject loses its self, and, in many ways, loses its sense. Because hearing is not a discrete sense, to hear is also to be touched, both physically and emotionally…these very characteristics rattle the foundations of Western metaphysics and Western culture generally, by questioning the status of the object and the subject, simultaneously. Because of this, the aural has been muted, idealized, ignored, and silenced by the very words used to describe it (Dyson 2009, p.4).
>
> - Frances Dyson

Only in the last century have academics turned their attention to listening to sound, prompted no doubt by a great deal of influences. Once sound could be recorded and manipulated it was heard with fresh ears. After sound was formed from noise, distinct from the voice and music, visualised and commodified it became something of importance. There are now ever increasing numbers of sound theorists around the world. Sound studies is a multi-disciplinary pursuit and so those working in the field can be found in a variety of different faculties, and indeed outside universities in many countries, rather than in specialist departments. As I will show, sound studies is increasing informed by, and indeed can be extended by, contemporary philosophy. However, it has been the arts that have provided the most inspiration for contemporary sound studies. Mirroring the development of phenomenology, a philosophical discourse that focuses on experience of the world, in the twentieth century artists began to experiment with sound, leading to a situation in which the arts assumed dominance in the study of sound.

Often it is argued that contemporary society is opto-centric. More specifically, I believe it is intently focused on a world of *things* that can be seen. Indeed the history of the study of sound supports this argument to some extent. However, contemporary philosophy has challenged that situation in recent years. Still the dominance of the natural standpoint remains and so even if people now pay attention to what they hear, they still place great emphasis on the idea that what they can see is what is real in the world.

As I will show, artists, researchers and theorists such as Pierre Schaeffer, John Cage and R. Murray Schafer have focused their attention very much on the sounds of the world. Interested in specific sounds, each came to their own conclusions but all share an interest in listening as the way to approach sound and have demonstrated the rise of the arts and social sciences as the site of contemporary thought about sound.

Necessarily, given their interest in experience as involving the mind and body as a whole, phenomenologists such as Don Ihde argue that people hear not just with their ears but with their bodies. There is a very real extent to which thinking of hearing and the action of sound in this way challenges fundamental ideas of self and leads to a situation in which people must consider not only how sound acts upon them but how it connects them to others and binds them into the world.

Listening itself is now frequently cited as offering an alternative approach to the world. It suggests the possibility of alternate metaphysics. Nonetheless, a focus on listening, while admirable compared with attempts to understand sound by visualising it, is limited in its scope. Sound has been constructed and what is heard is shaped by thoughts and language as much as what is seen.

The Perception of Sensation

Early in the twentieth century the philosophical method known as phenomenology emerged. It is primarily based on the work of Edmund Husserl, and subsequently Martin Heidegger, and concerned with the study of phenomena and their appearance in acts of consciousness – hence the name phenomenology and its roots in the Greek *phainomenon*, meaning that which appears, and *logos*, meaning study. Importantly, Husserl's phenomenology attempts to surpass what he calls the natural standpoint, the common sense view of the world upon which he argues the sciences are based, which assumes people are subjects situated in a world of things external to them that exist in

their own right (Husserl 1928, p.45 & 96). One of the most influential phenomenologists has been Maurice Merleau-Ponty, whose *Phenomenology of Perception* focuses on the study of perception and its constituents: sense and experience. Frederick Vinton Hunt argues that phenomenological investigation formed the basis of much early scientific discovery:

> In the seventeenth century the study of all branches of physical science was predominantly phenomenological. Falling bodies, swinging pendulums, vibrating strings, and the motion of the planets were for Galileo problems of comparable stature to be attached by similar methods of logical inference based on observations (Hunt 1978, p.141-142).

It is true that modern science was born from the Greek's natural philosophy, which relied greatly upon the empirical but nonetheless experiential study of phenomena. However, phenomenologists are interested not just in the empirical study of phenomena but an investigation of the perception of phenomena. In his own words, Merleau-Ponty did not accept the scientific opinion that 'the real world is not this world of light and colour; it is not the fleshy spectacle which passes before my eyes' and that 'it consists, rather, of the waves and particles which science tells us lie behind these sensory illusions' (Merleau-Ponty 2004, p.32-33). In his book *The World of Perception* he argued:

> If we consult a classical psychology textbook it will tell us that an object is a system of properties which present themselves to our various senses and which are united by an act of intellectual synthesis. For example this lemon is a bulging oval shape with two ends *plus* this yellow colour *plus* this fresh feel *plus* this acidic taste…This analysis, however, is far from satisfactory: it is not clear how each of these properties is bound to the others and yet it seems to us that the lemon is a unified entity of which all these various qualities are merely different manifestations (Merleau-Ponty 2004, p.45).

Merleau-Ponty uses the example of honey to explicate his point, claiming that 'honey is a particular way the world has of acting on me and my body' and 'various attributes do not simply stand side by side but are identical insofar as they all reveal the same way of being or behaving…the unity of the object does not lie behind its qualities, but it is reaffirmed by each one of them: each of its qualities is the whole' (Merleau-Ponty 2004, p.47-48). Similarly to other phenomenologists, he replaces ontology with phenomenology, eschewing the study of essences, common to traditional metaphysics, for one of experiences. Importantly, also, his work is focused on the presence of the body in experience, rather than just that of the mind.

Phenomenologists have attempted to address a perceived imbalance in scientific accounts of sensation due to their focus on the physics of phenomena at the expense of perception. Science, they argue, disposes with questions of perception all too quickly in favour of physical *truth*. Merleau-Ponty asks:

> If I want to know what light is, surely I should ask a physicist; is it not he who can tell me what light really is? Is light, as we once thought, a stream of burning projectiles, or, as others have argued, vibrations in the ether? Or is it, as a more recent theory maintains, a phenomenon that can be classed alongside other forms of electromagnetic radiation? (Merleau-Ponty 2004, p.2).

With none of the answers provided by the sciences seemingly satisfactory, phenomenologists seek to base their understanding of phenomena in the perception of sensation. However, unlike physiologists, for phenomenologists sensation is something experienced by the body and mind as a whole, rather than by discrete bodily processes or organs.

Don Ihde undertakes a detailed phenomenological investigation of sound in his *Listening and Voice: A Phenomenology of Sound*. He argues that 'what is needed is a philosophy of listening' (Ihde 1976, p.15). Ihde posits that 'sound is continuously present to experience' (Ihde 1976, p.80).

> The ocean now resounds with whale songs and shrimp percussion made possible by the extension of listening through electronic amplification. The distant stars, which perhaps are not so thoroughly in a "harmony of the spheres" of the Pythagoreans, nevertheless sputter in the static of radio-astronomy. In our urban environments noise pollution threatens the peace of mind which we now wishfully dream of in terms of quieter eras. It is not merely that the world has suddenly become noisier, or that we can hear farther, or

> even that sound is somehow demandingly pervasive in a technological culture. It is rather that by living with electronic instruments our experience of listening itself is being transformed, and included in this transformation are the ideas we have about the world and ourselves (Ihde 1976, p.5).

Just as the Greek philosophers, the acousticians, mathematicians and physicians of the *Ensoniment* and the fathers of phonography have done previously, phenomenologists seek to establish sound – and all experience – as sensible, existent and knowable. Importantly, however, they do so by replacing ontology with phenomenology, eschewing metaphysics and therefore any attempt to incorporate their approach to sound in the traditional assumptions of academic philosophy, providing a theoretical framework in which sound can be known by being listened to rather than visualised or recorded.

Making Sense

Articulating a commonly held argument, Hans Jonas claims, in *The Nobility of Sight*, that Greek philosophy's opinion of sight as 'the most excellent of the senses' is 'substantiated and at the same time qualified' by his own studies, which find that sight is 'incomplete by itself; it requires the complement of other senses and functions for its cognitive office; its highest virtues are also its essential insufficiencies' (Jonas 1966, p.135-136).

He believes that the 'unique distinction of sight' lies in its ability to support '*simultaneity* in the presentation of a manifold', which suggests a static observable 'persistent existence'; '*neutralization* of the causality of sense-affection', which allows a distinction between experience and action or theory and practice; and '*distance* in the spatial and mental senses' (Jonas 1966, p.136-152). This is, for him the most important of the three, because 'knowledge at a distance is tantamount to foreknowledge' and 'perceptual distance may turn into mental distance, and the phenomenon of disinterested beholding may emerge, this essential ingredient in what we call "objectivity"' (Jonas 1966, p.136-152).

Meanwhile, he suggests that 'the case of hearing is obvious: according to the nature of sound as such it can "give" only dynamic and never static reality', 'the rustling of an animal in the leaves, the footsteps of men, the noise of a passing car, betray the presence of those things by something they do' and that 'things are not by their own nature audible as they are visible; it does not belong to their mere being to emit sound

as it belongs to them to reflect light' (Jonas 1966, p.137 & p.145). However, to bestow things with an imagined essence rather than deal with *reality* as necessarily involving fluidity, change and activity is a mistake. Far from a limitation, sound's ability to bind individuals into a dynamic, manifold, reality is one of its greatest strengths.

In his book *Downcast Eyes: The Denigration of Vision in Twentieth Century French Thought*, in which he analyses theories of vision and twentieth century critiques of their dominance, Martin Jay contends, quite rightly I find, that one of Han Jonas's fundamental claims regarding sight is that it is 'intrinsically less temporal than other senses such as hearing or touch, it thus tends to elevate static Being over dynamic Becoming, fixed essences over ephemeral appearances' (Jay 1993, p.24). Jay goes on to argue, with regard to Greek philosophers' conception of light, that:

> Light could be understood according to the model of geometric rays that Greek optics had privileged, those straight lines studied by catoptrics (the science of reflection) or dioptrics (the science of refraction). Here perfect linear form was seen as the essence of illumination, and it existed whether perceived by the human eye or not. Light in this sense became known as *lumen*. An alternative version of light, known as *lux*, emphasized instead the actual experience of human sight. Here color, shadow and movement were accounted as important as form and outline, if not more so. In the history of painting, as well as optics, these two models of light vied for prominence (Jay 1993, p.29).

This points out that, contrary to Jonas's argument, light is not so different to sound anyway. In making his argument Jonas assumes that things which reflect light somehow do so of themselves more naturally, or essentially, than those which make sound do so and that is not necessarily, or even in any way arguably according to current scientific knowledge, the case. Indeed, it seems that it could be argued that sight, along with hearing, challenges assumptions dominant in the academic metaphysical tradition, but that is beyond my area of expertise and the scope of the exploration I am undertaking here.

As I have mentioned, it is often suggested that contemporary society is opto-centric – indeed this is the focus of Jay's research – and, while this may be true to some extent, it is, I believe, a simplification of the situation. It is not that people are focused on the visual at the expense of either the audible or that which people touch, taste or smell. Evidence of the interest in sound is there in the number of writers, such as myself, studying it. Still, privilege is given to *things* that are *seen* as constituting that which undoubtedly exists. As is demonstrated in Jonas's argument, people *see*, and indeed often write, that which is visible as that which is real.

Synaesthesia, perhaps more than any other example, demonstrates the questionable basis of such an approach. Synaethetes can see colours when they hear sound, or present other crossovers of the senses, and demonstrate that perhaps senses are not so discrete. Vilayanyur S Ramachandran, a neuro-scientist, explains that synaesthesia was first described by Francis Galton in the nineteenth century: 'he pointed out that some people who are perfectly normal in other respects have one peculiar symptom…they get their senses mixed up and that is every time they hear a particular tone they see a particular colour' (Ramachandran 2003). Ramachandran goes on to explain his own thesis that synaesthesia is a result of the nerves physically growing together such that 'maybe in some people there is some accidental cross-wiring' (Ramachandran 2003). Regardless of whether or not that is the case, synaesthesia emphasises the dangers of assigning one sense responsibility for displaying the real. Therefore, there is little sense in a focus on vision such as is often dominant in contemporary society.

Jonathan Sterne claims that Scott's phonautograph, along with other inventions of its time, 'subject visual phenomena to the orderings of time' such that 'through modern physics and acoustics, and through the new relation between science and instrumentation, auditory and visual phenomena could be first isolated and then mixed or made to stand in for one another ' (Sterne 2003, p.50). He goes on to claim that Scott's 'discourse on the phonograph and its successors suggests that this kind of synaesthesia – of mixing codes and perceptible material – is a constitutive feature of technological reproduction of sound and image' (Sterne 2003, p.50). He argues that 'this synaesthesia also directs us toward another tributary current in the history of sound':

> The names for these machines were all hybrids of one sort or another: *phonograph*, *graphophone,* and *gramophone* suggest a mixture between speech and writing; *telephone* suggests the throwing of speech, *radiotelegraphy* and *radiotelephony* suggest the radiation of waves out from a single point. At the

> core of all these transformations (alongside many others) is the isolation, separation, and transformation of the senses themselves. This history of the senses is simultaneously a history of a body – a body made up of functions like the tympanic that could be isolated, transposed, replicated, and *put to use* (Sterne 2003, p.50).

In a very real way the use of these technologies have all extended and changed the human senses, following the work of physiologists in the nineteenth century. However, the technologies are identified with utility and treat the senses as distinct. It is now possible to hear something on the other side of the world, to record an *individual* sound once and broadcast sounds around the world but all these practices are predicated on sounds being individuated and made available.

Potentiality

Exploring the issue of potentiality in his book *Potentialities: Collected Essays in Philosophy*, Giorgio Agamben draws on the thought of Aristotle, who believed that 'there is no sensation of the senses themselves' as 'sensibility is not actual but only potential', to argue that 'what is essential is that potentiality is not simply non-Being, simple privation, but rather the existence of non-Being, the presence of an absence' (Agamben 1999, p.179). Like Aristotle, Agamben is interested in a dialectical construction of potentiality in which possibility is defined in its opposite not by impossibility, but by the possible nonfulfillment of potentiality. Agamben refers to Aristotle's claim that 'the mind [nous] is like a writing tablet on which nothing is actually written', arguing 'the nature of the intellect is such that it is pure potentiality' and so 'nous is thus a potentiality that exists as such, and the metaphor of the writing tablet on which nothing is written expresses the way in which a pure potentiality exists' (Agamben 1999, p.215). According to Agamben:

> In the dark, the eye does not see anything but is, as it were, affected by its own incapacity to see; in the same way, perception here is not the experience of something – a formless being – but rather perception of its own formlessness, the self-affection of potentiality (Agamben 1999, p.217).

Developing this line of thought, Seth Kim Cohen argues 'sense can never be *in-itself*' and 'sense cannot partake of the absolute proximity of self-presence', rather 'sense is awareness of being aware; a conception that finds its most comfortable expression in the reverberant, expanded situation of sound' (Kim-Cohen 2009, p.184). This is

echoed and elaborated upon by Jean-Luc Nancy, who writes 'indeed, as we have known since Aristotle, sensing (*aesthesis*) is always a perception, that is, a feeling-oneself-feel: or, if you prefer, sensing is a subject, or does not sense' (Nancy 2002, p.8). Similarly, Agamben argues that 'between the experience of something and nothing there lies the experience of one's own passivity' and goes on to write, in an echo of Jacques Derrida's language, which I will explain, that 'the trace (typos, okhnos) is from the beginning the name of this self-affection, and what is experienced in this self-affection is the event of matter' (Agamben 1999, p.217).

This can be applied not only to human senses but also to the action of technologies, because comparable to Agamben and Aristotle's account of the potentiality of a sense is the potentiality of technologies. Like the human senses, technologies interpret and manipulate the sensation, or phenomena, of sound; it is not sound *per se* that is recorded on a record, tape or disc but something that has the potential to become sound. In this way technology exists as a sort of independent sense, operating as a filter through which the phenomena of sound passes. Moreover Nancy argues that 'it is perhaps in the sonorous register that this reflected structure is most obviously manifest' (Nancy 2002, p.8). Kim-Cohen goes on to argue that, as Nancy has theorised, 'sound is innately referential' (Kim-Cohen 2009, p.182). Quite rightly, Nancy argues 'one can say then, at least, that meaning and sound share the space of referral' in which at the same time they refer to each other and so 'a *self* is nothing other than a form or function of referral: a *self* is made of a relationship to a *self*' (Nancy 2002, p.182). Listening subjects should, therefore, themselves be considered multiple and various in their experience. That is, any phenomenological coherence attributed to such subjects is, like that attributed to sound, imposed rather than inherent. Just like sound people themselves are a product of difference; no more or less defined than everything else around them. It only through differentiation that things, including people, are considered different. Still, bound up in their own ability to sense, people cannot remove their selves from the situation.

Let Sounds Be Themselves

According to Dyson, 'John Cage, Pierre Schaeffer, and R. Murray Schafer have been, with their respective philosophical methods of "non-intentionality," "acousmatic listening," and "clairaudience," central to the developing phenomenology of sound, and they initiated discussions of the relationship between the visual object, the sound object and audio technology' (Dyson 2009, p.55). Each, it could be argued, has tried to approach sound on its own terms, however with variously problematic results.

Although each has contributed to the development of a phenomenology of sounds, Cage's urge to 'let sounds be themselves', Schaeffer's *objet sonore* and Schafer's acoustic ecology have led each of them to ontologically define individual sounds. In doing so, they have attempted to record, broadcast or otherwise control those sounds, making them available for their own ends as artists, researchers and academics, while also silencing some aspects of those sounds or the possibility of other sounds.

Famously, Cage called on the composer to 'give up the desire to control sound, clear his mind of music, and set about discovering means to let sounds be themselves rather than vehicles for man made theories or expressions of human sentiments' (Cage 1973, p.10). He notes, in his book *Silence*, that many composers object to the use of the term *experimental music* to define their work but, while he accepts their reasons – such as that while they may experiment when making their work the result is very much determined – he believes that 'where, on the other hand, attention moves towards the observation and audition of many things at once, including those that are environmental – becomes, that is, inclusive rather than exclusive – no question of making, in the sense of forming understandable structures, can arise (one is tourist), and here the word "experimental" is apt, providing it is understood not as descriptive of an act to be later judged in terms of success and failure, but simply as of an act the outcome of which is unknown' (Cage 1973, p.13).

Importantly, Cage's early theories emphasising duration as the *correct* basis of a structure for music, as opposed to pitch, timbre of loudness, because it is the only characteristic common to both sound and silence, imply that musical composition should correspond to what he perceived to be the nature of sound (Dyson 2009, p.60). However, as Alan Licht notes in his book *Sound Art: Beyond Music, Between Categories* that 'Cage's love of nature and all sounds still frames them either as a natural resource to be harnessed by the composer, or as humanist aural spillover from civilization' (Licht 2007, p.218).

Cage's interest in letting sounds be themselves paralleled his use of technologies such as the microphone, radio and amplification to access new sounds that he could use in his compositions. It is an important idea but nonetheless one that is perhaps not as noble as often thought; generally Cage and others have let sounds be themselves only when they consider them as being important in some way, once more demonstrating approaches to sound that regard it as an available resource.

The Objet Sonore

It wasn't until Schaeffer's *musique concrète* project in France in the late 1940s presented a concerted attempt to work directly with sound that ideas of sound technologies as purely mimetic in function were directly and significantly challenged in the arts. He felt music was in need of revitalization and was inspired to look to the world of everyday sounds. Schaeffer suggested the possibility of a 'music without adjectives', through working with the manipulation of everyday sounds to produce a formalised music of sound structures ignorant of objective representation and semiotics (Russcol 1972, p.85). Significantly, *Étude aux Chemins de Fer*, perhaps his most famous work, was composed using the sounds of trains, demonstrating the same regard for them as a mode of transport synonymous with modernism that had made them so disturbing to Henry David Thoreau and others in the nineteenth century. Schaeffer's acousmatic approach, named for Pythagoras's practice of teaching from behind a screen, involved the source of sound being theoretically unknown to the listener, who would hear it from a loudspeaker. Subsequently this practice was extended such that in concert artists would perform from the back of the room in a dark space. Interviewed in 1986 by Tim Hodgkinson, Schaeffer explained:

> You have two sources for sound: noises, which always tell you something – a door cracking, a dog barking, the thunder, the storm; and then you have instruments. An instrument tells you, la-la-la-la (sings a scale). Music has to find a passage between noises and instruments. It has to escape. It has to find *a compromise and an evasion* at the same time; something that would not be dramatic because that has no interest to us, but something that would be more interesting than sounds like Do-Re-Mi-Fa (Hodgkinson 1987).

Particularly central to the musique concrète project was the notion of the sonic object, or *objet sonore* as an individual sound. Schaeffer defines, in *Acousmatics*, the *objet sonore* not for what it is but what is not, which includes the instrument, the magnetic tape or a state of mind (Schaeffer 2006, p.79-81). Unlike the classical musical tradition, in which compositions were based on parameters such as pitch and duration, musique concrète pieces were based on the manipulation of sound objects. Schaeffer offered:

> The composer of musique concrète, takes at his point of departure the *objets sonores*, the sound objects, which are the equivalent of visual images, and which therefore alter the procedures of musical composition completely…The *concrete* experiment in music consists of building sonorous objects, not with the play of numbers and seconds of the metronome, but with *pieces of time torn from the cosmos* (these pieces of time being grooves on records) (Russcol 1972, p.85).

Brian Kane conducts a reading of Schaeffer's *Traité des object musicaux* in his paper 'L'Objet Sonore Maintenant: Pierre Schaeffer, sound objects and the phenomenological reduction' and analyses the relationship between the objet sonore and Husserl's phenomenology. He translates Schaeffer's assertion that 'for years, we often did phenomenology without knowing it, which is much better than talking about phenomenology without practising it' and argues that the *objet sonore* is an intentional object, which echoes Husserl's thought and, as a result of the synthesis of its perceived qualities, is transcendent to perception – that is, it necessarily involves conception and is not merely phenomenal (Kane 2003, p.15-16). Consequently, he suggests that 'for Schaeffer, the natural standpoint must be overcome if we are ever to uncover the grounding of our musical practices' and 'by bracketing out the physically subsisting fact-world, by allowing us to make no judgments in relation to it, and by leaving us only with perceptual experience in itself, hearing can no longer be characterised as a subjective deformation in relation to external things' (Kane 2003, p.17). Instead, he argues, 'listening become a sphere of investigation containing it's own immanent logic, structure and objectivity' (Kane 2003, p.17). Ultimately with such an approach listening must be considered an active activity and the *objet sonore* itself, as an idealised instance of sound, based in experience.

Eventually Schaeffer considered musique concrète a failure because he felt he was unable to use sounds in such a way that they would be heard as themselves rather than as signifiers or musical notes. However, as Claude Levi Strauss argues in his essay 'The Raw and the Cooked', 'by rejecting musical sounds and restricting itself exclusively to noises, musique concrète puts itself into a situation that is comparable to, from the formal point of view, that of painting of whatever kind; it is in **immediate** [emphasis in original] communion with the given phenomena of nature' (Levi-Strauss 1969, p.22-23). Just like Cage, Schaeffer was explicitly interested in the nature of sound and approached his work as experimental research. Dyson argues that:

> Despite his desultory estimation of his project some years later, there remains within the text the residual promise of not human but technological perception, which not only provides a context, or mediation, between the sound-in-itself and its perception, but creates new *forms* of perception and indeed new acoustic phenomena…Schaeffer unties nature and technology in an electronically geared vitalism. But more importantly, he reaches into aurality and the unknowable reality it represents and transforms it into a phenomenon than can be known through a prosthetic ear. Although this transformation occurs through technology, its real import is metaphysical: new, strictly audiophonic phenomena are created, having the same ontological status as nonrecorded acoustic sounds, and these sounds are perceived through a new acousmatic listening, which in turn creates new epistemic conditions (Dyson 2009, p.58).

Fundamentally the conception of the *objet sonore* makes individual sounds into things that are available to the composer and as such it represents an idealised example of sound – like the voice, sine tone and high fidelity recording before it – notable particularly for being far more clearly conceptually based than the others. Intrinsically it involves approaching sound, and specifically a multiplicity of individual sounds, as singular, discrete and located. However, importantly, it offers an extremely flexible way of locating and knowing sounds that does not privilege *originals* over copies.

Silence

It is Cage who is most well known for investigating silence. He used it his compositions, such as the notorious *4'33"*, and wrote about it extensively. Perhaps the earliest documented evidence of Cage's interest in silence lies in his proposed but never realised piece *Silent Prayer,* which he articulated as consisting of about four and half minutes of silence broadcast on the Muzak system (Gann 2010, p.128&177). It seems he chose that length because it is roughly the length of one side of a 78 rpm record, which is what the company used at the time, and demonstrated the influence of the format (Gann 2010, p.128). Importantly, however, at the time he proposed the piece in 1948 it seems he planned it to be a kind of silent meditation for listeners and, as Kyle Gann notes, 'in order to reach *4'33"* from *Silent Prayer*; Cage needed to go through experiences that would lead from attempting to listen to *nothing* to redefining silence as being not *nothing*, but *something*' (Gann 2010, p.127) During a visit to an anechoic chamber Cage had just such an opportunity and discovered that what he

thought was silence was in fact a whole world of new sounds just beyond the reach of the human ear. He exclaimed:

> There is always something to see, something to hear. In fact, try as we may to make silence, we cannot. For certain engineering purposes, it is desirable to have as silent a situation as possible. Such a room is called an anechoic chamber, its six walls made of special material, a room without echoes. I entered one at Harvard University several years ago and heard two sounds, one high and one low. When I described them to the engineer in charge, he informed me that the high one was my nervous system in operation, the low one my blood in circulation. Until I die there will be sounds. And they will continue following my death (Cage 1973, p.8).

There is debate about the science of Cage's claim – Peter Gena for one argues that humans cannot in fact hear the operation of their nervous system nor indeed, normally, their blood in circulation and suggests that Cage may simply have suffered from tinnitus – but as Kyle Gann notes 'medical fact leaves Cage's basic point unscathed: our bodies do produce sounds of their own, and in the vast continuum of human experience true silence is virtually unknown' (Gann 2010, p164). Inspired by the possibilities around him, Cage employed amplification, microphones and loudspeakers to render audible previously unheard sounds, from his own vital signs to all the vibrational resources of the world (Kahn 2001, p.192). Henceforth, Cage's interest in, to use his own words 'the physicality of sound and activity of listening', can, like Schafer's work, be described as phenomenological (Gann 2010, p.88).

Having decided that absolute silence does not exist, Cage approached silence as the absence of intention, most often articulated with the example of music, which is why silence is for him a chance to hear life. Silence, approached in way, rather than being the opposite of sound, which is for Cage omnipresent, replaces noise as the label for everything that is not intended sound.

> The anechoic chamber certified for Cage the impossibility of silence by becoming a padded cell for the refractory sound of his own irrepressible vital signs; however, he resisted transposing the conventional figure of silence split between presence and absence of sound, which he was in the process of abandoning forever, into a presence and absence of life and death' (Kahn 2001, p.191).

Apart from setting into motion sound's rise in contemporary arts and the acceptance, however reluctantly by some, of *all sound* into the contemporary musical palette, his ideas have subsequently left those that follow to deal with the implications of a world where there is *always sound*. Cage became fascinated with the notion of *always sound*, an idea that he extended 'outside the operations of his body to hear the vibrations of matter' such that 'sound was no longer tied to events but existed as a continuous state as it resonated from each and every atom' and realized that 'everything always made a sound, and everything could be heard' (Kahn 2001, p.159). Just as Kahn argues:

> This was a very important moment since it was here that *all sound* was joined to *always sound*. He went further still to rhetorically use the promise of technology to extend *all sound* and *always sound* outside the operations of his body to hear the vibrations of matter. Thus, sound was no longer tied to events but existed as a continuous state as it resonated from each and every atom. This certainly tipped the balance of the senses the other way since where one might expect night to remove light and give vision a rest, aurality would still exist. (Kahn 2001, p.159).

People often discuss sound as if it exists in a distinct place and often identify individual sounds based on their source but sound does not exist in such a way. How is it possible to define the border between one sound and another? It is impossible, or at the very least requires much simplification.

4'33" was premiered at the Maverick Concert Hall in Woodstock, New York on August 29, 1952 (Gann 2010, p.2-3). It was written using an indeterminate process involving the ancient Chinese text the *I-Ching* that Cage had developed and employed for determining the pitches, dynamics and durations in his previous work *Music of Changes*. However, as he had already decided that the piece would be silent, indeterminate procedures were used only to determine the duration of the piece (Gann 2010, p.174). Interestingly, Cage claims to have used the process to build up each movement from shorter silences until he arrived at *4'33"* for the entire piece (Gann 2010, p.174-175). This suggests that perhaps he had already planned the piece to be approximately that length, which seems likely given its parallels with *Silent Prayer* (Gann 2010, p.128&177). Also, it demonstrated his theory that 'there can be no right making of music that does not structure itself from the very roots of sound and silence – lengths of time' (Cage 1970, p.81-82).

Nevertheless Cage's process indicates that ultimately, for him, the piece is based on non-intentionality and the fundamental characteristic of it is duration. According to the program, on the night the durations of the individual movements were 30", 2'23" and 1'40" but when published the score stated the lengths of the three movements at premiere were 33", 2'40" and 1'20" (Gann 2010, p.186). Overall, Cage published three different scores of *4'33"*, culminating in the version published by C.F Peters in 1961 that replaces all musical notation with the use of the term *tacet* – which means 'be silent' - and states that 'the work may be performed by any instrumentalist or combination of instrumentalists and last any length of time' (Gann 2010, p.176-187). This demonstrates clearly that Cage's thinking about the piece changed over the years and, in fact, he eventually made comments which indicated that he considered the piece, as Gann writes, 'simply an act of listening' and as such it did not even need a performer (Gann 2010, p.186).

Despite the emancipatory rhetoric Cage employed, as is noted by Kahn, 'silencing would, in fact, run concurrently with his progressive opening up to all sound, and at the most fundamental level, it would entail a silencing of the social and ecological within an ever expanding domain of music' (Kahn 2001, p.159-160). Quoted, at length, in Kyle Gann's *No Such Thing as Silence: John Cage's 4'33"*, Kahn remarks about performances of the piece:

> Ostensibly, even an audience comprised of reverential listeners would have plenty to hear, but in every performance I've attended the silence has been broken by the audience and become ironically noisy. It should be noted that each performance was held in a concert setting, where any muttering of clearing one's throat, let alone heckling, was a breach of decorum. Thus, there was already in place in these setting, as in other settings for Western art music, a culturally specific mandate to be silent, a mandate regulating the behavior that precedes and accompanies the musical performance…*4'33"*, by tacitly instructing the performer to remain quiet in *all* respects, muted the site of centralised and privileged utterance, disrupted the unspoken audience code to remain unspoken, transposed the performance onto the audience members both in their utterances and in the acts of shifting perception toward other sounds, and legitimated bad behavior that in any number of other settings (including musical ones) would have been perfectly acceptable. *4'33"* achieved this involution through the act of silencing the performer. That is, Cagean silence followed and was dependent on a silencing. Indeed, it can also be understood that he extended the decorum of silencing by extending the silence imposed on the audience to the performer, asking the audience to continue to be obedient

> listeners and not to engage in utterances that would distract them from shifting their perception toward other sounds (Gann 2010, p.19-19).

Just as Gann notes, *4'33"* 'called upon the audience members to remain obediently silent under unusual conditions' and 'the pianist's refusal to play calls a whole network of social connections into question and is likely to be reflected in equally unconventional responses on the part of the audience' (Gann 2010, p.19). Similarly, the bars of silence in his work that allow everyday sounds to be considered music in doing so strip them of all other meaning and significance.

Gann argues that 'clearly *4'33"* is one of those pieces that has transcended the esoteric realm of the avant-garde to become famous among people who know almost nothing of its context, an emblem of Zen, of Dada, of American contrariness, of Cage's gentle humor' such that while '*4'33"* is often misunderstood – by people who've never heard it, who know nothing about Cage and have no interest in modern music' and '*4'33"* is commonly derided as a joke, a provocation…by the time Cage died most critics fully understood that the listener was supposed to appreciate the sounds of the environment in which the piece was performed – and if even the critics got it, the interested public was probably even better informed' (Gann 2010, p.206-213).

Analysing the work of Yoko Ono, and in particular a piece involving the recording of the sound of snow falling on tape that in turn is used to tie bows on gifts, Kahn suggests, contrat to Cage's practice, that in Ono's work 'there is no denial that silence exists' but 'on the contrary there is an acknowledgement of a multitude of silences' (Kahn 2001, p.240). He argues that 'whereas Cage carried the promise of technology forward to the point where there was no such thing as silence, where inaudibility was impossible and all matter was sonorous, Fluxus played at the delicate threshold of audibility and then edged over into a liminality of conceptual dimensions whose impossibility was left to flourish in its own right' (Kahn 2001, p.236).

Necessarily if sound is to be approached as multiple then the same must be done with silence. It is easy to argue that silence does not exist but such an approach does not account for the specific and multiple silences in the world. For example, silence is something that Cage used in his work, it may not have been absolute silence but that does not make it insignificant in that it constituted the prescribed absence of intentional sound. Silence then becomes ontologically indistinguishable from noise – although not wholly, or necessarily entirely, contiguous with it. Indeed, Cage himself famously wrote in his essay *The Future of Music: Credo*, delivered as a talk in 1937 and included in his book *Silence*:

> I believe that the use of noise to make music will continue and increase until we reach a music produced through the aid of electrical instruments which will make available for musical purposes any and all sounds that can be heard…Whereas, in the past the point of disagreement has been between dissonance and consonance, it will be, in the immediate future, between noise and so-called musical sounds (Cage 1973, p.3-4).

There is more specific and directed silencing present in Cage's latter work, and that is the silencing of loud sounds. In his 'Lecture on Nothing' he wrote 'half-intellectually and half sentimentally, when the war came along, I decided to use only quiet sounds' (Cage 1973, p.117). This is interesting to note given the significance of war and accompanying military spending and activity in fueling the development of sound technologies and extending the use of, often loud, sound as a resource, which I have already mentioned. Cage explained 'there seemed to be no truth, no good, in anything in society' (Cage 1973, p.117).

Silence for others, meanwhile, like sound, serves as a metaphor to critique metaphysics itself (Dyson 2009, p.95). Dyson argues that 'silence infers a subject that, in a trivial sense, exists outside or beyond the world (since the world is all sound and noise)' and 'like the aural metaphor generally silence is a wonderful compositional device: moving across metaphysics, music and phenomena, its abstract yet paradoxical permutations create a space that can remain transcendental and absolute while still very much "in the world"' (Dyson 2009, p.103).

Offering such an opinion of silence, R. Murray Schafer believes that 'man likes to make sounds to remind himself he is not alone' and 'from this point of view total silence is the rejection of the human personality' (Schafer 1994, p.262). As a result he believes that 'man fears the absence of sound as he fears the absence of life' (Schafer 1994, p.262). Inevitably, as the ultimate silence is death, 'since modern man fears death as none before him, he avoids silence to nourish his fantasy of perpetual life' (Schafer 1994, p.262). Schafer argues:

> Can silence be heard? Yes, if we extend our consciousness outward to the universe and eternity, we could hear silence. Through the practice of contemplation, little by little, the muscles and the mind relax and the whole body opens out to become an ear (Schafer 1994, p.262).

Although I am not inclined to accept the mysticism of his claims, I believe that, contextualised by the rest of his work, Schafer's conclusion points to a panaurality of the kind theorised by Kahn. Schafer's is an approach for which hearing is constant, regardless of whether there is anything to hear.

Jacques Derrida, meanwhile, uses silence to develop his term *différance,* which, in French, refers both to defer and to differ, although it does concretely mean both or either. Alan Bass explains in his translation of *Writing and Difference* of *différance*, 'its meanings are too multiple to be explained here fully, but we may note briefly that the word combines in neither the active nor the passive voice the coincidence of meanings in the verb *différer*: to differ (in space) an to defer (to put off in time, to postpone presence). Thus, it does not function simply either as difference (difference) or *différance* in the usual sense (deferral), and plays on both meanings at once' (Derrida 2002, p.xvii-xviii). As Dyson suggests, 'silence – or for Derrida perhaps – a *petit* silence, a soft sound, a semi-dysfunctional ear creates a dynamic that opens metaphysics to *différance* and interferes with its solipsistic circuitry' (Dyson 2009, p.102). Dyson notes that 'because in French, the *a* of *différance* can be inscribed on the page, but not heard in speech, *différance* is constituted by silence, but it is a silence formed from the oscillation between hearing and seeing, speech and writing, that is revealed through an absence or gap: the "silence" of the trace' (Dyson 2009, p.96).

Actually Derrida himself writes, in *Circumfessions*, of suffering from otitis of the tympanum as a child and notions of silence seems to have greatly influenced his metaphysics of presence (Bennington & Derrida 1993, p.117-118). Importantly *différance* 'is not a force but what makes force possible while dividing it – there are only forces and differences in the plural' (Bennington & Derrida 1993, p.84). If 'every element in the system gets its identity in its difference from the other elements, every element is in this way marked by all those it is not: it thus bears the trace of those elements' and 'every trace is the trace of a trace' (Bennington & Derrida 1993, p.74-75). A metaphysics based on *différance* requires that 'no element is anywhere present (nor simply absent), there are only traces' and 'these traces are not, as the word might suggest traces of a presence or the passage of a presence' (Bennington & Derrida 1993, p.75). Silence is thus conceivable as a trace of noise and noise a trace of sound, all traces echoing in multiplicity.

Touch at a Distance

R. Murray Schafer suggests, in his book *The Soundscape: Our Sonic Environment and the Tuning of the World,* that 'hearing is a way of touching at a distance' (Schafer 1994, p.11). Eschewing the accepted separation of the senses, his suggestion – while scientifically supported, given that physics defines sound as a pressure wave and such waves can be felt when at low enough frequencies – articulates the intimacy of sound. Sound touches us, not just physically but emotionally and intellectually – involving vibration but not based solely in it. Moreover, in the book, Schafer outlines the multidisciplinary field acoustic ecology, itself very important in the development of new approaches to sound, arguing that 'ecology is the study of the relationship between living organisms and their environment' and so 'acoustic ecology is therefore the study of sounds in relationship to life and society' (Schafer 1994, p.11).

Schafer is concerned with the level of noise in the world and argues that 'the very emergence of noise pollution as a topic of public concern testifies to the fact that modern man is at last becoming concerned to clean the sludge out of his ears and regain the talent for clairaudience – clean hearing' (Schafer 1994, p.11). He claims that 'the largest noises in the world today are technological' and outlines a number of practices that, as aspects of acoustic ecology, he believes will help people to become better listeners, be more aware of their auditory environment and, in turn, mindful of it (Schafer 1994, p.11). These include *clairaudience*, ear cleaning, and sound walks – all designed to improve peoples' ability to listen – and, significantly, through the World Soundscape Project, the practice of identifying, cataloguing and even recording culturally important, rare and endangered sounds, which he terms *soundmarks* (Schafer 1994, p.11).

This approach, as I have mentioned, ultimately leads him to an anti-noise position from which he hears the noise of humanity and particularly industry as somehow unnatural and therefore inherently destructive. While I share his concern for the sonic environment, it seems to me important to recognise humankind's place in that environment and avoid simplistic distinctions between natural sound and noise. As 'the study of sounds in relationship to life and society' acoustic ecology represents an encouraging attempt to approach sound in a more relational way which accounts for its entanglement with subjects (Schafer 1994, p.11). Still, despite his arguably noble intentions, like Cage and Schaeffer, his project represents an attempt to isolate, amplify and control particular sounds.

Sound and the Body

In keeping with Schafer's suggestion that hearing is actually touch at a distance, Ihde claims that 'phenomenologically I do not hear with my ears, I *hear* with my whole body' (Ihde 1976, p.45). He argues:

> Sound permeates and penetrates my bodily being. It is implicated from the highest reaches of my intelligence which embodies itself in language to the most primitive needs of standing upright through the sense of balance, which I directly know lies in the inner ear. Its bodily involvement comprises the range from soothing pleasure to the point of insanity in the continuum of possible sound in music and noise. Listening begins by being bodily global in its effects (Ihde 1976, p.45).

Similarly, Dyson's argument that 'hearing is not a discrete sense, to hear is also to be touched, both physically and emotionally' in many ways follows the work of Schafer that I have mentioned (Dyson 2009, p.4). The significance of the role of the body in phenomenology cannot be underestimated and so, for phenomenologists, people hear with their whole body.

Just as Ihde notes, 'I feel and take for granted the sounds which I hear returning from my voice. This also gives me a sense of how correctly I may be projecting or enunciating. But it may be that I fail to notice, until provided with the auditory mirror of a tape recorder, that I do not hear myself as others hear me nor do they hear me as I hear myself…this self-resonance which I take for granted does not appear on the tape, and I am initially surprised at the "thinness" and the "higher tone" my voice has on the recording' (Ihde 1976, p.138). Ihde notes that 'the same is the case in the presence of my "inner voice" which "thinks" in a language' (Ihde 1976, p.138). However, as Dyson argues, 'the voice has had to undergo a prior refinement – the transmission of sound into speech – utterance into language. In this process, a metaphysical filter has been engineered, allowing sound – as an abstraction – to occupy both natural and cultural realms simultaneously, and turning the voice into an instrument – separate from the body and the world in which it speaks' (Dyson 2009, p.8). Inevitably, 'sound disappears into the voice' (Dyson 2009, p.9).

People hear and experience sound with their bodies and minds but no longer can they remain convinced by the way they hear themselves. Ultimately, despite individual perceptions, voices have become in some sense distinct from bodies and, considered alongside the suggestion that hearing is something people do with their whole bodies, this brings the possibility of discrete selves into question.

Listening

Jean-Luc Nancy takes the phenomenological focus on listening one step further and asks in his book *Listening*, if 'the major concern of philosophy has been found in the appearance or manifestation of being, in a "phenomenology," the ultimate truth of the phenomenon (as something that appears as precisely distinct as possible from everything that has already appeared and, consequently, too, as something that disappears), shouldn't truth "itself," as transitivity and incessant transition of a continual coming and going, be listened to rather than seen?' (Nancy 2002, p.3-4). It is a question especially relevant when undertaking the study of sound. The French word *entendre*, which means 'to hear', also means 'to understand' and indeed *sense* itself also carries connotation of meaning (Nancy 2002, p.6). Here lies an alternative to the *eidomai* of the Greeks.

Over the last fifty years a great number of artists, researchers and theorists have turned their attention to listening as a practice and basis for understanding sound. This is an important step because it represents a meaningful attempt not only to move beyond earlier theories about sound and, perhaps even more importantly, the need to render sound observable and so knowable and real, but an attempt to question the underlying assumptions of the metaphysics that inform approaches to sound. Still, to approach sound as that which can be heard, and even more so, only by listening, is problematic. Sound is not just something that is heard, even if an expanded notion of hearing as a process that involves bodies is employed, as people think and write sound as much as hear or speak it. This is demonstrated when sound's mnemonic qualities are considered. In their book *Sonic Experience: A Guide to Everyday Sounds*, Francois Augoyard and Henri Torgue describe the way in which a memory can be triggered by sound and, equally, a previously heard sound can be imagined, naming the occurrences *anamnesis* and *phonomenesis* respectively (Augoyard & Torgue 2005, p.21). Therefore it is not possible for sound, considered in its entirety, to be purely conceptual, perceptual or social. Sound necessarily crosses and relates all these spaces.

When discussing listening, it has become common to speak of the *immersion* of sound as way or articulating its presence around individuals. Understandably the image of immersion, as if under water, is powerful, but I believe it is limited in its ability to explain how sound acts on subjects. Dyson analyses the term immersion and writes 'immersed in sound, the subject loses its self, and, in many ways, loses its sense', a statement that points towards a new approach to sound (Dyson 2009, p.4). Specifically, Dyson claims that theory around sound and in particular the terms immersion and embodiment have been used somewhat haphazardly to theorise the virtual. Attempting to offer an alternative, she listens to sound as a way to develop a framework with which to theorise new media. She argues that her book *Sounding New Media: Immersion and Embodiment in the Arts and Culture* 'aims first and foremost to expose the cultural and philosophical mechanisms – those built from audio technology, artistic practice, and, most important, the philosophy (or rather non-philosophy) of aurality that circulate like rumors, like noise, in the tropes of immersion and embodiment' (Dyson 2009, p.7). Sound acts on people in such a way that their sense of self is challenged. Sound moves constantly through the world and so doing demonstrates the fluidity of that which is generally assumed solid and distinct. However, immersion is a problematic term. Just as Dyson points out in respect to digital media, the term immersion makes it possible to conceal 'social and technological interventions and delimitations' that mediate experience (Dyson 2009, p.6). Sound does not only surround, it does not only immerse, it acts on and binds into the world but does not do so immediately. It penetrates visible barriers, refracts around corners and echoes into perception.

Usefully, Dyson suggests *atmosphere* as an alternative to embodiment, writing 'the body has given way to the atmosphere – the resonant, information-filled atmosphere as the site for technological deployment' and continues: 'like the aural, the atmospheric suggests a relationship not only with the body in its immediate space but with a permeable body integrated within, and subject to, a global system: one that combines the air we breathe, the weather we feel, the pulse and waves of the electromagnetic spectrum that subtends and enables technologies' (Dyson 2009, p.17). Atmosphere, she claims, is 'evocative of affective states within social situations' and this quality makes it an interesting approach (Dyson 2009, p.17). Just as she writes, 'thinking of atmospheres also returns us to the breath, the continuous and necessary exchange between subject and environment, a movement that forms a multiplicity existing within the space necessary for sound to sound, and for Being, in whatever form, to resonate' (Dyson 2009, p.17).

Developing a similar line of thought, Brandon LaBelle suggests that 'distraction may act as a productive model for recognizing all that surrounds the primary event of sound – *to suddenly hear what is usually out of earshot*' (LaBelle 2010, p.184). He writes:

> Often sound is what lends to directing our visual focus – we hear something and this tells us where to look; it eases around us in a flow of energy to which we unconsciously respond. Sounds are associated with their original source, while also becoming their own thing, separate and constantly blending with other sounds, thereby continually moving in and out of focus and clarity (LaBelle 2010,p.xix).

Just as LaBelle recognises, 'listening situates us within a relational frame whose focus, clarity and directness are endlessly supplemented and displaced by the subtle pulse, mishearings, and fragmentary richness of relating' (LaBelle 2010,p.182).

The Horizon of Sound

Ihde argues that metaphysics makes a leap in assuming that there is reality beyond experience and therefore that 'it is the appearance of horizons that occasions this first word of metaphysics' (Ihde 1976, p.105). He calls for a 'descriptive ontology' of sound that examines the 'horizon' of sound (Ihde 1976, p.15). Interestingly he claims that 'the invisible is the horizon of sight' and that correspondingly 'silence is the horizon of sound' (Ihde 1976, p.51). It is clear, however, through the example of Cage that it has already been possible for people to experience sounds that they were previously unable to hear and it is not possible to hear absolute silence, even if the horizon of sound is an imagined *silence*. It follows, therefore, that the horizon of hearing must be inaudibility – a horizon that is continually disappearing into the distance with the development of new technologies.

Due to the existence of a horizon of experience and the knowledge that such a horizon continues to move into the distance, it is necessary for people to both perceive and conceive sound. The possibility of hearing new sounds alone – something I imagine most people have experienced in some way – demonstrates the importance of considering the inaudible and potential when discussing sound. The horizon of sound of which Ihde speaks is constantly in negotiation, and it is through a focus on that process, the ontological definition of sound, that sound has been rendered knowable. However, necessarily such an approach does not consider sound as existing in any way beyond direct experience or address the difficulties associated with any notion

that sound somehow possesses an essence. Also, any phenomenology of hearing depends a great deal on who or what is idealised as the hearer. Generally in the academic tradition the standardised notion of a human hearer that hears frequencies ranging from 20Hz to 20kHz dominates but, of course, this should not be assumed.

Seth Kim-Cohen's book *In the Blink of An Ear: Towards a Non-Cochlear Sonic Art* is, for him, 'an effort to replace, or at least to supplement, the available options with a listening *about* sound' and his conception of 'a non-cochlear sonic art seeks to replace the solidity of *objet sonore*, of sound-in-itself, with the discursiveness of a conceptual sonic practice' (Kim-Cohen 2009, p.217). More broadly, he argues for an expanded notion of the sonic. He writes:

> A non-cochlear sonic art moves beyond the territory of the ear, resisting sound-in-itself…opposing not the focus on materiality as the central issue but the notion of a central issue. A non-cochlear sonic art does not accept the resolution of sound-in-itself – not because it seeks another kind of resolution, but because it denies the possibility of resolution, ipso facto. Thinking through the epistemological implications of sonic practice since 1948, it is apparent that resolution is not forthcoming. One can choose to move inward, toward the center, toward the essential, fundamental concerns of the field. Or one can choose to move outward, away from the centre, toward that which lies beyond the traditional borders of the field (Kim-Cohen 2009, p.259-261).

He believes that 'in order to hear everything sound has to offer, we'll have to adjust the volume of the ear, listening not *at* or *out* the window, but *about* the window. After all, about the window is the world' (Kim-Cohen 2009, p.262). The metaphor of the window refers to the *horizon* of sound but importantly it is a conception of sound that is necessarily framed and so involves explicit boundaries, which he argues people must listen beyond.

The word *about* here is of particular significance. If Kim-Cohen's window is the horizon, or frame, of sound then he argues that what is important is not what is on either side of the window or indeed the details of the window itself but what is about the window. Importantly, for Kim-Cohen, the *window* is a conceptual one and does not imply a specific site, such as transduction, where sound occurs. Ultimately this implies both a focus on the context and movement of sound. It is a sentiment that is echoed and extended by Michel Serres when he argues:

> I only really live outside of myself; outside of myself I think; meditate, know; outside of myself I receive what is given, enduringly; I invent outside of myself. Outside of myself, I exist, as does the world. Outside of my verbose flesh, I am on the side of the world. The ear knows this distance all too well. I can put it out the window, project it far away, hold it distant from my body (Serres 2008, p.94).

Here he suggests that hearing reaches across distance, giving access to the world and, in a very important way, to each individual themselves. Nonetheless, the image of the window, precisely because it is visual and appeals to peoples' sense of sight rather than their ability to hear, is somewhat inadequate. The study of sound has been focused on the 'horizon' of sound, whether it is referred to as such or as transduction, the threshold of inaudibility or a window, and so it teaches listeners about the liminal space that delineates individuals from the world around them. However, such visual tropes are limited in their ability to explain sound, and to whatever extent there is a horizon of sound it is not one that exists in a specific site.

There are many ways in which people can approach sound and it is not necessary to choose just one of them. Ihde suggests a more cross-disciplinary approach to sound and argues 'the philosopher, concerned with comprehensiveness, must eventually call for attention to the *word as soundful*. On the other side, the sciences that attend to the soundful, from phonetics to acoustics, do so as if the sound were bare and empty of significance in a physics of the soundful. And the philosopher, concerned with the roots of reflection in human experience, must eventually also listen to the *sounds as meaningful*' (Ihde 1976, p.4).

Hans Ulricht Gumbrecht seeks in his book *Productions of Presence*: *What Meaning Cannot Convey* 'to make a pledge against the tendency in contemporary culture to abandon and even forget the possibility of a presence-based relationship to the world' and in doing so offers a way to think as Ihde suggests (Gumbrecht 2004, p.xiv-xv). He argues for 'a relation to the things of the world that could oscillate between presence effects and meaning effects' because he is disturbed at 'the systematic bracketing of presence; and the uncontested centrality of interpretation in the academic disciplines called "the humanities and arts"' (Gumbrecht 2004, p.xv). He believes that 'every human contact with things of the world contains both a meaning and a presence component' and 'the tension/oscillation between presence effects and meaning effect endows the object of aesthetic experience with a component of provocative instability and unrest' (Gumbrecht 2004, p.108-109). However, importantly, he acknowledges, influenced by the work of Nancy, that 'those presence effects that we live are always already permeated with an absence' (Gumbrecht 2004, p.106). He details, 'presence

phenomena cannot help being inevitably ephemeral, cannot help being what I call "effects of" presence because we can only encounter them within a culture that is predominantly a meaning culture' (Gumbrecht 2004, p.106).

Dyson writes, 'as Don Ihde and Christian Metz pointed out decades ago, "a" sound is always multiple, always heterogeneous; being neither visible nor tangible, sound is never quite an object, never a full guarantor of knowledge…ontologically vague and semantically imprecise, sound begs the question of its own representation: just what exactly is a "thud" or a "cluck"? one might ask' (Dyson 2009, p.5). Unavoidably 'sound is always a polyphony' and must be approached as something which exists in multiplicity (Dyson 2009, p.76). Sound is multiple and penetrates the individuated.

Francois Jullien, in his *In Praise of Blandness: Proceeding from Chinese Thought and Aesthetics*, describes the blandness of sound, arguing that a bland sound is 'an attenuated sound that retreats from the ear and is allowed to die out over the longest possible time' such that 'we hear it still, but just barely; and as it diminishes, it makes all the more audible that soundless beyond into which it is able to extinguish itself' (Jullien 2004, p.79). I propose that murmur is such a sound. As he explains, 'this is the sound that, in its very fading, gradually opens up the way from the audible to the inaudible and causes us to experience the continuous movement from one to the other' (Jullien 2004, p.79). He is writing about the *horizon* of sound. He goes on to claim that 'as it gradually sheds its aural materiality' sound 'leads us to the threshold of silence, a silence we experience as plenitude, as the very root of all harmony' because 'perfect harmony exists only in that moment before actualization – or, otherwise, just afterward, as it submerges itself into undifferentiation' (Jullien 2004, p.79).

Although the influence of phenomenology and auditory turn of the last century has encouraged people to listen to sound, there is still a focus on ideal examples of sound such as the *objet sonore*. This suggests that sound has essential qualities. Sounds, however, are never in themselves because they are sites of contact and so must be approached as existing in multiplicity. Philosophers of multiplicity such as Michel Serres have been profoundly influenced by sound and, as I will show, their work as well as that of contemporary sound theorists emphasising the conceptual, relational and spatial dimensions of sound offers an opening to such an approach.

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Chapter 5
Murmur: Haecceity, Difference & Noise

> A murmur, seizing me, I can't master its source, its increase is out of my control. The noise, the background noise, that incessant hubbub, our signals, our messages, our speech and our words are but a fleeting high surf, over its perpetual swell…Sea, forest, rumor, noise, society, life, works and days, all common multiples; we can hardly say they are objects, yet require a new way of thinking. I'm trying to think the multiple as such, to let it waft along without arresting it through unity, to let it go, as it is, at its own pace. A thousand slack algaes at the bottom of the sea (Serres 2009, p.6-7).
>
> - Michel Serres

Sound has been defined over many centuries by a variety of disciplines. It is *seen*, more often than not, as natural and known. People listen, consciously and unconsciously, to the sound around them by differentiating it from noise that does not interest them. However, it is at the threshold between sound and not sound that people become most aware of its existence, hence to date it has been there that theorists have most frequently looked for sound. It is only recently, in the work of academics working in sound studies, that fresh theoretical approaches to sound have been made, approaches that are intertwined with contemporary work in the arts, the development and use of digital technologies and recent strands of philosophy.

I believe it is necessary to eschew traditional academic metaphysics that emphasise the existence of *things* in order to effectively think about sound. There are many such theories, from pre-Socratic philosophies of change, such as those of Heraclitus, to twentieth century theories based around identity and difference such as those of Deleuze, Guattari and Serres, which I will explore in detail now.

Gilles Deleuze writes, 'water is the most perfect environment in which movement can be extracted from the thing moved, or mobility from the movement itself' and so 'this is the origin of the visual and auditory importance of water in research on rhythm'

(Deleuze 2005, p.77). Indeed, Helmholtz himself initially located his study of acoustics in hydrodynamics (Goodman 2010, p.113). Therefore it makes sense to head to the water's edge in order to attempt to better explain sound, contemplating the noise of the ocean, as I will do in this final chapter.

Sound, as I have discussed, is individuated as a cultural artefact. It does not exist in a specific location in time and space but instead is an abstraction people use to help explain their experience of the world. The more closely it is studied, the less it can be located; the more exactly placed, the looser the definition. Ultimately, now that it has been defined, visualised and analysed in various ways and can be recorded, manipulated and synthesised, sound is considered simply as a resource available to serve human needs. However it is still not well understood.

Sound has been defined ontologically in a variety of ways. Despite this, as I believe to be suggested in some recent work in the field of sound studies, sound is multiple and most fully explained not using idealised instances of *pure* and simple sound but as murmur. Sound is not something that exists naturally but rather as an association of a series of characteristics, each, to some extent, real and describable in itself but ultimately not essential to sound. Demonstrating this, I will argue, as I have already mentioned, that murmur is a useful archetype of sound. Drawing on Deleuze and Guattari's concepts of the *refrain*, *assemblage* and *haecceity*, I will offer a theory of the way in which sound is individuated, using Deleuze's ontology based in difference and Michel Serres's metaphysics of noise, and present a philosophy of sound as multiple. Along the way I will relate such an approach to those of contemporary academics prominent in sound studies.

Of the Refrain

Digital technologies, as I have mentioned, are the most recent in a long series of technologies of sound reproduction and manipulation that have gradually been developed, explored, subsumed and replaced since the advent of phonography in the nineteenth century. More than other sound technologies, they are based in the creation of a sound that exists in strictly mathematical space. It was digital sound's existence as a space of potential which first drew my interest to the study of sound and it offers a useful opening to further arguments here.

Sound is now reducible to the binary condition of zero and one, on and off, and with that development has come the emergence of digital sound as an abstract space of potential. As a result, the role of technology in the mediation of experiences of sound is more explicit than ever and consequently digital sound has become of interest to academics. Kim Cascone, one of the first theorists to deal seriously with the area of digital sound, coined the term *post-digital* in reference to the specifically digital sound culture that emerged in the nineteen nineties, demonstrating the influence of new technologies on sound. Suggesting an 'aesthetics of failure' he argues that digital sound is defined through the unique artefacts of error, the *glitch*, that result from the malfunction and failure of digital technologies. However, although aesthetically Cascone's theories have resonated with the work of many artists, particularly in the sounds produced by artists such as Oval, Yasunao Tone, and others, his theories have also demonstrated an element of technological determinism.

Developing an understanding of the function of digital sound, rather than a constructed aesthetics of digital sound, is crucial to engaging with the digital as possessing agency over all sound. Only through such an investigation is it possible to explore fully the implications digital technologies have for engaging with sound, be it through sonic experiments, more traditional musical endeavours or even just listening to the world.

Engaging with the development of technologies of sound reproduction and manipulation, in a contemporary context sound cannot be considered simply as formless and fleeting, an ephemeral natural phenomenon of vibrating particles. Instead, sound exists as a recordable and mutable cultural artefact. As Achim Szepanski finds, 'the field of possibilities of the digital is to be discovered, because as such it is a medium which produces possibilities and not evidences' (Szepanski 2004). He suggests that digital technologies have created a situation in which 'sounds become visible and images audible' (Szepanski 2004). While providing a poetic account of the possibilities, the potentialities, that digital technologies present, Szepanski does not account sufficiently for the role of the technologies in the phenomenon he describes. Digital technologies do not render sounds visible and images audible, rather they render both reducible to data that may then be actualized as sound or image (or indeed something else) regardless of its origin.

In his essay 'Loving The Ghost In The Machine: Aesthetics of Interruption', Janne Vanhanen argues that digital media is characterized by its 'transparency' and 'smoothness', a kind of 'flux and mutability' which produces 'an immersive environment, rather like sound' (Vanhanen 2001). According to Vanhanen:

> Using the concepts of Deleuze and Guattari, we can state that the phonograph deterritorializes sound, flattens down the hierarchical organization of music into a rhizome, which is an open, multiple and temporal form of organization and susceptible to constant de- and recoding (Vanhanen 2001).

As Vanhanen examines with respect to the phonograph, technologies of sound reproduction and manipulation and in particular digital technologies, allow the deterritorialisation and reterritorialisation of sound, such that digital sound exists in a Deleuzian rhizomatic – that is decentralised and lateral – construction as a 'multiple and temporal form of organization' (Vanhanen 2001). Digital technologies can be used to generate, reproduce, manipulate and reconstitute sounds with great flexibility, enabling multiplicities of possibilities, deterritorialising and reterritorialising sound constantly. However, Vanhanen also argues that to 'approach the outside of thought', 'to be able to create new ways to feel the world, new percepts and affects, one has to court the chaos and worship the glitch' and, while this is a useful approach, the *glitch* can also function in another way (Vanhanen 2001).

As I have mentioned, Deleuze and Guattari theorise the refrain or *ritournelle* in '1837: Of The Refrain'. When writing the refrain, Deleuze and Guattari refer to the musical refrain of repetition and thematic re-statement, a motif perhaps.

> A child in the dark, gripped with fear, comforts himself by singing under his breath…the song is like a rough sketch of a calming and stabilizing, calm and stable, center in the heart of chaos…Now we are at home…the forces of chaos are kept outside as much as possible…Sonorous or vocal components are very important: a wall of sound, or at least a wall with some sonic bricks in it. A child hums to summon the strength for the schoolwork she has to hand in. A housewife sings to herself, or listens to the radio, as she marshals the antichaos forces of her work. Radios and television sets are like sound walls around every household and mark territories (the neighbour complains when it gets too loud)…A mistake in speed, rhythm, or harmony would be catastrophic because it would bring back the force of chaos, destroying both creator and creation… (Deleuze & Guattari 1987, p.310-350).

Deleuze and Guattari recount this scenario as one of three examples of the function of the refrain as a territorial agent – that is something that territorializes space. The *glitch* can be heard as such a refrain, as can all the idealised examples of sound I've mentioned.

Given the paradoxical situation in which sound technologies, though marketed for their *hi-fi* quality, are most conspicuous in their infidelity, it is not surprising that the initial attempt to engage and critique the role of digital technologies in sound was through an 'aesthetics of failure'. Arising from a generational focus on the world as represented as data, a poetical fascination with digital code and representation, the 'aesthetics of failure' and theory around *post-digital* music represents an important step in attempting to understand digital sound. However, preoccupied solely with the aesthetics of the digital through the poetic construction of the *glitch*, these theories fail to engage with notions of the greater system of Technology and its function through digital sound.

In Deleuze and Guattari's writing, chaos functions much the same way as noise in Serres's. As they explain, 'chaos is not the opposite of rhythm but the milieu of all milieus' and 'from chaos, *Milieus* and *Rhythms* are born', so chaos is a background to everything (Deleuze & Guattari 1987, p.313). According to them 'the notion of the milieu is not unitary: not only does the living thing continually pass from one milieu to another, but the milieus pass into one another; they are essentially communicating. The milieus are open to chaos, which threatens them with exhaustion or intrusion' (Deleuze & Guattari 1987, p.313). This is where the refrain comes in. Taking Deleuze and Guattari's line of thought, 'the refrain is rhythm and melody that have been territorialized because they have become expressive – and have become expressive because they are territorializing' (Deleuze & Guattari 1987, p.317).

Deleuze and Guattari claim 'rhythm is the milieus' answer to chaos' and theorise the refrain as operating as an agent of de- and reterritorialisation. In this way the *glitch* can be understood as a refrain, offering a point of anchor and reterritorialisation in the alien chaos of digital audio (Deleuze & Guattari 1987, p.313). Digital technologies generate, reproduce, manipulate and reconstitute sounds with great flexibility, enabling multiplicities of possibilities, deterritorialising and reterritorialising sound constantly. However, when they do not function as expected or, for some reason, decoding of binary information fails what results is noise, or chaos, and it is the *glitch*, as a symbol, that offers something to hold on to in such a case. Just as Yasunao Tone examines in his essay 'The Sound of the Outside':

> When Pierre-Henri Schaeffer created musique concrète, the situation of 20th century music was brought to a deadlock by dodecaphony and serial music … he introduced concrete sound – recorded noises, none other than negativity, without which it was impossible to revitalize the western music and organized them as if the noises were part of the western tonal system. So, even noise is sometimes not noise at all if it is an effect or substitute for the tonal system. This does not remain for Schaeffer alone, but so-called glitch has the same problem (Tone 2003).

To adequately apply Deleuze and Guattari's theory of the refrain it is necessary to approach rhythm as a movement, relationship and interaction that is social and, therefore, cultural. This is implicit in the *glitch* as well as in Deleuze and Guattari's examples.

According to Deleuze and Guattari, 'what chaos and rhythm have in common is the in-between…in this in-between, chaos becomes rhythm, not inexorably, but it has a chance to (Deleuze & Guattari 1987, p.313). This is the *horizon* of sound that has dominated so much sound theory. However, for Deleuze and Guattari this 'in-between' is not essential or a site of action, but merely a liminal space. Interestingly, Deleuze and Guattari do also claim that 'every milieu is vibratory', but while this reflects the use of figure of vibration by many theorists – an approach about which I have already articulated my reservations – they clarify that they mean a milieu is 'a block of space-time constituted by the periodic repetition of the component' (Deleuze & Guattari 1987, p.313).

Any definition of sound can be approached as a refrain, as I have said. Such definitions are rhythms that hold the chaos of noise at bay, offering a clear line of distinction around sound. Deleuze and Guattari themselves suggest, 'produce a deterritorialized refrain as the final end of music, release it in the Cosmos – that is more important than building a new system…Yet one was already present in the other; the cosmic force was already present in the material, the great refrain in the little refrains, the great maneuver in the little maneuver. Except we can never be sure we will be strong enough, for we have no system, only lines and movements' (Deleuze & Guattari 1987, p.350).

Continuity & Discontinuity

Approaches to the manipulation of sound such as the loop, originally made possible by the locked groove of a record and subsequently more practical through the editing of a tape loop, remain prevalent as perceptual constructions of sound, but sound exists in the digital domain stored as buffers, x/y graphs of binary data that can be read however desired. While the loop implies a linear, if eternally returning, conception of time, the buffer is nothing more than an array of data and contains none of the previous sense of linear time inherent in phenomenal sound. It is attributes such as the table of contents and the codec – providing respectively a map and translation of encoded data – and not the mechanism of the technology itself that constructs linearity in the data manipulated by digital technologies. This shift has huge implications for how people think about and work with sound.

In '1440: The Smooth and Striated', Deleuze and Guattari propose a distinction between smooth and striated space – smooth space suggesting continuity and striated space discontinuity. Presenting a dialectical construction of space in which 'the two spaces in fact exist only in mixture' they argue 'smooth space is constantly being translated, transversed into a striated space, striated space is constantly being reversed, returned to a smooth space' (Deleuze & Guattari 1987, p.475). In particular, the technological model of smooth and striated space Deleuze and Guattari put forward serves as a useful construction of the interaction between sound and digital technologies. Using the example of fabric, Deleuze and Guattari explain a conception of striated space in which there are 'two kinds of parallel elements; in the simplest case there are vertical and horizontal elements, and the two intertwine, intersect perpendicularly' (Deleuze & Guattari 1987, p.475).

Performing different functions, one of these remains fixed, the other mobile, as demonstrated by one piece of thread remaining in place while another interweaves or transverses it, or by the x-axis of time in a digital sound buffer which remains linear as its corresponding y-axis of amplitude simultaneously traces and diverges from it. It is crucial that 'a striated space of this kind is necessarily delimited, closed on at least one side', as 'fabric can be infinite in length but not in width' and although time does not constrain sound the limited headroom of digital audio indicates that amplitude must (Deleuze & Guattari 1987, p.475). Technological striated spaces are constructed with top and bottom, as belied by the seams of fabric or bit depth of digital sound (Deleuze & Guattari 1987, p.475). Digital sound involves a constant process of translation in which sound moves between the smooth phenomenal space of actualized sonority and

the striated space of potential that is the digital domain, while still presenting a smooth space of its own.

Importantly, Deleuze and Guattari do not regard homogenous space as smooth space but, conversely, see it as the form of striated space, which they refer to as 'the space of *pillars*' (Deleuze & Guattari 1987, p.370). Echoing Serres, they claim that space 'is striated by the fall of bodies, the verticals of gravity, the distribution of matter into parallel layers, the lamellar and laminar movement of flows' (Deleuze & Guattari 1987, p.370). Meanwhile, they argue:

> Smooth space is a field without conduits or channels. A field, heterogeneous smooth space, is wedded to a very particular type of multiplicity: nonmetric, acentered, rhizomatic multiplicities that occupy space without "counting" it and can "be explored only by legwork." They do not meet the visual condition of being observable from a point in space external to them; an example of this is the system of sounds, or even colors, as opposed to Euclidean space (Deleuze & Guattari 1987, p.370-371).

All sound can be represented through the binary system of digital technologies with accuracy so indistinguishable from the source that it is imperceptible to the human ear except in the case of error or malfunction in the technologies. This demonstrates that it is possible to consider smooth and striated space, or continuous and discontinuous forms, as coexistent. Importantly, the increasingly common conception that such technologies replace the continuous phenomenon of sound with the segmented, interrupted, non-linear abstraction of binary data is not entirely correct. Jonathan Sterne rightly points out in his article 'The Death and Life of Digital Audio' that sound in the digital world is not necessarily any less *live* than any other sound and:

> Discontinuous modes of data storage can still provide full modes of sensory experience, and this is a sensory effect, not an illusion. Thus, we cannot say that the segmentation of digital media renders them fundamentally different from analogue media, and we cannot say that their segmentation renders the experience of digital media inherently less full or substantial than the experience of analogue media (Sterne 2006, p.341).

Indeed the notion that digital sound is somehow less *live* and therefore more *dead* than analogue is unsupportable because, as Jonathan Sterne notes, 'the question of 'life' in a recording is a social question, not an ontological or metaphysical one' and the same is true with all music and art (Sterne 2006, p.339). Often theorists argue which

technologies are more *live*, most commonly that digital recordings do not have the *life* of their analogue counterparts, but it is people who bestow the life upon any recording or work. Digital technologies do have significant new implications for how people engage with sound but they are nonetheless a part of a long lineage of technologies that reproduce and/or manipulate sound. Rather than being based in any kind of aesthetic of poetic construction, digital sound is a complex potentiality that operates on all sound, exemplifying digital technologies' role as agents of a greater system of Technology through which understanding of all sound is mediated.

Digital technologies, like other sound technologies that have preceded them, have had a profound effect on peoples' relationship with sound. Apart from the effects of individual technologies, the system of Technology has, when applied to sound, taken a once fleeting, ephemeral phenomenon of waves and particles and rendered it cultural capital, to be manipulated as desired. However, it has in so doing demonstrated the complexity of the existence of sound. Digital technologies reproduce, manipulate and reconstitute sound with particularly great flexibility, enabling many possibilities and demonstrating sound's multiplicity.

The Parasite

Yasunao Tone is a Fluxus artist who has worked with sound for decades. Fluxus was an international network of artists whose name is based on the Latin word meaning 'to flow', purportedly inspired by the writing of Heraclitus. Developed in the 1960s, Fluxus owes a great deal to the work of Cage and other experimental musicians, and the work artists involved have produced is often known as *intermedia*. Importantly, although often treated as synonymous with, or perhaps a precursor to, multimedia, the term intermedia was coined by Dick Higgins and refers to art that involves the crossing of boundaries between media. Tone is most well known for his performances using prepared compacts discs (CDs), which he *prepares* with scotch tape and other things before playing them. This causes the CD players to fail and rather than *successfully* play the recording on the CD instead spit apparently random pitches and bursts of noise. Caleb Kelly records that Tone developed the technique with a friend using a Swiss made CD player and a copy of Debussy's *Preludes*, finding that 'the result changed the pitch, timbre, rhythm, and speed of the original piece' (Kelly 2009, p.237-238). As Kelly notes, 'the CDs also produced a "stuttering" that was different each time the disc was played' (Kelly 2009, p.238). Therefore, 'the sounds produced by the manipulated discs are never quite the same' (Kelly 2009, p.238).

Due to the sound he achieves with his *wounded* CDs, Tone's work has commonly been described as *glitch* but, as his own comments attest, this label represents at best a limited understanding of his work. He is, more than anything, focused on dealing with what is *outside* – that is, noise. It is his release *Musica Iconologos* that is of particular interest here because of the specific process he employed to create it. Tone outlined his method in his essay 'John Cage and Records', as he explained to Hans Obrist:

> I scanned images and digitized them, thus the images were transformed simply into 0's and 1's. Then, I obtained histograms from the binary codes and had the computer read the histograms as sound waves; thus I got sound from the images. So, I used visualized text (images) as source – that is, the message – which was encoded and laid on the CD. Now, when you play that CD, what you receive is not images as message but sound, which is simply as excess. According to information theory this is none other than noise; and as the French word for information noise 'parasite', indicates, it is parasitic on a host – that is, message. But, in this case there is no host, only parasite on the CD. Therefore this CD is pure noise (Obrist 2001, p.72).

Importantly, as Federico Marulanda notes in his essay from *Yasunao Tone: Noise Media Language* – writing about Tone's release *Wounded Man'yo 2/2000* which was produced using a similar technique to *Musica Iconologos* drawing on the ancient *Man'yoshu* poems – although like Cage he is interested in 'broadening auditory experience', 'Tone's playback technique is not an instrument for effacing the boundary between the musical and non-musical' and instead his 'sonic transliteration of the *Man'yoshu* poems represents a deliberate effort to recuperate, and then dissipate, specific bits of information, leaving as a trace only noise' (Marulanda, p.89-90). Tone is interested in the dissolution of meaning that occurs in any act of transcription, demonstrating the noise that exists in all communication. This also demonstrates the problematic nature of any claim made regarding any technology's ability to inscribe or reproduce sound; instead, these systems can be said to *transcribe* sound. This is reflected in Tone's use of the term *parasite* to develop his own concept of *paramedia* to explain his work. In French parasite also means noise, specifically static or interference. Tone has developed such an approach in reference to Serres's theory that parasitic noise exists with, and indeed in, every signal, with all meaning in the world, that 'mistakes, wavy lines, confusion, obscurity are part of knowledge; noise is part of communication' (Serres 1982b, p.12). Serres writes:

> The prefix para is counted, calculated, weighed in its difference from equilibrium. But it is also placed and situated. When the column holds the beam up, one line goes to the end of the second; here, the vertical joins the edge of the horizontal. That makes a right angle at the top. In any case, it makes an angle and a top. Move the pillar, mark a cantilever – a loss or difference, para (Serres 1982b, p.32-33).

The parasite is, therefore, a place of difference. However it is one that exists with signal. It cannot exist alone. Just as Serres writes, 'the difference is part of the thing itself, and perhaps it even produces the thing. Maybe the radical origin of things is really that difference, even though classical rationalism damned it to hell. In the beginning was the noise' (Serres 1982b, p.13). He refers here to Deleuze's theory of *difference*, articulated as a kind of *differential*, not the difference between things but abstract difference as an underlying principle, as I will explain.

Difference

Instead of considering sound to be traditionally ontic or, attempting to define it ontologically as people do other *things*, it is necessary to learn more about it by approaching it with a new approach to ontology. This is possible using Deleuze's concept of difference. Although Deleuze himself apparently did not use the term post-structuralist, his thought can be labeled as such as it emphasises relationships and therefore difference. Chris Barker explains it well in his book *Cultural Studies: Theory and Practice* when he writes that 'post-structuralism rejects the idea of an underlying stable structure that founds meaning through fixed binary pairs' such that 'meaning is unstable, being always deferred and in process' and 'cannot be confined to single words, sentences or particular texts but is the outcome of relationships between texts, that is, intertextuality' (Barker 2008, p.18). Deleuze outlines his theory as follows:

> Difference must become the element, the ultimate unity; it must therefore refer to other differences which never identify it but rather differentiate it. Each term of a series, being already a difference, must be put into a variable relation with other terms, thereby creating other series devoid of centre and convergence. Divergence and decentring must be affirmed in the series itself. Every object, every thing must see its own identity swallowed up in difference, each being no more than a difference between differences. Difference must be shown *differing* (Deleuze 1994, p.56).

Sound cannot be considered merely phenomenal. Nor can it be placed in any other site, such as the ear or *hi-fi* recording. Instead, sound demonstrates difference and interrelationship in the world. As Deleuze himself writes, 'movement, for its part, implies a plurality of centres, a superposition of perspectives, a tangle of points of view, a coexistence of moments which essentially distort representation: paintings or sculptures are already such 'distorters', forcing us to create movement – that is, to combine a superficial and a penetrating view, or to ascend and descend with the space as we move through it' (Deleuze 1994, p.56). This approach has implications not only for how people approach sound but how they approach themselves and the world around them.

Notably, Derrida's *differánce* and Deleuze's difference are by no means synonymous and should not be conflated. Both offer alternatives to conventional ontology that help to think sound but Derrida's *differánce* is limited by basis in linguistics. It is only able to address sound in relation to writing. Explaining Derrida's concept, Dyson writes:

> Against the absolute silence of the inner, metaphysical voice, Derrida poses his core concepts of *differánce* and the trace: the trace reveals and is revealed by the space, or spacing, of writing; be it the gap between letters on the page or the silence that differentiates (and constitutes) phonemes in speech. Writing allows the difference, the absence, the Other inherent in discourse, to appear. The difference that such spacing allows to be heard is captured in Derrida's concept of *differánce*. Meaning both to differ and to defer, *differánce* constitutes the structure of presence as intersected by the spatial and temporal differences in language, the production of which writing – *ecriture* – reveals…According to Derrida, this oscillation provides a way of both articulating the mechanisms or logics that constitute metaphysical presence and *interrupting* those mechanisms (Dyson 2009, p.96).

As Dyson points out, 'the silences, spaces, and gaps that circulate through Derridean deconstruction are defined within an overarching "science": the "science of writing," which Derrida calls grammatology' (Dyson 2009, p.96). She continues, 'this "science" reveals, however, a certain deafness in his thinking, for in the grammatological construction, logos is conflated with *phōnē*, and *phōnē* is assumed to represent both the technology of the voice-speaking-language and the sonority of the voice' (Dyson 2009, p.96). Thus, Derrida equates the sounded voice with one expressed in language. However, as Dyson explains, 'Jean-Francois Lyotard makes the point that the *phōnē* is what Aristotle called "the voice as timbre," which can be contrasted to "*lexis*," which he defines as "the articulated voice." The difference between the two, he suggested,

comes down to *noise* – the sounds of the body, of timbre and "grain," which interrupt "meaningful" speech (Dyson 2009, p.96). Furthering her argument, Dyson cites Agamben, who in turn claims:

> [Derrida] believed he had opened a way to surpassing metaphysics, while in truth he merely brought the fundamental problem of metaphysics to light. For metaphysics is not simply the primacy of the voice over the *gramma*. If metaphysics is that reflection that places the voice as origin, it is also true that this voice is, from the beginning, conceived as removed, as Voice. To identify the horizon of metaphysics simply in that supremacy of the *phōnē* and then to believe in one's power to overcome this horizon through the *gramma*, is to conceive of metaphysics without coexistent negativity (Agamben 1991, p.39).

Following that line of thought, Derrida's concept of *differánce* is unable to address sound as murmur. Not only does it fail in its attempt to surpass metaphysics but it does so by failing to consider a metaphysical negative, that is it does not account for the absence involved in the presence of sound, an Other that can be heard, the noise in the voice. In his later work, finding in 'audio recording a technological embodiment of *ecriture*' and using 'the metaphoric movements of various forms of audio technology', Derrida theorised the *cinder*, which can be considered a renamed *trace,* as 'a residue, a remainder, a still-glowing index of the fire that both repeats and makes possible difference' (Dyson 2009, p.96). In *Cinders* he presents a polylogue composed of a number of his writings and 'constituted, as he says, by "an indeterminate number of voices"' (Dyson 2009, p.96). However, this is still an attempt to address a silent call that can, for him, only be expressed in writing and 'the *phōnē*, which for Derrida also represents "sound in general," becomes literally a trace – the phonograph's grooves, the tape's magnetic configurations, the cipher of the "impossible emission"' (Dyson 2009, p.96). Therefore his concepts remain unable to adequately *hear* a sound of the complexity of murmur. Just as Daniel W Smith explains in *Deleuze and Derrida, Immanence and Transcendence: Two Directions in Recent French Thought*:

> The concepts of difference that Deleuze develops in *Difference and Repetition*…have a very different status than the notion of difference Derrida develops in his essay "Differánce". For Derrida, *differánce* is a relation that transcends ontology, that differs from ontology, that goes beyond or is more 'originary' than the ontological difference between Being and beings. Deleuze's aim, by contrast, is to show that ontology itself is constituted immanently by a principle of difference (and is thus a 'concept', in the Deleuzian sense of the term. And not merely a 'quasi-concept'). Deleuze is not often thought of as a

> Heideggerian, but *Difference and Repetition* can be read as a direct response to *Being and Time* from the standpoint of immanence: for Deleuze, Being is difference, and time is repetition (Smith 2003, p.51).

Deleuze believes empiricism becomes transcendental when the being of the sensible is based in difference - 'difference, potential difference and difference in intensity as the reason behind qualitative diversity' (Deleuze 1994, p.56-57). Therefore, 'it is in difference that movement is produced as an 'effect', that phenomena flash their meaning like signs. The intense world of differences, in which we find the reason behind qualities and the being of the sensible, is precisely the object of a superior empiricism. This empiricism teaches us a strange 'reason', that of the multiple, chaos and difference (nomadic distributions, crowded anarchies). It is always differences which resemble one another, which are analogous, opposed or identical: difference is behind everything, but behind difference there is nothing' (Deleuze 1994, p.56-57). Therefore, what Deleuze's theory of difference offers this study is a way to a new ontology of sound. Using this approach it is possible to avoid seeking sound's essence or attempting to define it.

Sonic Philosophies

Just as Frances Dyson argues, 'sound, technology and culture have combined to create a rhetorical structure through which prior notions of embodiment, materiality, humanity, art and science are reassembled for deployment in the information age' (Dyson 2009, p.7). She continues, 'fundamental to the development of communications technology, these notions are revised, remodeled, cut, and pasted to fit the new techno-epistemological regime, and….are never far from the influence of sound – either as medium, or a model, or a metaphoric ground' (Dyson 2009, p.7). Attributing the possibility of such remodeling to 'the absence of either a sonic epistemology or an aural ontology in our visually oriented technoculture', she argues:

> Without a knowledge system that can accommodate a phenomenology of sound, that can represent the listening experience, that gives weight to the ephemeral aural "object," and that recognizes an environment in its acoustic fullness, we see the concepts immersion, telepresence, and virtuality return endlessly to a rhetorical fault line in order to retrieve yet another set of metaphors, another conceptual framework (Dyson 2009, p.7).

It is this lack of a framework for thinking and discussing sound without employing some kind of reductive maneuver that I am attempting to overcome and there are a number of others doing the same. Specifically, I believe Deleuze's ontology of difference presents the basis of such an approach, as I will expand further. Offering an alternative approach to that of physics, Deleuze and Guattari make a distinction between *reproduction*, which they regard as a part of 'royal science' that treats difference of time and place as variables to extract constants or laws, and *following*, arguing:

> Reproducing implies the permanence of a fixed point of *view* that is external to what is reproduced: watching the flow from the bank. But following is something different from the ideal of reproduction. Not better, just different. One is obliged to follow when one is in search of "singularities" of a matter, or rather of a material, and not out to discover a form; when one escapes the force of gravity to enter a field of celerity; when one ceases to contemplate the course of laminar flow in a determinate direction, to be carried away by a vortical flow; when one engages in a continuous variation of variables, instead of extracting constants from them, etc (Deleuze & Guattari 1987, p.372).

This approach emphasises relationships and the multiple rather than the discrete and quantifiable. However, demonstrating the same concerns as Dyson, they warn, 'this synthesis of disparate elements…has the same ambiguity, perhaps, as the valorization of children's drawings, texts by the mad and concerts of noise' (Deleuze & Guattari 1987, p.343-344). Nevertheless, despite the ontological and epistemological difficulties involved in thinking about sound there is much to learn from it. Brandon LaBelle believes, as do I, that sound is 'a significant model for…thinking and experiencing the contemporary condition, for as a relational spatiality global culture demands and necessitates continual reworking' (LaBelle 2010, p.xvii). He argues that 'sound reroutes the making of identity by creating a greater and more suggestive weave between self and surrounding' (LaBelle 2010, p.xxi). He continues:

> Sound operates by forming links, groupings and conjunctions that accentuate individual identity as a relational project. The flows of surrounding sonority can be heard to weave an individual into a larger social fabric, filling relations with local sound, sonic culture, auditory memories, and the noises that move between, contributing to the making of shared spaces. This associative and connective process of sound comes to reconfigure the spatial distinctions of inside and outside, to foster confrontations between one and another, and to infuse language with degrees of immediacy…the *associative* dynamic of sound lends greatly to triggering *associate* forms of discourse and knowledge. This is

> both participant within the physics and phenomenological behaviour of sound, as well as forming the conceptual and psychodynamic frame for recognizing how hearing is already an associative act. For what we hear is not mostly what we see, nor can it be strictly pinned down to a given source, or brought into language (LaBelle 2010,p.xix).

Meanwhile, Seth Kim-Cohen, in arguing for a 'non-cochlear sonic art', identifies that, despite his interest in an outward reaching conception of sound, 'in the sonic arts, however, the movement has tended to be inward, a conservative retrenchment focused on material and concerns considered essential to music and/or sound' (Kim-Cohen 2009, p.261). He refers to the efforts to come up with a definitive account of sound using figures such as those of the wave, vibration and transduction, of which I have written. Offering an alternative, like me, he dismisses essentialism and argues that 'value is not inherent, but rather a process that overflows the boundaries of the thing-itself' such that 'meaning is always contingent and temporary, dependent on the constantly shifting overlap of symbolic grids' (Kim-Cohen 2009, p.261). 'It is never simply it', he writes (Kim-Cohen 2009, p.259-261). Although, his argument has generally been interpreted, due I believe as much as anything to his presentation of it, as specifically for a conceptual sonic art, I think it can be taken in a broader sense. Kim-Cohen's argument can be heard as a voicing of an already existing tributary in the sonic arts and a call for accompanying theories of sonic art that do not focus on aesthetics or place sound but deal with it in all its complexity.

It is possible to discern in these accounts of sound the implication that sound is multiple, as I am arguing here. These theorists each have their own approach, some are influenced by the same philosophers as I myself and others are not, but I find in their work much in common with my own. Just as the analogy of sound as a wave on the surface of a body of water has circulated, the scientific theory of sound has been repeated and phonography has many fathers, there are many involved in approaching sound as multiple.

Jacques Attali gives a vague account of a possible shift in contemporary society when he claims that 'we see emerging, piecemeal and with the greatest ambiguity, the seeds of a new noise, one exterior to the institutions and customary sites of political conflict' (Attali 2006, p.133). He believes that 'a noise of Festival and Freedom…may create the conditions for a major discontinuity extending far beyond its field' and as such 'it may be the essential element in a strategy for the emergence of a truly new society' (Attali 2006, p.133). He argues:

> Music was, and still is, a tremendously privileged site for the analysis and revelation of new forms in our society. It announced, before the rest of society, the destruction of sacrifice by exchange and representation, then the stockpiling of the simulacrum of usage in repetition. Thus what once were rites today appear to be wastefulness; what was the foundation of peace appears as antisocial violence; what was an element in the social whole appears as a work of art to be consumed. Our society mimics itself, represents and repeats itself, instead of letting us live. But the very death of exchange and usage in music, the destruction of all simulacra in accumulation, may be bringing about a renaissance. Complex, vague, recuperated, clumsy attempts to create a new status for music – *not a new music, but a new way of making music* – are today radically upsetting everything music has been up to this point…The only dimension permitting the escape from ritual dictatorship, the illusion of representation, and the silence of repetition. Music, the ultimate form of production, gives voice to this new emergence, suggesting that we designate it *composition* (Attali 2006, p.133-134).

Many artists, and indeed amateurs, already demonstrate the sort of approaches that Attali, Kim-Cohen, LaBelle, myself and many others argue is necessary. I read, more than thirty years after it was written, Attali's claim as describing an approach to music that is now commonplace in several different forms. It is the music made in bedrooms around the world. It is the music of buskers on the street. It is the music of experimental musicians and improvisers. Just as Attali argues 'we are all condemned to silence – unless we create our own relation with the world and try to tie other people in the meaning we thus create. That is what composing is. Doing solely for the sake of doing, without trying artificially to recreate the old codes' (Attali 2006, p.133-141).

Attali's argument is that play with sound itself offers a way forward. It employs the sort of approach of which I have been writing about here. It focuses on activity. It acknowledges the lack of absolutes and the necessity of creation. Attali's *composition* is akin to Deleuze and Guattari's *following* in that it offers an alternative to *reproduction* that deals with specificity and exists in multiplicity. Just as Deleuze and Guattari write of the refrain, 'one launches forth, hazards an improvisation. But to improvise is to join with the World, or meld with it. One ventures from home on the thread of a tune. Along sonorous, gestural, motor lines that mark the customary path of a child and graft themselves onto or begin to bud "lines of drift" with different loops, knots, speeds, movements, gestures, and sonorities' (Deleuze & Guattari 1987, p.311-312).

Ultimately sound offers the most useful model for its own theorisation, not in any sort of essential characteristics but in how it is present and acts in the world. It is telling, too, that it is the work of artists, drawing on scientific discovery, that has inspired the contemporary philosophers who have, in turn, tilled the ground for the interdisciplinary field sound theorists inhabit. Sound is connective, involving and multiple and as such it challenges people to think in new ways, with metaphysical, epistemological and ethical implications.

The Multivocity of Being

The discipline of ontology has always assumed the proposition that 'Being is univocal', that is that it has a single voice, a claim that Deleuze believes to have been most fully articulated by Duns Scotus, a significant theologian and philosopher of the Middle Ages (Deleuze 1994, p.35). However, as Deleuze claims 'from Parmenides to Heidegger it is the same voice which is taken up, in an echo which itself forms the whole deployment of the univocal' (Deleuze 1994, p.35). The voice has been influentially positioned and largely unchallenged as the expression of a unique, individual, self. Despite the limited usefulness of his concepts to my approach to sound, Derrida's critique of the *phonocentrism* of Western culture - his criticism of what he called 'the common belief that there is an immediate and unmediated relationship between the mind, the voice, language, and the nature of the world' which I have already explored in some detail – supports this point (Dyson 2009, p.95). This univocity underpins the natural standpoint and its assumption that it is things with essences that most assuredly exist but sound, with its multivocity, does not fit comfortably within such a schema and so it is necessary to find an alternative. To such an end, Deleuze's theories of difference and repetition are useful. He seemingly, at least based on his writing in *Difference & Repetition*, accepts the proposition that being is univocal but argues that univocity should be based in difference rather than identity or essence such that 'the extreme is not the identity of opposites, but rather the univocity of the different' and so offers a useful step toward a philosophy that accommodates multivocity by avoiding a focus on discrete identity (Deleuze 1994, p.55).

Based on his argument that difference is a transcendental, which incidentally is not essential to its usefulness as a concept, Deleuze further claims that 'identity, produced by difference, is determined as 'repetition'' (Deleuze 1994, p.41). For Deleuze, repetition 'consists in conceiving the same on the basis of the different' (Deleuze 1994, p.41). Moreover, he argues that 'individuation is mobile, strangely supple, fortuitous and endowed with fringes and margins; all because the intensities which contribute to

it communicate with each other, envelop other intensities and are in turn enveloped. The individual is far from indivisible, never ceasing to divide and change its nature' (Deleuze 1994, p.257).

Sound is frequently differentiated as univocal using traditional ontology. Even in such cases, however, it is still, necessarily, heard among a murmur of voices. Moreover, as I believe is suggested in Deleuze & Guattari's *A Thousand Plateaus: Capitalism and Schizophrenia* and will explain, there is a way to differentiate sound without disregarding its multivocity.

Assemblages

Deleuze and Guattari write a great deal about assemblages in their work. For them assemblages are necessarily territorial, indeed 'the territory is the first assemblage, the first thing to constitute an assemblage; the assemblage is fundamentally territorial' (Deleuze & Guattari 1987, p.323). Although, along with its territoriality, an assemblage also has '*consistency:* the "holding together" of heterogenous elements' (Deleuze & Guattari 1987, p.323). They write:

> We will call an *assemblage* every constellation of singularities and traits deducted from the flow – selected, organised, stratified – in such a way as to converge (consistency) artificially and naturally; an assemblage, in this sense, is a veritable invention. Assemblages may group themselves into extremely vast constellations constituting "cultures," or even "ages"; within these constellations, the assemblages still differentiate the phyla or the flow, dividing it into many different phylas, of a given order, on a given level, and introducing selective discontinuities in the ideal continuity of matter-movement (Deleuze & Guattari 1987, p.406).

Anything and everything that is individuated can be approached as an assemblage. The preceding chapters and the *ages* of sound they construct are assemblages. Therefore, whenever sound is individuated as a *haecceity*, as I will now explain, it is an assemblage composed of a constellation of elements. Importantly, 'the territorial assemblage is inseparable from lines or coefficients of deterritorialization, passages and relays toward other assemblages' and so every definition of sound, every delineation of its limits, overlaps with others (Deleuze & Guattari 1987, p.333).

Haecceity: A Season, A Winter, A Summer

Sound, when individuated in a way that does not define it as a *thing*, is a *haecceity*, of the sort defined by Deleuze and Guattari in the chapter "1730: Becoming Intense, Becoming Animal…" from their book *A Thousand Plateaus: Capitalism and Schizophrenia*. Approaching sound such as I am doing here bestows on it a singularity that lacks nothing and yet it has no essential characteristics. It exists but not in a way that fits easily with the natural standpoint. Deleuze and Guattari argue that:

> There is a mode of individuation very different from that of a person, subject, thing or substance. We reserve the name haecceity for it. A season, a winter, a summer, an hour, a date have a perfect individuality lacking nothing, even though this individuality is different from that of a thing or subject. They are haecceities in the sense that they consist entirely of relations of movement and rest between molecules or particles, capacities to affect and be affected' (Deleuze & Guattari 1987, p.261).

Deleuze and Guattari suggest that haecceities exist on a plane separate from that of 'forms, substance and subjects' and, indeed, in a different temporality (Deleuze & Guattari 1987, p.262). They argue that haecceities are based in '*Aeon:* the indefinite time of the event' as opposed to '*Chronos:* the time of measure that situates things and persons' (Deleuze & Guattari 1987, p.262). They suggest 'in short, the difference is not at all between the ephemeral and the durable, nor even between the regular and the irregular, but between two modes of individuation, two modes of temporality (Deleuze & Guattari 1987, p.262).

Therefore, sound, individuated as a haecceity, is distinct and discernible but multiple and resistant to traditional ontological definition, retaining its multivocity. It is a rhythm between milieus. Importantly, 'a haecceity has neither a beginning nor end, origin nor destination; it is always in the middle. It is not made of points, only of lines' (Deleuze & Guattari 1987, p.263). Jean-Luc Nancy argues similarly that sound is 'first of all presence in the sense of a *present* that is not a being (at least not in the intransitive, stable, consistent sense of the word), but rather a *coming* and *passing*, and *extending* and a *penetrating*' (Nancy 2002, p.13). It is recognisable in this sense only in change.

> The present of this perception is a present formed by the overlapping, in it or on it, of the present impression and the retention of the past impression, opening forward onto the impression to come. It is a present, consequently, that is not instantaneous, but differential in itself (Nancy 2002, p.30).

In positing sound as haecceity, I do not mean haecceity in the conventional sense of the term, such as is used by Keith Lehrer in his *Haecceity: An Ontological Essay* in which he defines it as 'the property of a being identical with a certain entity' (Rosenkrantz 1993, p.1). Rather, I intend it to refer to sound's existence approached with an emphasis on difference that does not privilege being and the existence of things in a traditional sense. Just as Deleuze argues, I believe:

> We must avoid an oversimplified conciliation, as though there were on the one hand formed subject, of the thing or person type, and on the other hand spatiotemporal coordinates of the haecceity type. For you will yield nothing to haecceities unless you realize that is what you are, and that you are nothing but that… It should not be thought that a haecceity consists simply of a décor or backdrop that situates subjects, or of appendages that hold things and people to the ground. It is the entire assemblage in its individuated aggregate that is a haecceity; it is this assemblage that is defined by a longitude and latitude, by speeds and affects, independently of forms and subjects, which belong to another plane (Deleuze & Guattari 1987, p.262).

Sound must be approached from within because, as Deleuze & Guattari argue, 'it is the wolf itself, and the horse and the child, that cease to be subjects to become events, in assemblages that are inseparable from an hour, a season, an atmosphere, an air, a life. The street enters into composition with the air, and the beast and the full moon enter into composition with each other' (Deleuze & Guattari 1987, p.262). The speed which the authors refer to is intensity, rather than something that is fast or slow – the result of dividing x by y and thus a way of finding depth in the flat, linear, Cartesian space of Euclidean geometry. Along with affect it provides a different set of measurements, which measure differences rather than positions in time and space. Sound does not move from one point to another, rather lines of it are drawn, conceptual and social as much as physical.

Noise

Imagine for a moment you are standing on the shore on a quiet night listening to the ocean. You look down from the constellations above and out to sea to watch the white foam atop each wave. The horizontal line separating the water from the sky stretches out to form the horizon before you. One after another you hear the waves crash with a tumult of noise. But it is not the waves you hear. There is a point at which the crest of each wave overturns and lets out that characteristic roar. The peak of each wave gets steeper as the height of the wave increases and eventually breaks into a mess of turbulent kinetic energy, including the noise you hear. At that moment simple physical models that describe the action of waves, particularly those that assume linear movement, also break up. The simple form of the wave crashes.

Michel Serres develops a metaphysics of noise that emphasises the multiple in his book *Genesis*. He believes that the way people hear places them in the world in a way very different to their other senses. He writes:

> *Noise* and nausea, *noise* and the nautical, *noise* and navy belong to the same family. We mustn't be surprised. We never hear what we call background noise so well as we do at the seaside. That placid or vehement uproar seems established there for all eternity. In the strict horizontal of it all, stable, unstable cascades are endlessly trading. Space is assailed, as a whole, by the murmur; we are utterly taken over by this same murmuring. This restlessness is within hearing, just shy of definite signals, just shy of silence. The silence of the sea is mere appearance (Serres 2009, p.13).

His argument, and mine, is that they way people hear along with the presence of sound, noise and silence offers a model for an alternate metaphysics that provides an opening to new approaches to the world. He suggests that 'hearing is a model of understanding' because it is the only sense that is always active and continuous (Serres 2009, p.7). *Noise*, for him, is all that is undifferentiated in the world and it is ever present. He argues:

> We are immersed in sound just as we are immersed in the air and light, we are caught up willy-nilly in its hurly-burly. We breathe background noise, the taut and tenuous agitation at the bottom of the world, through all our pores and papillae, we collect within us the noise of organization, a hot flame and a dance of integers. My acouphenes, a mad murmur, tense and constant in hearing, speak to me of my ashes, perhaps, the ones whence I came, the ones to which I will

> return. Background noise is the ground of our perception, absolutely uninterrupted, it is our perennial sustenance, the element of the software of all our logic. It is the residue and cesspool of our messages. No life without heat, no matter, neither; no warmth without air, no logos without noise, either (Serres 2009, p.7).

Building on this theory, Dyson argues 'the meaning that a signal might convey results from its serialization and periodicity – something that is heard and felt in rhythm – but what lies between signals, what in fact defines the signal…is an aesthetic, technological and metaphysical process that both filters and is constituted by noise' and that 'while noise – like flux, vibration, pulse, or signal – is indeed a good metaphor, its ceaseless movement between signal, music, rumour, and language unhinges any dialectic with which it is engaged, or to which it is applied' (Dyson 2009, p.189). Noise is always multiple and as such cannot easily be grasped. Serres explains of the multiple:

> Locally, it is not individuated; globally, it is not summed up. So it's neither a flock, nor a school, nor a heap, nor a swarm, nor a herd, nor a pack. It is not an aggregate; it is not discrete. It's a bit viscous perhaps. A lake under the mist, the sea, a white plain, background noise, the murmur of a crowd, time (Serres 2009, p.4-5).

There is particular significance in Serres use of the term murmur, a verb as often as a noun, which suggests a continuous, low sound on the threshold of inaudibility that has an inherent multiplicity. Sound, as signal, exists within a swell of noise with the 'mere appearance' of silence (Serres 2009,m p.13).

Serres argues that 'noise cannot be a phenomenon; every phenomenon is separated from it, a silhouette on a backdrop, like a beacon against the fog, as every message, every cry, every call, every signal must be separated from the hubbub that occupies silence, in order to be, to be perceived, to be known, to be exchanged' (Serres 2009, p.13). He claims that 'what are called phenomena alone are known and knowable' and the case can be made for this to be applied to sound (Serres 2009, p.18). Sound is defined as known but it is surrounded by and drenched in noise. He continues:

> The *noise* is incapable of differentiation, everything in it is indistinguishable. It is laminar and white; each lamina takes the place of any lamina, white noise, continuous aquarian outpouring, sustained noise of waterfall, a null signal, formless background. It is a saturation of differences: the cloud chaos returns to

> the aquarian chaos for, shall we say, a complementary reason, no signal will pass through the innumerable plurality. The indistinguishable returns to the continuous, the continuous returns to the indistinguishable. No difference or complete difference both produce the undifferentiated. The sense of hearing is lost in silence and also in pure noise (Serres 2009, p.118-119).

Here, silence and noise are interchangeable and sound has no clear horizon. Instead all are multiple and coexistent. *Noise*, for Serres, is chaos, the undifferentiated, the possible. Importantly, in Serres's conception, *noise* precedes and underlies not only all sound, but everything.

Consequently, the noises people hear are only momentary experiences of an all encompassing noise that is multiple and inaccessible. He describes how the grey of a studio floor where 'all hues have fallen' is noise, not of possibility but of culmination (Serres 2009, p.33). He argues that 'noises that come and go are contingent on an observer, they hinge on a listening post, on a channel, on an aperture, open or closed, door or window, through which they pass in part, and behind which the one who is the receiver of the flux, the wind, the manifestation, takes refuge and trembles (Serres 2009, p.62-63).

For Serres, this sort of 'noise is a turbulence, it is order and disorder at the same time, order revolving on itself through repetition and redundancy, disorder through chance occurrences, through the drawing of lots at the crossroads, and through the global meandering, unpredictable and crazy' (Serres 2009, p.59). Often people think of white noise when discussing noise – a mathematical noise that contains all audible frequencies at equal power, heard as a sign of the absence of signal, missing or lost, rather than as the *outside*. While Serres refers to such noise it is not his chief concern. The grey he writes of is more similar to pink noise - that is, a mathematical noise that contains all audible frequencies with equal power when heard in logarithmic space, as a model of the way people hear – but still it contains too much variation to be articulated so simply, it is not uniform. It is noise that can be found all around the *natural* world, in the tumultuous roar of the ocean, the subtlety of the wind in the trees, the hum of the city and even in the brain.

Turbulence is particularly important for Serres because, he argues, 'the turbulent state mixes or associates the one and the multiple, systematic gathering together and distribution (Serres 2009, p.109). He writes, 'it is 'widespread everywhere, almost everywhere, yet it is not universal' it is 'diversal' and it 'is a mix of foreseeable regions and chaotic regions, a mix of concepts in the classical, unitary sense of the term, and

of pure multiplicity' (Serres 2009, p.110&111). He claims, 'turbulence is an intermittence of void and plenitude, of lawful determinism and underdeterminism (Serres 2009, p.109). Importantly, turbulence is never pure but always multiple. Rhythms emerge from it and disappear into it. Sounds bob up only to be washed away. Goodman explains that Serres's 'preoccupation with the emergence of rhythm out of noise derives in part from his interest in the ancient atomic physics of Democritus and Lucretius (Goodman 2010, p.105-106; Lucretius 1951, p.66). Serres believes that 'existence or excellence lies in the fringe, it is on the edge that never stops; it is in the bath in which things are immersed' (Serres 2009, p.138). 'See it emerging from the waves, listen to it', he writes (Serres 2009, p.138).

> The degree of fury and noise that a living organism can deal with, that a device, a piece of equipment, a technical apparatus can process, that it can tackle, that a science integrates, assimilates, comprehends, that an art blends into its putty or its marble or its language of sense, that a culture accepts, that it expresses, that it produces, that it accommodates, that a political system tolerates and lets alone, for the sake of freedom – this amount, this dose, if it were measurable, would tell the excellence of the organism at the top of the taxonomy, this living being speaks out rather than take refuge in the redundant order of instinct, it spreads out every which way, it deals with the sudden gusts of circumstances, it has an unstable history, this dose would tell the suppleness, the power, the refinement of the technology under consideration, hardly any noise in a lever, a bit of noise in a clock, the topography of a motor is already designed in relation to the chaos in the boiler or the cylinder, the distance that separates mechanics from the living is a difference of contingencies, of handling unrelated multiplicities, of a flexible grip on turbulences, of return to equilibrium, after an incident via unpredictable paths, this dosage would tell the subtle progress of science, the overt refinement of a civilization or the sublimity of a work of art, would tell ultimately, would tell above all the simple happiness of living as a commonality in the heart of such a city, the subtle pleasure of inventing, within the plurality, one's own conduct, one's own language, one's own individual work and private existence, one's body itself (Serres 2009, p.137-138).

The metaphysics of noise that Serres offers accommodates sound much more effectively than the metaphysics of traditional academic philosophy. It calls into question senses of self in relation to the world because, as Serres writes, 'sounds reach the monad softly, through doors and windows' but 'noise is what defines the social' and 'the moment of death is marked by the final victory of the multiple' (Serres 2008, p.107-108). Just as he claims, I feel writing this now that 'I begin to fathom the

sound and the fury, of the world and of history: the *noise'* (Serres 2009, p.7). Sound has a common history with developments in academic knowledge and society and scholars have, quite literally, filtered out the noise of the world, the murmur of the crowd, the multiple. Noise is what there is before, after and when something meaningful, like sound, is created, it surrounds, includes, underlies and is within everything.

Murmur as an Archetype of Sound

The echo, as I have mentioned, is a redundancy, a repetition, perhaps the 'minimal redundancy, the initial repetition, incipient dawn above the waters of chaos' (Serres 2009, p.118). Echoes are sounds that give a perception of distance and, at once, of proximity. Heard from a source and from a series of reflections, they are not just lines of flight that crisscross, that bind a space and its inhabitants together, but resonances. They are of intensity and activity rather than location. Continuous and yet divisible into discontinuous sites, they can be heard as unitary but are multiple. Eventually, if there are enough of them, echoes become murmur. A murmur is composed of echoes. *Murmur* is a multiplicity of echoes.

According to Michel Serres, 'the word *murmur* in our languages is used to describe a repetitive and straightforward propagation…it is only a murmur when its voice is hardly audible, at the beginning' (Serres 2009, p.58). However, for Serres, 'a murmur is not primal', instead *Murs*, the French for walls, is the primal noise, '*Murs*, the atoms of murmurs, walls, the atoms of wails, walls, the atoms of noise' (Serres 2009, p.62). He plays on words, offering a speculative etymology of murmurs and presenting his conception of *noise* as that of imperceptible *walls* around perception. Maria Assad explains that, to Serres, 'the écho of Ur-noise bouncing off the *mur* creates *mur-murs* which will eventually grow into the clamor of history' (Assad 1999). The multiplicity of sound means there can be no Ur-sound and the 'Ur-noise' of which Serres writes is such due to its status as the potential in which the actual is grounded. There is not an *original* noise but an *originating noise*. Serres asks:

> Can we imagine a chaotic and primal multiple with respect to knowledge, a confused murmur, a noise that precedes and underlies the classified encyclopedia? I would like to hear the clamor of intellection in its nascent state, the rage to know (Serres 2009, p.100).

Here I have presented a murmur of the study of sound that originates in just such a noise. A hearing of some of the most prominent voices involved in that study and the murmur that they have created, as well as other murmurs that have been suppressed or ignored along the way. The clamor of those who have tried to know sound, 'the rage to know' as it has been expressed in respect to sound. I have found that there is no essence to sound. Sound has been produced by an interdisciplinary murmur.

Early studies of applied acoustics in ancient Greece traced the voice, as the earliest archetype of sound. So when the voice echoed, researchers were presented with signal, rhythm, a periodic sound. There was the inspiration for the wave analogy and its purest, most mathematically precise, archetype, the sine tone, which would form the basis of the scientific theory of sound and subsequently facilitate the development of phonography. However, as soon as there is more than one voice, echoes develop into murmur and, as I have shown, sound cannot be defined.

It is easy to think of the voice, or the sine tone, or even the *hi-fi* recording or *object sonore*, as an ideal example of sound. However, none of these say much about sound. Instead their stories are those of the history of academic study, of a world of *things* made known, conquered. Meanwhile, murmur whispers of a world always on the edge of perception, the sort of world that is better heard, listened to, sounded. Murmur cannot be ideal, perfect or pure – indeed that is part of the point – but it is a typical, archetypal, instance of sound.

Early applied knowledge about sound was developed in studies of the voice, music and acoustics for almost two thousand years from the time of the ancient Greeks. Notions of religious and musical harmony dominated and scholasticism allowed little development in knowledge over that time. Importantly, a politics of noise was present even then with meaningful sound distinguished from the noise of the world. Eventually, scholarship began to develop further in the Renaissance and Leonardo da Vinci, as I have mentioned, wrote about sound using the metaphor of *tremors* in a body of water (Kemp 2006, p.114). Although his work, following that of many others such as the Greek philosophers, would provide a foundation for theories of sound and in particular the wave theory, it is interesting in hindsight to consider his choice of terminology. The word *tremors* suggests multiples lines of movement, murmur, which may or may not be audible, while *wave*, a term he could just as easily have employed, creates a *thing* that is moving rather than articulating the movement itself. Still his tremors were never given enough volume to build up the required magnitude to break the wave.

Subsequently, it was *wave* that became the word used to describe sound with the rise of the sciences during the Enlightenment. Helmholtz used Fourier's heat equations to develop a mathematical wave theory of sound and in doing so was, as Kahn writes, 'compelled to rid his study of noise from the outset…he directed his readers away from the noise and noisy figures of 'the splashing of water…the splashing or seething of a waterfall or of the waves of the sea' and directed their imagination instead to a stone dropped into calm water' (Kahn 2001, p.79). Here, in a small body of still water, the wave theory explains the action of sound, but it does so only by imposing boundaries, and if the waves were to build in intensity eventually they would break up into noise. Kept to such scale that their murmur was, apparently, inaudible.

Gradually the image of sound as a wave on the surface of a body of water became the foundation for further attempts first to visualise and later, with the use of new instruments, inscribe sound so that it could be viewed objectively. This led to a focus on vibration as the basis for sound that persists to this day. Meanwhile, the scientific theory of sound and its development was paralleled by the development of modern notions of private property and individual liberty which involved the separation of acoustic spaces and regulation of noise in public space, pushing music indoors and making it a private affair, effectively silencing the murmur of the crowd in favour of the voices of a few.

The development of phonography and other technologies of sound reproduction, manipulation and transmission such as the radio and telephone have since altered the way people approach sound completely such that, as Sterne notes, 'sound technologies are said to have amplified and extended sound and our sense of hearing across time and space' (Sterne 2003, p.6). Sound has become *schizophonic*, *schizochronic* and, at least at times, material so that it is available. Importantly, however, such technologies have always been marketed for their *high fidelity* to an *original* source and when such a source is not audible the transducer itself becomes the site of the sound, creating a technological sound. The murmur of the noises of infidelity are kept at bay, the wave is not allowed to break up and sound is held still. Despite the interest of inventors involved with the development of phonography in its use as a *democratic* technology, a mass market for music developed. Instead of being used for *preservation* the technology assisted in the emergence of what Attali calls a 'culture of repetition', which rendered sound as a material commodity stored on media to be privately bought and sold. Extending its utilitarian appropriation further, sound has since been weaponised with the vast *unsound* of ultrasound and infrasound plumbed to supplement the available frequencies.

It is only in the last century, in the work of artists, phenomenologists and other philosophers and, most recently, theorists working in sound studies – particularly those who do not just address sound as an object but take inspiration from it to deal with subjects, objects and affects as intertwined – that attention has gradually turned to listening as a way of addressing sound and, in turn, finding new approaches to the world. Cage's use of silence in his music, in particular, allowed noise in. His discovery that he could not hear absolute silence led him from an interest in *all sound* to *always sound*, that in turn has led to a kind of *panaurality* in which, as LaBelle notes, 'sound is both all over and particular, global and geographically specific' (LaBelle 2006, p.297). However, Cage's work involved silencing on many levels. Similarly, the work of Pierre Schaeffer and his *musique concrète* built from the *objet sonore* silenced the meaningful aspects of sound to allow individual sounds to be appreciated aesthetically and R. Murray Schafer's acoustic ecology has developed *clairaudience*, a theory of listening that involves a silencing of all but *natural* sounds. All these artists and the phenomenological approach central to their work have focused on audibility without accounting for what exists beyond the horizon of sound. Therefore, while they laid the foundation for an *auditory turn*, like the scientific theory of sound, their work failed to hear sound of the complexity of murmur.

Contemporary thinkers such as Frances Dyson, Brandon LaBelle and Seth Kim-Cohen attempt to address the assumptions commonly made about sound in their work and suggest approaches to sound as multiple but each does so with a specific focus on the arts. Specifically, Dyson's work represents an attempt to use theory around sound to find a fresh approach to new media, LaBelle's a history of sound art and Kim-Cohen's a call for what he calls a 'non cochlear sonic art' that includes the conceptual. Each are rare examples of sound theorists that apply the ideas of twentieth century philosophers in their research, and their work is invaluable. Still I feel that, apart from using new understandings of sound in the arts, there is a need to go further. When closely studied, sound suggests alternative metaphysics that not only support different modes of thought but beyond that demand that people reconsider some of the assumptions they make everyday about the nature of reality and their place in it.

It is in the work of contemporary philosophers, themselves inspired by sound, silence and noise, that I have found a new way of approaching sound – in particular the work of philosophers of the multiple such as Michel Serres, Gilles Deleuze and Felix Guattari. In particular, Deleuze offers an ontology based in difference. This allows an approach to sound based on its individuation as a multivocal *haecceity* that is differentiated from the protean ocean of Serres's metaphysics of noise, clearly demonstrated with the example of murmur.

Murmur, sounded, is imitative, echoic, onomatopoeic, full of both meaning and noise, breath as much as word, a verb as often as a noun. It is a rare example of sonic language. Murmur itself murmurs. Always differing, as a result, sound, as murmur, is heterogeneous, like a day or a season. It should not be heard or thought as singular and homogenous. It is most interesting when not ideal. It involves activity, change and movement, and so cannot be held still in place as something, some sort of property. Nevertheless, there are many of examples of murmur – a heart murmur, a murmur of discontent, a roomful of murmur, the murmur of the wind, the murmur of machines, the murmur of rumour, the murmur of a crowd, the murmur of the sea, the murmur of the multiple.

Murmur is always there when I hear. Similarly, when I listen to any particular murmur it is always already there. There is, therefore, no originary murmur, nothing primal about it. I have demonstrated this in presenting a history of the study of sound, which itself serves as an example of murmur. Listening to, reciting and following the many voices that have contributed to the murmur out of which sound has been formed, I've offered an account of sound as a multiplicity that has been formed from a murmur. Murmur is itinerant and the study of sound, like other examples, demonstrates this. It is specific but spatially dispersed. Multiple voices together form a discernable field, sound studies, but are themselves spread across different spaces and times, traversing topographies of language, disciplinarity and geography. Despite this, scholars, of both formal and informal varieties, connect with one another, their work perhaps resonating with, conflicting with or confusing that of others, but always possessing social dimensions and making possible new associations. Emphasising the possibility of conflict, murmur can be understood as a kind of turbulence; disturbance, trouble. It contains repetition and redundancy but at the same time it is irregular and unreliable, always on the threshold of noise and at the same time full of silences. The study of sound, in this way, is formed of tropes that have been repeated to the point of being heard, usually mistakenly, as self-evident, total and universal truths, heterodox approaches that interfere, meddle and complicate, and intermittently imposed silences.

Murmur argues that sound is a cultural artefact as much as a sense perception or phenomenon, formed by the history of its study and exisiting as a multiplicity. It has been differentiated and named as a result of academic study that has been concerned with the voice, music, noise and silence as frequently as sound itself. Although it does exist as a wave perceptible to the human ear and brain, it is divisible into the simplex of the sine tone and it can be inscribed into a material form, at the same time it exists in a multiplicity of other ways. Idealised instances of sound such as the voice, sine tone, *high fidelity* recording and *objet sonore* are frequently presented as pure and simple but while such examples of sound may be simple, they are never pure and are therefore problematic archetypes of sound.

It is possible to study the transmission of sound as a wave, dissect the physiological processes involved when it is heard, develop technologies that can record, manipulate and store sound and use it to create artworks and culture of many kinds, all worthy and valuable pursuits, but each should be undertaken with an understanding of the reductive maneuvers involved and an ear to archetypes of sound that demonstrate its complexity, such as murmur. Murmur is, for this reason, a useful archetype of sound. Although murmur is a *haecceity*, a thisness, whenever it is thought – assembled from a constellation of disparate elements drawn into relation with one another – it is, nonetheless, always before, after and around, multiple.

Murmur, as an archetypal sound, undermines the many assumptions of the disciplines that have dominated the history of the study of sound. Murmur is differentiated from *noise*, that is, the undifferentiated, chaos; it is defined in a variety of ways but is, ultimately, indefinable. Murmur calls into question accepted notions of individual identity, ontological stability and periodicity and eschews independence, reproduction and universality in favour of specificity, variability and multiplicity.

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Conclusion

It is easy to think that the world is something solid, composed of *things* that can be grasped, but, even if people must live their day-to-day lives concerned with the things around them, sound's existence offers an opening to the manifold. Necessarily, as I have suggested, thinking about sound in this way leads to questions around individuals' being and sense of self. Sound is aural – it is associated with *aura*, with breath, breeze, and, therefore, life.

It has been my intention here to attempt to offer a history, mythology and philosophy of sound that emphasizes the dominance of various disciplines at different times, such as philosophy, the sciences and the arts. Similarly I have sought to follow the influence of particular ideas, images and technologies, such the wave, sine tone and phonography, on sound's study and, hence, existence. I have presented a hearing of the murmur of sound's history. I have sought to listen to the murmur that exists between the wave and when it breaks up as noise. Beyond that I have attempted to show that sound is problematic when discussed within traditional academic metaphysics. Sound is, instead, best discussed using metaphysics that emphasise presence, difference and activity.

I undertook work on *Murmur* with a desire to know sound. Instead, rather than learning about sound, I have, principally, learnt from sound. I find now that an emphasis on the multiple, on a thinking based in aurality, guides my thought.

The principals I have applied to sound apply just as much to any *individual*. As Gilles Deleuze and Felix Guattari argue, 'you are longitude and latitude, a set of speeds and slownesses between unformed particles, a set of nonsubjectified affects. You have the individuality of a day, a season, a year, a *life* (regardless of its duration) – a climate, a wind, a fog, a swarm, a pack (regardless of its regularity)' (Deleuze & Guattari 1987, p.262). My voice, along with the others presented here, is not always cohesive and singular. Instead it is itself multiple – it is dynamic, heterogeneous and, at times, disparate.

Michel Serres argues that time marches toward the determined and that 'our body comes down time, it comes down the valley, the thalweg of difference' (Serres 2009, p.35). 'It runs fatally along determination' (Serres 2009, p.35). 'The old man's interest lies in his determinateness, his body has as a whole become memory…the entire volume of the old body is occupied by archives, museums, traces, narratives, as if it had filled up with circumstances' (Serres 2009, p.33). He argues, 'the more the human body is young and the more it is possible, the more it is capable of multiplicity, and the more time it has: not time in its length and duration, but the more kinds of time, the more varieties of riverbeds it has to flow down, the more valleys it has before it' (Serres 2009, p.34-35). Conversely, for Serres, 'old age fades away, determined by the rumor of its memory, fixed by the noise of its history' (Serres 2009, p.33).

He asks 'When I just plain think, without a direct object complement, without determination, who am I?' (Serres 2009, p.30-31). He answers: 'the I is nobody in particular, it is not a singularity, it has no contours, it is the blankness of all colors and all nuances, an open and translucent welcome of a multiplicity of thoughts, it is therefore the possible' (Serres 2009, p.31). He believes 'it is imperative to be nothing, all you need to think is to be nobody' (Serres 2009, p.34). It is an important point, although I prefer to think of the I as *anybody,* or an instance of *everybody,* rather than *nobody,* because despite the complexity of identity the I remains, I remain, in some way, both embodied and not completed determined, not yet finished. In any case, Serres sees the whore, the statesman, the made up face on television and actor wearing the *persona* as examples of *nobodies*, having erased difference and left aside singularity such that on each smooth face 'is the capacity of the multiple that can be called the possible' (Serres 2009, p.29).

It is common to refer to people as *persons*. An interesting thought given that, as I have explained, the term comes from the Greek word *persona,* referring to the mask of a performer. I am a *person*. But this itself is a simplification – a reductive maneuver that gives the impression that I as an *individual*, I as distinct and discrete, am somehow whole and complete. This is not the case. I am, particularly as I think, I speak and I write, suffused with murmur. I have many *personas*, many identities that I present at different times and with different people, consciously or not, and each of them is, in turn, composed of the voices of others. I am not one, but multiple, and my identity is unstable – my many voices murmur, they mingle with one another and the voices around them and eventually are lost in the murmur.

Murmur is an example of sound that presents many possibilities. In particular, it offers a model with which to understand and recite the history of the study of sound. This is demonstrated by the way in which, as I have shown, murmur can be heard throughout the history of the study of sound, as turbulence that has been disregarded and discarded in the turning of attention to idealied instances of sound as well as in the way in which the many voices that have contributed to defining and studying sound, so often treated as discrete and individual, encircle and inform one another. As a result, the concept of murmur can be used to form new approaches to sound. I find that dealing with sound as murmur, as I have discussed, necessitates an approach that emphasises contingency, mutuality and complexity. This involves taking on the challenge of addressing the interdependence of and interaction between the multiplicity of subjects, objects and affects. Murmur is, therefore, an example of sound that, rather than being idealised, emphasises the multiplicity of sound, directing listening outwards and encouraging listeners to open themselves to the multiple.

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