UNIVERSITY OF CALIFORNIA

Los Angeles

From the Ruins of the Literal: Critical Organology, Timbre, and the Poetics of Affect

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Musicology

by

Sarah Caroline Davachi

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ABSTRACT OF THE DISSERTATION

From the Ruins of the Literal: Critical Organology, Timbre, and the Poetics of Affect

by

Sarah Caroline Davachi

Doctor of Philosophy in Musicology

University of California, Los Angeles, 2025

Professor Robert W. Fink, Chair

From the Ruins of the Literal, a title borrowed from the metaphor theory of philosopher Paul Ricoeur, offers a critical perspective within the fields of organology (the study of musical instruments) and timbre studies, moving past the materialist, neuro-cognitive, and modernist biases that have long dominated the disciplines. Although I find these parameters necessary in illuminating the full picture of instruments and timbre, I also render them severely insufficient in their scope, failing to rigorously account for the poetic and affective dimensions of sounding experience, which are inherently phenomenological categories.

As such, this discussion aims to push our understanding of timbre beyond the constraints of acoustic fundamentalism, and to position it as an emergent phenomenological construct (*the-sound-of*), as a total and autographic complex with its own time and space. To this end, I consider alternate ways of apprehending affordance, actor-network, and dialogic interaction theories, asserting deeper awareness of mediation, worldmaking, 'thickness,' and *this*-ness in the timbral experience. This discussion also

seeks to expand our appreciation of meta-objects that can be encountered timbrally, which includes but is not limited to traditional musical instruments. To underscore the importance of an embodied epistemology as the prerequisite to timbral ontology, I emphasize a methodology that incorporates my experience working at a musical instrument museum; my professional practice as a composer and performer of primarily keyboard-based minimalist music; my academic studies in phenomenology and hermeneutics; and, my musicological expertise in experimental music, early music, and studio-based record production.

Perhaps the most salient conclusion that can be drawn from accepting timbre as an emergent construct is the presupposition of an iconic-symbolic and transcendent structure; an implied transition from first-order sensation to a second order of feeling, affect, meaning, and, ultimately, truth. What we arrive at, then, is less the paradox of timbre, which ethnomusicologist Cornelia Fales correctly noted as empiricism's inability to account for the poetic dimension of sound, but rather the irony of timbre: as I contend, once we complete the cycle of timbral thinking, we inevitably arrive back in the realm of the prosaic but with our reality reconfigured and profoundly transformed.

The dissertation of Sarah Caroline Davachi is approved.

Catherine Ann Provenzano

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CHAPTER ONE

TOWARDS A CRITICAL ORGANOLOGY

i. *Genesis of an idea*

During my first quarter of doctoral studies, in a seminar dedicated to tracing the development of chord progressions in popular music, I was posed what seemed a simple question: could I determine from internal evidence alone whether a song had been written on a piano or a guitar? The implication was of course that the piano would tend toward one compositional direction while the guitar might tend toward another. The question itself was intriguing, and its presentation as a theoretical aside rather than as the main point of inquiry seemed equally significant. Musical instruments are most often understood in terms of their timbre: 'the sound of' the piano or 'the sound of' the guitar. Surely, though, if the music produced by a piano is somehow different than the music produced by a guitar, there must be a deeper complexity to our interactions. What, then, does it mean to understand 'the sound of' something? How exactly do we come to know such a concept as timbre?

I would argue that musicians encounter these kinds of questions regularly but are perhaps not naturally attuned to thinking about them in a rigorous or philosophical way, as it were. A composer, for instance, might sit at a piano to work through a melody or a harmony with the understanding that the material they create will eventually be assigned to a different instrument. They might have a particular instrument already in mind, in which case they'll actively compose with that instrument's idiom and affordances taken into account. Or perhaps they've not yet considered the orchestration of their music and are aware that they may need to later adjust the material to suit the sounding body. Are the results, then, of such decision-making simply a pedantic afterthought? Is the difference between a violin and a flute simply that one sounds like a violin and the other sounds like a flute? Even in the context of

acousmatic music, a quasi-academic compositional practice intended for music that is to be heard exclusively through loudspeakers and which necessarily results in the removal of any overt connection to sound sources, we relegate ourselves to a decidedly basic form of timbral communication. Sounds are described as "harsh" or "smooth," "intense" or "unsettling," and the music itself is perhaps typified as being largely "delicate" or "overwhelming." This language of course leaves much to be desired, but the bigger questions concerning timbre as it relates to experience, meaning, and affect are all but absent.

Recorded music and its associated art of production – a kind of electronic counterpart to orchestration – fares a bit better in terms of respecting the affective impact of timbre. The producer of recorded music has one foot on the land of the technical and the other foot in the waters of the aesthetic. They make decisions about how the recording should sound (one could say that they determine the 'timbre' of the recording) and then connect those aesthetic goals with the relevant technological tools and engineering processes required to get there. Whether the listener is aware or not, the production decisions that characterize the sound of a recording within the realm of popular music are often just as intrinsic to the recognition of musical style as the more typical parameters of rhythm, harmony, or form. The Brazilian bossa nova style, for instance, is easily recognizable not only by its syncopated samba rhythm but also by the qualitative aspects of its representative recordings, which achieve a unique sense of intimacy by way of close microphone placement in relation to the guitar and voice. Instrumentation, as it concerns musical style or historical era, is usually something that we tend to have slightly more cognizance of but, even then, we are rarely made aware of the historical or socio-political reasons for such realities. The guitar, for instance, is widely known for its prevalence in the musical traditions of Latin America, but its colonial roots and subsequent cultural functions are less discussed. And even rarer still are we wont to seriously imagine the range of impact between musical

instruments and sonic experience, between the people who interact with instruments and the psychological worlds that they create. Bossa nova is indeed a rhythmically oriented music and, of course, the guitar is often the central instrument. But as Brazilian musician Arthur Verocai contends regarding how João Gilberto initially adapted the samba rhythm specifically for the six-string classical guitar and its idiomatic fingerstyle playing technique, "If the guitar didn't exist, then neither would bossa nova."[1]

Organology, or the formalized study of musical instruments, is a relatively recent albeit distinctly antiquated discipline. As we'll see, it tends to define musical instruments and the sounds they produce from a measurable, positivistic perspective: one understands a musical instrument in terms of material design and construction, the way that vibrational changes in air pressure are generated, and the frequency spectra that result; similarly, one can understand timbre neurologically, the way the ear and brain translate those changes in air pressure with reference to our mental catalog of descriptive language. This understanding of sound in physical, acoustic, and cognitive terms is of course important and useful, but it does little to assert the significance of timbre beyond the boundaries of the literal. Musicological discourse also tends to place higher value on discrete musical constructs such as melody, harmonic progression, and rhythm, often leaving more emergent concepts such as timbre and texture at a seemingly unknowable distance. The broader and far more recent field of timbre studies has done great work to begin expanding the foundations of traditional organology, adjacent to timbral discourse around subjects like electronic music, recording technology, music performance and embodiment, perception and psychoacoustics, ecstatic sonic experience, and tuning and harmony, to name just a few. I sense, however, the lacuna of an overarching and deliberate through line, a framework that

[1] "Arthur Verocai," Red Bull Music Academy, accessed April 2022, www.redbullmusicacademy.com/lectures/arthur-verocai-seriado-serials.

could provide a comprehensive way of knowing and experiencing musical instruments that gestures toward a more profound and holistic understanding of timbre. As prolegomenon, I hope to offer a modest but meaningful contribution to the burgeoning field of critical organology with two primary goals: first, to emancipate the field of organology from the confines of its physical and historical biases; and second, and to situate timbre poetically within the realm of aesthetic experience.

ii. *Methodology and scope*

My methodological approach is drawn primarily from my personal experiences as a composer and performer of electroacoustic and experimental music, my decade-long employment as a researcher and docent at a musical instrument museum, and my academic background in philosophy, which focused largely on phenomenology, an area of inquiry concerned with articulating the nature of subjective experience. I studied the piano throughout my youth, working my way through Canada's Royal Conservatory of Music system of performance and theory, and was therefore well prepared to accept a position as a tour guide and collections researcher at the National Music Centre, known then as Cantos Music Foundation, located in my hometown of Calgary, Alberta. At this time the organization was exclusively focused on telling the story of keyboard instruments, both acoustic and electronic, through the aid of a "living" collection. This meant that tour guides were expected to craft historical and technological narratives while also demonstrating period-appropriate music on the respective instruments. I realized very quickly in this work that the 'keyboard' is not an instrument in itself but rather an interface, a means of selecting pitches that determines very little about the specifics of the instrument and how it produces its sound. The harpsichord, for instance, with its mechanized system of string plucking, is miles away from the modern piano, with its mechanized system of string striking. And nor is the harpsichord anything like a clavichord, nor a pipe organ, nor an electric organ for that matter, nor a Mellotron, nor a synthesizer; all 'keyboard' instruments in the general sense of

the word. When I was young, I regretted being given the piano as my instrument – I loved the sustaining qualities of the orchestral strings and had longed to play the cello – and when I eventually became interested in microtonality and historical tuning systems, it seemed that the piano, locked in its twelve-tone equal temperament, was useless to me. What I came to realize, however, was that identifying as a (generic) keyboard player could in fact be a blessing in disguise as it allowed for what was arguably my most valuable conceptual encounter with organology: at the keyboard, I now had access to myriad musical instruments and could come to know their differences and idiosyncrasies intimately, as a player. And, of course, it was a short mental step from there toward deeper awareness of further levels of difference: for instance, not all harpsichords are the same. Italian harpsichords, with their lighter construction and lower string tension, feel quite different from the heavier and more intricate designs of their Flemish counterparts, but they also speak differently due, in part, to the greater prevalence of the sympathetic vibrations that such acoustic architecture conditions. I was already aware as a pianist that a Steinway can be quite a different beast from a Yamaha, that one is often better suited to certain repertoire than the other, but I began during this time to explore this phenomenon in a more nuanced way; to not only interrogate these differences gesturally but also in terms of meaning, with the sense that the instrument itself is just one component of the more complex affective experience of its sound.

At approximately the same time in my life, and likely in response to my disidentification with the piano and the classical performance culture that surrounded it, I began to develop an innate interest in music composition. I was smitten in my teenage years with the music of Chopin, with its beautiful chords, cadences, and suspensions, and its reliance on rubato to emphasize the moment. On the piano, however, even the most extravagant rubato provided nowhere near enough time for me: the sound simply decays too quickly, and I found myself longing for the opportunity to explore harmonies in

extreme slow motion, to hit pause, as it were, and enter the vertical space of the sound.[2] This desire led, not surprisingly, to an interest in so-called minimalist music, especially the strands that center the timbral experience. The work of composers such as La Monte Young, Terry Riley, James Tenney, and Éliane Radigue were especially influential on my approach; Young in particular has articulated his fascination with the interiority of sounds at length, stating that his early compositional interests were concerned with, "getting inside [sounds] to some extent so that we can experience another world."[3] In the visual domain, minimalist thinking gives priority to overlooked formal elements – parameters such as color, texture, and shape – which are otherwise usually treated as tools, as a structural means to an end, rather than as aesthetic objects in themselves. Indeed, in my early minimalist musings, I was interested in chords and cadences almost entirely outside of their functional context; I was interested specifically in 'the sound of' a chord, and all the experiences that come with such a listening experience.

Very quickly, my compositional practice developed into what I would characterize as a composer-performer approach. This identifier is significant for me: it of course implies that I am both the composer and primary performer of my music, which is true in most but not all cases of the music that I write, but it also signals a critical connection between the creation of my music and the real-time interpretation of it, whether by me or by another. While many composers work indirectly, writing notes onto a page and ostensibly just imagining how they might sound in their final form, I learned to work in response to the acoustic realities of the generated sound, constantly refining the music through a back-and-forth negotiation between a player's actions and the resulting sound. Just as a player can control and alter the course of their instrument, so too can the instrument direct the perceptions and

[2] In tuning theory, 'vertical' is sometimes used to distinguish the spatial or timbral experience of harmony from its conventional musical function, as a horizontal structuring of chord progression.

[3] Keith Potter, *Four Musical Minimalists: La Monte Young, Terry Riley, Steve Reich, Philip Glass* (Cambridge, UK: Cambridge University Press, 2002), 47.

chosen articulations of the player. By incorporating the language and disposition of the instrument and its latent sound world into the compositional process, I have developed a deep reverence for the dialogic relationship between instruments and their players, and the impact that this relationship can have on musical meaning. My early predilection for studio-based electroacoustic composition, which treats sounds as quasi-sculptural objects and relies on real-time listening as a necessary component, suited both of these interests. In the acoustic domain, it was the organ (both pipe organs and larger reed organs) that drew me in and continues to fascinate me today. I was initially attracted to the organ's limitless sustain as a way to extend chords and harmonies long enough to explore their innards. But as my interactions with these instruments developed and deepened over the years, I also recognized that my appreciation for the autographic nature of timbre has been deeply influenced by the practice of composing for and performing with large pipe organs in particular, which necessarily requires some level of adaptation between instruments since these are singular beings, both in their design (similarities between instruments are common but exact replicas are very much not) and in the fact that they are in conversation with the unique physical-acoustic space in which they are installed. As a result, the same "music" performed on different instruments in different spaces will change with each iteration, sometimes quite drastically and sometimes more subtly but in no way less profoundly. This reinforces for me the idea that each sounding experience is its own entity.

My academic studies in philosophy and in particular phenomenology, all of which also curiously began to develop at around the same time in my life, have similarly had an enormous and especially salient impact on my relationships with organology, timbre, and sound more generally. The study of musical instruments is inextricably linked to discussions of timbre and understanding timbre as an expression of 'the sound of' (something) is, in my view, necessarily a phenomenological question. Specifying how sound is generated (by way of exploring the materials, design, and construction of sounding bodies)

and processing how sound is coded on a neuro-cognitive level are certainly necessary but not sufficient in truly appreciating what it means to consider 'the sound of' any sonic entity. From my perspective, such boundaries are plagued by an explanatory gap in their attempts to describe 'mind' in terms of 'meat,' as it were.[4]

Indeed, the entire experiential framework of sound can and ought to be reconfigured as subjective, mediated by perception, interpretation, and embodiment. Phenomenology and its neighboring field of hermeneutics, which focuses on the process of interpretation, figure prominently in the latter part of this thesis; for now, though, it's worth briefly elucidating my title, *From the Ruins of the Literal*, borrowed from the late French philosopher Paul Ricoeur. In many early essays, and particularly in *The Rule of Metaphor* (1975), Ricoeur asserts that the ability of metaphor as a rhetorical device to describe poetic experience has been overlooked. He cites the familiar dyadic structure of metaphor, juxtaposing elements which do not normally relate in a literal sense, and then goes on to posit that the power of metaphor goes well beyond a simple substitution of terms. Rather, the negation of literal meaning that occurs in the metaphor's deliberate non-sense allows the reader's imagination to take over, generating a new reality and, ultimately, a new truth. It's not, then, a matter of merely revealing a hidden or absent relationship but rather one of creating and building in the mind a relationship which previously didn't exist, and which is critically distinct in terms of impact. As Ricoeur said, "It is in the moment of the emergence of a new meaning from the ruins of literal predication that imagination offers its specific mediation."[5] Musical timbre, I believe, has long been poised to transcend its literal bias toward the

[4] The 'explanatory gap,' as coined by philosopher Joseph Levine, is a concept borrowed from inquiries into the philosophy of mind. It accounts for the limitations of physicalist philosophies, which fail to describe any sort of causal connection between physical, empirical properties and the nature of felt, subjective experience.

[5] Paul Ricoeur, "The Function of Fiction in Shaping Reality," in *A Ricoeur Reader: Reflection and Imagination*, ed. Mario J. Valdés (Toronto: University of Toronto Press, 1991), 130.

acoustic in a similar way, acknowledging the power of subjective interaction as a catalyst for altogether new worlds, affects, and meanings.

Before sketching this discussion's basic outline, I feel it necessary to clarify the scope and limitations of my project. Given the unique dialogic relationship mentioned earlier between instrument and player, and in favor of underscoring its importance in the production of sonic meaning, this discussion draws heavily on my personal experience of connection to keyboard instruments both acoustic and electronic. My compositional practice as it pertains to minimalist music specifically and experimental music more generally will similarly take precedence, alongside a broader musicological expertise in so-called 'early music' (that is, Western/European art music of the Medieval, Renaissance, and Baroque periods), especially as it relates to the history of tuning and temperament; and popular music, particularly as it relates to the art of record production and the creative function of the recording studio. It's also worth pointing out that these areas of inquiry exist largely outside the realm of the common practice of mainstream 'classical music,' and as such I also feel a personal obligation to normalize them in philosophical and musicological discourse as much as possible. My hope for this project is not to be exhaustive (an impossible task, anyway) but rather to provide an opening for further discussion by other scholar-musicians who choose to apply these expanded concepts and tools to their own instrumental and musical practices.

iii. *Project overview*

The following chapter offers a concise historical overview of the field of organology, surveying its main contributors and highlighting the steps that have been taken thus far to develop and deepen the modern understanding of what musical instruments are. Most critically, this foundational chapter will solidify what I perceive to be an indisputable link between organology and timbre, with the

understanding of timbre as 'the sound of...' and all that such a description entails. It will also begin to address the limitations of conventional approaches while establishing what I will critique as the 'historical' and 'physical' biases of traditional organology. The third and fourth chapters interrogate these historical and physical biases in greater detail. A pointed assessment of the historical bias of traditional organology primarily aims to challenge the prevailing narrative which privileges an illusion of progress. As we'll see, the evolution of musical instruments is not in fact a straight arrow of increasingly modernist sophistication, but rather a decidedly crooked path with numerous modes of expression which have been overlooked and/or pigeon-holed at best and rendered obsolete at worst. Addressing the deficiencies of the physical bias offers an invaluable opportunity to assert new dimensions for understanding musical instruments and timbre, for instance in terms of *affordance*, *idiom*, *embodiment*, *dialogic interaction*, *actor-network* theory, and *immanence*, to name just a few categories central to this project. This chapter also advances an appreciation of timbre as an emergent phenomenon, expanding and mirroring 'the sound of' something singular, like a musical instrument, into 'the sound of' a more compound or total sonic world, like that of an audio recording.[6]

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[6] These terms (affordance, idiom, embodiment, etc.) arise frequently in recent musicological discourse on timbre, which is also doing important work to articulate it as a phenomenon that is both dialogic and emergent. Several essays in *The Relentless Pursuit of Tone*, edited by Robert Fink, Melinda Latour, and Zachary Wallmark, explore these terms within a timbral context, particularly within the section that deals with record production as a form of mediation. In Jan Butler's contribution, which contrasts authenticity as it relates to live performance and recording practices in southern and northern California in the late 1960s, timbre is expressed as both a consequence of technological innovations and performance techniques, creating a more expansive appreciation of 'idiom.' Particularly interesting here is the idea of 'proxemics' (that is, the interpersonal distance between performer, listener, and surrounding musical environment), which alludes to the dialogic nature of sounding experience while also underscoring its contextual dynamics. Albin Zak focuses specifically on the stratification of recording techniques, reinforcing the notion that modern recorded spaces are constructed and imaginary (and thus one could say mentally 'emergent'), with individual components fitting into a larger structure, and the whole affair imbued with a certain sonic imprint. Paul Théberge explores this idea of 'space' directly in relation to reverb, asserting that such timbral considerations are not merely representational, as in the reproduction of an acoustic space, but that they also carry important extramusical meanings as well, especially as they aim for the creation of altogether new environments. Simon Zagorski-Thomas' contribution, which is greatly expanded upon in *The Musicology of Record Production*, illuminates the cognitive processes of interpretation through schematic representation, with special attention paid to concepts of affordance, embodiment, and mediation. Zagorski-Thomas also delves into the notion of timbre as an emergent property, one that arises in what we could describe as a kind of actor network, and one that is 'total' insofar as it resists isolation from its environment. He even pointedly references the structure of metaphor and its unique hermeneutical function, which similarly configures across our primary 'lived in' experience and that of the external

The fifth chapter focuses entirely on this emergent aspect, exploring the broader 'total' concept of timbre and 'the sound of' complex sonic experiences. Its burden is that a sounding object (referring to a larger category, including musical instruments like the piano as well as objects or systems that behave like musical instruments and function in a timbral way but that we wouldn't ordinarily identify as such, like a microphone or an audio recording) transcends the mere sum of its parts, so to speak, and that the phenomenon of 'timbre' can therefore occur on a multitude of levels. The sixth chapter turns to a close examination of the mediated nature of our encounters with this multi-leveled timbral construct. As we'll see, the mediated experience also presupposes a kind of poetic transcendent structure; an implied transition from first-order sensation to a second order of feeling, affect, and understanding. This chapter borrows heavily from phenomenology (with a particular emphasis on Ricoeur's metaphor theory) and hermeneutics, as well as from literary analyses that deal with immanence, transcendence, and emergence in musical encounters.[7] Finally, the seventh chapter offers

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world. Of course, my reference to *actor-network* theory is also indebted to the work of Bruno Latour, who first developed the concept in his study of complex social networks. As in the discourse of traditional organology, though, I find these musicological investigations of timbre to be significant and necessary but still falling short in offering a rigorous exploration of the affective dimensions of timbral experience, with too much reliance upon neural-cognitive models of perception. Even as these recent musicological investigations reach toward a firm foundation of timbre as emergent, whether implicitly or explicitly, there is a distinct lack of discussion on what it is that emerges and what it can mean. As we'll address in the fourth chapter, this thesis builds on these terms, sometimes suggesting alternate or expanded connotations, while also beginning to establish their critical function in the affective, and not just perceptual, dimensions of timbre. [Robert Fink, Melinda Latour, and Zachary Wallmark, eds., *The Relentless Pursuit of Tone: Timbre in Popular Music* (Oxford: Oxford University Press, 2018); Simon Zagorski-Thomas, *The Musicology of Record Production* (Cambridge, UK: Cambridge University Press, 2014).]

[7] Ricoeur provides the main discursive exposition for this chapter, primarily in relation to his metaphor theory. The writings of several other thinkers from the phenomenological tradition must also be explored in order to get a full picture of how emergence, embodiment, transcendence, and meaning arise in aesthetic experience, which of course includes sounding experience. In Mikel Dufrenne's *The Phenomenology of Aesthetic Experience*, for instance, we understand the resultant of aesthetic experience to be a kind of 'world,' which can perhaps offer an answer to the question of what arises on the other end of the emergent cycle. For both Dufrenne and Ricoeur, aestheticizing is not about representation but rather it's a process that generates new meaning and new truth. In relation to theories of perception, Maurice Merleau-Ponty has left an indelible mark: in *Phenomenology of Perception*, he asserts the embodied nature of all experience, not as a mere bridge between the external world and the cognitive realm, but rather as an active participant in the network. Later works such as *Sense and Non-Sense* tackle the process of transformation from first order prosaic experience to second order feeling and affect, offering a rigorous structure that could serve to

a few key summarizing thoughts as well as suggestions for additional avenues forward with alternative objects of study.

elegantly supplement the stimulus-response framework of mainstream psychology. In *Truth and Method*, Hans-Georg Gadamer provides a useful counterpoint to the concept of dialogic interaction in his concept of 'play,' which is not just about physical interactions with works of art (or gestural interactions with instruments, etc.) but also mental ones. Although these philosophical inquiries are able to provide a much-needed expansion into the affective dimension of timbre, it's important to point out that none of these works deal with music and sound explicitly. Ricoeur, especially, limited much of his writing to the field of narrative fiction. This lack of engagement with music is a notable problem across much of the philosophical discourse in aesthetics and perception. Even those who have addressed musical considerations head-on (either as musicologist-philosophers or as philosophers of music, including Theodore Adorno, Peter Kivy, Thomas Clifton, Roger Savage, Lydia Goehr, Eduard Hanslick, Carl Dahlhaus, Jean-Luc Nancy, Roger Kendall, and Lawrence Kramer, among others) tend to do so from traditional perspectives, primarily exploring the Western canon and its conventional musical forms. [Mikel Dufrenne, *The Phenomenology of Aesthetic Experience* (Evanston: Northwestern University Press, 1973); Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Colin Smith (London: Routledge, 1966); Maurice Merleau-Ponty, *Sense and Non-Sense*, trans. Hubert L. Dreyfus and Patricia Allen Dreyfus (Evanston: Northwestern University Press, 1964); Hans-Georg Gadamer, *Truth and Method*, trans. Joel Weinsheimer and Donald G. Marshall (New York: Crossroad, 1991).]

CHAPTER TWO

WHAT IS ORGANOLOGY? A REVIEW OF THE FIELD AND ITS LIMITATIONS

i. *A historical survey of organology*

Organology is a modern field of study, a product of the early twentieth century and its fraught relationship with the colonialist roots of what at the time was called 'comparative' musicology. As Western (at the time, mostly European) musicologists began to extend their interests toward the musical traditions and practices of non-European cultures, so too did their curiosity about respective musical instruments naturally begin to develop. Early organological discussions were also largely comparative, highlighting similarities among the contemporaneous instruments of European art and folk music, but soon developed into essentializing taxonomies of musical instrument types.[8] The early twentieth century saw the academic foundation and stratification of many subfields within the domains of music theory and musicology; curiously, traditional organology doesn't tend to directly identify the rise and institutionalization of antiquarianism (the study of the distant past) and historiography (the art of historical writing, which also implies the ethics of "doing" history) as especially important to the development of the field. Still, it's easy to imagine that the resultant formulation of so-called 'early' music as a concept and dedicated object of study in Western musicology would also have had a significant impact on the study of musical instruments, expanding research beyond the geographical and into the temporal as well.[9]

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[8] Nazir Jairazbhoy, "The Beginnings of Organology and Ethnomusicology in the West," *UCLA Selected Reports in Ethnomusicology* 8 (1990), 70.

[9] According to musicologist John Haines, the first expression of early music revival at the turn of the twentieth century did indeed emerge as a byproduct of antiquarian interest and was explored in large part in relation to the study of obsolete musical instruments. With respect to their reconstruction, there were two popular approaches that developed at roughly the same time but that were vastly different in concept: on the one hand, reputable piano builders such as Érard and Pleyel of France were pioneering 'revival' instruments (harpsichords, in this case) that fused traditional designs with modern industrial piano-building techniques – these instruments were larger, heavier, and produced quite a different timbre on account of their increased tension; on the other hand, instrument

Most readers are probably familiar with the four sections of the European classical orchestra: strings, brass, woodwinds, and percussion, with certain liminal instruments, the piano, harp, and organ, set apart to reflect the way they are compositionally highlighted against a unified orchestral texture. Leaving aside the total absence of electronics, this popular categorization is still very much at odds with the conventions of traditional organology, which defines musical instruments not according to what they are made of or how they are used, but by the method in which sound (vibration) is propagated through the instrument. It's important to note that this system does not primarily describe *how* vibration is generated (for instance, whether a string is plucked, struck, or bowed) but rather *what* is vibrating (a string, an animal skin, a piece of metal, etc.). Thus the organological approach separates musical instruments into *aerophones* (vibrations resonating in air through a tube), *chordophones* (vibrations resonating through strings), *idiophones* (vibrations resonating through solid objects, such as metal or wood), and *membranophones* (vibrations resonating across a stretched membrane). The method in which vibration is instigated (striking, plucking, etc.) as well as the physical material, plurality (single or double reed, for instance), tuning (pitched or non-pitched), and shape (framed or free-standing, for instance) are generic sub-categories. In the orchestral domain, the piano is often viewed as a percussion instrument, in the same world as the xylophone or the bass drum, because its strings are struck by mallets. In the organological model, however, the piano (chordophone), bass drum (membranophone), and xylophone (idiophone) belong to quite different instrument categories with different timbral implications.

enthusiasts such as the English craftsman, Arnold Dolmetsch, were interested in producing more accurate historical replicas based on extant design schematics. [John Haines, "Antiquarian Nostalgia and the Institutionalization of Early Music," in *The Oxford Handbook of Music Revivals* (Oxford: Oxford University Press, 2014).]

This classification system, first articulated in the early twentieth century by the Austrian ethnomusicologist Erich von Hornbostel (1877-1935) and the German musicologist Curt Sachs (1881-1959) is the basis of most traditional organology.[10] With emphasis placed on how sound travels into the acoustic realm, the Hornbostel-Sachs system provided European ethnologists a scientific and universal framework for understanding musical instruments across cultures and time. Both scholars are considered foundational figures for the academic study of music in the Anglophone world. Both were also heavily influenced by the Belgian musicologist and proto-organologist Victor-Charles Mahillon (1841-1924), who was the inaugural curator of the musical instrument collection at the Brussels Royal Music Conservatory and who is considered to have initiated the first systematic approach to categorizing musical instruments in the late nineteenth century.[11]

Of course, musicians have intuited and expressed deep connections to their instruments and the ways they can be understood and experienced since long before organology became a formalized and academic field of inquiry. According to Curt Sachs, in Mesopotamia – comprising much of present-day Iraq, Syria, and Turkey – the Sumerians and Babylonians were thought to have had a predilection for idiophone percussive instruments such as drums and rattles, while ancient Egyptians expressed in their strong visual culture a reverence for wind instruments such as flutes and reed pipes.[12] Idiophones were prominent in ancient China also, but during the Bronze Age dynasty of the Zhou their timbral predilections narrowed toward metals such as bells and gongs.[13] Both idiophones, again mostly drums

[10] See "Systematik Der Musikinstrumente," co-authored by both Hornbostel and Sachs, and published by the German *Zeitschrift Für Ethnologie* [Erich M. von Hornbostel and Curt Sachs, "Systematik Der Musikinstrumente," *Zeitschrift Für Ethnologie* 46.4/5 (1914): 553-590].

[11] Jairazbhoy, "The Beginnings of Organology," 72.

[12] Curt Sachs, *The History of Musical Instruments* (Mineola, NY: Dover, 2006), 68, 86-90.

[13] Sachs, *The History of Musical Instruments*, 151-157.

and rattles, and aerophones, especially flutes, seem to have been equally elevated in the musical traditions of the Maya, Aztecs, and Inca, with a near complete absence of stringed instruments. And through the Indus and Vedic periods of ancient India, Sachs notes the presence of overlapping instrumental influences that reflect the migration and trade patterns of the region.[14] Musical instruments of antiquity were also believed to have been imbued with great symbolic and ritualistic significance, serving as conduits for communal expression and spiritual devotion, which seems to support at least an initial foundation for the classification of instruments based not just on material and sound production mechanism but also on function.

Given the numerous pagan associations that many musical instruments held over from antiquity, a distinct schism seems to have formed in the deeply pious societies of medieval Europe in which the structures of musical thought (composition and performance) and the tools required to manifest sound (instruments) were sharply separated, with apparently little rigorous discussion occurring on matters of the latter.[15] Of the limited instrument theory that did emerge during this time, the system put forth by the late Roman mathematician Boethius (470–524) remained influential at least through the fourteenth century.[16] Inspired by Greek music theory, and especially the writings of Aristotle, Boethius divided what he recognized as *musica instrumentalis* – instrumental music, which is to say music that 'belongs to man' – into the categories of 'animate' and 'inanimate.' The animate demarcation encompassed the voice, given heightened significance in its perception of being divine, while the inanimate demarcation encompassed the lowly musical instruments. Within the latter were 'strings,'

[14] Sachs, *The History of Musical Instruments*, 162-170.

[15] Margaret Kartomi, *On Concepts and Classifications of Musical Instruments* (Chicago: University of Chicago Press, 1990), 139.

[16] Other fringe treatises, such as those by Isadore of Seville and Guido of Arezzo, gave more general divisions based on acoustic properties and were likely also influential upon Mahillon's methodology.

'wind,' and 'percussion,' in decreasing order of sacred status. Later, other categories arose to classify instruments according to social hierarchy, ceremonial function, moral affect, and now-obscured considerations of "that which is eternal" versus "that which is time-bound."[17] A common distinction was between 'high' (loud) instruments, such as trumpets and shawms, intended for outdoor use, and 'low' (soft) instruments, such as lutes and harps, reserved for intimate, typically indoor performances. Classifications were also intertwined with symbolic meaning: trumpets, for example, were often associated with power and authority, used to announce the presence of nobility or to signal military commands; in contrast, plucked instruments such as the lute were associated with courtly love and refined, introspective entertainment.[18]

In the ninth century, the first major rupture of this fundamentally religious schema was proposed within an anonymous Byzantine treatise that forwent spiritual concerns for alchemical – that is 'scientific' – inquiries. This system maintained the categories of percussion, wind, and strings, but classified internal divisions by material and mode of performance. By the thirteenth and fourteenth centuries, the humanistic and empirical foundations of what would later be called the Renaissance were beginning to emerge, and instrument theory became increasingly secularized within a larger view of musical function. New interest in keyboard instruments blossomed in the fourteenth and fifteenth centuries, with classifications often based upon morphological differences. The taxonomy put forth by the Italian theorist and composer, Gioseffo Zarlino (1517-1590) proved most useful during this time, with its adherence to vernacular language rather than the established Latin, reference to scales and tuning systems, detailed drawings and diagrams to illustrate technical function, and acceptance of

[17] Kartomi, *On Concepts and Classifications*, 140-141.

[18] Kartomi, *On Concepts and Classifications*, 143.

musical instruments primarily as performance objects.[19] Of course, instrument building also flourished throughout the Renaissance; the concomitant proliferation of workshops and guilds for instrument makers, as well as technical treatises by composer-theorists like Michael Praetorius (1571-1621) and Marin Mersenne (1588-1648), further fostered a culture of insight, collaboration, and exchange. The Renaissance also marked the beginning of European imperialism, resulting in a forced and fractured syncretism of instrumental interactions as well as a complete shift in the construction materials that colonizing countries were now extracting from indigenous environments.[20]

The history of the acoustic guitar offers a useful illustration: the six-string guitar is deeply embedded in the timbral and cultural landscape of Latin America primarily on account of its arrival via Spanish and Portuguese settlers. Curiously, the guitar – or more accurately, the *vihuela de mano,* its fifteenth-century ancestor – was not an especially widespread instrument at the time. During the Renaissance, the vihuela was largely supplanted by the lute, the presiding stringed instrument of the era. The lute itself is a descendent of the oud, an instrument of similar shape and sound that developed in the Arabic and Persian regions of southwest Asia and traveled to Europe with Islamic expansion into the Iberian Peninsula in the eighth century CE. The vihuela, too, is often considered a descendant of the oud in that it uses the same tuning as well as coursed stringing (multiple strings per note) and a short neck. It differs, however, in one critical way: the body of the vihuela is flat and elongated, while the bodies of both the oud and the lute are teardrop shaped, with a rounded back fashioned like a gourd. Perhaps keen to maintain some sense of cultural distance from both the Moorish musicians living and

[19] James Tenney, *A History of Consonance and Dissonance*, 1st ed. (New York: Excelsior Music Publishing Company, 1998), 40-43.

[20] Many of these hybrid instruments persist today – instruments such as the banjo, for instance, which was adapted from its African origins by enslaved musicians as a means of cultural memorialization, and then appropriated into the defining sound of American bluegrass music – while the original iterations were often suppressed into erasure.

working in Andalusian Spain as well as from the rest of the European continent, which had wholeheartedly embraced the lute by the start of the Renaissance, Spanish and Portuguese settlers chose to claim the vihuela as a detail of their imperial project. The sound and construction of the modern guitar was also enabled by colonialist plundering of the natural world: one of the determining factors of a high-quality acoustic stringed instrument is its use of tone-woods like Brazilian rosewood, well regarded for its resonant qualities and now, due to its vulnerable conservation status, a highly regulated material for the back and side construction of both steel- and nylon-string guitars.

Naturally, the advent of the Industrial Revolution radically changed the way instruments were designed and constructed, as technological advancements and mass production techniques proliferated rapidly and wildly. When we interrogate the historical bias of traditional organology in the next chapter, we'll see that the trajectory of instrument function in the seventeenth through nineteenth centuries (the 'common practice period' that gave rise to the Western musical canon) did not necessarily reflect the tonal interests of the time, but did engender the same yearning for standardization and quantification that would soon come to plague the conceptually limited underpinnings of traditional organology.

ii. *A review of the literature*

Since the days of Sachs and Hornbostel, a small but dedicated body of scholarship has defined the modern practice of organology, still a relatively niche subject within the discipline of what American scholars, following their German mentors, defined as a 'systematic' musicology. Among the field's most notable contributors are Bruno Nettl (1930-2020), Sybil Marcuse (1911-2003), Nazir Ali Jairazbhoy (1927-2009), Mantle Hood (1918-2005), and, perhaps most importantly, Margaret Kartomi (b. 1940), who was really the first to critically assess the state of the field and offer a new path forward in the early 1990s. Their late-twentieth century research, to which all students of organology remain

indebted, has determined how music scholars situate musical instruments both historically and culturally, usually through roughly the same material categorizations articulated by Sachs and Hornbostel, but challenging the narrow Eurocentric boundaries of the subject's formal inception. The early 1990s was something of a defining moment, starting with a 1990 issue of UCLA's *Selected Reports in Ethnomusicology* dedicated entirely to essays in organology.[21] Late twentieth century organologists also revolutionized the ethnographic study of musical instrument cultures, documenting compositional and performance practices and observing the aesthetic, sociological, and ecstatic functions, both sacred and secular, of musical instruments. As a byproduct of their efforts, a number of museums and archives dedicated specifically to the study and interpretation of musical instruments have emerged throughout the last half century as well.[22]

Scholars from adjacent fields have also contributed organological insights from within the sciences: from acoustics and psychoacoustics, which often touch upon instrument construction and design as well as timbre as a function of frequency spectra; and from cognitive neuroscience, which defines timbre as a psycho-physiological phenomenon that starts with vibrations propagating through air and then filtered by the outer ear, transduced by the inner ear, and translated by the brain into patterns of

[21] See: Sue Carole DeVale ed., *UCLA Select Reports in Ethnomusicology* 8 (1990): Issues in Organology.

[22] Notable among museums are the musical instrument collections and archives at the Musical Instrument Museum in Brussels (an extension of Mahillon's collection at the Brussels Royal Music Conservatory), The Metropolitan Museum of Art (New York, New York, USA), Yale University (New Haven, Connecticut, USA), The Royal College of Music (London, UK), The University of Leipzig (Leipzig, Germany), The Museum of Musical Instruments (Hamamatsu, Japan), Cité de la musique at the Philharmonie de Paris (Paris, France), The Musical Instrument Museum (Phoenix, Arizona, USA), Oxford University (Oxford, UK), The National Music Museum (Vermillion, South Dakota, USA), The National Music Centre (Calgary, Alberta, Canada), The Musikinstrumenten-Museum (Berlin, Germany), and The San Colombano Museum (Bologna, Italy). Alongside extensive ethnographic archives at institutions such as The Smithsonian and The Library of Congress in the United States, several academic institutions also hold important audio-visual archives pertaining to musical instruments, including a notable example in the ethnomusicology department at UCLA. Professional international organizations designed to support organological research have also developed concurrently, including the American Musical Instrument Society (AMIS), which formed in 1971.

neuronal excitation we experience as sound. The American acoustician Arthur Benade (1925-1987) devoted his entire career to the study of musical instruments, and his landmark *The Fundamentals of Musical Acoustics* (1976) is still regarded as a seminal text in the field.[23] What we know of timbre comes from this kind of research: we understand that flutes sound as they do to us because they emphasize the fundamental harmonic, while clarinets sound as they do to us because they also reinforce the odd-numbered harmonics above the fundamental. We also accept that the sound of the flute is dictated by its transverse passage of air through a cylindrical tube, while the sound of the clarinet is determined by its passage of air across a single wooden reed, a cylindrical bore, and a conic bell. Many instrument builders of the eighteenth and especially nineteenth centuries wrote in detail about their innovations, with key contributions from Theobald Boehm (1794-1881), the designer of the modern concert flute and its fingering system; and Adolphe Sax (1814-1894), inventor of a whole series of saxhorns including the ubiquitous saxophone, a kind of hybrid instrument with the mind of a woodwind and the heart of brass. In the twentieth century, numerous texts dedicated to the detailed elaboration of specific instruments and families of instruments emerged, combining design and construction, acoustic and spectral properties, and historical context to outline the evolution of musical instruments.[24] Without doubt the most notable of these was Curt Sachs' own *The History of Musical*

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[23] Other important texts that espouse a similar acoustic, spectrographic, or physiological focus include Hermann von Helmholtz's *On the Sensations of Tone*, the *Timbre: Acoustics, Perception, and Cognition* compiled volume edited by Kai Siedenburg and Charalampos Saitis, David Butler's *The Musician's Guide to Perception and Cognition*, Robert Cogan's *New Images of Musical Sound*, David Howard and James Angus' *Acoustics and Psychoacoustics*, and Myles Jackson's *Harmonious Triads*, which proposes an almost sacred union between science, music, and instrument design. [Hermann von Helmholtz, *On the Sensations of Tone as a Physiological Basis for the Theory of Music*, trans. Alexander J. Ellis (New York: Dover Publications, 1954); Kai Siedenburg and Charalampos Saitis, eds. *Timbre: Acoustics, Perception, and Cognition* (New York: Springer, 2019); David Butler, *The Musician's Guide to Perception and Cognition* (New York: Schirmer, 1992); Robert Cogan, *New Images of Musical Sound* (Cambridge, MA: Harvard University Press, 1984); David M. Howard and James Angus, *Acoustics and Psychoacoustics* (Oxford: Focal Press, 2001); Myles Jackson, *Harmonious Triads: Physicists, Musicians, and Instrument Makers in Nineteenth-Century Germany* (Cambridge, MA: MIT Press, 2006).]

[24] Tom Evans' *Guitars: Music, History, Construction and Players from the Renaissance to Rock*, Peter Williams' *A New History of the Organ from the Greeks to the Present Day*, and David Rowland's *Early Keyboard Instruments: A Practical Guide* are all frequently cited examples of such texts. [Tom Evans, *Guitars: Music, History, Construction and Players from the Renaissance to Rock* (New York: Facts on File, 1982); Peter Williams, *A New History of the Organ from the Greeks to the Present Day*

Instruments, first published in 1940, which has served as the de facto handbook for organology ever since.

The bridge between organology and psychology is less straightforward and occasionally fraught. Many ongoing studies in cognitive neuroscience attempt to identify how the brain processes timbral information; even for non-specialists, these studies present a path toward deeper understanding of what actually happens when we listen. When the affective dimension of sound is under discussion in psychology, however, the perceptual realities of musical instruments and the poetic character of their sounds are often treated as some sort of ineffable or inarticulable entity.[25] The discourse around music perception retains the stimulus-response framework of mainstream psychology, positing a two-tiered

(Bloomington: Indiana University Press, 1980); David Rowland, *Early Keyboard Instruments: A Practical Guide* (Cambridge, UK: Cambridge University Press, 2001).]

[25] Jeanette Bicknell suggests in *Why Music Moves Us* that aesthetic emotions belong to a different domain than our everyday ones, and she recognizes that they are impacted by the listener's personal associations; she even suggests that there is some kind of imaginative evocation process at play but falls short in giving details of what that looks like and how it occurs. Teresa Brennan suggests in *The Transmission of Affect* that there can be some collective sense of experience, that we can participate in shared emotional experiences, but she fails to expand upon how this might happen and avoids explicit acknowledgement of aesthetic experience. In *The Musician's Guide to Perception and Cognition*, David Butler gives descriptions of perception and timbre that are rooted very strongly in the physical and cognitive domains; he delves into psychology and emotion but keeps both tethered to neurological parameters. *The Psychology of Music*, edited by Diana Deutsch, is a landmark text in this field, and although it does discuss timbre it does so from squarely physical, spectral, cognitive, and neural perspectives, suggesting that the affective domain is a so-called 'black box' that cannot be meaningfully accessed by anyone other than the subject. Several essays in *Timbre: Acoustics, Perception, and Cognition*, edited by Kai Siedenburg and Charalampos Saitis, suggest a link between timbre and emotion, but ultimately default to vague language (words such as 'warm' or 'bright') and the extremely limited notion of 'evocation,' which fails to recognize the depth of timbre's affective power. Vladimir Jankélévitch presumes the ineffability of music from the outright in *Music and the Ineffable*, where he suggests that music ought to bypass language altogether, precisely because of its emotive and sublime methods of communication. In *Music and Emotion: Theory and Research*, edited by Patrick Juslin and John Sloboda, there is reference to a semiotic (or symbolic) function of music, offering a suggestion for how musical experience communicates, but again this research falls entirely upon empirical data. [Jeanette Bicknell, *Why Music Moves Us* (New York: Palgrave Macmillan, 2009); Teresa Brennan, *The Transmission of Affect* (Ithaca: Cornell University Press, 2004); David Butler, *The Musician's Guide to Perception and Cognition* (New York: Schirmer, 1992); Diana Deutsch ed., *The Psychology of Music* (Orlando: Academic Press, 1982); Kai Siedenburg and Charalampos Saitis, eds. *Timbre: Acoustics, Perception, and Cognition* (New York: Springer, 2019); Vladimir Jankélévitch, *Music and the Ineffable*, trans. Carolyn Abbate (Princeton: Princeton University Press, 2003); Patrick N. Juslin and John A. Sloboda, eds., *Music and Emotion: Theory and Research* (Oxford: Oxford University Press, 2001).]

transition between the objective, physical properties of sensory stimuli and the subjective, typically unconscious or hidden responses that they evoke, including the domains of feeling and emotion.[26]

Surprisingly, the nature of the transition itself (never mind the nature of the subjective mental experience that follows) is rarely, if ever, described in any meaningful or rigorous way beyond the mere positioning of its existence. One *hears* something, and then one *feels* something. But what is it to hear something? What does the shift from 'hearing' to 'feeling' look like? One could argue that this is simply a limitation of language: the pithy vernacular terms frequently used to describe timbral experiences – 'harsh,' 'bright,' 'soft,' or 'warm,' for instance – can only go so far. And, of course, there is no guarantee that what one listener experiences as a 'warm' sound will be felt the same way by another. A nominalist argument fails because emotive linguistics are only useful in helping us name the details of subjective experience, which is different from articulating the nature of the experience itself. One can use such language to describe the inside of a house, pointing to different objects in the immediate environment, but this does not explicitly and fully inform us what a house *is* and what it means. From this angle, quantitative acoustic data about sound is abundant and readily available, but the qualitative aspects of hearing seem destined to float in the aether – timbre is knowable but apparently only to a degree. This intrinsic explanatory gap is what ethnomusicologist Cornelia Fales has identified as the "paradox" of timbre: despite this emergent phenomenon's key role in determining how we experience sound, our acoustic and psychological explanations for it always seem to fall short.[27]

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[26] R.A. Rasch and R. Plomp, "The Perception of Musical Tones," in *The Psychology of Music*, ed. Diana Deutsch (Orlando: Academic Press, 1982), 2.

[27] Cornelia Fales, "The Paradox of Timbre," *Ethnomusicology* 46.1 (2002): 58.

The Oxford Handbook of Timbre (2021), co-edited by musicologists Emily Dolan and Alexander Rehding, is a recent collection of essays that engage with this very issue, indicating a turning tide on our adherence to the acoustic, neuro-cognitive, and psychological models. Both Dolan and Rehding assert as their foundational thesis that 'timbre' is a complicated and overlooked term, straddling both materiality and abstraction, far too long reduced to the shape of its harmonic content (i.e. its frequency spectra). The essays in this volume largely focus on interrogating how we comprehend timbre and how we understand the perceptual side of things, to distill something concrete in opposition to the historical stance of ineffability. Two essays in particular, by musicologists Daniel Villegas Vélez and Robert Hasegawa, explore many of the critical perspectives that underscore this discussion. Vélez critiques both the nominalist and empiricist accounts of timbre: the nominalist approach elevates pitch and rhythm (i.e. 'the notes') above timbre, suggesting that the latter can be simplified to a difference in nomenclature (i.e. 'piano' or 'guitar,' with the implication being that all pianos and guitars are the same); the empiricist approach, as we've already seen, recognizes only the measurable properties of sound. In both cases, sound becomes an idealized phenomenon that is strictly physical, what's left over when all other parameters are accounted for.[28] And, as he warns, in the presence of such a severe reduction, "we lose grasp of [timbre's] quasi-transcendental status."[29] We'll directly address the transcendent nature of timbre when we appeal to phenomenological texts in the sixth chapter of this discussion, but it bears noting that this is a significant yet rarely acknowledged aspect of timbre's poetic function. For his part, Hasegawa cleverly uses harmony to illuminate timbre as an emergent phenomenon, suggesting that the former is an expression of the latter, which is more complex than

[28] Daniel Villegas Vélez, "The Matter of Timbre: Listening, Genealogy, Sound," in *The Oxford Handbook of Timbre*, eds. Emily Dolan and Alexander Rehding (Oxford: Oxford University Press, 2021), 30-31.

[29] Vélez, "The Matter of Timbre," 42.

'the sound of' a singular thing, and that timbre has the capacity to function as the primary, rather than secondary, object of perception in music.[30]

As with the musicological and organological discourses we've already addressed, I don't seek to disagree with any of the perspectives being explored in this burgeoning field of timbre studies, but rather to propose that they are insufficient in their reach. Though I agree whole-heartedly with Vélez's and Hasegawa's arguments (and, indeed, with many of those espoused throughout the volume), what I find frustratingly lacking in these approaches is a thorough and practical appeal to next steps, toward an understanding of the poetic dimension of timbre. We agree that timbre *means* more than its literal boundaries allow, but most analyses stop short of articulating exactly what that can look like and how we can come to know it, whatever 'it' may be. Hasegawa's account of timbre as an emergent property is especially salient but limits itself in addressing the full scope of ontological possibility: indeed, "the definition of timbre as a property of a single note is no longer sufficient," but surely the idea of a "global timbre" for "composite events" doesn't begin and end at musical materials (chords, textures, etc.) alone?[31] What of the remainder of the total sounding experience? And what of its transcendental power? The aim of this discussion is to travel to these places, and in order to get there we need to posit a broader perspective of both timbre and organology. There is a foundational question at play when we speak of 'the sound of' (something), and the response requires both a reconfiguration of 'the sound of,' wherein timbre is situated as a complex phenomenological construct, and (something), which demands that we reframe what organology points to, shifting from 'instruments,' in the nominalist sense, toward a wider category of complex systems that generate sounding experiences.

[30] Robert Hasegawa, "Timbre as Harmony – Harmony as Timbre," in *The Oxford Handbook of Timbre*, eds. Emily Dolan and Alexander Rehding (Oxford: Oxford University Press, 2021), 547.

[31] Hasegawa, "Timbre as Harmony," 525.

This is not to perpetuate the so-called 'waste-basket' concept of timbre, which relegates to it everything other than pitch, volume, or rhythm, but rather to highlight its dialogic and contextual orientation, to view timbre as something that we *experience* – not just 'sound,' but 'the sound of.'

iii. *Timbre as* the-sound-of

As I see it, timbre and organology are inextricably linked, and thus timbre deserves dedicated space for rumination and clarification in any organological study. In a basic sense, timbre can be understood as the term that points to our qualitative experience of sound. It constitutes the sound of something; in a musical context, that 'something' typically refers to a musical instrument. When someone describes what a flute 'sounds like,' they're primarily talking about its timbre. It's often tempting to think of *timbre* and *tone* as being analogous to the way that we differentiate between *frequency* and *pitch* or between *amplitude* and *volume*, with the former term encompassing a measurable, physical phenomenon and the latter referring to how the brain accordingly perceives it. Frequency, for instance, is a measure of the number of regularly repeating cycles of compressions and rarefactions that occur in any given medium (usually air) in one second. The standard concert pitch of the modern era, A440, is so called because the sound it generates has a frequency of 440 vibrational cycles per second, measured in the unit of Hertz (Hz). On a functional musical level, that frequency has been set for almost a century now as an 'A' pitch, and specifically at A4, or the A above middle C. For most people, the perception of pitch tends to occur on a relational level, in terms of intervals, rather than on an absolute one: in the case of 440 Hz, then, acoustic theory dictates that every two-factor multiple (220 Hz, 110 Hz, 880 Hz, 1760 Hz, etc.) will be perceived as belonging to a single pitch class of A. Of course, when we encounter this phenomenon in the wild – that is, when we hear two notes whose frequencies are related by a multiple of two sounding together or in sequence – we experience it thus regardless of any understanding of the associated physics. What we experience is not two discrete

sounds interacting with one another, but rather a *third* and singular thing, which we call *an octave*. Pitch is thus a bit like color in this way, measured in varying wavelengths, with specific values assigned to classes within an otherwise infinite spectrum, and when different color-classes interact, they create a new and distinct experience. When yellow and red meet, for instance, they create orange.

This kind of perceptual framework can be applied to timbre, but with a caveat. We can rely on the same tenets of acoustic theory that traditional organology references without much trouble: timbre derives from the frequency spectra generated by a given sounding body, spectra which are direct results of its unique design and construction, which also determine its affordances for sound production. These spectra can even be seen in physical form by way of an oscilloscope, and in some cases one can predict a kind of timbral result based on the visual cues of the sounding body: because of their shape and material, one could deduce with fair certainty that a euphonium, say, will sound more like a tuba than it will a viola. In this way, timbre does function very much like frequency and amplitude, the latter of which is the measurable representation of a sound's relative intensity, which we perceive as volume, or loudness.

But if pitch and volume are abstract perceptual terms that exist only in relation to a single measurable scale, 'timbre' as both a descriptive term and a psychoacoustic phenomenon seems to do much more heavy lifting. And I do think that there is an important bias underlying the lack of separation. Pitch is a sort of mental object as opposed to a physical object; like numbers and letters, pitches are conceptual 'things' that exist in our minds as a means of communication, but not naturally, as it were, in the empirical world. They are, in effect, a set of integral values imposed on the infinite gradations of the real, abstractions in the truest sense. Even as timbre attempts to achieve symbolic and abstract 'thingness,' it remains heavily tethered to the realm of the literal: timbre points to sound-as-vibration,

an inescapably physical reality. Perhaps, then, it's on account of the obvious literal interpretation of 'sound' that timbre has been placed at a seemingly unattainable conceptual distance. The problem, though, is not the literal interpretation itself; rather, it's the assumption that timbre as *the-sound-of*, where it functions as a complex phenomenological construct, can be fully reduced to this acoustic level, that there is nothing worth seeking beyond the literal. And, in a larger sense, this is really a question of the nature of the sounding experience, in all ways that experience occurs. What we call 'sound' is indeed physical, but it is also a mediated and embodied occurrence; it isn't merely a bundle of visceral sensations. This tendency to ignore or to overlook the affective depths of timbre, to write it off as inexpressible in any way other than the acoustic, is what I identify as the physical bias of traditional organology.[32]

iv. *On the physical and historical biases*

As I said, it's not my intention to suggest that the acoustic foundations are incorrect in any sense; on the contrary, I firmly believe them to be critical and profound tools that aid in our understanding of timbre – and, more broadly, of sound itself. I do maintain, though, that acoustic fundamentals are insufficient to articulate fully the ontological implications of sounding experience; that is, in illuminating what such an experience is and how it occurs. As a first step toward addressing these ontologies and their affective dimension, we must assess the parameters of the acoustic as they stand and determine whether any adjustment is needed.

[32] Using 'tone' as a stand in for the perceptual side of timbre, as pitch does for frequency, is similarly insufficient in that it still fails to encompass or even reference the potential affective dimension of the phenomenon. This holds for other descriptors that arise in discourses on timbre, such as 'color'/'*farbe*,' 'texture,' 'sonority,' '*klang*,' or 'sound.' Thus a semantic or linguistic debate is beside the point in this discussion.

It turns out there's quite a lot of room for expansion upon the general categories of musical instrument acoustics, design, and construction. The guitar and the piano do indeed produce different frequency spectra, and thus they sound different, but they also produce different *music*, different sounding *experiences* as well. It is, after all, a unique experience to 'play' each instrument – to encounter their specific idioms, affordances, and limitations – and it's also a distinct experience to 'hear' each instrument. Even within the same instrumental pigeonhole, there are important differences: each hand-built violin will have its own way of speaking, and even mass-produced instruments will display material differences and function distinctly in the context of, say, two opposing tuning systems or scordatura. Any musician – composer, performer, or both – will inevitably construct a specific sounding experience based on the idiosyncratic way they interact with a given instrument; thus timbre can be understood as the result of an intimate dialog, with the player not just making the instrument speak but also being willing to hear what the instrument is saying back to them.

For the most part, timbre is discussed as a characteristic of singular things. We speak of 'the sound of' a piano or 'the sound of' a guitar. But what of 'the sound of' a *guitar and a piano together?* Most Western listeners have a general sense of what that would sound like, and even in the context of a homogeneous instrumental ensemble like a string quartet, we might be inclined to accept the resultant sound as its own sort of cohesive unit. But, strangely, 'timbre' is not usually the term that we use for such compounded sonic experiences. Musical instruments are also complex meta-objects comprised of numerous parts – so why is the conceptual leap from timbre as a characteristic of singular sounding experiences into one that can also describe other kinds of complex sounding experiences so difficult to make? The question becomes even more interesting when one considers *the-sound-of* more and more complex events: for instance, *the-sound-of* a specific musical performance occurring in a particular acoustic space; or *the-sound-of* varied live performances of the same musical text; or *the-sound-of*

recordings of those same musical performances; or, indeed, *the-sound-of* different listeners encountering the same recording, completing a cycle of *the-sound-of* in their own subjective way. In some sense, the listener is arguably the most vital component of the network because, when true listening occurs – which it does at every stage in the process of creating *the-sound-of* – it prefigures meaning, or a transition from the prosaic limits of hearing to the poetic realm of feeling. And, in asserting the nature of that transition, revealing what its structure is like and how it was made possible, we begin to arrive at the affective dimension of timbre and a phenomenological account of the sounding experience.

Before we delve deeper into the thorny terrain of organology's physical bias, we need first to address a historical bias that, in many ways, helped determine the field's quantitative stringency. The ethnographic and anthropological work of the scholars mentioned earlier in this chapter has been invaluable to our understanding of musical instruments in both historical and cultural contexts. It has proceeded, for the most part, with ethical prudence, and when course correction has been needed the field has, for the most part, taken the appropriate self-reflexive steps. What this body of work lacks, one might argue, is an examination of the *internal* narratives that shadow traditional organology's convictions, many of which are a simple reflection of the time and place of the discipline's consecration. If the physical bias impacts the *ontological* status of timbre (what and how it is and what it means), the historical bias narrows timbre's *epistemological* status (how we come to know it). A dialogic, mediated perspective presupposes that epistemology both precedes and cannot be separated from our understanding of ontology, and thus it may also prove prudent to move in that order.

Considering how our historical and cultural comprehension of musical instruments may be disentangled from dominantly held predispositions is the focus of the following chapter. To foreshadow, let's briefly consider the way that we typically come to know (of) a musical instrument:

encountering the physical manifestation of its sounding. Most of the time, that would be a safe entry point. But it begs the question of the function of musical instruments which, as we'll see, is not entirely or even primarily aural. In some cases, as in the 'high' and 'low' instruments typical of medieval Europe – and it is a consequence of the acoustic biases I have just identified that I must make explicit that 'high' and 'low' do *not* refer to pitch here – musical instruments often carry an important symbolic function that subsequently permeates into sonic meaning, highlighting the need to situate sounding objects within broader cultural, social, and historical realities.

As Margaret Kartomi suggests in her monumental and enduring *On Concepts and Classifications of Musical Instruments*, the theoretical writings produced within the monastic tradition of Tibet during the late medieval period were markedly different not only from those taking shape in Europe at the same time, but also from those circulating within larger Buddhist lineages of southeast Asia. In Tibetan Buddhist thought, Kartomi points out, music is conceived as a significant prerequisite to meaningful religious experience encountered through ritual occasioning. By the twelfth century, musical instruments were separated into four categories, ordered by decreasing associated status: 'beaten' instruments, 'rung' instruments, 'blown' instruments, and 'stringed' instruments, the last of which were rarely if ever used in practice and performance. Rather, stringed instruments were purely iconic, offered as visual inspiration for representative timbres of what was recognized as 'mental' music, projected solely within the mind of the listener, sound qualities heard in conjunction with the "real" sounds occurring in physical space. The distinction was embraced within the Tibetan model as a reflection of a fundamental tenet of Buddhist philosophy: as Kartomi notes, "the existence of alternative classifications reflects the high value placed in the culture on the challenging of received truths and the envisaging of alternatives in the process of perfecting wisdom by realizing the ultimate voidness

of things, including logical thinking."[33] A true sounding experience, then, like a correct understanding of the emptiness of existence, can only emerge from the ruins of the literal.

[33] Kartomi, *On Concepts and Classifications*, 80.

CHAPTER THREE

NEW INSTRUMENTAL NARRATIVES

i. *Organology as (progress) narrative*

From an epistemological perspective, any reliable historical survey of organology should concern itself with an understanding of how we come to know timbre (sounding experience), as well as how we come to know the objects and processes that engender it, including (but not limited to) musical instruments. Timbre and organology are mutually constitutive in meaningful ways. The aim of the following discussion is not to undermine the important organological work of the recent past, but rather to identify and call into question the historical biases that have given rise to a problematic bias toward acoustic fundamentalism. At the core of the organological narrative, itself the product of a specific time and place, is a distorted view of how musical instruments actually function in culture, one which limits our understanding of sound production as a material process.

Perhaps the most widespread and damaging historical myth of organology is that of inevitable progress, a reflection of modernist attitudes pervasive when the field was formed. Given modernism's innate bias toward empirical positivism, 'scientific' organology was primed from its inception to reject metaphysical abstraction and subjectivity. Modernism's progress narrative was predicated on the notion that the belief systems of the past were of little empirical use. They weren't rejected out of hand, and in fact their existence served the grand historical narratives favored by modernist thought, but their truth claims were rendered irrelevant to modern life, which placed emphasis on the changing realities of the present.[34] In social and political contexts, this tended to historical value judgement: the

[34] Throughout what is often called the High Modernist period, approximately 1900-1930, 'the past' primarily referred to nineteenth century society, viewed as impossibly complacent, even silly in the face of rapid social, cultural, and technological change. But modern thinking is usually traced back to the Enlightenment writings of René Descartes

sophistication of the modern world was naturally superior to more "backward" beliefs and superstitions, at best misguided stepping-stones, as it were, on the way to the triumph of reason. Of course modernism influenced the fine arts, and one can easily detect a fetish for technical progress in twentieth-century narratives of European music history, where everything preceding the eighteenth century is a mere coming-of-age tale, a necessary but ultimately flawed interval of exploration that culminates with the perfected musical instruments and structures of the High Baroque.[35] It's true that one can construct a through line leading from the earliest monodic chant repertoires to the intricate

(1596-1650), who formed the foundational philosophical theories that would eventually define contemporary modernism. In their rejection of all things nineteenth-century European, the modernists of the early twentieth century did seem to find solace in the study of ancient and non-Western cultures (albeit in variously appropriative and problematic ways – one need look no further than to the celebrated Swiss psychiatrist Carl Jung's pathological insistence on referring to non-European cultures as 'primitive'), which is reflected in the anthropological activities from which traditional organology initially emerged.

[35] Although outside the scope of discussion, it's worth briefly elucidating the central tenets of modernism and noting its impact on the arts, which contrasted in certain ways as it manifested in both music and in the visual arts. Perhaps the most obvious distinction regards the function of the past: in the visual arts, there seems to have been a stronger rejection of older styles, which were focused on representation, while in music the study of obsolete practices (which emerged as the wholly modern object of 'early music') significantly increased as a way of threading together the narrative of compositional progress. Despite the modernist embrace of rationality and reason, the visual arts burst with abstraction in the early twentieth century: it seems that a reversal of connotation was at play here in the sense that representation was now seen as metaphysical while subjective abstraction was seen as literal; this makes sense considering modernism's penchant for nihilism, which emerged indirectly from Cartesian skepticism, an epistemological theory that asserts the impossibility of objective knowledge. Early modern philosophers, helmed by Descartes, posited that the mind necessarily modifies its external objects of consciousness while trying to know them, and that it therefore can't be trusted or reliably neutral. Similarly, modernism rejected the concept of realism, which is the idea that the human mind can know reality in some concrete sense. And, so, representation was seen as the big lie, while abstract expressionism was equivalent to truth insofar as it depicted the realities of human subjectivity. Of course, this kind of abstraction was kept in the literal and representational domain by way of its reference to the real-time experiences of the artist; it was never intended to self-transcend or maintain autonomy as an art object separate from the creative act. This focus on the human mind spread into every aspect of modernist thought, resulting in a general embrace of relativism and an emphasis on individualism; the monumental theories put forward by European scientists of the time such as Einstein (relativity) and Freud (the subconscious mind) are a clear product of this mentality. On the other side of that epistemological coin was a heightened focus on scientific inquiry and logical reasoning, which were believed to be the true and only gateways to objective knowledge. Furthermore, in the visual arts, one sees an almost frenetic shift between styles or 'isms,' with artists seemingly anxious to stay with one for too long; this occurred in music of the early twentieth century also – with approaches such as impressionism, primitivism, symbolism, expressionism, serialism, etc. – but perhaps with less urgency. Another relevant contrast is that in visual art, there was a stronger push toward simplifications of form (Malevich, Kandinsky) while in the context of musical sound, richness and complexity was given the ultimate high status: as with Wagner's additions to the brass section, instruments were seen as having come into their 'final' and perfected form because of the kinds of intricate innovations made possible only by new technological means wielded by old-fashioned genius.

polyphonies of Bach, but to ignore the kaleidoscope of human contexts in response to which those changes occurred is ahistorical, condescending, and unethical.

Insofar as a musical instrument is a type of machine, made up of parts and systems of parts that all come together to serve a specific function, it's not entirely surprising that the history of musical instruments follows a linear path that conflates newer design, engineering, and construction with better sound, better performance, and, ultimately, better music. The story of the piano, for instance, construes the harpsichord as a sort of imperfectly expressive precursor. From a technical perspective this is wildly inaccurate: the mechanism of the harpsichord (strings plucked with hard plectra) is quite different from that of the fortepiano (strings struck with soft hammers). Placing the dominant keyboard instrument of the fifteenth through seventeenth centuries in sequential historical relation to that of the eighteenth and nineteenth centuries is understandable: both instruments were popular, one after another, and so it can be asserted that the piano took the place of the harpsichord sometime in the late eighteenth century.

But the story rarely ends there as it's necessary to draw the moral: the history of Western keyboard instruments is a story of rationalized technical *progress*. Most texts that discuss the evolution of the piano eventually perform a physical comparison between the two instruments in which the piano's dynamic action, where the hammers' force of attack is controlled by touch (thus *piano (e) forte*), becomes the dialectical sublation of the harpsichord's (in retrospect) "flawed" design, which, though it offers some timbral contrast through chorused octave stringing and damping, doesn't allow depth sensitivity and dynamic nuance of touch at the keys. What the harpsichord apparently lacks, perhaps due to a

deficiency of the requisite technology, the piano makes up for in spades – or so the story goes.[36] The pipe organ, an overwhelmingly different kind of keyboard instrument that predates the piano by many centuries, is often drawn into this techno-progressivist narrative, discarded as inferior for a lack of nuanced dynamics that Bach himself would have found absurd. (Imagine thinking that the organ could not play both soft and loud!) The clavichord is less frequently mentioned in correlation to the piano, despite the closer mechanical similarities between the two, perhaps because the clavichord was not widely used as a public performance instrument and therefore had less social status.[37] Of course, the harpsichord is only mechanically "inferior" to the piano if we accept that dynamic range and sensitivity are the *sine qua non* of any keyboard instrument – and that is seriously begging the question.

ii. *The Medieval and Renaissance instrumentarium*

In the broader context of European music, this predisposition toward the moralism of progress casts a shadow over the entirety of the fifteenth and sixteenth centuries, a golden age for musical instruments. In addition to those left over from the medieval period, such as the FLAGEOLET (a predecessor of the recorder), the HARP, the LYRE, the HURDY-GURDY, the BAGPIPES, and the ORGAN (in the form of the portative *organetto*), renaissance Europe was brimming over with new timbral variety: a whole menagerie of brass instruments including the CORNET (similar to the modern

[36] This narrative is perpetuated in myriad historical accounts of both the harpsichord and the piano, including seminal texts such as Frank Hubbard's *Three Centuries of Harpsichord Making* and Stuart Isacoff's *A Natural History of the Piano*, among many others. [Frank Hubbard, *Three Centuries of Harpsichord Making* (Cambridge, MA: Harvard University Press, 1965); Stuart Isacoff, *A Natural History of the Piano: The Instrument, the Music, the Musicians – from Mozart to Modern Jazz and Everything in Between* (New York: Knopf Doubleday Publishing Group, 2012).]

[37] The clavichord uses a series of exposed metal tangents, not unlike the felted hammers of the piano, that rise from below to strike a string when the respective key is depressed. In the clavichord, the tangent is directly connected to its key like a lever, moving upward as the key moves downward, and lowering from the string only once the key has been released back to its resting position. As a result, the tangent simultaneously activates the string and then dampens its vibrations, significantly muting the resultant sound. The piano bisects this levered mechanism with what came to be known as an 'escapement' action, which allows for the hammers to strike their strings and then fall back down on their own due to gravity, independent of the position of the key, resulting in a far more resonant sound.

trumpet), the SLIDE TRUMPET, the SACKBUT (similar to the modern trombone), and the SERPENT; multiple families of stringed instruments such as VIOLS, some played on the leg (*da gamba*) and some resting on the arm (*da braccio*), the fretted LUTE (arguably the dominant instrument of the period), and the CITTERN (a kind of plucked fiddle); and, aerophones like the transverse FLUTE, the SHAWM (similar to the modern oboe), the BASSOON, the RACKETT, and the CRUMHORN. There was also an entire phylum of keyboard instruments: the aforementioned CLAVICHORD and HARPSICHORD, along with variants like the VIRGINAL and SPINET, which used the same plucking mechanism but shifted the positioning of the strings and plectra in relation to the soundboard; and REED, POSITIVE, and CHAMBER organs.

From an organological perspective, this period is also significant as it marks an important functional shift in Western music from instruments-as-accompaniment to sounding objects in their own right, with idioms and characteristics increasingly taken into account in compositional and performance technique. Instruments were given a new visual status during the Renaissance as well, designed primarily for listening but also for looking at and admiring; decorative details such as inlays became popular during this time. As it relates to musical style, one can see an increasing delight in the intricacies of polyphonic music, which emerged toward the end of the medieval period, also reflected in the proliferation of keyboard instruments, which are inherently chordal.[38] Texturally, the Renaissance emphasized homogeneous and balanced sound, with blended timbral colors as the rule. Curt Sachs put it well when he observed that, during this time, "no player was supposed to draw all of the notes from their own instrument."[39] This preoccupation with the blended sound generated the

[38] The organ underwent significant changes during the Renaissance, after centuries of slow and incremental development. These adjustments were all polyphonic in nature, and included the addition of a second manual, a coupling mechanism, and a pedalboard.

[39] Sachs, *The History of Musical Instruments*, 328.

concept of the consort, a small grouping of identical or at least similar instruments, varying only in size or range. The blending was even further enhanced by thinner strings made by hand from organic materials, which would have led to great amounts of sympathetic resonance and inharmonicity. The human voice also stratified during the Renaissance toward the consort of voices that we use today, as specializations developed in the ALTO (higher) and BASSO (lower) voices whose tessiturae were directly above and below the natural TENOR of male choristers. Derived from the Latin *tenere*, which means 'to hold,' the tenor voice was originally reserved for chant melodies, while a new specialty in laying decorative descants on the top (*sopra)* of the texture was designated as the SOPRANO.

Woodwind instruments seem to have enjoyed massive favor during the Renaissance. According to Sachs, the royal collection of England's Henry VIII numbered a whopping 272 woodwinds but only 109 stringed instruments; the orchestra of the Berlin court in 1582 used only twelve stringed instruments alongside sixty woodwinds.[40] Two centuries later, the proportions were completely reversed: the luxurious forest of woodwinds had been severely pruned, while stringed instruments, particularly the viol family, solidified a dominating presence. Explanation of such a drastic shift seems to point in two directions. On the one hand, there was a hard swing in stylistic preference toward sharp contrast, ornamentation, and dramatic expression of feeling. The degree of mediation between instrument and player is generally more extreme in woodwind instruments than it is in stringed instruments – when playing a stringed instrument, the player arguably has access to a greater level of dynamic control and nuanced articulation, one that is comparatively unavailable when passed through a reed, or double reed, as was the case for most renaissance woodwind instruments.[41] As we learned

[40] Sachs, *The History of Musical Instruments*, 303.

[41] The distinction here is a mediation between the vibrating thing (i.e. a string or a column of air) and its level of direct connection to flesh.

from the story of the fortepiano, the Baroque era's fondness for dynamic expressivity carried through the common practice period, resulting in an orchestral hierarchy that favors the bowed strings. Thus the relatively unsung stringed instruments of the Renaissance, better suited for the desired sound of the Baroque than were their woodwind peers, avoided the fall into obsolescence.

In the narrative of traditional organology, however, the standardization of musical instruments in the mid-nineteenth century is regarded as an end point: it marks the natural conclusion of centuries of experimentation, with machine-made instruments taking their optimal form thanks to the precision and standardization capable in an industrial era. This second and clearly more insidious component of the narrative, then, which the biographer and musician Roger North (1653-1734) alluded to in his bizarre declaration that, "the labor of the lips is too great," relies on an invidious hierarchy of instrument categories, which serves to legitimize the 'classical' orchestral model, conflating the value of an instrument with its ability to produce a wide range of sound rather than a narrow or more specific one.[42] Of course the serpent is neither better nor worse than the viola da gamba – each is merely different, more appropriate for a certain mode of expression – and championing one mode of expression above all others entails an unfortunate loss of associated meaning.

Always slow to change, large pipe organs remained mostly in their Renaissance format throughout the Baroque, continuing to emphasize a homogeneous 'consort' sound produced by identical pipes in ranks of differing size. The polyphonic music of the Baroque demanded greater contrast and transparency of voices, however, which led to a wider implementation of stopped ranks organized by timbre rather than just register. By the nineteenth century, the fully modernized 'Romantic' organ had become a timbral chameleon, capable of reproducing (with varying degrees of accuracy) a wealth of

[42] Sachs, *The History of Musical Instruments*, 324.

different sounds, including simulacra of orchestral string and brass instruments; indeed, the modern concept of the pipe organ is largely synonymous with its ability to imitate other instruments. To accommodate such an expansion of means – a single stop might require several ranks of pipes to simulate the desired sound – and to provide the correct air pressure needed to power these bigger instruments, the mechanics of the instrument had to alter significantly. Baroque-style 'tracker' organs maintain lower air pressure as well as a direct connection between the keys, stops, and pipe valves, which, due to size and complexity, Romantic organs simply cannot.[43] In the Romantic organ the stops and the keys present themselves to the player with little room for finger-based articulation; this loss of digital nuance was compensated by the timbral variety that a larger selection of pipes enables.

The primary bias in musicological discourse is historical: 'obsolete' musical instruments are seen as serious objects of study insofar as they teach us something about the long-vanished musical worlds for which they were intended. There are serious epistemological issues with this antiquarian stance, which we'll delve into later in this chapter, and in my personal experience as a composer and performer, I have found instruments of the past to be anything but obsolete. In fact they are incredibly communicative and meaningful *now* in ways that transcend their use as harbingers of the past. Baroque-style pipe organs in particular have become increasingly important in my practice, precisely because of the direct mechanical linkages that had to be abandoned for the organ to fully modernize. By deliberately manipulating the speed at which keys and stops are engaged, I am able to access and command completely new realms of timbre, the result of gradual rather than immediate changes in the air pressure passing through the pipes. This "antiquated" instrument, unable to provide

[43] Peter Williams, *A New History of the Organ from the Greeks to the Present Day* (Bloomington: Indiana University Press, 1980), 197.

enough expressive range for the canonic modern organ repertoire, is actually better suited for the expressive needs of my own contemporary work.

iii. *Creative abuse*

The way I misuse Baroque organs in search of expanded musical expression is in many ways parallel to the concept of *creative abuse* in record production.[44] Creative abuse is a term that emerged to account for technologies initially meant to be corrective but eventually becoming creative; I feel that this model ought to carry far more weight in the organological vernacular as well.[45] It is, in a way, another call to proceed from the ruins of the literal. And, in this case 'literal' refers to a historical or functional bias that in its undoing also serves to emancipate the physical domain from its arbitrary boundaries.

To illustrate, let's look at an example drawn from the origins of audio recording. The first appearance of electrical methods in sound reproduction date from the mid 1920s, with the advent of condenser microphones for collecting sound and coil-driven loudspeakers for reproducing sound. With electrical recording and its much wider range of frequency and dynamic response came the concept of 'high fidelity' sound.[46] Still, recording engineers of the time were keenly aware that these early omnidirectional microphones were not especially selective: along with instrumental clarity came unwanted spatial awareness in the form of ambient and extraneous environmental noises picked up

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[44] Simon Zagorski-Thomas, *The Musicology of Record Production* (Cambridge, UK: Cambridge University Press, 2014), 140.

[45] The practice of extended techniques, which is relevant to the realm of orchestral instruments, is perhaps also loosely similar but, in my view, doesn't encompass the same implications for challenging the borders of sound production or the narrative impact of such decisions.

[46] Paul Théberge, "The Sound of Nowhere: Reverb and the Construction of Sonic Space," in *The Relentless Pursuit of Tone: Timbre in Popular Music*, eds. Robert Fink, Melinda Latour, and Zachary Wallmark (Oxford: Oxford University Press, 2018), 326.

by the increased sensitivity of the new recording apparatus.[47] Naturally, this was immediately seen as a negative byproduct and so, to overcome it, engineers (especially those working in radio broadcasting) quickly discovered that the sound sources needed to be placed as close as possible to the microphone to increase the signal-to-noise ratio between intended and unintended sound.

The result was a new kind of sonic intimacy that in the popular song of subsequent decades would come to be known as 'crooning.' The sound of these recordings is what musicologist Peter Doyle refers to as 'convex,' meaning that it extends outward into the listener's literal environment as if the singer and musicians were present in that very room.[48] As recording technology continued to develop, newer microphones emerged with even lower noise floors and better frequency responses, but by that time the crooner effect had also come to represent a specific aesthetic and style even as its practical use faded into obscurity. Although recording engineers that continued to promote this sound were not aware of the full impact of their decision-making, they were now in effect consciously and deliberately manipulating the affordances of their tools and technologies and making choices based on sonic preference. Ironically, the manipulated worlds of these recordings were considered early iterations of a 'realist' aesthetic, realistic in the sense that the sound was almost tangible, manifesting in the listener's space. A dialectic soon emerged with 'romanticism,' which emphasized the physical "space" and inner acoustic dimensions of the recording session. This alternate methodology manifested primarily in the folk arts, though especially in the popular blues, hillbilly, country, big band, swing, and jazz recordings of the 1920s and 1930s. According to Doyle, romanticism engenders a

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[47] Susan Schmidt Horning, "The Sounds of Space: Studio as Instrument in the Era of High Fidelity," in *The Art of Record Production: An Introductory Reader for a New Academic Field*, eds. Simon Frith and Simon Zagorski-Thomas (Farnham, UK: Ashgate Publishing Company, 2012), 30.

[48] Peter Doyle, *Echo and Reverb: Fabricating Space in Popular Music Recording, 1900-1960* (Middletown, CT: Wesleyan University Press, 2006), 65.

'concave' mode of immersion, drawing the listener into the recording and placing them among the musicians.[49] Curiously, developing practices for recording Western classical music would also adopt this 'romantic' attitude, creating a documentary illusion for the listener of being in the specialized performance spaces commonly associated with the repertoire (the church, concert hall, or music room).

In the 1940s and 1950s, romanticism in the studio gave rise to experimentation, as recording engineers became increasingly comfortable manipulating echo and reverb to create surreal sound worlds only available on record. With this reversal, 'realism' reassumed its position as a reflection of the recording-as-representation methodology, while 'romanticism' continued to be fascinated with the deliberate construction of artificial or imagined sound worlds.[50] One of the most well-known proponents of this latter attitude was the famed guitarist, engineer, and instrument designer Les Paul, whose experiments in the late 1940s with sound-on-sound and chorused layering helped pave the way for the development and eventual standardization of multi-track recording, accepted by the early 1960s as indispensable thanks to the unique sonic signatures that such foundational recordings popularized. Although these experiments in turn became the conventional practices of the next generation, an important distinction between the two eras is, as Doyle suggests, that the former *exhibited* fixed constructs while the latter transformed sound into an *inhabited* construct.[51] Exhibited sound worlds, imaginative and surreal though they may have been, did not afford the listener as much freedom to interact as did the inhabited ones; as an expression of 'black box' thinking, inhabited sound worlds persisted into the 1960s precisely because of their heightened immersive and affective qualities. A sonic space we can inhabit

[49] Doyle, *Echo and Reverb*, 91.

[50] Greg Milner, *Perfecting Sound Forever: An Aural History of Recorded Music* (New York: Faber, 2009), 13.

[51] Doyle, *Echo and Reverb*, 81.

also becomes a shared or dialogic space in which the listener gains phenomenal proximity to the sound not available in real, acoustic life. This pioneering work undermined the documentary status of recordings, creating tension between so-called 'studio' (emphasizing sound production) and 'live' (emphasizing sound reproduction) aesthetics. Both 'liveness' and 'authenticity' would emerge as key values of the 1960s counterculture, influencing both popular and non-commercial music.[52]

The spatial history of recorded sound thus offers a useful allegory for organology. Creative abuse in the studio means that one engineer's sonic trash can be another's treasure; so, too, the idioms and affordances of historical musical instruments needn't be dismissed as 'obsolete' if they are sufficient to the needs of the sonic moment. Indeed, the boundaries of sound production are mutable, often conventional, reflecting how things currently are but not how they *could* be – and certainly not how they *ought* to be. And with every articulation or iteration of a sounding object comes unique meaning and thus a new sounding experience. As musicologist Bruce Haynes has observed in relation to the postwar early music revival, "when you say something differently, you say something different."[53] Every single element that contributes to the sounding experience – from the initial creation through the final act of listening – contributes to the final sonic product, and changes made to any of its component parts will have sonic and phenomenological consequences.

iv. *Saying something differently to say something different*

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[52] Jan Butler, "Clash of the Timbres: Recording Authenticity in the California Rock Scene, 1966-1968," in *The Relentless Pursuit of Tone: Timbre in Popular Music*, eds. Robert Fink, Melinda Latour, and Zachary Wallmark (Oxford: Oxford University Press, 2018), 283-286; Simon Frith, "The Place of the Producer in the Discourse of Rock," in *The Art of Record Production: An Introductory Reader for a New Academic Field*, eds. Simon Frith and Simon Zagorski-Thomas (Farnham, UK: Ashgate Publishing Company, 2012), 208.

[53] Bruce Haynes, *The End of Early Music: A Period Performer's History of Music for the Twenty-First Century* (Oxford: Oxford University Press, 2007), 19.

Consider as another analogy the practice of Western classical performance and recording: every performance is what philosophers would call a *token*, one of many possible instances of a single *type,* represented here by 'the work' of the composer captured in a musical score. But the score (type) and the performance (token) are two different *kinds* of things: a type is essentially a set of instructions for making tokens, which are, at the very least, individual renderings, if not full-blown idiosyncratic interpretations of those instructions. This is not controversial: no one would claim that the performance tokens rendered by the Los Angeles Philharmonic and San Francisco Symphony of a canonical symphonic work-type are interchangeable. But – and this is where the ground starts to shift – the recording of either performance is *itself* a different token. A recording is also a kind of rendering, mediated by the technology that was used to capture it. Changing the performance space also filters the sound of a piece of music, even when performed by the very same musicians. (If the orchestras of Los Angeles and San Francisco were to exchange concert halls, their characteristic 'sounds' would certainly change as well.) And so too the ultimate sounding experience of a given recording will be transformed by (a) the medium on which it is stored (LP, CD, tape), (b) the sound reproduction system that it passes through (home stereo versus car stereo), and, of course, (c) by the physiological and subjective experience of the listener, whose ears and brain complete the process. This quasi-infinite cascade of types and tokens, the fact that *the-sound-of* any actual listening experience is completely unique and unreproducible, points to the autographic nature of sounding experience and its inherent *this*-ness, and prefigures an initial glimpse into the limitations of traditional organology's physical bias.

Furthermore are the countless examples one could point to of similar manipulations generating and consecrating altogether new musical styles and ways of meaning, as in the case of Jamaican dub, for instance, which employs creative abuse of studio equipment like tape echo and reverb as a core feature

of its production process.[54] And so, if we reject the idea that instruments need follow a teleological path toward perfect function, predicated on historically biased assumptions of the innate value of 'correct' sound, then we're also in a good position to challenge the idea of a universal desire for that one right sound guiding our path.

I think of this issue as a kind of chicken-or-egg myth, which is essentially a power struggle for cause and effect. In traditional organology, we often read that instrumental changes were the result of ideological or aesthetic demands: musicians were heading in a given direction and so the musical technology responded accordingly. This is not totally inaccurate. For confirmation we can look again at the history of the piano: one of the instrument's most lauded innovations is the double-escapement action, an improved mechanism that better controlled the flight of the hammers to and from the strings, allowing for more rapid striking of a single key. This increased the expressive capabilities of the instrument and so could be seen as a simple extension of the overarching modern project that started in the Baroque. Causality is key here, though: when Alpheus Babcock, an American piano builder based in Boston, patented the first cast-iron frame for pianos in 1825 – another of the instrument's glowing achievements – it was a technologically determined development, not possible before its time; but the late arrival of the double-escapement action in 1821, well over a century after the single-escapement action of the first fortepianos, seemed, in part, like a response to the highly virtuosic music that was emerging at the same time, which demanded the affordance of quicker movements.

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[54] This style of production renders acetate discs as musical material in and of itself and incorporates inherent processes of decay as a part of the timbral character of the medium. Having control over the physical means of production is critical here, as the music emerges from the deliberate manipulation and layering of these objects. [Michael Veal, *Dub: Soundscapes and Shattered Songs in Jamaican Reggae* (Middletown, CT: Wesleyan University Press, 2007), 81-85.]

The idea that this influence could also shift direction – indeed, that a musical instrument could shape and transform the psychological framework of the musician – is less commonly accepted, or at least less readily acknowledged, in traditional organology. Certainly, this is a phenomenon that has been made exceedingly clear by the advent of electronic instruments: as an altogether new category of sound producing technology, their way of being falls almost entirely on our understanding of how they encroach on previous (acoustic) modes of interaction. But it would be a denial of the dialogic relationship, or the symbiotic exchange, between object and subject that occasions all sonic encounters to view electronic musicking in opposition to its acoustic counterpart. We'll explore the intricacies of dialogic reciprocity in the subsequent chapter, but in terms of historical bias it's worth noting that the harpsichord seems to have had a strong influence on composers long after the invention of the "more expressive" fortepiano, remaining the main composing and performing keyboard instrument until well into the middle of the eighteenth century. Today, Bach's music is often performed on the modern piano, an instrument that existed neither materially nor conceptually at the time. For what it's worth, I don't believe that there is any inherent issue with this – after all, when you say something differently, you say something different – and I contend that a sinfonia performed on a modern piano is not a bad thing but rather a token sounding experience, and that in and of itself is valuable. It bears pointing out, though, that the structured interactions of Bach's contrapuntal music were not only written for but also very much a result of the textural (rather than expressive or dynamic) focus of instruments such as the harpsichord and organ. The intricacy and precision of sound in his music, uniquely afforded by these instruments, is, I would argue, drawn out of musicians only by the *absence* of another innovation of the modern piano, its sustaining pedal. Indeed, this kind of meaning and the affect that it gives rise to is solely accessible when the modern instrument moves backwards to approach the sounding experience of its ancestor: to achieve the "correct" sound, one plays the piano as if it were a harpsichord.

v. *Organology as historiography*

So, how exactly did we arrive at such a stubborn narrative? Certainly the progress narrative of organology is rooted in modernism, but its steadfast adherence to the myth of linearity – and its continued reliance on this way of thinking throughout the last century and then some – indicates a more sweeping issue in historical ethics. A comprehensive survey is outside the scope of this study, but it would be useful to briefly consider historiography – that is, the practice of writing history, choosing what to emphasize, what to ignore, and how to interpret. In his fascinating study of *The Modern Invention of Medieval Music*, musicologist Daniel Leech-Wilkinson examines a performance practice that was taken as a foregone conclusion for most of the twentieth century: the mixture of voices and instruments in the performance of late medieval polyphony. The so-called 'voices-and-instruments hypothesis' has its roots in the writings of Hugo Riemann (1849-1919), who had until the turn of the last century believed this music to be entirely vocal. In 1905, Riemann changed his mind, motivated by patterns he observed in musical manuscripts: he now claimed that the un-texted musical material bookending the cantus served the same purpose as instrumental preludes and postludes in German art song. As Leech-Wilkinson points out, Riemann brought a nationalist perspective into his assessment: German scholars valued Italian music of the thirteenth century over the Burgundian Ars Subtilior, primarily due to its incorporation of thirds and sixths, common in medieval England but largely avoided elsewhere. The Trecento could thus be made to anticipate the tonal, triadic structure of common practice music, and could also provide a greatly desired historical pedigree for romantic *Lieder*, in which prominently featured instrumental accompaniment was essential.[55]

[55] Daniel Leech-Wilkinson, *The Modern Invention of Medieval Music: Scholarship, Ideology, Performance* (Cambridge, UK: Cambridge University Press, 2002), 23-24, 28-31.

Riemann's hypothesis was unchallenged until the 1980s, bolstered by what appeared to be corroborating evidence from art historians who pointed to visual and poetic cues from illuminated manuscripts, which both depicted and described musical ensembles of wildly contrasting instruments alongside three or four singers.[56] Music theorists and performers further testified that elaborate melismata are difficult to sing and must therefore have been intended for instruments. Achieving agreeable intonation with voices alone must have been hard to imagine, thanks to the reigning *bel canto* singing style with its heavy vibrato, normalized for all types of music by the late nineteenth century.[57] The second wave of early music revival, which began in the 1960s, appealed to audiences with album jackets adorned by an appealing array of curious and unusual instrumentation, a novelty that, for better or for worse, helped propel acceptance of Riemann's hypothesis into the public sphere.[58]

What ultimately seems to have given this hypothesis staying power, though, was its fuzziness: scholars were convinced that instruments had been used but weren't at all clear on the details. Performers of the era cheerfully exercised the resulting freedom to experiment: David Munrow and his Early Music Consort of London focused on unique and imaginative instrumental combinations, while Thomas Binkley and his Studio der Frühen Musik wrote the performative micro-gestures of Arabic and Moorish tradition back into the Western understanding of the Middle Ages.[59] A voice-centered reaction to this exuberance, which became the '*a cappella* hypothesis,' emerged in the early 1950s but didn't gain significant traction until the early 1980s when Christopher Page and his Gothic Voices

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[56] Sylvia Huot, "Voices and Instruments in Medieval French Secular Music: On the Use of Literary Evidence for Performance Practice," *Musica Disciplina* 43 (1989): 68.

[57] Leech-Wilkinson, *The Modern Invention of Medieval Music*, 50, 84.

[58] Harry Haskell, *The Early Music Revival: A History* (London: Thames and Hudson, 1988), 127.

[59] John Haines, "The Arabic Style of Performing Medieval Music," *Early Music* 29 (2001): 374; Kirsten Yri, "Thomas Binkley and the Studio der Frühen Musik: challenging 'the myth of Westernness'," *Early Music* 38.2 (2010): 276.

ensemble released their first recording, a new take on Hildegard von Bingen called *A Feather on the Breath of God*. Despite the presumption that "Gothic" voices would have sounded like those of modern times, this music announced an alternative theory of medieval timbre, that it was not in fact colorful but rather clean and homogenous, free of vibrato and rubato.[60]

Riemann can be accused of a deliberate breach of historical trust: he took advantage of inherent uncertainty about music of the distant past in service of a partisan agenda. This kind of casual bias is hard to uproot, which suggests that we exercise skepticism about the inherent bias of any narrative – the present one by no means excepted. The modernist ethos prided itself on being largely free of bias by plunging into absolute relativism when it concerned subjective matters and taking scientific taxonomy as unabashed writ. But intellectual pursuits (including scientific ones) are human pursuits, always already biased insofar as they are the product of particular social, cultural, and political environments. As we've seen, organology as a discipline is a result of the European modernist climate out of which it grew. In its attempt to create a neutral, universal, and essentializing classification of the ways in which sound production can occur, it has necessarily imposed its own biases: that sound is acoustic; that acoustics is an empirical science; and that acoustic range, standardization, and versatility are the teleological goals of research and development into instrument building.

But the expressive meaning of sounding experiences transcends the narrow context of modernist organology, and one of the difficulties that the impartiality of modernism extended into the applied sciences was a sense of othering, alongside a relative inability to appreciate the distinction between etic and emic points of view. Contemporary organology is usually quite careful to defer toward the latter in ethnographic contexts, as with Margaret Kartomi, who drew attention to the Eurocentric

[60] Leech-Wilkinson, *The Modern Invention of Medieval Music*, 92.

biases that informed traditional studies of musical instruments. In recent ethnomusicological research, a great deal of work has been done to explore alternate, trans-acoustic functions for musical instruments, especially as they help channel altered states of consciousness. For instance, in his account of Stambeli, a syncretic religious tradition local to Tunisia that combines the spirits of its sub-Saharan originators, displaced north via the slave trade, with the Arab-Islamic saints of north Africa, ethnomusicologist Richard Jankowsky draws attention to an alterity that informs the highly musical practice. Both its formal structures and its musical instrumentation embrace deliberate and radical opposition, the purpose of which is to highlight the metaphysical presence of spirits in possession rituals and *nubas* (musical forms associated with saints and spirits), and to emphasize their earthly distance in space and time.[61] Surveying musical practices in the Arab world, ethnomusicologist Ali Jihad Racy suggests that these symbolic gestures are not limited to the sphere of sacred music and that Arabic secular traditions place greater importance on the role of musical instruments and timbre in constructing ecstatic experiences; for instance, in relation to *tarab*, a secular form of trance, which is a significant merging of sounding experience and emotional transformation. More generally in Islamic territories influenced by the Sufi tradition Racy notes strong spiritual associations with specific timbres and instruments, often to the same degree as structures such as musical modes. Racy also stresses the importance of emotion in Arabic music and the way in which *tarab* is both a physiological *and* a psychological effect: for him, the purpose of musical instruments in Arabic traditions cannot be reduced to the merely empirical.[62] In her studies of music and emotion, ethnomusicologist Judith Becker also challenges the bias toward interiorized listening, asserting that it doesn't apply to most non-Western musical cultures, with some exceptions such as in the Carnatic traditions of south India

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[61] Richard C. Jankowsky, *Stambeli: Music, Trance, and Alterity in Tunisia* (Chicago: University of Chicago Press, 2010), 6.

[62] A.J. Racy, *Making Music in the Arab World: The Culture and Artistry of Tarab* (Cambridge, UK: Cambridge University Press, 2003), 12.

and in Iranian classical music. Whereas prototypical Western musical emotion is complex and belongs to the individual, many other cultures seek a diametrically opposed situation in which emotion manifests communally and in which sound mediates an alternate reality experienced by a group.[63] Racy similarly highlights this as an aspect of Arabic music, which emphasizes an energized physicality, as does Jankowsky in Stambeli, which he defines as a communal activity that creates "experiential ritual empathy" in its participants.[64] This all differs quite sharply from the Western psychological bias of traditional organology, which, insisting on the absolute interiority of musical expressivity, renders the affective dimensions of sounding experience relatively incommunicable.

Of course, these are just a few specific examples, but they show us how subliminal bias can limit our understanding of sounding experiences as meaningful, and how musical instruments figure centrally into those meaningful experiences. But what of sounding experiences for which an insider account is impossible, as in the case of the distant past? What kind of context can these inquiries even attempt to disclose? The solution is not to give up on historical investigation altogether; one can and should certainly still try, but with the awareness that our modern context and our collective biases will necessarily shape whatever conclusions we do decide to draw. Thus we can arrive at possible truths that can offer valuable insight while prompting new meanings along with new affective realities, the additional creative dimension that can make the study of such mysterious music so rewarding and substantial.

The second wave of early music revival, hell-bent on historical accuracy, warns us where (or, rather, where not) to draw the line. The partisans of what was marketed as 'historically informed performance'

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[63] Judith Becker, *Deep Listeners: Music, Emotion, and Trancing* (Bloomington: Indiana University Press, 2004), 69-73.

[64] Jankowsky, *Stambeli*, 151.

(tragically often shortened to 'HIP') were obsessed with historical authenticity, lost in the belief that they could somehow access empirically an extinct world of long-dead practitioners, ignoring evidence that the spirit of medieval performance tended strongly toward the opposite – toward interpretation, iteration, and living tradition.[65] The polymathic musical intellectual and musicologist Richard Taruskin was a strong opponent of authenticity discourse in musical performance practice of any kind: as he pleads, "when followed unreflectively [authenticity] can become a positivistic purgatory, literalistic and dehumanizing, a thing of taboos and contingencies instead of the liberating expansion of horizons and opportunities it could be and was meant to be."[66] Ironically, in their search for the "true" sounds of the past, musicians of the authenticity movement did, without wanting to admit it, generate new sounding experiences and new sonic truths, some of which have, in their turn, changed contemporary music making. This is perhaps what Leech-Wilkinson meant when he hailed medieval music as a 'modern invention': it is and will inescapably remain a truth, but it is *our* truth, and not theirs.

vi. *Tuning and temperament in organology*

Before we close this chapter on the historical bias of traditional organology, I want to dedicate some space to two especially prickly historical topics that should take up more space in the discipline: tuning and temperament; and the influence of electronic mediation. Both subjects are severely overlooked in organological discourse – electronic instrumentation altogether, and tuning as it relates to instrument design and timbral function. More importantly, though, both topics have been especially prone to the historical biases we've been discussing.

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[65] John Butt, *Playing With History: The Historical Approach to Musical Performance* (Cambridge, UK: Cambridge University Press, 2002), 31; Jonathan Shull, "Locating the Past in the Present: Living Traditions and the Performance of Early Music," *Ethnomusicology Forum* 15 (2006): 90.

[66] Richard Taruskin, "The Authenticity Movement Can Become a Positivistic Purgatory, Literalistic and Dehumanizing," *Early Music* 12.1 (1984): 8.

In my view, the study of intonation is perhaps the most egregious lacuna in the field of organology. Shifts in tuning practice are closely linked with developments in instrument design and usage, and insofar as it pertains to the frequency content of both individual and composite sounds or the harmonic space between intervals and chords, the mathematics of intonation is also inextricable from the acoustic basis of timbre. So, let's start by looking at the "history" of tuning. The generally accepted story of intonational theory in Western art music begins in the Middle Ages, with evidence of musicians and theorists employing the Pythagorean system of ancient Greek fame.[67] The Pythagorean system is ostensibly a form of *just intonation,* or rational intonation – so called because it derives its tuning from whole-number ratios found within the harmonic series, a naturally occurring acoustical phenomenon that connects the vibrational nodes of a foundation tone with its mathematically related overtones. Emerging at a time before the devices and tools existed for precise measurement of sound waves, just intonation is at its heart a reasoned rather than measured system, conceived and constructed from the relative proportionality of discrete mathematical objects. In just intonation, prime numbers (1, 2, 3, 5, 7, 11, 13, etc.) demarcate a distinct unit of measurement, so to speak, within the harmonic series, each of which produces its own set of associated intervals: the unit of '1' produces only the unison and the unit of '2' produces only the octave; the unit of '3' introduces the interval relationship of 3 against 2, or 3/2, as well as 4/3 since '3' remains the largest prime in the ratio and since '4' is a multiple of '2,' and therefore another expression of the octave.

In psychoacoustic terms, the interval of 3/2 is perceived as that of a fifth (C-G, for example, if C is taken as our 1/1 fundamental) while the interval of 4/3 is perceived as a mirror fifth below (F-C) or

[67] Sachs, *The History of Musical Instruments*, 332.

a fourth (C-F) when placed into the octave range of the fundamental.[68] It can be helpful to think of prime domains as different units of measurement (for instance, centimeters versus inches) because, when placed against one another, they don't exactly make a proper fit. In theory, if a continuous row of octaves (C-C-C-C-C, etc.) is placed against a continuous row of fifths starting at the same pitch (C-G-D-A-E, etc.), they'll appear to merge in pitch again after a series (or 'circle') of twelve fifths. In practice, though, the actual frequency of the circle's end pitch will be slightly higher than that of the same final pitch in the row of octaves, precisely because the two belong to different forms of measure. In tuning parlance, this discrepancy is referred to as a comma, and in relation to fifths against octaves, this comma (referred to as the *ditonic* comma) is equivalent to around 24 cents. In the context of medieval vocal music, making these kinds of adjustments in real time wouldn't have been difficult given that the voice can easily alter its intonation, arriving where it needs to in accordance with the interval that's being sung.[69] Medieval Europe was a uniquely cosmological society and adopting a musical system predicated on the number three served numerological interests while also making symbolic reference to the Trinity; thus, the intervals of the 2/1 octave, 3/2 fifth, and 4/3 fourth were deemed significant because of their perceived consonance and spiritual immutability. (And thus these three intervals *only* retain the designation 'perfect' in our modern nomenclature.) When tuned from a series of just fifths (i.e. C-G-D-A-E), intervals such as the major third are quite dissonant (in this case the Pythagorean major third is a whopping 21 cents larger than the first just major third we encounter in the harmonic series), producing audible interference patterns perceived as rhythmic "beatings," and were thus avoided except in passing. This so-called '3-limit' system, built upon the interval of the just fifth (3/2), is what we refer to as Pythagorean tuning.

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[68] The pitch-class 'C' is arbitrary here and does not need to be tethered to any specific frequency.

[69] Stuart Isacoff, *Temperament: How Music Became a Battleground for the Great Minds of Western Civilization* (New York: Random House, 2001), 140.

At the end of the fourteenth century, a period referred to as the Ars Nova, a new kind of sound was emerging from the polyphonic experimentation of Gothic composers. Perhaps the most important aspect of this new sound was its increasing use of intervals like the third and its inversion the sixth (both harmonies that English musicians had already been exploring – apparently their off-continent isolation meant that they missed the memo) as well as a burgeoning sense of three-part (*aka* 'triadic') harmony.[70] Instruments of fixed pitch like the harpsichord and the fretted lute rose to prominence during this time, and thus an updated tuning system that could generate harmonious thirds was now required. (Whether it was the instruments' chordal affordances that helped encourage the use of triadic harmony, or whether the growing demand for the latter led to the former – a classic case of chicken-or-egg – is not known.) In the harmonic series, the major third is next in line after the fourth and the fifth: the ratio 5/4 (from a fundamental C, this arises as C-E) introduces a new prime domain of '5,' and continues with the ratio 6/5, sounding a minor third (E-G, where '6' is an octave multiple of '3' and therefore another G). As mentioned, the just major third built upon the prime '5' is some twenty cents smaller than the Pythagorean major third (81/64) derived from the prime '3'; another discrepancy that is referred to as the *syntonic* comma.

To overcome this discrepancy and create a closed system appropriate for keyboards with octave equivalency, the Renaissance birthed a temperament (so called because it involves adjusting or 'tempering' intervals from their mathematically pure form) which became known as quarter-comma meantone. Since the major third can be derived from a series of four fifths (i.e. C-G, G-D, D-A, A-E) and since the syntonic comma of just fifths against just thirds is approximately twenty cents, then if each fifth is equally shortened by five cents (approximately one quarter of the comma) a just third

[70] Tenney, *A History of Consonance and Dissonance*, 48.

will result (from C-E). And since a five-cent flattening of a perfect fifth is not noticeable when bisected by a just third, this actually worked, allowing fixed pitch instruments to produce a wide range of harmonious triads in different keys. But, with fixed-pitched instruments, the piper must eventually be paid: if you remove five cents from each fifth, you must find a place to add them back, so that the circle of fifths actually closes. Meantone temperament swept this problem under the rug by the use of a single wide fifth, around 35 cents sharper than just.[71] This noticeably out of tune fifth – called the 'wolf' because of its inharmonious howl – was effectively unusable, hidden away in a part of the cycle of fifths far from the keys favored by musicians (in meantone it usually occurs between A^b and E^b). When constructing the scale, the steps that bisected the temperament's just thirds (a D within C-E, for instance) were tuned to the mathematical average, or mean, of the interval, hence 'meantone.'

By the Baroque era, however, musicians were becoming increasingly adventurous with modulation, and a tuning system that could serve the new system of twelve major and twelve minor keys was needed. This led to 'well' or 'circulating' temperaments, a refinement of the meantone system: now, instead of eleven fifths tuned evenly flat and one fifth tuned excessively sharp, some fifths were tempered by only one fifth or one sixth of the comma while others were left just; the wolf was dispersed, its howling muted. Unlike the standard quarter-comma meantone temperament, well temperament was not a single set procedure but rather an approach to tuning; varying sets of miniscule compromises that resulted in a myriad of idiosyncratic temperaments, such as the several named after the theorists Andreas Werckmeister (1645-1706), Johann Kirnberger (1721-1783), and Francesco Antonio Vallotti (1697-1780). Indeed, it is as a demonstration of one of these systems that Bach wrote

[71] In tuning, the 'wolf' designation was eventually given to all intervals that were necessarily tempered to such an extreme as to be undesirable or altogether unusable.

his two famous cycles of preludes and fugues in all keys, *Das wohltemperierte Klavier* (The Well-Tempered Clavier).

A modern misconception, that The Well-Tempered Clavier was created to showcase the flexibility of equal temperament, is truly one of the most heinous oversimplifications in the history of music. This musical collection does *not* celebrate the neutrality of equal temperament, in which all keys are usable and sound indistinguishable from one other. In fact, the complete opposite is true: each pair of preludes and fugues was written in response to the distinct feel of a specific key within the specific well temperament that Bach favored, to highlight rather than obscure the temperamental differences that are the natural result of a tuning system which contains more than one size of each interval.[72] Nevertheless, if contemporary musicians are even taught about historical tuning systems, perhaps with the exception of those who go on to specialize in early music practices, they are often told that our version of equal temperament was standardized sometime in the seventeenth century, at the beginning of our untouchable modern era, and that it has maintained its reigning status as the ideal tuning system ever since.

In his passionate *How Equal Temperament Ruined Harmony (and Why You Should Care)*, musicologist Ross Duffin proposes a perspective that challenges this ubiquitous misunderstanding. Not only does he suggest that our mathematically exacting version of twelve-tone equal temperament (12TET) was not in fact standardized until the early twentieth century (and that it simply could not have occurred any earlier given a lack of the precision measurement devices that 12TET demands; prior to this era, temperament was achieved by comma division), he also contends that 12TET was fiercely opposed

[72] Ross Duffin, *How Equal Temperament Ruined Harmony (and Why You Should Care)* (New York: W.W. Norton & Co., 2007), 44.

by theorists and musicians throughout the seventeenth, eighteenth, and even nineteenth centuries. As evidence, he posits the persistence of notational conventions as well as theoretical distinctions mentioned in various treatises on performance practice, and cites indications assigned by fixed-pitch instrument builders for preferred tuning schema, such as those by esteemed piano builders Sébastian Érard and John Broadwood.[73] With respect to the orchestral strings of the eighteenth and nineteenth centuries, Duffin notes continual reference to 'extended' temperament, an augmentation of *musica ficta* practices of the Renaissance, which excludes enharmonic equivalence. Enharmonic equivalence is the notion that sharps and flats are equivalent ($G^{\#}$ and A^{b}, for instance) and it's a core element of equal temperament's fixed-pitch structure, but it was not automatically assumed in meantone and well temperament, which delineate functionally between larger (major) and smaller (minor) semitones. The indications that Duffin observed occur in various ways: for instance, an actual change of fingering on the same string rather than a slight upward or downward shading, coupled with notes that would move this gesture further up the neck of the instrument, thus placing the flat above the sharp in a way that is consistent with the extended meantone system.[74]

As musical aesthetics shifted in the nineteenth century, Duffin reports a detectable switch in the hierarchy of semitones, with sharps now voiced higher than flats so as to emphasize the tension of a sharp leading tone as it resolves to the tonic. This is quite a contrast from the theories of organologists such as David Rowland and Patrizio Barbieri, who both argue that the disappearance of split accidental keys, which were used to indicate a physical separation between sharps and flats on keyboard

[73] Duffin, *How Equal Temperament Ruined Harmony*, 63, 102, 108-109, 133.

[74] Duffin, *How Equal Temperament Ruined Harmony*, 51.

instruments, in the seventeenth century implies a movement toward equal temperament.[75] Indeed, many instrument builders of those early modern centuries do reference some form of 'equal' temperament, but the likelihood that it was the same thing that we now define as equal temperament rather than something more variable and lively, something more like a well temperament, is slim to none. When it comes down to semantics, the 'equal' component probably pointed to a roughly even division of the octave more than anything else, as well as perhaps a sense of evenness between the relative dissonances and beatings in a particular system.

Duffin's story does not uphold equal temperament as the teleological goal of European developments in intonation. He argues that its standardization was instead due to the serialist and atonal musical climate of the time, which sought a similar neutrality and "equality" with regard to pitch relations.[76] Thus equal temperament was not the best system, but rather the system that was best suited – that is, the most reliable and convenient – for modernist musical demands. Equal temperament certainly has its place and purpose, but its "triumph" in the early twentieth century effectively did away with all other approaches to tuning. As intonationally sensitive theorist-composers like Kyle Gann and W.A. Mathieu have lamented, 12TET contains only one interval, the 100-cent semitone, with every other harmony occurring as a kind of multiple.[77] What defines systems of well temperament and the many possible articulations of just intonation is that they explore different sizes of interval, and in so doing

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[75] David Rowland, *Early Keyboard Instruments: A Practical Guide* (Cambridge, UK: Cambridge University Press, 2001), 26; Patrizio Barbieri, *Enharmonic Instruments and Music, 1470-1900* (Rome: Il Levante Libreria Editrice, 2008), 19-21.

[76] Duffin places it around 1917, following the publication of William Braid White's *Modern Piano Tuning and Allied Arts*. [William Braid White, *Modern Piano Tuning and Allied Arts* (New York: E.J. Bill, 1917).]

[77] Kyle Gann, *The Arithmetic of Listening: Tuning Theory & History for the Impractical Musician* (Urbana: University of Illinois Press, 2019), 104-107; W.A. Mathieu, *Harmonic Experience: Tonal Harmony from its Natural Origins to its Modern Expression* (Rochester, VT: Inner Traditions, 1997), 112. Equal temperament was derived by removing the 24-cent ditonic comma that emerges between the interval of the fifth and the octave. With twelve pitch classes in the octave, each fifth can simply be shortened by two cents, from the 702 cents of the 3/2 ratio to 700 cents. When tuning in equally tempered fifths, each semitone then becomes evenly separated by 100 cents.

resist the temptation to reduce all music to twelve equidistant and interchangeable pitch-classes. In earlier approaches to tuning, different fifths – and by extension, the different thirds, sixths, seconds, and sevenths that occur as a result – could coexist within one system, and it's important to emphasize that these differences were actively embraced until well into the twentieth century precisely because of (and not in spite of) the divergent tone colors and affective shapes that they afford.[78]

In this version of the organological narrative, tuning becomes a conceptual extension of timbre: just as a composer may choose to orchestrate a part for flute rather than for clarinet, so too may they wish to call upon a given temperament because of its timbral affordances, to take advantage of how it shades the harmonic interactions of pitches and instruments. But equal temperament is effectively monochromatic, the experience of 'red' truncated to a single ideal type, eliminating evocative and expressive possibilities such as 'crimson,' 'scarlet,' 'maroon,' 'garnet,' and 'ruby,' to name a few. Equal temperament could also be likened to a composer having access to only a single timbre: there's nothing inherently wrong with the piano, but if all music were to be restricted in some hideous alternate reality to its specific way of speaking, then we would be much poorer for it. In the exceedingly finite grips of equal temperament, the timbral nuance and poetic language of tuning is completely lost.[79]

It's important to note that tuning is about relational interaction rather than individuation. Pitch classes don't mean much when removed from their intervallic context: 'G' is an arbitrary indicator of pitch, and its meaning only arises once we understand it in dialog with something else, for instance as a

[78] Music theorist Owen Jorgensen corroborates this sentiment and equates well temperament with nineteenth-century tuning practices altogether, suggesting that the idea of differing keys being imbued with unique qualitative characters was completely in keeping with the Romantic aesthetics of the era.

[79] In a similar way, one could also lament the lost affective dimension of mode, which has been reduced in modern art music from the eight church modes to just two (major and minor) scalar shapes. One broader musical exception is found in the folk revival of popular music, which explored other modes such as the Dorian and Lydian.

minor third above 'E,' or as a minor seventh above 'A,' etc. In this way, both frequencies and intervallic relationships (i.e. harmonies) occur on a spectrum, in multiple forms rather than singularities, which is the essential character of just intonation. And so, on the other hand, returning to 'pure' just intonation maximizes the possibilities of affective coloration. There is no imposition of an enclosed circular system in just intonation, but rather an open-ended spiral theoretically capable of encompassing an infinite number of intervals and possible tuning structures, each with their own character. As we saw, each arrival of a new 'limit' prime in the harmonic series brings a completely new group of intervals or, as tuning theorist W.A. Mathieu enthuses, a new musical universe of harmony.[80] Continuing from the domain of '5,' which generated the major third 5/4 and the minor third 6/5, we arrive at the domain of '7,' and, among others, the new interval ratio 7/6 (from the fundamental C, this arises as G-B^{b}). From a psychoacoustic perspective, this interval is also heard as a minor third, and so we are presented with two: the 6/5 minor third and the 7/6 minor third. But the two are not the same size, as in 12TET: the 6/5 minor third is 16 cents wider than an 12TET minor third, while the 7/6 minor third is 33 cents narrower. Both intervals function as a minor third, but they speak that third very differently and therefore say something different with it.

Intervals in just intonation need not be derived in a strict sequential format (i.e. 2/1, 3/2, 4/3, 5/4, 6/5, 7/6, etc.) either: a '7,' the natural seventh overtone, can be placed against a '4' (a B^{b} over a C in the same octave, for example) to create a just minor seventh, expressed as 7/4. Another interval that we would perceive as a functional minor seventh occurs between the fifth and ninth harmonics, creating a 9/5 ratio. But these sevenths are not in the same musical universe: 7/4 belongs to the domain of prime '7,' and we refer to it as a septimal minor seventh; 9/5 belongs to the domain of prime '5' (9 is not a prime number!), and as such we refer to it as a quintal or '5-limit' minor

[80] Mathieu, *Harmonic Experience*, 124.

seventh. The 7/4 minor seventh is some 31 cents narrower than a 12TET minor seventh, while the 9/5 minor seventh is about 18 cents wider. These are just two of a theoretical infinity of minor sevenths that might arise in just intonation. (There is no limit to the N-limit primes.) Sadly, this blossoming of harmonic richness has been excluded from the grand design narrative of musical instruments simply on account of practical logistics; in equal temperament, a minor seventh is a minor seventh and that's that.

In postwar America, a new species of experimental music began to emerge in response to the strict structures of serialism and atonalism. As the early practitioners of what would be called minimalism sought to detach themselves from the academic world, they looked in part to non-Western traditions, most of which bypassed European equal temperament and maintained contact with just intonation or structured microtonality; the tuning frameworks of both north India and central Java were seen as especially vital in offering a way forward. As composers began to appropriate borrowed models of just intonation into their own work, a deep interest in the mathematical theories that inform the tuning system started to proliferate, and concerns for the harmonic and timbral implications of tuning solidified as one of the hallmarks of experimental music more broadly. Much of this music tended to move quite slowly, incorporating sustained sound and repetition, and bringing into perceptual focus vertical and horizontal realities of timbral and intervallic relationships. Perhaps, then, a renewed interest in tuning was a necessity: as Arthur Benade pointed out, "most common practice period music moves too quickly for us to notice if an interval is precisely in tune."[81]

[81] Arthur Benade, *Fundamentals of Musical Acoustics* (New York: Dover Publications, 1990), 310.

Among the most dedicated composers in this practice were La Monte Young (b. 1935), Terry Riley (b. 1935), and James Tenney (1934-2006).[82] Young's landmark *The Well-Tuned Piano*, begun in 1964 and continually developed through the 1970s and 1980s, represents perhaps the most ambitious use of just intonation in the experimental canon. From an organological perspective, Young's idiosyncratic use of the modern piano plays an important part in the sounding experience generated by the piece. On account of the inherent inharmonicity that occurs in pianos due to string tension in the highest and lowest registers, Young confines the range of his performance of this improvisational work to the middle register to avoid disrupting the purity of his chosen intervals. The specific model instrument he has employed for all performances of this work is a Bösendorfer Imperial grand, unique in having nine additional sets of bass strings which give it a 97-note compass that spans C0 to C8. Although these keys are never directly activated in *The Well-Tuned Piano,* their presence provides a sympathetic resonance of enhanced depth.[83] The work also shifts between faster clusters or 'clouds' of sound, intensified by lifting the dampers, and slower melodic figures, both of which accentuate the coloristic and expressive character of the tuning in their own way. As Young himself states, the beatings produced in the 'cloud' sections enable him to respond with his instrument in rhythmic accord, in a real-time dialog.[84]

Young's interest in just intonation became exceedingly formalized in the early 1960s, shortly after his relocation from California (by way of Los Angeles then Berkeley) to New York City at the beginning

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[82] This list is in no way exhaustive: notable postwar composers who explored intonation and minimalism also include Phill Niblock (1933-2024), Pauline Oliveros (1932-2016), Yoshi Wada (1943-2021), Alvin Lucier (1931-2021), Charlemagne Palestine (b. 1945), Éliane Radigue (b. 1932), Terry Jennings (1940-1981), Tony Conrad (1940-2016), and Ernstalbrecht Stiebler (1934-2024), among others.

[83] Kyle Gann, "La Monte Young's *The Well-Tuned Piano*," *Perspectives of New Music* 31.1 (1993): 144.

[84] Gann, "*The Well-Tuned Piano*," 148.

of the decade. Early conceptual pieces, such as *Composition 1960 #7*, which consists of a perfect fifth that is "to be held for a long time," prefigured a preoccupation with psychoacoustic effects and the harmonic series as primary musical material.[85] The improvisational exploration of rational tuning was the focus of Young's new ensemble, The Theatre of Eternal Music, which included among its rotating members musician and theorist Tony Conrad (1940-2016), a trained mathematician and violinist who helped Young shift from intuited performing, focusing on 'pure' intervals like the fourth and fifth, to the intentional implementation of a wider tuning theory. It's significant that Young's increasing preoccupation with tuning during this time developed in tandem with a move from acoustic to electronic instrumentation, specifically in the use of function generators that were stable and could be set to precise frequencies.[86] Early electronic works such as *Drift Studies* (1964) were composed for two or more sine wave drones, requiring precisely tuned oscillators. And early works with The Theatre of Eternal Music, such as *The Tortoise, His Dreams and Journeys*, also starting in 1964, employed simple electronic drones as the foundational fundamental frequency, a pedal upon which players responded with amplified acoustic instruments. By the late 1960s, the ensemble's remaining core members were Young and his wife, the musician and visual artist Marian Zazeela (1940-2024), who turned their attention toward the *Dream House* series of installations, the most famous of which is still operating in Manhattan's Tribeca neighborhood. Alongside Zazeela's light and sculpture work, it was through these installations that Young began exploring electronic sound sources more deliberately and exclusively, using specific frequencies tuned to the harmonic series, generated by sine waves.[87] Young understood

[85] Potter, *Four Musical Minimalists*, 51.

[86] It's also interesting to contrast this with contemporaneous composers like Éliane Radigue, who worked exclusively with electronic instrumentation (primarily an ARP 2500 modular synthesizer) until the early 2000s when she shifted to working almost exclusively with acoustic instruments, expressed most notably through her ongoing *Occam* series, starting in 2011. Radigue's intonational concerns are less about fixed, precision stability and have more to do with controlled movements in pitch and timbre; to this end, her acoustic work is composed orally, in direct consultation with each intended performer.

[87] Potter, *Four Musical Minimalists*, 77-78.

that duration was critical, that the longer a sound is sustained the greater access the ear has to its harmonic innards. But his appeal to electronic mediation was not limited to his use of sound-generating 'instrumentation' in the traditional sense: high levels of amplification also served this timbral purpose and were a major component in achieving his desired sounding experience.[88]

vii. *The fifth family of electronics*

American experimental interest in just intonation was certainly not limited to the realm of minimalism, and it had a real impact on instrument building, especially in the prewar era. The most notable exponent was composer Harry Partch (1901-1974): in his seminal *Genesis of a Music*, which saw its initial publication in 1949, Partch sets out his theoretical and philosophical allegiances in great detail, supplementing his vision with diagrams of acoustic instruments he invented and constructed himself, such as the chromelodeon, a reed organ with 43 notes per octave.[89] His unorthodox attitude toward the rejection of common practice traditions influenced subsequent generations of experimentalists. Contemporaries Lou Harrison (1917-2003) and William Colvig (1917-2000) took a different approach, appropriating the instrumentation and tuning of the Javanese gamelan into what became known as the 'American' gamelan. Although many of these explorations of intonation were initially expressed acoustically, they entered an entirely new dimension with the advent of electronics. It's interesting and perhaps significant to note that many of the earliest electronic instruments were microtonal. In addition to offering a wide range of new and unusual sonics, early instruments such as the THEREMIN of 1919, which interrupts the electromagnetic fields generated by two vacuum-tube oscillators with the capacitance of the player's body in a heterodyning effect, and the ONDES MARTENOT of 1928, which employs a ribbon controller capable of a full sweep across the compass of the keyboard along

[88] Potter, *Four Musical Minimalists*, 65-66.

[89] Harry Partch, *Genesis of a Music*, 2nd ed. (Boston: Da Capo Press, 1974), 207.

with filters and loudspeakers for timbral variation, presented composers with relatively uninhibited access to a range of frequencies. Other early electronic instruments, such as the TRAUTONIUM, the Hammond NOVACHORD, and the ONDIOLINE, were intended to supplement the orchestral sound world, while others, such as Thaddeus Cahill's TELHARMONIUM of 1897, an early sort of electric organ, were more imitative.[90] Although commercial success eluded these instruments – perhaps apart from the Theremin, later sold to hobbyists in kit form by the thousands, and the ondes Martenot, featured as a solo voice in several French orchestral works of the 1930s and 1940s – their development can be seen as a reflection of the modernist and avant-garde longing for an expanded palette.[91]

Perhaps the most impactful moment in the chronology of electronic instruments was the arrival of the 'synthesizer.' The rise of this class of instruments in the early 1960s was the result of several factors: the cheap availability and surplus of transistorized electronic components left over from the immediate postwar period; shifting attitudes around the burgeoning field of electronic music; and the willingness of enthusiasts to take on building projects as an extension of the do-it-yourself and hobbyist interests of the time.[92] These instruments democratized academic, studio-based electronic music, which entailed a laborious process of coaxing signals from signal generator units, applying rudimentary processing techniques such as filtering, and attempting to edit and compose within the strict limitations imposed by tape recorders of the period.[93] The great discovery of the 1960s, independently realized by American engineers and instrument builders Robert Moog (1934-2005) and Donald Buchla (1937-

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[90] Peter Manning, *Electronic and Computer Music* (New York: Oxford University Press USA, 2004), 3-15.

[91] Kevin Pinch and Frank Trocco, *Analog Days: The Invention and Impact of the Moog Synthesizer* (Cambridge, MA: Harvard University Press, 2004), 54.

[92] Pinch and Trocco, *Analog Days*, 22-23.

[93] Allen Strange, *Electronic Music: Systems, Techniques, Controls*, 2nd ed. (Dubuque, IA: W.C. Brown, 1983), 45.

2016), was *voltage control,* which allowed the synthesizer to come into its own as a self-sufficient instrument. Voltage control effectively bypassed the slow, convoluted process of studio-based composition and allowed the instrument some level of agency*:* a voltage triggered by a keyboard could be used to control the frequency of an oscillator, and the resulting output could then be used to control the bandwidth of a filter, and so on.[94] Inputs and outputs are allocated across a consolidated unit, with groups of units connected in a modular format, communicating via some form of patching. This new control architecture had its greatest significance on live performance settings, where a feedback loop between performer needs and designer ingenuity engendered one of the most dialogic exploratory periods in electronic instrument design.[95]

Buchla also continued to explore microtonality with a series of touch plates, as they were called, that were meant to free the instrument from the constraints of a 12TET keyboard. Each key of his touch plates is individually tunable, allowing the performer to construct their own scales and tunings. In some cases, individual keys can also accept inputs from multiple oscillators, allowing for layering of intricate harmonies and complex timbres. As these analog instruments were superseded in the 1970s and 1980s, first by hybrids like the Sequential Circuits Prophet 5, which used digital circuits to control analog oscillators and filters, and eventually by fully digital instruments like the Yamaha DX-7, a narrative of improvement – indeed, of progress – took shape. First-generation analog instruments were relatively unstable, a result of the component parts the designers had at their disposal, and often drifted in pitch, making them nightmarish for live performance. Digital synthesizers were more precise

[94] Strange, *Electronic Music*, 34.

[95] Both Moog and Buchla were heavily influenced by the close relationships they maintained with the prominent users of their instruments, but they were also keen to impose their own concepts of gesture and control, which was especially true in the case of Buchla who designed from the 'outside in,' meaning that he would first conceive of the way that a module might be used and then build the circuitry to match.

and reliable; however, with the ability to lock onto frequency comes an intrinsic loss of richness, of the slight inflections and discrepancies that give both acoustic and analog electronic instruments their spectral vitality. In the pragmatic narrative of technological evolution, pitch instability is a problem to be overcome rather than an affordance of timbral expression.

A number of experimental composers of the era also explored the affordances of amplification and compacted signal processing devices such as delay units and sound recording devices such as tape machines into their performances.[96] Their practice, known as 'live electronic music,' was spearheaded primarily by performing groups such as the Sonic Arts Union (Robert Ashley, Gordon Mumma, David Behrman, Alvin Lucier), and Musica Elettronica Viva, which included the American composers Alvin Curran and Frederic Rzewski among its permanent members.[97] These composers were highly inventive in their use of amplification to produce new sonic experiences, and they also helped bring into question the role of the composer-performer, which Lucier did so elegantly in his *Music for Solo Performer* of 1965 and *I Am Sitting in a Room* of 1969. In the mid 1970s, Terry Riley developed a series of live performance techniques based on the use of a commercial electric organ modified to just intonation run through a series of tape delays and tape loops, producing a live version of sound-on-sound performance that enabled him to effectively accompany himself, generating intricate polyphonic and harmonic textures that are typically associated with the multi-tracked space of the studio.[98]

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[96] Although this perception lessened throughout the 1970s and 1980s when synthesizers became indispensable in the commercial music and film industries, their capacity for live performance was, at least early on, an important image to put forth for the sake of defining synthesizers as instruments in the traditional sense, distinct from their studio predecessors, which could not easily generate a piece of music in a conventional real-time setting. It is likely for this reason that the keyboard persisted as a convenient interface for the synthesizer, eventually taking over as one of its most defining visual features.

[97] Michael Nyman, *Experimental Music: Cage and Beyond* (New York: Schirmer, 1974), 89.

[98] Potter, *Four Musical Minimalists*, 97.

Most of these changes in instrument design and performance practice involved creative abuse; indeed, it is this feature that largely characterizes experimental music's embrace of technology. By its very nature, experimental practice seeks to subvert musical convention, and thus it is not at all surprising that practitioners would deliberately test and probe the limitations of their tools. In its focus on new instrumental designs and new gestural relationships, there's an important sense in which experimental music stresses the singularity of individual technologies. Despite a belief that electronic instruments were completely limitless in their timbral potential, they fortunately *do* have intrinsic limitations arising from variations in the tolerance of manufactured components, idiosyncratic circuit designs, even the unintended gestural constraints negated by the use of one interface over another – and thus remain enclosed 'instruments' in the most basic sense of the word. The analog synthesizer was never the universal instrument it was once hailed as, never the last word in organological evolution; electronic sound producing circuits from this era exhibit a unique historicity and autographic power that continues to elude simulation.

In fact, the phenomenon of imitation, especially in the context of electronic instruments, is a particularly interesting example of when "saying something differently" inevitably means "saying something different." Practical instruments such as the Hammond B3 organ (an electromechanical alternative to the chamber organ), the Mellotron (a tape-based sampling instrument and commercial precursor to the numerous digital samplers that emerged in the 1980s), and the combo organ (an electronic instrument of fixed oscillators and filters; early drum machines such as the Roland TR-808 also function this way, while digital successors such as the Roland TR-909 are sample based) – all were marketed as able to sound like acoustic instruments that already existed. But though the synthesized or sampled sounds were similar enough at one time to substitute for the original sound producers,

they remain unmistakably distinct as sonic objects. And, as we'll see in the next chapter, the parameters and conditions that combine to account for these phenomenal differences engender discrete sounding experiences as well.

Keeping recorded sound in mind, it's also important to make clear that discussions of electronic technology cannot be limited to the realm of instruments. To put it another way is perhaps more revealing: it's necessary to reposition sound recording and sound reproduction technologies – the realm of the studio – as a conceptually similar form of electronic instrumentation. It's no surprise that the postwar early music revival adopted the same recording methodology as the Western classical world, one of technological transparency. For a practice so vehemently preoccupied with obtaining an authentic sound, it seems sensible that production techniques would focus on clarity and natural acoustic space. Although these early music recording artists and engineers may not have viewed their engagement with technology as a form of romanticism, their reliance on the immersive qualities inherent in these aspects of recording very much exploits the notion that the listener can be brought into a specific sonic environment and, at least conceptually, suspended not only in space but also in time. Thus, the revival's embrace of the affective power of sound reproduction reflects what's often referred to as the 'portal' medievalism effect.[99] Still, the fact that performers and engineers did not take full advantage of the vast affordances made available by the studio at the time and the clear inclination of the public to subsume the unusual sounds of the past, exploiting experimental processing and recording techniques, is something of a lost opportunity.[100]

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[99] Thomas Prendergast and Stephanie Trigg, *Affective Medievalism: Love, Abjection and Discontent* (Manchester: Manchester University Press, 2018), 24.

[100] Curiously, the electrical manipulation of obsolete musical instruments is not entirely without precedent during this time, albeit manifesting in the realm of popular music rather than early music. In the 1960s, notable instrument manufacturers such as Hohner and Baldwin electrified through the common use of pickups the clavichord and harpsichord, respectively. Both instruments enjoyed usage in popular recordings, however it was the timbral

Postwar experimental musicians, on the other hand, tended to avoid categorization of their work as fixed in time and place, manipulating the instrumental and gestural possibilities of recording techniques for live performance. Absent was an interest in the creative affordances of the studio itself, in the 'black box' methodology of imagined or constructed sound worlds. This relative disregard for the recorded format is a little discussed aspect of experimental music in this era. Despite its subversive character, experimental music can still be viewed as a practice that emerged out of the academy – or, at the very least, as a response by those who wanted to break away from institutionalized backgrounds. Thus the adoption of the traditional recording-as-document attitude in this practice probably says more about the persistence of 'high art' conventions in the experimental consciousness than it does about the effectiveness of 'popular' studio techniques to create a world that would serve experimental purposes. It's curious, then, that when experimental performance practices did enter into the realm of the recording studio it was not in the case of wholly experimental projects but mostly in the case of cross-over popular genres, as in the work of musician-producers such as King Tubby, Lee "Scratch" Perry, Brian Wilson, or Brian Eno, auteurs who viewed the studio as a musical instrument in and of itself.[101]

Given the meaningful interaction between instrument and acoustic space in many early electronic works, translation to recorded formats was not deemed particularly desirable, defeating intended

possibilities of the former, which was marketed as the Clavinet from 1964 onward, that engendered not only a new style of playing on account of the unique touch of the instrument's keyboard and, thus, a new sound to accord with this change in physical design, but that – thanks to adoption by its most famous user, Stevie Wonder – then lent itself as a key timbral component within an entirely distinct genre of music. The idiomatic articulation of the Clavinet was a result of its lighter internal construction, which is often connected to the use of pickups within electrified instruments: because they are closely and directly amplified, the acoustic components of construction that would otherwise serve this function become unnecessary.

[101] Pinch and Trocco, *Analog Days*, 119; Virgil Moorefield, *The Producer as Composer: Shaping the Sounds of Popular Music* (Cambridge, MA: The MIT Press, 2010), 53-55.

spatial or durational effects. It's ironic that studio production and electronic instruments such as the synthesizer both openly and independently espoused the view that anything was conceivable within their boundaries, and yet exploitation of the recorded format remains another lost opportunity in the context of experimental practice.[102] Thus, the translation to genres outside of the popular realm for which the studio was, by and large, ripe to penetrate seem to have been useful in some ways and less so in others; the studio-as-instrument is instrument indeed, well suited for certain contexts and not for others.

[102] It's not to suggest that experimental musicians didn't produce records whatsoever. Notable synthesizer recordings from the late 1960s, such as Wendy Carlos' *Switched-On Bach* and Morton Subotnick's *Silver Apples of the Moon*, were pivotal in presenting these instruments to the public as musical machines. The goal was conceptual at first, to promote the new technology rather than exploit the merging of synthesized sound with production affordances. In the 1970s, musicians such as Terry Riley, Alvin Curran, and Robert Ashley, who founded the experimental record label Lovely Music, explored the recorded format with as much eagerness as their live works, and in some cases also explored the creation of fixed acousmatic works. However, only a small percentage were presented in a recorded format, with even fewer examples having been conceived specifically for it.

CHAPTER FOUR

THE EMERGENT NATURE OF TIMBRE

i. *An alternate typology of affordances; creative abuse as timbral recovery*

The purpose of the next three chapters is to explore the physical bias that underscores the field of organology as well as adjacent studies in timbre, starting in this chapter with an expansion of the parameters that allow us to understand timbre's ontological status. As we'll see, once we start expanding our conception of what timbre can be, we'll begin to understand how it, as well as the affect and meaning that it creates, function as emergent phenomena that, even as they transcend the domain of the psychological, can be intersubjectively described. The goal of this discussion isn't to undermine the acoustic and cognitive roots of organology and timbral studies; virtually all musical instruments and the sounds they generate are indeed measurable things. But the aim, especially in this chapter, is to demonstrate that they do not offer a full picture of timbre, and by extension, sounding experience. My intention is not to be comprehensive, but instead to promote a shift in thinking as well as outline a potential path forward based on my own instrumental experience. My hope, then, is that this approach will be further expanded by practitioners of different instruments and performance traditions, by those who can offer more evidence of their own instrumental interactions and the unique ways in which timbral experiences emerge.

Throughout the last chapter, I referenced the 'affordances' of musical instruments and technologies. Defining 'creative abuse,' I suggested that it was not the instrument being manipulated but its affordances. Affordance theory is at the heart of timbral ontology: it positions musical instruments as active agents rather than static objects, which they most certainly are not. Physical and acoustic descriptions of musical instruments – for example, those that indicate the shape, material, and

vibrational mechanism of an instrument – help us make sense of why an instrument might sound as it does but they don't allow us to envisage all the potential ways in which that sound can articulate itself. The concept of affordance, then, lets us encounter timbre in a more practical way. It lets us observe how a musical instrument speaks; it encompasses all the things that an instrument can say as well as how it goes about saying those things. Both the piano and the violin, for example, have the affordance of FIXED PITCH: they can isolate individual pitches in a perceptible manner and with a high degree of control. But the way in which they are able to do so is vastly different. In the case of the piano, the player is restricted by the interface of the keyboard and the singular unity of pitch that is inherent in the instrument's design: when a pianist wants to generate the pitch A4, they have only the option of selecting the key that strikes strings tuned to that frequency. The violinist, however, has the additional affordance of VOICING: they can find the A4 as a stopped node on their open G string, or they can generate it as a natural harmonic on their open D string, or simply play it on their open A string.

Each choice will have a consequence in terms of playability, which may indeed be a driving factor. For instance, the player may be performing a piece in just intonation that involves two different A4s, one tuned slightly higher than an equal-tempered A4 and one that's tuned slightly lower, each observing a different intervallic context. Instead of retuning an open string (a finicky process in live performance), the player may choose to reserve the sharper A4 for the open string, which can easily accommodate increases but not decreases in intonation, while the flatter A4 becomes an easy function of the open D string below. More interesting to note is the fact that each articulation of A4 will ultimately also carry a unique timbral character due to the relative tension of its origin string as well as the resonant capabilities of its sounding length. Thus, an A4 played as an open string will sound qualitatively distinct from an A4 played as a harmonic on another string. And, of course while the piano is technically also

capable of playing non-12TET pitches, it must be retuned, in advance, to do so; moreover, the violin has the affordance of full MICROTONALITY, while the piano is still limited to the confines of its closed-system keyboard. The piano can tune its A4 slightly higher, but if it also requires an A4 that's tuned slightly lower, it will have to sacrifice another pitch in the twelve-tone scale, likely the G^{b} below, to maintain octave equivalency. And even if octave equivalency is not required and the pianist simply desires a single octave of, say, 31 pitches, standard piano strings can only be retuned so far.[103]

Affordance theory allows us to formalize our intuitions about the idiosyncrasies, idioms, and limitations of musical instruments. I use the term *idiosyncrasy* to name the distinctive features of a musical instrument, not the entire range of its affordances, but the ones that have come to define the instrument type, like FIXED PITCH for the piano. *Idiom* is a related concept and refers here to the way in which instruments most often tend to behave; it implies their characteristic modes of expression more than their full range of expressive possibility. FIXED PITCH for the violin is idiomatic, while its MICROTONALITY is an idiosyncrasy. In effect, then, idiosyncrasies are the types of affordances that describe *what* an instrument tends to say, and idioms are the types of affordances that describe *how* the instrument often chooses to speak. *Limitation*, on the other hand, is the antithesis to idiosyncrasy and idiom: it calls attention to the things that an instrument is incapable of saying, or the ways in which it is incapable of saying certain things. Limitation is often a pejorative, suggesting failure. But this tendency is essentially a product of the modernist prejudice for "convenient" instruments with a standardized technique and a wide, flexible expressive range.

[103] Numerous microtonal composers have handled this limitation by composing for two pianos tuned slightly apart; usually with one kept in 12TET and the other tuned a quartertone (50 cents) sharper or flatter. Notable works include James Tenney's *Bridge* (1984), Charles Ives' *Three Quarter-Tone Pieces* (1923-1924), Mildred Couper's *Dirge* (1937), Georg Friedrich Haas' *3 Hommages* (1982-1984), Alan Hovhaness' *O Lord, Bless Thy Mountains* (1974), and Ivan Wyschnegradsky's *Cosmos* (1939-1940).

The MIDI protocol now ubiquitous in electronic music is a good example, introduced in 1981 as a standardized way to allow electronic instruments made by different manufacturers to connect, and as an antidote to what many musicians felt were the unwieldy idiosyncrasies of the first generation of hybrid digital-analog synthesizers.[104] MIDI did solve this problem – and remains the industry standard to this day – but in so doing it also sacrificed the nuance of each individual instrument's unique personality and it neutralized the numerous available affordances of multiple instruments in exchange for the limited affordances of a single controller. And, of course, that is the logical outcome if we are inclined to accept that *the-sound-of* something is the result of many factors, including the way that *sound-of* was articulated. Even in the context of instruments that aim for limitless functionality (the general subtext of early analog modular synthesizers and the hailed hallmark of modern computer music), limitations inevitably arise in practice, and their framing nature still serves to define an instrument's personality. I thus propose here an alternate, benign understanding of limitations as simply indirect affordances; they function as negative space, so to speak, just as capable of constraining and shaping *the-sound-of* a musical instrument in a profound way.

Alongside internal and external affordances, we could also consider the idea of intentional or deliberate affordances as well as unintentional or incidental ones. Of course, all musical instruments are designed with certain affordances in mind, most motivated by the needs of musicians. The piano's double-escapement mechanism is a good example of this. But musical instruments also carry an array of unintentional affordances as well, and these can arise for any number of reasons. In many cases, affordances may simply result from the technological realities of the time. Early analog synthesizers, for instance, have the affordance of PITCH INSTABILITY, a basic consequence of the components available to instrument designers in the 1960s. Increased SYMPATHETIC VIBRATION is an affordance

[104] Manning, *Electronic and Computer Music*, 263.

of viol consorts due to the thinner strings and lessened tension that unbraced instrument bodies and necks can accommodate. Some affordances we tend to think of as limitations (but which are actually just external affordances, such as the pitch instability of analog synthesizers) turn out to be intentional rather than as the imposed corollary to a deliberate decision. Internal affordances can also emerge incidentally as the result of an intended limitation, as in the case of FIXED PITCH when it emerges from the use of a twelve-tone chromatic keyboard. If we level limitations with idiosyncrasies and add them together to the larger pool of more general affordances that an instrument can possess, then we arrive at an interesting and, I think, useful understanding of musical instruments as 'individuals.' As with human individuals, the goal is neither to neutralize nor essentialize differences and capabilities but rather to honor and nurture them. I suspect that this is the spirit that prompts creative abuse, which I think might be better interpreted as a process of timbral recovery, uncovering hidden or overlooked affordances along with their associated sounds and meanings. Organological history shows us that instrumental idioms can change over time, and, in many cases, can develop into standard practice. Creative abuse as timbral recovery is, then, a yearning to emancipate and to explore what an instrument could be, and by extension, its immanent potential for new timbral experiences.

ii. *Case study: the Mellotron (1963-1986)*

On a basic level, the emergence of certain affordances and the suppression or absence of others are simply the result of mechanical designs that continue at every step to lead the instrument in one direction and not another, either out of necessity or out of choice. To see how this works, let's return to the example of the Mellotron, an iconic electro-mechanical instrument that was produced and most popularly used throughout the 1960s and the 1970s. The Mellotron is a sampling instrument, meaning that it plays back sounds that have been pre-recorded, or "sampled," from different sound sources. Early Mellotrons mostly contained acoustic samples, especially those of orchestral melody instruments

such as the violin, trumpet, and flute. Mellotrons are also analog (as opposed to digital) sampling instruments in that they employ a mechanical playback system to trigger strips of magnetic tape when a key is depressed. Magnetic tape recording originated in Germany in the late 1920s and early 1930s and originally employed long strips of paper coated on one side in ferric oxide powder. When passed across the electrified tape head of a recording device, the coated side of the paper strip is magnetically polarized through an arrangement that produces an analog of the outside sound source being directed into the recording device, usually by a microphone.[105] When the same strip of tape is passed across the playback head of the device, its magnetized information is read out as an electrical signal that can then be transduced into an acoustic signal by an amplifier and loudspeakers. Unlike most later samplers, Mellotrons were intended only for performance use, and therefore have only a single tape head for playback.[106]

Most Mellotrons, including the popular M400 model, feature an individual tape strip, playback head, and mechanism for each key on the instrument's keyboard. When the Mellotron is switched on, a small metal cylinder called a capstan, located underneath the back of each key, begins to rotate via a motor and belt assembly; when the key is depressed, another rotating rubber cylinder called a pinch roller, connected to the bottom of the key directly above the capstan, is moved downwards to contact the capstan. The tape strip, now threaded between the two, is pulled backwards. At the same time, a felt pressure pad is lowered, pushing the strip of tape down onto the key's corresponding tape head and playing whatever is recorded on the tape. As the tape strip passes over the tape head and capstan,

[105] The largely acoustic sound sources of the Mellotron would have necessarily required the use of a microphone to capture, but of course electronic sound sources can also be recorded onto tape through a direct line input.

[106] Nick Awde, *Mellotron: The Machine and the Musicians that Revolutionized Rock* (London: Desert Hearts, 2008), 25. In the case of the multi-track tape machines that were used throughout the same era, recording and playback components were combined into a single unit.

it falls into a small wooden compartment located at the very back of the key. The other end of the tape strip is connected via a series of small cylinders to a spring, which rises as the tape continues to move. When the key is released, the pinch roller and pressure pad lift from the tape and the spring pulls the tape back to its initial position, allowing the player to activate the sample again as desired.[107] This elaborate mechanism forms the Mellotron's primary limitation (indirect affordance): because the tape strips are not looped, the sample can only run the course of its recorded length once, amounting to approximately nine seconds of sound before the sample is abruptly cut off. When this occurs, the player must release the key and allow the tape to reposition itself to the beginning of the recording. It's not clear if this was an intentional or unintentional affordance: a tape loop mechanism seems to be the obvious and more practical solution, which might have been a design oversight, but its omission could also have been deliberate, to avoid an unwanted technical complication.[108]

The magnetic tapes employed by the Mellotron are in multi-track format, holding multiple layers of sound, each recorded independently. For instance, two-track (or stereo) tape is split into two separate halves lengthwise, each half being written and read by a separate track on the tape head. In the 1960s, four-track tape recording and playback was easily achievable at each key. Although the many intricacies of multi-track tape recording do not entirely come to bear on the behaviors of the Mellotron, it's worth pointing to some that do. One pragmatic result of this system is that it allows for stratified recording sessions: in the case of a string quartet recording, for instance, rather than the entire ensemble being captured by a single microphone or a stereo pair of microphones, each instrument can have its own microphone and, by extension its own track of sound on the tape. This setup also

[107] Awde, *Mellotron*, 16-17.

[108] The Birotron, a creation of the American engineer Dave Biro, was an attempt in the early 1980s to reconstitute the concept of the Mellotron with the help of eight-track tapes, which are already capable of looping continuously. The instrument suffered numerous issues, however, and never enjoyed any level of popular or even niche usage.

makes it possible to treat each of the tracks distinctly, changing presence and balance within the recording (mixing), applying signal processing like frequency equalization or reverb (effects), or rerecording and editing independent of the other sounds (punching in). Multi-track recording also makes overdubbing possible, which occurs when tracks are recorded separately, on top of one another, at different times. A multitrack approach often lends itself to a cleaner and more precise sound since each instrument is isolated in its own recording space. Modern digital recording provides a practical infinity of multi-track possibilities, but analog multitrack recording is limited in some interesting ways. The sound quality of the tape recording is determined by its overall width, divided by the number of tracks. A strip of ½-inch tape can be split into two or four tracks; if two, each track is ¼ inch wide; if four, half that much.[109] It might be helpful to think of it like a storage box: if the number of objects that need to go inside remains the same, then a difference in the size of the box is going to impact how much settling space the objects have; in a small box, they'll be close together and perhaps even overlap one another, and in a larger box they'll be more spread out each with their own space to breathe. With analog tape, if a signal is allowed more magnetic "space" for capture, that will result in greater clarity of sonic detail.[110]

The Mellotron uses a very non-standard three-track 3/8-inch tape, usually containing three separate sample layers from which the player can choose with a rotary switch on the instrument's front panel,

[109] Similarly, multi-track tape recording and playback machines have predefined track limits that correspond with a partitioning of their tape heads.

[110] An eight-track strip of 1-inch tape might seem better than a two-track strip of half-inch tape because of its increase in size and number of tracks, but each track of the former will have only an eighth of an inch in which to sound, while each track of the latter will have a more spacious quarter inch. The speed at which the tape moves while the recording is occurring will also affect fidelity: the most common speeds are 15 and 7.5 ips (inches per second); if the same signal is spread out over more tape length, that will also result in higher fidelity. The drawback, of course, is that more tape will be needed to capture the same amount of sound.

each sample set recorded to sound at the pitch of the corresponding key.[111] The instrument's front panel also features a general tuning knob that adjusts the overall pitch of the instrument by modulating the speed at which the capstan motor runs (faster speed results in higher pitch). Two other knobs allow the player to adjust the loudness and "tone," the latter essentially an adjustable bandpass filter that raises (brightens) or lowers (darkens) the output's frequency spectrum. The Mellotron's keys, effectively glorified 'play' buttons, have a non-linear depth sensitivity that results from their direct connection to the complicated playback mechanism. The Mellotron was originally intended as a live performance instrument: if a band recorded in the studio with a string quartet or choir, for instance, they could rely on the Mellotron as a touring replacement, easing logistics and lowering cost.[112] Because their peculiar sound was so particular, though, they were frequently used in recorded contexts as well, to the point that their distinctive sound helped define a genre like progressive rock. Mellotrons were also known for being extremely unstable and unreliable, requiring frequent servicing and specialized care, and although they were theoretically designed to be portable, regular movement of the instrument would often throw the tapes and components out of alignment. When digital sampling arrived in the early 1980s, with its higher fidelity of sound and much greater ease of use, the Mellotron quickly faded into obscurity.

Each and every one of these facts – including the articulations of the studio musicians hired to make the original sampled sounds – played a part in shaping the affordances of the Mellotron, what it says and how it speaks. And, as a result, they are also vital in appreciating how we come to describe *the-sound-of* the Mellotron. To the contemporary ear, the manifest limitations of the instrument's multitrack

[111] The master tapes for Mellotron samples were recorded onto 1/4" tape, however the manufacturer had to later convert these to 3/8" tape, a far less common format, but was required for the mechanism upon which the instrument's design had originally been based.

[112] Awde, *Mellotron*, 24-25.

tape mechanism, its warbling flutter-and-wow and thick oversaturation, are regarded as its most prized affordances. What from a modernist viewpoint was a limited or imperfect technology, perhaps just a stepping-stone toward the higher fidelity and reliability of digital samplers, can also be reconsidered as something valuable in and of itself. Some kind of timbral recovery can be made. It's not surprising that analog instruments like the Mellotron are enjoying a renaissance these days: surviving examples provide an unmistakably idiosyncratic sound experience for both performer and listener. There is no shortage of digital Mellotron samplers (yes, they play a sample of a sample) and emulators, some that even allow today's players to incorporate certain levels of the distinctive limitations and instabilities back into the modern keyboard.[113] But working with them often puts one into the uncanny (sonic) valley: close enough to fool the ear, but "off" enough to cause unease. In a book dedicated entirely to the wonders of the Mellotron, musicologist Nick Awde suggests optimistically that modern simulations allow us to re-enter its unique sound world – but do they, really? Any discomfort one might feel (perhaps without being able to place a – pun-unintended – finger on it), surely comes from the fact that the simulation is a different physical 'thing' – it has completely different affordances, both idiomatic and idiosyncratic – and it therefore just can't "be" the same. Mellotrons sound like nothing else precisely because they *play* like nothing else. Timbre is not just an impression, it is a holistic and autographic sounding experience, and *affordances matter*.

That's okay: the simulation, we can all agree, is neither better nor worse than the original, just different. Given the current market for vintage musical equipment, the simulation absolutely has the social benefit of wider accessibility. As with digital simulations of vintage tape echoes and tube amplifiers,

[113] Sequential Circuits, Inc., the company that designed and manufactured the massively successful and influential Prophet 5 synthesizer in the late 1970s, has been producing pseudo-reissues of their classic instruments, upgraded and expanded for the current era. Their recent Prophet 6 synthesizer similarly allows the user to deliberately incorporate pitch instability to mimic that of the original analog oscillators.

the modern instrument will also likely offer new affordances that the old gear never could. And since the Mellotron is itself an imitator of sorts, we can broaden our argument by considering its relation to those original sampled sounds in, let us suppose, a typical use such as substituting for a string quartet, where the felt difference between one and the other is most obvious.

The functional distinction is huge: one set of instruments generates sound via bowed vibrating strings amplified by hollow wooden bodies, and the other through a particular studio recording of those sounds, a recording which imposes a timbral mediation, further mediated by the vicissitudes of magnetic tape playback in itself and the specific mechanics of the Mellotron as performance instrument. Moreover, although the Mellotron can select and (in theory) isolate any of the three samples on a particular strip, the nature of magnetic tape is such that there will always be louder sounds spilling over from one track onto its neighbor, since analog sounds rely on the tolerances of a physical medium in a way that digital sounds do not. Depending on the strip being used, the violin sample triggered by a given key and knob setting might bear traces of a louder instrument, like a trumpet, recorded onto the adjacent track. It's difficult to keep thirty-odd tape heads in perfect working order, and crossovers can happen anywhere mechanical components get misaligned inside the instrument.

The sharp break in sound that occurs when the samples of the Mellotron have run the course of their recorded length has already been mentioned, but one of the most interesting aspects of these instruments is the general lack of a beginning, middle, and end (the envelope, as engineers call it) to their samples. Timbral identification of sounds is connected to the way they spread their energy across the frequency spectrum; just a few microseconds of a violin recording is often enough to hear this attribute correctly. But our full recognition of musical instruments includes their manner of articulation as well; a violin sound taken out of context, removed from its patterns of attack and decay,

is no longer *the-sound-of* the violin. It's likely that Mellotron samples were stripped of their envelopes as an indirect but intentional affordance, done so that the player could engage a key and hear sound right away without having to wait a split second for the recorded instrument to attack or fade in on its own. In this way, although the Mellotron may be playing something that has the spectral fingerprint of a violin, its affordances are closer to that of the organ, which also lacks nuance in the shape of its timbres. The Mellotron's violin samples, then, do not reproduce *the-sound-of* the violin, but rather produce *the-sound-of* the Mellotron itself. One could even argue that the Mellotron challenges the concept of imitation within its own borders as well: its tuning knob is useful for minute adjustments, but extreme ones will result in a severe degradation of sound quality and will not produce the same tone as in a sample originally recorded at the requested pitch. Thus, in an expression of creative abuse, a player can choose to play the key connected to the pitch A4, or they can choose to play the key that's connected to G4 and shift its pitch upwards by 200 cents with the tuning knob, generating an altogether different timbre.

It's important to note here that our close dissection of the Mellotron is not intended to argue the singularity of electronic instruments but to situate them simply as instruments, with their own unique affordances and ways of speaking that result from design and acoustics. The violin, in this way, is no more different from the Mellotron as it is from, say, the flute.

iii. *A new phenomenology of timbre*

All musical instruments are complex objects. Complex in the sense that they encompass numerous physical actualities, the result of decisions in design and construction, which determine a set of affordances. Ultimately, all these in turn contribute to our understanding of what an instrument 'sounds like,' or, rather, what its timbral experience is like. Indeed, you can't divorce *the-sound-of*

something from the way that sound came to be. When we point to timbre, we typically offer up individual musical instruments: we refer to *the-sound-of* the piano or *the-sound-of* the guitar. It's less common for us to speak about timbre non-transitively, without a particular object; we recognize that an ensemble of instruments or a recording of that ensemble of instruments also has a "sound," but we often hesitate to designate that sound as itself a timbre. I would argue that such delicacy of reference is the physical bias of organology at work. Timbre is nothing more than the result of acoustic behavior, and it is harder to quantify all the play in a system, especially one that changes over time, which is probably why the "play" that governs individual instruments is often overlooked in the context of timbre as well. Given, however, that 'things' such as an ensemble or a recording of an ensemble are theoretically no more complex than a musical instrument in and of itself, it seems ignorant at best and conceptually disastrous at worst to deny them timbre. And the reverse logic is worth considering too: we speak about the timbre of a violin, but couldn't we just as easily speak about the timbre of its component parts – say, its open G string? Of course, in this hypothetical *the-sound-of* the violin's G string is impossible to separate from the system to which it belongs and by which it is constantly impacted, and thus we have an even stronger motivation to redefine timbre as a necessarily "total" phenomenon.

Let's look at this from the perspective of studio recording. The engineer and producer who work together to create a record (and who may also be one and the same) might choose to capture an ensemble in a detailed multi-track session, in which case they'll have full control over the placement of the instruments; or, they might choose to capture the ensemble as it naturally sounds in the inward-looking, 'concave' acoustic space of the live room. Or they might combine aspects of both: a multi-tracked session with a microphone for each individual instrument, but also including some placed further away to capture a sense of the room. In this third scenario, the producer can customize the

mix according to their own sonic aesthetic: they might emphasize the close microphones while adding in a vague sense of the acoustic space, or vice versa, or they might start with a more intimate balance of close microphones that shifts over time, gradually revealing more spatial ambience. Each decision will affect the timbre of the recording and will dictate the possible avenues of sound that can follow. For instance, a contemporary producer can choose to record onto analog tape, a decision which will bring with it all the affordances (both internal and external) of that medium. Recording to tape will limit the number of tracks available, which will have consequences for mixing. The decision to work with tape might be intentionally motivated by its affordance of SATURATION (the "bleeding" we discussed earlier), which can be used creatively to produce a denser texture, difficult to simulate in the digital realm. In this case, the limitation of tracks is an external and unintentional affordance, a result of the decision to favor the sonic quality of magnetic tape.

A producer might even choose to work with tape precisely because of its limitations. In digital recording, each instrument of the ensemble can be given its own microphone – or even set of microphones, often done for bigger instruments like drum kits or pianos. Limiting the available tracks will force some decisions: if the tape offers eight tracks, the producer has a limited set of options, each with timbral implications. They might choose to allocate, say, four to one big instrument, one each to two others, and the final two to the room. And they could choose to record the performance in one go, with everyone playing together, or they could record with overdubs. They could also choose to allocate all eight tracks to close mic'ing of just one instrument, and then dub, or 'bounce' a carefully mixed version of that recording onto the first two tracks of another eight-track tape. This would significantly degrade its quality, and also create room to overdub six more tracks, which would then sound much cleaner than the first closely-microphoned instrument. The same "music" will occur in each scenario, but the resulting sound and meaning will be quite different. Naturally, the choices one

has in recording are never infinite, but they are wide ranging and, just as in the case of conventional musical instruments, they will all unequivocally come to bear on *the-sound-of* the recording. It is in this way that many producers tend to refer to the recording studio as a musical instrument; as something that is a complex and varying construct, and as something that can be "played" to generate a particular kind of sound. And, of course, this is also saying nothing of the numerous other aspects of recording technology – the types of microphones being used, the desk, the pre-amplifiers, etc. – that also impact the timbre of a recording.

The first conclusion we can draw from this analysis is the *autographic* nature of timbre, that it carries a *this*-ness, a sense in which it is always singular. This also places significant value on the practice of iteration, which is deliberately choosing to say something differently (no matter how seemingly narrow or subtle the difference may be) in order to say something different. This perspective greatly expands our notion of where timbre can occur, as well as the tools we use to measure its sounding experience. Microphones, for instance, each have a certain frequency range and direction in which they are sensitive and placing them with intent can help reveal sounds that may not be apparent to a player as they sit in close proximity to their instrument. Thus the microphone is not just a filter, selecting from a range of equally audible tones within the borders of its range, but also serves to coax out latent frequencies present in the acoustic space but otherwise undetectable. Sounding experience may thus include a projected or immanent dimension in which an additional element is generated above the "given" of the immediate encounter.[114]

[114] From a philosophical perspective, 'immanent' refers to the quality of being held within something rather than being external to it, which is 'transcendence.' The two are not mutually exclusive, though, and we see them intertwine in the concept of emergence.

Tuning is a perfect example of how emergent dimensions work in timbre. Tuning is an inherently dialogic concept, less about the harmonic structure of individual tones and more about the intervallic harmonic interactions between tones.[115] The sounding experiences to which tuning gives rise are, in part, informed by what we would conventionally think of as (degrees of) consonance and dissonance. Exploring the acoustic and perceptual depths of these terms is beyond the scope of this discussion, but the typical understanding is that consonant sound is settled, easy to tune by ear, and largely free of the acoustic beating that indicates instability. Dissonance, on the other hand, is characterized by a sense of restlessness and intonational friction.[116] Levels of consonance and dissonance are simply affordances of a given tuning, neither better nor worse than each other. The relative consonance and dissonance of certain intervals and chords will also result in other psychoacoustic phenomena: audibly reinforced upper harmonics, or overtones, a hallmark of just intonation; or perceptible combination and difference tones, corresponding to the positive or negative sums, respectively, of certain simultaneously sounding frequencies. Dealing with the full frequency spectrum of a complex musical event, the creative use of tuning to produce audible effects might be seen as the most basic exemplar of timbral emergence. These resultant tones are often referred to as "ghost" tones because they are heard but not written into the score as notes that the player actively performs. As Arthur Benade notes, "the timbre of instruments played together alters musical affinities that we find between the notes we play."[117] In this way, the affordances of tuning allow for an entirely distinct layer of immanent

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[115] Musicologist William Sethares hints at this overlooked dialogic aspect of tuning even though his writing is mostly spectrographic, suggesting that tuning is more about relationships and dependency and that different combinations can be manipulated to create new musical possibilities. W.A. Mathieu also discusses this concept in terms of the emotional resonance of tuning.

[116] Gann, *The Arithmetic of Listening*, 10.

[117] Arthur Benade, *Horns, Strings, Harmony* (New York: Dover Publications, 1992), 107.

sound that contributes equally, alongside the literal notes of the music, to the overall sounding experience we call timbre.

These psychoacoustic effects often take time to manifest and stabilize in our sensorium, and most normative forms of music move too quickly for the listener to perceive such interiority. This is, again, perhaps why tuning has become a major preoccupation for minimalist composers, who highlight the immanent harmonic characteristics of sound by way of duration and repetition. Indeed, the sounds that emerge from the affordances of different tuning systems are intentional components of the timbral landscape in such music, and often function as the primary compositional material as well. *In a large, open space* (1994), one of James Tenney's lesser-known works, does exactly this, framing just intonation in a decidedly visceral manner for a listener surrounded by the performers and thus enveloped within the generated sound. The score calls for twelve or more arbitrary instruments, the only requirement being that they be able to sustain held tones and precisely adjust their intonation. Tenney also specifies an expansive performance venue that allows the players to be situated widely and evenly at different spots and audience members to move freely. Players are instructed to choose one from a collection of notated pitches and maintain that note for approximately thirty to sixty seconds, very softly and using as gentle an articulation as possible. After a brief pause, another pitch from the collection is selected, and the process is repeated for the duration of the piece, which is left open-ended to the discretion of the performers.

Tenney provides but a single suggestion for the piece's teleology, asking that performers attempt to avoid as much as possible duplicating a pitch sounding on another instrument. Despite the openness of the instrumentation, duration, and counterpoint, the available pitches that Tenney selected are carefully defined, comprising a fundamental F1 (ca. 44 Hz), along with the next thirty-one overtones,

or partials, that follow in the harmonic series: the 2/1 octave (F2), the 3/2 fifth (C3), the 4/3 fourth (F3), the 5/4 major third (A4), the 6/5 minor third (C4), the 7/6 minor third (E^b4), and so on. These pitches are notated on a traditional staff with deviations from equal temperament indicated above the notes in 'cents' (one cent = 1/100 of a 12TET semitone). In this series F2 and F3 remain unchanged from 12TET, C3 and C4 are sharpened by 2 cents, A4 is flattened by 14 cents, E^b4 is flattened by 31 cents, and so on. This schema becomes especially significant when it reaches the upper harmonics falling between F5 and F6: the interval ratios become large enough to fit sixteen pitches into the octave; some notes, such as B5, appear twice, the first one falling by 49 cents below its equal tempered equivalent, becoming a quartertone between B and B^b, and the second one rising by 28 cents above.

The sounding experience of *In a large, open space* is ostensibly simple, but profound. In most musical contexts, the ear perceives the fundamental of a tone as definitive, because most instruments produce tones where the fundamental is the loudest frequency. An A4 played on a flute will sound like the same pitch as an A4 played on a violin, since the fundamental frequency of 440 Hz is the most prominent in both cases; this is how our brain resolves a complex tone into a single note. But most acoustically-produced tones also contain a mathematically regular series of harmonics above the fundamental, which defines the spectral aspect of timbre. These overtones, always nascent within a fundamental, are amplified according to the resonant properties of the vibrating medium; for instance, the column of air within a flute vibrates almost entirely as a whole, emphasizing the fundamental, while the strings of a violin vibrate in a much more complex way, producing an audible spread of harmonics. Upper harmonics get progressively weaker, and beyond the sixth or seventh are not typically perceptible to the ear. It is thus absolutely certain that the 32^{nd} harmonic generated by sounding a fundamental is never naturally experienced as such. *In a large, open space* thus manipulates and transforms the typical listening experience, allowing the highest harmonics to sound with equal

or even greater volume than the dominant lower harmonics. In effect, *the-sound-of* a single note is deconstructed, reconfigured, and then unfolded across the work's time and space, a radically new sensation of timbre mediated entirely by just intonation.

Tempered tuning systems also afford possibilities for timbral emergence – anytime multiple sounds are interacting there will be psychoacoustic byproducts – with one of the most idiomatic expressions of this affordance in 12TET arising in the form of pitch inflation, which affords effective changes in timbral quality in both extreme and subtle cases. Few musical instruments respond uniformly across their entire range. Higher frequencies vibrate faster and thus take up less physical space than lower frequencies, which in psychological terms is perceived as a "brighter" sound. When orchestral stringed instruments started to proliferate in popular music recordings, the violins were characteristically scored in their highest, flutelike register; this glassy "special effect" eventually became a sonic commonplace of many commercial styles and genres, including film music. Indeed, the concept of pitch inflation seems to have a special place in the modernist narrative at large: prior to the standardization of A440, various reference pitches were used, and most were lower than 440 Hz.[118] As instrumental music became increasingly more expressive, presumably so too did the need for greater sonic tension. But manipulating tuning to create a distinctive timbre is not limited to Western popular music, or even to music in 12TET: in the Balinese tradition, rooted in systems of just intonation, it's common practice to have two of the same instrument detuned slightly so that constant acoustic beating provides an overall sense of activated energy, especially impactful in higher registers and at important structural

[118] One notable exception here is the Chorton pitch (the "choir" or "church organ" pitch), usually set to A465, which was common in German pipe organs through the seventeenth and eighteenth centuries. This pitch was intended for accompaniment with liturgical choral music and, for logistical and economic reasons associated with maintaining large pipe organs, persisted even as the A415 Cammerton ("concert" pitch) became standard practice in secular instrumental music of the time. This meant that composition or performance of the latter music on the organ required transposition to a lower key, which would have imparted a slightly different timbre from the longer pipes.

moments in the music, where the beating might be allowed to ring out. (The analogy to the way vibrato has come to be used in Western classical music is exact.) As we proceed in exploring how timbre comes about and what it is, we thus must honor the fact that timbre is not simply *the-sound-of* static objects but rather of dynamic ones that are constantly negotiating their affordances in real time.

iv. *Timbre as a dialogic process*

Consider that famous psychoacoustic conundrum: *if a tree falls in the forest and no one hears it, does it still make a sound?* Acoustics answers yes, the felled tree obviously generates periodic fluctuations in air pressure that can be measured even in the absence of the human ear. But phenomenology says no. Sounding experience is *dialogic*; it requires agents of play, most of whom are humans, to both initiate and complete the conversation. To initiate in the sense of framing an event as a sounding experience; to bear aural witness to it, to conceptualize *the-sound-of*. And, of course, the experience must also be encountered, which includes both perceptual and affective dimensions. Agents of play are important at every stage of the aesthetic process: they make the design decisions that shape affordance, they form the compositional and performance relationships that direct affordance, and they complete the cycle at the intermediary and final points of listening, which is important to distinguish from the prosaic act of 'hearing.' In his collection of essays, *Music in the World*, musical anthropologist Timothy Taylor historicizes the commodification of musical experience, arguing that it occurred at the dawn of the mechanical era before the advent of sound recording and sound reproduction technologies. He remarks that player pianos were initially marketed as finally being relieved from the mechanics of the instrument which, according to the adverts, apparently had little (or perhaps even nothing!) to do with the "music."[119] Organology knows that this isn't true, that the mechanics of any instrument very much determine the music it plays, never mind the fact that the pianola mechanism is about as mechanical

[119] Timothy Taylor, *Music in the World: Selected Essays* (Chicago: University of Chicago Press, 2017), 62-66.

as they come. Indeed, the mechanics of a self-playing instrument simply provide a completely other set of affordances directing the listening experience. But the mechanics are not alone in impacting the music – the player figures into the process as well. Just as the same pianist playing on two different pianos will sound different, thanks to the distinct 'feel' of each instrument, so too will the same music played on the same piano by two different pianists (or three, if the lack of a human performer can be seen as a kind of performer *in absentia*), thanks to the distinctive "affordances" of each player.[120]

This dialogic aspect of timbre has not been entirely overlooked. We do seem to have a general sense of how human interactions affect timbre; for instance, the notion of stylistic idiom, which generally tends to imply a compositional bridge between musicians and their objects of sound production.[121] And this can occur in both directions, with the player influencing the direction of the instrument and thus the sound, or with the instrument shaping the space in which a certain approach to sound production can be found by the player. If we understand sounding experiences as dynamic events, changing and unfolding in real time, there is perhaps some space yet to account for what it means to "play" an instrument, to happen upon its sounding experience. Ethnomusicologist Christopher Small reminds us that 'music' (and, by extension, all sounding experience) is a verb, not a noun; it's an activity in which we engage rather than a thing we observe, more 'musicking' than music. As he defines it, "in using the verb 'to music,' we are reminded that all these different activities add up to a single event,

[120] Generative music could fall into this category of dialog, as well as instruments that engage natural phenomena, such as the aeolian harp, which entails string vibrations activated by wind.

[121] Interestingly, some of the scholars working at the intersection of psychology, music, and perception, such as the late David Wessel, have intuited interactive moments in which the player's perceptions of consonance, dissonance, harmony, and tonal center occur, but curiously they still hesitate to describe it in dialogic terms of "play," or much less as something that the instrument's affordances determined the direction of.

whose nature is affected by the ways in which all of them are carried out, and we have a tool by means of which we can begin to explore the meanings that the event as a whole is generating."[122]

Shouldn't this apply to musical instruments as well? Are not instruments, with their affordances and agency, participants rather than mere tools in the network of musicking and musical meaning? There is an odd tendency in modern thought to celebrate the "transparency" of musical instruments in the musicking process: only when we feel that the instrument has not inhibited the expression of the player in any serious way can we assess that "the music" has been communicated effectively. But, to deny the agency that musical instruments hold is to limit our understanding of what can be said; and, when we ignore these possibilities, we naturally miss out on meaning as well. Is there no space to see past the ways in which the mechanical resistance of musical instruments suppresses expression and meaning, and instead open the door to embrace the ways in which such mechanics cultivate it? Certainly, the "inflexible" woodwind instruments of the fifteenth and sixteenth centuries, cast aside so quickly in the common practice era, enabled distinctive forms of musicking that were thereby forced into dormancy, a massive loss in the turn from "what can you do well?" to "how well can you do this?" Thus we need a model that includes both instrument and player as active agents, and one in which the job of the player is not only to play the instrument, but also to listen to it and pay attention to what it is capable of saying in the moment of interaction. Instrumental mechanics are always already poised for mediation, *and so they should be.*

Anna Maria Busse Berger has written at length about the importance of memory and improvisation in both Medieval and Renaissance musical traditions, implying that compositional interests, and

[122] Christopher Small, *Musicking: The Meanings of Performing and Listening* (Middletown, CT: Wesleyan University Press, 1998), 10.

subsequent developments of style and form, emerged directly from exploratory interactions with musical instruments, likely alongside the notational experiments that began to emerge in the later period, such as that of canonical structure.[123] This exploratory ethos implicitly critiques the authenticity movement, whose historiography demanded a level of intellectualization that simply wasn't characteristic of pre-modern European musical traditions. Even the hermetic enharmonic vocal practices of the Renaissance were performed in an intuitive, responsive manner, which Karol Berger argues is perhaps what actually led to the introduction of split keys in associated keyboard instruments, so that musicians could choose among differently tempered options while improvising.[124] The work of theorist and instrument builder Nicola Vicentino (1511-1575) was especially influential in this regard, evidenced by his archicembalo, a short-lived harpsichord design with nineteen pitches to the octave. Berger posits this instrument, if successful, would have fostered a broader feel for chromaticism in the compositional attitudes of the period, but the restrained tonality of diatonicism, championed by rival theorist Gioseffo Zarlino (1517-1590), won out instead; perhaps this, and not a false embrace of equal temperament in the early seventeenth century, can account for the relatively brief lifespan of split keys.[125] Theories also circulate on the overall influence that larger positive organs, first introduced into church spaces during the ninth and tenth centuries, may have had on the development of polyphonic music: according to historian of the organ Peter Williams, the performance practice that emerged was intrinsically polyphonic, employing the left hand as a sort of early basso continuo and the right hand as melodic elaboration.[126]

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[123] Anna Maria Busse Berger, *Medieval Music and the Art of Memory* (Berkeley: University of California Press, 2005), 37.

[124] Karol Berger, *Theories of Chromatic and Enharmonic Music in Late 16th Century Italy* (Ann Arbor: University of Michigan Research Press, 1980), 98.

[125] Berger, *Theories of Chromatic and Enharmonic Music*, 50-52.

[126] Peter Williams, *The Organ in Western Culture, 750-1250* (Cambridge, UK: Cambridge University Press, 1993), 34-39.

Of course, examples in which musical instruments impact the unfolding of play are not limited to the distant past: another salient example can be seen in the I-IV-V harmonic progression characteristic of blues music precisely because it is idiomatic to the guitar.[127] This progression was then extensively appropriated into popular rock music of the 1950s and 1960s.[128] This progression is also intuitively derivable on the piano, but because of the difference in interface between the two instruments (the open-string and fretted structure of the guitar versus the chromatic note-to-note keyboard of the piano), its chords are naturally voiced in a completely different way. In this progression, the guitar still maintains a feeling of intervallic leap, of moving from I to IV or from V to IV to I in the bassline, and that's very much a part of *the-sound-of* music that employs it in such a way. The structure of this progression placed into the idiom of the keyboard, on the other hand, fosters an alteration of the chords so as to keep a smooth sense of articulation and playability; the same progression would then be comfortably voiced with the I chord in its root position, the IV chord in its second inversion, which would keep the tonic note in the bass, and the V chord in its first inversion, which would have the leading note in the bass. As an unfolding progression, moving through time from chord to chord, it is crucially distinct in the shape and feeling of the overall sound that emerges.

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[127] It's important to clarify that this "three-change" harmony was developed from the standard concert guitar tuning of E-A-D-G-B-E, but that this tuning was not necessarily typical of blues guitar. Rather, the exploration of alternate tunings dominated folk techniques for both six-string guitar and five-string banjo, done as a way of reconfiguring the instrument's idiomatic affordances in order to access different modes of expression. Among the favored non-standard tunings were Spanish "drop D" (D-G-D-G-B-D) and 'Vastopol' (D-A-D-F#-A-D). Both encourage use of a slide, since major triads are more accessible than in the standard concert tuning. They also foster harmonic ambiguity, maintaining a bass drone while merely suggesting variation in the treble, which is in contrast to the clear and circular voicing of I-IV-V that is achieved in a standard concert tuning. [Jeff Todd Titon, *Early Downhome Blues: A Musical and Cultural Analysis* (Urbana: University of Illinois Press, 1979), 46-47.]

[128] In *Origins of the Popular Style: The Antecedents of Twentieth-Century Popular Music*, musicologist Peter Van der Merwe argues that an initial interest in this harmonic progression, which circles in fifths about a tonic, may have derived from the modal structures of Islamic musical traditions, which were heavily present in north Africa during the medieval period. It also may be useful to note that I-IV-V is a reduction of the full chord progression typically used in the twelve-bar blues, which appears as I-I-I-I-IV-IV-I-I-V-IV-I-I. [Peter Van der Merwe, *Origins of the Popular Style: The Antecedents of Twentieth-Century Popular Music* (Oxford: Clarendon Press, 1989).]

We've come full circle it would seem, since songs written on a piano sound, or perhaps speak, in a noticeably different way than those written on a guitar. Even if we consider affordances or articulations that overlap, we find significant deviations: both the piano and the guitar are capable of voicing chords in both solid and broken gestures, but the latter does so quite differently. Both instruments can cleanly separate and isolate individual notes, and in both cases this articulation is quite characteristic of earlier traditions, of the Spanish five-string guitar and of the renaissance and baroque harpsichord, which both use broken-chord shapes to prolong cadential harmonies and emphasize important moments in time. Most uniquely idiomatic to the guitar, however, is the articulation of chords by strumming (with or without a plectrum), which can be done in a low-to-high voicing (starting with the lower strings and moving the hand across the neck from top to bottom) or in a high-to-low voicing (starting with the higher strings and moving the hand across the neck from bottom to top). Like orchestral stringed instruments, the guitar makes use of hand positions with string crossings that can interrupt the linear flow of pitch ascension, whereas on the keyboard higher and lower pitches correspond quite rigidly to higher or lower placements of the hands and fingers. Of course, chords can also unfold in either direction on a keyboard and they often do – as in the case of arpeggiated articulations like the Alberti bass – but the one-note-per-string interface of the piano, which it shares with the harp, pushes toward playing it (as the Italians called it) *arppegiando,* creating a clear, harp-like cascade of individual notes rather than chordal strums that simply give the overall impression of upward or downward directionality. The fingerpicking style of guitar playing achieves something in between, a harp-like delineation of notes *and* a highly resonant sustained sound. As such, instrumental affordances shape not only the playing but also the thinking and conceptualizing of music, and the sounding experience emerges from within the dialogic exchange, by way of the instrument speaking.

As a brief aside, it's interesting to consider the chordal approach that is central to La Monte Young's compositional practice and methodology, especially in keyboard-focused works such as *The Well-Tuned Piano*. These pieces are not through-composed in any traditional sense of the term but are rather improvisations built around a series of complex chords in just intonation scored for a retuned Bösendorfer Imperial grand piano. As Kyle Gann explains, "Young's notation for his themes and chords is artificial in that, while it shows what piano keys to play, it gives no specific picture of intervallic relationships."[129] *The Well-Tuned Piano* contains at least nine chords, including the central "Opening Chord" and "Magic Chord," which are explored in the contrasting 'theme' and 'cloud' figures that we discussed in the previous chapter in terms of their varying texture and density.

Young's chords are a direct product of his intonational concerns, but it's curious to appreciate that this approach is in many ways far more idiomatic to the guitar, wherein the player develops distinctive chords that sometimes involve a retuning of the reference pitches of the open strings, and then the music becomes an active exploration of variant expressions of that chord in the form of repeated broken or arpeggiated patterns. This method of composing is obviously possible on the piano, but it is not entirely intuitive to its modern technique given the deliberate harmonic neutrality of 12TET. Young's use of just intonation becomes the vehicle for timbral recovery, and its sounding experience is an emergent event that unfolds in both vertical ('clouds') and horizontal ('themes') space. That being said, it's also worth making the pedantic note that when guitarists refer to the 'tuning' of their instrument, what they're really pointing to is something more like a scordatura, or a retuning of the standard pitches of the open strings. Contemporary guitar practices that use alternate tunings still often adhere to the structure of equal temperament, if only due to the instrument's fretting; thus, 'retuning' an instrument in the context of *The Well-Tuned Piano* is technically, conceptually, and

[129] Gann, "La Monte Young's *The Well-Tuned Piano*," 137.

ultimately phenomenologically distinct in that it necessitates the use of an entirely different kind of tuning system and set of intervallic relationships. This is relevant insofar as Young's focus on chordal structure is primary rather than incidental – it is harmony that determines the path of the music and its meaning.

v. *Toward a carnal organology*

Christopher Small points out that musicking is an embodied affair; it necessarily enlists our bodies and our senses as a part of its creation of meaning.[130] We'll discuss this idea in greater detail later, but given the dialogic nature of timbre and sounding experience, we should ask whether our conventional understanding of instrumental musicking, in which the (active) human agent plays the (passive) instrument, is a little one-sided. Although it sits a bit outside the scope of our discussion, similar epistemological work is being done in the adjacent field of disability studies as well, with musicologists such as Jessica Holmes challenging the very idea of auditory expertise, pointing to the alternate ways that deaf and hard-of-hearing musicians encounter music in visual, tactile, and kinesthetic ways. Holmes contends that traditional musicology has privileged auditory perceptions of music, and that this has limited the field's understanding of sound as a multifaceted experience.[131] At the intersection of the two fields, one could imagine organology and disability studies working together to examine the idiosyncratic performance practices of musicians such as Django Reinhardt, the famed Romani jazz guitarist who suffered a near-fatal injury that left the fourth and fifth fingers of his left hand unusable. Reinhardt was able to adapt his technique in order to continue playing, but his injury was far from a limitation; on the contrary, it could be seen as the very thing that enabled his unique style

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[130] Small, *Musicking*, 113.

[131] Jessica A. Holmes, "Expert Listening Beyond the Limits of Hearing: Music and Deafness," *Journal of the American Musicological Society* 70.1 (2017): 173.

to emerge. Many guitarists credit him as an influence, including Tony Iommi of Black Sabbath, who lost the tips of the third and fourth fingers of his right hand in an industrial accident. Iommi is left-handed and therefore uses his right hand to fret the neck of the guitar. He discovered that tuning the strings lower would decrease their tension and make them more comfortable to play; the sonic implications of such an affordance are that of a decidedly "heavier" sound, which would play a huge part in the band's development of an associated style.

Musicologist and cellist Elisabeth Le Guin first called attention to moments like this as the subject for a "carnal" musicology, rooted in the realm of the physical but emphasizing felt and lived experience rather than the empirical. Le Guin herself explored the relationship that cellist-composer Luigi Boccherini (1743-1805) developed with his instrument, arguing that the resultant sound of such interactions was determined by the irredeemably physical aspects of instrumental technique.[132] With the cello, this might include the negotiation of bow-on-string resistance, for instance, or it could reflect an understanding that since the cellist's ear is directly next to the instrument during performance they will experience its acoustic realities differently than listeners dispersed in space. Call the present study carnal organology, then: my work as a composer and performer of minimalist music, my interest in historical tuning systems, my expertise in keyboard instruments – they are not merely *what* I know, but rather they account for *how* I came to know and understand the interactions that we've thus far been discussing. Embodied knowledge offers an important type of truth, otherwise lost in translation, and only gathered from those deeply embedded in musicking practices.

Musicologist Paulo de Assis distills this complex relation into the notion that the body is a transducer. He asserts that the process of *performative transduction* includes both human and non-human

[132] Elisabeth Le Guin, *Boccherini's Body: An Essay in Carnal Musicology* (Los Angeles: University of California Press), 24.

components, and that it vitally results in the creation of something new rather than something representational – not a process of becoming-*this* but always of becoming-something-*else*. He borrows from the writings of Gilles Deleuze, particularly on the *thickness* of concepts, their tendency to encompass diverse layers and levels, more system than singularity.[133] Interestingly, de Assis also borrows from Deleuze the term *haecceitas* ("this-ness") to describe sounding experiences: the Latin word, coined by medieval scholastics like Duns Scotus to oppose to *qualitas* (quality, or "what-ness"), is adapted to musical performances to refer to the individual "this-ness" not of a thing, but of an event happening in time and space.[134] What Boccherini knew – that a cellist might hear or perceive something different in the cello's sound than a listener in his audience – reinforces an important conclusion about the function of listening in the unfolding process of sounding experience as well. In his fascinating but overlooked *Music as Heard*, musical phenomenologist Thomas Clifton similarly denies that there are in fact musical "objects," reminding us that music is not an arrangement of things but rather a complex and intertwined event that unfolds in time.[135] He emphasizes the active participation of the listener in this unfolding, and indeed at every stage of the musicking process, suggesting that theirs is a similarly dynamic rather than static role, constantly reconstituted in the act of listening.[136] Listening, for Clifton, is always a lived experience and, therefore, the embodied aspects of a sonic occasion are equally subjective and meaningful.

vi. *Timbre as emergent*

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[133] Paulo de Assis, "Transduction and the Body as a Transducer," in *Logic of Experimentation* (Leuven: Leuven University Press, 2018), 141-143.

[134] de Assis, "Transduction and the Body as a Transducer," 148.

[135] Thomas Clifton, *Music as Heard: A Study in Applied Phenomenology* (New Haven: Yale University Press, 1983), 81-83.

[136] Clifton, *Music as Heard*, 285-290.

To approach sounding experience through such an intricate path – one that considers both human and non-human (instruments, room acoustics, recording and playback technologies, etc.) agents; that posits the equal importance of musical instrument designers and builders, composers, performers, recording producers and engineers, and listeners; and that sees these interactions resulting in a complex, dynamic, autographic event that emerges over time – is to understand timbre as, fundamentally, a network effect. Certainly this discussion is indebted to actor-network theory, a concept first developed by the French sociologist and philosopher Bruno Latour (1947-2022). According to Latour, society itself is a product of similarly elaborate networks. Latour defines 'the social' as the way things connect as well as the consequences of certain interactions between different actors, and it critically includes both human and non-human actors as equally important.[137] For Latour 'the social' is not an independent entity that exists outside of this network; to render it as a type of material thing rather than as a "process of assembling" is to misunderstand its purpose and to reify assumptions about just what is being assembled.[138]

On this point I respectfully diverge. I have tried to show that musical instruments are themselves complex 'things' with immanent meaning, arising precisely by way of an intrinsically emergent nature. As de Assis points out by way of Deleuze, to perceive instruments as cohesive entities is certainly not to deny the whole process of musicking, but rather to align them conceptually among other complex agents. So doing is precisely what allows us to encounter all manner of "thick" auditory experiences from a timbral point of view and therefore to understand the nature of their sounding experience. The same phenomenon occurs in the visual arts: the 'sculpture' *is* a thing, but our apprehension of its three-

[137] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network Theory* (Oxford: Oxford University Press, 2005), 10.

[138] Latour, *Reassembling the Social*, 38.

dimensionality is a dynamic unfolding over time. Even painting, which modern critics prized because of the possibility for instantaneous comprehension inherent in its two-dimensional flatness, is rarely experienced that way because the beholder, who must be present for an aesthetic experience to occur, inevitably encounters its different components and their interactions one after another.

Perhaps, in closing, an old proverb might be more useful for coming to grips with timbre as emergent property. If one observes one tree, and then another, and then another, and so on and so on and so on ... there arrives a point where one stops perceiving more and more trees, and becomes aware of a FOREST. Though that moment may imply the closure of a network, the experience-as-process persists; indeed, the meaning of 'forest' is different than 'many trees.'[139] I contend, then, that in the context of *the-sound-of*, the 'thing' in question is very much a processioned product of its constituent parts, but it is also something other, something more, than that mere sum.

[139] In acoustics, this phenomenon is similar to the 'critical band' effect: if two pitches are tuned to the same frequency and then one begins to slowly drift up or down, the critical band is that brief liminal psychoacoustic space one encounters before the brain is able to detect two distinct frequencies.

CHAPTER FIVE

THE TOTAL SOUNDING EXPERIENCE

i. *Beyond the sum of parts*

In the previous chapter, we posited the emergent aspect of timbre, suggesting that *the-sound-of* a complex 'thing' – whether an instrument in the traditional sense or not – transcends its literal origins as the sum of networked parts and becomes something altogether new and ontologically distinct. On a basic level, musical instruments are complex or composite things insofar as they consist of many smaller components that together create the 'instrument' as we know it. The modern piano, for instance, is comprised of a wooden cabinet and lid, a cast-iron frame, a carved wooden soundboard with bracings, eighty-eight wood keys encased in white and black plastic, the intricate keybed that builders adjust to determine the weight and depth of the keyboard, wood and felt hammers for each key, the elaborate double-escapement mechanism of each key, metal tuning pins, a wooden pin block, a wooden bridge, a fallboard, numerous strings of steel and spun copper, two or three brass pedals, and the wood and felt damper mechanism, amongst quite a few other things. But only the deliberate and complete structuring of these elements into a specific configuration allows us to refer to them collectively as 'a piano,' a semantic gesture we can't direct at any of the individual parts in isolation or in a different combination.

This distinction is not just mechanical: since each component necessarily interacts with the others in particular ways and therefore dictates certain modes of communication (affordances, idiosyncrasies, idioms, and limitations), there is a sense in which the meaning of the word 'piano' is remarkable and singular as well. Surely, the desire to assign a word to a thing – in our case, to musical instruments – is more than just a convenient way to abbreviate the laundry list of its components. That word can

and usually does signify some immanent function, poetic or otherwise. As I've intimated thus far, the 'thing' that emerges from an organological interplay of parts – that is to say, *the-sound-of* something – is itself a complex phenomenological experience also deserving of its own consecration.[140]

As we began to outline in the previous chapter, complexity of timbre is not the sole domain of conventional musical instruments. A host of other sonic encounters and sonic objects can be seen as similarly compounded. I will argue here that *any* sonic experience is intrinsically a 'total' experience, no matter how micro or macro its scale. On the smallest scale, we previously explored the idea that even something as austere as a single tone can be viewed as a composite entity by way of its unfolding within the harmonic series and subsequent articulation within the multi-dimensional harmonic space of just intonation. One could similarly argue that the basic and widely accepted acoustic definition of timbre that we outlined at the very beginning, predicated on variations in the richness of frequency spectra, is implicitly composite in the same philosophical sense.[141] The average listener is perhaps not accustomed to focusing on this micro level of the interior minutiae and thus not inclined to perceive the profound complexity of small musical things. But tuning is in many ways the ideal model for observing how timbre neither starts nor stops with a musical instrument, and how all complex phenomena can come to bear on one another.

Tuning, articulated as the balanced yet dynamic push and pull of frequency relationships, is essentially the pathway to the inner life and dialogue of sound; it is also intrinsically contextual and autographic.

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[140] Again, this is not 'complex' in the sense of being difficult or sophisticated, but in the Deleuzian sense of "thickness"; 'complex' in the form of a multi-dimensionality where all parts are dependent on one another.

[141] Such deliberate negotiations of additive and subtractive sound construction are at the conceptual heart of inherently timbral instruments such as the synthesizer and the pipe organ, as well, which are more alike in this way than most musicians would tend to assume.

In some cultural contexts, for instance the classical traditions of India, there is certainly a focus on isolated notes as they appear in the schema of a scale-type or *raga*, but at its core tuning is still always a relational and dialogic phenomenon rather than a closed or absolute system; it is a harmonic expression of timbre as it seeks to configure the vertical architectures of sonic space. And, of course, the timbral character of tuning is not limited to rational systems that build upon the orchestration of the harmonic series: just as each musical instrument (or, indeed, the same musical instrument played by two different people, or the same instrument sounding in two different rooms) speaks differently and says something different, the plethora of available tuning systems functions in a similar way. Sadly, the modern standardization of equal temperament has divorced tuning from its timbral context, blocking access to a wealth of significant experiences and messages.

On the macro scale, we can now see a musical instrument as rather a small component in a much larger network of both sound and meaning. We've danced around this wider notion of timbre in many different guises thus far: for instance, in the context of a concert or chamber ensemble, where multiple instruments blend to create something other – *the-sound-of* the orchestra or, say, the wind quintet; or, in the context of live performance, where the dispositions of acoustic space and of collective listening filter through to shape an atmosphere of something other – *the-sound-of* a sonic here and now; or, in the context of record production, where the vast affordances of the studio and the decisions of its denizens shape the imprint of something other – *the-sound-of* the recording. Each component step in the cycle, from inception to perception, is its own complex thing, and the emergent offspring birthed at the close of a poetic encounter between multiple complex beings is also a correlated but ultimately divergent whole.

Orchestration as a timbral endeavor isn't a new concept; but to assign timbre to something autonomous beyond the horizon of musical instruments is both more abstract and more literalistic. What is it to speak of the timbre of 'an orchestra' or the timbre of 'both a flute and a clarinet'? What is it to experience 'a recording' as a timbre? What is it to compare the timbre of 'this recording' and 'that recording,' or 'this piano' and 'that piano'? What is it to encounter the timbre of 'this recording' today and the same recording one year from now, in some other place? What is it to differentiate between 'this timbral moment' in the recording and 'the timbre of the recording at large'? And, further, what is it to encounter the same piece of "music" performed by different players, or arranged for different instrument types, or presented in different kinds of acoustic spaces, or recorded in different ways, or diffused through different sound systems, or listened to by different people in different states of mind? How can we possibly reduce *the-sound-of* or, more pointedly, the timbre of each of these distinct experiences (let alone the vastly abundant iterations that lay within them), into the same psychological and phenomenological brackets, simply because they all reference some aspect of the same musical framework?

Our reluctance to extend timbre to sounding experiences beyond the realm of individual musical instruments seems, in my view, to signal a broader unwillingness to imagine these kinds of meta-objects as having a special or discrete ontological status worthy of dedicated phenomenological attention. These complicated sonic encounters are already open to rigorous empiricism, always prey to the literal bias of modernist thought. Without doubt, one could just as easily point to a variety of tangible and measurable traits to distinguish *the-sound-of* 'this piano' from 'that piano,' or 'this recording' from 'that recording,' or 'this recording sounding in a car' versus 'this recording sounding in a living room,' and so on. We don't seem to be entirely comfortable with the whole notion of emergent experience, a concept that feels like it belongs to the more metaphysical realm of affect and meaning,

and is therefore difficult to quantify or translate with intersubjective precision. But few are likely to deny that something *feels* different about every one of these sounding experiences. Let's insist on this: hearing a recording of something is a different experience than hearing it live and, like it or not, an experience of something is *itself* something. Perhaps, then, the issue is simply a reluctance to qualify the way more abstracted or incorporeal sonic systems speak as 'timbral' in the same way that we would classify the way an instrument "speaks." *The-sound-of* the piano and *the-sound-of* a live performance both refer to something like a forest for the trees: a unitary phenomenon arising from multiple factors, some physical and some mental, many of which are the same. And it may be that there is even something to be said for reframing *the-sound-of* the piano into terms more like *the-sound-of* a live performance, and not the other way around. To articulate *the-sound-of* the piano, we must take into account the potentially infinite dialogic components that arise in relation to whatever our reference sound may be (i.e. 'this' piano, in 'this' setting, in 'this' moment). Although it's tempting to render musical instruments as sufficiently compounded on account of their mechanical architecture, as sufficiently complex systems in and of themselves, we mustn't forget that the actual experience of accessing their timbre is *necessarily* mediated and never occurs in a vacuum. If a tree falls in a forest and there is no one there to hear it – which is just to say that there is no one there to encounter and experience it – then there is simply no 'sound' to be heard at all.

Turning our attention to the timbre of the musical meta-object – whether it results from a musical instrument or from a larger and more elaborate network of sound – it's worth briefly returning to the act of listening. As we just suggested, it's not difficult to see that the listener's primary role is one of mediation, that they are there to necessarily apprehend *the-sound-of* something. But the listener is also in charge of framing the thing that is to be listened to, and their subjective place and time within the experience also determines its boundaries and its *haecceity*, its identity as 'this one' rather than 'that one.'

Listening occurs at every stage of the musical unfolding, and the specific listening that agents such as the composer and the performer (or, say, the performer in a live setting versus the performer in a studio setting) engage is equally as meaningful as that of the audience, all contributing to a singular instance with its own timbral reality. The individuating function of those who are "just" listening (i.e. an audience member in a concert hall, or the person listening to the radio in their car) is not given enough hermeneutic and creative consideration insofar as the complexities of their being also dictates the framing of the sounding experience *qua* experience. Just as the composer/performer makes decisions about the 'things they do,' and which they experience differently at various junctures of the doing process, so do the inner and outer world of the listener at any given moment determine the resultant 'thing they hear' – *the-sound-of*.

So far, we've focused on making a case for the 'total' and compounded nature of sounding experience, which is inherent regardless of whether it's a "small" experience or a "large" one, and we've also asserted that the 'thing' subsuming a particular sounding experience ('a recording,' for instance) is something phenomenologically distinct from the mere sum of its parts. We've also reasoned that since the 'total' sounding experience functions as a meta-object with its own enclosed structure, it follows that we should be able to talk about its timbre and the nature of our encounters with *the-sound-of* it on a multitude of levels, just as we talk about the timbre of objects that we refer to as traditional musical instruments. So, let's consider what precisely that resultant 'thing' and its associated 'total' sounding experience are (which is essentially to assess what they could mean beyond their literal connotations), and how that meaning emerges from within the realm of the literal (that is, how it transcends immanently without actually transcending in the metaphysical sense).

Referring to 'transcendence' and 'meaning,' we now begin to develop a sense of the affective dimension that arises in the transition from a first order of complexity (perception and sensation) into a more intricate and 'total' secondary one (feeling and meaning). This dimension is latent in all sounding experiences, including those of singular musical instruments as well as those not "quite" a musical instrument (a fundamental frequency, for instance), those not "only" a musical instrument (an orchestra, for instance), and those for which the concept of 'musical instrument' is not sufficient to encapsulate the richness of the dynamics at play (a live performance, a recording, and so on).

ii. *Beyond the empirical roots of timbre*

My goal here is not to come up with an altogether new term for the category of meta-objects that possess timbre but are not musical instruments in the traditional sense, like a recording or an orchestra. Nor am I advocating for a new organological vernacular that could encompass and replace the concept of a 'sounding experience.' We've been using the phrase *the-sound-of* in free exchange with 'timbre,' and I do feel that the two can be easily substituted without any semantic issue; when we're describing what something sounds like, we are in effect referring to its timbre in the generally accepted sense. The goal in previous chapters was not to challenge the conceptual or perceptual basis of timbre, but rather to expand the parameters that could be understood to have an impact on what something sounds like. And it's precisely the equivalence of timbre and sounding experience that allows us to extend the idea of timbre beyond the realm of musical instruments, to discuss the timbre of a recording, or of a room, or of an acoustic moment in time; to designate a describable 'sounding experience' to meta-objects that are not musical instruments in the strict definition. When we ask, "what does 'this' sound like?" we are essentially asking, "what is the experience of 'this' sound?" and, as we'll explore in the next chapter, this is a squarely phenomenological question.

I'm also not primarily concerned here with widening our understanding of what a musical instrument is or what it could be, nor am I aiming to imply that everything that has timbre is a musical instrument. What defines a musical instrument does constantly require renegotiation as both acoustic and electronic musical technologies evolve, and although we've had to touch on it in the formation of a critical organology, it's not the main goal of this philosophical enquiry. There are many moments when discussing non-instrumental 'things' where it will be appropriate and useful to reframe the 'thing' in question as a kind of musical instrument. With the recording studio, for instance, this shift in attitude makes a lot of sense and beneficially changes how we view the practice of record production. But I'm not sure that the same can be said of meta-objects like 'a recording' or 'a live performance,' or of a meta-object with as much *haecceitas* as 'the recording playing on *this* sound system in *this* room and being listened to by *this* person at *this* time.' The focus in these cases is more on the totality or 'thickness' of the sounding experience; the (yes) instrumental function we tend to ascribe to musical instruments as a kind of tool just doesn't seem appropriate to account for that. All entities that can be accepted as a type of musical instrument also necessarily participate in a certain kind of sounding experience, but not all sounding experiences are "useful" in the same way as a musical instrument, even though they can all be classified as complex networked meta-objects. I think it might be more revelatory to move in the other direction, to disregard the functional predispositions of musical instruments and to liberate the entire organological schema into the broader category of total sounding experiences, which includes all resultant sounding 'things' but which also vitally allocates a specific space and time to their unfolding. Starting from the here and now, we may be able to think more contextually and therefore more accurately about the timbre of 'a recording' or 'a concert' or 'a piano' or 'this single note' or 'this piano in this room at this time played by this person,' addressing the question, *what is the experience of 'this' sound?* directly and holistically.

One could still explain most, perhaps even all, elements of a 'total' sounding experience as physical and empirical. For instance, 'a recording' could be described as sound captured by a specific condenser microphone with a known frequency response curve and directional sensitivity, then transferred onto magnetic tape of a certain width moving at a certain speed, then accessed by reversing the process of transduction, involving amplifiers with fixed power and distortion specifications and loudspeakers whose behavior under varying loads can be precisely quantified. One could go further back and dissect the recording process itself, pointing to the instruments used and their relative proximity (whether they were captured at the same time, in the same room, or separately overdubbed), while also specifying the acoustic properties of the recording spaces themselves.[142] The enveloping pre-recording creative and post-recording listening processes could be similarly quantified, bringing in cognitive theory as it pertains to decision making and perception.

It's easy to understand the physical bias of traditional organology: what motivation is there to move beyond the literal when there is so much tangible evidence to uncover? Of course, these kinds of prosaic expositions are admirable and indispensable in their ability to chronicle what it looks like to listen to 'a recording,' to catalogue the things that contribute to what its sounding experience *is*. But ultimately, they fall completely short in grappling with what it *is* and with what it *means* to listen to 'a recording,' with what it *means* to encounter a sounding experience, which is also an important aspect of what it is to experience sound. And, as the realm of meaning comes to light, these inquiries inescapably require increasingly phenomenological answers. The point is not to replace or negate the prosaic, but rather to supplement it with the awareness that poetics are our ultimate goal: for us as

[142] As a notable example, multivolume book sets have been written attempting to specify in as much detail as is knowable the objective circumstances under which The Beatles worked at EMI's Abbey Road Studios.

mediating human beings in the world, to happen upon and eventually understand *the-experience-of-something* is unavoidably to apportion to it affect and meaning.

iii. *Timbral experience as 'worldmaking'; in defense of 'medievalism'*

If we're inclined to accept that all sonic things, including musical instruments, fall under the umbrella of total sounding experiences, then we welcome the idea that timbre never refers to anything singular but rather to *the-sound-of* a complex network, and, in some sense, *the-sound-of* a unique kind of world; indeed, this 'world' truly defines the emergent thing to which we've been wanting to give shape. This isn't meant in the prosaic sense, although a bit of that meaning is present insofar as we interpret 'the world' as an ecosystem in which all things are interconnected and in balance, dependent on and in communication with each other. We mean 'world' in its conceptual sense, a mental dwelling space populated by multiple and varied things, which together circumscribe a mood, atmosphere, or psychological orientation. Artistic and linguistic forms of 'worldmaking' work this way, and often involve either poetic or symbolic reconfigurations of existing 'real' worlds or else the creation of imagined worlds, allowing a willing inhabitant to experience directly the creation of affect, meaning, and ultimately, truth. The term was first coined by philosopher Nelson Goodman in his landmark *Ways of Worldmaking* (1978) and was designed as a non-dual way of explaining our phenomenological relationship to reality. In his rejection of a singular, objective reality that we simply observe at some distance, Goodman highlights both the role of subjective mediation as well as the act of willful creation; not only are we the inescapable filter, so to speak, through which reality is accessed and interpreted, but we are also active agents, instrumental to the building of our own worlds and in the construction of what we understand as truth.[143] Following Goodman, one can see how every encounter with a total sounding experience is also an opportunity to filter and create an artificial sonic

[143] Nelson Goodman, *Ways of Worldmaking* (Indianapolis: Hackett, 1978), 22.

world, while the concept of worldmaking is useful in helping us recognize how meaning arises within the poetic system.

Worldmaking for Goodman is a natural and ongoing state of subjective being. It may be helpful to explore a few examples of musical worldmaking, especially those which can be seen as phenomenological exemplars of sounding experience. As we discussed earlier, the sound world of so-called 'early' music is essentially a modern construction insofar as fleeting sound leaves no empirical evidence; thus any beliefs or attitudes that we may hold about the musical practices of bygone eras are by necessity, to varying degrees, the products of our own making. Engaging with the timbral world of these lesser understood centuries can only occur through the practice of worldmaking as Goodman demarcated it. Understood this way, the performance of early music is perhaps more a conceptual experiment than a historical project, a truth which partisans of the authenticity movement either failed to accept or keenly ignored as they strove to all but touch the fourteenth century. The empirical study of medieval culture reveals a great deal about both the past and the present. But as we seek to make sense of the sonic past, we must remember that we are also projecting our own sensibilities, orientations, and limitations, effectively creating our own truth. This isn't meant as pejorative; subjectivity is an unavoidable byproduct of our human way of being in (by making up) the world. Indeed, the drive for sonic authenticity in early music frustrated potential allies in early music scholarship by overlooking what scholars had actually documented about the ethos of early modern musicking, which embraced improvisation and variation over exacting repetition and faithful execution. Thus, the extant repertoire of this era fits neatly into the spirit of worldmaking, with nowhere else to go, predicated upon a hermeneutic imperative.

Adherents of historically-informed performance may not have liked to admit that they were engaged in creative worldmaking rather than epistemological excavation, but the colorful and diverse sounding experiences generated by their textural experimentation have generated vibrant swathes of meaning and affect, even if their intentions were completely the opposite. Musical worldmaking done openly in the service of new meanings and affects often takes the shape of *medievalism*. Medievalism is a creative device loosely rooted (with variable innocence) in the realities and aesthetics of the Medieval and Renaissance periods (with particular preference for the former, but both are often intertwined with an inaccurate but endearing devil-may-care abandon), but distinct from the "scientific" study of the Middle Ages – and from the musical authenticity movement – in that it does not primarily concern itself with historical accuracy.[144] Or, rather, it might be more gracious to say that the medievalist mindset is willing to overlook or twist historical accuracies for aesthetic, conceptual, or creative gain. In many cases, the two need not be diametrically opposed; references to the distant past can be and still are made in a way that both maintains historical integrity and embraces new poetic or symbolic meaning. The so-called Gothic Revival of the early nineteenth century, for instance, was a deliberate appropriation of late medieval style and form arising as a conceptual response to the mechanized, utilitarian building methods that came to define the Industrial Revolution.[145] The English instrument builder Arnold Dolmetsch, mentioned above in passing for his contributions to the first early music revival at the turn of the twentieth century, used his passion for obsolete musical instruments to broaden the sounding experiences and musical thinking of his time.[146] His reconstruction pursuits far preceded postwar preoccupations with historically-informed performance and it is thanks to this mild

[144] David Matthews, *Medievalism: A Critical History* (Cambridge, UK: D.S. Brewer, 2015), 178.

[145] Insofar as architecture dictates the borders of human behaviour, shaping the spaces in which we live our lives and act out daily functions, its theoretical study offers a poignant reflection of ethical, social, and political attitudes.

[146] Haynes, *The End of Early Music*, 40-41.

form of sonic worldmaking that countless primary students learned instrumental music by way of the recorder, a medieval instrument that Dolmetsch had mass-produced in plastic primarily for this purpose, and one that no child of the twentieth century would have otherwise had any business encountering. (He hardly worried whether the resulting school music was "authentic" in an empirical sense.)

There is, of course, a more extreme and troubling face of medievalism, one that reveals the ethical lapses of historical distortion and deliberate anachronism as well as the social and political failures that result from nostalgic thinking. Apart from the historical bias of traditional organology, these matters are largely beyond the scope of our discussion; it's worth highlighting, though, the problematic attitude that often accompanies interest in the Medieval period especially, which suggests that since we lack so much knowledge about this era and since we will perhaps never truly "know" a significant amount more than we already do, that we are somehow given the veritable green light to do as we please with its representatives.[147] Of course, the presence of historical holes and shadows doesn't supersede our duty to respect what we do know simply for aesthetic gain, which can quickly descend into tasteless hollow.[148] That being said, as long as ethical lines are not being crossed, medievalism as a creative device can provide us with a phenomenological model insofar as its sounding experiences construct something genuinely new (i.e. not representational of the "real" world) by way of the suspension of disbelief that is inherently at the heart of the practice. It's this aspect of medievalism that historians refer to as 'portal' medievalism; not in the pastiche of an objective doorway to a pre-existing world,

[147] Matthews, *Medievalism*, 178.

[148] Umberto Eco, *Faith in Fakes: Travels in Hyperreality,* trans. William Weaver (London: Vintage Random House, 1998), 301-305.

but the opening of a constructed world meant for feeling and imagining rather than documentation.[149] In *The Future of Nostalgia* (2001), art theorist Svetlana Boym is tolerant of this preoccupation, suggesting that, for better or for worse, the fragmentary character of the distant past allows the ruins of the associated historical period to be experienced affectively, as an atmosphere.[150]

The practice of medievalism is thus not unlike the 'concave' sounding experiences that musicologist Peter Doyle discussed in relation to the development of record production: that is, a "romantic" sonic space deliberately structured and dressed so as to invite a listener 'inside' for affective immersion. Boym acknowledges that such irreal interactions can, when happening on historical terrain, contribute to an undoing of the modernist narrative of linear progress, allowing us to embrace liberating detours and comforting alternative narratives.[151] When done with care, worldmaking is not escapism or a nostalgic lie but rather the pursuit of new meaning and new truth.

iv. *The 'world' in a studio*

Unsurprisingly, then, the art of record production can be seen as another useful example of sonic worldmaking. Although the seemingly transparent recordings that fall under the 'realist' or 'convex' aesthetic, characteristic of the Western classical music recording industry, are still a form of 'total' sounding experience insofar as they're complex and multi-layered, those which embrace the opposing 'concave' or 'romantic' methodology introduce a layer of deliberately opaque timbral experience by way of the studio. The so-called "black box" approach is an extreme version of this, treating the recording space as a zero point with no inherent sonic signature. From there, the recording space can

[149] Prendergast and Trigg, *Affective Medievalism*, 29-31.

[150] Svetlana Boym, *The Future of Nostalgia* (New York: Basic Books, 2001), 15.

[151] Boym, *The Future of Nostalgia*, 269-272.

be artificially "tuned" by introducing or removing objects and textures (carpet, furniture, glass, concrete) that alter its acoustic vitality (in effect, its reverberation time), while the timbre of each recorded track can be shaped by selection of microphones and their placement. After the fact, the timbre of each recorded track can then be modified with a highly nuanced depth of creative control: sounds can be edited in length, shifted in time, processed, manipulated, and mixed to sit in the desired sonic space-time of 'the recording.' There is indeed literal worldmaking taking place, as the producer determines both the setting (how and where things are placed in the dimensional environment) and the set (how they look and feel, what kind of atmosphere they exude) of the physical space of recording. The "black box" approach was standard practice in American studios of the 1960s and 1970s, in contrast with the "acoustic" perspective favored by British studios of the same era.[152] Here the aim is to incorporate the distinctive natural acoustics of (that is, *the-sound-of)* a room, while controlling the way sounds are captured within its space to maintain the desired 'concave' or 'romantic' sounding experience. The live room itself, then, embodies its own timbre and the choice to engage it becomes a form of 'orchestration.'

Many distinctive styles of popular music have emerged from this kind of worldmaking, and many of them derive their poetic meaning and truth precisely from the timbral possibilities that arise in the recording process. Musical Afrofuturism, for instance, is predicated, as its name might suggest, on the manipulation of modern technologies to serve political or cultural ends.[153] In the early 1970s Afrofuturist bandleaders like Sun Ra and George Clinton became interested in the power of analog synthesis to express their conviction that "space was the place" of liberation. For these musicians, electronic synthesis was a uniquely subversive and joyful technology of resistance for Black musicians

[152] Albin Zak, *The Poetics of Rock: Cutting Tracks, Making Records* (Berkeley: University of California Press, 2001), 181.

[153] Kevin Strait, *Afrofuturism: A History of Black Futures* (Washington: Smithsonian Books, 2023), 161.

who were otherwise marginalized from avant-garde musical experiences.[154] Similarly, the studio offered a larger and more meaningful opportunity for this act to expand into the narrative realm and become transformative in its function. Funk and soul producers exploited the new affordances of multitracking and studio mixing to construct surreal, symbolic, and futuristic worlds, reconfiguring and transcending a collective history of oppression by technologically superior colonial powers.

On the other side of the color line, the folk-rock explosion, especially as manifested by English groups of the psychedelic era, combined portal medievalism with recording romanticism, using the studio to frame and inhabit antique sounding experiences that referenced the past in modality, instrumentation, and form but that were ultimately a departure from anything even remotely historical.[155] Folk inflections in adjacent popular genres, such as progressive rock, also evoked the medieval, using twelve-string guitars to stand in for the lute and the cittern's double-coursed stringing); the Hammond B3 organ to reference the pipe organ and through it, sacred music; intricate vocal harmonies as a subconscious nod to the Anglican choral tradition; and the woodiest of woodwind instruments, the flute and recorder, as solo voices. In the studio, those wonderful Renaissance textures were resurrected from the modernist grave.[156]

As a brief aside, it's also worth taking a moment to draw the parallel between sound recording and commercial filmmaking, which overlap in some interesting and obvious ways but with the technological advances of the latter preceding that of the former at every step. Filmmaking, at least in

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[154] Strait, *Afrofuturism*, 162, 172.

[155] Edward Macan, *Rocking the Classics: English Progressive Rock and the Counterculture* (Oxford: Oxford University Press, 1997), 30.

[156] Macan, *Rocking the Classics*, 39-42.

the mainstream, prides itself on its elaborate worldmaking capabilities, almost always the direct result of careful and deliberate artifice. Almost every aspect of a film is a complete fabrication. Most of the time there's a practical, logistical, or financial purpose behind it: if a character is scripted holding a cold drink, the ice cubes in the glass will be fake so that they don't create unwanted sound that could obscure or mask the actor's voice captured on set by a production sound engineer. The sound of the ice cubes is then added artificially in post-production, potentially recorded by a foley artist while watching playback but, more often than not, culled from the manifold recordings in a sound effects library, then masterfully shaped by a sound designer and brought back seamlessly into the diegetic world of the film. In fact, the more 'realism' the filmmaker desires, the deeper and more controlled the artifice ironically tends to become. Stanley Kubrick's remarkable eighteenth-century period piece, *Barry Lyndon* (1975) is a particularly interesting example: widely regarded as groundbreaking in cinematography, the film is mistakenly believed to have been shot entirely in daylight and candlelight, both notoriously difficult to capture on film. To achieve the look, Kubrick and his cinematographer John Alcott actually went to great lengths to simulate 'natural' light, including the use of wide-aperture lenses originally developed for NASA in combination with exceptionally sensitive film stock, as well as hidden sources of artificial light diffused organically into interior sets.[157] However, when small amounts of 'real' natural light was allowed into the photographic field it conjured a blue tint from the film stock and looked comparatively unnatural; Kubrick went with it in small doses, though, in order to give the film a surreal, painterly quality.[158] For those who form, shape, and frame the emergent 'timbre' of a film – including but not limited to art directors, production designers, set decorators,

[157] "Kubrick by Candlelight: how *Barry Lyndon* became a gorgeous, period-perfect masterpiece," The Telegraph, accessed August 2024, www.telegraph.co.uk/films/2016/07/27/kubrick-by-candlelight-how-barry-lyndon-became-a-gorgeous-period.

[158] "Photographing Stanley Kubrick's *Barry Lyndon*," American Cinematographer, accessed August 2024, www.theasc.com/articles/flashback-barry-lyndon.

costume designers, gaffers, scenic artists, cinematographers, colorists, composers, sound designers, and, of course, the director, the affective dimension is paramount. And, just as in the recording studio, the final result will usually justify the means of getting there. Sometimes the *mise-en-scene* may be subtle and subliminal, and sometimes bluntly 'on the nose'; in any case, the poetic act of worldmaking is primary, the goal to provide viewers not just a portal to the diegetic world referenced in the script, but also into the symbolic 'world' of some entirely other thing that we call 'the film.'

The next chapter will confront the process by which sounding experience, which we call timbre, comes to *mean* something. Worldmaking, in its uniquely lived-in dimensional sense, occurs whenever complex artistic spaces are understood as 'worlds' unto themselves. We can thus appreciate that the phenomenology of timbre links *the-sound-of* to *the-experience-of* a given sound world. And this affective dimension of experience, encompassing feeling, meaning, and truth, requires a mental translation from the prosaic to the poetic: not only "what is this experience?" but also "what does it mean?" This is literalist organology's shadow realm, the hidden power of sounding experiences to *signify*. As promised, we'll approach this question phenomenologically rather than psychologically: what we are looking for is not simply "what is this sound?" but more importantly, "what is it to experience this sound?" This is the most important question that we could ask of organology, and it's the one that's kept us locked and pandering to the Hydra of empirical ontology. We intuitively know that sounds aren't merely 'bright' or 'happy' or 'warm' or 'ugly'; they trail serpentine tendrils of meaning, and thus we are obligated to dive into the metaphysical swamp, there to wield our golden poetic swords – or our clubs and our torches, depending on which version of the myth you prefer – to recover the truth of timbre.

CHAPTER SIX

THE POETICS OF AFFECT

i. *Metaphor as metaphor*

Although a psychological account of timbre and a phenomenological one might overlap, they are still very different. Psychological explanations of timbre aren't necessarily wrong – a sound (or, more accurately, a sounding experience) certainly can be heard as ugly, or happy, or warm, or bright, or rough, and so on – but as with most products of organology's physical bias, they are inadequate on their own. One should not conflate broader discussions of psychological-neurological analysis, which attempts to describe the cognitive processes that underlie perception, with the nature of the perceptual processes that engender the experience itself – that is, what the structure of the experience is like. The psychology of sound clings to its own subjectivism, assuming the ineffability of musical meaning and keeping timbre tethered to the literal. And phenomenology is uniquely poised to articulate the essence of perceptual experience while leaving behind the contingent particularities that color each individual expression. The question that ought to concern us is not simply, "what is this sound?" but more importantly, "what is it to experience the world of this sound?" and perhaps, eventually, "what does this sound mean?" A phenomenological hermeneutic allows us to pose this last question where empiricism simply cannot, and thus by engaging it as a methodological part of our critical organology we can begin to formulate a deeper understanding of the poetics of timbral affect.

Not often associated with discussions of music and sound, the work of Paul Ricoeur, whom we mentioned at the onset as inspiration for the project's title, left us with a wealth of insight into the unique aspects of aesthetic experience *qua* experience, as well as the critical role of an individual in perceiving, interpreting, and ultimately determining the nature of experience's associated truths and

realities. The latter, often called *embodiment*, is a central tenet of phenomenology and emphasizes its fundamental claim, namely that experience is necessarily dialogic: it is the experience *of* something. Ricoeur's greatest philosophical contributions have been to literary theory, but his ideas can be applied to other artistic practices, thanks to the comprehensive and brilliant way that he uses the literary device of *metaphor* as a metaphor in and of itself. In his essay, "On the Metaphorical Process as Cognition, Imagination, and Feeling," first published in 1978, Ricoeur muses that poetic metaphor – for instance, the expression 'a blanket of snow' – may be used as a microcosm of how aesthetic experience occurs more generally. The meaning of a metaphor isn't derived by way of literal substitution of one noun for another – that is, by changing how the reader perceives the subject of the statement – which would force one to imagine someone curling up in bed with a fresh layer of the white stuff being dumped on them – but instead happens at the higher level of a subject's relationship with its predicate, allowing us to project the feeling of insulation, calm, and warmth associated with a blanket (subject) onto a thick and undisturbed snowfall (object).[159] When one speaks of 'an endless night,' one suspends the ordinary experience of persistent time and introduces a series of either positive or negative evocations of the freedoms and anxieties associated with the infinite. In effect, then, a new and complex sort of mental image materializes in metaphor, bringing with it the keys to a unique affective world which we can't measure empirically but which we still inhabit.

This understanding, a species of network theory wherein the meta-(*phor*) is distinct from the mere sum of its tenor and vehicle, has ramifications for the argument of previous chapters. When extended to describe the work of art writ large – which Ricoeur does extensively in his later work – metaphor becomes mimesis, the master trope of narrative fiction. Ricoeur's elevation of the whole sentence above an isolated subject lends critical weight to his claim that experience must also be parsed in all

[159] Paul Ricoeur, "On the Metaphorical Process as Cognition, Imagination, Feeling," *Critical Inquiry* 5.1 (1978), 145.

its intricate totality. He occasionally uses the term 'fiction' to refer to the constructed qualities of *all* works of art, grounding in rhetoric our notion of art as the making of a 'world,' a unique meta-object that coalesces from and yet exceeds a collection of parts. What's more, in his recognition that meaning is a metaphoric process based in a constantly changing relationship between multiple disparate parts, we could also conclude that Ricoeur very likely sees the cycle of metaphor as inherently emergent rather than given. Perhaps most importantly, he suggests that the reader is also a critical component in the unfolding of this emergent process, actively contributing to the making of meaning by imagining or mentally "seeing" possible connections between a subject and the verb that describes it, and lessening the semantic difference between two otherwise nonsensical components.[160]

That aesthetic experience is emergent precisely by way of the individual's imagination also implies its own parallel consequences: for one, it neatly presupposes our fundamental idea that sounding experience is mediated and immanent in its unfolding, but it also elevates the mental image, the resultant thing that is "figured" in the metaphor above and beyond the status of a mere representation. The sounding experience of 'this piano, in this moment, in this space, played in this way, heard in this way' is surely deserving of an account much deeper than (the sound of) a piano is a piano. Ricoeur deals at great length with the problematics of representation, strongly rejecting the conventional theories of the many eighteenth-century philosophers who treat mental images as weak impressions of reality.[161] Rather, for Ricoeur, the mental images perceived in a work of art are wholly distinct from mental images that derive from reality: the latter have a referent while the former have a none. Or, rather, they have yet to develop and disclose their referent, inscribed in the work. In a 1979 lecture, "The Function of Fiction in Shaping Reality," Ricoeur points out that the represented object still

[160] Ricoeur, "The Function of Fiction in Shaping Reality," 231.

[161] Ricoeur, "On the Metaphorical Process," 146.

resides within what he calls a first-order mode of giving.[162] A reference is made to *The Imaginary*, a slightly out-of-step work from 1940 in which the French existentialist Jean-Paul Sartre explores the nature of mental images given *in absentia*, like the image of a familiar person not physically present.[163] Sartre thinks this sort of mental image singular, but for Ricoeur it's simply representational and does not transcend the world of prosaic experience; as such, it isn't transferrable to the second-order poetic images that arise in aesthetic experiences. According to Ricoeur, whether an image is given in presence or in absence is inconsequential if the referent already exists in the real world. Aesthetic images, on the other hand, are *unreal* in the sense that their referents do not exist until actively generated in a dialogic relationship between the work and the beholder; they are the product of a mediated emergent network and therefore phenomenally discrete.[164]

To this end, Ricoeur borrows from Kant to suggest that the imagination is productive rather than substitutive – that is, it creates *new* meanings – and from French philosopher Gaston Bachelard, who similarly argues that images are meanings emerging, and not simply perceptions fading.[165] In the context of music, where recordings are viewed as inferior representations of live performance rather than enclosed worlds unto themselves, an argument that opposes models of representation and instead favors nascent signification can become especially powerful with respect to our broader and more complex appreciation of timbre.

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[162] Ricoeur, "The Function of Fiction," 124-125.

[163] Jean-Paul Sartre, *The Imaginary: A Phenomenological Psychology of the Imagination*, trans. Jonathan Webber (London: Routledge, 2004), 20-24.

[164] Ricoeur, "The Function of Fiction," 125.

[165] Ricoeur, "The Function of Fiction," 215.

Within the framework of the metaphor, says Ricoeur, the opportunity for an individual's productive imagination to be put to work is fostered by what he refers to as a "semantic clash," a deliberate disagreement predicated on the juxtaposition of two different fields of meaning. As we saw, what is perceived when they're put together is not in fact nonsense but rather an alternative predication that communicates affective meaning on account of the productive imagination's ability to recognize the semantic distance and *schematize* (another term borrowed from Kant) a proximity between them.[166] Thus, Ricoeur contends that aesthetic meaning emerges precisely from the ruins of the literal, as it were, as they transcend into the poetic. At the level of sounding experience, the same deviating schema is made possible by a suspension that arises when the listener engages in dialog, or "play" – to borrow from the German philosopher Hans-Georg Gadamer, who we'll revisit in more detail later – with the work. And, as we asserted in previous chapters, it is ultimately the listener (whether that be the composer, the performer, or someone who is "just" listening, etc.) who completes the aesthetic experience, bringing it into being and participating in its affective world; it is the sonic witness to the fallen tree who engenders its sounding experience, who "hears" it.

Finally, this perceptual *epoché* or negative moment, as Ricoeur refers to it, serves to suspend the references of ordinary reality (the 'literal'), allowing the productive imagination to fulfill its second task, the restructuring of a new reality, new images, and new feelings that accord with the world that has opened up within the work.[167] And the new meanings developed in this experience in turn become the referent of the work. It's important to note that this restructuring is not escapism but connection: the aesthetic experience is certainly a denial of everyday reality, but it is only a denial of reality as

[166] Ricoeur, "On the Metaphorical Process," 147.

[167] Ricoeur, "On the Metaphorical Process," 153-154.

described by the ordinary and sensorial realm of knowing, and thus it retains an ability to evoke and express "real" meaning, in reference to an emerging rather than extant truth.

Perhaps the most interesting consequence of Ricoeur's thinking is that, in non-verbal works such as visual art and music, the resultant world becomes iconic or symbolic as well as figurative, in the sense that it *holds* more than it *shows*.[168] Borrowing from Nelson Goodman, Ricoeur asserts that a reversal of denotative meaning is at play in this process: if we have a word or a thought and we create an object to represent it, then that object can be said to denote that idea; but if we reverse the cycle, then we are effectively creating a symbol that doesn't denote something specific, but that rather actively creates and discloses the new ideas that it can then stand for.[169] Of course, the semiotic importance of art is nothing new – it was the famed cultural theorist Stuart Hall who proclaimed that, "you have to go to art; to where people imagine, where they fantasize, where they symbolize" – but for the concept of timbre to be afforded such status, for 'the sound of a piano' to transcend denotation and carry meaning within it that doesn't yet exist is quite substantial.[170]

Naturally, metaphor as metaphor has its limitations. In the context of a literary metaphor, it's fair to say that semantic clash is very much the goal, a compounding of essences that are not otherwise alike. But it's also important to comprehend that semantic clash is just one form of the negative condition or negative space that allows for the kind of suspension of the prosaic during which aesthetic experience occurs and new meaning emerges. A more illuminating way to perceive the negative

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[168] Ricoeur, "On the Metaphorical Process," 149.

[169] Paul Ricoeur, *The Rule of Metaphor* (London: Routledge, 1984), 91.

[170] "Why We Need Stuart Hall's Imaginative Left," Portside, accessed October 2024, www.portside.org/2021-04-03/why-we-need-stuart-halls-imaginative-left.

condition, then, would be as a conceptual framing, as a positioning of experience (any kind, really, not just aesthetic ones) as its own poetic world. This is very much the framing that occurs as we determine the *this*-ness of sounding experience, as we contextualize *the-sound-of* into its place and time. For Ricoeur, thinking of this suspended condition as a kind of framing puts the aesthetic experience into motion, shifting the seemingly invisible and poetic realms of feeling and revelation into plain view for the beholder. It's also what internalizes the aesthetic experience, making it our own.[171]

Ricoeur is by no means the only source for aesthetic phenomenology. As we concluded in the previous chapter, timbre can be generalized as a way of describing *the-sound-of* any total sounding experience, with the understanding that the resultant and referent 'thing' these experiences point to is also more than the sum of its parts. The resultant 'thing' that emerges in the timbral encounter is a mental world unto itself, with its own time, space, and its own dimension of affect and meaning. Mikel Dufrenne, an important but often overlooked French aesthetician, described the referent of aesthetic experience as atmosphere, mood, and ultimately a "world" that is constructed within the landscape of the work and within which the beholder "dwells." Dufrenne asserts that, "the aesthetic object aestheticizes its surroundings and integrates them into its own world, it makes the real unreal by aestheticizing it."[172] This 'reverse' ontology, in which the real becomes de-realized, begins with the work retreating into itself and perceptual bracketing as an aesthetic experience. This negation – and by extension a positing of new possibilities and questions about reality – opens a pathway for expressive mutability.

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[171] Ricoeur, "On the Metaphorical Process," 156.

[172] Mikel Dufrenne, *The Phenomenology of Aesthetic Experience* (Evanston: Northwestern University Press, 1973), 152-155.

Referencing John Cage's *4'33"* can (and perhaps should) feel like beating a dead horse, but in many ways this piece truly does engage in a blunt and definitive way the process of framing and aestheticizing, of contextualizing a sounding experience within its autographic *this*-ness. The performer remains still and silent, refusing engagement with the piano as a musical instrument, shifting focus to the environmental sounds of the performance space as the timbral material filling the phenomenal frame of the piece's duration – a 'timbre' that inevitably changes with each iteration. Of course, the iterative nature of much of Cage's work comes from his preoccupation with chance operations, but we now see that *all* sounding experience is iterative, that even the slightest change introduced into the sounding experience of any kind of music will make a unique world with its own rules of affect and meaning.[173] Indeed, in keeping with the idea that works of art are characterized by their ability to generate new realities, Dufrenne emphasizes that aesthetic experience is essentially the immanent promise of a world, and the prelude to knowledge.[174] Minimalist music also plays with framing, perhaps not with the conceptual extremity of Cage, but substantial reduction of materials and manipulation of duration creates a sounding world where the various participating agents (instruments, performers, audience members) act out their specific roles in a way that often heightens awareness of the borders of the experience. In a maximally determined sound environment, focus can be drawn inward, magnifying the bounded activity in and of itself, for its own sake. Insofar as it does this, minimalism is genuinely experimental, precisely *about* the framing and the subsequent experience of the resultant world that occurs within.

[173] It's worth noting that 'iteration' refers in this discussion to the practice of deliberately choosing to say something differently in order to say something different. This includes iteration as a continual refinement of ideas, but also in the more general sense of a repetition of conceptual structure, which produces a different *this*-ness each time.

[174] Dufrenne, *The Phenomenology of Aesthetic Experience*, 183.

Dufrenne sees the dialogic mediation of productive imagination as emerging from multiple moments. Music scholars have always assumed that listening is paramount. But, for Dufrenne, at least as far as the agent who initially brings the work into being (i.e. the composer) is concerned, the possible 'world' of the work is also something that is similarly felt in a preconceived way, before any actual creative work has begun. As he suggests, the aesthetic act begins with the recognition of a given mood or atmosphere that motivates the artist to "aestheticize" their feeling of it into a realized work.[175] The creative process, then, is one in which the artist is moved to action by a pre-existing atmosphere or feeling that demands to be articulated; far from Romantic fantasies of the genius of self-expression, the artistic role being described here can be appreciated as a dialogic attempt to render an atmosphere communicable. Dufrenne is careful to underscore that the resulting work always maintains aesthetic autonomy: the initial atmosphere felt by the composer is inscribed into and evoked by the work alone for their specific psychological context; it is certainly not something imposed upon the work for consumption by others.[176]

It's a great relief to be able to articulate rigorously how sounding experience refers to more than its literal sound objects – that the meanings evoked by *the-sound-of* a piano are not exhausted by empirical facts about the piano, but rather inscribed within the 'world' that emerges from its unfolding. Similarly, as we interrogate *the-sound-of* any complex totality, we aren't pointing to the overt empirical features of the meta-object in question, whether it be a sound recording, a string quartet, or a performance of some piece of music by some specific orchestra in some specific concert hall. In the discourse of phenomenology, Heidegger is often credited with this point (which he argues for in detail and, as always, in varying degrees of lucidity), so it would be hasty not to mention his contributions at least

[175] Dufrenne, *The Phenomenology of Aesthetic Experience*, 123.

[176] Dufrenne, *The Phenomenology of Aesthetic Experience*, 161.

briefly. For Heidegger, the origin (or essence) of the work of art (here, the sounding experience) is not the vessel, so to speak, but it is in fact the unique world that is held, and in many ways, concealed within.[177] This element of concealed-ness is crucial for his theory, which hinges on the idea that a work's ontological vehemence – that is, its pathos, its impact on our sense of being, and its ability to move the beholder in some tangible way – is the result of a similar process, namely the one in which that 'world' and its hidden elements are disclosed and become visible.[178] Like Dufrenne and Ricoeur, Heidegger recognized that the work of art always carries the function of signification rather than representation, even as it attempts to reflect the latter.

Within the continental tradition, there is arguably no philosopher more important to the concept of embodiment and the dialectic of sensation and perception than Maurice Merleau-Ponty, who is also regarded as a major figure in French existentialism. Merleau-Ponty's landmark work, *Phenomenology of Perception* (1945), upholds the primacy of experience, which he argues is characterized by the perceptual and sensual qualities of embodied or lived interaction. For Merleau-Ponty, every experience begins with the body, which he maintains is our fundamental way – and, essentially, our only way – of engaging with and coming to know the sensible world within which we operate.[179] All experience is mediated, and this mediation happens entirely and inescapably in the domain of sensation – that is, through touch, smell, sound, taste, and sight. His critiques of psychological and physiological empiricism as a way of understanding the body and the sensuous are similarly drawn on the tradition's

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[177] Martin Heidegger, "The Origin of the Work of Art," in *Poetry, Language, Thought*, trans. Albert Hofstadter (New York: Harper & Row, 1971), 43.

[178] Heidegger, "The Origin of the Work of Art," 35; Roger Savage, "Is Music Mimetic? Ricoeur and the Limits of Narrative," *Journal of French Philosophy* 16.1-2 (Spring-Fall 2006): 127. The term 'ontological vehemence' is borrowed from ethnomusicologist Roger Savage and his extensive writings on musical hermeneutics and Ricoeur. It refers in this discussion to a sounding experience's ability to impact the listener's sense of being-in-the-world.

[179] Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Colin Smith (London: Routledge, 1966), 96.

problematic willingness to postulate an objective world outside of or disconnected from subjective experience. For Merleau-Ponty, perception begins in the body, but it is absolutely not equivalent to the mere recognition of a bundle of sensations, a measurable response to a specific stimulus. On the contrary: it is an emergent characteristic of total lived experience, something belonging to but also rising above and beyond the senses.[180]

We see in Merleau-Ponty's arguments an echo of Ricoeur's contention that aesthetic experiences refer to and express something intrinsic or immanent, not something external to which they are merely a representation. As Merleau-Ponty reminds us, "to perceive is not to remember."[181] Anticipating Ricoeur, Merleau-Ponty renders experience as a dialogic encounter, in which we aim toward things that are presented to us from a particular (though certainly not immutable) perspective. One aspect of Merleau-Ponty's thought that is especially interesting to note is that he renders the body in aesthetic terms and vice versa, contending that the work of art is similar to a living organism, perceived and encountered as a unified and ramified whole.[182] As regards the individual and their experience of aesthetic experience within a framework of embodiment, we can see in Merleau-Ponty's arguments a further affirmation of Ricoeur's elevation of feeling, which results from the ambiguity that one unavoidably experiences between their own world (the "real" world in which they are grounded) and the world of the work (the "unreal" world into which one enters when engaging with it).[183] In this way, the two worlds are blended, and the new "reality" of aesthetic experience is reconfigured onto the lived experience.

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[180] Merleau-Ponty, *Phenomenology of Perception*, 37.

[181] Merleau-Ponty, *Phenomenology of Perception*, 22.

[182] Merleau-Ponty, *Phenomenology of Perception*, 152.

[183] Merleau-Ponty, *Phenomenology of Perception*, 88.

In *Sense and Non-Sense* (1945–47), Merleau-Ponty argues that aesthetic experience may begin with the first order of ordinary sensational experience, but that it ultimately transforms into a more complex second order of perception by way of a rejection or absence of the ordinary. He articulates a similar negative or suspended condition of being, which he circumscribes through his own interpretations of the terms 'non-sense' and, curiously, 'silence.'[184] Of course, the mental state required for the emergence of new meaning is achieved through lived experience, situated in both given experience (the realm of sensation) and subsequently in constructed experience (the realm of imagination), wherein perception is again not just a passive reception of data but an active and interpretive process. For Merleau-Ponty, aesthetic objects are never grasped at a single glance, arising in the mind through a dynamic and temporal process of transformation.[185] As with Ricoeur, a critical sense of transcendence underlies the aesthetic (sounding) process. Merleau-Ponty highlights indirect language that works through a kind of "resonance" (another aural term!), reflecting the complexities of experience and expressing worlds that remain invisible until the point of interaction.[186] The realm of the senses is how we come to know the first, prosaic order, but it's also the bridge and the mediating path to the second, poetic order, in which a "non-sense' sounding experience emerges as something more than its sensual components – as affect, feeling, thought, new meaning, and (perhaps) new truth.

ii. *Transcendence without transcending*

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[184] Maurice Merleau-Ponty, *Sense and Non-Sense*, trans. Hubert L. Dreyfus and Patricia Allen Dreyfus (Evanston: Northwestern University Press, 1964), 55, 75.

[185] Merleau-Ponty, *Sense and Non-Sense*, 68.

[186] Merleau-Ponty, *Sense and Non-Sense*, 65.

So far, we've described the relevant component parts of aesthetic experience in the language of phenomenology, which is effective insofar as we accept sounding experience to be the sonic form of aesthetic experience. But it bears emphasizing that the definition of sounding experience we've developed in this discussion began simply as an expanded application of timbre, and its associated notion of *the-sound-of*, into a comprehensive realm of complex and emergent total sounding worlds. Now that we're poised to delve into the mediated and dialogic aspect of sounding experience as a form of transcendence, the physical bias of traditional organology becomes sharply relevant, particularly its confusion and uncertainty about how timbre and *the-sound-of* can be rigorously discussed at all beyond the boundaries of the literal.

This is where the "metaphoric" process comes into its own. If the prime basis of all experience (including sounding experience) is in embodiment, beginning with sensory engagement of the real world, then the beholder (listener, in our case) by simply enacting this dialogue creates the necessary framing for the sounding experience to form a shape and context. This framing provides the necessary negative condition that will suspend the literal and allow the iconic function to take over. The imaginative "play" of the listener within the iconic world of the experience then allows for the emergent synthesis of a second-order poetic experience, characterized not by percepts but by affect, feeling, thought, truth, and meaning.

Let's focus in on the transcendent or emergent process itself, fear of which seems to keep discussions of timbre rooted in the realm of the physical. This is really a fear of the metaphysics of sound, of the idea that there might be a meaningful way of experiencing timbre beyond the empirical. The paradox of timbre – the idea that scientific discourse is incapable of describing the nature of timbral experience, despite the extent to which timbre determines what we hear – is well known to empirical organologists.

They know that instrumental sounds must mean more than their literal acoustic structure, but because this meaning cannot be grasped with empirical methods, they prefer to render it inarticulable, ineffable, inescapably subjective and ultimately unknowable. But the affective dimension of sounding experience need not escape us if we focus on the nature of its unfolding, on *how* it occurs. For the purposes of this discussion, phenomenology is the methodology that offers us this path for understanding, and it manifests from yet another form of emergent theory, namely that of immanent transcendence, from the first-order prosaic realm of sensation to the second-order poetic realm of affect. The concept of transcendence may seem to bring us uncomfortably close to nineteenth-century Transcendentalism, based in spiritual pseudo-divinatory inclinations. But the phenomenological context posits a kind of transcendence without spiritualism. This form of transcendence is not to be viewed as mere escapism or idealism; on the contrary, phenomenology maintains that the aesthetic experience is an approach to truth and that art is very much an alethic enterprise, and in that sense more "real" than reality.

The first indication that a transcendent process was at work began to appear when we posited that timbre was an emergent phenomenon, wherein the totality of a complex sounding experience is not perceived as a collection of parts but as an ontologically distinct 'world' with its own situational feeling and meaning. This emergent 'world' is not something materially or physically discrete *per se,* comprising its parts and yet also above and beyond them. In this sense, it's fair to say that the transcendent action that enables the sensation of timbre is a phenomenological or conceptual one; it is a felt and perceived difference in experience. All this is very much aligned with Goodman's notion of worldmaking, perhaps not in the literal sense of the term but in relation to something more metaphoric and affective. There is, perhaps, no empirical difference between 'the sound of two violins, one viola, and one cello' and 'the sound of a string quartet,' but nevertheless the two experiences are separate, not just terminologically but also in semantics and signification. The sounding experience of the latter is *in* the

world, as it were, but not *of* it. Ricoeur refers to the affect that emerges as immanent in the sense that it has simply emerged from latency, just as a symbol or icon behaves, rather than actively ascended into some other state of being; it is an occurrence of the beyond within, as it were.[187] This is transcendence without transcending. Moreover, because the listener takes active part in the process, the resultant 'world' is therefore made more accessible for being constructed, controllable, and malleable, rather than simply manifesting inexplicably on its own. Merleau-Ponty assigns this same structure, one of a benign form of transcendence, to signs and symbols, which he recognizes not just as tools for communication, but as integral to our making sense of the "real" world.[188]

There's no dispute that the real world can be characterized by its empirical qualities; it is populated by objective and material things that, as Heidegger memorably puts it, present themselves to us as "ready to hand."[189] However, reality as a conglomerate of subjective, phenomenal experiences also comes to bear on our ontology, a quality of being-in-the-world unavoidably characteristic of all conscious living things. Heidegger advances the idea that truth is not to be understood simply as an amalgamation of facts about the world, but rather as a realization of our modes of being inside the world of empirical facts. In this way, then, truth emerges in congruence with thought, feeling, and action, not despite it or in conflict with it. Heidegger was certainly not the first to posit that aesthetic works could possess ontological vehemence, the ability to affect our ways of thinking, feeling, and acting in the world, but he did make significant explanations of the structure behind this phenomenon. He not only suggests, as mentioned previously, that the work functions as a symbol, inscribing within itself a certain meaning

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[187] Ricoeur, *The Rule of Metaphor*, 319.

[188] Maurice Merleau-Ponty, *Signs*, trans. Richard C. McCleary (Evanston: Northwestern University Press, 1964), 20, 90-95.

[189] Heidegger, "The Origin of the Work of Art," 19-21.

revealed only in engagement, but he also points toward an outcome, in which the beholder's experiential sense of reality is expanded. According to Heidegger, "in the vicinity of the [art] work we were suddenly somewhere else than we usually tend to be."[190] Of course he is referring in part to the world opened up within the work of art but also, by extension, a new state of being in the real world that is closer to truth than it was before submitting to the affective power of art. A dichotomy begins to emerge in which normative reality is transformed by art into something fictive and decidedly unreal.

iii. *Mediation and play*

All branches of phenomenology and hermeneutics (and not just the aesthetic theories that are rooted in them) are preoccupied with the idea that we know the world through our necessary mediation of it, and that this is the only epistemology that we have. It might be tempting to suggest, then, that phenomenology seemingly builds from the modernist mindset, in line with the kind of Cartesian thought which asserts that all knowledge comes through the human mind. This way of thinking takes the side of skepticism and sees mediation as negative bias, meaning that it can't be trusted as a path to objective truth. In response, it seeks to straddle extremes, with one foot in scientific method and the other in psychology, playing two opposing roles in a closed-off theater of the mind. The phenomenological approach, however, seeks a middle ground and suggests that not only is it possible to know the real world through the mind, but that the two interact and even exert a mutual influence to generate the very reality that we somehow claim to observe at a distance rather than experience firsthand.

In this way, the observing subject is intimately intertwined with the truth of the real world, working to change and shift it. There is no descent into solipsism (the idea that only one's mind is axiomatic

[190] Heidegger, "The Origin of the Work of Art," 35.

and that all other percepts, including the external world and other minds, may not exist outside of it); the theoretical goal is to admit that there indeed is a concrete and objective world but that there is also nothing beyond our experience *of* it. The salient difference, then, between psycho-cognitive and phenomenological accounts of experience is that phenomenology firmly believes that important truths about the world can be acquired through productive acts of imagination. The subjective nature of the experience doesn't make this mediated frame of reality any less real; on the contrary, it is *more* real given that the interplay of mind and world functionally creates reality, dismantling the perceived chasm between something and *the-experience-of* something. As the mind plays with the objective world to create reality, it also communicates back, helping shape it in turn.

Gadamer is perhaps the most adamant on emphasizing the dialogic nature of transcendence, taking as start point Heidegger's notion that truth happens in its "eventing." For Gadamer, the aesthetic experience is procured only in the process of engagement: the painting that hangs on the wall is not behaving as art until it is brought into interaction, or play, with a viewer. (Without a listener, the tree falling in the forest cannot make a sound).[191] This assertion, basic though it may seem, has complex implications. Most critically, perhaps, a work's unfolding has a phenomenological counterpart in the beholder: just as the work only reveals gradually the hidden components of its being, so too is the subject's state of being augmented and reconfigured in accordance with the world, or atmosphere, of the work. In this way, the experience comes full circle: the transcendent process brings the subject back into the territory of its own reality, this reality now different having undergone a metamorphosis.

[191] Hans-Georg Gadamer, *Truth and Method*, 2nd ed., trans. Joel Weinsheimer and Donald G. Marshall (New York: Crossroad, 1991), 109.

For Gadamer 'truth' emerges in the interpretive process, in the dialogics of interaction. *Truth and Method* (1960) is predicated on a critique of the scientific method as the sole arbiter of truth, suggesting that in art (and other imaginative mental pursuits) a different possibility exists. Gadamer further critiques modernism's claim that we should free ourselves of history and context, hailing these as essential to what he dubbed the 'hermeneutic circle,' an act of interplay between various parts.[192] In the first volume of his monumental *Time and Narrative* (1984), Ricoeur asserts that what emerges from this circular interaction and suspension of the real is not merely previously hidden ideas and feelings, but altogether new understandings about reality.[193] He posits that the aestheticized real – the altered reality that springs from the ruins of the literal after impact with the mind – is not only expanded but reconfigured, and therefore has a unique capacity for ontological vehemence. According to Dufrenne, such a phenomenon is possible because reality is never fixed; the world of the subject and the world of the work are bounded by movable horizons that, when brought together to complete the process, are capable of shifting or being heightened.[194] Then, the quality of the subject's state of being and their ontological awareness surfaces again as a changed entity, transmuted by way of the manifestations of the unreal.

iv. *Transcendence and ecstatic experience*

Reconfigured reality and ontological vehemence, the tangible impact that an experience leaves on our way of being-in-the-world, are the final and perhaps most important components of phenomenological method, since they extend our line of advance into the territory of meaning. Before

[192] Gadamer, *Truth and Method*, 113.

[193] Paul Ricoeur, *Time and Narrative*, trans. Kathleen McLaughlin and David Pellauer (Chicago: University of Chicago Press, 1984), 45.

[194] Dufrenne, *The Phenomenology of Aesthetic Experience*, 149.

we go there, however, it would be useful to briefly explore comparative views of transcendence and sounding experience, especially since many of them rely on the timbre of musical instruments as a means of achieving mental (in the case of secular ecstatic practices) or spiritual (in the case of sacred and devotional practices) transformation. With sacred practices, we typically note either shamanistic rituals, in which the facilitator or healer communes with spirits; or in possession rituals, in which the individual becomes immersed within the spirit world as in a form of submission or takeover. In either case, the object is to lose oneself in order to *go* somewhere; the suspension of the literal makes room for something new to emerge. Many secular ecstatic rituals share the same kind of structure, although their associated musical practices exhibit something more in line with an immanent transcendence insofar as they use the concept of negative space as the path to an engaged and altered state of mind, a 'second tier' of experience that they control and construct themselves. It is in these contexts that timbre and musical instruments figure prominently.[195]

One of the main proponents of immanent transcendence in sounding experience has been the Greek-Armenian composer, teacher, and writer George Ivanovich Gurdjieff (1866-1949). For Gurdjieff, embodied experience was paramount – simply observing, discussing, or lecturing was not comparable to action – and so he deliberately incorporated physical motion into his practice.[196] Although much has been written about his life, it's been suggested by historiographers of his work that all that can be truly known stems primarily from his theories, which he expressed through a series of formalized writings in development of a so-called "Fourth Way" to consciousness. Gurdjieff asserts that humans

[195] There are also numerous secular theories of musical transcendence that don't suggest this feedback loop in which the ecstatic state comes to impact the waking life of post-experience, instead claiming that the two realms are distinct. In these scenarios, when one enters the ecstatic state, it is as if they are briefly visiting a different place and then simply coming back into the real world as they were before, largely unaffected by the journey for more than a short period of time.

[196] G.I. Gurdjieff, *In Search of Being: The Fourth Way to Consciousness* (Boston: Shambhala, 2012), 114-116.

live their lives "asleep," meaning in a lessened state of consciousness, and that this prevents them from being their most complete and productive selves.[197] The path he proposes to "reawakening" serves an internal spiritual longing, but it also increases the individual's sense of being, potentially reorganizing and reconfiguring external connections to the objects of prosaic experience.[198] His goal was not transcendence, but reconnection with the absolute(ly) ordinary.

For Gurdjieff, knowledge was only obtainable through an interconnected psychosomatic perspective, implying a critical balance between mind, body, and soul as a complex totality.[199] To this end, his writings were bolstered by a physical practice which came to be known as 'the movements,' borrowing heavily from Sufi practice. Although Gurdjieff was very active as a composer, having written early works for ballet and hundreds of shorter compositions for piano and harmonium, music remained somewhat tangential to the several hundred sets of body movements he created in which the secrets of the Fourth Way to consciousness could be better revealed. His musical compositions hold to a restrained minimalist aesthetic, and as such diverge from the conventional notion that ecstatic music must build in tempo or volume, rather than relying on timbral manipulation to provide the listener with an increasingly more active stimulus to achieve an altered state.

As we saw, Ali Jihad Racy points specifically to Arabic musical practices as a place where timbre plays an important role in constructing secular ecstatic experiences. According to Racy, evocation of feeling

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[197] Gurdjieff, *In Search of Being*, 125-128.

[198] Gurdjieff, *In Search of Being*, 35-38.

[199] Gurdjieff, *In Search of Being*, 43-47.

is central as both aesthetic and philosophy in their music.[200] *Tarab*, which we discussed earlier as an induced form of trance, can be read as a bridge between sound and affective transformation, the merger that signals that a transitional act has occurred. Although Arabic music is often presented in informal, live settings, *tarab* still has a ritualized structure that emerges from a sequence of stages: an entry phase that arises from the ordinary (that is, from 'normal' consciousness); a central phase, a high point that marks the individual's farthest departure from an ordinary state of consciousness (referred to as *saltanah*); and an exit phase, which leads back to ordinary consciousness, but radically transformed.[201] For Racy, *tarab* is immanently transcendent in the sense that it removes the listener from the realm of ordinary consciousness and draws them into the 'world' of the music, absorbing them in the listening experience, rather than projecting them somewhere outward; almost as a form of concave listening, to use the parlance of audio recording.[202]

And, as we noted earlier, Racy understands *tarab* as not just psychological but physiological, which we now can read as an expression of ontological vehemence: it is a visceral and felt experience, not just an altered state of consciousness but rather a "borderline" consciousness between the real and the unreal, with an impact on the former as much as on the latter. As a foil, Racy also discusses Iranian classical music and its mostly equivalent concept of *hal*, which encourages the listener to withdraw into themselves rather than go out into the collective world of performers and audience.[203] In both cases, according to Racy, it is actual musical instruments and the manner in which they're played that

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[200] A.J. Racy, "Spirituality in Art Musics of the Islamic World," in *The Wiley-Blackwell Companion to Islamic Spirituality* (Hoboken: Wiley-Blackwell, 2022), 436.

[201] Racy, "Spirituality in Art Musics," 450.

[202] Racy, "Spirituality in Art Musics," 451.

[203] Racy, "Spirituality in Art Musics," 445.

brings about these heightened states, sometimes even more than the theoretical mode being used, as well as the environment or setting of the performance.[204] There is in Western music simply no lexicon or rigorous method of articulating these kinds of experiences, particularly as regards timbre; we may blandly refer to the 'sublime' character of music or cop-out with hackneyed words like 'ineffable' or 'indescribable.' But we can hardly pursue the subject further, which would require acknowledgement of a transcendental phenomenon at play and a way to comprehend it.

Similarly, ethnomusicologists like Miriam Phillips have emphasized the importance of the nylon-stringed guitar in the performance of Flamenco music and the emergence of *duende*, a secularized version of ecstatic experience. This tradition developed during the Inquisition, when the Romani population was driven out of Aragon and Léon into the mountainous southern regions of Andalusia; there it became a manifestation of the need to express and thereby release human suffering. Phillips traces the etymology of *duende* from the Latin *domitus*, which can refer to a wide range of interpretations of "spirit," including definitions that animate it as a vital force of productive imagination.[205] The amount of *duende* a person or thing exudes is the defining purpose of flamenco practice. Phillips also points out different ways of interacting with *duende*: one may go in search of it, may wait for it to come to them, be transported by it, transmit it to others, be possessed by it, even abandon oneself to it.[206] Due to its animating force, Phillips observes that practices in which the body plays a central role, such

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[204] In Arabic musical performance, it's vital that the lights are kept on so that the audience can see the players and experience a kind of sympathetic transcendence in relation to how they are playing; similarly, the disposition of the audience has a strong influence on the players as well, so it's equally important that they can also see them.

[205] Miriam Phillips, "Where the Spirit Roams: Toward an Understanding of 'Duende' in Two Flamenco Dance Contexts," *UCLA Journal of Dance Ethnology* 11 (1987): 45-46.

[206] Phillips, "Where the Spirit Roams," 53-55.

as live musical performance and dance, are especially expressive; it is through a particular way of dancing and playing the guitar that *duende* occurs and is transmitted.[207]

v. *Structures and symbols; the varieties of sounding experience*

Theories of benign transcendence with great ontological import also arise quite regularly in more conventional discussions of human experience and its interpretation. In his well-known investigation of *The Varieties of Religious Experience* (1901–02), philosopher William James expresses these concepts more universally, suggesting that transcendence is a realm of consciousness not necessarily distinct from that of ordinary consciousness, but rather one that is above or in addition to it, the realm of the super-sensible.[208] Despite the title, James isn't necessarily focused on the particulars of religious experience but rather, phenomenologically, in the nature of their experiential structure. As he sees it, encounter with the "unseen" is an important psychological need that attracts people to organized religion; he describes it as like a deep, open well within the mind that allows us to experience awe and mystery.[209] James suggests that religious experiences share this drive for self-transcendence as a key feature. Many forms connect transcendence to numinous experiences immanent within but fundamentally different from the experience of everyday reality.[210] These moments of transcendence have exceptional ontological vehemence, pointing to the existence of a hidden experiential truth that can change our whole sense of being.[211]

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[207] Phillips, "Where the Spirit Roams," 50.

[208] William James, *The Varieties of Religious Experience* (New York: Modern Library, 1994), 408.

[209] James, *The Varieties of Religious Experience*, 53-60.

[210] James, *The Varieties of Religious Experience*, 25.

[211] James, *The Varieties of Religious Experience*, 26.

We see this relational duality of experience in myriad philosophical systems, especially the Buddhist and Vedic traditions, as well as in monotheistic religions, hermetic traditions, and even the occult, which all share the idea that there is no immutable distance between the object and the subject (non-duality). It's a common theme within the realm of functional semiotics as well, where focus is placed on the power of symbols to engender change in a physical state, on signs as tools for ontological vehemence. The famed anthropologist Claude Lévi-Strauss tended to differentiate between the sign and its meaning (that is, the physical symbol and the 'thing' being symbolized), borrowing the Jungian idea that we use symbols to represent concepts that we cannot fully articulate or comprehend, which places a contrast between the "reality" of the unconscious and the misguided rational thought of the discursive mind. Of course, Lévi-Strauss, as a representative of structuralist tendencies within the social sciences, can be seen as having participated in a severe modernist reduction of "culture" to essential categories with a concomitant removal of context and nuance. Still, he strongly supported the practice of using psychological myths to enact physiological responses, understanding that the symbol is a mediator of experience but that it also participates in a larger network of shaping meaning and behavior.[212]

As we previously saw, the importance of symbolism in comprehending musical instruments and sounding experiences as more than the sum of their empirical constraints, at least in the context of Western art music, is a practice that may have existed during the medieval period before fading into a system of literal representation; for instance, in the case of musical instruments being used to directly imitate animal and natural sounds. Of course, these naïve expressions of symbolism-as-representation couldn't be further from our hermeneutical understanding of the iconic function of sounding

[212] Claude Lévi-Strauss, "The Effectiveness of Symbols," in *Reader in Comparative Religion: An Anthropological Approach*, 4th ed., ed. William A. Lessa and Evon Z. Vogt (New York: Harper and Row, 1979), 321-325.

experience, and from our appreciation of the mental 'world' that emerges from an encounter with it. However, we've started to see the model for a more earnest treatment of the symbolic and transformational power of timbral experience arise in many non-Western musical practices, and in fields such as phenomenology and hermeneutics which rarely overlap with traditional organology. We suggested previously that the capacity of musical instruments (or of any complex and total sounding experience) to function symbolically was beyond a historically biased and acoustically limited organology's ability to explain. But it appears now that symbolism is in fact the inevitable and foundational mode of all sounding experiences, since *the-sound-of* anything fosters a space of meaning whose impact is far greater than a simple reference to its physical container or to some momentary emotional response that fails to reverberate back into the real world.

vi. *Reality reconfigured and the irony of timbre*

For Ricoeur, the power of aesthetic experience is not just to populate our minds with new truths and meanings, but to also reconfigure, transform, and shape the everyday reality to which we return after having experienced it. As such, the need for Western musicology to admit that there is a second order of sounding experience, and that it can indeed be articulated, is still not the root of our polemic. The notion that timbral experience can beget something, whether a mental image or a feeling or a thought, that is altogether new rather than representational implies a profound conclusion about its ontological vehemence. This is perhaps the most salient and singular aspect of Ricoeur's metaphoric theory: that aesthetic experiences afford the opportunity to increase, augment, reconfigure, and ultimately remake reality itself and the lived space of our being-in-the-world, made possible because experience unfolds *through* lived reality and not over and above it.[213]

[213] Ricoeur, "On the Metaphorical Process," 148, 155.

Ricoeur defines this relation to experience as a special form of 'feeling,' asserting that not only do aesthetic experiences enable us metaphorically to "see as" or "hear as," but they also enable us to *feel as:* our embodied nature becomes uniquely entwined with the world of the experience, not just for the duration of it, but also afterward, as we continue with an inevitably altered disposition into our ordinary existence.[214] Thus the mode of feeling is understood as a long-term affect, while emotions can be viewed as immediate, passing, and sensuous. (When we describe the "happy," "soft," or "warm" emotional associations of the flute, we're squarely within the prosaic.) Indeed, there's quite a lot at stake in the notion that aesthetic experience is not one in which new ideas simply float around in our inner psyches in relative isolation from the real world, but rather one in which those ideas have an actual impact on our day-to-day lives, on our actions and behaviors. It is in this way that Ricoeur sees aesthetic experiences as altering or augmenting the real such that it (reality) is in fact *more real* than it was before the experience began.[215]

This paradox has been postulated, far less rigorously, by those who recognize an ethical aspect of art. The late American composer Pauline Oliveros was certainly of this persuasion, noting that her so-called deep listening practices were radically political. For Oliveros, *hearing* is a first-order individual response to sonic stimulus, while *listening* is a mediated (often group) process that arises in the context of a network and modulates aural perception into transformative action.[216] We see similar implications in Ricoeur's writing: he emphasizes that aesthetic experience is not an interiorized dimension but

[214] Ricoeur, "On the Metaphorical Process," 155-157.

[215] Ricoeur, "The Function of Fiction," 136.

[216] Pauline Oliveros, *Sounding the Margins: Collected Writings 1992-2009* (Kingston, NY: Deep Listening Publications, 2010), 76-90.

rather one that derives great ontological and affective consequence in its ability to restructure intersubjective reality, which will naturally shade and change collective materiality as well.[217]

As we come full phenomenological circle, back to the arena of the real, a momentous sense of irony arises in relation to timbre: *the irony of timbre,* one could call it, which may be the more accurate way of reframing the paradox with which we began. Timbre is often the first musical parameter to be relegated to the realm of the literal because of our innate bias toward the physical, which is to say that its ontological status is determined by measurable empirical aspects such as frequency spectrum, construction material, and acoustic design. But we can (and ought to) expand our understanding of what timbre can mean to reflect how it encompasses the *experience of* sound, with the *the-sound-of* referring to an intricate, total, and complex entity that exceeds the boundaries of any musical instrument. Thus if we are timbral in our thinking, we can then appreciate how sounding experience becomes iconic in its disclosure of a 'world' that the listener can interact with, actively influence, and be profoundly influenced by.

Ultimately, we end up back in the realm of the literal, but completely transformed. A reconfiguration of our reality, and of the real world itself, has occurred by way of the sounding experience. There are two sides to this irony, then. On the one hand, as we loosen our clenched fists from the literal perspective on timbre, we are granted access to the emergent dimension of affect, and we bear witness to the deeply symbolic structure of timbral experience. And, on the other, as we transcend to this other 'world' of sounding experience, we are inevitably brought back into the domain of the prosaic, where sound experience has its greatest meaning. To understand the affective dimension of sounding

[217] Paul Ricoeur, "Mimesis and Representation," in *A Ricoeur Reader: Reflection and Imagination*, ed. Mario J. Valdés (Toronto: University of Toronto Press, 1991), 45.

experience, we must think precisely in timbral terms, in reference to the meaning of a parameter that is otherwise almost aggressively physical in its conventional ontology. The result of allowing timbre to immanently transcend into the metaphysical realm is not entrance to a world of fantasy, unverifiable and therefore less valuable; it is renewed access to the realm of the real, now transfigured by the poetic function of the sounding experience.

The death of the literal, in that fabled utopic space where timbre is free, doesn't require a departure from real experience, but rather opens the door to an incredible intimacy with it. This dance between prosaic and poetic states reveals something truthful and meaningful, something more critical than any observable reality that we know. As Gadamer eloquently stated, "Art possesses a mysterious intimacy that grips our entire being, as if there were no distance at all, and every encounter with it were an encounter with ourselves."[218]

[218] Hans-Georg Gadamer, *Philosophical Hermeneutics*, trans. David E. Linge (Los Angeles: University of California Press, 1976), 181.

CHAPTER SEVEN

PROLEGOMENA TO FURTHER THOUGHT

This discussion began with the earnest hope that the new perspectives we would articulate on organology and timbre could offer a way forward, open a door rather than make a final statement. Our aim was not to be comprehensive or exhaustive, but to emphasize the idea that there is a very meaningful rather than merely incidental sense in which timbre is encountered in an embodied and dialogic way, not just through the mechanisms of the instruments in question but also through their players and associated acts of play. Outlined above is the beginning of a holistic framework for critical organology, filtered in this case through my intimate firsthand expertise with sounding experiences. It feels appropriate in closing, then, to dedicate some space to summarizing what those viewpoints are and to musing on what further directions they could, and should, lead.

Retracing the steps of organology and associated studies of instrumental timbre, we found gaping holes in the common understanding of both topics due to a set of biases that have dominated the field since its institutionalization in the late nineteenth century. We saw how the historical bias of traditional organology favors a modernist progress narrative in which the development of musical instruments toward more flexibility, practicality, and expressivity elevates the status of some among others in ways that still affect us today. Majestic wind instruments such as the serpent and crumhorn, for instance, sadly remain on the fringes of modern musical society, their unique timbres effectively lost to contemporary music. In a critical organology, however, there is no linear narrative but rather the understanding that, as early-music historian Bruce Haynes best articulated it, *when you say something differently, you are saying something different.* Musical instruments are neither inherently good nor bad; they

are simply better suited for one sonic situation and not another. And, of course, with the loss of 'things that say something differently,' we lose access to what they might let us say and help us to experience.

Organology's physical bias, which depends on the apprehension of musical instruments in relation to their design and construction and timbre as cognitive-acoustical mechanics, is especially limiting. We expanded our interpretive net beyond the usual suspects (the shape and materials of a resonator; the frequency, amplitude, and volume produced; the psychoacoustics of perception) to include a broader system of affordances and limitations alongside a deep respect for the embodied and dialogic relationships that occur between instrument and player, whether 'instrument' refers to a material object in the conventional sense or one more meta-objective, like the ambience of a recording or a moment in listening time and place; and whether 'player' refers to a composer, a performer, a listener, or some combination of the three.

We arrive at the conclusion that timbre has a distinctly autographic nature, functioning as an ever-shifting complex in which something phenomenologically discrete emerges from beyond the mere sum of component parts. We argued that musical instruments behave this way, but that the vast catalog of 'sounding objects' includes far more than musical instruments. Any kind of sounding meta-object necessarily entails the situating of a context with its own sense of *this*-ness, inhabiting a unique and total emergent sounding experience. Following this emergent character of timbre is like tracing the process of what Nelson Goodman calls *worldmaking*, referencing something that exists in the physical world but can be accessed in another, more affective way.

The phenomenological and hermeneutic aspects of sounding experience, a domain separate from psychological accounts rooted in a physical, empiricist bias, and arguably the most overlooked aspects

of timbre and organology as bona fide generators of sonic meaning, then came into focus. Our guide was Paul Ricoeur, who used the literary device of metaphor as a model for describing the aesthetic experience and the way in which the affective dimensions of experience, so often dismissed as ineffable or inarticulable, can be accessed. We saw that as the poetic structure of sounding experience emerges, it does so immanently, from within, and that it creates a path for new truths and meanings to form and in turn leave an imprint on the prosaic world of experience from which they grew but were ultimately detached.

It's a benign transcendence at work here, a transcendence without transcending. In this way, there's an unmistakable sense in which timbre as a phenomenon is thus framed by a double irony: on the one hand, it is perhaps the most tangible and quantifiable sonic parameter we have but it's also one that offers a profound understanding of the poetic aspect of sonic encounters, which we access only by projecting timbre's emergent metaphorical character onto sounding experience. On the other, we find that the greatest impact of this poetic experience of timbre is how it changes our interaction with the prosaic, and how we extend this changed perspective back into our everyday lives. Of course, this model of transcendence unfolds in myriad experiential theories; it is not reserved only for specific musical experiences, or even for musical experiences as a particular category of aesthetic ones. Rather, it is constantly lying in wait, ready for the dialogic agent that cares enough to provide it a rigorous and meaningful framing. Timbral thinking, as it were, is an expansive hermeneutic action that engages a whole array of sonic systems by recognizing their unescapably intricate haecceity. The acoustic side of timbre that we've been so conditioned to accept is of course a necessary part of the story, but by no means sufficient.

Since I believe that a dialogic relationship with sound is paramount, I made the decision to focus the illustrative material for this discussion on musical worlds I understood firsthand, shaped by my training as a keyboardist, my current practice as a composer-performer of minimalist music, and my practice as a listener to and scholar of early music and popular recorded music. Clearly the fields of critical organology and timbral studies are wide open, though, and the lived perspective of composers, performers, and listeners in other musical worlds have yet to be considered.

To close, then, I would like to provide some specific (not comprehensive or exhaustive) suggestions, for further research. To my mind, the most urgent expansion for a critical organology should be into the practices, theories, and instruments of non-European musical traditions. We have already pointed the way here, borrowing from recent ethnographic work on how musical instruments and timbre function in diverse cultural contexts. It would be especially interesting to gain a sense of what level of influence, if any, empiricism and acoustic fundamentalism have had on the understanding of what we call timbre outside of Western academic circles, and what other biases arise in such discourses that might inhibit phenomenological appreciation of timbral thinking. The modern European perspective on the affective dimensions of timbre seems especially plagued by an enduring hostility toward metaphysics, a taboo not shared by other non-Western musical traditions who reflect a cultivated connection to the concept of transcendence and an apprehension of how musical instruments figure into this structure. Our discussion was shadowed by the immanent metaphysics of alternate tuning systems and the lost possibilities for timbral expression that accompany the West's standardization of 12TET; this level of disregard for tuning and intonation as an articulation of harmonic poetics is a feature that seems to be unique to Western musical practices, which would make it a particularly salient point of intersection to our discussion.

One could also develop a critical organology of other instrumental types, exploring their idiosyncrasies and idioms. This would surely expose ways of knowing that can't be captured at the keyboard. I expect that the instrumentalization of the voice, given its unique relationship to embodied engagement, would be an especially interesting realm to examine. Moving beyond the standard musical instrument categories, it would be interesting to find and assess other kinds of complex musicking systems and their distinctive sounding experiences, as we did with the recording studio, to further expand our appreciation of what a musical instrument can be and what it means for a complex system of meta-objects to function unitarily to make timbre. Similarly, an in-depth survey into other types of musical practices, traditions, and styles would also be illuminating. Approaches explicitly rooted in improvisation, for instance, would surely lend a fascinating shape to the discussion of dialogic relationships between players and instruments, and of course the vast realm of film music is predicated on the explicit worldmaking power of moving pictures, a practice whose metaphysics have been deeply and persuasively debated for generations. The music that carried this project deserves more breathing room, too: for instance, one could assess the dialogic implications of the Fitzwilliam Virginal Book, a collection of generic 'keyboard' works from the late Renaissance, wherein it is impossible to ignore the affordances of a chosen performance instrument and how they shape the sounding experience.

We suggested in the previous chapter that timbral thinking needs an ethical component, dealing with the ontological vehemence that works of art invoke in the beholder: they force us not only to see or to hear as, but also to *feel* as, engendering ritual empathy (to quote ethnomusicologist Richard Jankowsky) that impacts our sense of being-in-the-world long after the experience is over. The anthropological dimensions of timbral thinking could thus be further explored, bringing to bear a deeper sense of the relationships among music, sound, and instruments alongside theories of social, cultural, and political behavior. Such awareness would help break down the historicist bias of

traditional organology, especially insofar as we "use" or come to "know" instruments. We also very briefly explored disability in relation to the articulation of sound, but that inquiry could of course be taken much further especially with respect to the phenomenology of what occurs mentally *in excess of the audible* when we are listening and hearing (or not). And one could certainly bring in more adjacent methodologies regarding ecstatic experience in music, as we began in the previous chapter. Indeed, the notion of "timbral thinking" could even be applied to other art forms – the visual arts, dance, or film – independent from how they function in relation to the music that may occasionally accompany them but rather insofar as they display correlates to emergent components. A transfer of concepts may end up revealing something even more meaningful about the vast poetic dimension of timbre, which effectively seeks to see the forest through the trees, so to speak.

Finally, I think that there's a poignant way in which some of the metaphysical speculations we discussed could come full circle, not just to supplement the physical foundations of timbre, but to upend them. It may be that this feeling is already circulating: a recent research report from McGill University seems to challenge the conventional scientific understanding of how we process music, suggesting that our relationship with music is not just cognitive, but fully embodied. According to the study, which falls under the growing psycho-cognitive branch of Neural Resonance Theory (NRT), "for decades, scientists believed [that] musical experiences primarily stemmed from learned expectations and statistical predictions – essentially, our brains constantly forecasting what notes or beats would come next. NRT offers a more elegant explanation: our neural systems physically resonate with musical patterns across multiple timescales."[219] The report goes on to suggest that "music is powerful not just because we hear it but because our brains and bodies become it," while predicting

[219] "Our Brains Don't Just Hear Music – They May Physically Become It," McGill University Science Blog, accessed May 2025, www.scienceblog.com/our-brains-dont-just-hear-music-they-may-physically-become-it.

that theories like NRT may be able to provide a framework connecting the mechanisms of brain function to conscious experience, bridging neuroscience with broader questions of perception and cognition.

The report goes on to suggest that such research is particularly valuable because of its grounding in empirical and verifiable mechanisms rather than "abstract metaphors," which of course signals an underlying condescension toward the phenomenological and metaphysical. But by this point insisting that the embodied nature of sounding experience and its ontological vehemence go together should not be controversial. This was the motivation of my study: to argue polemically for the position that the empirical and verifiable cannot account for the full range of subjective mental experience, and especially not for the imaginative capacity engaged when an aesthetic experience of sound presents itself. One could certainly reduce the emergent nature of timbre to a semantic formality (perhaps it's actually a simple and uneventful neural moment when 'the trees' become 'the forest'), but the poetic import of timbral thinking, the "abstract metaphors" that we use to assign timbre its proper iconic function toward the revelation of altogether new truths and meanings, are ultimately not *just* a way of filling in the gaps between mind and meat. Perhaps the physical foundations of timbre have something poetic to gain as well, not to exist in binary opposition with the phenomenological perspective but rather to participate in an open and creative dialog within its depths.

> "Hearing does not presume as much as vision. It is not so arrogant, and it is willing to refer its experience to evanescent qualities without insisting, as sight does, that they have to be tethered unambiguously to definite things in the material world. The ear is not hung up on the reality of things."[220]

[220] Jonathan Rée, *I See a Voice: Deafness, Language and the Senses--A Philosophical History* (New York: Holt, 2000), 46.

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