The Materiality of Space*

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Space is a concept central to music. Particular spaces can be seen as the enablers and analogues of social configurations for music-making. Thus, for example, concert halls, clubs or cathedrals determine significant aspects of the social and auditory presence of heard music, in terms of concepts such as proximity, separation, resonance, silence, community. Recording technologies have forced us to reconsider musical space as a much more complex phenomenon, including the possible presence of imaginary spaces. Bearing in mind Henri Lefebvre's assertion that space must be 'produced', and starting from Pierre Schaeffer's notion of spatial development, this article considers the 'materiality' of space and the implications of such materiality for thinking about music and sound. Taking the recent reconstruction of the Denman exponential horn at the British Science Museum as an emblem, in relation to the recent resurgence of interest in historic sound recording practices, space is considered in relation to current discussions of material culture.

1. INTRODUCTION

When Pierre Schaeffer proposes 'to provide the sound objects of concrete music with a spatial development in keeping with their forms' (Schaeffer 2012: 99) he touches on a matter of critical importance for sound and music: sounds exist in space, and space is an indelible component of the experience of listening. Music, indeed, inhabits some very particular spaces, such as the cathedral, the club or the concert hall, that determine significant aspects of its auditory and social presence and meaning. These aspects could be identified in terms of concepts such as resonance, silence, proximity, separation, community and so on. Architectural acoustics provides the relevant domain of knowledge with concepts and measurements. Yet Schaeffer's notion of spatial development introduces a mobile, temporal and hermeneutic approach to space. Here space is *explored by* sound, rather than merely registering it. The relation between sound and space is articulated by the proposal that there *could be* a 'spatial development' of sounds 'in keeping with their forms'. Perhaps this is merely an intuition on Schaeffer's part, yet it is an intuition that rings true, and that has provided the impetus for more than half a century of creative experimentation in the spatialisation of sound (cf. *Organised Sound* 3(2): August 1998).

However, Schaeffer's spatial development aspires to be more than mere motion. In coupling space with the forms of sounds, the notion of spatial development aims at a poetics of space, such as that attempted for the literary imagination by Gaston Bachelard (1994). Bachelard's insights depend on a philosophical practice that he characterises as phenomenology, 'that is to say, consideration of the onset of an image in an individual consciousness' (Bachelard 1994: xix). Where Bachelard is concerned with literary images of space, Schaeffer is concerned with sonorous images of space, but both have in common the experience of space as a material encounter. It is the nature of this spatial materiality that I wish to explore here.

As an espoused phenomenologist, Bachelard himself gives some insights into the nature of such material encounters: 'The first specific instance of the notion of matter is resistance' (Bachelard 1953: 10).[1] Thus materials are not simply disclosed to us: their resistance requires us to enter into an active relationship with them. This relationship is once again not straightforward, as an act of bonding, or of mastery, but comes within the domain of what Pierre Bourdieu defines as the habitus, where 'objects of knowledge are constructed, not passively recorded and … the principle of this construction is the system of structured, structuring dispositions, the habitus, which is constituted in practice' (Bourdieu 1990: 52) This resistance of material engages us in a set of socially determined practices, evolved in historic relationship with the material on the one hand and with our fellow beings on the other. It induces what Bachelard calls an active materialism, in which 'every philosophy that engages will find, at the very least, its metaphors, the true force of its expressions, in short its whole language in the resistance of the matter' (Bachelard 1953: 11).[2] Thus we need actually to engage with material

*This article is a revised version of a presentation given as part of a panel, together with Simon Emmerson, Sally Jane Norman and Simon Waters, at the conference Musical Materialities, 27–29 June 2014, University of Sussex.

[1] 'La première instance spécifique de la notion de matière est la résistance.'

[2] 'Alors le matérialisme actif commence et toute philosophie qui travaille trouvera, pour le moins, ses métaphores, la force même de ses expressions, bref tout son langage dans la résistance de la matière.'

Organised Sound **20**(3): 323–330 © Cambridge University Press, 2015. doi:10.1017/S1355771815000254

https://doi.org/10.1017/S1355771815000254 Published online by Cambridge University Press

practices, in all their social determination and objective insufficiency, before we can speak sensibly about the material itself.

Bachelard, however, warns us further that the matter is not itself already isolated for our ease of approach, 'since the substance is given, naturally given, it is not pure. It will become pure when technique will have purified it. There is thus an essential metaphysical difference between a materialism connected to raw matter and a materialism drawn from a coherent, dematerialised substance that carries the evidence of techniques of purification' (Bachelard 1953: 80).[3] This tells us that the ideal notion of space we carry may contain other sorts of impurities: precisely those 'techniques of purification' that allow us to speak of 'space' at all.

The writings of Henri Lefebvre also come into this issue, albeit from another angle. Lefebvre shows us that space is intimately connected to its inhabitants in ways that deeply affect our possible understanding of music and sound. As Lefebvre notes, 'Physical space has no "reality" without the energy that is deployed within it' (Lefebvre 1991: 13). This presents sound as in fact one of the defining forces of space. However, both these approaches assume a pragmatic, externalised engagement with space. Perhaps most critically, Bachelard also draws our attention to the twofold nature of the engagements and techniques he discusses, drawing together the outer world of sensory encounter with the inner world of thought and imagination. This twofold nature arises from 'the total separation between the rational life and the life of dreams, thus accepting a double life; that of the existence of the night, and that of the existence of the day, the double foundation of a complete anthropology' (Bachelard 1953: 19).[4]

These are the terms within which I want to attempt an exploration of the space of sound and music as a material encounter, rather than as the delineation of an abstract and neutral geometry. The nature of such an assumption of materiality will be questioned further, and some exploratory metaphors will be drawn from it. As an example of a practical encounter with space as material, the recent reconstruction of the Denman exponential horn at the British Science Museum will be discussed. This installation is emblematic of the recent resurgence of interest in historic practices of sound recording and amplification that take materiality as a fundamental attribute of sound through the presence of mechanical devices and material objects. How can space be drawn into this discussion?

2. THE DENMAN HORN

In the summer of 2014, the British Science Museum in South Kensington, London, presented an exhibition: The Exponential Horn: In Search of Perfect Sound. The curator was the composer and sound artist Aleks Kolkowski, who had overseen the reconstruction of an enormous exponential horn loudspeaker, which was the centre of the exhibition. The loudspeaker measured 8.23m (27 feet) in length, with a cross-section that curved exponentially from 27mm ($1^1/_{16}$ in.) to a massive 2.16m sq. (7 feet 1 in. sq.) at the horn mouth. It was designed in 1929 by the Museum's then curator of 'Electrical Communication' R. P. G. Denman, 'to provide a standard by which commercial apparatus could be judged',[5] and it was connected to an electrical compression driver built by the American company Western Electric, designed for use in the cinema sound systems that were then just emerging. The horn, in the original Science Museum exhibition, was used for public performances of material received directly from BBC broadcasts on the London Regional and National stations, and it attracted considerable public interest. Unfortunately the horn was destroyed in an accident, and only the plans remained.

The spectacular nature of this device presents, for me, an almost magical image: like the so-called 'worm-hole' theorised in astro-physics as the connection between parallel universes, or the rabbit hole in 'Alice in Wonderland' (Carroll 1865) that leads to a place of strangely shifting relative sizes, the acoustic horn connects one space with another, where those spaces have clearly incommensurable properties. At one end, there is a physical space encoded as electrical impulses – the broadcast programme; at the other end, a physical space responding to acoustic energy – the hall. In between them, the horn itself encloses a space, which it collapses or expands as it mediates between the material circumstances at each end of its trajectory: the space of the listener and the space of the broadcast sound. It is a sort of space engine, and the excitement is in the way the Denman horn reveals what the black box of a more familiar loudspeaker conceals. The horn reveals the intimate connection of space and amplification.

From the start of sound recording in the 1870s, horns have figured prominently as a conduit of both recording and reproduction. The classic gramophone horn, as seen in the logo for the company His Master's

[3]'puisque la substance est donnée, naturellement donnée, elle n'est pas pure. Elle sera pure quand la technique l'aura purifiée. Il y a donc une différence métaphysique essentielle entre un matérialisme attaché à la matière brute et un matérialisme instruit sur un ensemble cohérent de matières qui portent un témoignage de pureté technique.'

[4]'Ainsi les problèmes du matérialisme se poseront d'autant plus nettement que nous réaliserons plus franchement une totale séparation entre la vie rationnelle et la vie onirique, en acceptant une double vie, celle de l'homme nocturne et de l'homme diurne, double base d'une anthropologie complète.'

[5]Inside the Science Museum blog: http://blog.sciencemuseum.org.uk/insight/2014/04/24/in-search-of-perfect-sound-introducing-britains-largest-horn-loudspeaker/ (accessed 13 February 2015).

https://doi.org/10.1017/S1355771815000254 Published online by Cambridge University Press

Voice, was conical, but a conical horn produces a certain amount of acoustic distortion since its cross-section does not increase in regular steps along its length. In a paper to the American Institute of Electrical Engineers, C. R. Hanna and J. Slepian (Hanna and Slepian 1924) described the principles behind the exponential horn; a device whose cross-section does increase in regular steps along its length, thus allowing the regular expansion of the physical airwave, minimising acoustic distortion. Since that time, such horns have been important components of sound reproduction technology. However, even the exponential horn has some acoustic limitations, and the 8m Denman horn at the Science Museum demonstrates the physical scale required to achieve a high level of acoustic fidelity.

3. SPACE, SOUND AND PERCEPTION

The sheer length of the Denman horn provokes an element of visual astonishment. It also brings us to a consideration of the notion of proximity in relation to sound. The horn not only brings a removed sound source into our immediate presence, but also allows us to experience loudness by distancing us once again from the heart of the sound. Our proximity to a sound is a critical and often an emotionally charged factor in our listening experience. This proximity is bodily, and relates to clearly defined social habits and practices. For example, what we term 'personal space', related to proprioception, maps a particular spatial relationship in terms of both physiological response and qualitative experience. Thus the whine of a mosquito, quite apart from its threat of actual penetration, can come too close, and human aggression often presents sound 'in your face' in a physical enactment of trespass. Similarly a distant sound presents as physically separate, and is often accompanied by a sense of loss or longing.

These examples present what could be see as twin 'resistances' in the material of space. They locate the poles of proximity in terms of spatial characteristics that require specific types of physical encounter and interrogation. To become accepting of, or accustomed to either extreme physical closeness or extreme physical distance of a sound requires us to develop an appropriate experiential practice. Similarly, the resonance of a space, as an index to its 'space-ness', has an impact not only on the relative situation of the sounds that happen there but also on our sense of the space itself. Resonance betrays aspects of spaces that might otherwise be obscure. The sense of proximity to or distance from a source is paralleled by the sense of compactness or expansiveness of space itself, engendering perhaps the emotional charges of claustrophobia or agoraphobia.

At this point, we might ask why would we wish to discuss space in terms of materiality? On the one hand, the provision of concepts such as proximity, separation and resonance might seem to be sufficient. And on the other hand, the notion that space has a materiality might in itself seem slightly suspect. Materiality is usually associated with solid objects, while space is most often configured as openness or emptiness, and its conceptual confines and orientation are not necessarily clearly encountered. We might, for example, understand the curved and warped spaces of theoretical topology but these remain far from our actual experience.

The examples above have tried to reveal what is palpable about space, but the real reason for trying to approach space in terms of its materiality is to reframe the notion of human perception, and to attempt an investigation of the mutual dependence of space and beings in music. As Shelley Trower points out, discourses of materiality allow us to think, 'about how objects or things interact with humans in ways that supposedly move beyond clear distinctions between them' (Trower 2012: 7). In other words, this discussion is an attempt to investigate how humans encounter space, as an equal entity in the production of the world, rather than as a conceptual frame, or as a dull 'stuff', out there and waiting to be 'perceived'. In this, both Bachelard and Bourdieu caution us about the nature of perception, with their emphases on practice, construction and resistance.

4. SPACE AND MATERIALITY

Space as we encounter it is an attribute of our inhabited environment, so perhaps we should begin there in our attempt to understand our perceptual encounter with its materiality. In James Gibson's ecological account of visual perception (Gibson 1979), he proposes three components that define the inhabited environment: medium, substances and surfaces. For human beings, the medium is air, and air – unlike, say, mud – allows us to breathe and to move freely, to encounter the wind, to smell and, crucially, to hear. Air presupposes a space, yet as Henri Lefebvre has pointed out in his extensive work *The Production of Space* (Lefebvre 1991), the very notion of space is not so straightforward as being a simple receptacle. Lefebvre shows that space, as both concept and encountered reality, is far from being 'an empty area', and he warns against 'the view of space as innocent, as free of traps or secret places' (1991: 27). For Lefebvre, space must be produced, as a set of codes, 'each characterising a particular spatial/social practice … along with that space corresponding to them' (1991: 17). This proposes an experience of space and spatiality that is complex and ambiguous. As a sociologist, Lefebvre is concerned to undermine acts of concealment, carried out for the purpose of wielding power. Thus he tries to demonstrate 'the active … role of space, as knowledge and action, in the existing mode of production' (1991: 11).

https://doi.org/10.1017/S1355771815000254 Published online by Cambridge University Press

This understanding moves us from the domain of the empirical into the realm of the social. It presents space not as something to be theorised as given to our senses, but as a palpable material that is nevertheless created, shaped and formed by human action. Like Bachelard, Lefebvre works from a social perspective, regarding any material encounter of space as a social practice, rather than as some effect of a perceptual apparatus located within individuals. This is not in any way to deny perception, but it does contextualise perception in a way that serves to divert an instrumentalist approach. This also creates a moment of concern for the notion of the 'material' itself.

In a recent paper in *Archaeological Dialogues* (Ingold 2007), the anthropologist Tim Ingold takes some well-aimed potshots at the whole enterprise of material studies. He points out that few writers in this area seem able to say what 'materiality' actually is, despite the fact that it does attempt to address a real issue: the relationships between minds and matter. As what is termed the 'materiality' of objects comes to the fore, so to Ingold the nature and experience of materials seem to recede into the depths of a discussion that obscures the flux of the world, where, in his words, 'Like all other creatures, human beings … swim in an ocean of materials' (Ingold 2007: 7). What Gibson's account of ecological perception brings to the discussion is the separation of one kind of material – medium – from another kind of material – surface – and in Ingold's view this allows a sidestepping of the whole idea of materiality as a quality, in favour of 'the multiple trails of growth and transformation' that for him characterise both materials themselves and the stories of lived interaction that they generate. Thus,

> the forms of things are not imposed from without upon an inert substrate of matter, but are continually generated and dissolved within the fluxes of materials across the interface between substances and the medium that surrounds them. Thus things are active not because they are imbued with agency but because of ways in which they are caught up in these currents of the lifeworld. (Ingold 2007: 1)

And so, in his final remark, '*The properties of materials … are not attributes but histories*' (Ingold 2007: 15, author's italics). Thus Ingold opens up both the social aspect of the discussion of material culture and a temporality that is crucial to any consideration of sound. He proposes that the encounter with space, through sound, can best be traced through narratives and I want now to consider what such narratives might consist of.

5. SPACE AND HISTORIES

Space, in Henri Lefebvre's terms, can take on the properties of a material like wax or tin: thus it can have an origin, a history of creation, uses, ownerships and processes of transformation. Its logical and mathematical attributes do not by any means account for its whole existence. Lefebvre's argument is somewhat aided by the fact that the French term *éspace* has a rather broader meaning than the English *space*. Thus, for example, economic and political spaces are not conceived of metaphorically but as determinate and demarcated, as well as disjunct and flawed by fissures. The space of sound sits neatly in Lefebvre's description:

> When we evoke 'space' we must immediately indicated what occupies that space and how it does so: the deployment of energy in relation to 'points' and within what time frame. (Lefebvre 1991: 12)

This speaks to the particular relationship between music or sound and the world. It is clear that this relationship is indeed special and fundamental: the world, for example, is not bathed in sound as it is bathed in light; there is no sonic equivalent of 'darkness', and the fact that we hear without the aid of a source of sonic 'illumination' gives sound an inherent energetic quality, unbeholden to any extra-terrestrial power source. Every sound is evidence of a particular, earthly vitality, and the provenance and impact of these vitalities create spaces. Those spaces are scored with the social imprints as well as the physical impacts of the sounds that create them. Thus, crudely put, 'club-space' is different to 'concert-space', regardless of the nature of any architectural construction that might enclose them. The same building might contain both spaces, but the nature, use and history of each space will remain separately constructed.

This construction alerts us to some potentially useful terminologies of space. Joanna Demers, in her book on experimental electronic music entitled *Listening Through the Noise* (Demers 2010), identifies the terms *place* and *location* as critical concepts that have focused recent discussions of sound and space (Demers 2010: 113–15). These seem like useful refinements in the current discussion since the starting point for any narrative is the possibility of 'spatial development'. Place, in Demers's terminology, is that particular form of space constrained to a locality and a set of conditions, created by certain social, political, physical and ecological circumstances. It is encountered through specific properties in relation to sound and music, determined in terms of the concepts mentioned earlier of proximity, separation, resonance, silence, community, genre and so on. In common with the life of materials described by Ingold, places are established in relation to the stories that accompany their presence and use, and the experience of a place is a complex phenomenon. On the one hand, a space such as a concert hall or recording studio may be identified acoustically by its so-called impulse response: its moderation of a single sound containing, theoretically, an equal portion of every frequency. This impulse response can indeed be recorded, and used to print the

https://doi.org/10.1017/S1355771815000254 Published online by Cambridge University Press

qualities of that place onto other sounds. Thus space gets itself embedded in sound and music, not only through the experience of a particular place but also through the impact of that place on the sounds that inhabit it. The impulse response changes through social action: an empty hall sounds different to a hall that is full of people. The impulse response also partially freezes time and location, since it prints the moment and experiential orientation of a place onto a flow of sound. Thus the material presence of place and location is encountered, both actually there and by transference through the technical processes of sound recording, and these places and locations have actual functions within the music. As Lelio Camilleri remarks, 'It is clear that sonic space becomes a part of the musical discourse used to mark out the musical and, in certain cases, extra-musical features of the piece' (Camilleri 2010). However, particular spaces also have social histories, and those histories relate to the invention and creation of the space, as well as to the train of events that have happened there. These histories can also be imprinted on our experience. A recording from the Vienna Musikverein or the London O_2 Arena carries an anecdotal charge, a sense of excitement that relates to our knowledge of the cultural and personal significances of those two locations. Gregory Bateson notes that the stories of our engagements with others, and with the world and its artefacts are not simply more or less ephemeral anecdotes that we tell to our friends and acquaintances: 'I come with stories – not just a supply of stories … but stories built into my very being' (Bateson 2002: 13).

The acoustic properties of spaces can be described as having particular types of attributes, and for this discussion these attributes should best be considered in the context of Gibson's ecological framing. Gibson was of course theorising the visual domain, but David Worrall (Worrall 1998), gives a convincing account of Gibson's theories in the domain of sound within space. The basic acoustic properties of a space might accord with Gibson's notion of the 'ground'. As Worrall explains:

> According to the ground theory, information contained in the ground (usually horizontal) plane is a texture gradient. The elements that make up a textured surface appear to be packed closer and closer together as the surface stretches into the distance; there is more texture detail the closer the object is to the observer. This gradient results in an impression of depth, and the spacing of the gradient's elements provides information about the distance at any point on the gradient.
>
> For sound, Gibson's ground roughly equates with background ambience and texture roughly equates with reverberance, which causes the texture of a sound to be more indistinct the further away from the auditor it is. Along with reverberation, texture gradients share other depth cues such as relative loudness (more distant elements of the gradients get softer) and spectral profile. (Worrall 1998: 96–7)

These attributes of sound have a long history of interaction with human culture, as we can tell, for example, by the story of Echo and Narcissus (cf. Graves 1960). Our listening to these spatial attributes is clearly an evolutionary cooperation with the actual places of the world. As Eric Clarke tells it, also in terms rooted in Gibson's ecological perspective:

> Rather than considering perception to be a constructive process, in which the perceiver builds structure into an internal model of the world, the ecological approach emphasizes the structure of the environment itself and regards perception as the pick-up of that already structured perceptual information. The simple, but far-reaching, assertion is that the world is not a 'blooming buzzing confusion', but is a highly structured environment subject to both the forces of nature (gravity, illumination, organic growth, the action of wind and water) and the profound impact of human beings and their cultures; and that in a reciprocal fashion perceivers are highly structured organisms that are adapted to that environment. (Clarke 2005: 2)

In this sense, technologies have expanded our spatial awareness, by presenting us with a growing set of phenomena that structure our listening: the bandwidth and artefacts of the telephone line; the distance between the sound of the surface of a vinyl disc and its contents; the consequences of MP3 compression; and so on. These perceptions allow, for example, a band such as Portishead to produce tracks where each element of the mix appears to inhabit a different space, resulting in a fractured and fragmented experience. The fracture and fragmentation here seem emblematic of the trip-hop aesthetic. Thus Portishead member Dave McDonald presents his memory of the time: 'You had hip-hop and the punk thing. And what was going on in New York – the electronic sort of dance, and hip-hop – and punk. It was all fused, fused in together' (quoted in Wheaton 2011). In the context of this discussion, different recording mediations present as the sonic imprints of places and spaces. Simon Zagorski-Thomas chooses to represent these sonic imprints as icons of 'technique', thus in Portishead's album *Dummy* (Portishead 1994):

> The professional and creative practice of the DJ and the producer are being foregrounded here by deliberately highlighting the crackle, hiss and distortion of various forms of mediation that are associated with that practice: the crackle of vinyl, the hiss of tape and the distortion added by the extreme treatments in the studio. (Zagorski-Thomas 2010: 260)

Yet the responses of the music critics to these practices clearly foregrounded their emotional and existential effects:

> Critics said it 'sounded like nothing else on earth' [Mixmag 1999]; it 'seemed to come from the past and the future at the same time.' [Lucas 1997] The band created 'an invitation to a nightmare' [Lien 1997]; 'a world so

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> ghostly you may think the C.D. player has channeled the musical netherworld.' [People 1995] (Wheaton 2011: 11)

A 'ghost' is in another space, and the last track on the *Dummy* album, 'Glory Box', for example, does appear to emanate from one of four different spatial environments within the mix. The beats and bassline seem to inhabit a space of recording normality: 'our space' you might say. The string sample is clearly distant and reverberant, and carries a weight of nostalgia emphasised by the explicit crackle of a record groove. This crackle is generic: it does not actually sit with any of the other musical elements but rather presents the space of recording itself. Finally, Beth Gibbons's voice is equalised as if coming to us down a telephone line, or some such distancing technology; freighted in with its distancing clearly audible.

These elements are already present in the Denman horn, a device that mediates three spatial circumstances: the distant situation of the programme material, the spatial manifestation of the horn itself, and the situation of the listener within the place of reproduction. The material spaces to be encountered arise out of this complex of structured artefacts.

Thus, sounds develop place, and it seems to me that they do this in different ways, depending on different time-spans: a single sound, impact or impulse excites a complex acoustic response that is palpable and is unique to that moment and that location, that is, the perceiver, through their position, co-creates the acoustic response. However, a succession of sounds, or a phrase, appears to arise in an ambience, a conflation of the instantaneous properties of place that imprints a strong affect on the sound. Only over longer time-spans do we encounter the sense of a place as it is lived, with the complex streams of sounds engendered by the inhabitations of people, heating and ventilation systems, doors and windows, insects, the expansions of wood and plaster, and the social interactions allowed and facilitated by the space and its histories. These material experiences of place register in many ways, but always as some mode of aural attentiveness capable of invoking active response: through physical engagements like dancing; through acts of practical interference identified as processes of tuning or moderation (cf. Coyne 2010); through manifestations of momentary surprise, or as emotional entanglement with the affect or social codes of behaviour within the place; and so on.

The acoustic attributes of place also allow the possibility of non-places, as Marc Augé has defined them. A non-place is 'a space which cannot be defined as relational, or historical, or concerned with identity' (Augé 1995: 77–8); it speaks to a slightly dystopian view of the networked, transnational world of anonymous malls and hotel lobbies of our contemporary world. In the realm of recorded sound, the distributed space of the commercial recording studio, as described by Paul Théberge (Théberge 2004), acts as a sort of non-place, its artificially constructed resonances and reverberations producing the outward semblance of a place that does not correspond to any actual circumstance. These non-places may still be experienced as material artefacts however, and loved and valued for the encounters that they allow. Thus Simon Frith remarks:

> I listen to records in the full knowledge that what I hear is something that never existed, that never could exist, as a 'performance,' something happening in a single time and space; nevertheless, it is now happening, in a single time and space: it is thus a performance and I hear it as one. (Frith 1996: 211)

As Ingold also asserts, they have their stories of material process and transformation, their possibilities and actualities, and their ability to get caught up in social and personal affects that constitute material engagement.

The concept of location, what Lefebvre called 'the deployment of energy in relation to "points"', might perhaps be regarded as the most substantial aspect of space, since it places sounds and actors in identifiable positions with the same intransigence as a stone encountering the point of a finger. This is not to say that human auditory perception is able to locate all frequencies with equal accuracy, or to resolve all the spatial cues within one location. The fire engine often appears frustratingly indeterminate with respect to its trajectory, and recorded sound reproduction presents the possibility of the spatial simulacrum of stereo or surround-sound, where the image of spatial location invades the actual location of the listener with the effect that things are not arranged spatially as they seem; as if two quite separate places had become impacted.

Nevertheless, location provides the sonic evidence of the extension that we suppose space to have. Those images of extension and simulacrum are presented impressively by the Denman horn which locates itself physically in two clearly differentiated spaces: the one listened in, and the one listened to, each with its own set of locations. In this way location becomes evident as more than the implacable phenomenon of spatial extension, and starts to encompass notions that are geographical and historical. Radio and sound recording allow quite different locations to appear where you are, and those locations can bear tangible, material imprints: the sounds of instruments playing as no instruments now play, or the energy of a music identifiable as coming from a different place. One could say that sound recording has allowed the trading of space: as the acquisition and sharing of actual locations, (both current and historical), ambiences, social spheres and constructed non-places. The nature of this trade has altered as new means of registering and constructing spaces have appeared: the cylinder or disc; the telephone; the radio; the Internet; and so on.

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6. SPACE, PLACE AND VOLUME

The Denman horn, of course, is an amplifier, and amplification needs to be considered in this context as a spatial practice. As described above, the horn increases its spatial capacity as a function of distance from the source. The listener occupies the space precisely at the end of the horn, as if enveloped by the horn's continuation. The engine of the horn transports sound from one end to the other, as it transports the listener in the opposite direction. What I am saying here is that the loudspeaker creates the space of the sound at the location of the listener: as if the listener and the sound occupied precisely the same space. The amplification consists in placing the ear 'close' to the source of the sound. This becomes more complicated if the 'sound' itself already encodes a further space, as it almost certainly does. This image allows us to consider the 'volume' of a sound as a spatial construct. It also represents 'volume' as a question of distance, in relation to the proprioceptive construction of individual space discussed previously: too quiet, and we are not yet at the source space of the sound; too loud and we are actually within the absolute origin of the sound. It is clear that loudness is also a social construction (cf. Devine 2013), where the 'listening formations' Devine discusses can also be viewed as the result of spatial strategies. Loud sound is impressive, frightening and addictive. This spatial representation of loudness, with its implication of presence at an absolute origin, proposes almost a fusion between the space of a sound and the space of a living being: an impaction of two spatialities – what Gilles Deleuze and Félix Guattari might count as 'becoming-music' (Deleuze and Guattari 1987: 299ff.).

Space is also clearly implicated in the discussions surrounding music in relation to health and well-being, where the capacity of humans to engage with space as an equal becomes critical. Both Tia DeNora, in her accounts of music in everyday life, and Richard Coyne in his investigation of what he calls 'the tuning of place' (Coyne 2010) construct narratives that present the impulses towards the self-construction of individualised places, whose material encounters are engaged with the help of the resources of networked media. The iPod and the mobile phone are powerful actors on place, through sound. In her recent book, *Music Asylums*, DeNora is clear about the spatial characteristics of the therapeutic endeavour undertaken within daily living, and about how, 'musical and sonic media enable individuals and collectives to redraw the boundaries between public and private spheres' (DeNora 2013: 63). This presents contemporary space as a fractured and potentially alienated experience, whose material aspects need to be reconfigured in order to render them tractable. It delimits different spaces, as the public and private, in terms of their material properties, and the actions that can be taken within each depend on the ways in which each is experienced. In-ear listening, on headphones or ear-buds with their unrestricted portability, allows the (private) space listened-to to be written transparently onto the (public) space inhabited, giving the listener the opportunity to reframe problematic moments of their existences. Once again we see how Ingold's refusal of the notion of materiality, and its consequent solidities, in favour of stories of encounter and transformation supports an open and active approach to the material of space and its possibilities. Our encounters with space can be characterised as rhythmic, in the sense that the material presence of the world is not simply there for our sensory perception. We act on it, as it acts on us; we tend it, as it tends us; and the rhythmic flow of those encounters follows the same path as rhythm in general: where regularity or irregularity correspond to both a grain of engagement and a sense of style.

7. CONCLUSION

The start of this discussion was the contemporary reconstruction of a historic artefact, but this reconstruction is not a unique event. The physical amplification of the exponential horn arrives as part of a resurgence of interest in 'old' technologies, such as wax and tin cylinder recording and analogue audio equipment. Is this a symbolic refusal of the digital, and its illusory obfuscation of space?

I feel there is little evidence of any Luddite or reactionary tendency here, but the clarification of the material aspects of sound is salutary. These practices seem to extend a hybrid network, which now places side by side the analogue and the digital, the physical hand skills of actual materials and the organisational and algorithmic skills of digital materials in ways that test the boundaries of sound's existence for us. This seeming backward step from the grand vision of ever more sophisticated digital engagement presents as a stocktaking of how technologies and humans can interact. If, as I have tried to argue, sound arises out of the presence and materiality of space, this hybrid network of the analogue and the digital presents not as an opposition, but as a recognition that stories matter in the construction of space. The spatial materialities that arise from a reading of the surface of a wax cylinder or a vinyl disc extend and illuminate the spatial materialities that arise from a reading of data from the digital network. They do not replace each other. There is no originary precedence or authenticity. They reveal spatial distributions of different extension, substance, history and affect.

I have tried to consider ways of thinking about the material experience of space, through sound, without much consideration of the nature of space as it is physically encountered. Space in its raw apprehension is not unstructured. As Gregory Bateson points out, left and right are impossible to define logically, while on the earth

https://doi.org/10.1017/S1355771815000254 Published online by Cambridge University Press

up and down are clearly definable (Bateson 2002: 77–8). This points to the distinctions between symmetry and a-symmetry, but it also shows a way in which the body itself defines the spaces it inhabits. Left and right experience comes only from proprioceptive determination, while up and down get imposed on us through gravity. As Buckminster Fuller observed, on the earth we experience the 'in pull of' and 'out forcing from' its gravity; the terms 'up' and 'down' being used metaphorically from a non-flat-earth (human) world perspective (Fuller 1979: 541.02, 541.03).[6] In thinking about space and embodiment, we should remember that space and body are intertwined through proprioception, and that it is perhaps this fact that allows us to encounter space as a material, incorporated into the very fabric of our existences. The materiality of space seems important to us, not least because of the technologies we create and invoke in response to its mysteries. Schaeffer's notion of spatial development incites us to continue our phenomenological encounters with it.

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[6]I am grateful to one of the anonymous reviewers for this observation.

https://doi.org/10.1017/S1355771815000254 Published online by Cambridge University Press