COMPOSING WITH TIMBRE:
Saturation, (Dis)integration and Space

A portfolio of eight original compositions
with written commentary

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Acknowledgements

Abstract

This project, consisting of eight original works and an accompanying commentary, explores in depth a timbre-focused approach to composition. Tracing the genesis of these works, I outline the methods that emerged as I sought to sculpt complex sonorities and larger forms—investigating the reciprocal relationship between discourse and timbre at both a micro and macro level. Each of the four chapters presented is thus allied to a broad organisational scheme: integration, disintegration and saturation become the subject matter of Chapters One, Two and Four respectively, with specific reference made to the instrumental writing of Pierluigi Billone and Raphaël Cendo. Chapter Three, on the other hand, investigates the effects of space upon sonorities' temporal unfolding; the music of Natasha Barrett and Rebecca Saunders is cited here as central to my compositional development. Though the relationship between timbre and form is the principal lens through which the portfolio works are discussed, several interlinked research strands emerge. These include explorations of: lo-fi compositional approaches; sonic 'landscape'; noise and white noise; parataxis; 'directional' growth processes (drawing upon the spectromorphological writing of Denis Smalley); and multiply directed time. With the influence of plastic arts upon my practice increasingly apparent as the research project develops, physicality and the body become key to my discussions. Drawing particular inspiration from Italian artist, Alberto Burri, whose work is often described as eliciting a visceral and corporeal response in the viewer, I too seek to conjure something of the intimate and human out of my own ruptured musical structures. This sense of physicality, communicated in performance and encouraged by the materials upon the page, is ultimately seen to be prefaced by a hands-on and tactile compositional process: a method I have found to be essential when moulding and shaping volatile and fragile matter as I compose with timbre.

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Figure 1: *Alberto Burri in Città di Castello* **(1976)** Photographer: © Aurelio Amendola – DACS, 2022 © Fondazione Palazzo Albizzini Collezione Burri, Città di Castello – DACS, 2022. Please note that the CC-BY-NC-ND licence given to this thesis does not apply to these images

Introduction

Composing with timbre

The commentary and music presented here constitute a comprehensive overview of my recent creative practice, as I have worked to explore and develop a timbre-focused approach to composition. The works included in this submission reflect a substantial aesthetic shift in my writing. Prior to doctoral study – and even during the early stages of this DMus project – 'timbre' played a limited role in my compositional thinking. At this time I viewed it primarily as a modifier of pre-existing, pitched materials, and as a means of providing surface-level coloration. It was an adjunct and a retrospective consideration: a means through which I sought to introduce micro-level movement and kineticism – most frequently through subtle alterations in instrumental playing technique[1] – to independently conceived, and often comparatively static, harmonic structures.[2] Whilst I was initially satisfied with the outcome of these works, as my interest in more marginal sonorities grew, and as increasingly 'extended' techniques and noise-based sounds became more ubiquitous in my writing, I started to question the relationship (and perceived non-correspondence) between materials and their temporal unfolding within the broader compositional design.

Working with complex, often unstable, sonorities at sound object level, I found myself confronted with timbres whose morphologies and sonic histories were highly intricate and detailed: individual sounds which, as Ligeti observes, might themselves be heard as 'complete, through tiny, autarchic form(s)'.[3] This zoomed-in perspective of timbre-as-form aligns with the terminology of Pierre Schaeffer too (a key source throughout this commentary). For Schaeffer, the word 'form' holds a very particular meaning in his *Traité des objets musicaux*,[4] used exclusively to describe the temporal evolution of a single sound object:

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[1] Typically, these techniques would result in sonorities in which the written pitch(es) remain(s) clearly discernible, but new elements – overtones, increased breath profile etc. – were added; or, alternatively, the spectrum of sound was curtailed or filtered in some way. With musical discourse unfolding here primarily through pitch content, timbres/colorations were, to my ear, to an extent interchangeable and, as such, chosen relatively arbitrarily. That is to say – to borrow from the field of musical semiotics – an array of 'paradigmatic' units could be exchanged, without the syntagmatic flow being affected (so long as harmonic attributes remained clearly perceptible): see Victor Kofi Agawu, *Music as Discourse* (Oxford: Oxford University Press, 2014).

[2] Typically, this approach would first entail the creation of a series of chord rotations (a method discussed in detail during Chapter Two). Initially conceived at the piano, these harmonic progressions were sketched out temporally and then retrospectively 'orchestrated', with marginal sounds and extended techniques distributed across the ensemble, as I sought to weather, fragment and colour the global texture.

[3] György Ligeti, trans. Cornelius Cardew, 'Metamorphosis of Musical Form', *Die Reihe*, 7, Form – Space (1965), 5-19 (p. 18).

[4] Pierre Schaeffer, *Traité Des Objets Musicaux* (Paris: Éditions du Seuil, 2002). Michel Chion's distillation of Schaeffer's ideas (as cited below) will be the primary source used in relation to the *Traité* throughout this commentary.

form being that 'which shapes…matter in duration and perhaps makes it evolve'.[5] In this sense, individual timbres could be said to convey inherent small-scale structural implications: implications for which my existing – and pitch-centric– early doctoral compositional strategies were ill-suited. Moreover, timbre in this context becomes an emergent entity, whose very character and definition are 'woven' into the 'spectromorphological fabric'[6] of the music—registering through sound objects' unfolding in time. As such, when composing with extended sonorities as the principal compositional resource, it quickly becomes impossible, as Denis Smalley observes, 'to disentangle timbre and discourse'.[7]

The two entities become flip sides of the same coin: such are the morphological characteristics innate within particularly complex 'raw' sound objects that, as Pierre Boulez notes, timbre has the capacity to 'form the entire discourse on its own'.[8] As timbre unfolds, it *is* discourse.[9] And yet, when organised and structured intentionally, sound objects in combination – both on a syntagmatic and vertical level – have the potential to create and evoke the 'acoustic illusion of timbre by the way [they are] composed'.[10] As discourse unfolds, it *is* timbre. In this way, in my compositional practice, asking 'what is timbre?', or 'how is timbre functioning?' has become inextricably bound up with questions of 'how is discourse unfolding?' and 'what is form doing?'

The intersection of these two domains, timbre and discourse, becomes the focus of this project and the lens through which the portfolio works are discussed, as I devise strategies to organise my materials on both a micro and macro level: to compose with timbre.

Each chapter is aligned to a broad organisational scheme:

- In Chapter One, **Timbral Integration** is explored as the principal means of organising my materials

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[5] Michel Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, trans. by John Dack and Christine North (2009), p. 127. <http://ears.huma-num.fr/onlinePublications.html> [Accessed 1 January 2021].

[6] Denis Smalley, 'Defining Timbre — Refining Timbre', *Contemporary Music Review, 10*, 2 (1994), 35-48 (p. 43).

[7] Ibid., p. 35.

[8] Pierre Boulez, 'Timbre and Composition - Timbre and Language', *Contemporary Music Review*, 2.1 (1987), 161-171 (p. 170).

[9] Discourse is understood here as the unfolding-in-time of organised sound objects/complex timbres, predominantly on a small-to-medium scale (the 'sentence' or 'paragraph' domain, to borrow from Kofi Agawu's analogy of music as language). Discourse might thus be understood as a 'set of events, which succeed and relate to each other, the whole making a meaningful impression to the listener'—with those 'events' taking the form of a 'gesture, an idea, a motive, a progression, or more neutrally, a building block, phrase, segment or unit': see Agawu, p. 7. In my own writing, 'discourse' is often used interchangeably with the word 'form'. Conversely, I reserve the word 'structure' largely for macro-level, architectural, organisation: the pre-ordained divisions, which are often operational at a global level of my work. 'Discourse' in this commentary will thus assume a necessarily broad and flexible meaning—reflecting the mediation of musical matter and its temporal evolution across several levels of the compositional design.

[10] Boulez, p. 169.

- In Chapter Two, **Timbral Disintegration** comes to fore, as the continuum between pitch and noise is investigated

- In Chapter Three, **Timbre in Space**, an alternative approach to sonic organisation is taken, as space – both architectural and virtual – becomes bound up in sonorities' temporal unfolding

- In Chapter Four, **Timbral Saturation** moves into focus, as I seek to generate expectation patterns through the densification and overloading of the frequency spectrum

In order to contextualise my artistic approach, this commentary will trace the influence of a range of composers from past decades, whose soundworlds have informed my practice: in particular, the fragility of late-period Luigi Nono, the delicate whisperings of Salvatore Sciarrino, the sheer physicality and volatility of Pierluigi Billone, and the gestural intimacy of Rebecca Saunders. The music of the electronic tradition will become increasingly important too as the chapters progress: notably, the ambisonic work of Natasha Barrett, and the spectromorphological writing of Denis Smalley. As I seek to create new colours, textures and structural models, I increasingly turn to the plastic arts as a point of reference—drawing on the monochromes of Robert Ryman, and the highly charged and tactile canvasses of Alan Davie.

Whilst the relationship between timbre and form is the principal thread of this commentary, several interwoven and amalgamated strands – central to my thinking and critical to the evolution of my timbre-focused practice – will be identified, drawn out and interrogated in depth. These include:

- **Noise/white noise**
- **Lo-fi compositional approaches and formalised sonic 'landscapes'**[11]
- **Paratactic structures**
- **Directional processes and 'multiply directed linear time'**[12]

An ever-present theme throughout the commentary,[13] **physicality** will emerge as a central topic in the closing passages of the thesis. Here, I detail the hands-on contact – and bodily connection – I have increasingly found to be critical when dealing with timbre as the principal compositional resource.

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[11] The notion of 'landscape' – derived from the writing of Trevor Wishart – is detailed in Chapter Three.

[12] The term 'multiply directed linear time' is taken from the temporal vocabulary of Jonathan D. Kramer and is explained during Chapter Four.

[13] Although, in the first instance, necessarily implicit and unexplored, as I limit the scope of my investigation.

Commentary Outline

Whilst this commentary is centred on an exploration of timbre and its temporal unfolding, my aim is not to offer scientific answers as to how timbre might operate psychoacoustically as a morphophoric[14] musical element. Rather, each chapter will offer a personal, artistic reflection upon what timbre is, how it is formed and experienced, and how it might therefore function as part of a distinct compositional language.

List of Portfolio Compositions

- **Bríatharogaim** - for countertenor, bass clarinet, baritone and bass flute (2016)
- **fili / strands / stränge** - for three sets of loudspeakers (pre-recorded media): alto flute, accordion, violin, viola, cello, double bass, soprano and electronics (2016)
- **æsc** - for cello and piano (2017, rev. 2018)
- **Soliloquies** - for string quartet (2017)
- **Analogue** - for piano trio and microcassette dictaphones (2017)
- **Dhātu** - for two percussionists, three singers and electronics (2019)
- **Plastica** - for sextet and electronics (2020)
- **Hyphae** - for organ and electronics (2021)

Portfolio works are assigned to chapters according to theme, as opposed to their compositional chronology. On occasion, discussion of a single work is split across multiple chapters, in order to better group emergent lines of enquiry. This is notably the case with *Dhātu* (the discussion of which is divided between Chapter One and Chapter Three) and *Plastica* (whose commentary falls between Chapter Three and Chapter Four).

Two early doctoral works, *æsc* and *fili / strands / stränge*, are included within the portfolio as pre-cursor compositions. Sharing similar concerns with subsequent works within the primary portfolio – *æsc* with the tactile instrumental investigations of *Soliloqui*es, and *fili / strands / stränge* with the saturation-related experiments of *Plastica* and *Hyphae* – discussion of these works is comparatively brief, with compositional aims and thematic areas highlighted, before the reader is directed towards more detailed discussion of comparable techniques and subject matter within the six principal portfolio works.

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[14] 'Morphophoric' will be used interchangeably with 'form-bearing' in this commentary.

The following section will offer several preliminary definitions of timbre, both from an established psychoacoustical perspective, and from a personal, compositional standpoint. Along the way, I will seek to situate my work in relation to existing scholarship, and to introduce the reader to the key compositions and themes of the chapters.

What is Timbre? A psychoacoustic perspective

It is accepted science that timbre is not the result of a waveform;[15] rather, it is an 'emergent' acoustic property. This is best understood through the framework of Auditory Scene Analysis (ASA),[16] where, during the initial 'concurrent grouping' stage, components of a sound – principally spectrum, amplitude, onset and harmonicity[17] – are fused as they reach the auditory cortex. This fusion, conducted instinctively by the listener, takes place in order to identify the sound source of incoming sonic data: an instinctive and primitive response, especially when occurring in the natural world.[18] The principal factor for this sound source identification is what we might call 'timbre'.

Three core issues, vital to any exploration of timbre, are thus flagged up at this early stage of ASA: 1) timbre and a sound's source (the producer—instrument, object or sounding body) and cause (the means of production—agent, tool, implement, activity or method) are fundamentally interlinked; 2) timbre is, by definition, a multidimensional attribute;[19] 3) timbre is an 'emergent' entity: born in time, and affected by musical context, space and, crucially, the perceptual experience of its auditor.

When composing with marginal and complex sonorities, this latter phenomenological and personal understanding of timbre is perhaps most crucial to my practice,[20] as I adopt the role of composer/listener – and increasingly composer/performer[21] – in constructing my materials: embracing the subjectivities and

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[15] Stephen McAdams and Albert Bregman, 'Hearing Musical Streams', *Computer Music Journal*, 3.4 (1979), 26-43+60 (p. 40).

[16] See Albert S Bregman, *Auditory Scene Analysis* (Cambridge, Mass: MIT Press, 2006).

[17] See Curtis Roads, *Composing Electronic Music* (Oxford: Oxford University Press, 2015), p. xix; Stephen McAdams and Bruno L. Giordano, *The Oxford Handbook of Music Psychology*, 2nd edn (Oxford: Oxford University Press, 2016), pp. 113-124.

[18] See Cornelia Fales, 'The Paradox of Timbre', *Ethnomusicology*, 46.1 (2002), 56-95 (p. 62).

[19] It is, to an extent, scientifically reducible to (copious and complex) amounts of data (although too *much* data, I have concluded, to handle realistically as a composer without significant computational intervention). See Roads for recent advancements – and potential drawbacks – of multi-dimensional MPEG-7 timbral descriptors: Roads, *Composing Electronic Music*, pp. 58-62.

[20] Nonetheless, more scientific approaches to timbre do arise within this commentary: particularly the use of spectrograms (seen compositionally in relation to *fili / strands / stränge* in Chapter Four, and post-hoc/analytically in relation to *Dhātu* in Chapter Three).

[21] As detailed in Chapter Four, I use this term to describe pre-compositional mock-ups and instrumental experimentation, as opposed to my assuming the role of performer in a concert setting.

imperfections of the listening process and attending to the physical and bodily nature of this complex musical element.

Overview of Chapters

A multidimensional perspective of timbre acts as the starting point for the compositional process in **Chapter One**. In both *Dhātu* and *Soliloquies*, I begin by investigating a fragile and complex sound object: that which might be described as resulting from an 'extended technique'. Drawing upon the work of Pierre Schaeffer – in particular his morphological criteria – I define aurally, and subjectively,[22] the multidimensional properties I perceive to make up the timbral profile of my selected sonorities.

Through systematic parametric alteration, I then create an extended palette of interrelated sounds: materials which are subsequently arranged within a pre-compositional 'timbral map', or 'distance model'.[23] Influenced by the work of composers such as Trevor Wishart, Panayiotis Kokoras, Frédéric Le Bel – in addition to psychoacoustic modelling[24] – my own use of these topographical formations will be presented as distinct and particular, owing to the incorporation of physicality and 'source-cause' gesture[25] in determining their ultimate design. As materials are realised temporally within the final structure, **Timbral Integration** will become key to the unfolding of discourse; and several techniques, designed to achieve continuity, integration and perceptual fusion, will be detailed, as I retrace my steps in devising the chapter's key works.

A Schaefferian concentration upon the individual sound object remains a helpful point of reference, as we continue to draw up preliminary definitions of timbre and turn our attention to **Chapter Two**. In the latter decades of the 20th century, a now widely debated dictionary definition by the Acoustical Society of America was symptomatic of a more global oversimplification of timbre. Described as 'that attribute of auditory sensation which enables a listener to judge that two non-identical sounds, similarly presented and having the same loudness and pitch, are dissimilar',[26] timbre was relegated to the role of sonic differentiator and, implicitly, understood as a means solely to ascertain instrumental identity. With the increasing dissemination of electronic music's lexicons and theoretical frameworks, however, the timbral

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[22] Rather than employing the objective, psychoacoustic/spectrogram-facilitated approaches mentioned previously.

[23] This term is used to refer to a diagrammatic structure in which timbres judged to be similar are placed proximally to one another.

[24] See Stephen McAdams, 'Perspectives on the Contribution of Timbre to Musical Structure', *Computer Music Journal*, 23.3 (1999), 85-102.

[25] This term will be introduced in relation to the writing of Denis Smalley in Chapter One.

[26] 'ANSI S1.1-1994', *American National Standard Acoustical Terminology,* (New York: American National Standards Institute, 1994), p. 34.

definition undoubtedly shifted. In Schaeffer's *Traité*,[27] pitch becomes only *one* of several sonic characteristics, which cumulatively contribute to the identity of a sound object. Moreover, 'locatable pitch' or 'tonic sound' (the tempered building block of Western Art Music) are now by no means the only mode by which the frequency field might be occupied. Just as likely, we could be dealing with pure sounds (sine waves) or channelled sonorities, where 'locatable' tonic sounds might be present in bands or clusters. Or, moving away from a traditional notion of pitch altogether, we might identify 'nodal' sounds or nodal groups: essentially varying forms of noise texture. None of the aforementioned sonorities now falls under the remit of 'pitch', but rather under the broader category of 'mass'.

It is within this context that I will introduce the key works of **Chapter Two**: *Analogue* and *Bríatharogaim.* In both of these pieces, a process of **Timbral Disintegration** sees locatable pitch slowly morph into nodal groups and/or eventual white noise. In *Analogue*[28] this sense of gradual decay is linear: the musical discourse unfolding progressively between the two outer poles of the 'mass' continuum. In *Bríatharogaim*, on the other hand, paratactic juxtaposition of pitch and noise drives the form—ultimately stimulating a process of incremental erosion.

In **Chapter Three,** timbre's relationship with space is examined. In both *Dhātu* and the electronics of *Plastica*, a sense of form is engendered not only through perceived timbral morphology in time, but through the perceived evolution of sound objects in space. In *Dhātu*, such changes take place in 'real world' space, with several elements of the multidimensional timbre complex seen to assume new compositional significance, owing to the transformative effects of the architectural environment in which the work is performed (and/or according to the diverse spatial positions adopted by the work's performers). In *Plastica*, on the other hand, such changes take place in virtual space. 'Formalised landscapes' – evoking pre-recorded, 'historical' spaces – extrinsic sounds (conjuring up 'real-world'/non-musical environments) and the changing disposition of objects within these virtual spaces are explored as key structuring strategies within the electronic elements of the work.

Whilst in the key works of Chapter Two – *Bríatharogaim* and *Analogue* – timbre was seen to collapse, and undergo a gradual process of disintegration and erosion, **Chapter Four** will rather ask, 'what happens when the frequency domain is overloaded?' When individual instrumental timbres are forced to a point of excess and distortion, and when a work reaches a state of **Timbral Saturation**. These questions will lead me initially to discuss the music of Raphaël Cendo and Yann Robin—exponents of the 'Saturation' movement that has developed in France in recent years. Whereas, in the works of the 'Saturationists',[29]

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[27] Itself penned thirty years prior to the above dictionary definition.

[28] *Analogue* takes its name from the microcassette dictaphones used throughout by the piano trio. The lo-fi element of this work – and the conscious employment of white noise throughout – become key lines of investigation in this chapter.

[29] This word, which to the best of my knowledge is not an established term, will be used for ease when discussing the aforementioned composers.

sonic excess often appears to be a permanent state of musical being, in my own composition, saturation is invariably tied to process. In **Hyphae**, for example, endogenous and exogenous procedures intersect the discourse, generating expectation through the incremental overloading of dense frequency bands. In **Plastica**, meanwhile, I seek to communicate a fractured compositional design, through innumerable and overlapping webs of 'beginnings, middles and endings': each stage allied to its own accumulative/dissipative procedures.[30] With timbre – both individual and collective – pushed to its extremes in passages of 'global saturation', I conclude the chapter by investigating the physicality involved in the performance, perception and composition of such materials.

Finally, and as the commentary draws to a close, I widen these corporeal investigations, focusing on the bodily nature I have found to be essential in *any* compositional dealing with complex timbre. In seeking to contextualise my sculpting of form from delicate, volatile, coarse and granular materials, I ultimately return to the image of Italian artist, Alberto Burri, presented at the start of this discussion: photographed by Aurelio Amendola in 1976, blowtorch in hand, as he tends to the plastic filament of his *Combustioni*.[31] Cooling and controlling the perforated membrane with his breath, the artist mediates between matter and its eventual form directly—the volatile and molten surface shaped instinctively and viscerally through his body. Negotiated via intimate physical contact, the 'chain of pulls and tensions'[32] inherent in his materials is moulded skin-on-skin into a final 'unbalanced equilibrium'.[33]

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[30] Drawing on the writing of Jonathan D. Kramer – and a brief examination of Rebecca Saunders' *Fury II* – I will outline how these processes are conceived in 'multiply directed linear time': a temporal unfolding in which an overall sense of progression and direction is perceived (often retrospectively) in the music, even when goals and end points occur chronologically in the 'wrong' order.

[31] Alberto Burri's *Combustioni plastiche* series – started in 1957 – sees the artist mould industrial sheets of plastic primarily through the use of a blowtorch. These works take centre stage during Chapter Four of this commentary.

[32] Milton Gendel, 'Burri Makes a Picture', *Artnews*, 53.8 (1954), p. 69.

[33] Stefano Zorzi, *Parola di Burri. I Pensieri di una Vita* (Milan: Mondadori Electa, 2016), p. 32.

Chapter One: Timbral Integration

"Well, we're very much looking forward to hearing you play!" beams the shop assistant as she emerges from the store cupboard, brandishing a newly polished hire cello. Not just any cello – I'm told – but the finest they have in store. "We don't usually lend this one out!"

At that moment, I'm deeply regretting asking for the student discount. Regretting brandishing my Royal College of Music identity card. Regretting implying, inadvertently, that some kind of prodigy has stumbled through the doors of this provincial music shop on this dreary September morning. The truth is, I've never played the cello. Not a note. I don't know where to put my hands; where to hold the bow; I don't know how to balance the thing between my legs.

The shop doorbell rings. A family of four walk in. The children are hushed. The concert – they're told excitedly – is about to begin. "Well, what are you going to play for us?"

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Taking possession of the hire cello during my early doctoral studies was a watershed moment in my compositional practice. As timbre has become the central musical parameter in my writing, so too has physicality – and a connection with the instruments for which I'm composing – become essential. Not just as a strategy by which new sounds are discovered, but a means too of establishing more complex – even proprioceptive (see p. 22) – gestural relationships between sonorities. Moreover, it has proved to be an indispensable way of perceiving accurately how complex timbres emerge, interact, and are experienced temporally.[34]

Charting the genesis of *Soliloquies*[35] (for string quartet) and *Dhātu*[36] (for two percussionists, three voices and electronics), this chapter will begin at 'sound object'[37] level, as I focus on individual, 'marginal' sonorities, executed by myself on single instruments. Drawing on several of Pierre Schaeffer's[38]

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[34] Physicality will materialise as a recurrent thread throughout this commentary. Whilst discussed somewhat fleetingly in the first three chapters, this topic will move more decisively into focus during the latter stages of Chapter Four.

[35] I was commissioned to write *Soliloquies* by Festival de Royaumont in 2017. The work was given its premiere on 9/9/2017 at Royaumont by Quatuor Tana and was later broadcast (27/9/2017) on France Musique.

[36] *Dhātu* was commissioned by Glasgow Cathedral Festival and Glasgow Experimental Music Series, and received its premiere on 26/9/2019. It is worth noting at this early point that – like several works in the portfolio – *Dhātu* will be discussed twice. Whereas the percussion writing takes centre stage here, the work's vocal writing, and the distribution of musicians in space, becomes the key focus in Chapter Three.

[37] This terminology is borrowed from the writing of Pierre Schaeffer: '(sound object) refers to every sound phenomenon and event perceived as a whole, a coherent entity'. Michel Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, trans. by John Dack and Christine North (2009), pp. 31-32 <http://ears.huma-num.fr/onlinePublications.html> [Accessed 1 January 2021]. My own usage of these words, within the context of acoustic music – where 'reduced listening' (i.e. independent of 'its origin or its meaning') is impossible – freely extends Schaeffer's original definition. Nonetheless, through my creation of mock-ups, and by recording individual timbres and dissecting them aurally, my methods become quasi-acousmatic, with the focus undoubtedly on 'the sound itself'.

[38] Although himself a peripheral figure in this commentary, the influence of Helmut Lachenmann – who extended Schaeffer's theories through his own 'musique concrète instrumentale' – should at this point be noted. Through his teacher Luigi Nono, pupil, Pierluigi Billone, and a plethora of younger composers, working within a post-Lachenmann

morphological criteria (through which I noted the observable 'properties of the perceived sound'),[39] as well as aspects of Denis Smalley's 'spectromorphological' approach,[40] the pre-compositional process for these works saw me defining in depth the timbral attributes of my chosen sonorities. Several personal methods of timbral exploration will be outlined, as I recount my development of complex, integrated sonic networks. Lastly, I will examine how sound objects were employed to construct the final works, and how discourse was organised through integrative methods at both a micro and macro structural level.

Soliloquies (2017) and *Dhātu* (2019): initial sound objects

At the pre-compositional stage, both *Soliloquies* and *Dhātu* took as their starting point a fragile, complex sound object or marginal sonority: the result of an extended technique, executed upon a single instrument. *Soliloquies'* core sonority (Figure 2) sees the bow drawn slowly – and with vertical friction ('drag') – from *molto sul tasto* to *ordinario*, and from frog to tip. Initially conceived upon the cello, this gesture is executed ultimately in various guises upon all four instruments, with each member of the quartet making use of their scordatura fourth string.[41]

Figure 2: *Soliloquies*, bar 31 (violin 1), core sonority
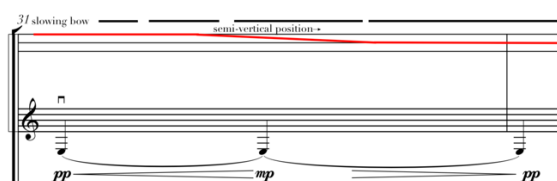
Dhātu similarly incorporates a slow bow action in the production of its core sonority (Figure 3), employing vertical motion and heavy pressure upon a large salad/mixing bowl. The resultant sounds, generated by these relatively straightforward physical procedures, appealed to me—both in terms of their rich and multifarious pitch materials, and their inherent instability (with a number of sonic results possible, within a defined range). My next step would be to describe these sound objects aurally,[42]

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aesthetic, in which extended techniques are used freely, the influence of the German composer is undoubtedly felt across the portfolio.

[39] Chion, p.158.

[40] 'Spectromorphology' and 'spectromorphological' are used throughout this chapter. Originating from the writing of Denis Smalley, these words elide the terms 'spectro' ('interaction between sound spectra') and 'morphology' ('the way they change and are shaped through time'.) Denis Smalley, 'Spectromorphology: Explaining Sound-Shapes', *Organised Sound*, 2.2 (1997), 107-126 (p. 113).

[41] The fourth string of all four instruments is detuned to a low E: in the case of the cello and viola, a minor sixth below their open string; and in the case of the violins, a minor third beneath their open string.

[42] This process involved me recording myself upon the instruments in question. Such a focus upon tactility and physicality in the act of creation marked a distinct change in my compositional practice during these works. This topic becomes a key area of exploration in Chapter Four.

deconstructing timbre into multiple parameters and attributes. The manner in which this analysis was carried out differed between the two pieces:

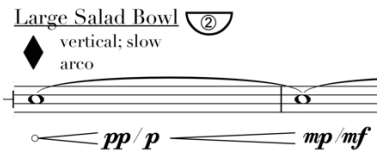**Figure 3: *Dhātu*, bar 10 (percussion 2), core sonority**

Figure 4: *Soliloquies*, core sonority. Initial timbral observations

In my original notes for *Soliloquies*, I observe freely the following characteristics, as the bow moves slowly from *molto sul tasto* to *ordinario*:

MST ↓ ord.	▪ *constant grain/noise in the lower-middle register*
	▪ *emergence of a subtone glissando, which splits into multiple overlapping glissandi at an extreme/low tessitura*
	• *Sound divides into pronounced grain and raspiness; emergence of a clear fundamental pitch*

Figure 5: *Dhātu*, core sonority. Application of morphological criteria

Two years later, when composing *Dhātu*, this initial timbral classification became more formal and systematised, through recourse to Pierre Schaeffer's morphological criteria: the third, descriptive stage of his *Solfège de l'objet sonore*. As outlined below, I described in detail the characteristics of my chosen sound object, making reference to four of Schaeffer's seven criteria. (It is important to note that this process was an end in itself, with the results analysed in order to gain an intimate knowledge of the core material. This information was subsequently used to extend and develop sonorities through systematic parametric alteration). Unlike in Schaeffer's full system, however, there was no subsequent 'characterology', 'analysis' or 'synthesis'. Schaeffer's preceding stages of 'identification' and 'classification' – requisite in the acousmatic domain when selecting, isolating and segmenting sound objects into individual units – had, in effect, already occurred, through my initial experimentation upon the instruments and selection of the work's core sonority.

Morphological Criterion:	*Dhātu* Core Sonority Observations:	Schaefferian classification:
Mass *'The capacity for a sound object to be heard as pitch'* [1]	Piercing sinewave-like sounds in a high tessitura (flickering, but several 'locatable' tonic pitches); other frequencies amalgamated into nodal groups; hollow middle register (a more consistent quality of sound).	Channelled sound (i.e. an 'ambiguous mass, composed of tonic groups…[and] nodes') [2]
Grain The *'microstructure of the matter of sound', evoking the 'texture of a cloth*		Perceptible 'rubbing grain'—as caused by the 'rasping of breath of

or a mineral'; or the 'overall qualitative perception of a large number of small irregularities of detail affecting the "surface" of the object' [3]	A clear grain, sediment (audible bow rosin?) discernible in the sound as it is sustained.	the sustaining agent: bow or breath…'[4] Fine iterative grain discernible as bow is rearticulated.
Allure *Oscillation in sustainment of a sound; the allure of a sound 'reveals what the agent of its energy is'* [5]	Sustainment is through grain, rather than allure. (See Chapter 3 for discussion of *Dhātu's* voices and allure in space).	N/A
Dynamic *'The study of the dynamic criterion is largely based on the attack phase':* [6] *If sound is sustained, 'its dynamic can be relatively or wholly independent of what it is at the moment of attack': i.e. 'amorphic' [i.e. homogeneous], crescendo, decrescendo, delta (crescendo and subsequent decrescendo) '…hollow (the opposite) and mordant (with a peak of intensity, then returning to a fixed intensity)…'* [8]	Mode of attack and sustainment are largely independent of one another. Core gesture is either homogenous in attack and continuation, or executed with a slight crescendo.	Typically, 'amophoric' or 'crescendo' in dynamic.[7]

[1] Chion, p. 135.
[2] Ibid., p. 165.
[3] Ibid., p. 171.
[4] Ibid., p. 172.
[5] Ibid., p. 179.
[6] Ibid., p. 174.
[7] Ibid., p. 175.
[8] Ibid., p. 175.

In order to then approach building a musical discourse centred on these sonorities, I generated a pre-compositional network of timbrally interconnected elements: isolated sound objects, produced on individual instruments. When devising this pool of sonorities, my priority was to maintain an audible link[43] between each sound object and the work's core timbre (previously detailed), whilst provoking subtle change in their spectromorphological attributes. This careful balancing act was achieved through the application of several key methodologies, outlined below. Although the aforementioned morphological criteria remained essential at this stage – as I sought to isolate, maintain, or indeed evoke by new means specific timbral attributes – the formerly exclusively aural approach now took on an important physical dimension too, as I charted new sounds with the instruments in hand.

It is important to note at this point of the pre-compositional process that the work remained largely atemporal: that is to say that I had no preconception of a broader structure or mould for these materials, nor a sense of form beyond the most microscopic sound object level.

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[43] That is to say, that a degree of timbral invariance (achieved through the retention of morphological /multidimensional attributes) remained perceptible between sonorities.

Below, I chart the principal techniques of timbral exploration, common to both *Soliloquies* and *Dhātu*, alongside several examples of these methods as they would later occur in the final works. Each of these steps takes as its starting point the respective work's core sonority, as detailed on pp. 12-13.

Methods for extending the sonic network

> *Method 1) Eliciting sonorities similar to the core gesture through the application of the same, or a comparable, physical action upon a) a different part of the instrument or b) a different instrument*

In *Soliloquies*, the semi-vertical down-bow drag from *molto sul tasto* to *ordinario* – previously enacted upon the cello's scordatura fourth string – is now, for example, possible upon the instrument's first, second or third strings—in this instance, provoking a progressively cleaner, less raspy timbre, but continuing to elicit a similar series of low-frequency glissandi, and a comparable granular profile. When this gesture is transferred to the other three members of the string quartet, a high degree of timbral similarity is again achieved (albeit occurring at a higher tessitura), particularly when executed upon the viola and violins' scordatura string:

Figure 6: *Soliloquies*, bars 4-7 (violin 1 and violin 2). Core gesture executed on strings IV and III, respectively

An analogous process is evident in *Dhātu* too, with the vertical, slow movement of the bow (executed with heavy pressure) transferred to the percussionists' flat-lying gongs. Whilst producing vastly different spectra from the core instruments (mixing bowls), a comparable channelled sound is emitted, with discernible – although lower-frequency – nodal groups present, and a certain coarseness of grain still evident.

> *Method 2) Eliciting sonorities similar to the core gesture through the application of different playing techniques/physical actions upon a) the same instrument or b) a different instrument*

Conversely, setting aside both metals and bow and making use of auxiliary instruments, such as harmonicas, *Dhātu*'s percussionists are able to produce high frequency sounds of locatable tonic pitch,

highly reminiscent of the mixing bowls' upper partials. Moreover, through the simultaneous use of the musicians' voices, a familiar instability and 'flickering' of these pitches becomes evident, with noisier channelled elements introduced into the mid-low register. Although elicited by vastly different means, the characteristic 'rubbing grain' of the core sonority is maintained, drawn out through the 'rasping…of the sustaining agent'[44] (in this instance, breath, rather than the bow).

Figure 7: *Dhātu*, bars 143-145 (percussionist 1)
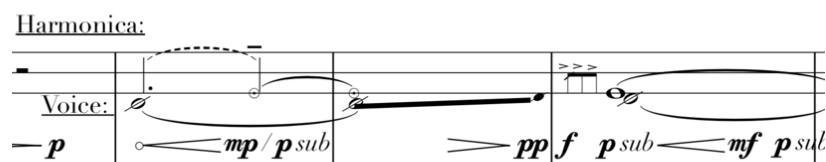
This second method of timbral exploration is employed in *Soliloquies* too, where the execution of a complete – rather than semi- – vertical drag of the bow upon the tailpiece is able, I discovered, to elicit a similar quality of timbre to the work's core sonority, with a muted, sub-frequency glissando emerging via this means of sound production. Furthermore, with the left hand of the cellist unoccupied whilst performing this gesture, the aforementioned grain – or roughness – presently lacking from this sonority can easily be replicated and added to the sound, through the simultaneous rapid movement of the left-hand fingers upon the strings' wrapping.[45]

Figure 8: *Soliloquies*, bars 1-3 (cello)

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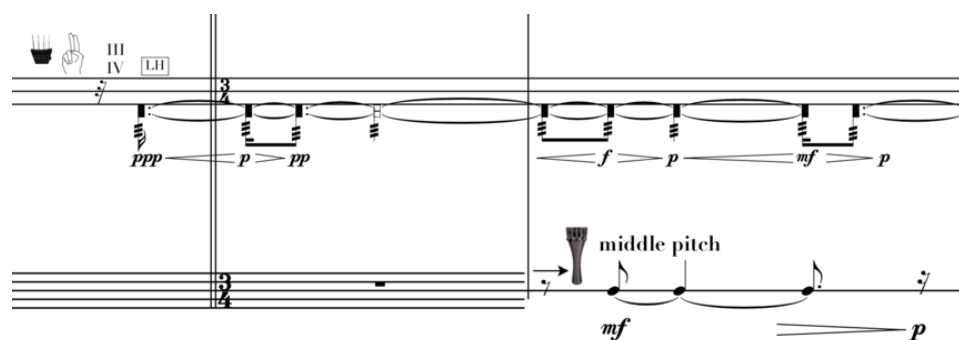
[44] Chion, p. 172.

[45] This word is used to describe the coloured 'silk', wrapped around the bottom of the cello's strings, at that point where they meet the tailpiece.

Method 3) Eliciting sonorities similar to the core gesture through combinations of playing techniques/physical actions upon multiple instruments (ie. composite timbres)

In selecting the initial sound object, and by following methods 1 and 2, I was thus far dealing with isolated sonorities: that matter which Pierre Boulez might describe as 'raw timbre' (sound objects heard individually).[46] Conversely, with the introduction of composite timbres during method 3, I moved into the realm of 'organised timbre', whereby sound objects are heard collectively and organised 'from within'.[47] As such, with decisions now being made as how to combine, overlay and blend sonorities, I started to move away from the pre-compositional, edging towards matters of discourse and form.[48]

Composite sounds were a key consideration at the pre-compositional stage of *Soliloquies*, contributing to much of the 'evocation' material (detailed more fully overleaf). To take an obvious example – and drawing upon the results of method 2 – one can imagine, for instance, the cello's previously mentioned dual-component sonority (right hand vertical bow motion upon the tailpiece, executed in conjunction with friction sounds carried out by left hand fingers upon the wrapping) evoked by the entire quartet— with gestural materials spread across the ensemble, culminating in fused and collective sound objects (see Figure 9). Or, to move away from the quartet's instruments altogether, one could imagine, for instance, the musicians employing their voices collectively, eliciting the rasping, overlapping sub-frequency glissandi of the core gesture through guttural vocal fry,[49] executed with small deviations in pitch contour (Figure 10).

Dhātu, on the other hand, takes an alternative approach to composites. Here, novel timbres are much more likely to be presented simultaneously and fused *with* the core sound object (see Figure 11), serving to enrich or highlight certain aspects its timbral profile, rather than being used independently to evoke

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[46] Pierre Boulez, 'Timbre and Composition - Timbre and Language', *Contemporary Music Review*, 2.1 (1987), 161-171 (p. 169).

[47] Ibid., p. 166. With regard to this latter example, Boulez uses the word 'fusion' (bringing to mind the notion of an 'emergent timbre', as observed during the first stage of Auditory Scene Analysis, and as detailed in the Introduction). In 'organised timbre', Boulez explains, 'the reality and identity of an instrument can…be enveloped in a network of ambiguities, which either hides it within a fused sound-object or reveals it in its absolute state'. (Ibid., p. 169.)

[48] Whilst Boulez's distinction is helpful in outlining the basic distinction between isolated and fused/composite sonorities at the pre-compositional stage, my own approach to timbre in *Dhātu* and *Soliloquies* slightly recalibrated Boulez's rather black-and-white duality. In the first instance, I took 'raw timbre' – that is to say individual sonic entities (conceived successively), as opposed to fused sonorities (conceived concurrently). However, drawing upon a Schaefferian attention to micro-parameters, and a concentration upon the physicality of gesture, I then manipulated *these* sounds from the 'inside' (before moving on to deal with composites)—creating a web of, often marginal and extended, sonorities: sounds Boulez appears to exclude from his thinking, as 'peripheral techniques', or even 'anecdotal effects'. (See Boulez, p. 162 and p. 165.)

[49] As explained in the performance directions to the quartet, by vocal fry I am referring to a 'low pitched 'creak' or 'groan' of the voice; quiet, coarse and grainy. Although far more extreme and dramatic in execution, comparisons may be drawn here with the work of Julio Estrada, whose work is cited later in this chapter—in particular, his *Quotidianus* for vocalist and string quartet (a collaborative piece, performed by the composer and the Arditti quartet at the Donaueschingen Musiktage in 2006).

it.[50] As will be explained in due course, this timbral fusion takes on a very specific role in this work, becoming bound up in the murky world of harmonic timbre (see p. 41). Cornelia Fales' 'Timbral anomaly by extraction' is an obvious point of comparison in the psychoacoustic realm here. Fales uses this term in reference to timbral manipulation that 'leaves the global organisation of the original timbre intact [in my case, the core sonority], while emphasising one or a small group of those elements to stand out…against the remainder of the tone'[51] (i.e. through the simultaneous presentation of an additional, enriching timbre in *Dhātu*).

Figure 9: *Soliloquies*, bars 137-139

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[50] This method is a common occurrence during the materials of constellation C (detailed in due course).

[51] Cornelia Fales, 'The Paradox of Timbre', *Ethnomusicology*, 46.1 (2002), 56-95 (p. 66).

Figure 10: *Soliloquies*, bars 258²-260

Figure 11: *Dhātu*, bars 280-282 (percussion 1 and 2). Core sound object (percussion 1) fused with harmonica and foil in percussion 2

With the introduction of this physical, gestural dimension, the web started to extend outwards from the core sonority. In prioritising tactility above aural connection, method 4 might perhaps be seen to operate in a similar vein to the works of Pierluigi Billone. In conversation with the composer Esaias Järnegard, Billone outlines a method of instrumental exploration of particular interest here, suggesting that, when exploring timbre upon a sounding body, we might 'learn to apply on A the typical contact of B'.[52] We observe this, for example, in his *Mani Mono*, where the 'pumping' action of the palm upon the open top of the spring drum (ubiquitous in the early stages of the work) is later applied to the torso of the percussionist. In Billone's words, through these means, we can learn to 'evoke B in A': an evocation which seems to transcend the purely aural (the sonic correlation between the sounds here is minimal), operating instead on a more sensory, physical and gestural level.[53]

We observe method 4 in action in *Dhātu*, for example, when the core sonority's 'typical' means of 'contact' – slow bow movement with heavy pressure, applied to the mixing bowls (here labelled 'B') – is instead enacted upon the singing bowls ('A'), producing a markedly different, clear and dry, single frequency in the mid-tenor register. Or, when the same contact is applied, but the left hand is released, mid-application – and the bowl has been placed upon the flat-lying gong – resulting in a violent buzz, or rapid tremor, as the vessel's base vibrates and rattles upon the metal surface (see percussion 1, bar 167).

Similarly in *Soliloquies*, we might 'learn to apply' the typical semi-vertical motion of the bow not upon the usual site of contact (string IV of the cello) but instead upon the coarse wrapping beneath the bridge. When extreme pressure is applied with the bow, the usual guttural frequencies and sub-tone glissandi are completely eradicated, replaced by a raucous and extremely harsh nodal sound, bordering on distortion.

Figure 12: *Soliloquies*, bar 82 (cello)

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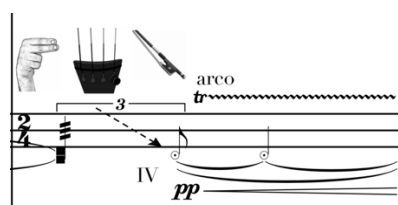
[52] Esaias Järnegard, 'Ordermusiken' (unpublished master's thesis, University of Gothenburg, 2013), p. 98.

[53] This notion is explained more fully in the below section on gestural 'source-cause' relationships.

In my work, each of these 'evocations' – generated by methods 1-4 – then became the centre of a new series of timbral explorations. No longer did my methods seek to evoke (in sound and/or gesture) solely the core sonority, but once any sound was introduced to the network it became usable in its own right (and itself evocable).[54] In this way, local-level variation was integrated into the timbral network, and ultimately into the musical discourse. This necessity for change and development is addressed more fully on p. 32.

Gestural 'source-cause' relationships

Although the sound objects elicited through method 4 might share some degree of loose aural connection with the core sonority, the resultant timbres, albeit produced by corresponding physical actions, do not always produce aurally similar results. And yet, when trialling materials (and particularly when listening to my pre-compositional 'mock-ups'),[55] a connection of some kind often seemed inherent to me—with vestiges of a sound's physical origins somehow communicated.

Despite being intended primarily for acousmatic music, Denis Smalley's writing upon gestural 'source-cause'[56] relationships is a helpful point of reference here. Smalley traces resultant spectromorphologies – produced through the 'application of energy' upon a sound source, by implement[57] (a bow, a stick, or a hammer, for example), or even through the specific tactile actions of the musician him-/herself – back to the original cause (the 'human agent'). The physical 'sound-making' gesture is essential here, described by Smalley as stimulating an 'energy-motion' trajectory: something we pick up upon intuitively as listeners.[58] Heard in these terms, *Dhātu* and *Soliloquies'* 'evocations' may be materialised upon different sounding bodies – ultimately resulting in different spectra (often substantially so) – but the most fundamental aspects of their source-cause trajectory remain identical: that is to say the means of their 'application of energy' (in morphological terms, the overall quality of their attack), their shared 'motion of their gesture',

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[54] We see this, for example, in *Dhātu*, where the previously detailed buzz becomes replicable through the placement of foil within the bowl (with the same rattling sonority now possible on any of the six bowls, even when an object is set down upon a non-metallic surface). Or, for instance, in *Soliloquies*, where the friction sound, formerly emitted by the rapid movement of fingers upon the wrapping (previously part of the core sonority) becomes itself evocable through, for example, tremolando motion of the bow, or through *sul pont* double harmonic trills. (Or, equally, the bow and fingers might be dispensed with altogether, with an auxiliary tool – for example, a credit card – employed as a means of generating new friction sonorities). Once this tool has then been introduced, I might begin the entire process all over again—seeking to elicit the core sonority with the new implement through recourse to method 1, before moving on to method 2-4, and so on.

[55] Multitrack recordings upon which I experiment with materials first-hand on several instruments.

[56] Denis Smalley, 'Defining Timbre — Refining Timbre', *Contemporary Music Review, 10*, 2 (1994), 35-48 (pp. 38-40). Smalley uses the term 'source-cause' in the aforementioned article from 1994. In his later writing, the term 'cause-source' begins to appear; whilst in his spectromorphological investigations from 1997 (cited below), this term seems to fuse with notions of an 'energy–motion trajectory'. I will draw upon both these terms in my own writing.

[57] Smalley, 'Spectromorphology: Explaining Sound-Shapes, p. 111.

[58] Ibid.

and their identical human agent. Moreover, our detection of this musical 'gesture process'[59] extends further, arguably encompassing a more deep-rooted physical dimension—such that, 'when we hear spectromorphologies, we detect the humanity behind them, deducing gestural activity, referring back through gesture to proprioceptive and psychological experience in general'.[60] In other words, we as listeners possess an inherent awareness of the physiology of many sounds, and a first-hand knowledge and feeling of the tactile human activity needed to apply appropriate energy to a sounding body.

Both *Dhātu* and *Soliloquies* make use of a simple – even primitive – core gesture: the straightforward drag or scrape of an implement (bow, card or wood) upon a sounding body. Through these means, 'evocations' of the primary sound object could be said to operate at the first level of Smalley's 'gestural surrogacy'[61] —taking a 'primal' gesture (which could easily occur 'outside music in all proprioceptive perception'),[62] and projecting it within the context of organised sound. As such, when we listen to these works, we are able to group instinctively those sounds emanating from similar physical actions, filling in the gaps left by timbral discontinuity, through recourse to innate proprioceptive knowledge. In this way, 'evocations' can start to diverge substantially on an aural level, whilst arguably remaining, on another, perceptually integrated.

Through the four methods of timbral exploration just detailed, I developed at the pre-compositional stage of *Dhātu* and *Soliloquies* an intricate network of integrated timbres.

The next stage of the compositional process saw me organise and divide up this network. As the means by which this was achieved differed according to the piece in question, I will discuss the two works independently.

As seen in the sketch material presented in Figure 14, I formulated a basic timbral network at the planning stage of *Soliloquies*. Orbiting around the previously detailed core – or 'anchor' – sonority are several 'evocations', each of which seeks to elicit, through shared timbre or physical action (the results of methods 1-4), the core sonority. These 'evocations' subsequently branch off into individual constituent elements, and occasionally into 'sub-evocations', or off-shoots (in effect, 'evocations' of 'evocations').

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[59] Ibid.

[60] Ibid. In 'Defining Timbre — Refining Timbre', meanwhile, Smalley similarly states: 'behind the causality of instrumental gesture lies both a broader experience of the physicality of gesture and its proprioceptive tensions, and a deeper, psychological experience of gesture' (p. 39).

[61] Smalley devises a five-tier structure of 'gestural surrogacy', ranging from 'primal gesture' through to 'remote' gesture, where 'source and cause become unknown and unknowable as any human action behind the sound disappears'. (See Smalley, 'Spectromorphology: Explaining Sound-Shapes', p. 112).

[62] Ibid.

The devising of this diagram was an ongoing activity during composition—with new elements added *ad hoc* during the writing process, as I experimented upon each instrument of the quartet, and developed new sonorities.

Figure 13: Precursor work, *æsc* (2017/18) – for cello, piano and electronics

In the months preceding the composition of *Soliloquies*, I completed work on *æsc*: a precursor piece for cello and piano – later revised to include triggered electronics – whose tactile timbral interests would overflow into the string quartet.

æsc takes its name from an eponymous typographic ligature, whilst drawing inspiration from a modern-day homophone:

æsc [æʃ]

noun:
An Old English runic letter, comprising the letters 'A' and 'E'; a grapheme, originally a ligature.

ash

noun:
The powdery residue left after the burning of a substance.

Like its sister work, *Soliloquies*, *aesc* works with a reduced palette of timbres, generated through highly physical, and often intimate, actions: the cellist's fingers running down the third and fourth strings, exploring contact between skin and rosin, bow-hair and wood; the pianist brushing and combing the keys with their palms. A number of these sonorities, initially devised through my first-hand experimentation upon the instruments (a subject explored in-depth during Chapter Four), would spill over into the string quartet: in particular, the friction sounds applied to the strings' 'wrapping', the bowed 'air' sounds executed upon the bridge, and the double harmonic trills, articulated *sul pont*. A shared interest in a certain corporeality in performance is also discernible between the two pieces.

This subject becomes a key area of focus throughout this commentary: both in Chapters Two and Four (in relation to *Analogue*, *Bríatharogaim* and *Plastica*), and during the latter stages of this present chapter, where the gradual emergence of increasingly physical sonorities will be presented as a key macro-level formal trajectory in *Soliloquies*. *æsc*'s employment of these tactile and bodily sounds – in particular, the in- and exhalations of both cellist and pianist – operate within a different framework to these pieces, however. Emerging regularly throughout the work's structure (and often encased by repeat marks), this material acts as a refrain of sorts, binding together the often disparate groups of sonorities it intersects. As *æsc* unfolds these repeated bodily gestures are extended and begin to occur more frequently, as embers of the work's initial musical material start to assume a more concrete and stable identity.

Dhātu: timbral map and constellations

Through the generation of a **timbral map,** a much more formalised and complex categorisation of timbre at the pre-compositional stage was undertaken in *Dhātu*. Initially, by employing methods 1, 2 and 4 upon my chosen selection of percussion instruments,[63] I charted 64 individual timbres of potential

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[63] The final percussion line-up features two large metal coils, two mixing/salad bowls (one large, one small), two large singing bowls, two small singing bowls and two spring drums. Two flat-lying gongs were later added to this instrumentation, but did not feature at the timbral map stage. Although, in the final work, items are divided up between the two percussionists, the assignment of instruments between players was not considered at this point. Similar techniques applied to similar objects (particularly singing bowls and, on occasion, mixing bowls) were often grouped together as a

compositional interest. Each one of these sonorities was compared to the other 63 and allocated a similarity/dissimilarity rating between 0 (no discernible correlation) and 20 (identical).

Figure 14: *Soliloquies*, anchor and evocations sketches
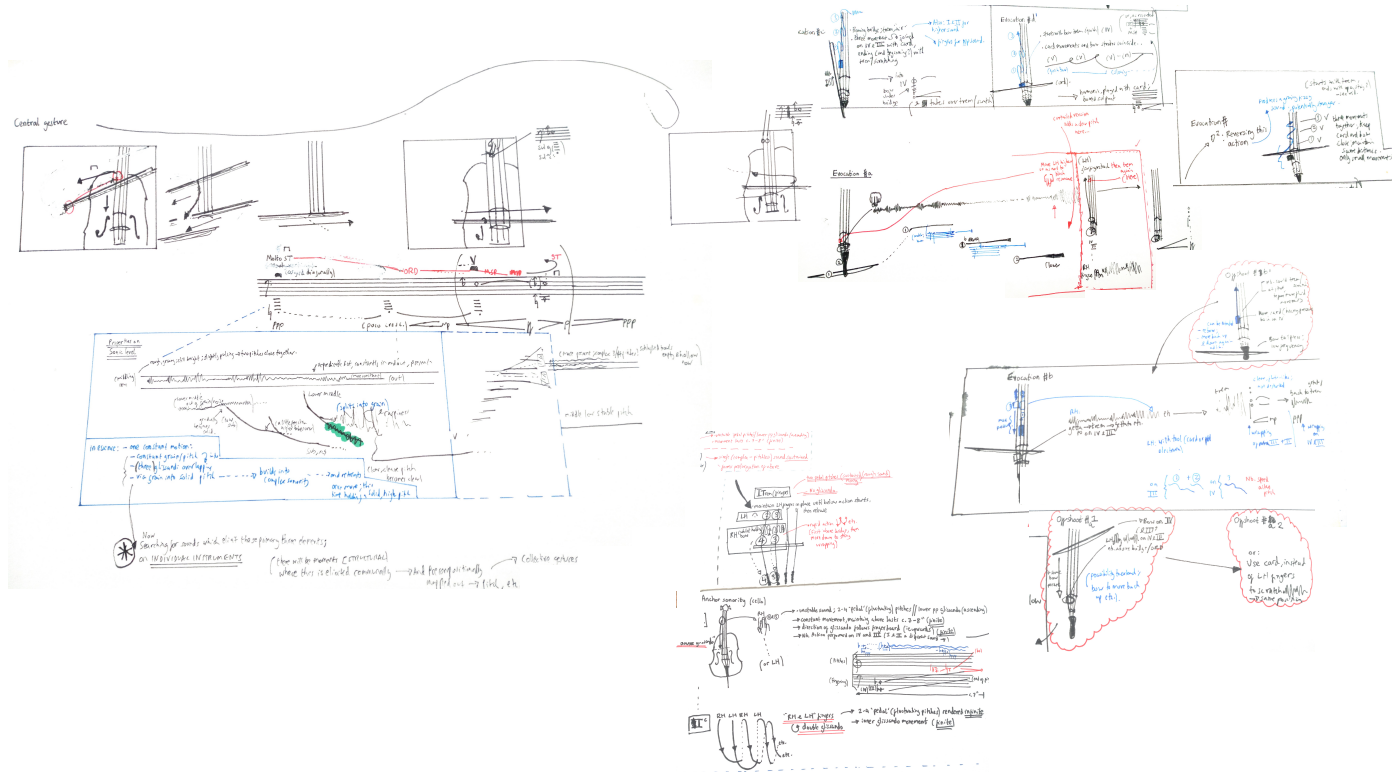
This comparison was achieved through entirely aural – and subjective – means, taking into account the entire (multidimensional) profile of a given timbre. As only one measurement between sonorities would be listed, it was necessary for me to judge a sound's dominant attribute(s), and to compare only that which was most immediately discernible to the ear. My comparative criteria here were, by necessity, very flexible: if a sound was short, the primary timbral quality noted would likely be its means of attack. If a sound was sustained (through bow or breath), I might chart its continuant properties: whether that be the level of grain, or the quality of its harmonic timbre. For those sounds where contact was applied through an implement (mallet, triangle beater, etc.), I might gauge similarity in the length and quality of resonance.

This numerical information was then fed into Gephi:[64] an open-source data visualisation programme, designed to devise graphs and networks. Through Gephi I was able to generate a topographical

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single timbre, in order to restrict the breadth of the map. It is important to note that not all sounds appearing on the map were selected for the final work.

[64] https://gephi.org/

arrangement of this data: with 63 nodes (timbres), connected through several hundred undirected (ie. bidirectional) edges.[65]

Figure 15: complete list of nodes

1	Sng Bowl (L): arco	11	Coil 1: mall trem	30	Coil 1: Soft mallet richt
2	Sng Bowl (L): mall trem	12	Sng Bowl (L) > (S): arco	31	Vert. bow Sld Bowl (S)
3	Coil 2/3: arco	13	Coil 2/3: mall trem	32	Vert. bow Sld Bowl (L)
4	Sd Bowl: (S) nails/rim	14	Whistle/Palm	33	Sd Bowl L) arco ricochet
5	Sng Bowl (S): arco	15	Sing/Fry	34	Sd Bowl (S) arco ricochet
6	Sng Bowl (S) > (L): arco	16	Fry + Harmonica	35	Coil 1: arco ricochet
7	Sng Bowl (S) > (L): soft mallet	17	Hum gliss + harmonica, low prs	36	Vert. bow (col leg) Sld Bowl (S)
8	Sd Bowl: (L) arco	18	Whistle + hum	37	Vert. bow (col leg) Sld Bowl (L)
9	Sd Bowl: (L) frog, slow	20	Beater on Sd Bowl (L)	38	Sng Bowl (L): arco ricochet
39	Sng Bowl (S): arco ricochet	48	Sd Bowl: (L) mall trem	57	Flumi Trem arm gliss: Sng Bowl (S)
40	Sng Bowl (L): soft mall	49	Sd Bowl: (S) mall trem	58	flumi/soft gliss: Sd Bowl (L)
41	Sng Bowl (S): soft mall	50	Sd Bowl (L): nails/rim	59	gam. fngr gliss: Sng Bowl (L) reverse
42	Sng Bowl (S): mall trem	51	Sd Bowl: (S) frog, slow	60	gam. fngr gliss: Sng Bowl (S) reverse
43	Sng Bowl (L): nails/rim	52	Coil 2,3: arco ricochet	61	Coils: TdC damping gliss
44	Sng Bowl (S): nails rim	53	Coil 1: arco	62	Spring Drm: scrape coil; secco
45	Sd Bowl: (S) arco	54	Coil 1: nails/rim	63	Spring Drm: ord, thunder
46	Sd Bowl: (L) soft mall	55	Coil 2,3: nails/rim	64	Spring Drm: coil on metal (elec)
47	Sd Bowl: (S) soft mall	56	Flumi Trem arm gliss: Sng Bowl (L)	65	Spring Drm: coil (vib/non vib) in Sng Bowls
66	Spring Drm: ord, thunder/palm gliss				
67	Sng Bowls: Foil arco (high elec)				
68	Flumi trem w foil: Sng Bowls (buzz, spec)				
69	Vocal: hum/vowel o+, beat chest				
70	ord. harmonica				
71	ord. harmonica gliss				
72	ord. hum				
73	Sng Bowls: buzz				
74	Sng Bowl: col legno				
75	Sng Bowl: scrape on metal				

* Omitted numbers (i.e., 10, 21-29) represent timbres ultimately grouped together with other sound objects, subsumed into one single listing: for example, all singing bowls bowed with foil attachments are grouped at 73: *Sng Bowls: buzz*. The words following each number are short-hand descriptions, allied to a particular instrument, physical gesture and resultant sonority.

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[65] That's to say, I had deduced roughly 650 discernible aural connections between sonorities (registering a similarity rating of between 0.1 and 20).

Figure 16: example of edges and similarity ratings. Node 31: Vert. bow Sld Bowl (S)

Source	Target	Edge Weight (/20)
31	32	17
31	8	12
31	6	3
31	36	14.5
31	34	2.5
31	33	2.5
31	14	1
31	12	3
31	9	10
31	3	1.5
31	37	12.5
31	45	13

My next step saw me make use of Gephi's ForceAtlas 2 algorithm: a force-directed layout, which generates a spatial representation of a network. Through this feature 'nodes [ie. timbres] repulse each other like charged particles, while edges [ie. connections] attract the nodes, like springs. These forces create a movement that converges to a balanced state'.[66]

The similarity values I assigned (0-20) play a vital role here, calculated in Gephi's data laboratory as edge 'weights'. In ForceAtlas 2's layout, the greater the numerical weighting, the higher the degree of attraction between nodes. In this way, proximity of nodes and force enacted becomes proportional (this procedure replicates physical systems, in which 'forces depend upon the distance between the interacting entities', and where 'closer entities attract less and repulse more than distant entities and vice versa').[67] In this way, a simple timbral 'distance model' is created:[68]

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[66] Mathieu Jacomy and others, 'Forceatlas2, A Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software', *Plos ONE*, 9.6 (2014), e98679 <https://doi.org/10.1371/journal.pone.0098679> [Accessed 3 February 2021].

[67] Ibid.

[68] Context for this way of working can again be provided through the field of psychoacoustics. In this discipline, a similar graphic representation of timbral interconnection is often used, with sounds conceptualised in multidimensional 'Timbre Space': a distance model, organised according to several spectral attributes, eg. 'spectral centroid', 'log attack time' and 'spectral flux': see Stephen McAdams, 'Perspectives on the Contribution of Timbre to Musical Structure', *Computer Music Journal*, 23.3 (1999), 85-102. Although a helpful point of reference, this system is of course very different in design and purpose to my own. In the case of McAdams and his team, working at IRCAM in the 1990s, for example, 3D distance models were drawn up *post*-experiment, in order to model the patterns of connection made by listeners (trained and untrained), as they compared and contrasted pairs of prior-composed sounds. Importantly, these sounds were played in isolation, outside the context of a musical work.

Figure 17: *Dhātu* **timbral map.** Edge weighting is represented here not only by topological proximity, but also by the thickness of the lines adjoining separate nodes
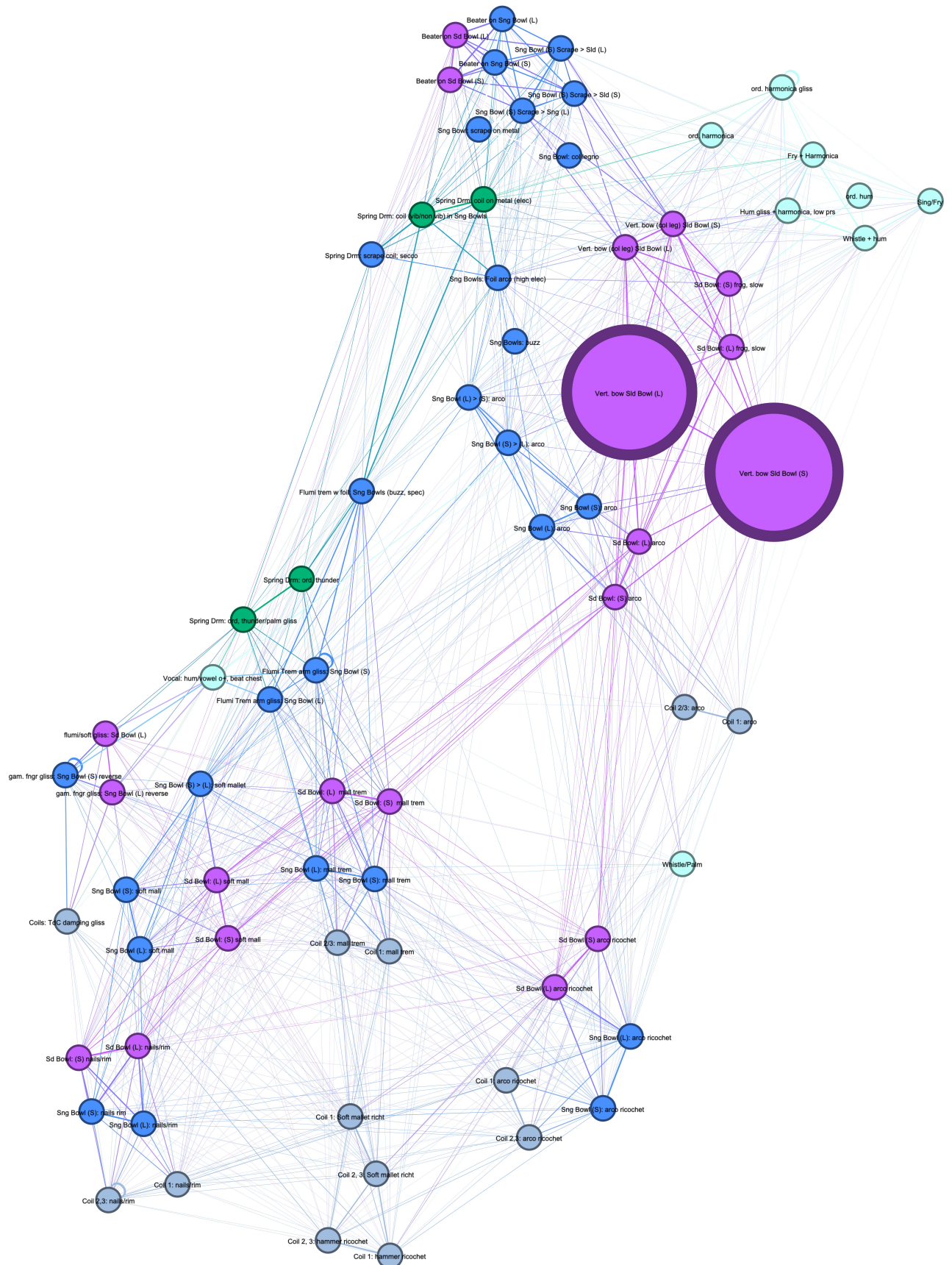
As outlined in the Introduction, the generation of the above topological formation finds a precedent in Trevor Wishart's 'Timbre-Map for Strings', as detailed in his *On Sonic Art*.[69] However, whilst comparisons between the two systems might be drawn – not least the general proclivity towards timbral integration, when the map is realised in musical time (something facilitated via the 'principle of adjacency')[70] – key differences are evident. Firstly, my palette of sonorities is vastly restricted in comparison to Wishart's: the result of starting with a specific, fragile sound object, as opposed to charting *all* possible timbres available upon a given collection of instruments. Secondly, whereas Wishart's map treats all sounds as if they are of equal importance, my own network, as I will go on to explain, treats preferentially certain regions within the structure: specifically, those timbres most closely connected to nodes 31 and 32, at the centre of constellation C.

Further precedent for a topological way of working, and specifically for the use of Gephi within a musical context, can be found in the work of composer Frédéric Le Bel.[71] Whilst data visualisation and timbral networks are key to the composer's practice, however, the remit of his approach is somewhat different to my own. Working with electronic materials, Le Bel deals with an existing library of sounds ('raw audio'), using predominantly unsupervised machine learning at every level of the compositional process.[72] This empirical approach is maintained all the way through to the finished work, where the piece's final architecture is devised through the use of a sequencer, with statistical modelling employed to translate data into the temporal domain.[73] Through these means, 'the more similar are two sounds of two clusters [Le Bel uses this word to refer to smaller internal groups of sounds, within the broader/complete network], higher is the probability to transit from one area to another, or vice versa'.[74]

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[69] Trevor Wishart, *On Sonic Art,* ed. by Simon Emmerson (Amsterdam: Harwood Academic Publishers, 1996), p. 84.

[70] Through Wishart's 'principle of adjacency' timbral objects situated near to one another in timbre space are perceived as being closely related by the listener; as such, Wishart suggests, a 'feeling of progression' can be inculcated in the eventual work, through movement between neighbouring sonorities. However, movement is less successful, he asserts, when timbral progression is non-adjacent. Ibid., p. 81.

[71] I had encountered Le Bel's work at IRCAM in 2018, where he had presented upon his composition *Mais plutôt de trouver la, ou les justes relations accordant l'existence de tous ses éléments* during the ManiFeste festival. Whilst the work was engaging and highly immersive – perhaps in part owing to its multi-channel projection in a relatively small concert space at the Centre Pompidou – I noted that there seemed scant correlation in performance between the intricate pre-compositional topological arrangement of sonorities and the spatial placement of these timbres in real-life space. (In Le Bel's defence, this seemed an intentionally unimportant aspect of the work—with each sound, in his own words, assigned to 'one of 16 evenly spaced source positions… in order to give a *sense* [my emphasis] of imprint to each cluster'). Frédéric Le Bel, *From Timbre Decomposition to Music Composition: Proceedings of Timbre 2018: Timbre is a Many-Splendored Thing,* (Montreal, Quebec, Canada, July 2018). However, hearing this work – and noting this opportunity for expanding the remit of the timbral map – prompted my own investigations into the realisation of distance models in a real-world setting (as described in Chapter Three).

[72] At the initial 'timbre deconstruction' stage, for example, enormous collections of pre-existing sound files are analysed using the signal's short-term Fourier transform—with multiple acoustic parameters subsequently factored into the deduction of dissimilarity ratings between sonorities. (See Le Bel, *From Timbre Decomposition to Music Composition*).

[73] Using data analysis (and specifically the 'minimum spanning tree' algorithm) Le Bel at this point seeks to 'fin(d) a path within the timbre-space that could suggest way(s) of sequencing the different clusters of sounds and their components in a chronological order'. (Ibid.)

[74] Ibid.

Although I experimented with a data-derived approach to the final compositional structure of *Dhātu*, I ultimately made use of a different method to create the work's architecture. As noted by Wishart, although continuous linear progression through the principal of adjacency – or, travelling through timbre space 'chronologically' (and algorithmically) in the case of Le Bel – enables us to register 'noticeable distance' from one timbral area to the next, we are, however, unable to measure 'how far we are from a different timbral area occurring earlier in the piece'.[75] Consequently, long-term connection between sonorities starts to become imperceptible, with the 'sense of causality or necessity in the musical progression…confined to the short term'.[76] For this reason, as I sought a more large-scale trajectory in my work, it was essential for me that I anchor timbre space upon a stable, referential core: something that could remain unchanged, acting as a structural marker through its continual recurrence.[77] For this reason, a timbral hierarchy of sorts was established when devising *Dhātu*'s overall architecture, with constellation C – and nodes 31 and 32, in particular – achieving prominence within the compositional design.

Building the weighting of this core sonority into the data set and attempting to replicate this hierarchy temporally through empirical means would, however, have been an extremely complex task, placing firm restrictions upon how my materials might unfold in time—an option that was highly undesirable for me.[78] My own navigation of the timbral map was consequently far more intuitive. Once the starting points and durations of constellation C occurrences had been set,[79] a free approach was taken when selecting sonorities, constellations and when seeking to engender timbral continuity and integration: with the principle of adjacency employed frequently, although not exclusively, both horizontally and vertically.

Constellations

With ForceAtlas 2's 'gravity' parameter altered to 1.0 – generating sufficient distance between timbral conglomerates for sonorities to be grouped by eye – the resultant network was divided up manually into eight secondary constellations (arbitrarily labelled X, H, E, T, B, R and N)[80] and one primary, core constellation (C).

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[75] Wishart, p. 81.

[76] Such an arrangement of materials could thus be seen to operate in a similar mould to the 'moment form' structures of Stockhausen. (See Jonathan D Kramer, *The Time of Music* (New York: Schirmer, 1988), p. 70.

[77] Through its inclusion of a separate, stable/unchanging central core – around which vastly different constellations orbit – *Dhātu* takes a contrasting approach to *Soliloquies*. Conversely, in the string quartet, the core 'evocation' material is more changeable and diverse upon its various occurrences. As a result of this comparative instability, I felt that the work's other materials – the 'meshes', 'soliloquies' and 'superimpositions' introduced in the forthcoming pages – were able to venture less far timbrally, remaining relatively integrated at a macro level.

[78] Consistent with my approach across the whole portfolio, I place great importance upon being able to deviate – or even disregard entirely – any pre-compositional plan, should musical intuition dictate that more suitable options are available.

[79] A series of ratios were used at the outset of the compositional process, to determine the broad architectural divisions within the work.

[80] Labels were chosen at random here, with chronological letters avoided, so as not to imply a temporal order.

Figure 18: timbral map constellations
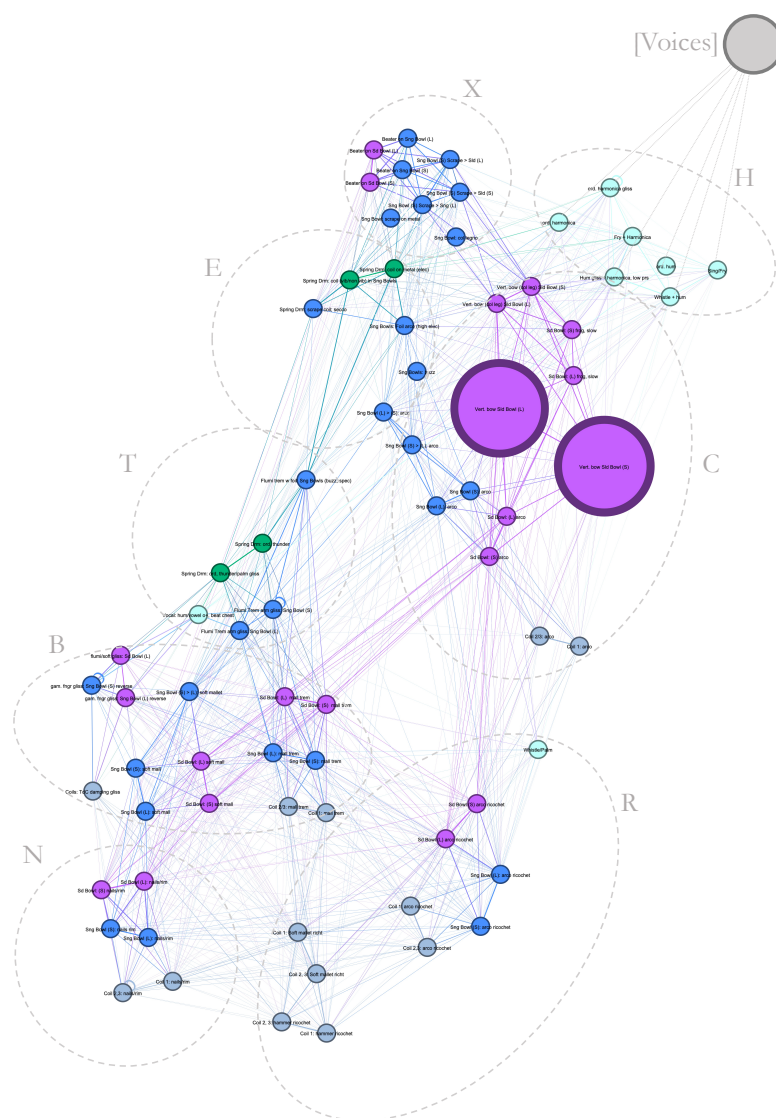
Differentiating between form and structure

Form

Before delving deeper into these pre-compositional materials and explaining their ultimate realisation within the musical works, it is first necessary for me to differentiate between two key words used throughout the ensuing discussion: 'form' and 'structure'. The first term, form, is used principally here in relation to the evolution of sound objects at a micro level: in particular *within* the aforementioned 'constellations' of *Dhātu* and the 'evocations', 'meshes' and 'soliloquies' of *Soliloquies*.[81] Timbral continuity

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[81] The Schaefferian perspective of form, cited previously in the Introduction, remains a helpful point of reference here: form as that 'which shapes…matter in duration and perhaps makes it evolve'. (Chion, p. 127).

remains at the heart of this material, and several techniques specifically devised to achieve integration at a local level of discourse are discussed in relation to these passages.

Structure

Owing to the malleability and ambiguities of my timbral materials, I've found it helpful, however, to restrict my options as to how the broader architecture (or 'structure') of a work unfolds, integrating certain fixed elements into the pre-compositional design. In keeping with Ligeti's approach (for example, in *Apparitions*, where he describes that through providing a 'pre-formed network of choices and limitations' composing freely becomes 'paradoxically'[82] more possible), I drew, in both *Dhātu* and *Soliloquies*, upon pre-compositional durational timelines. These structural charts (in which global divisions and allocations of material were pre-conceived) were devised through a series of ratios, derived from the work's core sonority.[83] Again, in keeping with Ligeti's approach, where the 'elastic contours' of the design are maintained, but subject to expansion and contraction, my structural maps too were manipulated and altered, often substantially, during the act of composition.[84] It is these larger, preconceived divisions in the compositional design that I will refer to as 'structure'.[85]

Before investigating in-depth *Soliloquies* and *Dhātu* from a formal perspective it is, however, first necessary to zoom out to a more macro/structural level, and to introduce materials within their broader architectural context:

Soliloquies: **overview**

Evocations: the aforementioned 'evocations' of *Soliloquies* account for the majority of the work as it unfolds. Consisting of the core gesture (as detailed on pp. 12-13) and sounds which seek to 'evoke' it, derived through methods 1, 2, 3 and 4, form is organised at a local level through the intricate manipulation of sound objects: both upon individual instruments, and by the ensemble, as fused entities are conceived. These sonorities often operate in pockets and clusters, closely gathered around the

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[82] György Ligeti, trans. Cornelius Cardew, 'Metamorphosis of Musical Form', *Die Reihe*, 7, Form – Space (1965), 5-19 (p. 12).

[83] See Figures 19 and 20.

[84] This flexibility applies to all the structural maps detailed throughout this commentary.

[85] As I go on to explain, however, each of these 'sections' is often constructed of timbrally similar materials. As such, 'divisions' are often more conceptual/pre-compositional than perceptible in performance—with timbral continuity becoming evident both on a macro level (between sections), as well as internally *within* sections.

'anchor' sound. (See Figure 14). As detailed previously, integration[86] is the principal organisational means here, with discourse unfolding horizontally primarily through timbral continuity.[87]

With the duration of *Soliloquies'* 'evocations' and their points of occurrence preconceived within the overall architecture of the work, further structural divisions – the start and end points of separately devised and differentiated materials – were next mapped out. These materials are described below:

Meshes: continuous, ensemble texture, conveying a communal 'harmonic timbre'. Whilst the fragility of this writing and its recourse to the scordatura fourth string is reminiscent of the 'evocations', the 'texture-carried' homophony marks out this material as individual.

Soliloquies: solo lines, initially fusing voice and instrument. Although this material is distinct from the 'evocations' in its more continuous, quasi-melodic writing, it again remains timbrally closely connected to the soundworld of the core gesture through all four instruments' unanimous employment of their scordatura fourth string.

Superimpositions: initially intended as perceptually discontinuous, even interruptive, the 'superimpositions' progressively undergo a macro-level journey of timbral assimilation—ultimately achieving a high degree of integration with surrounding materials.

The integrative formal strategies employed within each of these sections and their compositional influences and points of departure are explored on the following pages ('Meshes', pp. 41-44; 'Soliloquies', pp. 44-46; 'Superimpositions', pp. 46-49).

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[86] Whilst successive timbres linked through methods 1-3 are, by definition, closely matched in their spectrotemporal properties – encouraging perceptual integration, or providing local-level variation and development, though incremental parametric alteration – sound objects arising through method 4 introduce a certain timbral *dis*-continuity at a micro level. Although appearing to contradict my objective of timbral assimilation, these more distantly related materials appeared to me requisite in driving the form and in engendering the expectation of – and need for – continuation. The words of Pierre Boulez summarise this necessity for material contrast: 'discontinuity provides a means of transition and of this frequently-mentioned continuity, as much as it provides abrupt divisions and separations': see Boulez, 'Timbre and Composition - Timbre and Language', p. 170. In the realm of the visual arts, I am reminded too of the words of American installation artist, Robert Irwin, who discusses the necessity of change in stimulating a viewer's (i.e. listener's) perception. Change, Irwin says, is 'the key physical and physiological factor in our being able to perceive at all. Our perceptual process is a kind of 'perpetual motion' assimilator. No change, no perceptual consciousness': Robert Irwin, *Being and Circumstance* (Larkspur Landing, California: Lapis Press, in conjunction with the Pace Gallery and the San Francisco Museum of Modern Art, 1985), p. 9. Whilst method 4 often introduces local-level discontinuities, the aforementioned gestural source-cause relationships, I have argued, provide an overriding sense of cohesion on a more global, even phenomenological and proprioceptive, level.

[87] Such continuity is well explained in the psychoacoustic domain by Auditory Scene Analysis, where – at the second, 'sequential grouping', stage – 'successive events that are similar in their spectrotemporal properties' and may have 'arisen from the same source…should be grouped together': see Stephen McAdams, 'Perspectives on the Contribution of Timbre to Musical Structure', *Computer Music Journal*, 23.3 (1999), 85-102 (p. 95). In this way – and in Alexander Rehding's words – timbral continuity becomes a 'principal factor in organising streams', acting as an 'Ariadne thread for the ear': Alexander Rehding, 'Timbre/Techne', in *The Oxford Handbook of Timbre*, ed. by Emily I. Dolan and Alexander Rehding (Oxford: Oxford University Press, 2018), <10.1093/oxfordhb/9780190637224.013.31> [Accessed 11 January 2021].

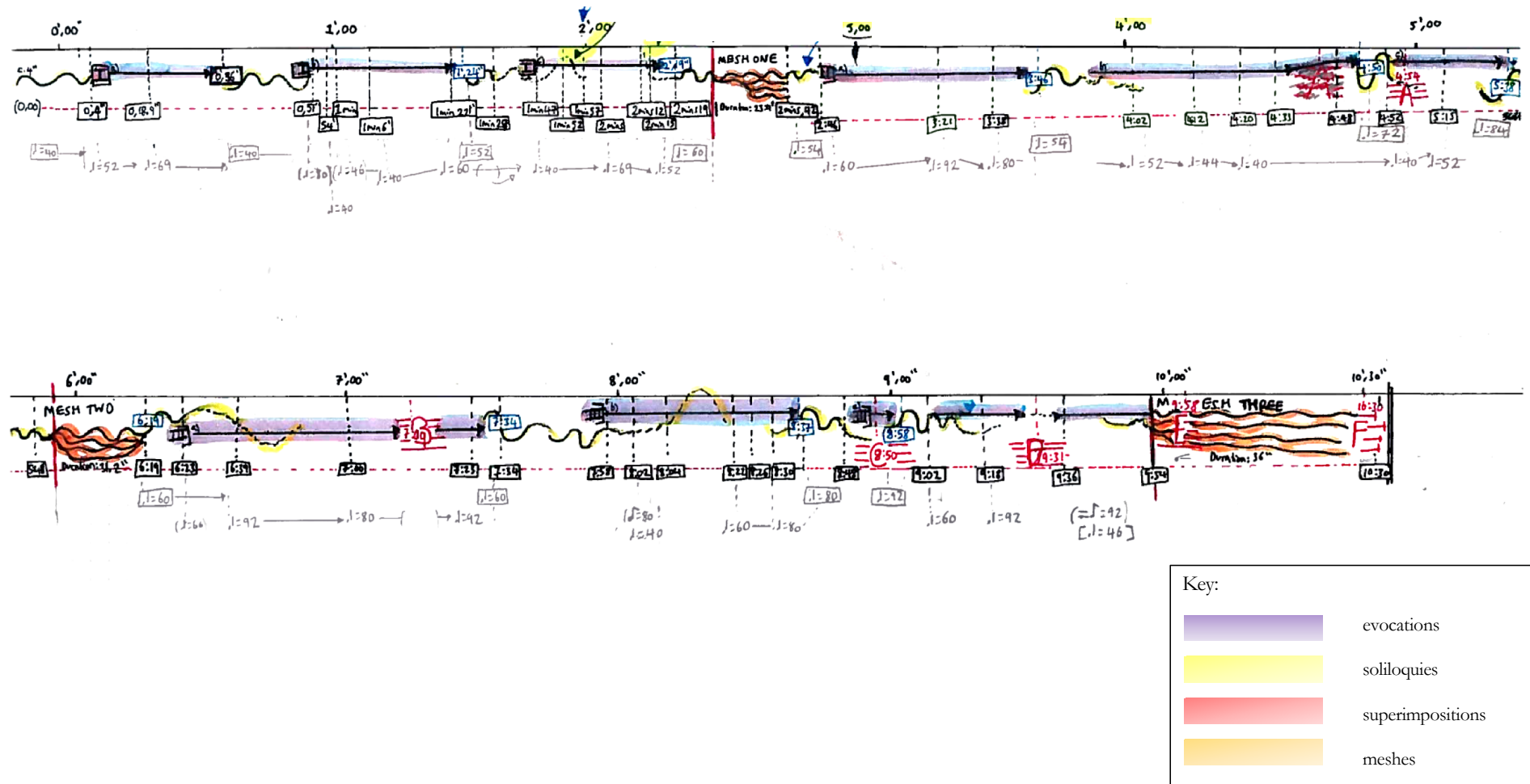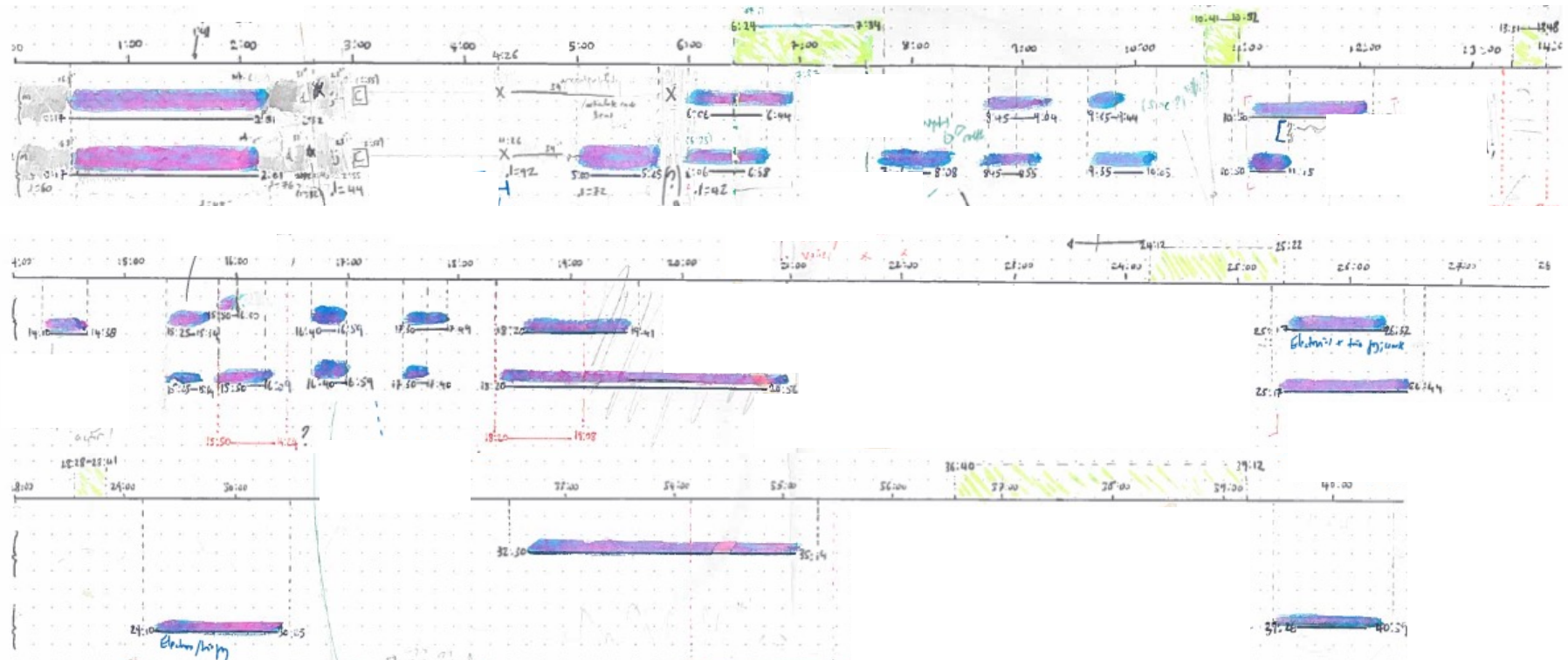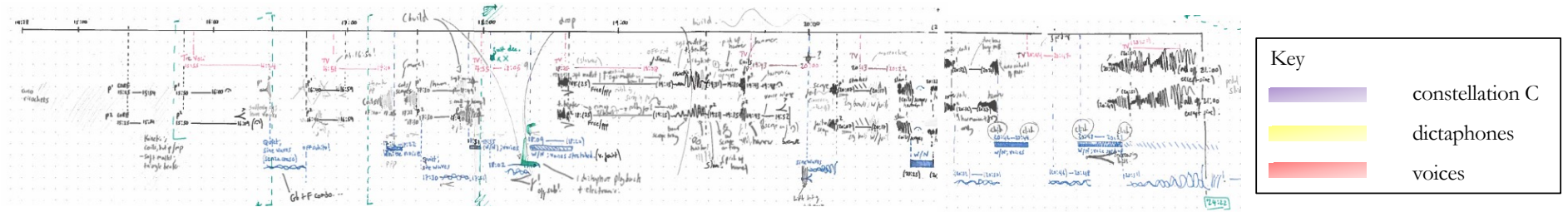**Figure 19:** *Soliloquies*, pre-compositional structural map

Figure 20: *Dhātu*, pre-compositional structural map. Allocation of constellation C materials, dictaphones and voices

Micro planning: 14:00 – 24:22

Key

constellation C

dictaphones

voices

Dhātu: overview

In *Dhātu,* meanwhile, the previously detailed core timbre becomes – along with its spectrotemporally matched neighbour sonorities in constellation C – the principal material of the work. Once again, integration is at the heart of the compositional construction. Whereas *Soliloquies*' 'evocations' consist of multiple sound objects, dovetailing, overlapping and coalescing, *Dhātu*'s principal material consists of one single and continuous timbre: the slow bow technique previously outlined, executed by one – or both – percussionists upon salad and singing bowls, coils and gongs.[55]

Whilst the points of occurrence and respective durations of constellation C materials are – like the 'evocations' of *Soliloquies* – predetermined, all other constellations are selected and organised intuitively. Timbral continuity is again central to the temporal unfolding of discourse, with methods 1-3 often employed *within* constellations, and integrative techniques of *Constellation Homophony, Constellation Continuity, Constellation Adjacency, Constellation Fusion,* and *Constellation Exchange* employed at more macro levels of the structure. Despite the integrative focus of this chapter, variation and contrast nonetheless become apparent intermittently, primarily through methods of *Constellation Discontinuity* and *Constellation Polyphony*. The music derived through these disintegrative techniques will be seen to preface more global junctures in the work's architecture: in particular the appearance of the voices and dictaphones—presented as timbrally distinct or 'other'.[56]

*   *   *

I will now take each work in turn, exploring the techniques used to organise form at a variety of structural levels. In keeping with the subject matter of this chapter, each of these compositional methods relates to matters of **timbral integration.**

Dhātu: Form and Structure

In order to demonstrate the allocation of timbral map constellations within the eventual structural design, three short case studies are now presented, outlining the various techniques by which sonorities are deployed and discourse is organised.

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[55] When both percussionists produce this sonority, the result is a closely integrated, communal 'harmonic timbre' (as discussed in relation to *Soliloquies*' 'meshes' in due course). On occasion, the core sonority is supplemented by the second percussionist employing concurrently techniques 2 or 3 (resulting in 'timbral anomaly by extraction', discussed previously on p. 18)

[56] A quality rendered more pronounced by the spatial separation of the work's musicians, as discussed in Chapter Three.

Case Study One: letters B to D (bars 43-76)

Figure 21: Timbral analysis, letters B to D

Bar	Timbral Map Node	Con.	Constellation Relationship	Edge weight between vertical sonorities	Edge weight from previous horizontal/ syntagmatic sonority	Electronics
43-46	Player 1(P^1): Sld Bowl (S) arco [node 45] Player 2 (P^2): Sld Bowl (L) arco [node 8]	C C	Vertically: matched	15.5		Largely sampled from node 38 (Large Singing Bowl, arco ricochet): a well-connected node, embracing members of constellations C, R, E, T, B, N. As such, it provides macro-level continuity throughout the section.
47-53	P^1: Spring Drum: scrape coil, secco [62] P^2: Coil 2,3 arco ricochet [52]	E R	Vertically: distant Horizontal: P^1 = adjacent; P^2 = distant	0.8	Negligible connection	
54-59	P^1: Coil 2,3 arco ricochet; coil 2,3 soft mallet ricochet [29] P^2: Spring Drum; scrape coil, secco [62]	R E	Vertically: distant Horizontally: P^1 and P^2 = constellation exchange	0.8	P^1: 0.8 (Spring Drum to coil scrape); 2.5 (Coil 2,3 mallet to ricochet) P2: 0.8	
60-68	P^1: Sng Bowl (L) arco ricochet [38]; Coil 2,3, soft mallet ricochet [29] P^2: Sng Bowl (L) arco ricochet [38]; coil 2,3 soft mallet ricochet [29]	R R	Vertically: matched Horizontally: P^1 = matched; P^2 = inherits P^1 constellation	20	P^1: 9.8 (Coil 2,3 to Sng Bowl L). P^2: 0.8 (Spring Drum to Sng Bowl L); 9.8 (Sng Bowl to Coil 2,3)	
69-76	P^1: Sng Bowl (L) arco ricochet [38]; Vocal Hum [72]; coil 2,3 soft mallet ricochet [29] P^2: Vocal Hum [72]	R H H	Vertically: P^1 fused Horizontally: P^1 = matched; P^2 = distant	38 + 72 = negligible connection. (However, through timbral fusion, together they form a strong correspondence with node 69: Vocal hum / vowel + o, beat chest. Closely connected to R components)	P^1: matched/con tinuous P^2: timbral exchange with preceding material	

In these bars, the two percussionists frequently inhabit the same timbral constellations: constellation C (bars 43-46), constellation R (bars 60-68) and constellation H (bars 69-76). In this way, an exact, or similar, pool of sonorities is often heard concurrently. Parallels might be drawn here with Alfred Schnittke's 'Timbral Harmony', whereby timbrally 'consonant' individual lines (in which 'combination(s) of related timbres…create a blended sonority difficult for the ears to analyse')[57] are heard simultaneously. Acknowledging that, at times, sounds here are 'fused into a single total colour'[58] – but, at others, despite a keen similarity between timbres, qualities of individual sonorities are still independently discernible – the term **Constellation Homophony** is preferable.

Whereas *Constellation Homophony* permits assimilation at a vertical/concurrent level, **Constellation Continuity** and **Constellation Adjacency** facilitate timbral integration at a horizontal/syntagmatic level. The former technique requires little explanation—clearly evident between bars 60-68 and 69-76, for example, where percussionist 1 remains deployed within the same constellation (R), whilst percussionist 2 deviates more freely. On a more macro level, *Constellation Continuity* is also evident in the electronics throughout this section, with a well-connected node (38 – Singing Bowl [large], arco ricochet – whose edges extend to constellations C, E, T, B and N), providing a background glue,[59] spawning strong timbral relationships with each of the foreground constellations inhabited by the percussionists.

On the other hand, *Constellation Adjacency* entails seamless movement between bordering regions of the map. We witness this technique between bars 43-46 and 47-53, for example, where Percussionist 1 transitions smoothly from constellation C to neighbouring constellation E.

Again, operating on the syntagmatic axis, **Constellation Exchange** involves the percussionists inheriting one another's pool of timbres, either through reciprocal (bidirectional) exchange, or through one-way (unidirectional) transfer. This technique is used with frequency during these bars—observable at bar 54 (where percussionists swap constellations), bar 60 (where unidirectional transfer occurs between players) and mid-way through bar 70, where percussionist 1 belatedly joins percussionist 2 in inhabiting constellation H.

A final, more complex, technique of integration – **Constellation Fusion** – sees disparate timbres (and constellations) combined concurrently, usually between players, with the resultant composite sonority resembling an entirely different area of the timbral map. This 'evoked' constellation will be, in some way, integrated with the surrounding discourse. We witness this at bars 69-76, for example, where negligibly

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[57] Alfred Schnittke, *A Schnittke Reader,* ed. by Alexander Ivashkin (Bloomington: Indiana University Press, 2002), p. 102.

[58] Ibid.

[59] Consistent with much of the electronics in the work, the tape part here is constructed of samples of the same collection of percussion instruments.

connected nodes 38 (Singing Bowl [large], arco ricochet – of constellation R) and 72 (Vocal Hum – of constellation H) in combination form a strong aural correspondence with node 69 (Vocal Hum / Vowel o+; beat chest – of disparately located constellation T). Constellation fusion here provides a means by which the percussionists can transition continuously – via **Constellation Adjacency** – to the disparate sonorities directly proceeding the case study passage (bar 77 onwards, where constellation T's neighbouring region, constellation E, becomes the dominant timbre pool).

Formal conclusions

Each of these techniques is employed as a means of facilitating maximum integration and perceptual fusion between sonorities. The location of this material within the broader structure, its relatively extended duration, and the selection of a specific and limited number of constellations are conscious compositional decisions. As a result, within the opening minutes of *Dhātu*, the sonorities situated at the north-east corner of the timbral map (constellation C and its neighbouring regions) are set out as the principal material of the work, and a constellation hierarchy of sorts has been established.

Case Study Two: letters K to L (bars 199-216):

Figure 22: Timbral analysis, letters K to L

Bar	Timbral Map Node	Con.	Constellation Relationship	Edge weight between vertical sonorities	Edge weight from previous horizontal/ syntagmatic sonority	Electronics
199-202	P^1: Vocal hum/vowel + o beat chest [69]; Sng Bowl (col legno) [74] P^2: Sng Bowl (s) Scrape [25]; Vocal hum/ vowel +o, beat chest [69]	T X X T	Vertically: distant Horizontally: P^1 = adjacent; P^2 = matched		P^1 = 1 P^2 = continuous	Time-stretched and pitch-shifted Spring Drum shake [63] with occasional striking of coil [64] and bowed foil singing bowl (67)
203-207	P^1: Sng Bowl on metal [75] P^2: Coil 2,3 arco ricochet [52]; Beater on L Sld Bowl [20]	X R X	Vertically: distant Horizontally: P^1 = continuous; P^2 = continuous, then distant	P^1 = negligible P^2 = nodes 70 and 20 = close (13); nodes 52 and 20 = negligible	P^1 = 18 P^2 = 0 (nodes 52 to 24); 13.5 (nodes 20 to 24)	
208-209	P^1: Vocal hum/vowel + o beat chest [69] P^2: Vocal hum/vowel +o, beat chest [69]	T T	Vertically: matched Horizontally: P^1 = distant; P^2 = distant	Matched	P^1 = 0 P^2 = 0	

210-216[2]	P[1]: Sng Bowl on metal [75]	X	Vertically: distant	Negligible	P[1] = 0	
			Horizontally: P[1] = horizontal; P[2] = continuous, then distant		P[2] = 1	
	P[2]: Vocal hum/vowel +o, beat chest [69]; Coil 2,3, soft mallet ricochet	T R				

With the exception of one moment of *Constellation Homophony* (bars 208-209), vertical sonorities are generally disparately related between letters K and L.[60] Moreover, as opposed to Case Study One (where percussionists tackle individual timbres), three to four unrelated sonorities are often presented simultaneously in these bars, with the percussionists executing multiple techniques concurrently.

Drawing once again upon Schnittke's terminology, these unrelated sonorities might be labelled timbrally 'dissonant'; that is to say, they combine 'distantly related timbres that retain their own individual characteristics'.[61] When drawn out over an extended duration, the resultant texture, according to Schnittke, might be called 'Timbral Polyphony'. (Or, in my case – and within the broader context of the timbral map – **Constellation Polyphony**). This technique is deployed throughout these bars, with simultaneous, non-adjacent constellations evident in bars 199-202, 203-207 and 210-216.

Timbral dissonance is additionally apparent here on the horizontal axis—with the second half of the passage making clear use of **Constellation Discontinuity**. (We see this in the transition from bars 203-7 into 208, where constellations X and R move to non-adjacent constellation T; and again, at bar 210, where the reverse journey is made).[62]

Formal conclusions

In these bars, timbral integration is momentarily eschewed in favour of techniques of *dis*integration. The placement of this passage within *Dhātu*'s global architecture is of significance. Through *Constellation Discontinuity, Constellation Polyphony*, and the rapid alteration of non-adjacent timbral regions, a certain tension and conflict is introduced into a previously stable structure. This volatility occurs in the moments directly preceding (and indeed, after) the initial entry of the three singers, serving to mark out this key passage within the structure, and framing it within the compositional design.

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[60] We can observe this in Figure 22, where the edge weight between vertically presented materials is often 'negligible'.

[61] Schnittke, p. 102.

[62] Whilst the electronic strand here inhabits constellation T and E-derived material, a firm aural connection is stymied by severe pitch-shifting of the sampled spring drum sonorities.

Case Study Three: letters R to V (bars 300-336)

The way in which the timbral map is translated into musical form is of particular note in bars 300-336, not because of the internal workings of constellations (indeed, movement between sonorities is achieved through several of the integrative techniques already mentioned). Rather, it is through the *choice* of constellations – and the location of these regions within the compositional architecture – that Letters R to V merit further exploration.

Only two constellations are employed between bars 300 and 336: B and N (closely integrated/related to one another, but those areas of the timbral map most distantly located from the core constellation,[63] and the only two regions not yet heard). Through employing these materials at this point in the work, I seek to generate a strong sense of timbral disconnect, or of timbral remoteness. Consisting principally of struck bowl sounds (hit with mallets, triangle beaters and hands), these sonorities stand in stark contrast to the coarse, fractured rubbing grain attributes associated with constellation C. Moreover, with the bell-like purity of the struck singing bowls adding a dramatic, ritualistic quality to the soundworld,[64] this remoteness appears to be mirrored on a more experiential level, too; in performance, I was aware of a peculiar stagnation of the musical flow during these bars—as if time were suspended temporarily, and we, the listeners, became the uninitiated observers of an unexplained ritual.

Formal conclusions

The location of this passage within the broader structure is noteworthy: not just owing to its occurrence two-thirds of the way through the form (at a possible 'high point' in the architecture), but also owing to its occurrence directly preceding the first entrance of the singers in Inner Crypt Space (see Chapter 3). As apparent in Figure 18 – where the voices are located as an off-map continuation of constellation X, at the north-north-east corner of the graph[65] – the vocal timbre is as far removed from constellations B and N as topographically possible. I thus employ ***Constellation Polarity*** here to generate a kind of timbral friction or tension—serving to render the juxtaposition of sonorities upon the entry of the voices all the more extreme and keenly felt at this critical juncture in the structure.

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[63] As such, these regions are located at what might be described as the core timbre's topological pole (hence, my adoption of the term 'Constellation Polarity').

[64] Perhaps achieving a timbre close to that associated with their intended use, as Buddhist meditation aids.

[65] In contrast, constellations B and N can be located at the opposite, south-south-east corner. This topographical timbral friction might be viewed as equivalent to the kind of tonal tension discussed in Neo-Riemannian Theory. Richard Cohn, for example, discusses the juxtaposition of 'hexatonic poles' (opposite ends of a PL cycle map) occurring in Romantic-era music—often at moments of structural tension within the compositional design: see Richard Cohn, 'Maximally Smooth Cycles, Hexatonic Systems, and the Analysis of Late-Romantic Triadic Progressions', *Music Analysis*, 15.1 (1996), 9-40 (pp. 18-23).

Whilst these three formal case studies reflect only a snapshot of the complete work, the cited examples are representative of the integrative techniques used to organise discourse throughout *Dhātu*: both at a micro (inner-constellation) level, and from a broader, more macro, perspective of the compositional design.

Soliloquies: **Form and Structure**

Mesh

Up until this point, timbre in *Soliloquie*s has been discussed as both a singular matter (consisting of individual gestures/sound objects) or as a fused entity, where combinations of marginal sounds/extended techniques – elicited through methods 1-3 – are melded together to evoke the work's core timbre and related sonorities.

Conversely, the three 'meshes'[66] function as a unique type of composite. Instead of individual and diverse sonorities contributing to an emergent whole, rather the *same* quality of sound is replicated here across the ensemble, generating a shared and communally integrated timbre. As is evident upon its three occurrences – in bars 49-63, 163-172 and 270-276 – this material presents a primarily static frequency field, with double stopped harmonics (often marked *pp*, and executed with extreme placement of the bow), contributing to an audible instability and fragility of sonic matter.[67] In these textures, pitch becomes a prominent facet of the ensemble sound (indeed, more so than at any other point in the work); not in the sense that exact intervals, or chords created, are intelligible to the listener—but rather that we experience a blended and ambiguous tonic mass: amalgamated pitch, heard as a certain quality of timbre.[68] In this

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[66] This word, intended to evoke an entangled and intertwined communal soundworld, has been retained from my initial sketches and pre-compositional plans. The words 'evocations', 'meshes', 'soliloquies' and 'superimpositions' are at no point present in the score.

[67] As evinced by Figure 23, the pitches here were pooled from a spectrogram reading of the core gesture. Whilst parallels will undoubtedly be drawn with Spectralism, it is important to note that my work operates within a very different framework to works emanating from this practice. Other than spectrogram analysis of an initial musical object, no further spectral procedures were used: whether relating to the unfolding of materials in time – for example, working towards a complete harmonic spectrum or a gradual disintegration of sound/increase of noise profile – nor relating to the use of techniques such as ring modulation, filtering or subharmonicity etc. (See François Rose, 'Introduction to the Pitch Organization of French Spectral Music', *Perspectives of New Music*, 34.2 (1996), 6-39). Rather, I generated pitch material through a spectrogram here as a means of ensuring an audible relationship between the three 'meshes'—with the same process of spectral analysis carried out for all three occurrences of this material. Moreover, for me the *quality* of sound was paramount here (over and above spectral accuracy)—with octaves displaced in my ultimate orchestration (and even pitches added and amended), in order to facilitate certain playing techniques: particularly natural harmonics, and fifth harmonics, which contribute to the fissured – and at times, hollow – sonic landscape.

[68] This melding of timbre and harmony is famously one reading of Schoenberg's much debated 'Klangfarbenmelodie', as outlined in his *Theory of Harmony*: '…I think the tone becomes perceptible by virtue of tone colour, of which one dimension is pitch. Tone colour is, thus, the main topic, pitch a subdivision. Pitch is nothing but tone colour measured in one direction': Arnold Schoenberg, *Theory of Harmony, trans by. Roy E. Carter* (Berkeley, CA: University of California Press, 1978), p. 421.

sense, the three 'meshes' could be seen to exist on the threshold of timbre and harmony—operating in the 'hybrid space between the two domains':[69] a distinct kind of 'harmonic timbre'.[70]

Figure 23: pitch materials for the three 'meshes' derive from spectrogram readings of the core gesture. Notes here are liberally arranged between the four instruments, with octaves freely displaced
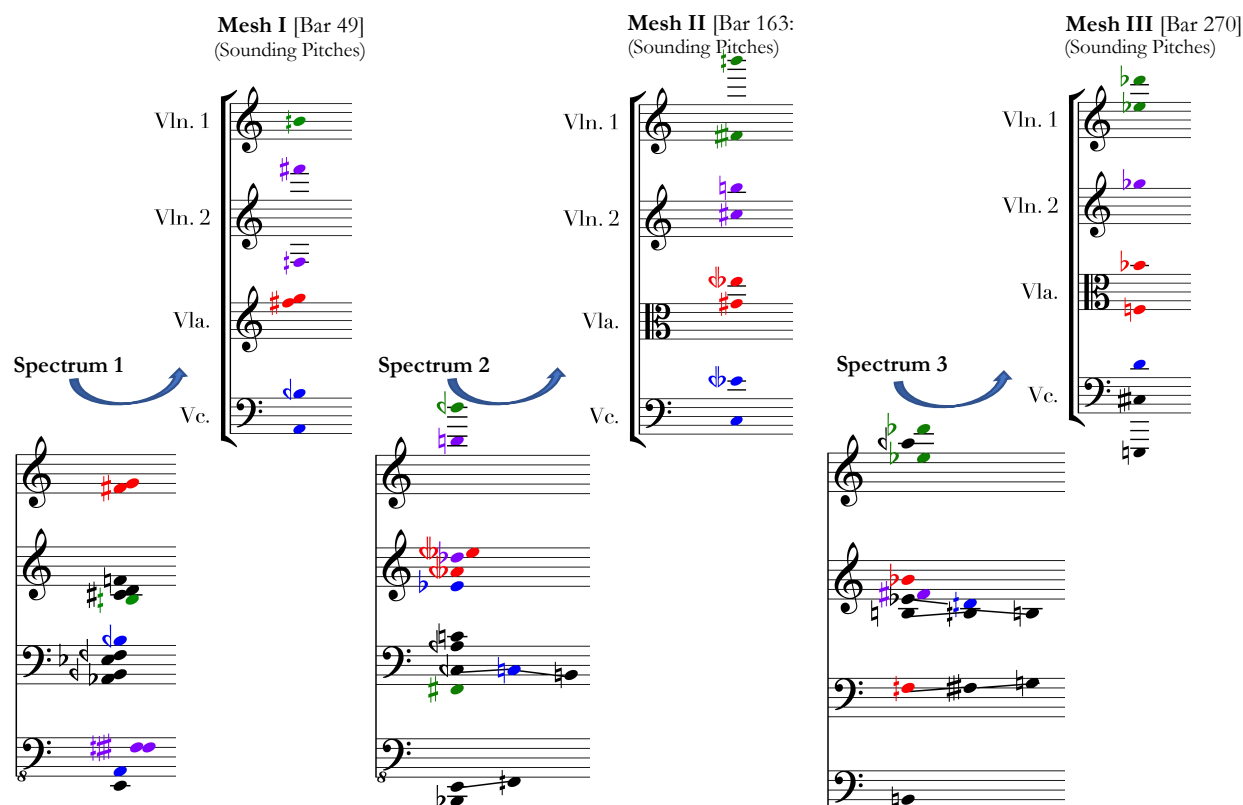
The relatively sustained and slowly unfolding nature of this homogenous ensemble sound might be described, using Denis Smalley's terminology, as 'texture-carried'[71] discourse: music in which the energy appears to be 'directed inwards'[72] (at the 'expense of forward impetus'),[73] and where the concentration is

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[69] Robert Hasegawa, 'Timbre as Harmony—Harmony as Timbre', in *The Oxford Handbook of Timbre*, ed. by Emily I. Dolan and Alexander Rehding (Oxford: Oxford University Press, 2018), <10.1093/oxfordhb/9780190637224.013.11> [Accessed 22 January 2021].

[70] I employ this term in a different sense to Schaeffer, for whom this word implies the 'perception of the harmonic spectrum' of a sound (Chion, p. 168.)—a contributing factor in ascertaining instrumental identify. Hasegawa's description of 'harmony mediated by timbre' might also be applied here, with pitch occurring within a 'context in which the emergent properties of the composite timbre are foregrounded instead'. (Hasegawa, 'Timbre as Harmony—Harmony as Timbre'). *Dhātu*'s core sonority – the slowly bowed bowls of constellation C – might similarly be described as conveying a strong 'harmonic timbre', with amalgamated, hollow-sounding channelled sonorities appearing as a constant quality of its overall course, rubbing grain timbral profile.

[71] Denis Smalley, 'Spectro-Morphology and Structuring Processes', in *The Language of Electroacoustic Music* (Basingstoke, Hampshire: The Macmillan Press, 1986), pp. 61-93 (p. 83).

[72] Ibid., p. 82.

[73] Smalley, 'Spectromorphology: Explaining Sound-Shapes', p. 114.

upon 'internal behaviour patterning'[74]—in this case, the intricate granularity of the communally generated harmonic timbre. The aforementioned 'evocations', by way of contrast, unfolding through a network of closely connected physical actions and their resultant spectrotemporally matched sonorities, might be described as 'gesture-carried'[75] discourse: music propelled by the 'application of energy and its consequences'.[76] As a result of these differing micro-level structuring schemes, the three 'meshes' are intended to be perceptually distinct and formally defined from the materials surrounding them within the work's overall architecture. That said, through frequent recourse to the ensemble's scordatura fourth string, a certain degree of macro-level timbral integration is maintained between 'sections': these are musical materials very much cut from the same cloth.

Influences upon 'mesh' material

The murky, composite world described above was attractive to me when devising this material; and stylistically, the influence of two particular quartets/quintets from the last few decades, which employ similar discourse, may well be discernible to the listener. Firstly, Ole-Henrik Moe's *Vent* – the first movement of a three-part work (*Vent, Litt, Lenger*)[77] – served as an important model for my own composition. The fractured harmonic landscape and extreme fragility of *Vent*'s opening four minutes, in particular, appealed to me, with the string quintet's *sotto voce, sul tasto* utterances (where slow movement of the players' bows generates a granular, coarse texture), leaving their imprint upon my work. Indeed, at times, the playing upon the closely mic-ed Arditti recording is so quiet that the instrumentalists' inhalations and exhalations are very much audible, to my ear becoming bound up in the intimate, communal feel of this passage. Building upon Moe's approach, I decided to actively find a place for this (formerly performative residue) in the 'meshes' of *Soliloquies*, rendering both in- and exhalation, and other vocal utterances, part of the final material.

Moreover, the consistently muted and veiled quality evident in Moe's work, produced through *sul tasto* bow placement, is taken further in my own composition, with the quartet's slowly shifting harmony mirrored by subtle movements of the bow between fingerboard and extreme *sul pont* positioning. This latter colour, in combination with slow bow movement and hollow-sounding harmonics, is again reminiscent of the opening of an existing quartet: Pierluigi Billone's *Muri IIIb*. However, despite similarities in approach, the rate of change in my own material is much slower and more restrained than

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[74] Smalley, 'Spectro-Morphology and Structuring Processes', p. 82.

[75] Ibid., p. 83.

[76] Ibid., p. 82.

[77] This work is recorded on the Aurora label by the Arditti Quartet. With the composer himself featuring as an additional violinist, the work is scored for quintet, rather than quartet: Arditti Quartet and Ole-Henrik Moe, 'Vent', *Vent Litt Lenger* (Aurora, ACD 5054, 2008) [on CD].

in Billone's work, where gesture is at times violent and forceful, frequently rupturing the communal sense of stasis.
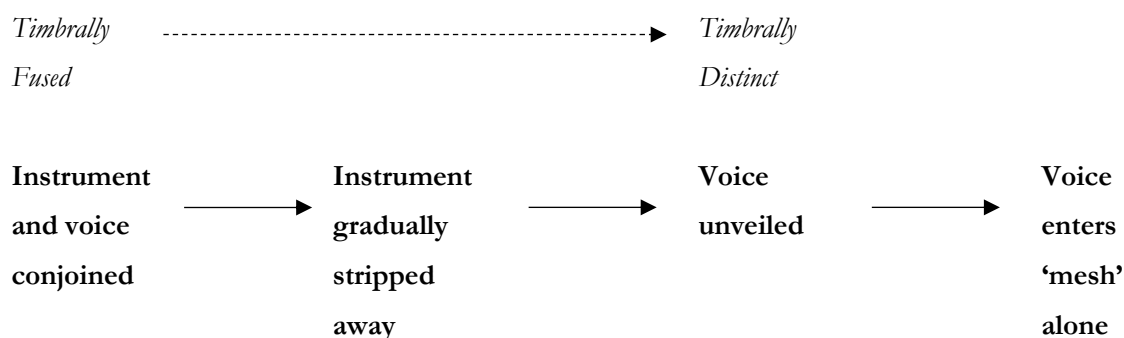
Figure 24: Pierluigi Billone, *Muri IIIb* (Vienna: self-published, 2010), bars 36-39

Soliloquies

Adjoining the 'meshes' and permeating the entire quartet is a network of 'soliloquies': solo lines, initially integrating both voice and instrument. As the work progresses, each member of the ensemble soliloquises in turn, following the same linear trajectory at a formal level:

Figure 25: trajectory of 'soliloquy' material

Timbrally Fused --▶ *Timbrally Distinct*

| **Instrument and voice conjoined** | → | **Instrument gradually stripped away** | → | **Voice unveiled** | → | **Voice enters 'mesh' alone** |

In these passages, the quartet play almost exclusively upon their scordatura fourth string,[78] with a series of short, meandering glissandi executed at a low and guttural frequency. Concurrently, the instrumentalists map these melodic contours with their voices—on occasion matching pitch content exactly (see, for example, the viola in bar 1), or more frequently, inhabiting a more general, shared tessitura (for example,

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[78] As observed with the 'meshes', the distinctive granular profile of material played upon this string conveys a certain timbral coherence and sense of sonic integration across the work.

the viola in bar 16). Vocal material here is predominantly hummed, with a high degree of timbral fusion between voice and the scordatura string. This near-unison integration (albeit combining vastly disparate sound sources) could perhaps be seen to exemplify Cornelia Fales' 'timbre anomaly by redistribution':[79] a specific kind of composite sonority, in which 'additional timbres are added to an existing grouped unit – causing new groupings to form'.[80] This process effectively constructs a novel instrument, rendering individual sources indistinguishable from one another. Such timbral fusion was indeed evident in this material during the premiere performance of *Soliloquies*, and I was surprised by the extent to which voice and instrument became amalgamated, with a decidedly 'other worldly' resonance created by the close timbral doubling.

The gradual stripping back of instruments to reveal voices – a journey from initial timbral fusion to ultimate sound source separation (as set out in Figure 26) – arguably becomes the key macro-level formal trajectory of this quartet: a linear process, played out chronologically, reaching a logical conclusion in bars 277-281 and 299-306.[81]

Figure 26: macro trajectory of work's vocal elements:

Internalised Murmuring	→	Vocal Fry	→	Spoken Fragments / Syllables
Instrumental Soliloquies *[See above]*		Superimpositions *[See below]*		Bars 277-281 and 299-306
- mouth predominantly closed		- mouth open		- speech / mouth open
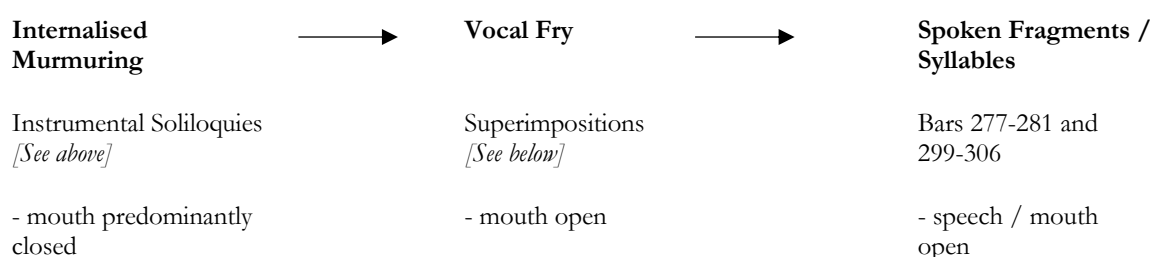
Influences upon 'soliloquy' material

In these closing bars of the work, each performer embarks simultaneously upon a final soliloquy: this time, spoken. Consisting of isolated syllables, vowels and consonants, the stimulus for this material again might be traced to Pierluigi Billone, who frequently incorporates dislocated Italianate/Latinate words into the spoken texts of his instrumental works. These – often detached and monotonous – utterances convey a ritual language, or 'secret linguistic formulas, the meaning of which remains obscure…to the

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[79] Fales, pp. 68-71. (In contrast, see p. 18, where Fales' 'Timbral anomaly by extraction' was previously discussed, in relation to *Dhātu*).

[80] This type of sonic organisation has a tendency, says Fales, to 'disrupt perceptual complacency, presenting anomalous sounds that subvert a listener's instinctive knowledge of source behaviour, creating instead a profound, if momentary, disorientation' (see Fales, p. 71). Within the ethnographic domain, Fales discusses the 'whispered inanga', as an example of this timbral composite: a Burundian technique, through which voice and stringed instrument are combined into a perceptually novel sonority (Fales, p. 79).

[81] As observed in Figure 26, a gradual inter-strand trajectory is evident as the work progresses: with the performers' vocalisations beginning as internalised murmuring, modifying incrementally through vocal fry towards spoken utterance.

uninitiated'.[82] Wishing this material to be located on the cusp of semantic comprehensibility, I draw in my own work upon three dramatic monologues,[83] seeking – despite awkward divisions and fractures within words and sentences – to capture credible linguistic patterns.

Although operating at a much more extreme, even confrontational, level, parallels too may be drawn with the vocal mutterings often present in the instrumental works of Julio Estrada.[84] Discussing his frequent recourse to primitive, voiced sonorities, Estrada describes how his music's murmurings and intonations often communicate a certain intimacy in performance, as if betraying an infant's 'self-seeking' utterances (those sounds heard during the 'perceptive exploration' stage that 'precedes spoken language').[85] Such a quest for personal expression is arguably communicated in my own work. With little/no semantic content decipherable through the players' vocalisations, the listener is left only with a general notion of four performers each engaging in a personal, private dialogue, whose meaning is internal and unknowable.

Superimpositions

Until now, this chapter has been dedicated to methods of timbral integration. However, with the inclusion of *Soliloquies*' 'superimpositions',[86] the quartet wilfully embraces *dis*integration. Performed with the bow upon auxiliary instruments (polystyrene blocks, attached to the players' stands),[87] the 'superimposition' strand is intentionally interruptive: its auditory attributes and spectrotemporal properties so vastly different to the surrounding discourse that it is segregated as a distinct auditory stream.

Influences upon 'superimposition' material

Drawing upon techniques employed by Luigi Nono in his *Fragmente-Stille, an Diotima* – where interruption and fragmentation are achieved through the introduction of 'foreign material'[88] (timbrally distinct musical

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[82] Tobias Schick, *Suono, Corpo, Rituale: Un Ritratto Del Compositore Italiano Pierluigi Billone*, 2020, p. 11 <https://www.pierluigibillone.com/pdf/suono_corpo_rituale_2020-tobias_schick.pdf> [Accessed 10 December 2020]. Translated by the author.

[83] Words are taken from monologues found in Kafka's *The Metamorphosis* (Steven Berkoff's adaptation), Shakespeare's *Richard II*, and Seneca's *Oedipus*. Despite their semantic ambiguity (with words written out phonetically, even on the page these passages are somewhat indecipherable!) each of these three speeches was selected carefully owing to particular personal and private connections I have with the texts.

[84] For example, his *Yuunohui'Ehecatl* (2012) or *Ni die saa* (2013).

[85] Julio Estrada, 'Emanation of The Voice', *Perspectives of New Music*, 42.2 (2004), 88-120 (p. 97).

[86] This term was lodged in my mind when writing, implying to me the retrospective addition of an element external to the existing discourse.

[87] A technique which produces a complex and violent nodal spectrum in an extremely high tessitura.

[88] Carola Nielinger-Vakil, *Luigi Nono: a Composer in Context* (Cambridge: Cambridge University Press, 2015), p. 164. Labelled the 'Diotima' strand by Nielinger-Vakil, this material – usually marked *pp*, with *tremolandi* executed *sul pont* by the strings – arises periodically, immediately perceptible as timbrally distinct from the surrounding discourse.

elements) – I had trialled a purely instrumental[89] approach to discontinuity in earlier doctoral works. *Hibeh* (for mezzo soprano and chamber ensemble), for example, sets aside a limited palette of specific instrumental colours, deploying these sonorities as a means of rupturing and intersecting the established discourse. In contrast, and through the inclusion of 'concrete sound sources'[90] – often 'found' objects, such as metronomes, record players and music boxes – Rebecca Saunders' works of the late 1990s and early 2000s often take a more extreme approach to timbral juxtaposition. In *Molly's Song 3 – Shades of Crimson* (1995-96), for example, four untuned radios enter the fray two-thirds of the way through an otherwise entirely acoustic work: a jarring and heavily interruptive juncture in the structure. Saunders refers to such materials as 'sound surfaces', saying that she is intrigued by the 'static and removed quality' of these objects, and the means by which they create 'a sense of distance between the listener and the music.'[91] Whilst I am fascinated by the temporal implications of these interjections,[92] and have been heavily influenced by Saunders' recourse to an extended palette of auxiliary instruments (which serve the purposes of extreme timbral *dis*integration very well),[93] my own approach to the incorporation of sound surfaces – in this instance, polystyrene block 'superimpositions' – is distinct, as I will go on to outline below.

In order to clarify my own position, I will elaborate a little further here. Saunders' sound surfaces are generally consistent between appearances; that is to say, the music boxes and untuned radios are themselves unchanged each time they emerge. Furthermore, the surrounding discourse – that which they interrupt – generally remains unaltered upon its resumption. As such, any perceptual difference felt upon hearing the recurrence of these materials is an entirely phenomenological occurrence—existing through experience, rather than explicable upon the musical page.[94] On the other hand, in his music, Ligeti describes a reciprocal relationship between 'events' – fixed sonic elements which 'emerge suddenly'[95] – and 'states': the surrounding, more integrated discourse, where materials 'alternate with one another,

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[89] That is to say, like Nono, forging timbral contrast through (altered) use of the *same* acoustic instruments.

[90] James Saunders, 'Interview with Rebecca Saunders - James Saunders', 2006 <https://www.james-saunders.com/interview-with-rebecca-saunders/> [Accessed 2 May 2021].

[91] Ibid.

[92] I discuss the effect of these materials upon musical time in my discussion of Saunders' *Fury II* in Chapter Four, in relation to my own work, *Hyphae*.

[93] Whilst less interruptive in their respective contexts, the use of auxiliary instruments in the works of Clara Iannotta – for example, *Limun* (2011), for violin, viola and two page turners (who unexpectedly double as harmonica players) – and Francesco Filidei (*Ballata No.2* [2012], for example, in which instrumentalists make use of bubble wrap, crystal glasses and corrugated tubing, amongst other items), were equally influential upon my choice of materials for *Soliloquies'* 'superimpositions'.

[94] Saunders perhaps insinuates this when explaining 'It is this juxtaposition of sound worlds that provides the basis of much of my music. It continues to fascinate me how differently a sound world can be perceived depending on its context in time and in musical space': see Saunders, 'Interview with Rebecca Saunders - James Saunders'.

[95] György Ligeti and Jonathan W. Bernard, 'States, Events, Transformations', *Perspectives of New Music*, 31.1 (2021), 164-171 (p. 166).

engulf one another, or flow into one another to the point of blending'.[96] Influenced by a childhood dream, in which a dense web, entangling disparate objects, appears to undergo constant transformation – its structure perpetually altering when any element is mobilised – Ligeti refers to the construction of musical forms in which emergent events 'leave traces behind' (as such, affecting and altering the surrounding 'states' permanently).[97]

Soliloquies takes an alternative approach to timbral interjection. Whilst the work's 'states' (to which I've referred previously as 'evocations') are largely consistent across the structure, it is the 'superimpositions' (comparable to Ligeti's 'events') that undergo a process of transformation. The evolution of this interruptive material is directly stimulated by the sonic environment into which it is inserted, with the 'superimpositions' slowly assimilating the timbral characteristics of the work's 'evocations'.

Figure 27: corporeal trajectory within 'superimpositions'

External →→→→→→→→→→→→→→				Internal
Foreign body / auxiliary instrument				*Performer's body only; fry (breath)*
Superimposition 1 Bar: 153 – 154 Duration: 5.5 beats [crotchet = 44]	**Superimposition 2** Bar: 258 – 261 Duration: 9 beats [crotchet = 92]	**Superimposition 3** Bar: 270 – 274 Duration: 12 beats [crotchet = 60]	**Superimposition 4** Bar: 283 – 290 Duration: 12 beats [crotchet = 60]	**Superimposition 5** Bar: 308 – 312 Duration: 19 beats [crotchet = 60]
- Fry (neutral vowel) for c.6 beats	- Fry (neutral vowel) for 6.5 beats - Fry (hummed /closed mouth) for 2.5 beats	- Fry (neutral vowel) for 8 beats - Fry (hummed /closed mouth) for 4 beats	- Fry ('ah') for 8.5 beats - Fry (breath) for 3.5 beats	- Fry ('ah/ee') for 7.5 beats - Fry (breath) for 11.5 beats
- Polystyrene Blocks for c.3 beats [3 players]	- Polystyrene Blocks for 3.5 beats [2 players]	- Polystyrene Blocks for 6 beats [1 player only]	- No Polystyrene Blocks	- No Polystyrene Blocks

Corporeality and Form

As observed in Figure 27, the process of timbral transformation evident in the 'superimposition' strand – in keeping with other linear trajectories observed within the work, and indeed across the portfolio (see

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[96] Ibid.

[97] Moreover, the reverse is also true, with the modified states having a 'certain effect upon the type of events, for these must be of ever new kinds of character, in order to be able further to transform the transformed states'. (Ibid. pp.167-170).

Chapter Four and the Conclusion) – is one of increasing corporeality. In Superimposition 1 (bars 153-154), the dominant timbre is the external/auxiliary sonority: three polystyrene blocks, played simultaneously. Although vocal fry is present in these bars, it is a subsidiary timbre: existing – certainly within the concert hall[98] – on the threshold of audibility. With every occurrence of this strand, however, the balance between auxiliary sound object and vocalisation begins to tip. By Superimposition Three, the vocal fry (at first executed on an indistinct, neutral vowel) adopts a more speech-like 'ah' or 'ee' vowel shape. Coupled with an incremental reduction in the number of players performing upon the polystyrene blocks, the audibility of this vocal material is greatly enhanced. By Superimposition 4, only voices remain, with the fry becoming increasingly internalised, retreating into a breathy exhalation by bars 283 and 306.

From a formal perspective, this gradual transformation from external sound object to intimate vocalisation is in fact a macro-level trajectory of timbral assimilation and integration—with the resultant vocal fry/breath ultimately forging a close auditory correlation with the surrounding 'evocation' and scordatura string-focused 'mesh'/'soliloquy' material.

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Timbral Integration: A Summary

In both key works of Chapter One, timbral integration has been presented as the principal means through which discourse is organised. Within the 'evocations' of *Soliloquies* and the constellations of *Dhātu*, timbral continuity became apparent at a micro/sound-object level, with form unfolding through closely matched sonorities – presented both concurrently and syntagmatically – and through subtle parametric alteration/variation, enabled by methods 1-3. Whilst method 4 was seen to introduce contrast on a local scale, source-cause gesture, I argued, provided a more phenomenological, gestural cohesion and continuity. At a macro level, meanwhile, *Soliloquies*' structure was seen to be punctuated by preconceived 'divisions': markers designed to break up the discourse. These materials ('soliloquies' and 'meshes') were presented as distinct, organised internally through their own integrative formal schemes (timbral 'fusion', or 'timbral anomaly by redistribution', and 'harmonic timbre', respectively). However, through shared recourse to the quartet's scordatura strings – pivotal to the aforementioned 'evocations' – a sense of timbral integration ultimately became apparent between these sections at a global level. Meanwhile, in *Dhātu*, large-scale continuity between various areas of the distance model/timbral map was observed, instigated by specially devised techniques of *Constellation Homophony, Continuity, Adjacency, Fusion* and *Exchange*.

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[98] Hearing the work, as recorded by France Musique, with the microphones placed close to the quartet was a very different experience to encountering the work in the concert hall, with this fry material substantially more audible on the radio than it was within the physical performance space.

Whilst integration took centre stage in the exploration of both works, occasional *dis*continuities became apparent at multiple structural levels. In *Soliloquies*, initially interruptive 'superimpositions' were seen to penetrate the structure intermittently, ultimately becoming assimilated into the work's core timbral palette through their own internal linear change. In *Dhātu*, on the other hand, techniques of *Constellation Polarity, Discontinuity* and *Polyphony* were explained as foreshadowing more macro-level timbral discontinuities within the work's architecture. These elements of the compositional design, inextricably bound up with a notion of space, become the principal subject matter of Chapter Three.

Chapter Two: Timbral Disintegration

In Chapter One, discourse was seen to be organised through timbral integration (or continuity), with broader changes within the structure instigated by pre-conceived, macro-level discontinuities ('superimpositions', in the case of *Soliloquies*, and disparate vocal and electronic materials in *Dhātu*). In this forthcoming chapter, it is rather progressive and linear timbral *dis*integration which becomes the principal means of controlling the discourse.[99] In *Analogue*, this disintegration – along a continuum between the poles of 'locatable pitch' and white noise – is facilitated by the use of microcassette dictaphones (whose 'lo-fi' timbre will become an important point of discussion). Conversely, in *Bríatharogaim*, disintegration occurs in the acoustic domain. Here, complex paratactic structures will be seen to govern the form, with retrospectively inserted units engendering progressive timbral decay and prompting the predominance of nodal and channelled sound. In both works, an emergent corporeality becomes associated with this disintegrative trajectory—with intimate and tactile utterances ultimately coming to the fore, as timbre starts to erode.

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Analogue (2017)

Commissioned as an artistic response to John Milton's *Paradise Lost*,[100] *Analogue* – for piano trio and dictaphones – received its premiere at Christ's College, Cambridge, within the framework of the 2017 *Echoes of Paradise* conference.

At the outset of the pre-compositional process, my initial thoughts turned to the poem's broader structure. Reading *Paradise Lost*, I was particularly struck by the recourse to repeated imagery, and by the interconnecting strands which run throughout the work. The frequent conjuring of extremes of darkness and light, of height and depth which interlink the early books of the poem, or the re-emergence of images from Book One's Parliament of Devils during Book Nine, for example, are just a few instances of Milton's atemporal employment of epic form: an abandonment of a straightforward sense of chronology. This notion of a 'folded' structure, which 'continually returns upon itself, or a spiral that circles on a single centre'[101] appealed to me compositionally. Within this form, developing meaning – where we might be continually presented with something new – is of secondary importance. Instead, we accumulate over

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[99] It is important to note here that said disintegration might still be viewed through a lens of continuity (as opposed to *dis*continuity)—with timbral attributes steadily undergoing deteriorative change along a linear continuum.

[100] John Milton, *Paradise Lost* (Oxford: Oxford University Press, 2005).

[101] Isabel Gamble MacCaffrey, *Paradise Lost as Myth* (Cambridge, Mass: Harvard, 1959), p. 45.

time a 'deepened understanding'[102] of the same thing: a message that is 'as present in the first line as it is in the last'.[103]

In musical terms, this idea of a re-emerging or resurfacing strand of material suggested some form of cyclical repetition. Early sources of inspiration here included Salvatore Sciarrino's *Sui poemi concentrici* (1988), whose similar subject matter – the concentric inner circles of Heaven and Hell (this time evoked by Dante, rather than Milton) – is depicted through a 140-minute progression of cycling, seemingly infinite, harmonic material, conceived by the composer as a 'single arch'.[104]

A second point of departure was the trajectory of the central character of Satan. It is widely assumed that, before the start of *Paradise Lost*, the devil has *chosen* to do wrong, and that his behaviour throughout is thus driven by compulsion; his future has been set and is inescapable. This sense of permanence and consequence of action – combined with the aforementioned desire for a recurrence of material on a musical level – brought to mind the most literal form of repeated playback: reproduction via the use of recording technology. Incorporating recording devices would also, I thought, enable the possibility of some kind of performative 'choice' regarding what musical material would be captured, and when to press 'record'. Satan's decision to err could be reflected musically and remain tangible throughout the work—bar one present in bar ten, in bar 100 and so on. I decided to use analogue cassette dictaphones, as it occurred to me that these devices could offer a truly 'permanent' sonic legacy. Rather than storing data as digital memory (which could be wiped clean at the touch of a button), sound could be recorded directly onto physical tape: its imprint lasting and tangible, providing a strong sense of sonic history and an ever-presence of material.

Structure

I chose Satan's five soliloquies (IV:32, IV:358, IV:505, IX:99 and IX:473) as a means of loosely structuring *Analogue*. Each moment of oration is assigned to an instrument or combination of instruments:

- Soliloquy one: piano (*Material A*)
- Soliloquy two: piano *(Material B)*
- Soliloquy three: violin (*Material A* or *B*, depending on cellist's initial decision)
- Soliloquy four: cello (*Material A* or *B*, depending on cellist's initial decision)

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[102] Ibid.

[103] K. M Newton, *Theory into Practice* (Basingstoke: Macmillan, 1992), p. 117.

[104] Rainer Pöllmann, CD liner notes in *Salvatore Sciarrino: Sui poemi concentrici* (Kairos, 0012812KAI, 2009), p. 11.

- Soliloquy five: all three instruments *(Material A and B)*

Overview of *Analogue*

Assuming that, even at the start of Milton's poem, Satan has already chosen to do wrong, and has thus set his own path, so the material of *Analogue* is predetermined. At the work's opening, the piano presents two contrasting strands of solo music: *Material A* and *Material B*. The cellist, with no prior arrangement or discussion with the trio, decides in concert which of these strands to record – and subsequently play back – using their dictaphone.

This choice will go on to define all material that follows.[105] If *Material A* is chosen, then this strand of music is played throughout by all three instruments (similarly, if *Material B* is selected, then this material becomes the work's focus). Furthermore, the dictaphone technology renders the ramifications of the cellist's initial decision – or Satan's choice to do wrong – even more tangible; with the selected material continually passed from recording device to recording device, the opening bars of the work are heard time and time again, remaining, in theory, ever-present on tape until the final few seconds of the work.

Experimental points of departure

Through both the incorporation of microcassette dictaphones and the relatively indeterminate unfolding of its materials, *Analogue* could be seen to operate within a more experimental – post-Cageian – lineage than any other work presented in this portfolio. In terms of the heavily coloured lo-fi timbre of the cassette machines, Jürg Frey's *Landschaft mit Wörtern* (2008) – a 60-minute sound installation for three loudspeakers[106] – served as a conscious point of reference. Whilst Frey's 'easy and plain' materials ('sounds of harmonics, melodica, sounds of stones, wind noise, pitches and pianos, single words…')[107] are timbrally very disparate, a certain unification of these sonorities is evident through their unanimous diffusion via simplistic means ('low budget cardboard, plastic loudspeakers, accumulators and batteries').[108] This primitive and basic technology is at one with – and seems to enhance – the understated, *sotto voce*, fragile colours of the musical material. Such lo-fi timbre was very much in my mind when constructing my own sonorities—in particular, the delicate and precarious double-stopped string harmonics of Material B, whose brittle timbral qualities I knew would be exaggerated and heightened through their ultimate cassette-machine projection.

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[105] There have been three performances of *Analogue* to date: *Material A* has been selected once and *Material B* twice.

[106] I had encountered the work at the Huddersfield Contemporary Music Festival in 2015.

[107] Jürg Frey, 'Sound Installations', in *Huddersfield Contemporary Music Festival 2015 Programme*, 2015, p. 14.

[108] Ibid.

A similar use of low-budget and lo-fidelity technology is prevalent in the work of British composer James Saunders. It is through exploring Saunders' music – particularly the #*unassigned* (2000-9) and *assigned* (2002–) series – that I first encountered the compositional use of the microcassette dictaphone: a pivotal discovery and catalyst for my work on *Analogue*. Hearing these works by Saunders, particularly *unassigned 15* (a 45-minute work for flute, percussion, piano, organ, viola, cello and dictaphones), I was struck not only by the many sonic qualities of the technology, but also by the strong organic relationships Saunders manages to forge between the microcassette machines and disparate acoustic instruments. After conducting further research into dictaphone technology (in particular, the Sanyo TRC-580M, discussed at length by Saunders in his article, *The Dictaphone in My Life*),[109] it started to become evident to me that these microcassette players embodied several of the attributes I was already seeking in my trio. As demonstrated in *unassigned 15* their playback is heavily coloured, its quality difficult to control—prone to deterioration and disintegration.

Formal overview: timbral disintegration / towards white noise

The influence of Milton's folded epic structure upon the architecture of *Analogue* – circling around a single centre and eschewing a more straightforward chronology – was discussed above. But, despite *Analogue* emulating this spiralling, circling form there undoubtedly remains a trajectory in the re-emerging material played by the dictaphones. Whilst retaining a blueprint of the work's opening on each appearance – the piece's constant and recognisable 'centre' – this microcassette strand is in the process of continual evolution and change: half-speed playback (and consequently the lowering of pitch by around an octave), combined with the inherently lossful nature of the analogue recording technology leads to a gradual erosion of material, degrading exponentially on each appearance. Through experimentation with the recorders, I found that this distortion is felt especially keenly when the devices are doubled up, used in tandem to record not just the acoustic sounds of instruments, but the playback of other recorders. The effect here is one of bleaching, or whitening; pitch and harmony are progressively blotted out and begin to fade. Instrumental timbre and the acoustic identities of the violin, cello and piano are neutralised, simmered down to a shared sonic mass.

In this way, *Analogue* progresses formally from clear musical gesture towards noise – or more precisely, towards *white noise* – in spite of its twists and turns. Importantly, by adopting this trajectory of timbral disintegration and deterioration, the work could be seen to evoke another of the narrative arcs evident in Milton's poem: the progressive degradation and corporeal descent of the character of Satan. A fall from a 'shape and gesture proudly eminent' (I.590), which has 'not yet lost/All her original brightness' (I.592), through to 'monstrous serpent on his belly prone' (X.514).

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[109] James Saunders, 'The Dictaphone in My Life', *Leonardo Music Journal*, 17 (2007), 33-34.

Maintaining timbral invariance under transformation

With much of *Analogue* existing in the murky world between pitch and noise, I will again adopt Schaefferian terminology, and talk of changing *mass* and its associated typomorphological characteristics. In this way, a false pitch/noise dichotomy is avoided, with all sounds conceived through the same timbral lens—existing on a continuum between 'locatable pitch' and 'nodal groups'/white noise. In this ambiguous timbral hinterland, it is essential – in terms of the work's form – that we continue to perceive invariance on some level, as the music deteriorates.[110] As such, both *Material A* and *B* are designed to withstand the aggressive analogue manipulation and transformation to which they would be subject (ie. retain some audible semblance of their original character).

In Figures 28 and 29, below, the opening bars of *Material A* and *B* – as heard upon their initial appearance in the piano, and subsequently committed to tape – are split apart into several multidimensional timbral attributes.[111] As this material is passed from dictaphone to dictaphone, certain of these parameters are intended to remain perceptible – or even acquire prominence – whilst others dissipate quickly:

Figure 28a: *Material A*, piano opening gesture (bars 1-2)

Dynamic Profile:	*p* ———————— *ff*
Melodic Profile / Tessitura:	Extremities, inwards towards middle:
Density:	Thin ----------▶ Thick
Mass:	Locatable pitch: dissonant/unclear
Attack:	Prominent attack; elongated sustain via pedal

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[110] The perception of 'invariance' within 'musical patterns' upon their transformation is noted as a key morphophoric (form-bearing) criterium by McAdams: see Stephen McAdams, 'Psychological Constraints on Form-Bearing Dimensions in Music', *Contemporary Music Review*, 4 (2021), 181-198. Curtis Roads, in his discussion of timbre as a formal building block, goes on to propose the significance too of our perception of a 'continuum between two contrasting poles along some dimension': see Curtis Roads, *Composing Electronic Music* (Oxford: Oxford University Press, 2015), p. xix. It is interesting to note that *Analogue* itself embodies this continuum formally – as described previously – through its incremental transition along the dimension of mass profile (from pitch to noise).

[111] The attributes used here are, as with Chapter One, freely derived and adapted from Schaeffer's morphological criteria.

Figure 28b: *Analogue*, bars 1-2 (piano)

The dynamic profile, melodic profile and density of *Material A* are bound up within (interlinked) linear processes: dynamics are unidirectional in their trajectory (*p* to *ff*), whilst both tessitura and density might be described as bidirectional, or agglomerative.[112] Together, these attributes contribute to a strong gesture, and ensure clarity and recognisability under analogue transformation. In contrast, exact details of mass profile (locatable pitch) are relatively ambiguous—with the material conveying a general sense of dissonance and of tightly compacted spectral space. Whilst an incidental timbral attribute to begin with, attack attains great prominence once *Material A* is transferred to violin and cello, with the *ricochet* bow motion becoming the most distinctive, and invariant, sonic element under extreme transformation by the dictaphones. By the latter stages of the work, locatable pitch is largely imperceptible; instead, it is attack that we continue to recognise amid the white noise.

Figure 29a: *Material B*, piano opening gesture (figure A, bars 1-2)

Dynamic Profile:	Largely uniform: *ppp, pp or p*
Melodic Profile / Tessitura:	Consistently mid-treble
Density:	Evenly spaced chords between hands; transparent density
Mass:	Locatable pitch: limited and circling
Attack:	Discernible attack; softened by low dynamic and use of sustain pedal

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[112] These spectromorphological terms are taken from the writing of Denis Smalley—they will be discussed, and employed more fully, in Chapter Four.

Figure 29b: *Analogue*, **figure A, bars 1-2 (piano)**
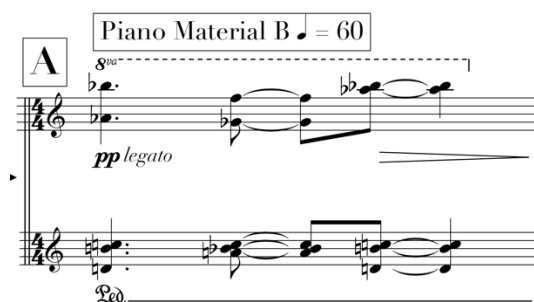
Conversely, in *Material B*, attack, dynamic profile and melodic profile are relatively uniform, contributing negligibly to the recognisability of the music under transformation. Rather, it is locatable pitch – and, to an extent, density – which are most distinctive here, with a limited palette of slowly cycling pitches creating an enclosed and easily identifiable harmonic world. This pitch material – the genesis of which is explained in Figure 30 – in combination with the even distribution of notes across a two-octave range, is designed to evoke a luminous and clear timbre: qualities which remain perceptible even when transferred to the lower registers, via the dictaphones' half-pitch/half-speed playback. Once transferred to the violin and cello, the piano's vertical sonorities are reinterpreted as fragile – often double-stopped – natural harmonics. At this point, sustain becomes a key timbral characteristic, with a discernible granularity becoming prominent in the sound profile. As the music undergoes extreme transformation in the latter stages of the work, the once locatable pitch of *Material B* gives way to grain – and specifically 'rubbing grain' – as the principal timbral parameter.

Through the above definition of *Materials A* and *B*, I seek to ensure that, whichever strand is chosen, vestiges of the original remain audible as the music disintegrates, ensuring the continued perceptibility of the cyclical and recurrent form.

Figure 30: genesis of *Analogue* pitch material

Taking my lead from the antimetabole (mirror patterning) of five words from Milton's verse – 'the hell within him, for within him hell' (IV, 18-23) – I similarly arranged five pitches in the same self-repeating formation:


Furthermore, these notes were selected from a specific mode (a 'mode of limited transposition', as described by Olivier Messiaen in his *The Technique of my Musical Language*).[1] Through restricted pitch content, this scale creates a strong sense of non-tonal harmonicity and a self-contained, immediately distinguishable harmonic palette. The mode's inherent inability to be transposed (Mode Six – used here – can only be repeated six times, before repeating itself), provides the potential to generate a feeling of entrapment, even claustrophobia, consonant with Milton's text.

Through several transformative processes, this eight-note and five-pitch progression goes on to form the harmonic content of the majority of the work. Firstly, through the employment of a system derived from Per Nørgård's 'infinity series',[2] the 1-2-3-4-5-3-4-2 pattern starts to cycle, slowly expanding away from the pitches of Mode Six, before immediately recoiling, turning back on itself and repeating a familiar pattern of notes. The first twelve pitches of this series are subsequently divided and amassed vertically into two pentachords.
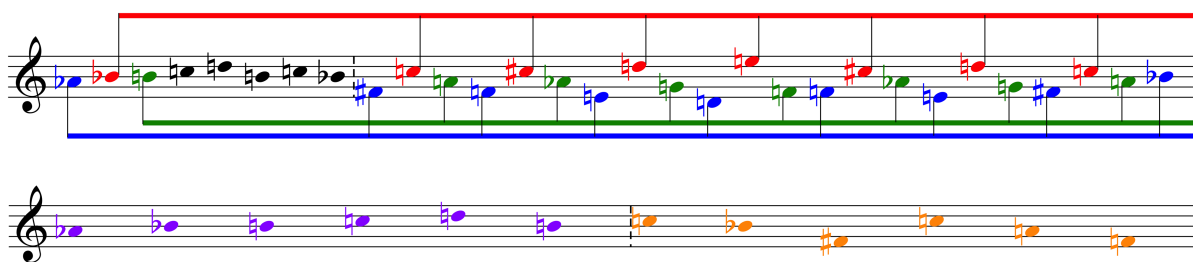

The above techniques generated a rich pre-compositional repository of closely related, cycling material, which would go on to inform much of *Analogue*'s harmonic makeup—sometimes in a very literal sense (see the opening of *Material B* in the piano. below), and often more loosely (e.g. the more subjective arrangement of pitches in piano *Material A*).

Piano: *Material A*
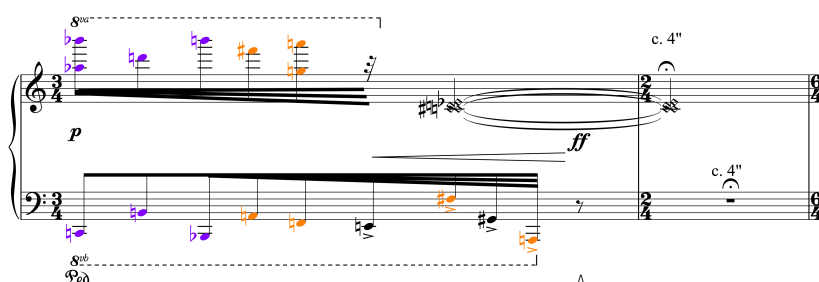
Piano: *Material B*
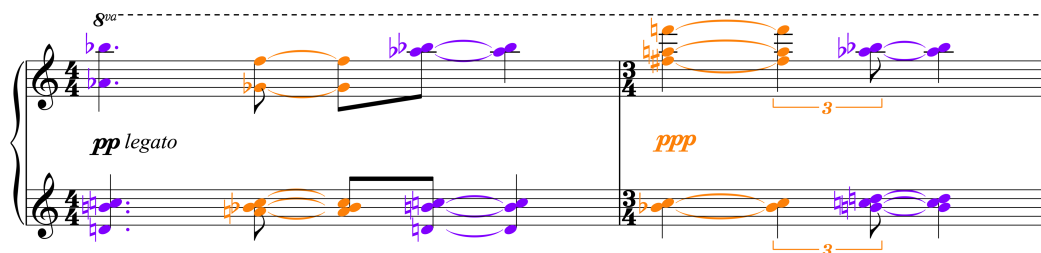
[1] Olivier Messiaen, *The Technique of my Musical Language* (Paris: Alphonse Leduc, 2007).
[2] An explanation of this technique, derived from Per Nørgård, can be found in: Yu Hin (Gary) Au, Christopher Drexler-Lemire and Jeffrey Shallit, 'Notes and Note Pairs in Nørgård's Infinity Series', *Journal of Mathematics and Music*, 11.1 (2017), 1-19.

Embedded white noise and its functions

The structure of *Analogue* is, however, more complex than a simple linear trajectory from locatable pitch to white noise. Indeed, white noise is not just an end state, but a ubiquitous timbre as the discourse unfolds.

Abrupt and unexpected, we first hear it enter on a pre-prepared tape track, triggered 30 seconds after the trio commences, and left to run at low-level volume throughout. My intentions in preparing this layer of material were two-fold. From a purely practical perspective, this ever-present sound provides a blanket that, to some extent, might conceal and disguise the many clicks and pops of the dictaphones—even the rustles of page turns, and the picking up/putting down of devices. (After all, *Analogue* is a piece in which unintentional, and potentially distracting, noises are abundant). But, even if this track cannot fully mask these extraneous sounds, I hoped it might provide a constant: a stream that represents ongoing duration, and which delineates musical time by signaling the start and end of the work, no matter how fragmentary and disconnected its internal elements become.[113] Furthermore, the permeation of white noise into the lengthy pauses which punctuate the work as the dictaphones are rewound, encourages them to become spaces for reflection. We feel the weight of the music which has just passed and form an expectation as to what might happen in the future; and so, 'internal projections, imaginings, constructions and assumptions' start to emerge in the mind of the listener.[114]

Despite its low-level projection, it occurred to me during initial rehearsals that, at several points during *Analogue*, this element acquires unexpected prominence: particularly at those moments when the players rewind their dictaphones. The whirring sound produced during this procedure is accompanied by a hiss emitted by the devices, its quality not dissimilar to that of white noise. The coupling of these sounds brings the tape track temporarily to the fore, alerting our ears to its presence.

Moreover, the conjoining of the physical, dramatic, action of the players rewinding their dictaphones with the emergence of this white noise (especially at pivotal moments in the work's structure) instils a sense

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[113] Similar reasoning lay behind my decision to include a constant layer of white noise in my earlier installation work – *fili / strands / stränge* – discussed in Chapter Four.

[114] Elizabeth Hellmuth Margulis, 'Moved by Nothing: Listening to Musical Silence', *Journal of Music Theory*, 51.2 (2007), 245-276. (p. 255). Margulis goes on to describe this process as 'meta-listening'. When discussing the function of white noise in his music, Peter Ablinger, similarly talks of 'rauschen' acting 'as a mirror', reflecting 'what we project onto it': see Peter Ablinger, 'Rauschen', 2013 <https://ablinger.mur.at/rauschen.html> [Accessed 23 September 2020]. 'Rauschen' seems to possess the potential to instigate a personal response to musical discourse—it becomes a vehicle for '(individual) projection, interpretation and acoustic illusion', a field for 'experience and exploration': see Aaron Cassidy and Aaron Einbond, *Noise in and as Music* (Huddersfield: University of Huddersfield Press, 2013), p. 8. When there is an absence of acoustic sound, white noise does not represent a void pause. The music (our expectation, memory and anticipation) remains present. The passage of time is ongoing.

that white noise is linked to process—to the nuts and bolts of the piece. *Analogue* is a work in which process is extremely evident, our visual experience (watching the players rewinding and pressing play on dictaphones) correlating directly with our sonic experience (the entry of electronics, the slowing down and stretching of material). Sounds have concrete and explicit origins, and no attempts are made to cover my tracks, or to make the listener's aural experience more streamlined or seamless. With these thoughts in mind, I sought – by two main approaches – to further this association between the continuous white noise track and key structural moments in the work, where process is highlighted and becomes evident:

Firstly, during those instances when the violinist (or cellist) rewinds and resets their dictaphone, the cellist (or violinist) bows their bridge with long strokes in a continuous motion, producing an 'air' or 'white noise' sound analogous to both backing track and spinning cassette mechanism.

Figure 31: *Analogue*, figure E (violin and cello)
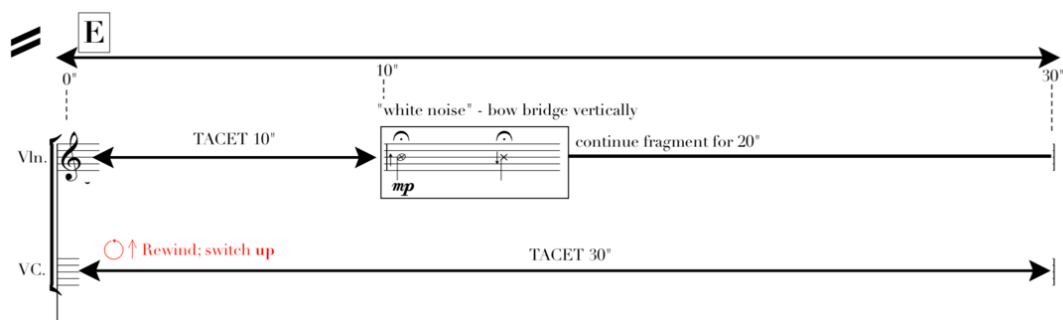
At the work's conclusion, the pianist also joins the string players in this gesture, depressing and lifting the damper pedal in a constant motion, producing a near-silent rumbling inside the body of the instrument.

Figure 32: *Analogue*, figure L
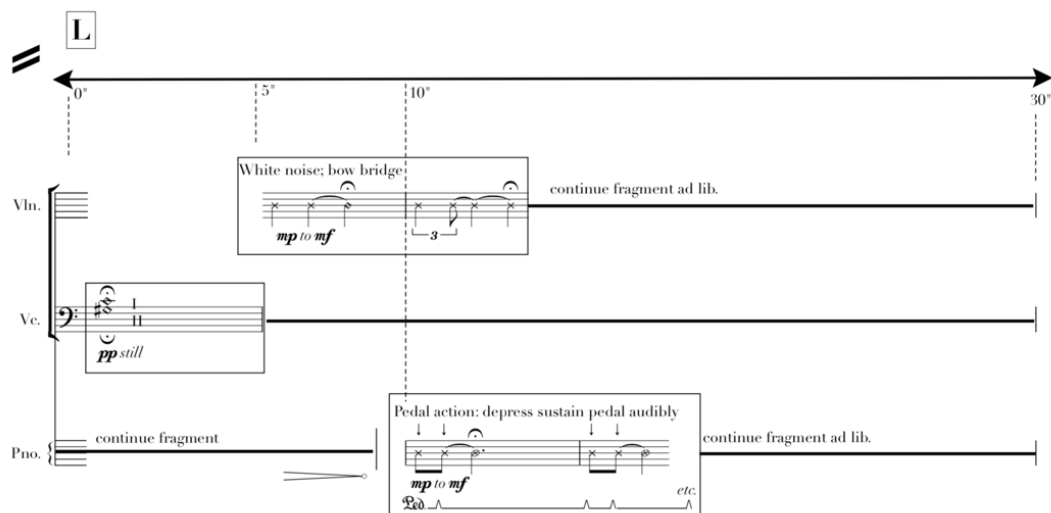
My second approach focused upon the loud and very present click of the dictaphone playback mechanism, heard each time the tape is stopped, and each time playback commences. (This sound is particularly conspicuous in the aforementioned moments when the microcassettes are rewound.) Seeking to render the correlation between this timbre and the process at work during *Analogue* ever-more pronounced, I set about sampling this click. I subsequently embedded it into the white noise backing track, on which it features every so often on a randomised loop: a constant aural reminder of the mechanics at play in the piece, even when not visually evident.

Secondary Linear Trajectories

i) Lo-fi timbre

Hearing this click-laden white noise track at work in rehearsal brought to mind unexpected aesthetic associations too. In particular, the self-conscious and concrete reference to an outmoded recording technology seemed evocative of a certain trope of late 1990s/early 2000s popular music, in which analogue sounds – cracks, distortions, pops – were sampled (particularly during intros and outros of songs), acting as a kind of vehicle for nostalgia, willing us to make associations with eras/traditions beyond the confines of the song's own sense of musical time.[115] I found there was something rather poetic and haunting in this idea, and its relevance to *Analogue* was obvious – relating both to the depiction of present, past and future in *Paradise Lost*, and to the physical reality of the dictaphones: lo-fidelity, clunky and cumbersome and, for certain generations in the audience, redolent of a very specific period of recent history (1980s/1990s). Hoping to render even more vivid this sense of nostalgia, I looked outside the timbral palette of the piece, further embedding within the backing track – alongside the previously-mentioned cassette mechanism click – that most quintessential and evocative of analogue sounds: the pop and crackle of the record player needle, nestling into the surface of a vinyl LP.

An unexpected joy of the Sanyo TRC-580M dictaphone is its relatively powerful directional microphone, which is indiscriminate when picking up sounds within its vicinity. As rehearsals progressed, it became clear that these newly incorporated ephemera within the backing track were frequently being recorded by, and transferred between, devices. Just as with the notated, acoustic music, this sonic matter then becomes subject to transformative processes of stretching, distortion and pitch-shifting; each crack and pop leaving a sonic legacy, imprinting a mark upon the work. And so, an unplanned but significant secondary

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[115] For example, we might consider White Town's *Your Woman* (1997), in which the trumpet line from Lew Stone's 1932 recording of 'My Woman' is embedded as a recurring trope. See White Town, 'Your Woman' (Brilliant!, 07243 8 83753 2, 1997) [on CD]; Lew Stone & His Monseigneur Band, My Woman (Decca, F. 3313, 1932) [on Phonograph].

linear trajectory emerges at a global level throughout *Analogue*: sonic artefact and recording 'byproduct' undergo a journey too, moving from secondary noise to primary musical material.

The willful and purposeful embedding of these sounds could be seen as adhering to what might be described as a 'lo-fi aesthetic'.[116] Referring to popular music of the early 2000s, Adam Harper discusses the incorporation of self-consciously lo-fi effects: incidental noises of poor sonic 'quality', added for deliberate colouristic purpose. Harper discusses these sounds as often being of secondary importance within a song, in the sense that they 'could not...dispen(se) with the music they ac(t) upon'.[117] Whilst true of the opening of *Analogue,* where the pops and clicks stand out in contrast to the more robust and gesturally defined music of the acoustic instruments, the work perhaps embraces a more complex relationship with a lo-fi approach. Through the transformative and disintegrative processes mentioned previously, the incidental noise, both genuine byproduct and embedded artefact, undergo a change in how they function within the work. At some point – and it's impossible to say exactly when or quite how – the relationship between music (notated/played, and played *back)* and noise is levelled out and the deliberate lo-fi aesthetic is disbanded. Noise is no longer an 'incidental effect',[118] but has become the primary 'resource'[119] and material; noise is the musical argument itself.

ii) Disintegration and emergent corporeality

By the closing stages of the work, the previously mentioned instrumental 'white noise' sound is prominent. Violin and cello bow their bridges, and the piano depresses and releases its sustain pedal, producing a pitchless, airy sound. As previously stated, this is designed to evoke the whirring and rotating of the dictaphone mechanism. But, as the music starts to settle into a regular, recurring pattern, we become aware of an altogether different connotation: a gathering and releasing of breath – sometimes three bodies independently, sometimes a communal in- and exhalation.

This passage heralds the start of a new and distinctive soundworld at the work's conclusion. With dictaphone and acoustic materials now bleached of their previous clarity of gesture – and original locatable pitch – a new intimacy and corporeality is revealed in the music. The physicality of the players is

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[116] The development of a lo-fi aesthetic in popular music is discussed in detail by Adam Harper in the publication cited below. Three – increasingly contemporary – dictionary definitions of 'lo-fi' are given by Harper, which show a changing understanding of the word in last few decades of the 20th Century: Lo-fi: *Noun* OED (1976): 'Sound reproduction less good in quality than *hi-fi';* OED (2003): 'A genre of rock music characterised by minimal production, giving a raw and unsophisticated sound'; OED (2008): 'Unpolished, amateurish or technically unsophisticated, especially as a deliberate aesthetic choice': see Adam Harper, 'Lo-Fi Aesthetics in Popular Music Discourse' (DPhil., Wadham College, University of Oxford, 2014), p. 11.

[117] Ibid. p.31.

[118] Ibid.

[119] Ibid.

evident here, both visually and sonically: the violin and cello rotate their bows, scraping wood *col legno tratto* on strings, the pianist places their hands inside the body of the piano, running fingernails up and down the thick corrugated metal of the resonant bass strings. In that moment we're aware of three individuals on stage: their hands, their breath, their skin. And I hope we too, as listeners, feel something of that same tactility: a shared experience, a communal corporeality.

This singularity of experience is heightened at the very end of the piece, reaching a logical conclusion of sorts, as at the three players unite for the first – and only – time as one singular sound mass. Violin, cello and piano are all notated at the same tempo marking—temporally aligned, with no room for choice or personal expression. Their trajectory is exact, metric and controlled; their sound a degraded unison, an impaired and constrained fragment of conjoined melody, slithering and twisting between pitches in a series of short glissandi.

Figure 33: *Analogue*, figure O + 4-5

The tape material too has now eroded and disintegrated beyond meaningful recognition: a faded tapestry of white noise, and the embers of dictaphone material (some of which was first heard over 12 minutes ago). The analogue audio is compressed and squeezed into one singular strand – a short filament of microcassette, recorded over again and again, the tape worn thin under the rotating mechanism – along with the forcibly amalgamated violin, cello and piano, constricted within one singular, tightly bound body. As with Milton's central character of Satan, the trio's fate seems inescapable, permanent, their previous freedoms now unimaginable. They twist and they rake together in serpentine form:

O foul descent! That I who erst contended
With gods to sit the highest, am now constrained
Into a beast, and mixed with bestial slime,
This essence to incarnate and imbrute,

That to the height of deity aspired

IX.163-167[120]

*　　　*　　　*

In this way, the principal formal trajectory of *Analogue* is one of changing mass profile: a linear timbral disintegration from locatable pitch to nodal sound and white noise. Whilst this process of deterioration ultimately ushers in music of increased corporeality, the emergence of this bodily material occurs relatively late on in the work.

Conversely, in my 2016 work, *Bríatharogaim*, an emergent corporeality goes hand in hand with progressive linear timbral disintegration. That is to say, the noise profile of materials increases as sounds become more physically rooted over time.[121] Disintegration in this instance is, however, not a simple linear trajectory along a continuum. Rather, incremental alterations in the mass profile of the work's principal (initially pitched) materials are stimulated by juxtaposed panels of contrasting (noisier, nodal and channelled)[122] sonorities. Over time, these 'inserted' passages begin to leave their imprint upon the surrounding discourse, ultimately shaping the timbral trajectory of the composition.

Bríatharogaim (2016)

Overview of the work

Bríatharogaim[123] was composed as part of the *Voix Nouvelles* programme at Royaumont Abbey in France, and given its premiere in September 2016 by EXAUDI and Talea Ensemble. The Scottish Gaelic term 'bríatharogaim' refers to word oghams: two-word kennings found in Early Irish literature, which explain the meanings of the letter names of the ogham alphabet. *Bríatharogaim* takes as its principal stimulus the ogham inscription found upon the Newton Stone at Culsalmond, Aberdeenshire (dating from the 5th or 6th century). Rather than portraying one of the many attempted translations of this inscription – likely written in the now-lost Pictish[124] language – the work focusses on the ogham letters themselves.

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[120] John Milton, *Paradise Lost* (Oxford: Oxford University Press, 2005), IX, pp. 163-167.

[121] A wider trend of emergent physicality is observable across the portfolio. Chapter Four and the Conclusion pick up this thread.

[122] Michel Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, trans. by John Dack and Christine North (2009) <http://ears.huma-num.fr/onlinePublications.html> [Accessed 1 January 2021]

[123] The work is scored for countertenor, bass clarinet, baritone and bass flute (with instruments divided upon both score and stage into two duos).

[124] Pictish is an extinct language that was spoken in Scotland during the 6-9th centuries.

Through derivation of numerical and proportional information from these characters I devised an overall architecture for the work, in addition to micro-level details of rhythm and pitch.

	Ogham Inscription	
	Transcription	IDDAR[R]NNNFORRENNI[K^P]O[T^C] [C^E] | [R]OSR[R]

Figure 35: ogham reading as a pitch series

Deriving Pitch Materials

At the outset of the pre-compositional process, each letter of the ogham alphabet was allocated a number, 1-20. I then assigned these numbers a pitch class microtonally (i.e. 1 = C natural, up to 24 = B quarter sharp), and processed the characters horizontally (see Figure 35). An infinity series was additionally constructed around the numerical values of the stone's first two 'words' – IDDARRNNN VORRENNI – subsequently providing materials for the opening 79 bars:

Figure 36: pitch series opening. *These notes were liberally distributed between the relevant duo, with occasional intuitive omissions and additions. (The below diagram illustrates this process at work in the opening 16 bars of Bríatharogaim)*

Baritone/
Bass Clarinet
Strophes: Bars 1-4   Bars 7-15   Bar 16 →
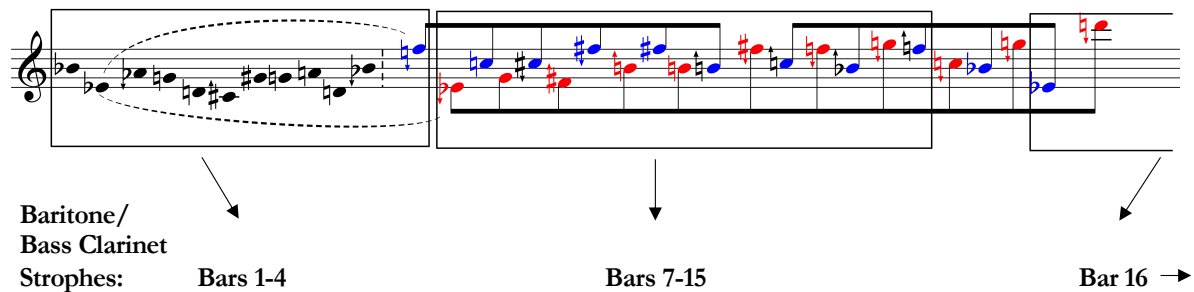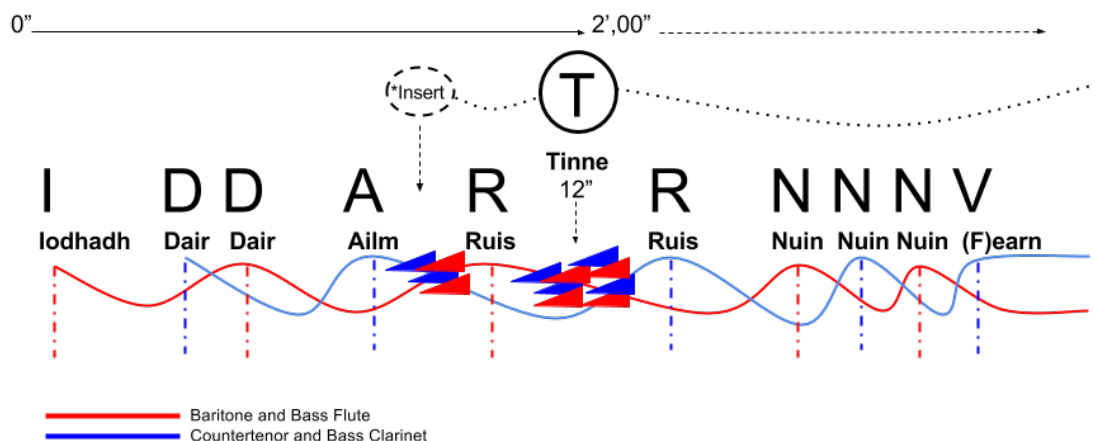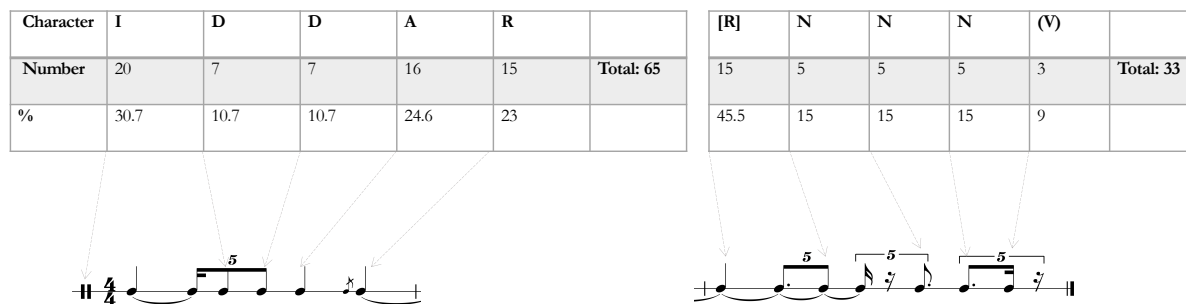
Figure 37: antiphonal exchange

The initial section of the work consists of a series of antiphonal exchanges (see Figure 37) between baritone/bass clarinet and countertenor/bass flute, with 10 strophes heard in total.[125] The cycling pitch materials outlined above are employed here in order to generate a sense of continuity and forward momentum—rendering the effects of subsequent interruption (explained in due course) all the more keenly felt.[126] The strophic design of *Bríatharogaim* – along with its decorative grace-note figuration and relative rhythmic complexity – are reminiscent of an established vocal and instrumental work, which similarly sets a Scottish Gaelic text: James Dillon's *A Roaring Flame* (1982). Dillon's duo – for voice and double bass – was a key reference point when writing *Bríatharogaim*, not only influencing my own stanzaic

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[125] Strophes are heard both in alternation (with utterances, on occasion, separated by rests or pauses) and as dovetailed phrases.

[126] Materials within this section might thus be described as 'hypotactic', as opposed to 'paratactic': a term which will be introduced on p. 72.
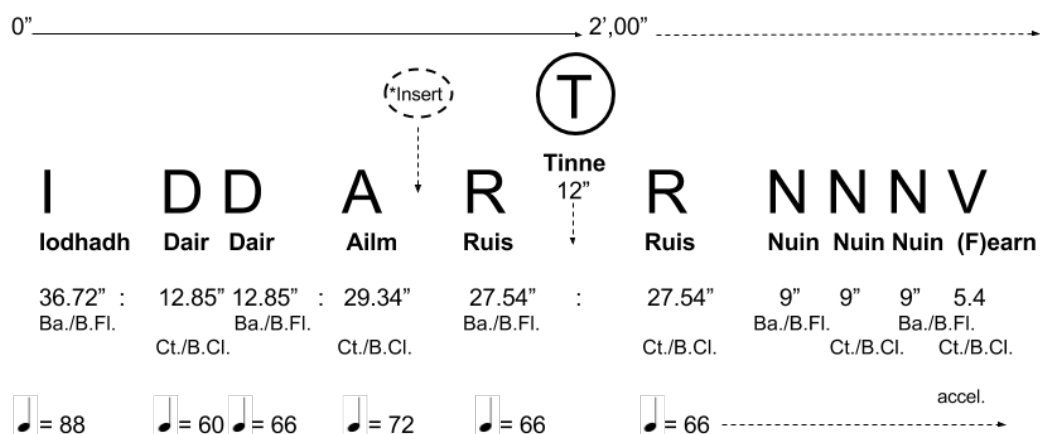
design, but providing a stimulus for the breathy and eroded vocal timbres I employ at the work's ending.[127]

Figure 38: bars 1-2, small-scale processes. Rhythm here is devised at a local level, with ogham values determining note durations. (Such micro-scale calculations – as evident in the below example – underpin much of *Bríatharogaim*'s strophic materials)

Character	I	D	D	A	R		[R]	N	N	N	(V)	
Number	20	7	7	16	15	Total: 65	15	5	5	5	3	Total: 33
%	30.7	10.7	10.7	24.6	23		45.5	15	15	15	9	

The opening 79 bars of the work take the first ogham word, and first letter of the second word – IDDARRNNN V… – as their basis for duration and tempo. With an initial metronome mark (of crotchet = 88) arrived at intuitively, according to the type of momentum I wished to instigate at the work's outset, all other tempi and section durations were subsequently derived proportionally, according to their ogham values. Figure 39 shows this process in action during the first two minutes of the work.

Figure 39a: bars 1-79, macro-scale structural processes

Figure 39b: bars 1-79, macro-scale structural processes

From this point onwards, the proportions of the ogham readings go on to influence directly duration and tempo within this initial material:

Letter	I	D	D	A	R	(Total)
Ogham Number	20	7	7	16	15	65
%	30.76%	10.76%	10.76%	24.62%	23.1%	100%
Duration	36.72"	12.85"	12.85"	29.34"	27.54"	2'
Tempo	88	(30.8)*	(30.8)*	(70.4)*	66	

- All ogham numbers are added together: forming a total of 65
- With an overall duration of 2'00" decided, the length of each 'letter' is assigned structurally, according to its proportion within this total
- Tempi are ascertained proportionally from the initial marking of crochet = 88. The tempo of crotchet = 70.4 is rounded up to 72. The marking of 30.8 – too slow to be practical in this context – is read as a minim marking (i.e. crotchet = 60)
- Within the final performance (and in the score/parts) these markings were each fine-tuned (usually a few degrees slower on the metronome), in the interests of practicality. The original markings are listed above however in order to elucidate more clearly intended structural processes, which went on to influence directly the material within.

On a micro level, in each of these letters (I, D, D etc.), individual note duration was prescribed according to the same ogham proportions (as evident in Figure 38).

Introduction of channelled sonorities / 'interruptions'

Into the continuous strophic framework of *Bríatharogaim*, I inserted an additional strand, which surfaces periodically. (In bars 1-79, this material is evident at bars 30-32, 42-45 and 48-55. It is locatable upon Figure 39 at the sections marked 'Insert' and 'T'). Through the following changes made to texture, pitch, and language, this music is designed to be contrasting and discontinuous:[128]

- All four musicians now play together, rather than in two duos
- The music is conceived according to vertical, rather than, horizontal pitch processes
- The new material is frequently framed by rests and fermatas[129]
- There is a distinct change in language, with English words now discernible, rather than dislocated Gaelic vowels and consonants

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[128] The reader will likely have registered the notational changes evident in the score during these 'inserted' passages, with thick horizontal lines indicating note durations. These markings were an attempt to differentiate visually this material upon the page: in the first instance for myself (at the creation stage), and subsequently for the performers when workshopping materials. Feedback from the musicians regarding the altered score formatting was unanimously positive in rehearsal and, as such, this initially pre-compositional notational idiosyncrasy remains in the final score.

[129] The interruptive role of silence here might again be compared with Nono's *Fragmente-Stille, an Diotima*, where 'interruption and stagnation' are 'achieved by means of rests and fermatas': see Carola Nielinger-Vakil, *Luigi Nono: a Composer in Context* (Cambridge: Cambridge University Press, 2015), p. 164.

The principal contrast is, however, provoked through timbral means. Not only does *Bríatharogaim*'s instrumentation undergo a sudden and unexpected change in these passages (with countertenor and baritone now playing upon pitch pipes), but noise becomes the most discernible sonic characteristic. At Figure D, for example, the harsh sonority of the pipes is rendered yet more abrasive through the addition of the countertenor and baritone's voices. When auxiliary instrument and voice are combined, a complex channelled sonority is created, with tight pitch clusters and a coarse granularity evident in the overall sound profile. Within the context of the surrounding strophic discourse (of cycling, and locatable, pitch), this noise-based material feels very much interruptive—even confrontational.[130]

As opposed to *Analogue*'s gradual linear transformation from locatable pitch to white noise, markedly different qualities of tonic mass are juxtaposed here on a syntagmatic level. As such, the ensuing conflict between stanzaic materials (of discernible pitch) and interruptions (of channelled/nodal quality) might be seen to operate upon the 'sound/noise axis', as described by Kaija Saariaho.[131] In this construct, notions of consonance and dissonance are transferred into the timbral domain[132]—with the push and pull of tonal language replicated through sound and noise, respectively. In Saariaho's words, a 'rough, noisy texture would thus be parallel to dissonance, whilst a smooth, clear texture would correspond to consonance'.[133] Through controlling these two domains, she says, friction or 'tension' can be introduced into a musical narrative.[134]

Whilst true of the opening few minutes of the work, the relationship between locatable pitch (sound) and nodal/channelled sonorities (noise) becomes, however, more complex than a simple duality as *Bríatharogaim* develops. The interruptions incrementally begin to leave their trace upon the surrounding strophic material,[135] with an increasing noise profile becoming clearly discernible in these passages. This gradual proliferation of noise across all materials is achieved through a handful of compositional strategies:

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[130] Such interruption is undoubtedly reminiscent of the 'superimpositions' referenced in relation to *Soliloquies* in Chapter One. The inserted materials in *Bríatharogaim*, however, operate in a slightly different context—going on to dominate the work and, ultimately, prompting substantial changes in the overall timbral trajectory or the composition. (In *Soliloquies*, the reverse process was evident: 'superimpositions' were instead shown to assimilate the sonic characteristics of the surrounding discourse).

[131] Kaija Saariaho, 'Timbre and Harmony: Interpolations of Timbral Structures', *Contemporary Music Review*, 2.1 (1987), 93-133.

[132] It should be noted here that this terminology differs from Schnittke's, referenced in the proceeding chapter, where timbral consonance and dissonance instead refer to degrees of timbral similarity or ensuing fusion (irrespective of sound/noise content).

[133] Ibid., p. 94.

[134] Ibid.

[135] The reader will likely again draw connections here with Chapter One, where Ligeti's 'events' and 'states' were discussed in relation to *Soliloquies*. In a sense, *Bríatharogaim*'s modus operandi is a reversal of that heard in the string quartet, with events going on to influence states, rather than vice versa.

- The pitch pipes begin to be employed in the stanzaic, as well as interruptive, passages

- The bass clarinettist and bass flautist begin to vocalise through their instruments (initially adding vowels to played pitches), together creating complex multiphonic-like sonorities

- Proportionally, the balance of materials is altered: stanzas gradually become shorter, whilst the channelled sound passages are extended

By Figure J, a fundamental shift in the sound/noise hierarchy is perceptible. Nodal and channelled materials now dominate the discourse—the singers almost exclusively singing into pipes (or producing air sounds against the surface of their auxiliary instruments), and the instrumentalists incorporating into their played material not only vowels, but consonants. When these consonants are combined in the bass flute with *ad lib.* key clicks and a dramatically shifting tessitura in the player's voice, a notably raucous and distorted sonority is produced. This timbre in particular (evident at bar 144, for example) begins to acquire specific prominence at this point in the piece.[136] Conversely – and as evident in bars 120-124 – stanzaic pitch materials are increasingly fleeting in appearance.

As revealed by *Bríatharogaim*'s early compositional sketches, fragmentation in this section of the work was in fact a retrospective process—with the continuous/cycling material intersected (quite literally split apart upon the page) by extended passages of inserted nodal/channelled materials:

Figure 40: fragmentation of cycling harmonic materials (initial sketches)

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[136] My employment of this extended technique can be traced to Raphaël Cendo's *Graphein* (upon which the French composer presented at Royaumont), where it lends a primitive, almost animalistic, energy to the musical discourse. (This quality is discussed further in relation to *Plastica* during Chapter Four).

Parataxis

The discourse here – and indeed to an extent in the opening sections of the work – might thus be described as 'paratactic' (a word originally used linguistically[137] to describe the 'chain-like juxtaposition of independent clauses'[138] found in epic recitation). Whilst I had encountered this term in relation to contemporary music – notably Carola Nielinger-Vakil's examination of Luigi Nono's *Fragmente-Stille, an Diotima*[139] – my familiarity with this structural device rather stems from early 18th-century repertoire; in particular, the music of Handel.[140] As described by David Hurley in *Handel's Muse*,[141] the composer's practice has been shown to have involved the 'insertion of phrases or smaller units between or within phrases'. As evidenced by Hurley, such interjections are often 'relatively autonomous units…each with its own distinct set of characteristics'[142]. In *Bríatharogaim*, such autonomy is conveyed particularly by the infinity series-generated strophes, which communicate a discernible linearity and feeling of forward thrust[143] comparable to the linguistic 'syntax' of which Adorno speaks in poetry (see note 137). In this way, the non-compliance of – and indeed 'artificial disturbance' by – the noise-based sonorities is keenly felt here, further emphasising a notion of independence between the two nested strands.

However, parataxis in *Bríatharogaim* is yet more complex. Rather than strands remaining consistent between occurrences – with form communicated by the juxtaposition and intersection of two stable states – morphology starts to be become perceptible on the horizontal axis *within* materials. This is particularly true of the strophic utterances, which appear increasingly fractured, and indeed bodily, each time they emerge:

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[137] The term 'parataxis' was used by Adorno in his lecture *Parataxis: on Hölderlin's late poetry*, delivered in 1963. Here, Adorno described this linguistic device as being an 'artificial disturbanc(e) that evade(s) the logical hierarchy of the subordinating syntax': see Theodor W. Adorno, 'Parataxis: on Hölderlin's Late Poetry', in *Notes To Literature,* Volume 2 (New York: Columbia University Press, 1992), p. 131.

[138] Michael Spitzer, *Music as Philosophy* (Bloomington, IN: Indiana University Press, 2006), p. 114.

[139] As found in both Carola Nielinger-Vakil, 'Quiet Revolutions: Hölderlin Fragments by Luigi Nono and Wolfgang Rihm' *Music and Letters, Vol. 81, No.2, (*2000), and Nielinger-Vakil, *Luigi Nono: a Composer in Context.*

[140] Between 2014-15 I was employed as Composer-in-Residence at Handel House Museum, where – in preparation for a series of commissions, to be premiered at both the museum, and at Handel's London church, St George's, Hanover Square – I undertook a period of research into Baroque-era repertoire. As I noted during these explorations, the concept of parataxis has become particularly associated with the Baroque, in which music is often constructed using shorter, independent units, which work towards their own goals. In contrast to 'hypotactic' music such as that of the Classical era, which is teleologically oriented towards large-scale closure, 'paratactic' music instead uses individual clauses that remain distinct and separate.

[141] David Ross Hurley, *Handel's Muse* (Oxford: Oxford University Press, 2001), p. 144.

[142] Ibid. Indeed, Hurley goes on to show the degree to which Handel pursues such autonomy of paratactic materials, with examples cited in which the composer borrows not only from across his own oeuvre, but from the works of others (in particular, Telemann). This subject area become the principal stimulus for both music and text (by Edward Allen) for my 2015 work, *Villanelle.*

[143] Hurley's 'distinct characteristics', on the other hand, have of course already been set out in terms of locatable pitch vs. nodal/channelled sound.

Figure 41: progressive timbral disintegration within strophic material (bars 120-147)

In this way, not only does the macro shape of *Bríatharogaim* involve the gradual dominance of nodal/channelled sonorities (little by little saturating the discourse, through incremental alterations to the proportional distribution of noise vs. pitch-based materials); but an independent – and audibly differentiated – linear transformation occurs *within* the principal strophic strand upon the syntagmatic axis.

This timbral morphology, embedded within a complex paratactic discourse, entails a drastic alteration in the mass profile of the work's central material: locatable, and directional, pitch ultimately disintegrating into nodal sound and breathy rubbing grain sonorities. Furthermore, through recourse to pitch pipes (in the case of the singers) and voices (in the case of instrumentalists), this linear disintegration occurs hand in hand with a palpable emergence of corporeal sound. By the end of the work, a private and hushed dialogue is evident; the countertenor and baritone whisper and whistle intimately into their auxiliary pipes, whilst the bass flute and bass clarinet embark upon a series of internal murmurings, speaking directly into the barrel of their instruments. Strophic materials have finally been bleached and stripped of their initial colour, character, and indeed timbre.

Like the Pictish words, the music is now divested of its original context and identity: timbre eroded by the inevitable passage of time.

Chapter Three: Timbre in Space

Travelling towards us at high speed is what looks like a spherical conglomerate: sulphurous particles, soon to engulf and envelop the viewer. Just as quickly as it forms, this molecular cluster fractures: singular points disperse and dissolve into the darkness. With the visual component of Pockets of Space[144] utilising 3D projection, we are not just passive observers of these bursts of light and colour, but – in the words of co-artist, Paul Kaiser – the audience appear to be 'inside (the) things that are in the process of being created'.[145] Through its ambisonic projection and 64-loudspeaker array, Natasha Barrett's audio is the perfect counterpart to this projected video. Like the imagery, at times the propagation of multiple points/frequencies opens up vast sonic spaces; at others, sound sources appear to 'com(e) so close as to touch and seemingly penetrate the body'.[146]

*   *   *

Whilst the two key works of this chapter – *Dhātu* and *Plastica* – are electroacoustic, not acousmatic (nor indeed ambisonic), key elements of Barrett's spatial practice, and my experience of *Pockets of Space*, would go on to inform my writing. In *Dhātu*, a similar sense of 360° immersion is emulated both through the quadraphonic projection (in communion with the natural 3D reflectivity of the performance venue in which the composition was premiered), and the spatial mobility of the work's musicians. A comparable concentration upon the expansion and recontraction of space also becomes a principal focus. In the electronics of *Plastica*, on the other hand, specific spatial environments are conjured up through the loudspeakers, at times drawing – as in Barrett's work – upon concrete sounds and their associated behavioural characteristics.

Within the broader context of my compositional portfolio, these two works are unique. Form here is no longer organised solely through timbral morphology (whether that be through integrative or disintegrative means); rather, the behaviour of timbre in *space*, both architectural (*Dhātu*) and virtual (*Plastica*) will be seen to play a key role in shaping the musical discourse.

Dhātu (2019)

Given its premiere in the crypt of Glasgow Cathedral in September 2019,[147] *Dhātu* is a site-specific work, composed with the resonant and architectural properties of its performance space in mind. Making use of

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144 Natasha Barrett, *Pockets of Space* (2018). [Installation]. 3D ambisonics with 3D video; collaboration with Open Ended Group. Premiered at Centre Pompidou on 23 June 2018.

145 Ircam, *Pockets of Space: Report*, online video recording, YouTube, 4 December 2018, <https://www.youtube.com/watch?v=T9CTa4BiK4Y> [Accessed 12 December 2020].

146 'Pockets Of Space (2018 DOWNIE KAISER + NATASHA BARRETT)', *Openendedgroup* <http://openendedgroup.com/artworks/pockets.html> [Accessed 12 December 2020].

147 Full details of the commission and performance can be found in Chapter One's discussion of the work.

the natural reverberant qualities of the building's 'lower church' – with its innumerable reflective surfaces (pillars, walls and stone floors) and distinct enclosures, each with their own specific acoustic characteristics – the work was conceived spatially. Whilst the audience remains static throughout (seated in the central quadrant of the crypt), the work's musicians are mobile, changing performance positions at designated moments in the score—and, as such, able to investigate the countless resonant possibilities of the space.

During the first two-thirds of *Dhātu*, the performance area can be divided into two distinct zones, referred to in the following discussion as 'inner' and 'outer' crypt space.

Figure 42: inner and outer crypt space; performance positions. Glasgow Cathedral Drawing: © HES. Please note that the CC-BY-NC-ND licence given to this thesis does not apply to this image
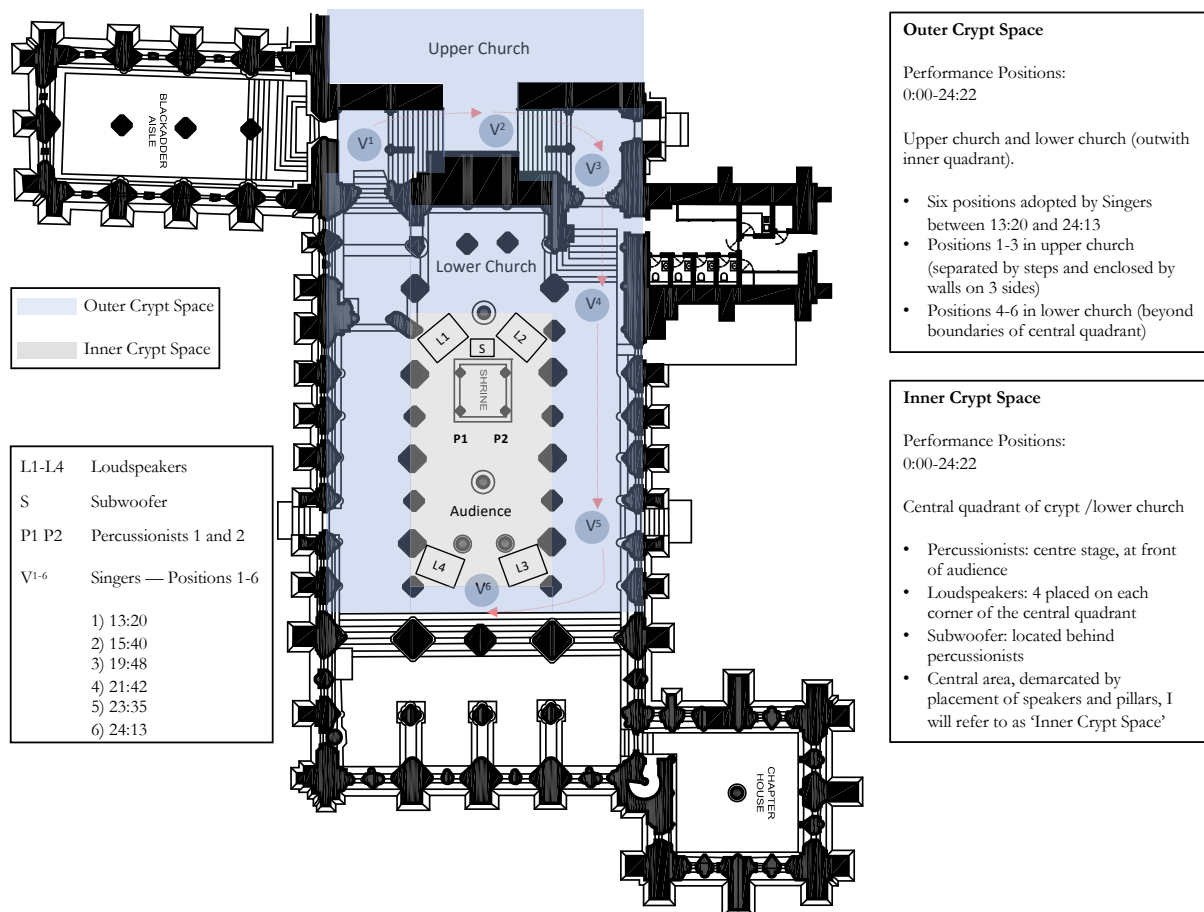
Whilst serving to exploit the architectural and acoustic potential of this historic building, the inner/outer division in fact operates on a more fundamental level of the compositional substructure, providing a means through which timbre is both separated out and melded together. In order to illustrate this point, the focus of my discussion will return briefly to Chapter One, and specifically to *Dhātu*'s Timbral Map.

As previously detailed, this pre-compositional diagram projects multiple nodes (specific timbres) in two-dimensional space. Through distance modelling, the 'weight' of aural connection between sonorities becomes visible within the structure: those sounds with audible similarities are placed in close proximity to one another (fanning out from a central timbral node), whilst those sounds more distantly related are assigned to the map's periphery. By creating a distinction between inner and outer crypt space in *Dhātu*, I seek to realise in real-world space the basic tenet of this pre-compositional model.[148]

Inner crypt space; inner timbral space

All sounds – both acoustic and electronic – encountered in inner crypt space are closely related, drawn out through the application of a limited number of playing techniques upon a small family of timbrally interconnected percussion instruments: metal bowls, coils, springs and flat-lying gongs.[149] Through the spatial placement of both the percussionists and the four loudspeakers, a 360° diffusion area is established around the audience, who are located at the centre of the lower church's inner quadrant. (See Figure 42.) Moreover, there is synergy between this speaker-defined enclosure and the architectural space—with the well-documented drawbacks of quadraphonic projection (where holes in the diffusion area, particularly at the sides, are commonplace)[150] to some extent overcome by the extreme reflectivity of the crypt's stone surfaces. (Low ceilings, not least the raised canopy overhanging the upturned subwoofer, and several prominent pillars situated either side of the loudspeakers provide particularly notable acoustic reflection.)

As such, the 360° loudspeaker coverage is extended, rendered almost three-dimensional, as the listener is immersed and enveloped on all sides by the work's core timbres: a real-world manifestation of the timbrally interconnected map.

Outer crypt space; outer timbral space

Conversely, any sounds heard outside this inner quadrant are sonically much more loosely connected: residing "off map", to continue the notion of a distance model actualised in real-world space. This timbral

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[148] In doing so, my compositional practice begins to deviate substantially from the works and concerns of the aforementioned composers, whose thinking stimulated my initial interest in pre-compositional timbre space.

[149] See Chapter One for a full discussion of the work's timbral palette. Whilst the electronic sounds – particularly in the opening stages – are largely sampled (and, as such, bear a strong timbral likeness to their acoustic/live counterparts), more distantly related synthesised elements are progressively introduced. These sonorities will be discussed in due course (see 'Range in Space' on p. 86).

[150] See Michael Gerzon, 'Ambisonics. Part Two: Studio Techniques', *Studio Sound*, 17 (1975), 24-26, 28 and 30. (24).

disconnect operates on a very basic level, with the three female voices providing a stark contrast in colour and sonority to the aforementioned percussion timbres.[151]

As will be explored in due course, this inner/outer equilibrium is, however, by no means fixed. Indeed, the encroachment of external sounds upon the crypt – and the expansion (and ultimate recontraction) of acoustic space more generally – becomes a key morphophoric trajectory as the work progresses.

The timbre complex in space

At the pre-compositional/sound investigation stage of *Dhātu* described in Chapter One, individual timbres were considered in isolation. Sonorities – often fragile or complex – were divided into multiple attributes, with individual dimensions systematically adjusted, in order to a) find new sounds, and extend the timbral map and b) build continuities through the 'principle of adjacency',[152] as an initial compositional framework was devised. However, when these same sonorities are heard within a complex physical setting – with separation between the sound source and listener, and with complications arising from pronounced architectural reverberation – space has a marked effect upon our perception of timbre.[153] As such, the multidimensional complex opens up in a very different way.

Whilst certain parameters, relevant to Chapter One – dynamic, onset/offset, range and sustainment, for example – remained principal considerations (albeit here assuming new significance), new timbral variables, hitherto neglected, became, I found, fundamental to working in space. Particularly important were those musical elements emerging from the combination of multiple sonorities; either at the concurrent grouping stage of ASA, where timbres are fused (discussion here will focus upon the central parameter of density),[154] or at the sequential grouping stage, where auditory information is parsed into separate streams. Texture – and in particular what I will call 'spatial texture' – at this stage becomes the subject of our attention.

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[151] Viewed in terms of Auditory Scene Analysis, the physical boundary created by the 360° diffusion of the loudspeakers and three-dimensional reflectivity of inner crypt space might be viewed as reinforced by this instrumental contrast—with perceptual fusion between the sounds of inner and outer crypt space prevented through this 'timbral heterogeneity': see Gregory J. Sandell, 'Roles for Spectral Centroid and Other Factors in Determining "Blended" Instrument Pairings In Orchestration', *Music Perception: An Interdisciplinary Journal,*, 13.2 (1995), 209-246 (212).

[152] Trevor Wishart, *On Sonic Art,* ed. by Simon Emmerson (Amsterdam: Harwood Academic Publishers, 1996), p. 81.

[153] It is worth noting at this stage that this relationship might equally be viewed in reverse: not only does space affect timbre, but timbre – to a certain extent, and more than other musical parameters – is an inherent communicator of information about space, providing both details of the 'location' of a source, in addition to 'information about the environment through which the sound has travelled' en route to the listener. See Cornelia Fales, 'The Paradox of Timbre', *Ethnomusicology*, 46.1 (2002), 56-95 (p. 57).

[154] I will go on to distinguish between two types of density: 'spectral' and 'spatial'.

I found, when workshopping *Dhātu* in the complex physical setting of the cathedral, that for timbre to function convincingly as a principal compositional element – for its relationships to be heard as intended, and for its full form-bearing potential to be exploited – each of these aforementioned parameters needed to be considered: both how they were affected by space, and how they interacted with one another in a given architectural environment. I will now discuss each of these timbral variables in turn, both retracing my steps – recalling my trialling of music in space, as new structural possibilities became apparent – and exploring the eventual unfolding of these materials within the ultimate compositional structure.[155] More than any other work in this portfolio, I will draw upon my own retrospective experience, having heard the work in rehearsal and in performance.

Density in space

'In *Murmurs*…it's all about density',[156] says Rebecca Saunders, as she discusses her 2009 spatial work on stage in IRCAM's Salle Stravinsky. Scored for ten players, *Murmurs* comprises seven individually composed modules, played by musicians dispersed around the concert hall. Whilst operating on a fixed timeline, its materials appear free and improvisatory, often notated at decidedly slow speeds. Despite many differences with my own approach in *Dhātu* (not least in terms of the mobility of my musicians, the comparative kineticism of much of my own music, and my relative notational prescription), *Murmurs* served as an early source of inspiration—particularly with regard to matters of density.

For Saunders, density is a parameter that is especially 'important' when working in space. 'Not just moving up and down the core of sounds…', but also 'expanding and compressing acoustic space'.[157] Although this dual distinction between spectral and physical compression/expansion is left tantalisingly implicit and unexplored in the composer's short talk, it is nonetheless palpable when listening to *Murmurs*,[158] with density appearing to act throughout as a key structural force.

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[155] The formal approach taken here – concentrating largely upon the role of the three voices, and upon my personal and subjective experience of hearing the work in space – will differ to that taken in Chapter One (where timbral map-devised techniques of integration were explored upon the page). Nonetheless, and despite exploring differing passages of *Dhātu*, analyses from both chapters are intended as complementary, together presenting a more complete perspective upon the work. As such, findings from the preceding analyses from the first chapter will be referenced intermittently, to provide a more global account.

[156] Ircam, *IRCAM Classes: Composer Rebecca Saunders and Bassoonist Paul Riveaux*, online video recording, April 14, 2020, <https://www.ircam.fr/article/detail/les-cours-de-lircam-la-compositrice-rebecca-saunders-et-le-bassoniste-paul-riveaux>, 1:11:00. [Accessed 1 June 2020].

[157] Ibid.

[158] The temporal autonomy of the modular approach, for example, leads to unpredictable moments of simultaneity – and consequently pronounced density – in shared pitch space. (We hear this at 12:25, for example, where the sudden entrance of the bass flute, violin and piano and percussion duo results in a blanket of sound, which appears to envelop and enfold the oboe's sustained mid-treble register utterance.) Through the spatialisation of instruments – dispersed around the concert hall, based upon the exact acoustic properties of the space in question – a quite different sense of density is, however, on occasion evident: one directly relating to the geographical separation of musicians. We hear this, for example, at 1:55, where the oboe plays simultaneously *with* – but at opposite ends of the hall *from* – the bass clarinet, generating a very specific feeling of diffusion (or spatial relaxation/expansion).

In my own work, I will refer to two interlinked phenomena: **Spectral Density** and **Spatial Density**.

Spectral Density

At its most extreme (compressed or contracted), a multiplicity of sonic information within a limited band of spectral/pitch space.

Spatial Density

At its most extreme (compressed or contracted), a multiplicity of sonic information within a limited acoustic or architectural space.

Whilst, in keeping with several compositions across my portfolio, the stylistic influence of Saunders is clear, my own work takes a more extreme approach than *Murmurs* to the compression of spectral and acoustic space. We hear this, for example, at *Dhātu*'s moment of greatest volatility, Letter O: an early structural climax, where both spectral and spatial density reach a point of maximum contraction.
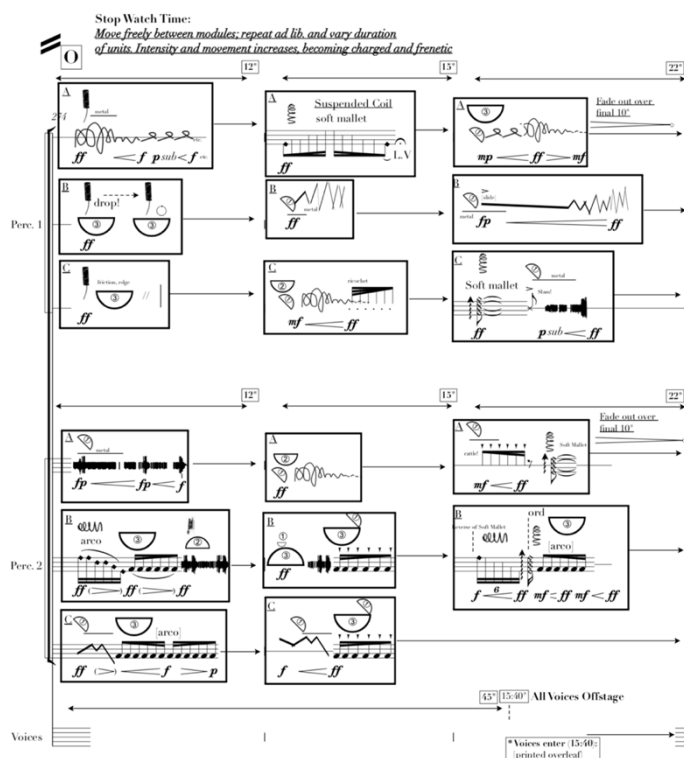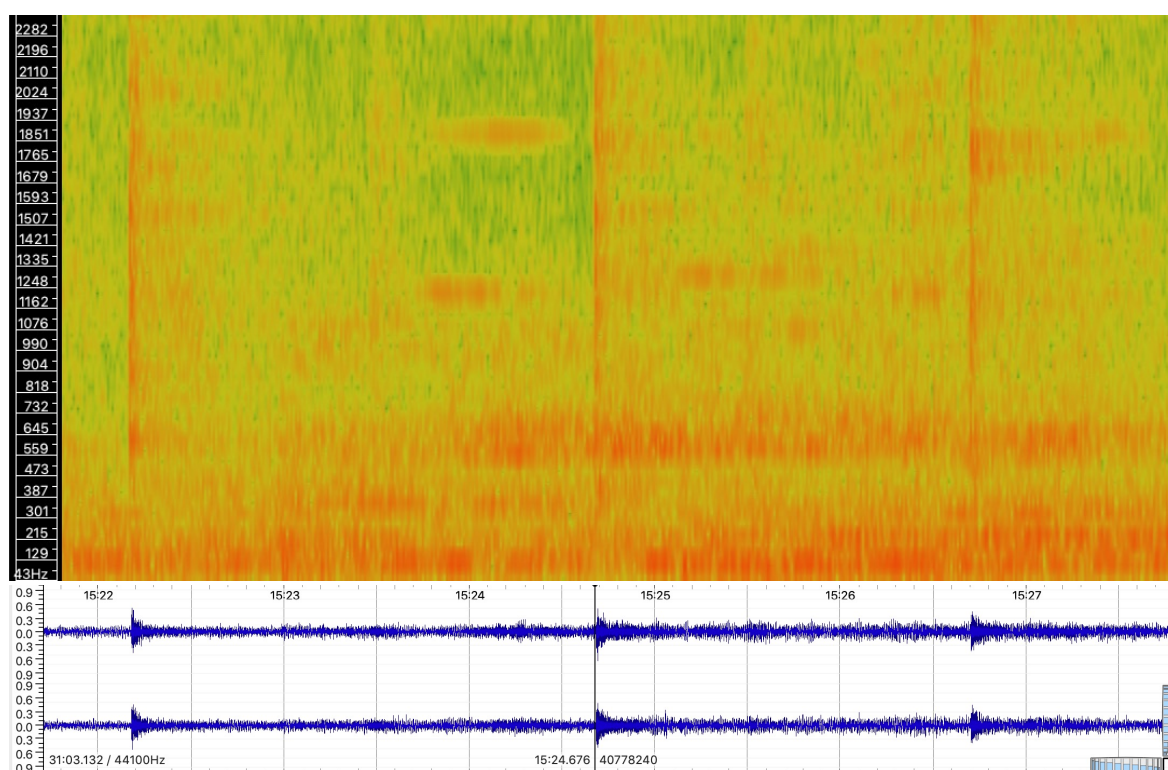
Figure 43a: *Dhātu*, letter O

Figure 43b: spectrogram, letter O (15:22 to 15:28)

As evident in Figure 43a, both percussionists alternate here between short notated fragments, conjuring up a reduced palette of sounds: a reductivity further enabled by the musicians' identical instrumentation. Supplemented by simultaneously sounding electronic samples derived from the same metal bowls and coils, specific frequency bands become overloaded. (The region around c.600hz, and the lower end of the frequency spectrum, in particular – as highlighted on Figure 43b – become densely populated). Moreover, this *spectral density* is matched by a certain feeling of physical compression or *spatial density*. With electronic sounds diffused continuously through the 360° loudspeaker array – and with a constant flurry of activity produced by the centrally placed percussion duo – the listener is bombarded on all sides, and within a restricted enclosure, by the same collection of timbres and frequencies.

The timbral map analysis in Chapter One (Case Study Two) of the music prior to this passage – at Letters K to L – provides context for the climactic feel of Letter O. Through *Constellation Polyphony* and *Discontinuity*, non-adjacent timbral areas were seen to introduce a certain friction at this point of the structure—framing the arrival of the singers at Letter M. As such, the subsequent music at Letter O was intended as an aftershock of sorts: a violent response to the preceding events, with spatial and spectral contraction employed to mark out this passage formally within the work's wider architecture.

Conversely, Letter Y, and the bars preceding it, explore opposite ends of the two density continua simultaneously. With all three vocalists now located in the lower church, the singers become spatially separated for the first time, moving independently. Here, I am seeking to generate a sense of inner-crypt

space opening up or expanding, as distinct, and previously unencountered, architectural areas become activated. With the voices having remained, until this point, inseparable, a noticeable sense of diffuse *spatial density* is now intended to be discernible.

On the other hand, we witness within these same bars intense saturation within the frequency domain, with all three voices moving freely within a restricted area of pitch space (circling around the pitches D_5, E-flat$_5$ and E_5). Through shared vocal timbre, weight (with three operatically trained female voices) and oscillation, and through the continued compression of spectral space, a certain degree of integration between the spatially separate voices appears to be maintained (see Figure 44).

Figure 44: spectrogram, letter Y (24:00 to 24:02) The bars directly preceding Figure Y demonstrate this density most clearly upon the spectrogram, with a dense mass of sound orbiting around c.587hz (D_5)
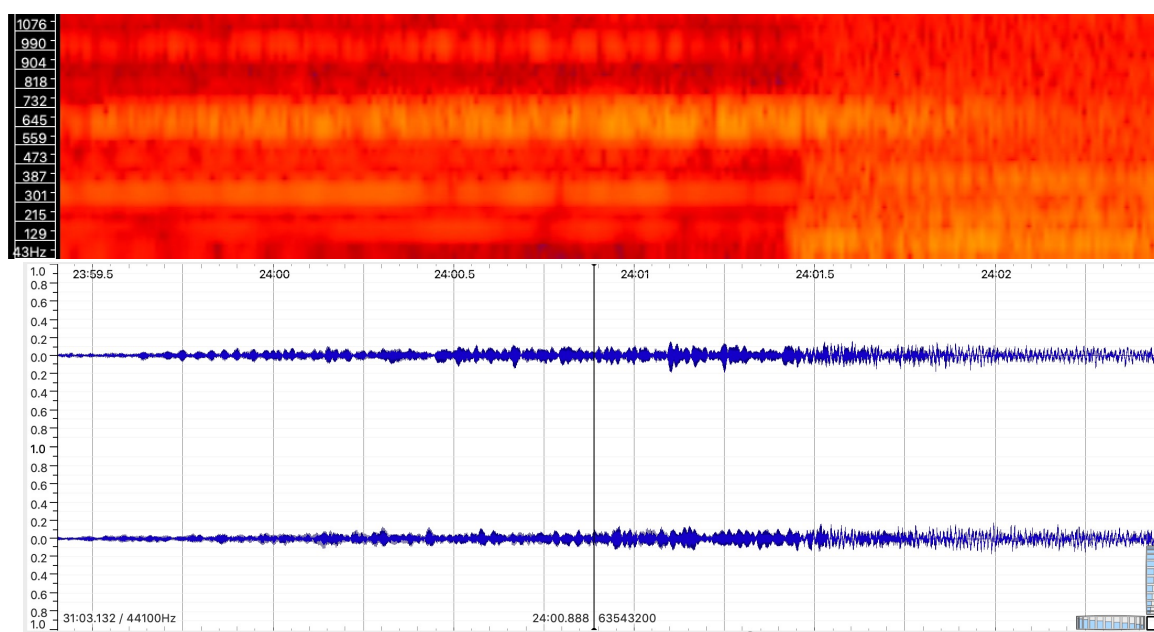
In both these examples (Letter O and Letter Y), extreme *spectral density* – generated by the saturation of a specific frequency range, and the multiplication of identical instrumental/vocal colour – results in auditory fusion, or timbral integration, between multiple sources.[159] Through trialling materials in *Dhātu*, I concluded that the compression of *spatial density* appears to enhance this fusion markedly: at Letter O, it is, at times, unclear which sounds emanate from which percussionist or loudspeaker[160]—with timbres blending as one within a restricted architectural space. A comparable sonic integration is evident at the

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[159] A process which, psychoacoustically speaking, emerges at the 'concurrent' grouping stage of ASA. (See Introduction, p. 6.)

[160] This is particularly true of those sounds whose sustain is more prominently heard than their attack.

beginning of Letter Y, too (in the bars preceding the geographical separation of the singers), with all three voices fused, indecipherable from one another, and forming an 'auditory chimera' of sorts.[161]

However, with the three voices separating out geographically after Letter Y, and as a relaxation[162] in *spatial density* becomes increasingly apparent, timbral fusion appears to decrease.[163] Although a clear-cut connection remains between sonorities (accentuated by a consistent degree of *spectral density*), multiple streams are now evident, with individual qualities of the voices now audible.[164]

Spatial Texture

By taking *spatial density* to a point of extreme expansion/relaxation – a tactic I employ in the first half of *Dhātu,* through the architectural separation of the percussion duo and vocal trio – and by exploiting the resultant segregation of instrumental streams,[165] new structural possibilities emerged when trialling materials within the performance space. These compositional strategies, employed at a local level of discourse, might best be described as forms of ***spatial texture***:

At Figure P+45", for example, voice and percussion strands are heard simultaneously, yet – through their physical separation, and disparate timbral relationship – they remain fundamentally unfused: perceptible as independent and discrete strands. Space takes on a clarifying textural role here resulting, from the audience's perspective at the centre of inner crypt space, in a natural foregrounding/backgrounding of materials,[166] which enables independent lines to exist simultaneously in ***spatial counterpoint.***[167]

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[161] Hasegawa, discussing the work of Bregman, uses this term to convey different sonic sources [combined] into a 'single, unified percept': see Robert Hasegawa, 'Timbre as Harmony—Harmony as Timbre', in *The Oxford Handbook of Timbre*, ed. by Emily I. Dolan and Alexander Rehding (Oxford: Oxford University Press, 2018), p. 9. <10.1093/oxfordhb/9780190637224.013.11> [Accessed 22 January 2021].

[162] As will become apparent in Figure 50, this relaxation in spatial density reflects a more global 'internal spatial expansion', occurring within the latter stages of the work.

[163] Indeed, as we are aware from ASA, it is not only continuity in 'spectral content' and 'intensity' that is necessary for event/stream connection, but, so too, shared 'spatial location': something stymied here by the movement of the singers: see Meghan Goodchild and Stephen McAdams, 'Perceptual Processes in Orchestration', in *The Oxford Handbook of Timbre*, p.12. <http://10.1093/oxfordhb/9780190637224.013.10> [Accessed 30 January 2021].

[164] Thoughts here again return to the work of Cornelia Fales (discussed in Chapter One), and her definition of 'timbral anomaly by extraction'. Although space is not discussed by Fales when defining this process, potential remains for an extension of her terminology: timbral anomaly by extraction, according to Fales, involves 'leav(ing) (the) global organisation of the original timbre intact, while emphasising one or a small group of those elements to stand out…against the remainder of a tone'. Depending upon your position as a listener within the inner crypt, and according to your respective proximity to the nearest vocalist, such individual emphasis of a singular entity (within the context of a whole, which was previously heard in a timbrally assimilated context) may well be experienced. (Fales, p. 66).

[165] Viewed through the lens of ASA, we are now dealing with the second (contiguous) stage: auditory stream segregation.

[166] Space perhaps becomes analogous here, in its clarifying role, to the registral distinction, or rhythmic independence, found in traditional tonal counterpoint: technical considerations made by the composer in order that independent lines might be heard successfully when sounding simultaneously. (Goodchild and McAdams discuss these factors in orchestration—although the link to space remains largely unexplored in their writing: see Goodchild and McAdams.)

[167] Comparisons might be made at this point to Smalley's 'Spatial Simultaneity': a form of 'spatiomorphology' in which one might encounter two 'simultaneous spaces'—for example, a 'granular texture directly in front…while in the distance a

Figure 45, *Dhātu*, P+45". Voices here appear distant and rather blurred (although intense) to the audience (located in the inner crypt), with onset/offset largely imperceptible. Conversely, the percussionists' strands, sounding at close proximity to the listener, despite being quiet – and comparatively lacking in energy/intensity – are crisp and distinct, with details of timbral granularity clearly audible

Whilst comparable passages of *spatial counterpoint* are evident elsewhere in *Dhātu* (see for example, Letter V), at times I choose instead to juxtapose inner and outer crypt space, drawing upon a technique I'll refer to as ***spatial antiphony:***

Figure P itself provides a good example of such a texture. Here, percussion and electronics cease suddenly. With no sound emanating from the lower crypt, the voices are heard alone in the upper church. As this spatial alternation takes place, I seek to instigate a moment of stark juxtaposition—again, highlighting this pivotal moment within the work's overall structure. Not only are inner and outer timbral spaces juxtaposed, but several resultant differences in sound quality become apparent: defined/clear (with audible onset and offset), versus blurred/blended (with imperceptible onset/offset); immediate and immersive, compared to distant and reverberant; or spatially compressed, as opposed to spatially diffuse. Moreover, the electronics play a clarifying role in this antiphonal relationship, with a further juxtaposition

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door closes in a large reverberant space': see Denis Smalley, 'Spectromorphology: Explaining Sound-Shapes', *Organised Sound*, 2.2 (1997), 107-126 (p. 124). Whilst the author's point of reference is exclusively acousmatic, the relevance of this concept in relation to the aforementioned passage of *Dhātu* is striking. Moreover, it serves as a reminder that the distinct timbral qualities of both layers are, to some extent, the result not only of their individual instrumental characteristics and geographical separation, but also of the specific acoustic environments and enclosures in which they were produced— heavily affected by reflective floors, surfaces and cavities, etc.

evident between the dictaphone-manipulated voices (heard within the tape part at Letter P-15", where they are clearly perceptible as a type of 'formalised',[168] or pre-recorded, electronic element) and the live vocal trio, who communicate at Letter P a certain sense of liveness,[169] or realness.[170]

Whilst this alternation of geographically disparate inner and outer crypt space reveals *broad* sonic differences between strands, in the latter stages of *Dhātu* – where spatial antiphony occurs at various locations within the *same* (inner crypt) space – a much more specific juxtaposition of sonorities becomes possible, with a greater number of timbral variables rendered audible, and potentially operational, in space.

In particular, **onset and offset** are primary considerations here, facilitating the articulation of precise areas within space. This is particularly true during the climactic closing moments of the work, where on/off juxtapositions between voices and percussionists (and/or electronics) is a frequent compositional tactic, as tension is generated, and the singers assume a variety of spatial locations around the crypt. We hear this at 24:06, for example, where the voices collectively crescendo from *mp* towards *f espress.*—their newfound proximity to the listener resulting in both audible onset (clearly marking out to the listener their new location at 'Crypt Space Four') and offset (at 24:09), where the discernible cessation of their sound meets the sudden hammer blow attacks of the spatially separate percussionists. Furthermore, onset/offset enables moments I conceived during the latter stages of *Dhātu* as structural tuttis (or ***homophonic spatial textures).*** In these instances, simultaneous onset across the ensemble serves to articulate spatial boundaries around the audience in a very specific way—with perimeters defined by the disparate positions assumed by performers at the moment of communal attack. We hear this clearly,

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[168] This term, taken from the work of Trevor Wishart, will be discussed in due course.

[169] As will become central to my discussion of 'allure' later in this chapter, this 'liveness' is principally communicated through the voices' oscillation/vibrato.

[170] Context for this spatial interpolation technique might again be made through reference to Smalley and the acousmatic tradition. The emergence of the voices at Letter P – as if they had been already sounding, albeit imperceptibly, all along – could be seen to convey a kind of 'implied spatial simultaneity': a term Smalley uses 'when contrasting spaces are intercut and alternated…giving the impression of simultaneity even though the spaces are presented successively': Smalley, p. 124. Whilst this description could be seen as a succinct retrospective analysis of this passage, my decision to juxtapose music in this way perhaps owes more to the work of Salvatore Sciarrino than to Smalley. In a work such as *Quaderno di Strada (2003)* – and, in particular, the first movement, *Se non ora, quando?* – frequent, almost conversational juxtaposition ensues between the baritone and ensemble instruments. Making use of extreme *pianissimi*, the antiphonal exchanges – particularly between the singer and bass clarinet and violin – frequently dovetail and overlap; at times, the musicians noticeably engaging in a brief moment of hushed polyphony, as they hand over their lines, at others allowing harder edges to appear between their respective offset and onset. These passages (and further examples from Sciarrino's choral work *12 Madrigali*), were at the forefront of my mind when sketching these spatially antiphonal exchanges between voices and percussion/electronics. Equally important in my thinking was again the music of Rebecca Saunders, who had herself commented during a lesson on *Dhātu* that 'hard edges' between materials might be necessary in order to 'cut through' the reverberant space within which I was working. Such ruptures are of course audible in a great number of Saunders' works: for example, the sudden breaks heard throughout *Fury II* (see, for example, bar 89: a moment which will feature within my brief analysis of this work, presented during Chapter Four), or the sudden interruptions of unexpected 'sound surfaces', heard in *Molly's Song 3*.

for example, at 23:05, as the percussionists' sudden articulation of pitch pipes (at centre stage) coincides with the vocalists' onset at Crypt Position Two:[171]

Figure 46: *Dhātu*, Crypt Position Two

Thus far I have discussed two key musical parameters I found to be essential to working in space: *density* (reflecting the fusion of sounds; a factor affected not just by spectrum, but by spatial proximity) and *spatial texture*, in which geographically disparate performers enable the employment of compositional strategies, including *spatial counterpoint*, *spatial homophony* and *spatial antiphony*. Whilst these particular parameters became novel considerations when workshopping materials in space, others – such as range and sustainment – had featured prominently at the pre-compositional/timbral map stage (see Chapter One), before assuming even greater compositional significance upon being heard in the resonant acoustic of the upper/lower church. These parameters will now be discussed.

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Range in space

Owing to the registral limita[...] ified, in my early sketches of the timbral [...] e electronic components of *Dhātu* provi[...] sine waves would serve to enrich the u[...] sine waves – diffused principally by the [...] , providing

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[171] Crypt Position Two is labelled V[5] on Figure 42.

an extension to the shaken spring drum, or to those sounds emerging from the execution of bow pressure techniques upon the various bowls.

However, when heard in space (for example, at Letter A), these electronic sounds assumed unexpected gravitas, and greater structural significance than anticipated—their vibrations seemingly permeating and saturating the stone floors and surfaces of the inner crypt. Despite their projection through one principal speaker (the subwoofer), these low sine waves somehow felt ubiquitous, rather than directional, as if the whole inner-structure of the lower church (and everything encompassed within it, including the listener), were absorbing – even resonating *with* – the frequencies. As such, the 'core passages' in which these bass sonorities are heard – centred around constellation C (and nodes 31 and 32, in particular) – are rendered all the more immersive, when experienced live within their intended architectural environment: the listener bound up in an intimate and communal soundworld. The phenomenological significance of this passage, when heard in space, I hope marks out this material formally as *Dhātu* unfolds, adding 'weight' to this key area of the timbral map.[172]

Indeed, so synonymous do these bass frequencies become with the resonances of proximate inner timbral space that, upon their first discernible spectromorphological change (at Letter L, where the wave form's function alters from resonance to active, and evolving, sound object), a vast alteration in the architecture of the work – and its sense of spatial expansion and contraction – is triggered. This timbral change results from a pronounced modification in the wave form's oscillation, or its 'allure',[173] to borrow once again from the lexicon of Pierre Schaeffer.

Allure

When drawing up early sketches of *Dhātu* (see Figure 47a)*,* the bell-like voices of late-period Luigi Nono were very much in my mind: in particular, the crystalline and often stratospheric choral textures of *Das Atmende Klarsein* (1980-83), and the microtonal deviations heard in *Quando Stano Morendo* (1982)—see, for example, bars 19-21, depicted in Figure 47b.[174] Mirroring these textures in my own writing appeared to offer a pleasing timbral contrast to the grainy, inharmonic spectra of the percussionists' array of metallic instruments. However, whilst finding these sketched passages pleasing in isolation – and especially when

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[172] In Case Study One (Chapter One), the music directly proceeding this passage (Letters B-D) was explored. Through techniques of *Constellation Homophony*, *Continuity*, *Adjacency* and *Fusion*, the aforementioned structural weight of constellation C (as experienced at Letter A) was seen to be built into the musical discourse, as it further develops. That is to say, the effects of Letter A are designed to linger on, long after the sine waves have ceased.

[173] As detailed in Chapter One, Schaeffer's 'allure' is used in reference to oscillation in the overall 'sustainment' of a sound.

[174] A clear connection between *Quando Stano Morendo* and the pre-compositional sketches for *Dhātu* is evident here—with Nono's microtonal inflections (deviating freely from a series of slowly evolving unison notes) going on to influence my own writing. Parallels can also be found between my own (+ and o) notation – ultimately disbanded in the final work – and Nono's circular symbols: both of which instruct the vocalist to vary the degree to which their mouth remains open or closed whilst singing.

recording closely mic-ed mock-ups within a dry acoustic – it became clear, upon trialling materials within a larger performance venue, that many of these timbral details would become lost over distance. Moreover, through workshopping passages with the vocal trio, it was evident that the sine-like, *senza vibrato* sound production I was seeking was in fact difficult – and even physically uncomfortable – for the operatically trained singers with whom I was working.[175]

Figure 47a: *Dhātu* vocal material, early sketches (initially written for four voices)

Figure 47b: Luigi Nono, *Quando Stanno Morendo, Diario Polacco n.2* (Milan: Casa Ricordi, 1982), bars 19-21; soprano 2, mezzo soprano and contralto

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[175] It is telling that in the preface to *Das Atmende Klarsein*, André Richard and Marco Mazzolini note that Nono sought 'young singers whose voices are not yet completely formed', and for whom 'fragile' *senza vibrato* singing would be unproblematic: André Richard and Marco Mazzolini, preface to *Das atmende Klarsein*, score, xiiii, quoted in Carola Nielinger-Vakil, *Luigi Nono: a Composer in Context* (Cambridge: Cambridge University Press, 2015), p. 215.

As such, I began to sketch instead very different materials, in which vocal freedom – and consequently vibrato – is actively encouraged: communicated notationally through frequent crescendi, marked *'espressivo'*.[176] In addition to matching more closely the skillset of my chosen performers, an unexpected consequence arose when I first heard this material workshopped in space—one which I would subsequently exploit to shape and define the formal trajectory of the work. For Schaeffer there are two principal means of 'sustainment', (the means by which 'form' and 'matter' are joined): grain, a sound prolonged through iteration,[177] and allure, oscillation (particularly associated with instrumental or vocal vibrato). In the words of Michel Chion, allure is a key morphological criterium, as it 'spontaneously refers back to the causality of a sound', with oscillation acting as a key determinant in identifying the source of a sonority.[178] With frequent crescendi and sustained pure vowels written into the vocal lines in *Dhātu* (both of which encourage the performers to allow natural vibrato), this means of sustainment becomes a key feature of the sung material.

Allure in space

Acoustic studies have consistently shown that, owing to the 'sound-absorbing properties of air' – and through transferral of sound to walls, cavities and surfaces en route to a listener[179] – the spectrum of a sound is fundamentally altered when a large distance exists between source and auditor. (Indeed, the larger the distance, the greater the degree of 'reverberant' compared to 'direct' energy, and the more noticeably affected the resultant sonority). This phenomenon is particularly true at higher frequencies, where the 'intensity' of a sound appears greatly reduced 'as the distance between a source… and a receiver is increased'.[180]

At those moments in *Dhātu* in which the singers are geographically separated from the listener, such a reduction in sonic 'intensity' is palpable: not just the anticipated reduction in amplitude over distance but, importantly, a reduction in the audibility of oscillation. When trialling materials in the upper/lower church, it was evident to me that, at greater distances, vibrato appears to be neutralised or flattened out: the reflectivity of enclosures and stone surfaces en route to the listener absorbing frequencies in the upper register and lessening the intensity of vocal production. Indeed, it is only as the singers encroach

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[176] Whilst deviating from my initial vision for the work, I was satisfied that this material would still offer significant timbral contrast to the aforementioned percussion palette.

[177] See Chapter One's discussion of rubbing grain.

[178] Schaeffer/Chion go on to distinguish between three subcategories of allure: 1) 'mechanically regular oscillation' (ie. a machine), 2) 'unpredictable irregularity' (i.e. natural phenomena) and 3) 'supple periodicity' (i.e. a 'living agent'): see Michel Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, trans. by John Dack and Christine North (2009), p. 179. <http://ears.huma-num.fr/onlinePublications.html> [Accessed 7 January 2021].

[179] Pavel Zahorik, Douglas S Brungart and Adelbert W. Bronkhorst, 'Auditory Distance Perception in Humans: A Summary of Past And Present Research', *Acta Acustica United With Acustica*, 91.3 (2005), 409-420 (p. 414).

[180] Ibid., p. 411.

upon crypt space – and become more proximate to the listener – that vibrato starts to become discernible.

The physical separation of the vocalists, their relationship with *Dhātu*'s electronics (as detailed overleaf), and, crucially, the assumed spatial effect upon the perception of allure, became key considerations when moulding the structural framework of the vocal material. As I will explain below, a large-scale trajectory is established here—with pre-recorded vocal utterances gradually transitioning into ostensibly live singing.

Occurrence of vocal material: live and pre-recorded/electronic

Occurrence No.	Location	Live, pre-recorded or electronic?	Observations on quality of vocal timbre	Observations on sense of space
Occurrence 1	Letter H	Pre-recorded voices/electronic	- Lo-fi coloration (sample recorded upon dictaphones); voices amalgamated with sine-like sonorities - Some oscillation/vibrato perceptible - Closely mic-ed; detail audible	- Material perceived as 'near' - However, a 'formalised', pre-recorded, rather than real/live, space is clearly communicated
Occurrence 2	Letter M-c.5"	Live	- More clearly 'human' (no discernible sine element; some oscillation; fuzzy, undefined quality); this time more distant—somewhat unclear to listener if live or pre-recorded	- Spatial location feels non-specific (other than a general sense of sounds occurring from the front, at some distance)
Occurrence 3	O → P	Pre-recorded voices/electronic ⟶ live	- Juxtaposition of recorded or unreal (high sine waves and dictaphone-colored sounds) sonorities at Letter O and real – discernibly live – voices at Letter P	- Rapid alteration between 'formalised'/external space at Letter O and real-word, locatable space at P (with sounds clearly emanating live from far up stage left)
Occurrence 4	T-c.20" → T	Pre-recorded voices/electronic ⟶ live	- At T-c.20" voices are pre-recorded, although listener may well be uncertain as to their liveness. - Live singers emerge (as if from the tape) at Figure T. Discernible allure now appears to betray their	-At T-c.20" voices feel close (or closely mic-ed): liveness is ambiguous - At T voices are unmistakeably live and again locatable—approaching up stage left. A different sense of closeness is palpable

			physical presence in the space	
Occurrence 5	V	Live	- Vocal detail is now clearly audible (and increasingly so as singers move in and amongst audience): oscillation/vibrato, onset and offset discernible. Physical presence much more obvious to listener	- Voices are more precisely locatable in *same* proximate physical space as the listener (now in crypt with audience) - Auditory cues are assisted by singers' increasing visibility to watching listener

The initial appearance of the singers is pre-recorded. Through close mic-ing, timbral details are captured crisply and the material is clearly discernible as human. However, with this material recorded upon analogue dictaphones, I intend to render a certain antiquated quality of sound reproduction audible, with the sonic artefacts of this outmoded equipment detectable to the listener. Through these means, I seek to establish a 'formalised' – rather than live – space (as discussed with regard to *Plastica* later in this chapter).[181]

Subsequent pre-recorded vocal samples continue to make use of this microcassette technology, with the dictaphones' half/double-speed (and altered pitch) playback capabilities exploited. Here, vibrato is the parameter most notably affected by this analogue process. (This is perhaps most audible in the very specific tape colour heard at bar 315).[182] With oscillation no longer 'supple' and living, but pronounced and exaggerated – even rendered mechanical – it is again clear that the voices are being diffused electronically, rather than appearing live. On the other hand, and as previously discussed, it is space – and, more precisely, the separation of singers and listener – which affects perception of the live vocalists' vibrato, upon their initial appearances, with oscillation rendered all but inaudible over larger distances. Consequently, with the singers stripped of this key characteristic of their colour,[183] and within the context of a work in which a precedent of pre-recorded vocal material has already been established, I once again encourage the listener to question whether this music emanates from real performers, distanced in the space, or from the loudspeakers.

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[181] And so too I aim to establish in the mind of the listener the possibility that the voices throughout *Dhātu* may well never be live, but are always an electronic component.

[182] A key influence upon this material was Andreas Dohmen's *Portraits und Wiederholung* (1997-1998), for 7 voices and dictaphones. With its discourse primarily constructed of energetic bursts of dictaphone-manipulated sonorities (often at extreme frequencies) and highly kinetic vocal lines, Dohmen's writing in many ways differs substantially from my own in *Dhātu*. Nonetheless, through the intricate interplay between live voices (themselves purposely engaging in exaggerated oscillation) and the half/double speed analogue playback – in which the vocal allure is captured and rendered yet more pronounced – the impetus of a certain timbral colour, found in *Dhātu*, can clearly be traced back to Dohmen's work. Conversely, the flashes of high dictaphone-manipulated electronics (which appear later in my work, after Letter X) betray a quite different lineage—informed by the spatialised flashes of vocal material, which are found in the latter parts of Nono's *Isola Secunda* (Hölderlin) from *Prometeo*.

[183] Equally, a certain blurred, or 'fuzzy', quality seems to emerge at these early moments of the work, owing to the boxed-in architectural enclosure in which the singers are located.

In both these examples, it is allure that communicates this sense of 'liveness', and allure that we instinctively seem to reach for as listeners, in a bid to identify the source of a sound. This observation is again in line with Schaeffer, who states that: "with allure, perception clings to everything that might reveal the presence of the specific, the living…'.[184]

Having workshopped the new vocal material within the performance venue, I thus decided to build vibrato into the work as a key morphophoric consideration. With gradually encroaching voices in the space, I seek to render allure systematically more perceptible as the discourse unfolds, coaxing the listener towards a moment of realisation that the singers are indeed performing live within the space.[185]

Vocal harmony in space   ◊

Accounting for the anticipated loss in timbral detail resulting from the singers' physical separation in space, the harmony – and notation – is vastly simplified upon the initial appearance of the voices. A simple dyad features at M-5", for example, opening up to a trichord at Letter P—and performative licence is given as to the dynamic, vowel and phrase length selected, with the musicians free to adapt their utterances, according to the specific resonant properties of each enclosure.

Figure 48: *Dhātu*, letters M and P (voices)

Although intermittently pre-empted in the electronics, and with its opening pitches linked by inversion to the trio's material at P (see Figure 49b), the music at Letter V, meanwhile – now heard clearly in the

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[184] Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, p. 180.

[185] In performance, it was surprising how late this moment of realisation seemed to come for the audience, with several colleagues in attendance commenting that it was only after visual confirmation of the singers that they fully trusted their initial assumptions as to the distinction between the live and the pre-recorded.

proximity of inner-crypt space – is seemingly novel and harmonically much more complex.[186] Through a cyclical progression, loosely based upon a series of pentachordal rotations, a self-repeating harmonic structure causes the music to loop back continually upon itself.

Figure 49a: genesis of vocal material (stage 1)

Pitches taken from *Bríatharogaim*'s opening vocal line (transposed up a tone):
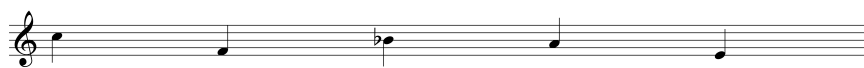
Pitches verticalised (chord 'I' below) and rotated [1]

Rotation: I   II   III   IV   V
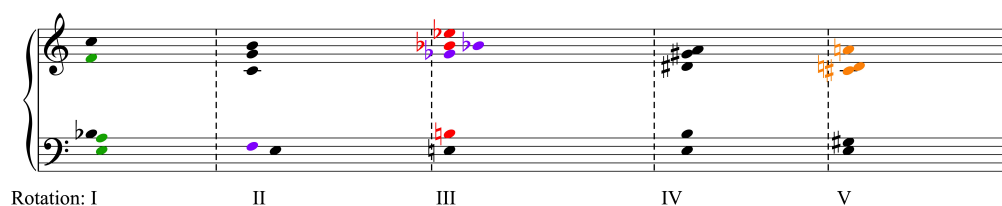
[1] This harmonic practice, fairly ubiquitous across this portfolio, is outlined in detail by Julian Anderson in the following article: Julian Anderson, 'Harmonic Practices In Oliver Knussen's Music Since 1988: Part I', *Tempo*, 2002, 2-14.

Starting at different points in the cycle on each occurrence, this sequence is repeated four times, with each vocal entry delivered from a new spatial location in the crypt. By maintaining harmonic consistency between iterations (with harmony and texture largely invariant), I seek to reveal, as this material unfolds over time, subtle timbral differences – of onset, allure and reverberance etc. – resulting from the altered spatial location of the performers. Turning once again to the acousmatic tradition, comparisons might be drawn here with Trevor Wishart's concept of 'landscape', in which a sound object's 'disposition' is able to stimulate a change in our qualitative perception of that sonority, even when the object itself remains identical: a formal trajectory made possible only when dealing with sounds in space.[187] In the latter stages of *Dhātu,* impetus for these perceptual changes is increasingly built into the score: for example, through the tempo indication provided at 24:13, which results in familiar material sounding at 'double speed'—as if a sudden change in velocity has been enacted.

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[186] An increase in *textural* complexity is evident here too—with greater independence between each voice part created, in the knowledge that more detail would now be audible at close proximity.

[187] This concept will be explored more fully in the second part of this chapter, when discussing *Plastica*.

Figure 49b: genesis of vocal material (stage 2). Set theory is used below to demonstrate the trichord (transposed and inverted) which underpins the singers' harmony throughout

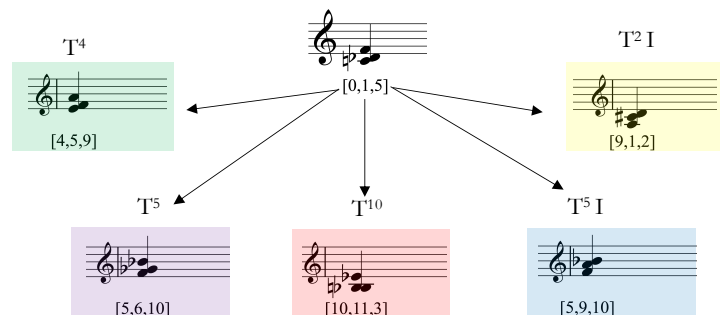Pitches freely extracted to form singers' material:

Vocal Parts: pitch reduction of Figure V

Vocal Parts: pitch reduction of Figure P

Prime Form:

T⁴   [0,1,5]   T² I

[4,5,9]   [9,1,2]

T⁵   T¹⁰   T⁵ I

[5,6,10]   [10,11,3]   [5,9,10]

Expansion and contraction of space

'So, in a way, what I'm doing is…creating a kind of resonance box, within which we sit—and the music is then around us and in the middle of us',[188] says Saunders, as she elaborates upon her thinking behind *Murmurs* to the conference participants at IRCAM. Such a sense of space – defined by static performers, playing in disparate locations around the audience – is clearly discernible when we hear Saunders' work. As listeners, we gradually become aware of the subtle topography of the auditorium, as distinct areas are 'activated' by the musicians, developing (by the end of *Murmurs*' full 27-minute duration) an intimate knowledge of a defined 'single spatial setting'.[189]

In comparison, *Dhātu* takes a more nuanced approach to space. Having established a tight 360° diffusion boundary around the listener in the inner crypt, a gradual sense of expansion ensues, as the work progresses. This process occurs initially through electronic means (in particular, additional reverb – as detailed in Figure 50 below – the incorporation of 'formalised' recorded spaces, and the projection of 'external' sonorities through the loudspeakers). Subsequently, this expansion is consolidated through the

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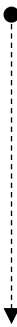[188] Ircam, *IRCAM Classes: Composer Rebecca Saunders and Bassoonist Paul Riveaux*, 2:01:15.

[189] Smalley uses this term to describe the creation (though loudspeakers) of a 'single type of space of which the listener is aware at the outset': see Smalley, p. 124.

introduction of the spatially and timbrally distinct singers, whose utterances go on to reveal enclosures and areas of the upper church, beyond the confines of the crypt.

In the latter stages of the work, as the singers encroach upon the outer reaches of the lower church, an internal expansion of sorts then takes place (*en*dogenous, as opposed to *ex*ogenous growth, to borrow from the lexicon of Chapter Four), as new areas *within* the crypt are utilised and activated for the first time.

Finally, as the vocalists cross the threshold of inner crypt space, and move towards centre stage, a rapid sense of recontraction and spatial compression is engendered: the singers now encroaching upon the same restricted space as the audience.[190] Having permeated – even broken down – the boundaries of the inner sanctum, the 360° perimeter is quickly re-established, however, through the use of the analogue dictaphones (used by the vocalists to capture their grainy, timbral utterances, produced live upon pitch pipes). Again, making use of the microcassette machines' half-speed playback function – now projected through the loudspeakers – a blanket texture of degenerated sound (timbrally evoking the metal bowls heard thirty minutes prior) envelops the listener once more on all sides. With the sonic legacy of this electronic strand known to the listener – who bore witness to its creation – this final etched version of the vocal material communicates a very literal, and final, process of compression: the once live sound, rendered upon the filament of the analogue microcassette. The previously pure voices now corrupted: their timbre forced to conform to the laws of inner timbral space.

Figure 50: table of compression and expansion

Bar Number	Observations	Spatial compression / expansion
Bar 1	Sound is diffused at the front of the audience, with the percussionists at centre stage. Electronics, like the broader architectural space of the lower crypt, initially appear reflective/resonant (as if an extension of the stone surfaces and walls). Material largely consists of untreated, sampled percussion sounds, which frequently serve as an extension of their live counterparts.	*Compressed*
Bar 18	Silence here appears resonant and passive—acting in communion with the cathedral's natural reverberance.	
Figure A	Addition of bass sine waves in electronics enhances the feeling of immersion in inner crypt space (see Range), reinforcing the boundaries of the inner enclosure.	

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[190] At *Dhātu*'s premiere, this ingression into the audience's territory felt surprisingly Brechtian and dramatic in its violation of the performative boundary between musician and listener.

Figure B	A sense of inner crypt space beginning to expand; a small amount of revolution in electronics begins to give the impression of the loudspeaker materials becoming more active (no longer acting simply as a resonance of the live sonorities).	
Bar 107	White noise acts as a resonance, but feels more active than the silence at bar 18, betraying a sense of space beginning to open up.	
Bar 112	A rare moment of inactivity. Silence now feels wholly active, as if sound could punctuate the void at any moment.	
Bar 123	Silence as interruptive; sudden offset. An anticipation that the electronics will uncoil and start up again with no warning.	*Expanding*
Figure F	Heavy reverb applied to the electronics (suggesting a space even more cavernous than that within which the audience are situated). As such, a sense of expansion beyond the inner-crypt diffusion boundary is conveyed.	
Figure H	'Formalised' electronic space of dictaphones is introduced. A sense of external space is, for the first time, communicated through the loudspeakers. Lo-fi coloration suggests a previous – perhaps historic – vocal recording (see Allure).	
L-10"	Bass sine waves – formerly passive/resonant, and synonymous with the core percussion sonorities (always beginning and ending through gradual onset and decay) – now oscillate independently for the first time, beginning with a firm attack. Consequently, there is a sense of the building's resonance becoming more active: of space opening up—as if the architectural characteristics of the crypt are changing before our ears.	
O	Point of maximum saturation (see Density). Sound objects spin and move rapidly around the 360° diffusion area in the electronics (i.e. a quick sense of revolution).	
P → T	External voices appear to activate previously 'unknown' enclosures in the outer crypt; a sense of wider architectural space expanding outwards	*Expanded*
V → Y	Singers encroach and ultimately enter inner crypt space. New areas (up stage left, and at rear of the audience) are activated; a feeling of already inhabited/known space being redefined.	*Redefined / Internal expansion*
Y → Z	Singers intersect the audience; new areas of central inner crypt space activated by the vocalists (maximal proximity to audience); a sense of the 360° boundary moving in and compressing.	*Compressing*
AA → end	360° projection of dictaphone materials (through four loudspeakers) re-establishes enclosure boundary around audience. Percussionists move from centre stage to rear of audience, far beyond reaches of inner crypt space; previously 'unknown' enclosures in the extreme rear lower church are revealed.	*(Re)-compressed Redefined*

Conclusions

The incremental expansion of 'activated' architectural space, encountered between Letter B and T – as new and distinct enclosures are explored by the voices – and the subsequent recontraction of the performative area experienced at Letter Y (as the singers encroach upon the inner crypt and intersect the audience), becomes one of the clearest formal arcs of the work when *Dhātu* is experienced live: a global-level spatial trajectory, which runs throughout the composition. The Schaefferian morphological criterium of allure was seen to be intimately bound up in this journey, with the singers' vibrato becoming

increasingly perceptible, communicating a sense of 'liveness', as the vocalists approach the audience, and as the activated architectural space begins to 'recontract'.

At a more local level of the musical discourse, meanwhile, considerations of **spatial texture** – in particular spatial antiphony and counterpoint – were explored as key compositional strategies. Furthermore, with the multidimensional timbre complex opening up in novel ways, as sounds are realised in the work's intended architectural environment, certain musical elements were seen to attain phenomenological significance when heard in space—accentuating elements of the compositional design previously explored in the case study analyses of Chapter One. The climactic material of Letter O, for example – where **spatial** and **spectral density** reach a point of saturation – was framed within the context of the preceding timbre map-generated discontinuities employed between Letters K-L. On the other hand, the durational 'weighting' of constellation C materials (as presented during my initial explorations of the pre-compositional proportional timeline in the first chapter) was seen to be enhanced through the immersive and potent experience of hearing – and 'feeling' – the core passage's pronounced bass sonorities live in space.

Finally, through my explorations of the vocal **harmony**, I began to explore the qualitative differences perceptible when the 'disposition' – or landscape – of a relatively static sound object is altered within space.

This line of enquiry now leads me to the second key work of this chapter, *Plastica*, where external and historic spaces, extrinsic sonorities and notions of 'landscape' become primary considerations.

Plastica (2020)

Electronics Layer 3: Changing Landscape

Written in 2020, *Plastica* is scored for sextet and quadraphonic electronics.[191] Inspired by an artwork of the same name by Alberto Burri, the musical discourse is organised through varying degrees of timbral saturation in the three acoustic layers and in the 'global strand' of the electronics. These elements will become the central focus of the next chapter. Discussion here will instead focus upon a single layer of the tape part: Electronics Layer 3. Timbral morphology in this particular strand is perceptible not through changing levels of saturation, but rather through a changing sense of space. However, space in this

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[191] Full details of the commission and premiere performance are detailed in Chapter Four. It is important to note here that the sextet (B. Fl. B. Cl, Pno. Vln. Vla. Vc.) is, for the most part, divided into duos: B. Fl and Vc. (Duo/Layer 1), B. Cl and Vla. (Duo/Layer 2) and Pno. and Vln. (Duo/Layer 3).

instance – unlike in *Dhātu* – is a virtual phenomenon: communicated by the work's four loudspeakers, as opposed to the complex architectural experience outlined in the preceding pages.

Figure 52: *Plastica*, electronics layers*

Each of the acoustic strands is bound to a corresponding tape part, triggered at cue points throughout the work. Electronics Layer 1 (with Duo 1) and Layer 2 (with Duo 2) for the most part form a tight unity with their acoustic counterparts—dovetailing, introducing and handing over material. They are very much drawn from the same sound palette. Conversely, Electronics Layer 3 (with Duo 3) forms a more complex relationship with its acoustic partner: at times residing within the same group of sonorities, at others, diverging substantially.

Electronics Layer 1 takes dictaphone-manipulated sonorities as its starting point: slowed down and analogue pitch-shifted samples of the Vc.'s scordatura IV string, and of low B. Fl. multiphonics.
Electronics Layer 2 embeds the concrete sound of the dictaphone's playback button in operation, forming a close aural likeness with the B. Cl's live key click and tongue rams. This sample is again rendered lo-fi and overdriven through analogue pitch shifting.
Electronics Layer 3 initially features sampled piano trio material (from *Analogue* – discussed in Chapter Two), again slowed down and pitch-shifted by dictaphones. The timbral link with the acoustic duo here is more basic—for the most part provided by the matching instrumentation of live duo and pre-recorded trio. The relationship of these two elements is flexible, however: at times the electronics act as a resonance of the Pno. and Vln. material; and at others, the reverse is true. Although clearly bound, these are distinct, independent materials: co-existing, and almost engaged in counterpoint. As *Plastica* progresses, new spatial environments are constructed and evoked in this layer.

*This table is reproduced in near-exact form on p. 121 of Chapter Four.

In pinning down these observations more clearly, Trevor Wishart's term 'landscape' will become a useful point of reference, as I discuss spatiality in Electronic Layer 3. 'Landscape', says Wishart, refers not just to the actual physical source of electronic projection: the four, in the case of *Plastica*, loudspeakers used in performance. Rather, it details the 'source from which we imagine the sounds to come'.[192] Through the involvement of loudspeakers (and associated landscapes), it is thus possible to set up a huge variety of 'virtual acoustic space'(s) during performance. These could be 'real' spaces (eg. a recording of a concert hall or a rainforest); or, by distorting certain aspects of the presentation, they might be rendered 'unreal'; be that by changing the 'disposition'[193]/placement of objects within space, modifying the nature of those objects (and thus our 'recognition'),[194] or indeed by manipulating the nature of the space itself. Each of these changes has the potential to fundamentally alter our perception of timbre. As such, they become key structuring tactics in the organisation of this musical strand.

Electronics Layer 3 of *Plastica* (piano trio material – taken directly from *Analogue* – played back upon a microcassette dictaphone) is initially one of the most specific landscapes projected in the work, in terms of its acoustic origin. The analogue playback quality (discussed in Chapter Two) is redolent of a certain 'bygone' era. A sense of nostalgia – of a performance already completed – is evident, reinforced by the distinctive record-player crackle embedded throughout. The landscape of this layer in the early stages of the work thus communicates two distinct acoustic spaces: we sense something of the auditorium in which the original trio performance was recorded, but we sense also the distinctive tinny timbre of the antiquated tape mechanism upon which it is played back (a 'formalised' acoustic space, to employ once more terminology from Wishart).[195] Through a projection of these landscapes I seek to convey a sense of a historical and external space—something beyond the confines of our immediate experience.

Having introduced the 'formalised space' of the dictaphone early on, and, in particular, the distinctive sound of the vinyl needle, I felt intuitively as if the way had been paved for the inclusion of further extrinsic timbres.[196] Several of these concrete sounds are again suggestive of their own idiosyncratic

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[192] Trevor Wishart, *On Sonic Art,* ed. by Simon Emmerson (Amsterdam: Harwood Academic Publishers, 1996), pp. 134-135. Wishart's term is originally used within the context of purely acousmatic music. Here, the definition is used rather more freely, spilling over, as and when appropriate, into the instrumental domain.

[193] Ibid.*,* p.140

[194] Ibid.

[195] Ibid. pp. 142-144. Wishart points to the musical incorporation of a human voice on the telephone as an example of a 'formalised' landscape, discussing historical precedents of music which plays with this 'convention of a mode of presentation'. In Chapter Two, examples of lo-fi 'formalised spaces' influential upon my work *Analogue* were cited (James Saunders' *unassigned 15*, in particular). When writing *Plastica* these works were still fresh in my mind, as well as newly discovered pieces where analogue technologies are prevalent – not least Andreas Dohmen's *Portraits und Wiederholung*, for vocal ensemble and microcassette dictaphones (discussed previously in this chapter, in relation to *Dhātu*).

[196] With *Plastica* organised chiefly through the evolution of timbre, any intrinsic/extrinsic distinction might best be expressed in timbral terms: 'intrinsic electronic elements' generally refers here to those sonorities which are assimilated with ease into the acoustic soundworld. These sonorities are likely to be (or could conceivably be perceived as) instrumentally derived or sampled. 'Extrinsic electronic elements', on the other hand, are those sonic events which clearly

spaces and associated temporal characteristics. The running tap heard at 7:25, for example, suggests particular behavioural properties, of which we are conscious through our 'knowledge of natural physical laws'[197] (i.e. that it will run continuously until a sudden on/off action is applied). Such 'transcontextual' or 'intertextual' sounds – as described by Denis Smalley[198] – are, however, interactive with their intrinsic counterparts, and, indeed, communicative with one another. In this way, the spatiality implied by these extrinsic elements is far from clear-cut. For example, the recognition of sounds objects may be reliant upon 'contextual cues';[199] and thus, when multiple sonorities are employed, they become prone to masking one another, or to implying fictitious/artificial connections. To take an example from *Plastica*, had the scrabble tiles, heard in Layer 3 at 5:18, been combined with rolling dice, or shuffled playing cards, they might have been contextually identified with accuracy and ease (as games materials). But presented, as they are, in conjunction with running water, they could conceivably be heard as pebbles or shingle, evoking a virtual environmental space. Likewise, the stream of white noise heard at 4:00 might be assimilated into the same natural landscape.

This timbral transaction between the intrinsic and extrinsic (which Smalley terms 'source bonding')[200] becomes a conscious structuring device mid-way through the work, as I seek to create a fractured and complex sense of sonic landscape and space, as the layer develops and evolves. In doing so, I aspire to replicate the volatility and febrility of Burri's artwork (as discussed further in Chapter Four).

By modifying the 'disposition of sound objects' within their virtual acoustic space, the listener's understanding of 'landscape' in *Plastica* is again changed significantly. This becomes a key compositional tactic at the crux of the compositional architecture: Letter R.[201] In this passage, the sound of harmonicas – already introduced as 'real'/onstage objects by the ensemble – is transferred to the electronics. Through positioning this sonority at the very centre of the quadraphonic space, and through multiplication of the sound (effectively forming a harmonica orchestra, projected within the same narrow location of the 360° diffusion area), I seek to create a friction between 'real object' and 'unreal space'. Through these means,

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derive from *outside* the timbral palette of the piece; or which, although having the potential to become timbrally assimilated, are – nonetheless – clearly suggestive of a means of production external to the sextet's instrumental palette.

[197] Natasha Barrett, 'Little Animals: Compositional Structuring Processes', *Computer Music Journal*, 23.2 (1999), 11-18 (p. 14).

[198] Smalley, 'Spectromorphology: Explaining Sound-Shapes', p. 110. *Plastica* was my first concerted effort to embed concrete sonorities organically into an electronic work. This new-found interest was primarily sparked by an encounter with the work of Natasha Barrett, during my time as a participant at Manifeste/IRCAM in 2018.

[199] Wishart, *On Sonic Art*, p. 152

[200] Smalley, 'Spectromorphology: Explaining Sound-Shapes.' p. 110. Smalley defines this process as 'the natural tendency to relate sounds to supposed source and causes, and to relate sounds to each other because they appear to have shared or associated origins'. Barrett too notes this phenomenon in her own work, describing the possibility of a 'two-way transfer' between music and real world association: see Natasha Lee Barrett, 'Structuring Processes in Electroacoustic Composition' (Doctor of Philosophy, City, University of London, 1997), p. 23.

[201] Comparatively static, this passage acts as a moment of calm before the ensuing chaos and wild simultaneity of Letter T.

Letter R becomes the end point of a shifting landscape, played out at a macro level of the discourse, which sees real timbre (live harmonicas) gradually transition to surreal timbre (recorded harmonicas, zoomed in and expanded beyond the physically possible). As opposed to the change discussed within the acoustic layers in Chapter Four, morphology here does not refer to the spectrotemporal evolution of timbre. Indeed, the timbre remains unchanged. Rather, it is by manipulating the placement and location of sounds in virtual space that I hope to alter one's perception of a sonority and to generate a sense of change in this layer of the electronics.

Electronics Layer 3 of *Plastica* is thus structured through a handful of specific spatial compositional techniques:

- **Formalised landscapes** – and reference to past performances/antiquated recording practices – are employed to evoke external and historic spaces, beyond our present experience
- Likewise, **extrinsic sounds** (often linked in some way to nature) are incorporated to communicate real-world/environmental landscapes, conveying specific behavioural traits and expectations outside of our immediate environment
- Through **'source-bonding'** of similar-sounding (or contextually interconnected) elements, intrinsic sonorities – by design, or by accident – become bound up in these landscapes and their implied spatiality
- And, through **landscape variants** (acoustic space, disposition within space, and contextual recognition – as defined by Wishart), we can start to perceive timbral change, even when sound objects themselves remain unchanged

Further context for these elements will be provided by the following chapter – Chapter Four: Timbral Saturation – where both electronic and acoustic components of *Plastica* are explored in detail.

Chapter Four: Timbral Saturation

In the instrumental music of the last few decades the word 'saturation' has become associated with three French composers prevalent in the European new music scene: Raphaël Cendo, Yann Robin and Frank Bedrossian. Writing in 2008, Cendo describes the adoption of this term, making reference to the phenomenon of electrical saturation, where a 'sinusoidal signal is amplified to excess [and] ends up saturating and transforming'.[202] In this process, saturation is created by an 'excess in a limited space'.[203] With the input strength too great to replicate 'without the introduction of non-linear, noisy timbral components', the 'energy of the signal exceeds the threshold, resulting in a distorted, "hard-clipped" waveform'.[204] Such 'non-linear components' – discussed quite literally in relation to waveshaping in due course – are interpreted more liberally within the instrumental 'saturation' domain. Here, they are frequently brought about through an overload, or superabundance, of complex information; or, when, working with pitched materials, through the saturation of frequency bands.

Whereas, in the music of the three composers mentioned above, saturation is frequently seen to be a permanent state of being, in my own work it is often tied to *process*: with the accumulation/dissipation of density driving form and generating expectation. In *Hyphae*, saturation is interpreted as the densifying of frequency space: the organ generating Ligeti-esque 'sound masses', which blur the distinction between pitch and timbre. Saturation in this work is governed by macro processes of textural accumulation: both endogenous and exogenous. In *Plastica*, meanwhile, the definition of 'saturation' becomes a little less scientific—no longer limited to accumulating spectral density, but rather generated through the simultaneous existence of diverse – often noisy – extended sonorities, executed on multiple instruments. In both *Hyphae* and *Plastica*, the work of Italian artist Alberto Burri (1915–1995) will be cited as a key source of inspiration—leading me to explore nuanced senses of time, as the saturation process assumes 'multiply directed' routes towards its agglomerative goals.

In the latter stages of this chapter, a more phenomenological approach to the subject of saturation is taken, as I focus upon the listener confronted with an overload of information, the performer tasked with communicating dense materials, and the composer, seeking to control such discourse. Ultimately, as I trace these various roles, a recurrent theme of this commentary – left largely undeveloped thus far – will come into focus, as I explore the corporeal elements that are key to my writing, and central to my creative process when dealing with complex timbre.

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[202] Raphaël Cendo, 'Les Paramètres de la Saturation', Brahms.Ircam.Fr, 2008 <http://brahms.ircam.fr/documents/document/21512/> [Accessed 1 May 2021]. Translated by the author.

[203] Ibid.

[204] Zachary Thomas Wallmark, 'Appraising Timbre: Embodiment and Affect at the Threshold of Music and Noise' (Ph.D, University of California, 2014), p. 224.

Hyphae (2021)[205]

Directed saturation of frequency space

In his spectromorphological writing, Denis Smalley discusses the 'expectation patterns'[206] that arise from perceptible changes in spectral space. These patterns, says Smalley, are based on contours of 'motion and growth'[207]—processes of which we have an inherent awareness through their occurrence in the natural world. Through a knowledge of these shapes, when listening to a work, we 'attempt to predict the directionality implied in spectral change'.[208] For Jonathan D. Kramer, such 'directionality' is often 'linear'; that is to say, we are able to determine 'characteristic(s) of [the] music in accordance with implications that arise from earlier events of the piece',[209] and to then imagine a logical continuation. (Linearity of this kind has already been highlighted within this commentary, locatable in the pitch to nodal trajectory of both *Analogue* and *Bríatharogaim*, for example, as outlined in Chapter Two.)

Smalley differentiates between two types of spectromorphological process: 'motions' (unidirectional, reciprocal and cyclic centric) and 'growth processes' (agglomeration/dissipation; dilation/contraction; divergence/convergence and exogeny/endogeny).[210] In *Hyphae* I actively draw upon these latter two 'bi-/multi-directional' operations as a means of conveying timbral/textural directionality, with two macro-level linear strands – one exogenous, the other endogenous – running throughout the work. Both of these layers are concerned with the incremental saturation of frequency space; and both seek to convey 'structural function'[211] at a large-scale formal level.

Processes of exogeny and endogeny

Endogeny
'Growing from inside'; implying 'some kind of frame which becomes filled, or texture which becomes thickened'.[212]

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[205] *Hyphae*, for organ and electronics received its premiere in September 2021 at the Royal Musical Association Annual Conference at Newcastle University. The work was performed by Andrew Forbes (organ) and Edwin Hillier (electronics).

[206] Denis Smalley, 'Spectromorphology: Explaining Sound-Shapes', Organised Sound, 2.2 (1997), 107-126 (p. 113).

[207] Ibid., p. 110.

[208] Ibid., p. 114.

[209] Jonathan D Kramer, The Time of Music (New York: Schirmer, 1988), p. 20.

[210] Smalley, p. 116.

[211] Ibid., p. 114.

[212] Ibid., p. 116.

Exogeny

'Growth by adding to the exterior'; 'could be allied to dilation and agglomeration'.[213]

Both endogenous and exogenous strands are driven by the organ, with largely pre-recorded electronics playing a supportive role, reinforcing frequencies as and when they occur, and adding a certain timbral complexity through the overlaying of sampled sounds.[214] Although the discussion here will focus solely upon the layers' acoustic materials,[215] the importance of the electronics should not be understated. Through micro gradations in intonation and tuning, the spectral space *between* the organ's pitches is frequently 'filled in' by the concurrent tape strand. As such, the sense of density and thickness, created by organ and electronics in combination, at times borders upon that of an 'inharmonic tone cluster': one in which – as Curtis Roads describes – the sound 'transcends intervallic perception and veers towards pure colour or timbre'.[216]

The **endogenous** layer consists of a compound perfect fourth (F^4 to B-flat[5]), gradually filled from the inside (see Figure 53). Whilst the order in which the notes are slowly depressed was largely determined according to performability (once a note sounds, it remains held, physically restricting the possibilities for the distribution of the 18 pitches between hands and feet), a second compositional consideration also arose when workshopping materials. Where possible, I sought to eliminate the generation of triadic consonances, or audibly diatonic chords. Such sonorities appeared to lead the ear away from a sense of accumulative directionality, and to focus instead upon the specific qualities of each new verticality. Despite the necessarily restricted options this left for the unfolding of the chromatic cluster, I was satisfied, upon hearing the materials, that the agglomerative process generated a sufficient degree of expectation for the listener—and did so early on within the material's development.[217]

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[213] Ibid.

[214] These sounds consist of sampled organ, singing bowls and dictaphone-manipulated vocal material. As the dictaphone technology, and its associated 'formalised landscape', has been widely discussed in this portfolio (see Chapter Two and Chapter Three) it will be left undiscussed in relation to *Hyphae*.

[215] This decision to limit the scope of my enquiry reflects the instrument-led nature of this musical material. The relevant electronic strands are, nonetheless, incorporated within the endogenous and exogenous layer spectrograms at Figure 53b and 54b.

[216] Curtis Roads, *Composing Electronic Music* (Oxford: Oxford University Press, 2015), p. 211.

[217] Indeed, the writing of Henry Cowell supports this observation: 'If the outline of a cluster is filled in from several different points', he says, 'the cluster will be thought of as essentially fixed, even though the notes are not struck simultaneously, and this for the reason that the listener recognises the intention to fill in complete an exact interval'. Henry Cowell, *New Musical Resources* (Cambridge: Cambridge University Press, 2000), pp. 133-134.

Figure 53a: *Hyphae*, endogenous layer. The early sketches ('Endogeny Study') presented below, containing the endogenous process as a continuity, correspond to the spectrogram located at Figure 53b. The thick duration lines, employed in the final score, were at this stage absent

Figure 53b: Endogenous layer. Spectrogram taken from above sketches of *Hyphae*: a 2'30" version of the complete – and continuous – endogenous process. An incremental saturation of frequency space (by both organ and electronics) is evident here between F_4 (349hz) and B-flat$_5$ (932hz)
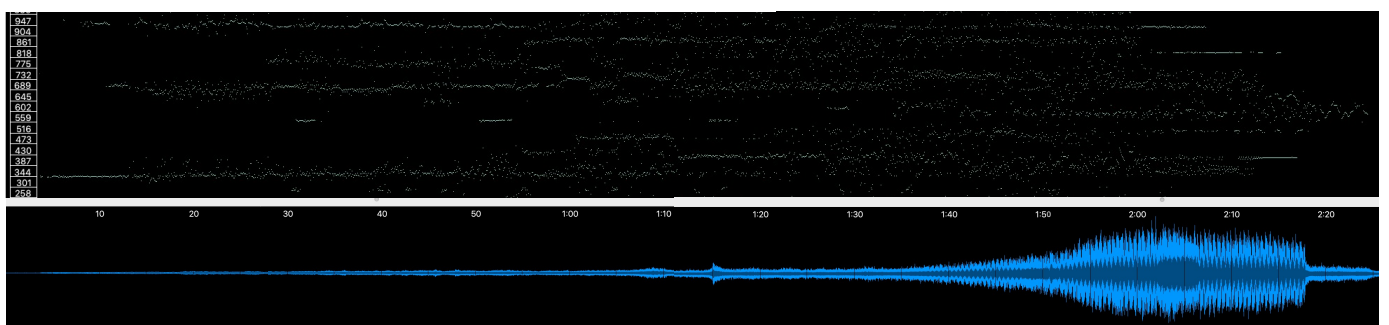
The **exogenous** layer, on the other hand, unfolds bi-directionally in clear contrary motion. Fanning out from a central dyad (F^4 and G-flat^4), the tessitural expansion extends ultimately to a double-compound perfect fifth (D^3 to A^5). Owing to the distance covered – and consequent physical stretch upon the organ

– literal prolongation of all pitches was not possible. In order to generate a sense of progressive accumulation, I thus employ three tactics:

1) The organist frequently retreats inwards towards those pitches already depressed, before moving further outwards (in this way, conveying a sense of the continued sounding of all frequencies).

2) The electronics play an increasingly important role, generating a sense of perpetual resonance of those pitches released in the organ part, through a blanket of sampled/integrated sound.

3) The exogenous material – unlike that of the static endogenous layer – undergoes growth whilst itself in motion, with a rapid circling figure gradually expanding outwards from a central dyad. (Figure 54a depicts the end of this process). This kineticism appears to enhance the feeling of accruing saturation. The writing of Smalley, in his discussion of spectromorphological 'density', adds weight to this observation—the author noting that a gestural rapidity and dynamism of this kind, occurring within a restricted frequency band (where spectral space becomes 'filled by the active contours of convoluted and turbulent motions'), can result in a certain quality of 'saturate noise'.[218] In my own work, this is especially the case when the complexities of the organ's multiple voicings and timbres begin to amass and interact as the layer develops.

Figure 54a: *Hyphae*, exogenous layer (6:45-7:10)

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[218] Described in these terms, Ligeti's 'micropolyphony' – the kind exhibited in the first movement of his Chamber Concerto, or in the third movement of the Ten Pieces for Wind Quintet, for example – immediately comes to mind. Jennifer Iverson argues convincingly that this technique, employed in Ligeti's instrumental oeuvre, originates from the composer's time at the Westdeutscher Rundfunk in 1957. Here, through Gottfried Michael Koenig (whom he was assisting in the studio), Ligeti experienced an electronic method ('bewegungsfarbe'), in which sine waves sound with such rapidity and convolution that they appeared 'no longer as melodic, but rather as curious agglomerations of pitches': i.e. they start to become perceived as sound masses, or as densities. (György Ligeti, 'Musik und Technik', *Gesammelte Schriften Vol. II, ed. Monika Lichtenfeld* (Mainz: Schott, 2007), p. 237. Quoted in Jennifer Joy Iverson, 'Historical Memory and György Ligeti's Sound-Mass Music 1958-1968' (Doctor of Philosophy, The University of Texas at Austin, 2009), p. 124. A common textural approach in *Volumina*, for organ, this technique (found for example in the passage located at Figure 20) served as inspiration for the exogenous material of my own work.

Figure 54b: Exogenous layer. Spectrogram of the second appearance (35" in duration) of the exogeny layer within *Hyphae*: an outwards expansion and saturation of frequency space (in both organ and electronics) between C_4 (261hz) and B-flat$_4$ (466hz) to D_3 (146hz) and A_5 (880hz)
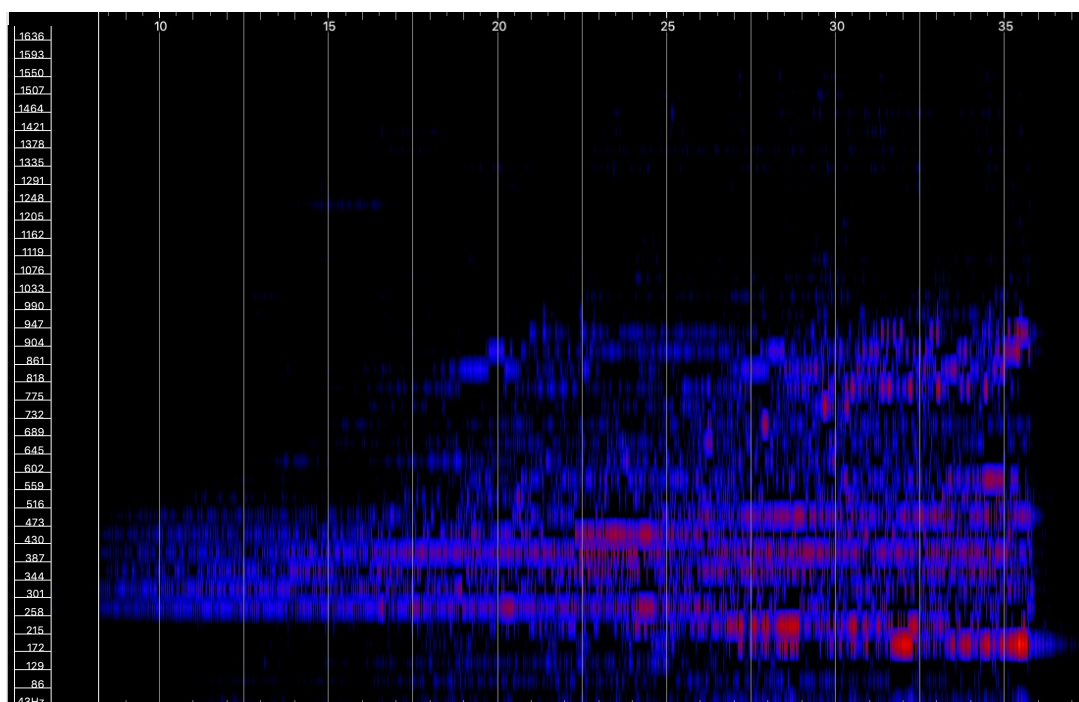

Figure 55: Alberto Burri, *Muffa* (1952) © Fondazione Palazzo Albizzini Collezione Burri, Città di Castello – DACS, 2022. (Please note that the CC-BY-NC-ND licence given to this thesis does not apply to this image). Muffa is catalogued within the *Muffe* series ('Molds'), from which *Hyphae* draws its inspiration

Multiply directed linear time

Although written as complete processes, both endogenous and exogenous layers are ultimately segmented into smaller units—their individual components distributed intermittently across *Hyphae*. Through these means, I seek to emulate Burri's *Muffe* paintings, in which a subterranean network of filaments appears to germinate and multiply beneath the surface of the canvas, erupting unpredictably in gravelly spores and clusters of pumice before resubmerging. Despite seeking to ensure that an incremental accumulation of spectral density is clearly perceptible within both growth processes, I actively thwart the sense of straightforward linearity here through 1) the regular intersection of surrounding (non-process driven) timbral materials and 2) the reordering of exogenous strand components (as outlined below). The resultant directional complexity could, in this way, be described as exhibiting Jonathan D. Kramer's 'multiply directed linear time'. That's to say, we experience a 'direction of motion…so frequently interrupted by discontinuities', where the music 'goes so often to unexpected places, that the linearity, though still a potent structural force, seems reordered.'[219]

Exogenous strand: a multiple temporal continuum

Clock time and gestural time

Through the chronological exchange of its units – the four parts appearing in the progression 2-4-3-1 (see Figure 56) – the exogenous strand differs significantly from its endogenous counterpart: the listener hearing the 'end' of the saturation process in advance of encountering its beginning.[220] With such a non-correspondence between 'clock time' and 'gestural time', the process might thus be described as presenting a 'multiple temporal continuum'.[221]

'Clock/absolute time'
'…measurable, whether by beats, pulses or seconds'[222]

'Gestural Time'
'…depends on our recognising the shapes and hence understanding the implied meaning of gestures'[223]

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[219] Kramer, p. 46.

[220] With its 'goal(s)…placed elsewhere than at the ends of the proce(ss)', the exogenous layer again exemplifies one of Kramer's criteria for multiply directed time. (Ibid.)

[221] Ibid.

[222] Kramer, p. 151.

[223] Ibid.

Despite the clock time reordering of components, the function of units (i.e. their degree of accumulation within the original chronological and intact exogenous growth process) is, however, designed to be sufficiently clear that, upon completion of the strand, the listener retrospectively 'understands' the entire process that has taken place. Through 'cumulative listening',[224] the 'loose ends' are 'sewn together'[225] post-hoc in the minds of the listener: continuity is 'reassembled'. Whilst Kramer's enquiry cites as evidence of this phenomenon works including Beethoven's Op.135 quartet (Mvt.I)[226] and Schoenberg's Op.45 String Trio – two pieces in which 'function' and directionality are arguably communicated by pitch/gesture, and gesture, respectively – my own frame of reference centres upon a much more recent work.

Multiply directed linear time in Rebecca Saunders – *Fury II* (2009)

In Rebecca Saunders' *Fury II* (2009),[227] timbrally differentiated 'sound surfaces'[228] recur intermittently. Centred around single pitch areas, these strands of largely static material undergo incremental alteration upon each occurrence, conveying – to my ear – a gradual sense of linearity. This linearity, appearing to unfold in two directional strands, takes the form of a gradual pitch ascent: D → E-flat → E-quarter flat → E quarter sharp (in what I will call 'Sound Surface 1'), and F→F#→ G →A-flat→A-natural in 'Sound Surface 2'.

Each process-led strand can be divided into three iterations, as labelled below.[229]

Sound Surface 1:

Unit	Bars	Central pitch class
A[1]	17 - 26	D
A[5]	96 - 99	D → D-quarter sharp
A [end]	183[3] - 195	D → E-quarter sharp

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[224] Kramer says on this subject: '…we understand when a gesture seems to be misplaced in absolute time, and we await the consequences of this misplacement. Then, eventually, through the mechanism of cumulative listening, we reassemble the essential continuity of the work'. Kramer, p. 161.

[225] Ibid., p. 48.

[226] Where, from a modern – even 'post'-modern – listener's perspective, argues Kramer, the movement's gestural time ending might be said to occur as early as bar 10; as such, influencing the way in which the work is heard, and how continuity is assembled by the auditor. See, Jonathan D. Kramer, 'Multiple and Non-Linear Time in Beethoven's Opus 135', *Perspectives Of New Music, 11.2* (1973), 122-145.

[227] Rebecca Saunders, *Fury II* (Frankfurt: Henry Litolff's Verlag/ C. F Peters, 2009).

[228] This term is used by Rebecca Saunders in: James Saunders, 'Interview with Rebecca Saunders - James Saunders', 2006 <https://www.james-saunders.com/interview-with-rebecca-saunders/> [Accessed 2 May 2021].

[229] Owing to the timbral similarity between the two process-led sound surfaces, the same formal lettering – 'A' – is used for both materials. The reasoning behind the non-chronological numbering appended to these letters will become clear shortly.

Figure 56: deriving proportions from Rebecca Saunders' *Fury II*

Rebecca Saunders, *Fury II*: proportions*

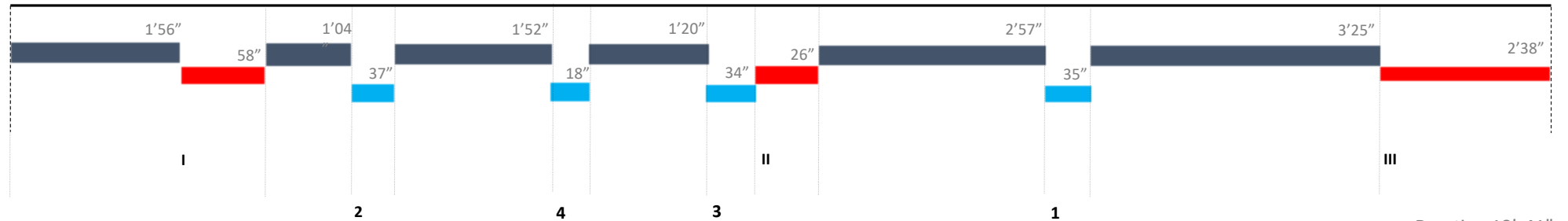*Proportions derived according to calculations made from the score.
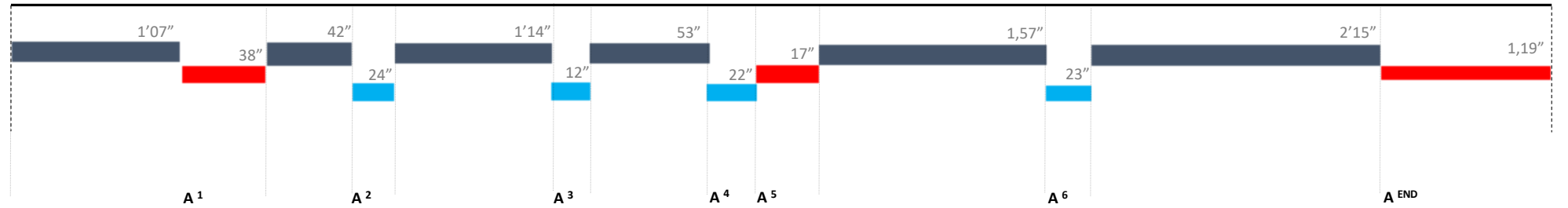
Duration 11', 53"

Fury II Key:

Sound Surface 1
Sound Surface 2

Hyphae, pre-compositional structure* (*Fury II* proportions, enlarged to 18' 41"*)

*Minor amendments made to proportions during composition process
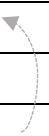

Duration 18', 41"

Hyphae Key:

Modules
Endogenous Strand
Exogenous Strand

Sound Surface 2:

Unit	Bars	Central pitch class(es)
A^2	35 - 40	F#
A^3	70 - 72	F#/G
A^4	$89^2 - 95^1$	F-natural/F#
A^6	140 – 146	G→A-flat→A-natural

Rather than being presented syntagmatically, however, each sound surface is interrupted by the surrounding timbral discourse (non-directed materials, which make up the bulk of the work) and appearances of the other interwoven sound surface: timbrally interconnected material, but clearly differentiated on a pitch level. As such, the listener is ultimately impelled to 'sew together' retrospectively the relevant units of each process, forging their own sense of continuity.[230] Moreover, whilst a sense of directed pitch ascent is evident within Sound Surface 2, a gestural reordering of clock time units is required within this strand, in order that the complete progression might be perceived linearly:[231]

Strand 2: Gestural time reordering

Unit	Bars	Central pitch class(es)
A^4	$89^2 - 95^1$	F-natural /F#
A^2	35 - 40	F#
A^3	70 - 72	F#/G
$[A^4]$		
A^6	140 – 146	G→A-flat→A-natural

Inspired by the fractured and complex sense of time communicated by these materials, I actively drew upon Saunders' work as I devised the architectural framework for *Hyphae*. Extended from c.12 to c.18 minutes in duration, the proportions of *Fury II* would go on to provide a structural scaffolding for my own composition—with points of emergence and the respective lengths of the endogenous and exogenous layers' units derived from Saunders' ensemble work. (See Figure 56, where the endogenous

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[230] My own perception, upon listening to Saunders' work, is that this 'sew(ing) together' appears to happen very organically/intuitively (as opposed to occurring as a conscious/active process): an experience corroborated by my postgraduate analysis students during our discussions of this work.

[231] Although the compositional intentionality of this linearity might be a little hard to 'prove' or might even be seen as farfetched (particularly as Saunders is a composer well-known for her instrument-led writing, where pitch considerations seem, more often than not, secondary to/governed by timbral decisions), it is interesting to note that such a reordering is consonant with the composer's own descriptions of her practice. In conversation with composer James Saunders, Rebecca Saunders discusses the 'juxtaposition of separately written and strongly contrasting sound surfaces' in her music. Decisions as how to best 'creat(e) the structure, the large-scale organisation, of a work' then occur, she says, once 'all material has been composed', with the music 'decid(ing) for me how (it) can best be juxtaposed....' (Saunders, 'Interview with Rebecca Saunders'). The composer's studio – I have observed personally – bears witness to this practice, with sheets of isolated manuscript paper affixed in a seemingly atemporal or arbitrary order to the wall, awaiting ultimate reordering.

strand can be seen to replicate the temporal locations and durations of Sound Surface 1, whilst the exogenous strand assumes the role of Saunders' Sound Surface 2.) However, whilst in Saunders' work directionality within these two layers might be said to originate from linear pitch processes, my own compositional methodology in *Hyphae* employs timbral agglomeration (i.e. the progressive saturation of a wide frequency spectrum) to convey macro directionality within the two 'growth process' strands.

Saturation through white noise and waveshaping

Burri's *Muffe* and *Bianchi* were painted during a similar time period in the early 1950s and share several notable characteristics. Comparing, for example, *Muffa* (1952) with *Bianco Nero* (created during the same year), I noticed similar features: small spores of bacteria-like ground pumice (more prevalent in the former painting, although still discernible in smaller deposits upon the latter), and isolated patches of earth-like colours, intermittently dispersed around the canvas. In both series, the principal focus is, however, undoubtedly the colour white**.** Not the white we frequently describe as 'blank', 'empty' or 'neutral' (white as a 'non-colour');[232] but white as a *saturate* phenomenon. White that contains 'every colour in the visible light spectrum'[233]—capable of infinite forms of texture and density. White(n) which exists as both 'colour and action'; as 'process' (verb) and as 'noun'.[234]

These two definitions, drawn from art historian Emily Braun's writing upon Alberto Burri – white as noun, and white(n) as verb/process – would serve as starting points when composing the noise-based timbral 'modules' which intersect, and are intersected by, the aforementioned processes of exogeny and endogeny. Two brief musical examples, inspired by Braun's definitions and Burri's work, will now be discussed:

Bianco *noun* [masculine][235]
/'bjanko/
White

'Creamy or desiccated, pasty or effluent, viscous or chalky' [236]

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[232] Emily Braun, 'Alberto Burri's Roman Whites', *Pensiero: Rivista Di Filosofia, LVI.1* (2017), 79-88 (p. 82).

[233] 'Alberto Burri, Bianco (White), ca. 1949 | The Guggenheim Museums and Foundation', The Guggenheim Museums and Foundation, 2015 <https://www.guggenheim.org/audio/track/alberto-burri-bianco-white-ca-1949> [Accessed 5 July 2020].

[234] Braun, pp. 82-83.

[235] 'Bianco', Dictionary.Cambridge.org <https://dictionary.cambridge.org/dictionary/italian-english/bianco> [Accessed 8 July 2020].

[236] Braun, p. 82.

Several passages in *Hyphae* take Burri's lead in employing an extended white palette: here interpreted as varying intensities of coloured sound and, in particular, that most saturate of textures: white noise.[237] Module II (heard at 3:30), for instance, makes extensive use of Logic's ES2 synthesiser: utilising oscillator 1 and 2 to produce frequency modulated sound, whilst oscillator 3 introduces noise into the resultant waveform. By adjusting the degree of frequency modulation, and the ratio between the 3 oscillators, a vast collection of coloured noises can be generated; sonorities which are subsequently overlaid and superimposed in *Hyphae*, white over white. We hear this, for example, at 7:30-8:00, where thick blankets of ES2-generated saturate sound coalesce, veil and subsume one another—whites of all shades and nuance, 'warm, cool, creamy, pearly, translucent, shiny or matte, rough or smooth'.[238]

Turning to the acousmatic tradition, one might perhaps compare the interaction of such saturate sound masses to Bernard Parmegiani's *Géologie Sonore* from *De Natura Sonorum* (1975): particularly the passage at 3:00, where dense weather systems of coloured noise enter and retreat. (See Figure 57 below, where these conglomerates are visible in the middle of Pierre Couprie's enlightening spectrogram realisation of this passage). Taking inspiration from *Géologie Sonore*, my own noise-textures – in search of a greater sense of kineticism and variation of colour – make use of frequent automation (altering the ratio between the three ES2 oscillators), consequently undergoing more significant timbral morphology between onset and termination than Parmegiani's comparatively static blocks.

Figure 57: screenshot (2:30-4:00) from Pierre Couprie's spectrogram video of Parmegiani's *Géologie Sonore*
< https://www.youtube.com/watch?v=lkZKUMmv5WE> [Accessed 20 June 2021] Image reproduced with the permission of Pierre Couprie

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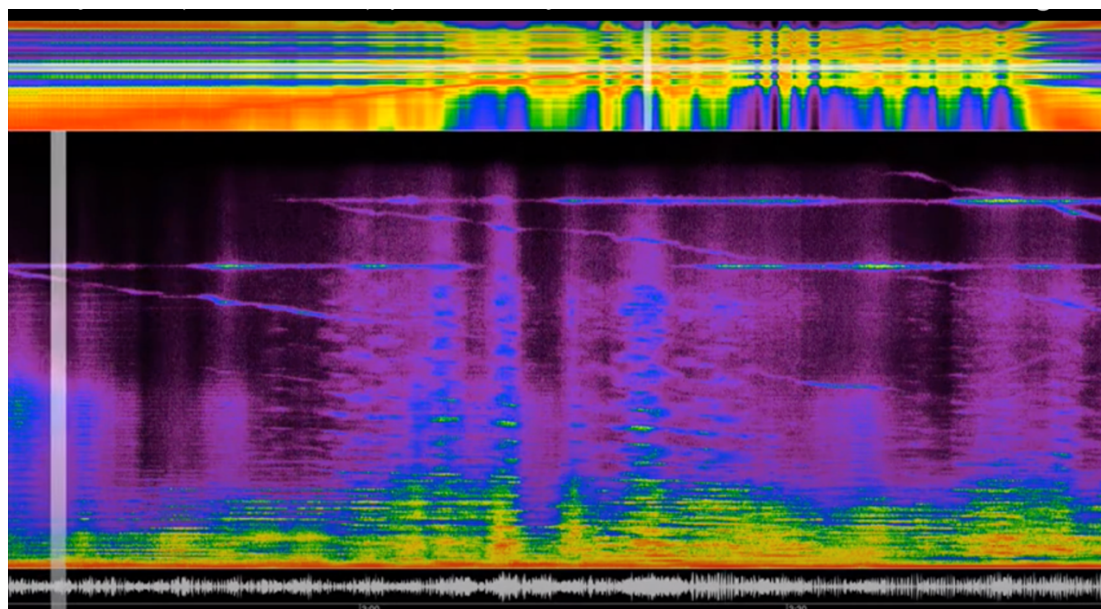
[237] As explained by Roads, white noise takes its name by 'analogy to the spectrum of white light, in which all colours are present with the same intensity'. Roads, *Composing Electronic Music*, p. 103.

[238] 'Alberto Burri, Bianco (White)'.

Sbiancare *verb* [transitive][239]
 /zbjan'kare/

To bleach, to whiten

Whereas 'bianco', the noun saw the liberal introduction of dense masses of saturate white and 'off-white' coloured noise, here, pitched materials (played by the organ) undergo a 'whitening' of sorts through live processing. Waveshaping/distortion – introduced at the start of this chapter, as we teased out a preliminary definition of 'saturation' – becomes the principal means of colouration: the 'periodic signal'[240] of the organ 'remapped' to encompass increasing levels of 'broadband sound'.[241]

iZotope's Trash 2 module is the primary means by which distortion is introduced in *Hyphae*:

Figure 58a: a normal 'balanced' ratio is evident between input/output (the top section of the diagram displaying the positive portion of the incoming wave form, whilst the lower half displays the negative side)

Figure 58b: the red 'base' line indicates the chosen pre-set algorithm (commonly described as a 'shaping function')—deviating from the original 'balanced' wave form. The blue 'result' line indicates the ultimate signal output—generated through largely intuitive adjustments I made to the pre-set shape function, according to the timbral attributes required, and the degree of assimilation desired with the surrounding sonorities

The use of distortion is clearly audible in the opening passage of the work. (Indeed, the waveshaping evident in Figure 58 can be heard at 0:05–0:15 of *Hyphae*, where the organ's 'start-up' mechanism is transformed via Trash 2—its previously gentle stream of air remapped to encompass a much broader, noisier spectrum of saturate sound, at a much higher amplitude and intensity.) During the process of

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[239] "Sbiancare", Dictionary.Cambridge.org <https://dictionary.cambridge.org/dictionary/italian-english/sbiancare> [Accessed 5 July 2020].

[240] Curtis Roads, *The Computer Music Tutorial* (Cambridge, Massachusetts: The MIT Press, 1999), p. 337.

[241] Ibid. I use the term 'whiten' rather freely, even poetically, here: the bleaching of sound, through distortion, and the incorporation of increased wide band elements, rendering the resultant wave form closer to the 'maximally random' spectrum of white noise introduced previously.

constructing this heavily distorted opening section, the overdriven sounds of Stefan Prins' work – in particular the saturated timbres occurring three minutes into *This is it! (study for Fremdkörper #3)* and the more ubiquitous waveshaping apparent in *Not I* (for guitar and electronics) – were at the forefront of my mind. However, whilst *Hyphae*'s saturate textures occasionally seek to match the intensity of Prins' work, more often than not subtler gradations of distortion were sought, as I constructed a palette of bleached and whitewashed colours. These live sonorities, transformed by the Trash module, are often designed to blend into – to coat and indeed be encompassed *by* – the matte textures of the ES2-generated coloured noise.

In contrast to the previously detailed endogenous and exogenous strands, which unfold at a global level of *Hyphae*'s structure, the 'white', 'off-white' and 'whitened' materials of the work's 'modules' operate at a more local and immediate level of the discourse—'project(ing) us, continually or abruptly from one moment of musical experience to the next'.[242] Engendered by the aforementioned automated ES2 sound masses and waveshaped organ figuration, this sense of movement and direction is ultimately designed to set up broader patterns of tension and relaxation, which drive the form.[243] The noise-based nature of the modular materials is significant here. In their discussion of the 'building and release of musical tension', McAdams and Giordano cite 'auditory roughness'[244] as a decisive factor in the listener's perception of intensity or tension. In works of the tonal tradition, this 'roughness' has frequently been linked to the friction, introduced into musical discourse by dissonance.[245] In Chapter Two's discussion of *Bríatharogaim*, Saariaho's 'sound/noise' axis was seen to reframe this dichotomy within a non-tonal context. In the modules of *Hyphae*, meanwhile, tension and release are not instigated through binary means (whether through the axes of consonance vs. dissonance, or sound vs. noise). Rather, the previously detailed 'extended palette' of whites – equating to gradations of saturation or varying degrees of auditory roughness – propels the music forwards, instilling a feeling of moment-to-moment continuity, through subtle accumulations or abatements in perceived intensity. Collectively, these overlaid whites contribute to a Burri-esque 'defiled' monochrome: both matte and brilliant; 'dirty and pristine'.[246]

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[242] Stephen McAdams and Kaija Saariaho, 'Qualities And Functions of Musical Timbre', *Proceedings of the 1985 International Computer Music Conference* (1985), 367-374 (p. 374).

[243] The compositional possibility of an 'accumulation and release of tension' is widely cited as a key morphophoric criterium, when composing with timbre. See Roads, *Composing Electronic Music*, p. xix.

[244] According to the authors, 'roughness is an elementary timbral attribute based on the sensation of rapid fluctuations in the amplitude envelope'. See Stephen McAdams and Bruno L. Giordano, *The Oxford Handbook of Music Psychology*, 2nd edn (Oxford: Oxford University Press, 2016), pp. 113-124 (p. 120).

[245] McAdams and Giordano point to Lerdahl and Jackendoff's writing here; see Fred Lerdahl and Ray Jackendoff, A generative theory of tonal music (Cambridge, Massachusetts: The MIT Press, 1983).

[246] Whilst Burri's work remained the primary influence upon my writing in *Hyphae*, my investigations into his *Muffe* and *Bianchi* led me to the work of Robert Ryman, whose monochromatic whites often take a vastly simplified and minimalist approach to the same subject matter. See for example the block colours of the *Seven Aquatints* (1972); or the almost-uniform strokes of enamel paint, applied row-after-row upon Bristol board in *Untitled* (1965). In my own work, the repetitive white noise interjections, which appear during the latter stages of *Hyphae*, were in part stimulated by these artistic ideas.

Figure 59: Precursor work, *fili /strands/stränge* (2015/16)

fili /strands/stränge was commissioned by Handel House Museum in 2015 to mark 330 years since the birth of J.S. Bach, Handel and Domenico Scarlatti. The work ran as a sound installation at Handel House from 19th-29th November 2015.

The central concern of the piece was simple: three distinct strands of material – one for each composer – interacting in a prescribed space (Handel's bedroom, situated on the top floor of the museum). Each of these sound sources was played through a different set of monitors, spread around the room and, where possible, concealed visually. My intention was to allow listeners to move around the space and focus in and out of different layers of material (effectively adjusting – albeit within the confines of a much smaller spatial environment – the integration and segregation of auditory stream information, as discussed in relation to *Dhātu* in Chapter Three).

Installation set-up in Handel's bedroom, Handel House Museum (2015). Photograph by the author. Image reproduced with the permission of the Handel House Trust

Each strand consisted of pre-recorded material. This music was acoustic in the case of the Scarlatti and Handel (the former was scored for alto flute, accordion, violin, viola, cello and double bass, whilst the latter was performed by a solo soprano) and electroacoustic in the case of the Bach. Although the layers took one of the three composers as their starting point, the music heard was originally composed, and – whilst retaining glimpses and shadows of its stimulus – was in keeping with my own compositional approach and language. (See Appendix II, where the genesis of these materials is outlined).

With visitors present throughout the day at the museum, I sought to develop a work which would play continuously during opening hours. For this reason, I wished to avoid inundating the listener with constant sound, instead allowing moments of repose and comparative inactivity. This concern prompted me to create a blanket of barely audible white noise and high sine tones, which would run throughout, acting as a canvas, or neutral state of the work. (This technique is reimplemented within the concert domain in *Analogue*—see Chapter Two).

Whilst instrumental material within layers was strictly composed and notated, the live order of this material was fluid in performance and determined by chance upon playback. Each set of monitors was linked to a randomised and continuously running playlist of twenty to a hundred possible permutations, including tracks consisting of silence. This approach remained consistent across the three strata and so, when combined, gave rise to a constantly shifting array of material: prolonged periods of silence/white noise, singular activity and heavily saturated densities: subject matter I go on to explore more thoroughly in *Plastica* shortly.

In 2016 I created a c.17-minute concert version of this work (included with this submission): capturing upon the page a number of the saturation permutations possible between the three strands.

Plastica

On the fifth level of the Pompidou Centre, hanging on the far wall of a room at the end of the corridor, is what seems, at first glance, like an oil painting. As I move closer, however, its form and dimensions are evidently more sculptural: a membrane of plastic stretched over a frame—patches charred, singed and burnt through. Holes revealing thin filaments below: layers of subterranean tissue. There is something almost living about it; not only the skin-like quality, but the seemingly fresh formations and deposits upon the surface, erupting from beneath. Yet, at the same time – and paradoxically – the unmistakable signs of fire damage and destruction are apparent: punctures and scars in the flesh. A coexistence of birth and decay.

*   *   *

Plastica (1964) is typical of Burri's work—its name, like the *Bianchi* mentioned previously, deriving from the material from which it was created.[247] In adopting such an approach, Burri strays from the mid-20th century 'abstraction/figuration paradigm'.[248] His work neither depicts, nor self-consciously avoids depiction; rather, it communicates its constituent materials. Like its companion works in the *Combustioni Plastiche* series, *Plastica* is fundamentally an exploration of process. In approaching the canvas, not only do we witness the having-been-burnt (fire left to run its course, or extinguished mid-incineration), but we register the material upon which the flames have not yet encroached: the to-be-burnt. Moreover, we sense the burn-*ing*—the act. That's to say, each stage of the combustion process is discernible. *Plastica* becomes a study in time: in materialisation, activity and deterioration.[249]

Plastica – for sextet and electronics

When the London-based Explore Ensemble approached me in late 2019, with a view to writing a new work for ensemble and electronics,[250] Burri's work was still fresh in my mind. The brief for the commission (of c.14' duration) was left open, other than a suggestion that extended passages of complex materials and a heightened level of activity would be welcomed by the players. Responding to this, my initial considerations were practical: in seeking to achieve moments of complex simultaneity across the ensemble, without the need for a conductor, I would divide the ensemble into three duos. These

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[247] Equally, Alberto Burri (1915–1995) would often assign titles according to the method(s) by which a work was constructed.

[248] Jaleh Mansoor, *Marshall Plan Modernism: Italian Postwar Abstraction and the Beginnings of Autonomia* (Durham: Duke University Press, 2016), p. 101.

[249] Burri's contemporary Calvesi refers to this experience, stating that – when surveying the *Combustioni* – we seem to 'confron(t) the relative temporality of [both] deterioration and action…the constructive phase that interacts with the destructive one'. Maurizio Calvesi, 'Percorso di Burri', Fondazioneburri.Org <https://www.fondazioneburri.org/images/alberto_burri/ita/calvesi.pdf> [Accessed 7 April 2020]. Translated by the author.

[250] The ensemble line-up (B. Fl. B. Cl, Pno. Vln. Vla. Vc.) was fixed at the outset of the commission.

instrumental pairings would play their own intricately notated material at independent tempi, creating dense and heavily saturated textures.

In developing these ideas, similarities with Burri's working practice during the creation of the *Combustioni* became evident: not only the controlled chance resulting from his methods – the precision of the blowtorch (precisely notated materials), balanced with the volatility of the plastic (the aleatoric nature of the simultaneities arising between duos) – but also the necessity of performative decision making 'in the moment'. Burri is said to have worked with the torch in one hand whilst the other attended to the surface, responding instinctively to unexpected formations as and when they occurred, and making spontaneous decisions regarding whether to extend, puncture, or smooth over the membrane.[251] The *Combustioni Plastiche* series at this point became a conscious point of reference for the composition. *Plastica,* for Sextet and Electronics, would take Burri's lead in exploring the complex interaction of different layers: independent substances with their own unique chemical makeup, yet fundamentally (polymeric variants of) the same basic matter.

With such a heightened level of activity and density planned, a different approach to that employed in other ensemble pieces of this portfolio (*Dhātu* and *Soliloquies*, in particular) was necessary. With finer details of sound liable to become masked and overwhelmed by the simultaneous presentation of materials, the expansive and detailed pre-compositional timbral map now seemed redundant. Rather, and more like in Burri's work, once a smaller, reduced palette of sonorities is established (see Figure 60 below) – the working material – process moves to the fore. Timbre is bound to a clear tripartite structure: sound systematically materialises and fleetingly flourishes, before disintegrating. Layers of plastic igniting, combusting and burning out, several times over, at various, and independent, speeds and intensities. A complex array of musical functions: beginnings, middles and endings.

Stages of Combustion: creating global structure through levels of saturation

The incineration of plastic can be divided into three stages: 1) time to ignition 2) duration of pyrolysis 3) duration of char burning.[252] Each of these phases is affected by two factors: the exact type of plastic and the temperature of incineration. When several plastics combust at once – as in Burri's *Combustioni* – these variables result in a complex lattice—interwoven layers, displaying a multiplicity of textural detail and areas of dense saturation.

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[251] Calvesi, 'Percorso di Burri'.

[252] Ron Zevenhoven and others, 'Combustion and Gasification Properties of Plastics Particles', *Journal of the Air & Waste Management Association, 47.8* (1997), 861-870 (p. 865). The first stage of this process – here labelled 'time to ignition' – the authors define as the 'recorded time between inserting fuel particle into the furnace and first appearance of the visible flame'.

Figure 60: devising *Plastica'*s timbral palettes

Acoustic Layers

With the sextet divided into duos – bass flute and cello (Duo/Layer 1), bass clarinet and viola (Duo/Layer 2) and piano and violin (Duo/Layer 3), each instrumental pairing is allied to a certain type of plastic, the combustion attributes of which, as will become clear, would go on to determine points of emergence and cessation, as well as duration. A fourth 'Global Layer' – during which all instruments play at the same universal tempo – materialises periodically. At the outset of the compositional process, a number of core colours and sonorities within each duo were established. Whilst timbral attributes are specific to layers, a more general sonic unification across the ensemble is sought through the universal employment of fragile, unstable writing, frequently situated at tessitural and dynamic extremes.

Duo 1: B. Fl. and Vc.	Timbral Palette: fragile; extremes within the same sound • Vc: scordatura string IV; subtle colouration through *molto sul pont (msp)* and *molto sul tasto (mst)* • Flute: limited pool of fragile multiphonics, varied air content • Vc: double harmonic trills (on strings III and IV), *msp* • Flute: overblowing on same multiphonics; addition of consonants • Vc: slow bow on string IV; *mst* to *ord./msp* • Flute: close (tone–, semitone– and quartertone–) dyads around C
Duo 2: B. Cl. and Vla.	Timbral Palette: bright and metallic higher end; curtailed and subdued lower end; percussive and short sounds • Vla: pizzicato on wrapping; LH pizz. • B Cl: key clicks; tongue ram • Vla: natural harmonic crescendo *de niente* and *msp* with metal foil; double harmonic trills – III and IV (with blu tack) or I and II (with foil) • B. Cl: jaw multiphonics (focus on higher end of spectrum and *flz.*); *bisbigliandi* in upper tessitura
Duo 3: Vln. and Pno.	Timbral Palette: clean, more melodic and pitch-based • Pno: frequently dyads in treble register (increasingly coloured by chromatic clusters) • Vln: *sul tasto* mid-range notes, high melodic line (coloured by blu-tack mute)
Global Layer: Tutti	Timbral Palette: harmonic, inverted bell-like, high; dyads crescendoing *de niente* • Strings: harmonics moving from *ord./st* to *msp*; use of open strings, building 'thicker' spacings of chords • Piano marking attack points of *crescendi* (and increasingly doubling on melodica) • B. Fl. And B. Cl: high crescendoing *bisbigliandi*

120

Figure 61: Electronics Layers

Each of the acoustic strands is bound to a corresponding tape part, triggered at cue points throughout the work. Electronics Layer 1 (with Duo 1) and Layer 2 (with Duo 2) for the most part form a tight unity with their acoustic counterparts—dovetailing, introducing and handing over material. They are very much drawn from the same sound palette. Conversely, Electronics Layer 3 (with Duo 3) forms a more complex relationship with its acoustic partner: at times residing within the same group of sonorities, at others, diverging substantially. A sense of timbral unity is nonetheless provided across all tape layers, through the unanimous employment of microcassette dictaphone filtration.

Electronics Layer 1 takes dictaphone-manipulated sonorities as its starting point: slowed down and analogue pitch-shifted samples of the Vc.'s scordatura IV string, and of low B. Fl. multiphonics.
Electronics Layer 2 embeds the concrete sound of the dictaphone's playback button in operation, forming a close aural likeness with the B. Cl's live key click and tongue rams. This sample is again rendered lo-fi and overdriven through analogue pitch shifting.
Electronics Layer 3 initially features sampled piano trio material (from *Analogue* – discussed in Chapter Two), again slowed down and pitch-shifted by dictaphones. The timbral link with the acoustic duo here is more basic—for the most part provided by the matching instrumentation of live duo and pre-recorded trio. The relationship of these two elements is flexible, however: at times the electronics act as a resonance of the Pno. and Vln. material; and at others, the reverse is true. Although clearly bound, these are distinct, independent materials: co-existing, and almost engaged in counterpoint. As *Plastica* progresses, new spatial environments are constructed and evoked in this layer.

*This table is reproduced in near-exact form on p. 98 of Chapter Three.

Similarly in my own work, I devise material for each duo as a three-stage process of A) beginning (incineration), B) middle (pyrolysis) and C) ending (burnout). This procedure is repeated at three different 'temperatures'/intensities per instrumental pairing (see Figure 66). As with *Hyphae,* the 'gestural time' function of these units is allied to growth processes involving density. In this instance, however, growth – and associated expectation patterns – occurs not through a single unidirectional expansion of the frequency spectrum (ie. the *end/ex*-ogenous 'sound masses' discussed previously), but rather through multiple arch-shaped progressions of: A) density and energy accumulation → B) saturated activity → C) gradual dissipation.[253]

Overleaf, I discuss several examples of the compositional strategies I use to convey these functions.

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[253] Several tactics are employed to convey each of these gestural time functions. As I will go on to detail, these include: a quickening in the rate of timbral change (from one marginal sonority to the next) and the gradual saturation/overloading of both narrow and wide frequency bands.

Beginning / 'A' Units (incineration)

Beginning (or 'A') units in *Plastica* almost universally begin *de niente*. (See for example, bar 1: Duo 1 – unit Ia – Figure 62).[254] Using Lewis Rowall's terminology, we might describe such an opening as 'emergent'[255]—synonymous with a 'creation out of nothingness'.[256] As is evident in unit Ia, the texture is often pared down and relatively transparent, with a slow rate of timbral change and augmented rhythmic values. Emergent openings are often followed by an attack proper: a downbeat or 'outbreath' (for example, bar 8 of unit Ia). As such, the beginning is understood retrospectively as a kind of structural upbeat (or 'intake or breath') before activity commences and density starts to accumulate. The latter stages of beginning units are identical to the beginning of middle units (discussed shortly)—consisting of saturated and active materials, frequently employing a quick rate of timbral change. Beginnings tend to cease suddenly, cut off mid-flow by new materials or by silence.[257] (We see this, for example, in Duo 2, Unit IIb at Figure D-1—see Figure 63.)

Figure 62: *Plastica*, bars 1-8 (Duo 1, unit Ia)

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[254] A complete list of unit labels can be located on Figure 66.

[255] Lewis Rowell, 'The Creation of Audible Time', *The Study Of Time IV* (1981), 198- 210 (p. 203). Rowell lists four 'fav(o)rite opening gambits of Western composers: assertion, entrainment, emergence and pure duration.

[256] Ibid.

[257] This compositional tactic draws on an unlikely source: Kofi Agawu's Classical-era 'Beginning-Middle-End Paradigm'. In this model, beginnings are described as ending in a 'partially open' state (that's to say ending on or in the dominant chord/key). Within the non-tonal context of my own work, an avoidance of closure – and a feeling of 'open'-ess – at the end of beginning units is instead replicated through the aforementioned abrupt cessation of material. (See V. Kofi Agawu, *Playing with Signs* (Princeton: Princeton University Press, 2016), p. 59.)

B. Fl.

ff   *p* — *fp* — *ff*   *p sub* — *fp* — *f*   *p*

Vc.

II mst → msp   ord   [above fb]   I   II msp   sp
III

fp — *ff*   *p* — *ff*   *p sub* — *ff*   *ff* *p sub* — *f* *p*

**Bass Flute and VC enter
at independent tempo**

B. Cl.   [timbral]

Vla.

B. Cl.

Vla.

Middle

Middle

here as beginning *in medias res*, often launching immediately into heavily saturated, complex materials and ceasing without warning). This description is true of Duo 1 at Letter J, for example, where the *msp* double harmonic trills on the cello and high bisbigliando flute writ⁓esult ⁓opulated upper frequency spectrum.[259] Furthermore, the kineticism and noise profile of both materials engenders a certain saturate 'turbulence' (as discussed in relation to *Hyphae* previously). Middles frequently end in the same way they started: cut off mid-flow by other materials, be they acoustic or electronic.[260] Other methods are evident on occasion, however. Such is the case with the final bars of Unit Ib, Duo 1, (see Figure 64), where simultaneous markings *from* and *to pianissimo* effectively cancel one another out, muddying function and bringing the segment to a sudden and 'open' point of cessation.

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[258] Ibid.

[259] Saturation here is the result of the 'multiplication' or overlaying of similar 'instrumental gestures' (as discussed by Raphaël Cendo: See Cendo, 'Les Paramètres de la Saturation'), generating a densely populated, narrow band of frequency space. Other tactics are, however, used in *Plastica*'s middle units—for example, during Unit Ib (Duo 2) – discussed shortly – where an excess of diverse materials and a rapid rate of timbral change over a wide frequency spectrum engenders a feeling of heavy density.

[260] Middle material, like Duo 1, Unit Ib, where the segment 'does not really begin, (but) simply starts' (Kramer, *The Time of Music*, p. 50.), could perhaps lead to parallels being drawn with Stockhausen's Moment Form; and indeed, with the creation of these units, I intentionally attempted to create the impression of 'tuning in' to an ongoing stream.

Figure 64: *Plastica*, letter K-2 (Duo 1, unit Ib)

Ending / 'C' Units (burnout)

When devising the conclusion of end units, I systematically deploy the basic building block of *a niente* deterioration—frequently in conjunction with a stretching out of materials, a reduction in density, and a deceleration in the rate of timbral change. The beginning of an end unit, on the other hand, is identical to the end of a middle (that is to say, as discussed in note 257, 'open'). Thus, when joined together syntagmatically with its preceding unit, it might 'only retrospectively be perceived as having begun'.[261] Ic (Duo 2) encapsulates all these functions: a set group of sonorities – established at the 'open' ending of unit Ib (Letter M-2) – are continued at Letter O, initially contributing to a widely populated frequency spectrum.[262] These timbres subsequently begin to disintegrate slowly, becoming quieter and less kinetic, before ultimately disappearing beneath Duo 1 and Duo 3 at Letter Q.

Figure 65: *Plastica*, figure M-2 (duo 2, unit Ic) and duo 'clock time' continuation at figure O (unit Ib)

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[261] Agawu, *Playing with Signs*, p. 67.

[262] This is in part engendered through a rapid rate of change in the bass clarinet and viola's aleatoric fragments.

Temporal Multiplicity

As with the exogenous layer of *Hyphae*, however, the chronology of *Plastica*'s beginning, middle and end components is systematically reordered and jumbled throughout. My intention here was to create a fractured teleology: for the *materialisation → activity → deterioration* process to function primarily in 'gestural' rather than 'clock' time. This reordered linearity would occur in parallel across the three instrumental groups, creating complex and unpredictable moments of intense simultaneity and timbral

overload. In this way, I hoped to capture something of Burri's artwork: both the superabundance of textural detail, and the complex sense of time communicated by the materials—the 'co-existence of birth and decay' mentioned previously. (Figures 67 and 68 reveal the intricate distribution and interaction of all 36 beginning, middle and end units within the global structure).

Until Figure T, the *materialisation → activity → deterioration* process is carefully controlled. Saturation – whether through the overloading of a narrow frequency space, or through the coexistence of diverse timbral materials and a quick rate of change – is relatively measured, both in terms of instrumentation (restricted primarily to duos) and duration, with moments of heightened density confined to short time frames. Moreover, when duos' materials overlap, a high degree of 'permeability' is often evident. That is to say – in Ligeti's words – that the instrumental strands 'resis(t) mixture':[263] the sonically differentiated and defined timbral palettes of each pair allowing the other to speak clearly within the overall texture. (We see this at Figure D+7, for example, where Duo 1's static and prolonged mid-tenor register unison B is easily 'penetrated'[264] by a series of treble register dynamic surges and attacks from the Violin and Piano/Duo 3).[265]

Global Saturation: Figure T

Conversely, at Figure T, we encounter **global saturation** for the first time—with all three duos embarking simultaneously upon their longest middle/'incineration' units. In these bars, an 'excess' of complex timbral information is palpable, and – in contrast to the beginning, middle and end units just discussed – a certain *loss* of control becomes discernible for performer, listener, and composer alike.[266]

The compositional methods employed to generate this globally saturated discourse will now be discussed:[267]

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[263] György Ligeti, trans. Cornelius Cardew, 'Metamorphosis of Musical Form', *Die Reihe, 7, Form – Space* (1965), 5-19 (p. 15).

[264] Ibid.

[265] Gestural function here arguable enhances this permeability too: with the deteriorative nature of Duo 1's IIc unit enabling the more active IIa unit of Duo 3 to achieve overall textural prominence.

[266] This notion will be discussed more fully in due course.

[267] The music and writing of the three French 'Saturationist' composers (mentioned in the introduction to this chapter) will become a central point of reference throughout the ensuing discussion. Both Methods 1 and 2 took Cendo's investigations into the saturation of instrumental timbre as their starting point. 'Les Paramètres de la Saturation', in particular – where both 'excessive energy' and 'hybridisation' are discussed – was particularly influential upon my practice. In a later article, Cendo reviews his methodologies, reframing 'hybridisation' as 'saturation of the instrument body' and introducing 'saturated gestures', where the addition of the performer's voice is briefly discussed. (See Raphaël Cendo, 'An Excess of Gesture and Material: Saturation as a Compositional Model', *Dissonance: Swiss Music Journal for Music and Creation,* (2010). Available online: <https://dissonance.musinfo.ch/upload/pdf/125_21_hb_cen_saturation_engl_def.pdf> [Accessed 15 March 2020].
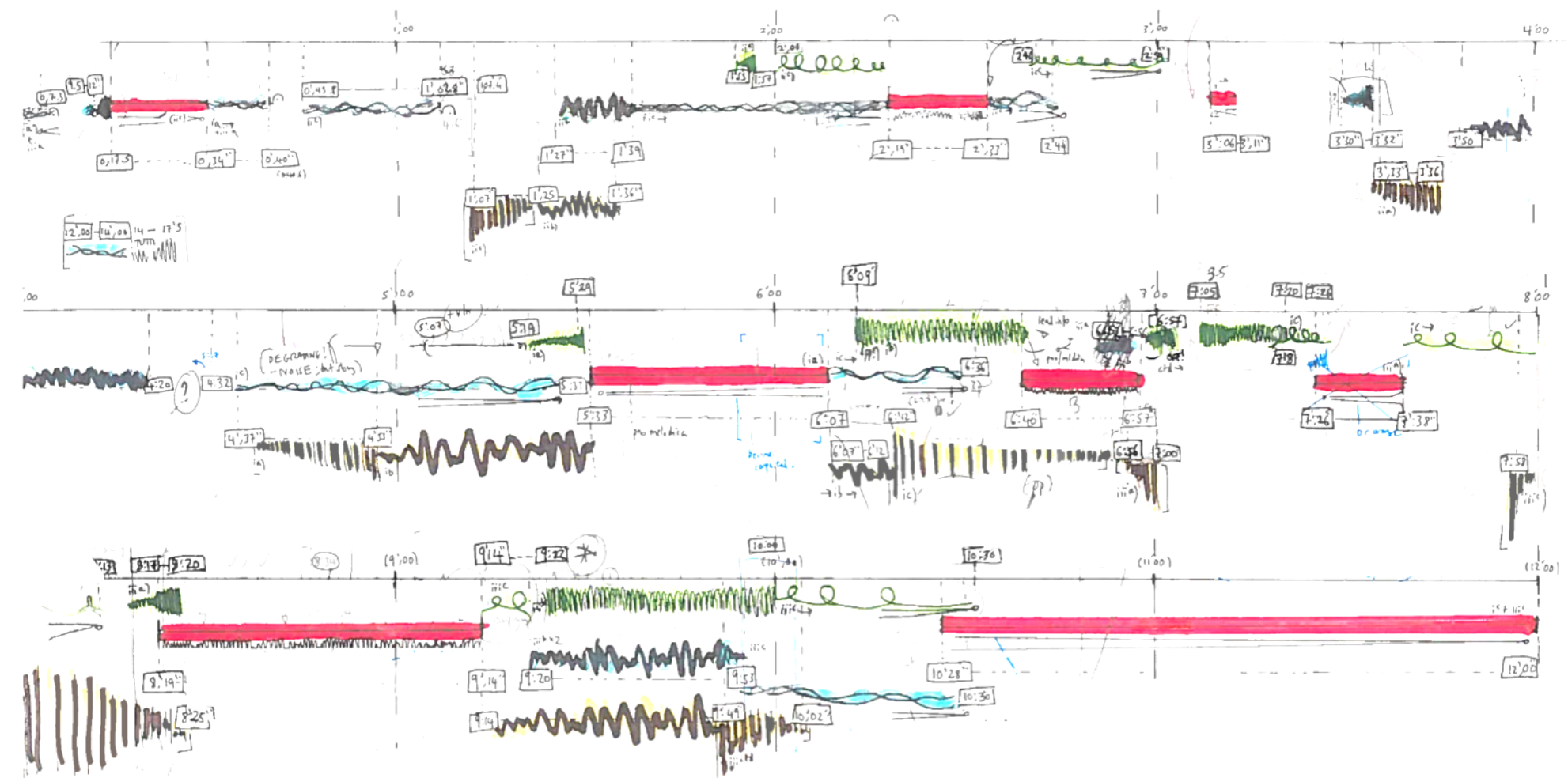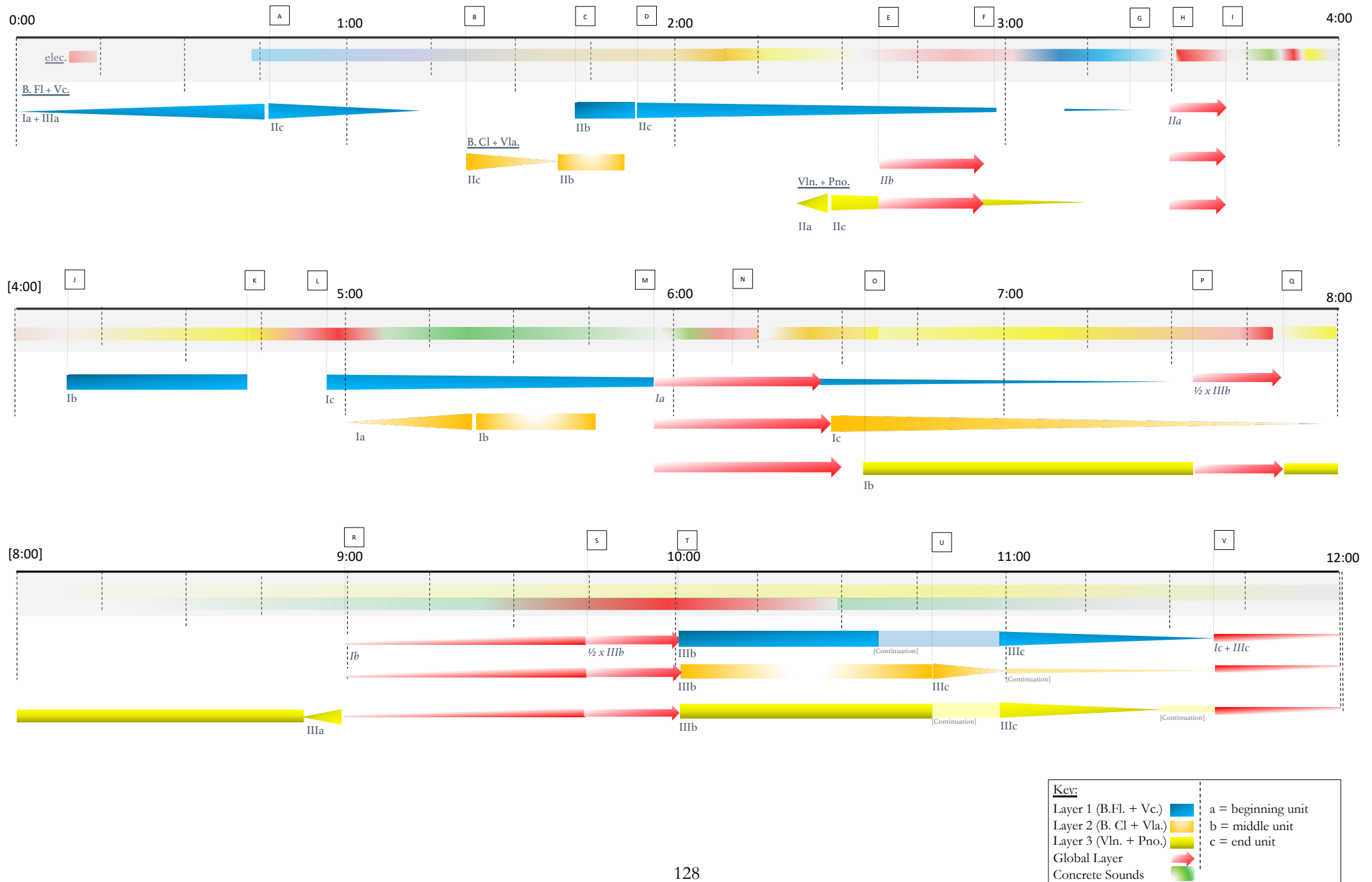
Figure 67: pre-composition allocation of *Plastica*'s units

Figure 68: final structural allocation of units within *Plastica*

1) Saturation of individual timbres through 'excessive energy'[268]

Individual timbres – marginal sounds or 'extended techniques', with a certain 'roughness' or perceptible noise profile – can be enhanced by what Cendo calls 'excessive energy' in performance, ultimately resulting in an even greater spectral complexity. 'Intensity' and loudness are a pre-requisite here,[269] encouraging sounds to splinter, fracture and burst wide open, amplifying and exaggerating their existing noise components.[270] In *Plastica* this technique is evident, for example, in the bass flute part of bars 6-8 at Letter T (see Figure 69). Here, a fragile multiphonic dyad is played *fortissimo* at the very top of the instrument. Combined with rapid, iterative articulation (occasionally in conjunction with flutter tongue) and glissandi up/down the overtone series, a complex and noise-heavy spectrum is produced.[271] When such 'excessive energy' is applied in this way, the instrument – as Paul Craenen notes in the music of the Saturationists – 'is forced past the limits of where its sound output is controllable'.[272] In encouraging such performative intensity, I am thus seeking – as with the electronic distortion discussed at the beginning of this chapter – to provoke an overload of information at the input stage—generating, in the resultant signal, a warped and misshapen waveform.

Figure 69: *Plastica*, **letter T+6, 7-8 (bass flute and cello)**

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[268] Cendo, 'Les Paramètres de la Saturation'.

[269] Indeed, *ff* markings are typical throughout all three composers' scores: see, for example, the opening of Bedrossian's *Charleston* (2005/2007), for 15 instruments, or the final passages (from bar 190 onwards) of Robin's String Quartet no. 2., *Crescent Scratches*.

[270] Paul Craenen describes such 'saturated sounds' resulting from this 'extreme energy' as 'conglomerates of harmonics, subtones and all kinds of unstable, granular spectra'. Paul Craenen, *Composing Under The Skin* (Leuven: Leuven University Press, 2014), p. 213.

[271] Whilst the energy and volatility of this passage are undoubtedly reminiscent of the bass flute part in Cendo's *Graphein* (in particular, as heard during the final few minutes), this technique – and indeed this particular multiphonic – perhaps owe more to Rebecca Saunders' *Skin* (2015-16), where it can be found – albeit within a much less kinetic context – in bars 36-42.

[272] Craenen discusses this within the context of 'enlarging tactics'—which amplify the performative body. See Craenen, p. 213.

2) Saturation of individual timbres through 'hybridisation'[273] of the instrument

i) modification to the body of the instrument

This technique is most notably employed in *Plastica* through the addition of foil to the viola's bridge.[274] Significantly increasing the noise profile of any materials played upon the instrument, this appendage can be seen in action at Letter T, where the viola's frequent *crescendi* – often on resonant natural harmonics (eg. T+6) and open strings (T+5) – encourage the vibration of the metal foil, and the emergence of a wide and rough harmonic spectrum (see Figure 70). Moreover, my intention is that the foil acts almost like a mute—imposing a limitation, or impediment, upon the viola's sound production. Consequently, this impediment requires performative intervention, again through excessive energy or force, to be overcome (ie. to achieve sufficient volume). The by-product of this intensity, as with Method 1, is a further alteration to the sonic characteristics of the instrument: the introduction of additional unstable and granular elements.[275]

Figure 70: *Plastica*, letter T+5-6 (viola)
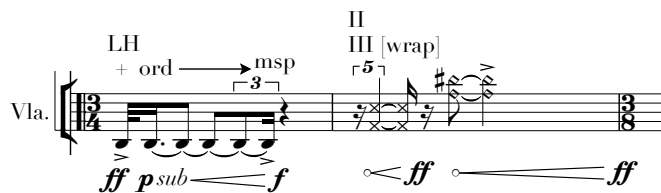
Similar timbral attributes result from a second method of 'hybridisation': **ii) the addition of the voice to the bass flute and bass clarinet.** Employed throughout Letter T (at bars T+1, T+3 and T+7 in the bass flute, for example, and bars T+6-8 and T+18 in the bass clarinet), this technique – drawing upon a method of playing I first heard in Cendo's *Graphein* – was introduced previously in Chapter Two.[276] Discussion of this material will continue in the below section regarding 'primitivism'.

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[273] Cendo, 'Les Paramètres de la Saturation'.

[274] A second prominent example might be the substantial scordatura detuning employed by the cello's fourth string. Auxiliary appendages can be seen elsewhere in the portfolio—for example in *Soliloquies*, where the soloistic violin 1 part makes use of blu-tack upon its scordatura fourth string for the final stages of the work.

[275] Zachary Wallmark describes such a performative obstruction as a 'blockage'—stating that when sound production is 'mediated by a physical obstacle', the ultimate negotiation of this hindrance 'leaves a mark upon the resultant timbre'. Interestingly, Wallmark goes on to observe the physical correlations between this process and distortion (as outlined earlier in this chapter). Wallmark, 'Appraising Timbre: Embodiment and Affect at the Threshold of Music and Noise', pp. 131-132.

[276] To take another example, this time from Cendo's ensemble work, *Tract*, we hear the same technique executed on the bass clarinet at bars 131-133.

Figure 71: *Plastica*, letter T+6-8 (bass clarinet)

Through both **instrumental hybridisation** and **the addition of the voice**, the unpredictable and saturated sounds generated are, to some extent, the result of a performative loss of control; *Plastica's* musicians, like artist Alberto Burri, are required to embrace the volatility and unpredictability of the materials at hand. When these techniques are multiplied across the sextet – as seen at Letter T – we begin to witness en masse the 'destruction of instrumental identity',[277] and the emergence of an 'impermeable'[278] global saturation: discourse in which individual sources are rendered ambiguous—subsumed within the greater 'collective wall of sound'.[279]

The 'Primitive' Performer of Saturation

Listening to the opening seconds of Evan Johnson's *L'art de toucher le clavecin, 2* (2009) – as the piccolist splutters, murmurs and gasps for air – our attention is instantly drawn to the 'performing body'. This corporeal 'presence'[280] is not solely the result of the extreme physicality of the sounds emitted, but equally due to the superabundance and complexity of the materials upon the page. (Evan Johnson himself, in the introductory notes to the work, admits that the music is indeed 'impossible'—subsequently requesting that the performer 'project' – albeit in an understated way – their exertion and 'attempt(s) to succeed' to the listener).[281] In such deeply physical and energetic playing, the traditionally 'transparent' body of the musician starts to become eminently visible and conspicuous to the watching listener (as might be the case, Paul Craenen proposes, when observing onstage the 'untrained' musician, whose body has not yet become 'fully attuned to its sound production').[282] In the hands of such a performer, the instrument is

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[277] Craenen, p. 214.

[278] See Ligeti, p. 15.

[279] Craenen p. 214.

[280] A 'surplus' of corporeal 'presence', Craenen observes, has been a frequent compositional strategy of music over the past fifty years. Craenen lists several 'strategies' which might be linked to the 'emergence of a specific body identity': 'physical obstruction' – discussed here – 'generates a primitive or untrained body' (Craenen, p. 207), whereas 'enlarging' tactics – discussed previously – concentrate upon 'an excess of energy spent on music making'. (Craenen, p. 213).

[281] The opening of Richard Craig's performance captures this corporeal quality very well; the stark difference in tessitura between instrument and voice instantly focusing the ear upon the performative body. Richard Craig and Karin Hellqvist, L'art de toucher le clavecin, 2, *Richard Craig: Inward* (Metier, MSV28517, 2011) [on CD].

[282] Craenen, p. 208.

rendered into a much more 'primitive tool'—and a struggle to command and control the machinery becomes palpable to the audience.[283]

Clear differences between Johnson's work and my own are discernible. *Plastica's* instrumental writing might occasionally lie on the *cusp* of playability, but my music here is conceived as – theoretically, at least – possible. Conversely, Johnson's duo operates within the lineage of post-Ferneyhough 'new complexity', where performative impracticality is embraced. Furthermore, and perhaps needless to say, there is a more immediate difference discernible here too, with *Plastica* residing at a dynamic marking several notches higher than the blanket *ppp*, employed in *L'art de toucher le clavecin, 2*. Nonetheless, through notational intricacy and heightened physicality (i.e. the aforementioned techniques of instrumental saturation) – I still seek to capture something of the relentless bodily exertion evident in Johnson's work.

Through recourse to a quite literal 'primitive tool' – an auxiliary melodica adopted by the pianist throughout Figure T of *Plastica* – a corporeal quality becomes a key point of focus in the latter stages of the work. Not only does the brazen, toy-like timbre of the free-reed instrument convey a certain primitive or unrefined character, but performative difficulties in playing the auxiliary instrument become evident. Playing the melodica is hard. An excess of breath is often required to produce *any* sound in the lower register; but *too much* airflow in the upper-middle and top registers produces an overly harsh/shrill sonority. When the melodica player is not a woodwind specialist – and when the writing is especially complex – this lack of control is exacerbated. Such is the case at Letter T (eg. T+2, T+5, T+7, T+8 etc.), where the pianist is required to alternate virtuosically between intricate piano figuration and specific dyads and clusters upon the melodica—often picking up and putting down the cumbersome auxiliary instrument at high speed. At moments such as T+24-26 – where both high and low clusters are executed in quick succession – a certain exertion and breathlessness are intentionally made audible to the listener.

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[283] A certain performative primitivism initially became an interest of mine during the composition of *Analogue*, discussed in Chapter Two. Here, the microcassette dictaphone machine is pushed far beyond its original intention and purpose (by design, to record meeting and conference dialogue—the half-speed playback allowing more time for retrospective minute-taking/transcription purposes). When used in musical performance, it is, however, expected to function at a maximum – and unintended – capacity, under the spotlight, as visible on stage as the performers themselves. Far from a world of digitised autonomy, this antiquated technology requires physical contact to function: fingers on buttons, negotiating the cumbersome and awkward playback mechanism. As such, in performance, there's a discernible sense of man battling with machine, willing it to sound and run smoothly.

Figure 72: *Plastica*, T+24-26 (piano/melodica)

An even greater sense of physicality is evident in much of the bass clarinet's writing from Figure T onwards. This is especially the case at Letter U, where the listener – and, in particular, the *watching* listener – observes an apparent battle between instrument (producing an array of complex multiphonics, high partials and rapid flutter tongue figuration) and voice (executing *sforzandi* in conjunction with sung vowels and an aggressive 'teeth on reed' technique in combination with quasi-spoken utterances). With a rapid rate of change between these sonorities, the clarinettist communicates a sense of extreme exertion here— a palpable struggle to tame the instrument, resulting in an 'unpredictable (and uncontrollable) richness of detail'.[284] Whilst operating at a much less confrontational and violent extreme than works such as Yann Robin's *Art of Metal III* or Raphaël Cendo's *Décombres*,[285] I seek to engender in this final part of *Plastica* a similar sense of the primitive and the carnal. An intense saturation, which almost becomes a 'quest for animality'.[286]

Figure 73: *Plastica*, letter U (bass clarinet)

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[284] Craenen, p. 210.

[285] Both works are written for contrabass clarinet, making use of primordial vocal sounds (often full throttle screams) which imbue multiphonic and overtone sonorities with a certain force and brutality.

[286] Cendo, 'Les Paramètres de la Saturation'. Translated by the author.

Figure 74: Alberto Burri, *Rosso Combustione Plastica* (1957) < https://www.christies.com/en/lot/lot-6038656 > [Accessed 1 February 2021]

[Image removed due to copyright]

Created seven years prior to (the artwork) *Plastica* in 1957, the 'scars' and 'skin-like' qualities described previously appear even more pronounced in Alberto Burri's *Rosso Combustione Plastica*. Writing during the year of its exhibition, critic Francesco Arcangeli describes 'an infernal wall', revealing 'the imprint of a body burnt and broken up to the last vertebra'.[1] The blood red (seen widely elsewhere in Burri's work—not only in the *Combustioni*, but in the earlier burlap sack collection, *Sacchi*) suggests 'wounds, healing almost like flesh', displaying signs of 'laceration, cauterisation…gaping, piercing….'[2] Prior to devoting himself to art, Burri had trained as a physician—for a time serving as a military doctor in Libya, during the early stages of World War II. It has been widely observed that the *Sacchi* and *Combustioni* bear evidence both of Burri's front-line trauma, as well as revealing the artist's in-depth anatomical knowledge. In the words of Emily Braun, his sculptures appear to 'turn the body inside out, as if probing beneath the skin and into the tissues and membranes'.[3]

[1] Francesco Arcangeli, Alberto Burri, 'presentazione nel catalogo della mostra', quoted in Massimo De Sabbata, '"Ho in mente da tanto tempo di dire come bruciano le cose". Le combustioni di Alberto Burri tra carta, legno, ferro e plastica', in *Alberto Burri Nell'arte e Nella Critica* (Milano: Scalpendi, 2017), 56-67 (p. 61).

[2] Calvesi, 'Percorso di Burri'.

[3] Emily Braun, 'The Red and the Black, Alberto Burri', *Alberto Burri: The Trauma of Painting*, (New York: Guggenheim, 2015), p. 61.

The Listener of Saturation

"A pair of these, Sir?" The warning bells have started to ring as I'm handed a small packet of disposable foam ear plugs upon entering the concert hall. All the same – and despite this modest aural protection – I remain vastly ill-prepared for the sheer volume of what I am about to encounter. Three minutes into the work, Ilan Volkov's downbeat is met with an eruption of sound: squeals and screams from the two saxophonist soloists; indecipherable low-frequency grumbles from the brass and percussion; and a wall of white noise and granulated activity projected from innumerable loudspeakers piled high at the front of the stage. Even from the back of the auditorium, I can not only hear the vibrations in my ears but feel them too—my whole body appearing to resonate with this excess of sound.

*   *   *

This overtly bodily sensation – recounted in relation to Dror Feiler's *tikkun olam*[287] – is frequently described by commentors of 'noise' music. Paul Hegarty (author of *Noise/Music: A History*),[288] suggests that, when listening to such music, we undergo a kind of 'experience' of 'difficulty, of defamiliarisation, or unpredictability. But also, of something physical'.[289] Whilst global saturation in *Plastica* is a comparatively short-lived phenomenon (having commenced at Figure T, all three duos' 'incineration' units have ceased by Figure U and 'burnout' is underway),[290] through an excess of sound, and a superabundance of timbral information, I seek to generate a similarly immersive and visceral experience.

This sense of physicality is, however, arguably not solely the result of volume and detail overload. There is an important proprioceptive aspect which should be addressed too. Denis Smalley's gestural 'source-cause' was discussed at length in Chapter One. Applying Smalley's theory, I proposed that, by drawing upon their inherent physical and psychological knowledge of sound making, a listener might hear gestures within *Dhātu* and *Soliloquies* as being related (or 'integrated'), despite their apparent surface disparities. These perceived relationships, I argued, were in part due to what Smalley terms a shared 'energy-motion trajectory'.[291] Whereas both *Dhātu* and *Soliloquies* make use of an isolated and memorable 'primary level' gestural unit (the straightforward drag of the bow), however, Figure T of *Plastica,* presents – by contrast – a knotted mass of sound, whose component sound objects and gestures are inextricably bound within a saturated discourse. Although such a texture initially appears too dense for a listener to ascertain such gestural 'source-cause' relationships, one aspect is designed to stand out, and offers fleeting opportunities for proprioceptive recognition: the vocal utterances and interjections by the bass clarinettist and bass flautist.

Whilst Smalley places emphasis upon the 'direct human, physical, and therefore psychological links'[292] provoked by encountering voices unexpectedly within an acousmatic context,[293] this line of thought is left relatively unexplored in his spectromorphological writing.[294] The more recent research of Zachary

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[287] I heard this work at the Tectonics festival in Glasgow on 5th May 2018, performed by the BBC SSO/Ilan Volkov, with Mats Gustafsson, Lasse Marhaug and the composer himself, featuring as soloists.

[288] Paul Hegarty, *Noise/Music: A History* (New York: Continuum, 2007).

[289] Paul Hegarty, 'Why Like Noise?', rosa-menkman.blogspot.com, 2010 <http://rosa-menkman.blogspot.com/2010/09/why-like-noise-by-paul-hegarty.html> [Accessed 17 December 2020].

[290] By comparison, in Felier's orchestral work (of 26 minutes duration) and previously mentioned works by Cendo and Robin, global saturation is the predominant texture throughout.

[291] Smalley, p. 111.

[292] Ibid.

[293] Smalley's text is written with electronic repertoire in mind – where vocal presence is 'encountered unexpectedly and inferred' (Smalley, 111.) – but a similar state of play is arguably observed in *Plastica*, where sounds and their sources are hard to identify, and where there is no prior assumption or knowledge of the performers' vocalism.

[294] In Smalley's words, 'Identifying intrinsic–extrinsic threads [i.e. upon hearing vocal utterances unexpectedly in an acousmatic context] is one thing. Interpreting their meanings, expressivity, and psychological significance is a more distant but ultimate goal, a study of which is beyond the scope of this essay.' Ibid.

Wallmark, however, offers further food for thought in this domain. For Wallmark, 'timbre perception is fundamentally "motor mimetic"' : that's to say, when we encounter sound – instrumental, sung or produced through other means – we 'take up a "bodily attitude" consistent with the corporeal articulation of each particular timbral quality'.[295] This is especially the case in vocal music, where 'perceiving the singing voice involves the covert rehearsal of the motor acts involved in singing'. Although *Plastica*'s vocal utterances at Figure T are not sung, the murmurs, hums and fragments of speech are arguably proprioceptively even *more* 'known' – or commonplace – to the audience, and are thus exclamations that might conceivably trigger 'vicarious motions within the listener'.[296] From Figure T to U of *Plastica*, therefore, the aforementioned sense of immersion and viscerality I seek to generate through overload and exertion is arguably heightened on a motor mimetic level too, through unexpected recourse to the performers' voices.

Moreover, drawing further upon Wallmark's findings, it appears that performative excess and *effort* – the kind I have detailed in relation to *Plastica*'s saturated sounds on the preceding pages – is, to some extent, mirrored on an auditory level. Describing such saturate timbres, Wallmark states that 'sonifying the outer bounds of physical exertion, noise demands that same exertion for the listener'—in other words, 'noise perceptually flirts with the thresholds of the body'.[297] Viewed through this lens, the subjective accounts offered in relation to *tikkun olam*, or Hegarty's words in *Why like noise?*, are perhaps afforded a little more credence. Saturation becomes a *physical* experience.[298]

The Composer of Saturation

Listening to double bassist Nicolas Crosse executing intricate pressure techniques – his left hand high above the fingerboard, the bow engaged in rapid circular motions, sporadic vertical *tremolandi* and percussive ricochets – it's hard to imagine such sounds having been devised other than through intimate collaboration between performer and composer—or indeed through the composer's first-hand research upon the instrument in question. Saturationist Yann Robin – whose *Triades* I describe above[299] – alludes

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[295] Wallmark, p. 24.

[296] Wallmark, p. 38. The author's study goes on to show – through functional magnetic resonance imaging (fMRI) that these 'vicarious motions are…evidenced in activity in larynx control areas of the brain'. Ibid.

[297] Wallmark, p. 69.

[298] When encountering such overload, the proprioceptive listener is – like the aforementioned performer, presented with a surplus of technical information and physical instruction – tasked with making sense of the discourse: compelled, in the words of Aaron Einbond, to 'trace a path in time and space, filtered through his or her own body and attention to shape the experience'. See Aaron Einbond, 'Subtractive Synthesis: noise and digital (un)creativity' in *Noise in and as Music*, ed. by Aaron Cassidy and Aaron Einbond (Huddersfield: University of Huddersfield Press, 2013), pp.57-75 (p.62). The listener of saturation – of the kind seen at Figure T of *Plastica* – could thus be seen as markedly active: engaged 'as a creator, making his or her own selection from the tangled surface'. Ibid.

[299] I document here my reaction when listening to Ensemble InterContemporain's premiere performance of Yann Robin's *Triades* (in particular, the passage occurring roughly five minutes into the work): Ensemble InterContemporain, *Triades*

to the importance of such a visceral connection with one's materials: 'I feel more than I hear', the French composer says in conversation with Pierre Rigaudière and Christian Bahier. For Robin, to compose is to 'sculpt and bring into life through writing…morphologies of masses and densities'.[300]

In seeking to employ comparable levels of physical intricacy in my own work I decided, when writing *Plastica*, to embrace a similar tactility, trialling all materials directly, as I experimented first-hand upon violin, viola, cello and piano, and collaborating closely with both bass flautist and bass clarinettist. Moreover, and partly in response to the potential compositional 'loss of control'[301] I have found to be experienced when handling such a multiplicity of detail and an excess of sound, I increasingly recorded my various instrumental improvisations and experiments—generating several multi-tracked 'mock-ups' of the work's most active and dense *tutti* passages. In this way, I found the traditional boundary between composer and listener started to become blurred during my creation of *Plastica*—the relationship moving more in line with that associated with the electroacoustic tradition, in which compositional decisions are made from a position usually assumed by the auditor.[302] This fluidity – as detailed in relation to the mock-ups above – can equally be observed in the boundary between composer and performer. (It is interesting to note that the residue of my DAW-facilitated multitrack experiments can be traced in the final notated work: particularly through the idiosyncrasies and 'primitive' qualities evident in much of the string writing—the result, perhaps, of my self-taught experimentation upon the instruments.)

Whilst these ambiguities of the *composer-performer* and *composer-listener* distinction were highlighted to me when working with such saturated materials, I have, however, found the necessity for physical/instrumental connection during the creative process to be true more generally when composing with timbre as the principal organisational parameter. As such – and as this commentary draws to a close – I will now seek to broaden this line of inquiry.

(Yann Robin), online video recording, YouTube, 30 March 2020, <https://www.youtube.com/watch?v=onjNHJCq0Ww> [Accessed 10 May 2020].

[300] Centre Pompidou, Ircam-Centre Pompidou Paris, Images d'une œuvre n°14 : Inferno de Yann Robin, online video recording, 2012, < https://www.centrepompidou.fr/en/ressources/media/MqOOM2K> [Accessed 30 May 2020]. Quotation transcribed in Pierre Rigaudière, 'La Saturation, Métaphore Pour La Composition?', Circuit, 24.3 (2014), 37-50 (p. 47). Translated by the author.

[301] I have found that it has often been difficult to 'hear' accurately and imagine internally the complexities of saturated writing when multiplied across several instruments. Paul Craenen comments upon this occurrence, describing a loss of control 'not only for the listener confronted with a wall of both horizontally and vertically saturated sound, but for the composer who deliberately seeks out the limits of physical and instrumental resistance…': Craenen, p. 214.

[302] Natasha Barrett comments upon the peculiarities of this relationship in the acousmatic tradition—observing that the, usual mutually exclusive, 'esthesic' (involving perception, and modes of listening) and 'poietic' (pertaining to compositional intention) aspects of Jean-Jacques Nattiez's 'Semiological Tripartition' feed into one another when the composer assumes the role of listener during the creative act. Natasha Lee Barrett, 'Structuring Processes in Electroacoustic Composition' (Doctor of Philosophy, City, University of London, 1997), p. 12.

In Conclusion: Composing with Timbre

Through the addition of several auxiliary instruments (pitch pipes, harmonicas and the melodica) – each of which engages the players' breath – a new corporeality is evident in the closing stages of *Plastica*. Taking my lead from Burri's artwork, often described as eliciting a visceral and charged response in the viewer,[303] I too seek to conjure something of the tactile and human out of my own ruptured design. Such a desire to draw out an intimate and physical response in the listener is, however, by no means particular to the works of **Chapter Four**; it was in fact evident throughout the portfolio. It was observable in **Chapter One**, where in *Dhātu* I argued that 'primary level' gestures – scrapes and drags – drew upon the listener's innate proprioceptive knowledge; and in *Soliloquies*, where spoken utterances in the work's closing moments – situated on the threshold of semantic comprehensibility – were designed to evoke an intense and personal auditory encounter. In **Chapter Two**, on the other hand, I endeavoured – in the final minutes of *Analogue* – to render the machinic whirring and spinning of the microcassette mechanism somehow bodily, through the piano trio's communal in- and exhalations: a musical depiction of Milton's vivid bestial imagery. A similarly corporeal soundworld was apparent in *Bríatharogaim*, too, where the instrumentalists took on a vocal presence in the work's final seconds, whilst in **Chapter Three**, the ever-encroaching singers of *Dhātu* ultimately broke down the performative boundary between musician and listener – the 'fourth wall' – as they moved in and around the audience within inner-crypt space.

In each case, this sense of the body – communicated in performance and encouraged by the materials upon the page – is rooted in a deeply physical and tactile composition process: the residue of which I hope remains palpable in the final work. In adopting such tactility in the act of creation, I once again find resonance with the plastic arts: the 'ecstatic impulse'[304] evident in the visceral techniques of Cy Twombly, for example; the spontaneous and aleatoric etching practices adopted by Alan Davie in his monotype prints;[305]; or, perhaps most importantly, the working methods of Alberto Burri—a constant source of stimulation throughout the latter stages of this research project.

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[303] See, for example, Judith Rozner's application of phenomenology to Burri's oeuvre, in Judith Rozner, 'Alberto Burri: The Art of the Matter' (Doctor of Philosophy, The University of Melbourne, 2015); or Emily Braun, *Alberto Burri : The Trauma of Painting* (New York: Guggenheim Museum Publications, 2015).

[304] Cy Twombly, quoted in Nicholas Cullinan and Nicholas Serota, 'Ecstatic Impulses': Cy Twombly's 'Untitled (Bacchus)', 2006–08', *The Burlington Magazine*, 152.1290 (2010), 613-616. I find particular resonance with the work and working methods of Twombly (an acquaintance of Burri, who visited – and likely exchanged ideas with – the Italian artist in Rome). In particular, the Bacchus works—enormous canvases, adorned with vermillion spirals: continuous lines, which betray the kinetic movements and full-bodied exertion of their creator.

[305] As described in the below exhibition description, Davie – effectively working blind, and by chance – would scratch with his fingers upon an overlaid sheet of the paper, ultimately leaving behind traces of his movements; primordial shapes and intricate gestural patterns, which appear to dart across the surface: see 'Alan Davie — Night Sky on a Holiday, 1948', *Tate* <https://www.tate.org.uk/art/artworks/davie-night-sky-on-a-holiday-p77277> [Accessed 23 May 2021].

In the first instance, Burri's approach is preconceived: a work's dimensions and frame are set—the canvas, celotex, cloth etc. selected and prepared. In the same way, I too devise the broad architecture of my composition: the structure within which I will be working.[306] Next, materials are sourced and set aside: PVC, pumice, emulsions and acrylics (sound objects, marginal timbres, maps of interlinked sonorities and descriptions of their associated physical gestures). Thereafter, however, in dealing with the unpredictable and protean nature of this matter (its morphologies, interactions and changeability over time—its ultimate form) – Burri adopts a more instinctive and immediate modus operandi: in the case of the *Combustioni*, moulding the volatile plastic with his bare hands, even with his own breath. (See the evocative photography of Aurelio Amendola, included at the beginning of this commentary.) Such an instantaneous and bodily response is clearly adopted out of necessity, with the final settled state of the materials – to quote art historian, Massimo De Sabbata – 'unforeseeable a priori'.[307] It is only through experience, even through the hand[308] – a posteriori – that form can be properly negotiated and understood by the artist. In my own work, this sculpting of form may not, as with Burri, take place in 'real time'[309] (as matter is born, and in the seconds, that fleeting window, before the celotex cools). However, musical discourse at a local level is necessarily negotiated and forged in context – as opposed to pre-determined[310] – in response to the inherent micro-level formal implications suggested by individual sound objects, and by their 'chimeric' interactions, amalgamations and inferred continuities. The tactics I have devised to organise these sonorities, as they unfold into larger forms, have taken centre stage throughout this commentary:

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[306] See the pre-compositional structural maps, included throughout this commentary.

[307] Massimo De Sabbata, '"Ho in mente da tanto tempo di dire come bruciano le cose". Le combustioni di Alberto Burri tra carta, legno, ferro e plastica', in *Alberto Burri Nell'arte e Nella Critica* (Milano: Scalpendi, 2017), 56-67 (p. 63). Translated by the author.

[308] Pierluigi Billone, a key source throughout this commentary, frequently discusses the 'the hand' in his writing— describing it as a 'privileged place of contact with the world': see Laurent Feneyrou, 'Il Suono è la mia Materia (2010): Intervista con Pierluigi Billone e Laurent Feneyrou', 2010. <https://www.pierluigibillone.com/it/testi/il_suono_e_la_mia_materia_2010.html> [Accessed 16 May 2021]. In his programme notes to *Mani.De Leonardis*, Billone talks of the compositional unification between the 'writing hand' (the composer also calls this the 'hand that thinks') and the 'listening hand' (that which comes into contact with the instrument)—see Pierluigi Billone, 'Mani.De Leonardis', *Pierluigibillone.com*, 2004 <https://www.pierluigibillone.com/en/texts/mani_de_leonardis.html> [Accessed 20 May 2021]. The marriage of these two entities results in the 'intelligent hand': an alignment, in Tobias Schick's words, of the 'tactile, haptic and reflective': see Tobias Schick, *Suono, Corpo, Rituale: un Ritratto del Compositore Italiano Pierluigi Billone*, 2020, p. 14 <https://www.pierluigibillone.com/pdf/suono_corpo_rituale_2020-tobias_schick.pdf> [Accessed 10 December 2020]. In my own work, the careful balance – or mediation – of organisational techniques with close physical contact/mock-ups finds resonance with Billone's writing on the 'intelligent hand'.

[309] Such spontaneity interpreted musically is of course suggestive of improvision: a mode of creativity I occasionally *do* adopt when forming my 'mock-ups'. Nonetheless, with each instrumental line created separately – with the opportunity always available to retrace my steps and alter my decisions – my own definition of 'real-time' composition is rather different here.

[310] Although the wider 'structural' boundaries of a composition are preconceived, they remain – as described in Chapter One – flexible, with the option always available to extend, shorten or curtail materials, as the sonorities demand.

In **Chapter One**, **Integration** became the focus: both at a micro level, as maps of closely related sonorities were devised and organised, and from a more macro perspective, where constellation techniques (*Dhātu*) and 'evocations'/ 'meshes'/ 'soliloquies' (*Soliloquies*) were explored. In **Chapter Two**, ***Dis*-integration** rather came into focus, as progressive linear erosion became a key structuring force. In *Analogue*, timbral invariance under transformation became a priority (with material at a local level designed to withstand the gradual bleaching of its sonic attributes); whilst in *Bríatharogaim*, large-scale erosion was steered by small-scale paratactic intervention. **Chapter Three** took **Space** as its principal subject matter. In *Dhātu*, the placement of sounds within their architectural environment, and the expansion and contraction of space around the listener were seen as pivotal to the unfolding of discourse; meanwhile, in the electronics of *Plastica*, recourse to extrinsic sonorities, external landscapes, as well as the placement of sounds within virtual space, became key means of controlling the form. Finally, in **Chapter Four**, **Saturation** was discussed as the primary mode of organisation: with macro-level processes of endogeny and exogeny central to the construction of *Hyphae*, whilst in *Plastica*, each duo's timbral palette was allied to tripartite structures of accumulation, activity and dissipation.

These organisational tools and strategies were, however, only part of my creative process—requiring, I have found, mediation through an even more direct contact with my materials. As detailed in relation to *Plastica* – and as employed more widely across the portfolio – mock-ups and recorded improvisations have become key to my work, and central to the organisation of my musical forms. I have found this first-hand interaction with the instruments for which I am writing,[311] and a direct contact with the materials themselves – experiencing the 'pulls and tensions'[312] of sonorities through my fingers, skin, lips and voice[313] – to be indispensable when sculpting complex timbre, a posteriori, into its final design: when moulding matter into an ultimate 'unbalanced equilibrium'.[314]

Such an involvement of physicality in the pre-compositional process can be traced throughout this portfolio: it was apparent in the gestural explorations of **Chapter One**, where timbral maps and

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[311] The composer-as-listener and composer-as-performer distinction – as mentioned in Chapter Four – is perhaps not clear-cut here; as mock-ups derive from my own previous first-hand interaction with the instrument(s), and as the proprioceptive motor actions needed to produce the relevant sounds remain intimately 'known', hearing them back, I have found, is a peculiarly physical experience.

[312] Alberto Burri, quoted in Milton Gendel, 'Burri Makes a Picture', *Artnews*, 53.8 (1954), p. 69.

[313] Rebecca Saunders' preface to her work *Miniata* (2004) has for a long time resonated with me deeply: 'Surface, weight and feel are part of the reality of musical performance: the weight of the bow on the string; the differentiation of touch of the finger on the piano key; the expansion of the muscles between the shoulder-blades drawing sound out of the accordion; the in-breath preceding the 'heard' tone … Feeling the weight of the sound is an integral part of the composing process': see Rebecca Saunders, *Miniata* (Frankfurt: Henry Litolff's Verlag/ C. F Peters, 2004), p. ii.

[314] Alberto Burri, quoted in Stefano Zorzi, *'Parola di Burri. I Pensieri di una Vita'* (Milan: Mondadori Electa, 2016), p. 32. Burri's use of this term – whilst undefined by the artist himself – seems to capture perfectly the tensions of his volatile, often aleatorically sculpted, matter: now cooled and contracted into its final resting state (a state which still betrays signs of its violent and alchemical genesis). In my own work, this turn of phrase similarly reflects well the – often protean, unpredictable, bodily and living – material with which I am dealing, as it finds its ultimate position within the clock-time architecture of the work.

'evocations' were devised through first-hand instrumental investigation (and where physical gesture was prioritised in the subsequent categorisation of sounds). It similarly underpinned the central work of **Chapter Two**, *Analogue* (whilst the palpable struggle of man vs. machine was described here in relation to the musicians *onstage*, as they battled with the clunky and antiquated microcassette dictaphone mechanism, a comparable tussle with the knobs, buttons and controls of this analogue technology had taken place *backstage*, in the composer's studio, as I initially devised materials). In **Chapter Three,** on the other hand, timbre – in particular that of the vocalists – was seen to assume new significance and meaning only when trialled (and once materials had been encountered *aloud*) within the reverberant architecture of inner/outer crypt space. Whilst, in **Chapter Four** – as previously discussed – mock-ups and instrumental investigation became integral to the act of composing.

This need for physicality and tactility surpassed mere sonic experimentation, however. I found it to be essential on a temporal level. That is to say, it was difficult to gauge the time and space that complex sonorities require to speak, register, unfold and interact – at that juncture where discourse and timbre coalesce and intertwine – other than through experience. The atemporal, internalised and imagined time we so often inhabit as composers no longer seemed sufficient. In this respect, my methods align with the writing of Craenen, who notes that the 'space of "acoustic reality"' can only result by means of 'literal embodiment of the time within the music': through the 'composing body occupy(ing) the same space as the performing and listening body'.[315] Within the psychoacoustic realm, Cornelia Fales – widely cited throughout the first three chapters of this commentary – remarks that 'perceived timbre exists in a very real sense only in the *mind* of the listener, not in the objective world'.[316] Through our initial discussions of Auditory Scene Analysis, we became aware of the rapidity through which timbre is assimilated—our primitive and essential need to identify a sound source occurring at the initial 'concurrent grouping' phase of the three-stage process. As such, this instinctiveness – 'a shift of attention to a time zone where the experience of sound becomes so direct that the distance needed for cognitive reflection is lacking'[317] – leads Wallmark, during his motor-mimetic research, to adapt Fales' statement. Our perception and experience of timbre could be described as so immediate – so innate – that this musical parameter 'exists only in the *body* of the listener'.[318] And, I have found, when dealing first-hand with such complex

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[315] Paul Craenen, *Composing Under the Skin* (Leuven: Leuven University Press, 2014), pp. 246-247. Craenen discusses this observation in relation to the working methods of Scelsi who frequently notated (and/or was *assisted* in notating) his own improvisations, and Feldman, who discussed the necessity of hearing aloud his music at the piano. I would add to this list Pierluigi Billone, who, in relation to his *Mani.De Leonardis,* explains his tactile interaction with the work's metal springs, as follows: 'I am playing, but it is not all: I am also sounding, and in fact I am playing on my own body': see Pierluigi Billone, 'Mani.De Leonardis'.

[316] Cornelia Fales, 'The Paradox of Timbre', *Ethnomusicology*, 46.1 (2002), 56-95 (p. 62).

[317] Paul Craenen, *Composing Under The Skin* (Leuven: Leuven University Press, 2014), p. 258.

[318] Zachary Thomas Wallmark, 'Appraising Timbre: Embodiment and Affect at the Threshold of Music and Noise' (Ph.D, University of California, 2014), p. 4.

sonorities, when sculpting and moulding discourse from fragile, volatile or marginal matter – when composing with timbre – it exists most clearly and faithfully in the *body* of the composer.

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Appendices

Appendix I: *Plastica* – Unit Calculations[1]

Data on four plastics – each used by Burri in the *Combustioni* – was derived from the aforementioned study into the *Combustion and Gasification Properties of Plastic Particles*.[2]

<u>Stage One</u>

PVC / Polyvinylchloride (Duo 1: B. Fl. and Vc.)

Incineration Temperature:	Rate of Pre-ignition	Rate of Combustion	Rate of Char Burnout
750°	33.82%	10%	3.26%
850°	61.62%	10%	3.38%
950°	86.76%	20.33%	3.82%

PP White / White Polypropylene (Duo 2: B. Cl. and Vla.)

Incineration Temperature:	Rate of Pre-ignition	Rate of Combustion	Rate of Char Burnout
750°	17.41%	9.1%	7.18%
850°	43.88%	8.97%	7.1%
950°	52.35%	9.54%	8.41%

HDPE Film / High Density Polyethylene Film (Duo 3: Vln. and Pno.)

Incineration Temperature:	Rate of Pre-ignition	Rate of Combustion	Rate of Char Burnout
750°	32.5%	8.39%	7.35%
850°	65.59%	8.5%	8.06%
950°	100%	8.97%	8.85%

LDPE / Low Density Polyethylene Film (Global Layer: Tutti)

Incineration Temperature:	Rate of Pre-ignition	Rate of Combustion	Rate of Char Burnout
750°	9.31%	8.28%	6.47%
850°	23.24%	9.08%	7.53%
950°	28.5%	10%	7.88%

<u>Notes</u>
- Figures here show the rate of pre-ignition/combustion and burnout (% per minute). The higher the percentage, the quicker the time elapsed for process completion. All figures are scaled down – by 100% – from original figures, for ease of working.
- All figures are estimates derived from bar charts.

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1 As explained in the main body of the commentary, figures here relate to pre-compositional workings (as represented by the hand-written diagram shown in Fig.67). Final unit durations and points of occurrence were subject to tweaks and changes throughout the composition process (with final durations and locations of layers displayed in Fig. 68).

2 Ron Zevenhoven and others, 'Combustion and Gasification Properties of Plastics Particles', *Journal of the Air & Waste Management Association, 47.8* (1997), 861-870 (p. 865). All figures deduced from charts (by eye, and from monitor!).

<u>Stage Two:</u>

- All plastics' combustion durations determined in relation to initial PVC calculations. The quicker the rate of incineration process, the shorter the musical unit.
- Pre-ignition timings = musical beginnings (A); rate of combustion timings = musical middles (B); rate of char burnout (C) = musical endings.
- 750° = Musical Unit I; 850° = Music Unit II and 950° = Musical Unit III
- Starting PVA duration of *138" deduced intuitively

PVC / Polyvinylchloride (Duo 1: B. Fl. and Vc.)

Incineration Temperature:	Rate of Pre-ignition (A)	Rate of Combustion (B)	Rate of Char Burnout (C)
750° (Unit I)	1) *138 % 33.82 = 4.08 2) 4.08 / **60.23) x 138 **= 9.35"**	**= 31.6"**	**= 97"**
850° (Unit II)	[750° % 850°] x 138" = 122" 1) 122 % 61.62 = 1.98 2) 1.98 / 50.25 x 122 **= 4.8"**	**= 29.6"**	**= 87.6"**
950° Unit II)	**= 3.9"**	**= 16.6"**	**= 88.5"**

<u>*Notes*</u>
**60.23 = (4.08 + 13.8 + 42.35)

<u>Stage Three:</u>

Durations for all other plastics were then deduced in relation to PVC data, using the below method (here taking Unit Ia of the LDPE Layer, as an example):

PCV Ia rate	%	LDPE Ia rate	=		x	PVC Duration	=	New LDPE Duration
33.82	%	9.31	=	3.6	x	9.35"	=	34"

<u>Stage Four:</u>

Durations of all units/layers calculated:

PVC / Polyvinylchloride (Duo 1: B. Fl. and Vc.)

Incineration Temperature:	Rate of Pre-ignition (A)	Rate of Combustion (B)	Rate of Char Burnout (C)
750° (Unit I)	9.35"	31.6"	97"
2000° (Unit II)	2"	12.4"	36.8"
950° (Unit III)	3.9"	16.6"	88.5"

PP White / White Polypropylene (Duo 2: B. Cl. and Vla.)

Incineration Temperature:	Rate of Pre-ignition (A)	Rate of Combustion (B)	Rate of Char Burnout (C)
750° (Unit I)	18.2"	34.8"	44"
2000° (Unit II)	2.8"	13.8"	17.5"
950° (Unit III)	6.5"	35.4"	40.2"

HDPE Film / High Density Polyethylene Film (Duo 3: Vln. and Pno.)

Incineration Temperature:	Rate of Pre-ignition (A)	Rate of Combustion (B)	Rate of Char Burnout (C)
750° (Unit I)	9.7"	37.7"	43"
2000° (Unit II)	1.9"	14.6"	15.4"
950° (Unit III)	3.4"	37.7"	38.2"

LDPE / Low Density Polyethylene Film (Global Layer: Tutti)

Incineration Temperature:	Rate of Pre-ignition (A)	Rate of Combustion (B)	Rate of Char Burnout (C)
750° (Unit I)	34"	38.2"	48.9"
2000° (Unit II)	5.3"	13.7"	16.5"
950° (Unit III)	11.9"	33.8"	42.9"

Notes
For exaggerated durational effect, all Unit IIs (formerly 850°) modified to 2000°.

Global Unit Distribution
Case Study: LDPE Layer [All other layers calculated using comparable process]:

Stage One

Points of unit occurrence established:

	*	+121.6" **		+35.5" ***		+88.6" ****	
Point of LDPE occurrence	0" —	17.5" ——	138.6"	—— 174.1"	——	262.7"	——

* Initial point of occurrence – 17.5" – established intuitively
** +121.6"[duration of LDPE units Ia, Ib and Ic]
*** +35.5" [duration of LDPE units IIa, IIb and IIc]
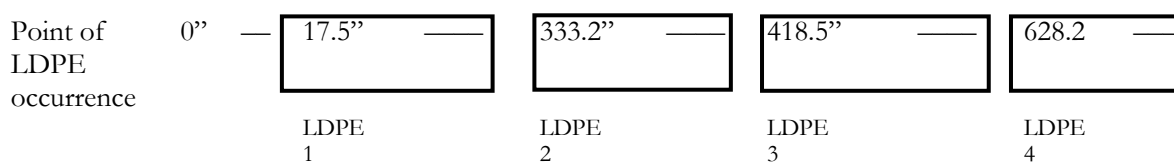*** +88.6" [duration of LDPE units IIIa, IIIb and IIIc]

Stage Two

Units, and associated durations, allocated to each point of occurrence as follows:

Point of occurrence:	Units Allocated:
17.5"	IIc + IIb + IIa
138.6"	Ia + ½ of IIIb
174.1"	IIIa + Ib + ½ of IIIb
262.7"	Ic + IIIc

<u>Stage Three</u>

LDPE ratios converted to global attach points (within a pre-decided 12' duration). Last group onset occurs at 628.2": ie. 720"-91.8" [Ic/48.87" + IIIc/42.93| = 91.8"]. Thus:

Point of LDPE occurrence	0" —	17.5" ———		333.2" ———		418.5" ———		628.2 ———
		LDPE 1		LDPE 2		LDPE 3		LDPE 4

<u>Stage Four</u>

Distribution of micro units, proceeding initial onset of group:

LDPE 1:
333.16 – 17.5 = 315.66" Section

	Unit IIc	16.5"	IIb	13.7"	IIa	5.3"
Micro points of strand occurrence	17.5"	———	2' 19"	———	3' 06"	———
			38.6%* x 315.66"+ 17.5" = 2'19| *ie. 17.5 % 35.48 [6.5"+13.7"+5.28"]		14.9% x 315.66 + 2'19" = 3'06"	

LDPE 2:
418.5 – 333.16 = 85.34" Section

	Unit Ia	34"	Unit IIIb
Micro points of strand occurrence	5' 33.2"	———	6' 40"

LDPE 3:
628.2 – 418.5 = 209.7" Section

	Unit IIIa	11.9"	Unit Ib	33.8"	[+ ½ of Unit IIb*] *nb. erroneously changed from IIIb	[+6.9"]
Micro points of strand occurrence	7' 26"	———	8' 18.6"	———	continues	———

LDPE 4:
12' (720") – 91.8" = 628.2"

	Unit Ic	48.9"	+ Unit IIIc	[+42.9"]
Micro points of strand occurrence	10' 28"	———	continues	———

Appendix II: *fili /strands/stränge*. **Genesis of the three strands**

Scarlatti

For the Scarlatti music, I selected as my starting point a passage from his Sonata in A minor K175 (bars 25 to 32, as printed below). This short line of music encapsulates much that could be called typically 'Scarlattian': unusual dissonances (constructed around verticalised harmonic minors), and direct sequential repetition in a parallel minor key. Moreover, the repetition of E$_4$ in the right hand – which spans both the iterations in D minor and E minor and acts almost as a pivot note – along with the prominent articulation of pitch classes D and G (bar 25, 26 left hand), could be interpreted as betraying Scarlatti's propensity towards open string guitar configuration: a trait frequently noted in his music by scholars of this period.[3]

Bars 25-32, Domenico Scarlatti, Sonata in A minor K175. *Domenico Scarlatti: Sonates, Volume 4* (Paris: Heugel, 1976), pp. 74-77

Indeed, when K175 is performed in the transcribed version for guitar, these bars seem to take on an added significance, with the aforementioned open string pitches ringing out with great clarity, extending these notes with much resonance.

The idea of prolongation was key to the composition of the Scarlatti strand, as I began to explore these bars over a longer duration, treating the passage as a complete sound source that is magnified, extended, and projected far beyond its original context. One way to achieve this was simply through time-stretching. Taking a recording of these few bars of K175 (played in the transcribed version for guitar), I slowed the extract down by a considerable amount: to almost twenty times its original length. Although the effect was

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[3] See Leo Eisenhardt, *Italian Guitar Music of the Seventeenth Century,* (Rochester: University *of Rochester Press* 2015), p. 164;
Ralph Kirkpatrick, *Domenico Scarlatti*, (Princeton, New Jersey. Princeton University Press 1983), p. 205.

striking, particularly in bringing to the foreground frequencies and inner lines previously obscured or inaudible, the outcome was quite a crude one, and the ear drawn more to the process (of time-stretching) than to the new sounds it had revealed.

Thus, my next step was to reverse the extract, which went some way to rectifying this problem. The open string sonorities – my cornerstone reference to Scarlatti's style – were still clear, and the modal and harmonic language still present, albeit in a distorted form. Yet now the functions and harmonic role of each chord were much less laboured and self-conscious (an adverse effect of the initial slow-motion treatment). As a result, the listener may have perhaps been more inclined to listen to each sound on its own terms, rather than as part of an overt process of time manipulation. Having settled upon this segment of musical material (now around 1' 20" in duration), I started the next step of the compositional process.

Importantly, I wanted this to be an acoustic, not an electronic, part of the work. In this way I could interact with and sculpt material in a much more tangible and visceral way as I 'orchestrated', allowing me to start making compositional choices that reflect my own language and approach to timbre, whilst still staying true to the concept and original material. My first step was to analyse the Scarlatti recording spectrally (see below). My intention was that this would be a candid and true representation of the time-stretched material: not only do layers of the Scarlatti become apparent that were previously hidden, but glitches and imperfections in the time-stretching process bring about other sonorities and distortions, adding a certain amount of textural coarseness to the sound world, which resonated with my own timbral interests.

The next step, guided by the spectrograms I had created, was to notate each of these spectral analyses: each frequency, line, its duration and its amplitude.

Scarlatti Spectrogram: 1', 00" to 1', 25. 200 – 395Hz

36
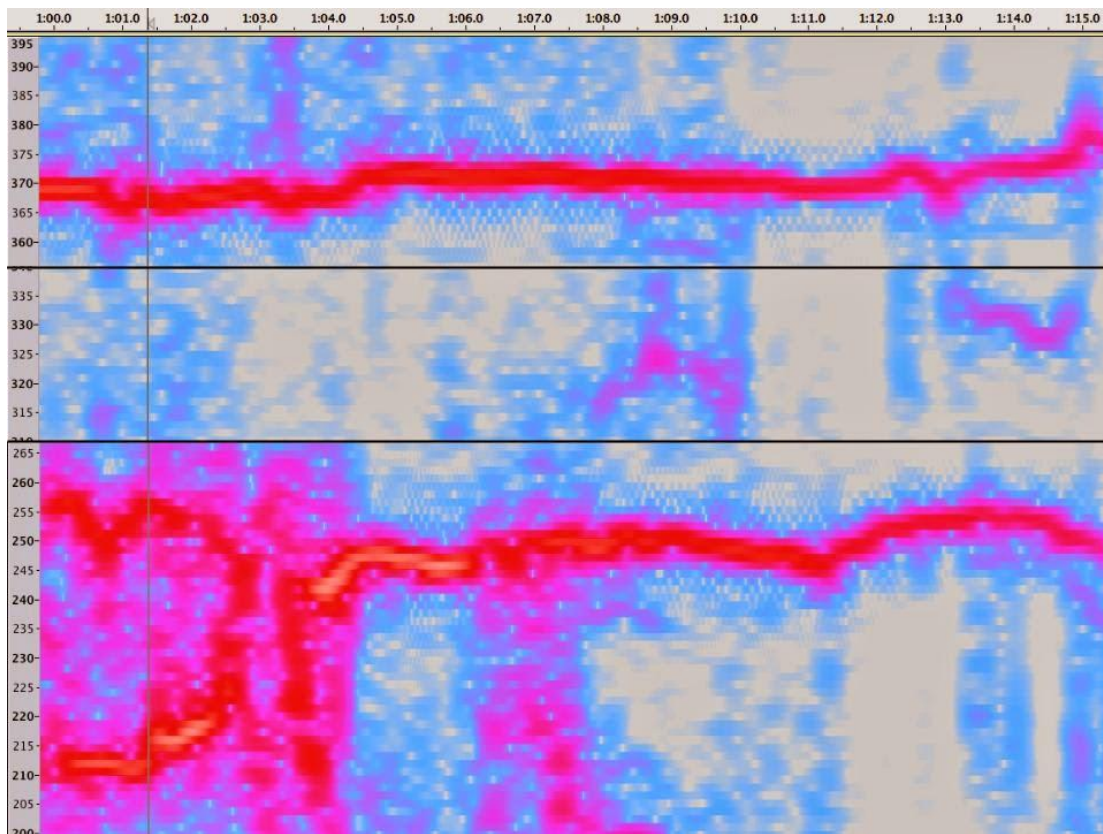
Spectrogram workings/analysis: 1', 00" to 1',15"
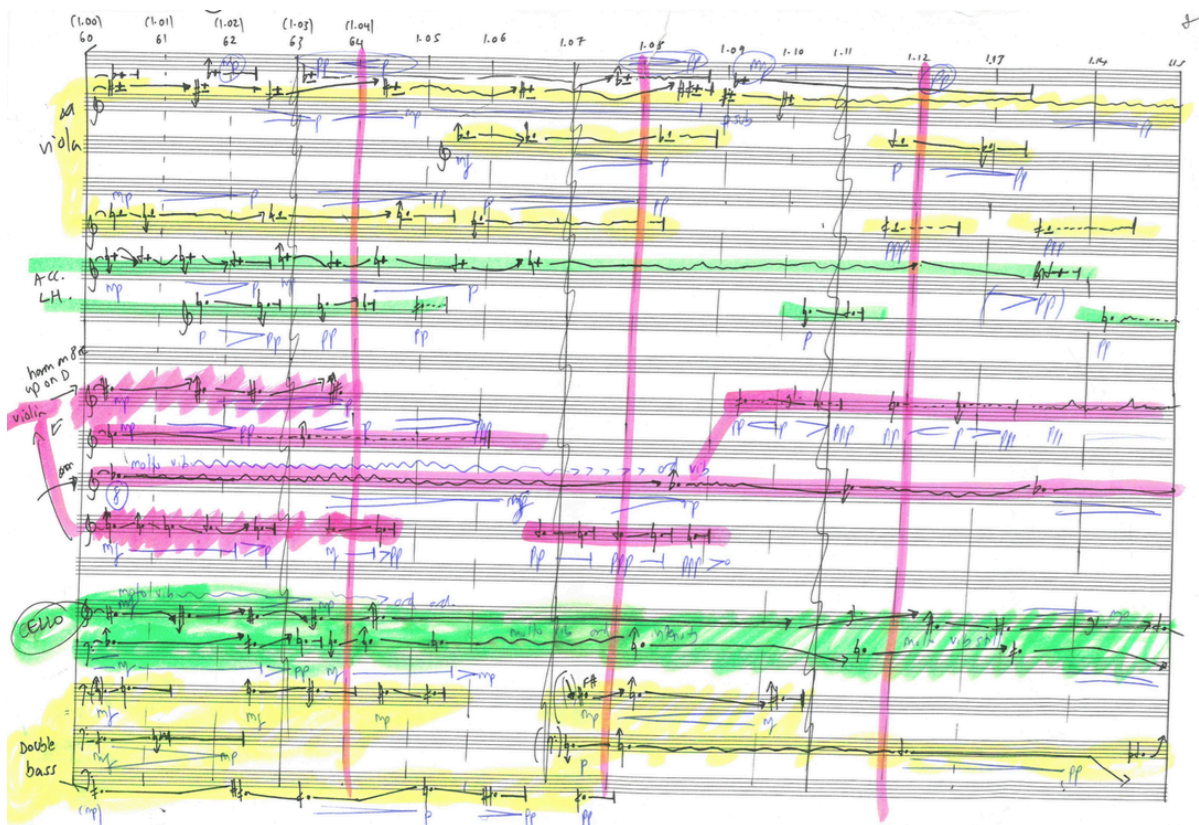
Working in 15" segments, I then set about re-composing the music, for a chamber ensemble of six instruments: Flute, Accordion, Violin, Viola, Cello and Double Bass. Upon playback, any combination of this ensemble was possible—from solo instrument to tutti sextet.

Handel

The Handel strand of music is sung by solo soprano and remains most faithful to the original source material. Taking eight bars from the vocal line of Cleopatra's aria 'Piangero la sorte mia' from *Giulio Cesare*, octaves are displaced, consonants are removed, vowels elongated and sequences extended and stretched beyond their original context.

Bars 25-31, 'Piangero la sorte mia' from *Giulio Cesare*

In the initial part of the passage, intervals remain intact (transposed up a perfect fourth), with one octave displacement, and one pitch omission (see below). This transposition was carried out for two reasons: firstly, I wished the soprano to lie in the upper part of her tessitura (to be audible with comparative ease in fuller textures between strata). Secondly, I felt this new tonality would allow the vocal line to sit alongside the Scarlatti strand more comfortably, through use of shared pitch classes. Towards the latter part of the extract, the transposition interval starts to change: firstly, to a Major 3rd (interrupting the expected sequential pattern), before a three-note figure (labelled below 'motif x') is expanded and unravels far beyond its original tonal setting. This three-note motif (a 0, 1, 3 trichord) in this context is

perhaps something more common to my own vocal writing than that of Handel, and its organic incorporation and extension at this point seemed a fitting way to complete this strand.

Comparison of Handel's original vocal line, and new pitch material

Version 1 (of 3) of the Handel Strand (for solo soprano)

Construction of the final version of the soprano line involved the breaking up of Handel's continuous passage into three distinct phrases, each of which is re-barred in a new rhythmic configuration. Nearly all consonants are removed, but vowels left largely intact (with occasional modifications to ease transitions over the vocal passaggio in the new higher key). Further to this, three different versions of the passage were recorded: that seen above, a second in double note values, and a third in which the soprano executes each phrase in two complete full breaths, extending each note to its longest duration possible in these conditions. Upon playback, tens of tracks existed which mixed individual phrases from each of these

three performances – combined by a randomised process – interspersed by varying long (and short) periods of silence.

Bach

The role of the Bach strand is somewhat more complex than that of Scarlatti and Handel, taking as its basis a canvas of white noise and high sine tones, which are present in the performance space at all times. This element – sounding continuously at very low-level amplitude – acts as the neutral, base state of the work: the natural mode of being, from which any sound in the performance space emerges and subsides.

From this grainy and high-pitched stratum, the Bach strand itself surfaces—often very subtly and, at first, inaudibly. The composition of this stratum is based upon the instrumental opening of Bach's *St Matthew Passion*: specifically, the melodic lines of the upper parts (outlined below). The fleeting appearance of this passage at a very slow tempo, normally in extremely high frequencies that meld with the white noise and sine tones, renders its origin largely indeterminable within the framework of the installation: perhaps a refraction, silhouette or negative space of the original.

Bach, *St Matthew Passion*, 1. Chorus (bars 1-3, upper instrumental parts, reduction)

Unlike the acoustic construction of both Scarlatti and Handel layers, the composition of the Bach strand was achieved largely through electronic means. As a first step, I 'built' an instrument (using Logic's EX24 Sampler), taking a series of melodica overtone samples as my basis. These overtones are produced through semi-depressing keys at the very top of the instrument, combined with a strong and consistent airstream. This action produces a harmonic sounding two octaves above the ordinary pitch, registering aurally as a sine tone-like sonority, combined with a certain quality of human breath.

Recording the above line of the *St Matthew Passion* on this electronic instrument, the passage was then subjected to a variety of different electronic processes—altering sonic envelopes, modifying cut-off and resonance, and employing LFO filters. In keeping with the previous two strands, tens of these combinations were then constructed as possible textures, and combined on their playlist with 'blank' tracks consisting only of sine tone/white noise.