



Microtonal Music Studios

Music Outside Keys & Cultures: Social, Cultural, Political, & Personal Perspectives

Edited by Timo S. Tuhkanen

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Microtonal Music Studios Reader I

**Music Outside Keys and Cultures:
Social, Cultural, Political, and Personal Perspectives**

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Introduction

This book addresses microtonal music by presenting texts that discuss the influence of cultural perspectives and societal customs on musical choices and tuning systems. The aim of the book is to present a lenticular view of musical and musicological practices, often insisting to stay in between multiple points of views to show the variety of approaches and experiences within the field of microtonal music. As far as the authors are aware it is the first contemporary book attempting to give an overview of what is happening in the cultural study of microtonal music today. The authors address microtonality beyond its harmonic and mathematical foundations, without excluding it, and they ask:

Why does music sound the way it does? What are the cultural foundations of tuning systems? What type of concepts and musical ideas can emerge from it? And what type of approaches and perspectives there are in artistic and cultural production of microtonal music?

Microtonality in this sense is not defined stylistically but it is considered a normalised term merely for any musical infrastructure that doesn't adhere to a very strict measurement of the semitone. This book argues against this essentialist approach to tuning in which the standard western tuning system dominates, but instead argues for a much more subtle and diverse approach that invites the reader to consider how all music made by humans is really microtonal and that it is the conceptual framework, constructed by culture and traditions, which defines music as being in tune or out of tune. Understanding the mechanism by which this choice is made by individuals is vital for any study of the cultural foundations of music.

This book was also greatly inspired by my private discussions with Johnny Reinhardt and our subsequent discussion "Microtonality as a Social Construct" in April 2021 held at the online Microtonal University. However this book grew out of more than one thing and is the culmination of several decades of work within the field. While my personal road to microtonal music is not that dissimilar to others. Growing up in multiple countries, I embody the various cultures that nourished me, and my ear became accustomed to varying tuning systems without knowing it. When I started studying western classical music I struggled with the problem of tuning systems because I had no guidance of where to start

understanding why what I heard sounded different to what I had learned studying Classical Arabic and Indian music. It wasn't until I went to Brunel University and met Bob Gilmore, one of the most eminent writers and musicians in the field of microtonal music, that from our conversations I understood that there are historical and cultural reasons why music sounds the way it does. While the mathematical operations we use to calculate pitches is based on acoustics, the person making the calculations has almost an infinite variety of possibilities of algorithms and axioms to start with, which are always based on the personal preferences and aesthetic sensibilities. This realisation opened to multiple questions and areas of interests that connected to my already strong interest in musicology, sociology, ethography, and psychology.

Practically, this book was created as part of my project Microtonal Music Studios: Music Outside Keys and Cultures – a Kone Foundation funded project that brought together more than 30 students, 65 artists, and many more audience members – and the book contains some remnants and results from artists working in parallel and tangent to the project. The project allowed me to create an institutional framework that increased both the visibility of microtonal music but also the physical resources available to microtonal music enthusiasts by constructing and modifying musical instruments, by organising workshops with artists, and academics, and so forth. During the research, we didn't focus just on music, but rather included anyone from any field interested in including microtonality and its concepts in their works. Thus the participants ranged from musicians with decades of experience in microtonal music to ceramicists interested in including microtonal music into their installation practice to develop musical ideas based on their indigenous backgrounds, leaving behind the constraints of western norms. This meant that the richness of practices within the project allowed for a cultivation of a wide range of ideas well beyond the traditional visions of microtonality. When I envisioned the project I saw it as a relational-art project that would use methods and processes of contemporary art to create resources within the field of microtonal music, asking the question: can one field of art be used to create resources for another field of art?

This book is an answer to that question. It contains fourteen chapters that all deal with aspects of microtonality and microtonal music from social, cultural, political, and personal perspectives from a wide range of writers with manyfold visions of what microtonal music is and how it functions and is situated within culture, society, and artistic practices. These

chapters illuminate the existing wide scope of microtonal music and its contemporary phenomena across the globe within music but also across disciplines and in contemporary art. Interjected with academic writing, this book includes speculative fiction on alternate histories and a poem from workshops held at the Microtonal Music Studios project. With this I have wanted to present a multitude of articulations interesting and relevant to microtonal music practices.

Colleen Gallagher's chapter *Is Microtonality Approaching an Inflection Point?* tries to uncover the mechanism of the spread of microtonal music and looks at the growth of resources within the field and singles out some of its most interesting and important participants. Haiyun Yu's chapter *The 12 Moon Temperament: Decolonising Chinese Tuning System* translated ancient texts and recreated the tuning system of Jiang Kui [1155-1221] the previous documented use of which was 800 years ago and talks shortly about the use of microtonal tunings as a decolonising factor in music. Thokozni Mhlambi's chapter *Tuning Systems, Ancient Greek Musical Ethos & African Possibilities* Dr Mhlambi presents musical ethos and the ways in which we make various educational models and tuning systems important but also what alternatives there already are to these systems. Tomás Cabado's chapter *A Chord is a Sculpture* discusses his multidisciplinary way of approaching the visualization of microtonal tuning systems such as latices through sound-sculptures and the installation practice of a contemporary artist. Sami Abu Shumays's chapter *Arabic Maqam and "Microtonality" as a Social Phenomenon* argues for a redefinition of microtonal through a de-colonial view making the valid point that as a normalised term microtonality itself is a perspective that poses a dominant and subdominant value structure in society. Demian Claudio Araya Lobos's chapter *The Revolution of the Sonido-13 Today* looks at the legacy of Julian Carrillo today and presents his inventions in microtonal computation for use. Orlando Zavala Galindo's chapter *The Pythagorean Xylophone* shows a practical explanation in images and text about constructing a microtonal 53 comma xylophone from aluminium. Dylan Rodgers's chapter *Subverting the Equal Temperament Ubiquity: Use of Auxiliary Frets in Lutes, Guitars and Beyond* blends practical and theoretical work through the use of musical-tools that can extend instruments and create more resolution in tuning systems. Robert Prokopowicz's chapter *What if Nicolo Vincentino Won the Debate: An Alternate History for Music* presents a socio-political-musical fiction and alternate universe where microtonal music becomes the norm. Amalia De-

orola's chapter *Negotiating Thought Through Sound: The Prepared Piano as a Site of Microtonal Contestation* discusses compositional practices between different microtonal cross-cultural settings. Idin Samimi Mofakham's chapter *My Non-Tempered Universe: Engaging in Self-Reflection Through Personal Analysis via Silent Conversations with an AI Colleague* is a personal meditation on microtonal concepts within cultural relations. Angus Barnacle's chapter *Novelty Cadences: Suspensions as Stepping Stones Toward Complex Microtonal Targets* looks at his method for Just Intonation harmonic development that can give harmonic movement direction. Casey Hale's chapter *Draw a Straight Line and Follow It? Xenharmonics, Queer Theory and Categorical Perception* looks at the queer turn and ideas about orienting and path finding as conceptual frameworks to analyse the development of models for describing consonance and dissonance. And finally Moe Louanjli's chapter *Thoughts from the Workshop with Lucía Hinojosa Gaxiola: Writing with The and Echo Between Space* is about his experience participating in Lucía's workshop in Helsinki in 2024.

Microtonal music itself is a growing field of study, yet more often than not the focus of these studies is the mathematical structure of harmonic and melodic or naming aspects, what to call each new interval and how to categorise these aspects of the music rather than the humanistic and cultural world in which these exist. Studies into the contemporary cultural existence and possibilities of microtonal music do not really exist in a centralised way either. Perhaps precisely because of this the field is extremely exciting and the I am proud to be able to finally present the first in a series of books investigating precisely that.

I would like to thank all the artists and researchers who participated or were helpful making a reality of the microtonal music studios project activities, the order is colorised only by the slight tint of being somewhat chronological: Nicolina Stylianou, Henrik Frisk, Timo Pyhälä, Markku Toikkanen, Teemu Mastovaara, Anna Sofia, Zhenhua Li, Hans-Gunter Lock, Gonzalo Muruaga, Marc Sabat, Anna Matveinen, Shinji Kanki, Diemo Schwarz, Dewa Alit, Jani Ruscica, Nicolas Kliwadenko, Mathijn den Duijf, Mathijs Leeuwis, Dario Lo Cicero, Mila Di Addario, Andrew Bentley, Juhani Liimamatainen, Suva, Tolgahan Cogulu, Andrus Kallastu, Marloes Van Son, Dirar Kalash, Sylvia Hinz, Laura Mehmeti, Juhani Nuorvala, Eija Kankaanranta, Martin Dahlström-Heuser, Paul Devens, Stéphane Clor, Lucía Hinojosa Gaxiola, Linda Sormin, Laura Naukkarinen (Launau), Oteanankanduro, Peter Wiegold, Irena Ruiz Perez, John C Jansen, Idin Samini

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Introduction, 5 - 9

Contents, 10 - 11

Colleen Gallagher, 14 - 35

Is Microtonality Approaching an Inflection Point?

Haiyun Yu, 38 - 49

The 12 Moon Temperament:
Decolonising Chinese Tuning System

Thokozani Mhlambi, 52 - 76

Tuning Systems, Ancient Greek Musical Ethos & African Possibilities

Tomás Cabado, 81 - 103

A Chord is a Sculpture

Sami Abu Shumays, 106 - 122

Arabic Maqam and “Microtonality” as a Social Phenomenon

Demian Claudio Araya Lobos, 124 - 143

The Revolution of the Sonido-13 Today

Orlando Zavala Galindo, 150 - 165

The Pythagorean Xylophone

Dylan Rodgers, 168 - 188

Subverting the Equal Temperament Ubiquity:
Use of Auxiliary Frets in Lutes, Guitars and Beyond

Robert Prokopowicz, 194 - 211

What if Nicola Vicentino Won the Debate:
An Alternate History for Music

Amalia Dearsola, 216 - 247

Negotiating Thought Through Sound:
The Prepared Piano as a Site of Microtonal Contestation

Idin Samimi Mofakham, 254 - 271

My Non-Tempered Universe:
Engaging in Self-Reflection Through Personal Analysis via Silent
Conversations with an AI Colleague

Angus Barnacle, 278 - 288

Novelty Cadences: Suspensions as Stepping Stones Toward Com-
plex Microtonal Targets

Casey Hale, 292 - 321

Draw a Straight Line and Follow It?
Xenharmonics, Queer Theory and Categorical Perception

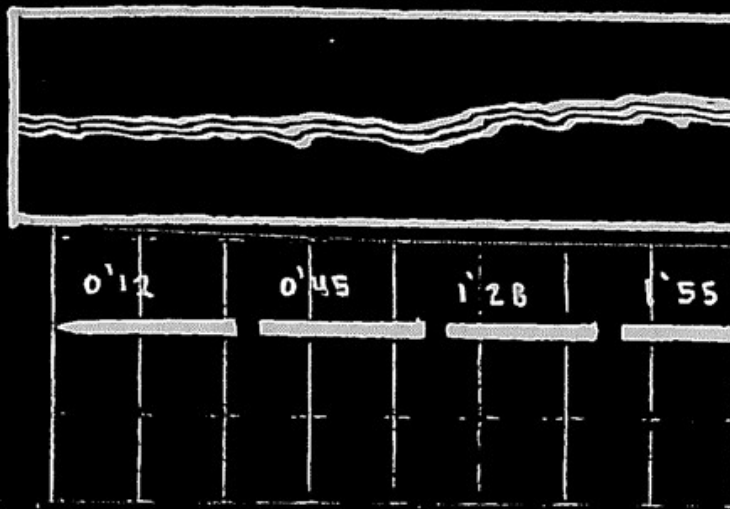
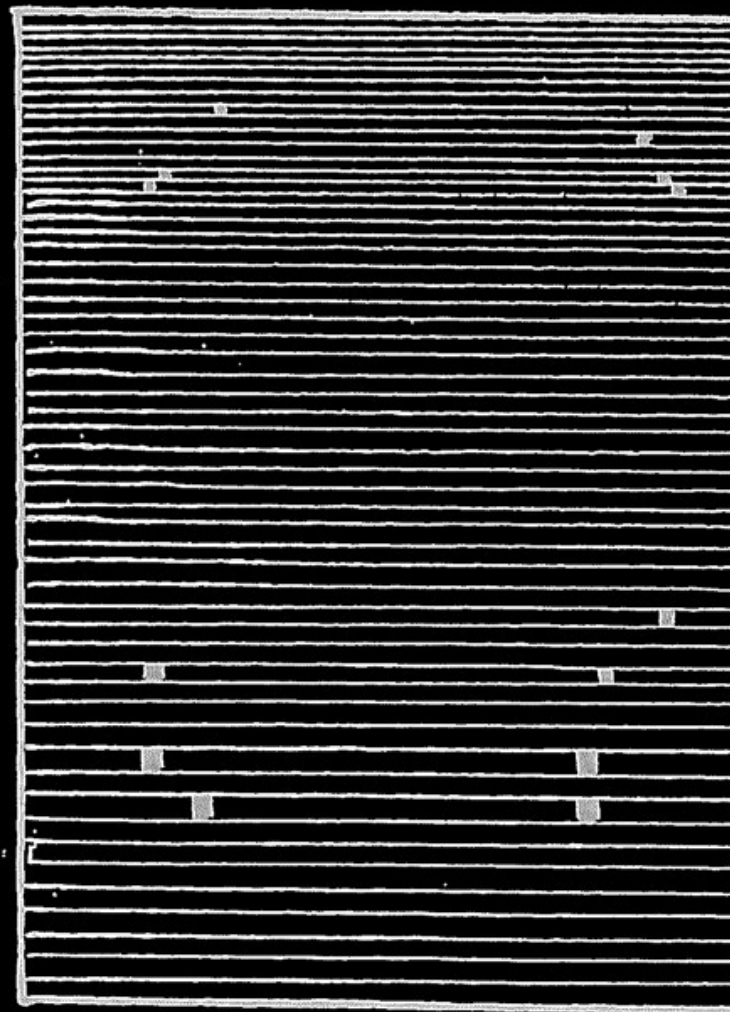
Moe Louanjli, 327 - 328

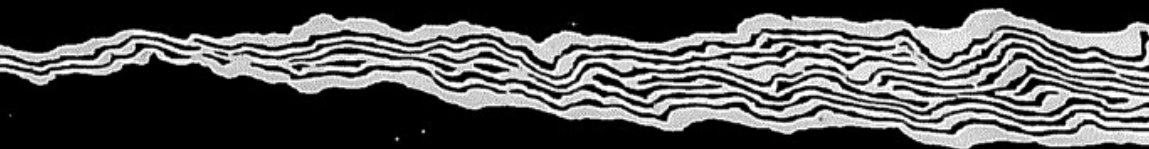
WATERSHED

Thoughts from the Workshop with Hinojosa Lucía Gaxiola:
Writing with The and Echo Between Space

Acknowledgements, 333 - 338

TWO HARMONICAS IN THE JEWELER'S COURT





	2'28	3'00	3'25	3'33	
	2'46	3'18		3'50	



Colleen

Gallagher

Is Microtonality Approaching an Inflection Point?

Riding the Boom

The digital revolution's impact on microtonality has been profound. Powerful advancements in microtone-capable music software and hardware have led more music creators to exit the confines of the traditional Western chromatic scale and explore a universe of alternative tunings and scales. The result: More music in every imaginable tuning is being pumped out than anyone can keep up with, the vast bulk of it created and consumed entirely electronically.

Direct measurement is elusive, but indirect indications of microtonal music's inroads are compelling: Numbering 5,000 shortly before the pandemic, membership in the largest microtonal music discussion group on Facebook had doubled by 2023, and now exceeds 28,000.¹ On Bandcamp, a favored distribution platform for new-music creators in general and microtonalists in particular, some 3,400 albums at last count were tagged as microtonal, with hundreds listed under the terms just intonation and xenharmonic.² Anecdotally, variations on Ensemble Scala's observation are commonly voiced online: "Because the possibilities to produce microtones (with the advent of advanced software) have become much more extensive since the end of the past decade, the world of microtonal music has grown tremendously."³

The future of microtonal composition capabilities looks even brighter. A trio of recent technological achievements — notably, work by Southern California electronic composer Marcus Hobbes and others to put into practical use the theories of Ervin Wilson⁴ (1928-2016) — has opened up "a new, more powerful composing environment," according to longtime microtonalist Warren Burt:

Over the past year or so, a number of new programs have emerged which make the composing and exploring of microtonal music much more easy and efficient. In the interaction of these programs, a new eco-system to support microtonal music has come together, and these, with the tools and abilities they imply have greatly expanded the possibilities for [digital] microtonal performance, especially in real-time.⁵

Microtonality, of course, is but a sliver of the music world that digital technology upended. The financial fallout of this new order is ongoing — the same forces that allow DIY creators to put their music in front of the world mean even many established artists pocket barely a pittance

from each download or streaming play. At the same time, the logistical and cost barriers to producing and distributing music of one's own making, whether microtonal or not, are drastically lower, and a tech-adept creator today can single-handedly make, mix and master virtually any conceivable collection of sounds, then market and disseminate their creative output via streamed and downloaded digital audio files.

For microtonal music in particular, digitization had an outsize impact, opening up vast tuning and scale possibilities to theorists, composers, and hobbyists alike and rendering pragmatic hurdles once central to microtonal music-making — retuning instruments and retraining musicians — optional.

The resulting effect on Western microtonal culture is striking. The esoteric, even eccentric vibe of earlier decades has evolved into an accessible, international, genre-spanning environment for legions of alternative tuning enthusiasts. Today, a microtonalist is about as likely to be a classical composer with a Ph.D. as an autodidact who may or may not play an instrument or write notation. “The barrier to entry,” one online commenter recently observed, “is thinning.”⁶

With the middleman cut out, so to speak, the heroic efforts of microtonal lore evoke a fading era: No more need to invent and fabricate instruments.⁷ No trusted protégé needed to painstakingly retune the concert grand. No Tribeca immersion loft.⁸ No musicians laboring for 14 years and 1,999 takes to record 10 intricate string quartets.⁹ Just a few tech tools, a Bandcamp page, and a social media account, and you are good to go as far as your mind's ear will take you.

Meanwhile, this tech-centric environment raises some interesting aesthetic questions. Is the ongoing nature of technological advancement creating a bias toward previously unheard temperaments and scales? Does microtonality by its very nature require a culture of constant discovery? If ever more robust tools make for ever more enticing exploration, does that dynamic direct undue attention on the furthest frontiers of the tuning landscape? If so, does that focus serve genuine artistic innovation?

For music in general, the full artistic ramifications of digital creation and consumption are probably still unfolding. For microtonal music, at least, technology arguably exerts a perceptible influence on the music itself, at least for certain styles. Digital recording — being free of the fleeting

pitch fluctuations one might detect on a tape recording, for instance — seems particularly beneficial for music designed to focus the ear on sustained or slowly developing microtones. Absent this stable medium, would these minimalist and quasi-minimalist approaches to microtonality be as prevalent as they are today?

Technology may influence the type of microtonal music in another, perhaps more oblique, respect. For many enthusiasts, a big part of microtonality's appeal is the unprecedented ability that current technology affords them to experiment with and evaluate novel tuning systems. Of course, using modern means to explore the bounds of tuning is nothing new. Composers who recognized the possibilities that 20th century advancements held for microtonal composition include Wendy Carlos and James Tenney.¹⁰ What is relatively new, though, is wide access to sophisticated composing software and online infrastructure that supports learning and sharing of outcomes and ideas.

Bust?

In a key respect, however, the boom has clunked. Demand for live microtonal art music, particularly in the U.S, is somewhere between scant and nil. Whatever momentum may once have been building toward bringing microtonal performance into the American concert hall appears stalled. Almost 100 years after Julián Carrillo's quartertones filled Carnegie Hall and more than 80 years after Harry Partch followed suit with his chromelodeon and kithara, live alternatively tuned music remains a novelty that a culturally adventurous American might encounter only at the occasional new-music festival or university event.

What is holding live performance back? Considering the inroads microtonal composition has made, why has contemporary classical microtonal performance not kept pace, particularly in the U.S. where so much modern microtonal music got its start?

Conventional wisdom points to an ingrained negative-feedback loop: Conservatory curricula provide little exposure to alternative tunings, classically trained musicians are incentivized to focus on mastering the performance of a relatively limited canon, orchestras and chamber music societies know they can fill more seats by programming traditional piec-

es, so musicians are seldom called upon to venture beyond their tuning comfort zone, and audiences remain seemingly contentedly unaware of what microtonal music even is. Lather, rinse, repeat.

The often-cited scarcity of willing and able musicians, with an emphasis on the “willing,” suggests the problem stems more from a lack of familiarity than some inherent difficulty of playing microtones. Either way, it is hard to deny that executing micro intervals on a standard acoustic instrument presents a certain challenge. As Lou Harrison biographer Brett Campbell observed, “Musicians who’ve devoted years to internalizing the equal temperament that’s so dominated Western music for a century have to retune their instruments — and ears — to embrace this wider spectrum of sounds.”¹¹

Composer John Adams tells a cautionary tale of his *The Dharma at Big Sur* and the Los Angeles Philharmonic:

The first part, ‘A New Day,’ is a long rhapsodic reverie for the solo violin, an ‘endless melody’ that soars above the stillness of an orchestral drone with its quietly pulsating gongs and harps and distant brass chords. The first version of this ‘concerto after Kerouac’ called for both the soloist and the orchestra to play in ‘just’ intonation, that is, with intervals between the notes of the scale differently tuned than in the conventional manner. I spent more than a month in my home studio carefully tuning my synthesizers and samplers to represent exactly the special tunings I wanted. ‘A New Day’ is an homage to Lou Harrison, who lived not far from Big Sur and who was the first significant American to compose in other tuning systems. But at the first rehearsal in Los Angeles I realized almost immediately and to my intense distress that the seventy players in the orchestra could not possibly agree on the minute distinctions between frequencies that I’d required in their parts. Furthermore brass instruments, being coils of long tubing, were unpredictable and capricious in their resonant characteristics. In later performances I had to revert to a more standard tuning for most of the orchestra, but I was still able to keep the strange ‘natural’ intervals of the brass partials and the otherworldly resonances of the harps, samplers and piano, who remained tuned to a special ‘just’ scale based on B major.¹²

Toronto-based composer Taylor Brook put it bluntly: “I can’t help but think that most ensembles, when they open my scores and see all the microtones, close them up again.”¹³ Some composers avoid the issue by playing their own acoustic pieces. Others form collectives to perform one another’s works. A few take a cue from Partch and fashion new instru-

ments. The fascinating music performed on some of these adaptations — notably, Stephen Altoft’s microtonal trumpet and flugelhorn,¹⁴ Ben Neill’s electro–acoustic “mutantrumpet,”¹⁵ Michael Harrison’s “harmonic piano,”¹⁶ — makes a compelling case for going that route.

One possible drawback of such workarounds, however, is they skew contemporary classical microtonal music in favor of pieces for one or a few musicians and away from music for large ensemble and orchestra. Composers get few cracks at writing the kind of large–scale acoustic works that traditionally can become a composer’s trademark and that could let alternatively tuned music assume what is arguably its rightful place in the classical repertoire.

Given such challenges, the prospect of so much exceptional microtonal music ever reaching the ears of mainstream audiences, let alone finding favor or even achieving familiarity, seems remote.¹⁷

But what if this narrative is overstated? What if live performance of contemporary classical microtonal music is actually poised to become a thing? What if the ingredients are actually already there for microtonality to provide the “ferment” Partch sought to reinvigorate the Western concert hall?

Poised for Breakout: Signs of Receptivity

More contemporary classical music than ever is being performed, and audiences do not seem to be rebelling. U.S. orchestras and chamber series are increasingly programming and commissioning the music of today’s composers, and in the process are potentially leaving audiences more open to the new and different. Attitudes toward new music in the cultural hubs of Los Angeles and New York are steadily brightening — the New York Philharmonic performed works by just four living composers during its 2010–2011 classical subscription series, but by 2014–2015 had doubled that number, and quadrupled it in 2024–2025.¹⁸ Even in the small market of Pittsburgh, maestro Manfred Honeck’s traditional Viennese sensibilities have not prevented him from scheduling the works of 17 contemporary composers in the Pittsburgh Symphony’s 2025–2026 classical series.¹⁹

The classical establishment’s embrace of contemporary music is not uni-

versal, nor especially whole-hearted. As critic Jeremy Reynolds observed, “To look at most modern symphony orchestras’ classical programs, one might think that composers ceased to exist sometime during the 20th century.”²⁰ Even orchestras that do program contemporary works have settled on a formula that speaks volumes about where new music stands in the repertorial pecking order: Lead off the evening with a short work from a short list of living composers firmly in the conventional tuning camp and then get on with the Beethoven or Brahms.

Does this trend still leave microtonal performance out in the cold? Not entirely. At least a few U.S. ensembles and orchestras appear willing to play music that ventures a bit beyond 12-edo:

- The premiere of a commission by Reza Vali, whose compositions incorporate microtones based on traditional Persian music, is featured in the Pittsburgh Symphony’s 2024–2025 season. “To help musicians schooled in the Western style, he developed a “mixed tuning” system that augments the twelve-tone equal tempered cycle with four additional intervals.”²¹
- Although Gloria Coates’s orchestral catalogue has been largely ignored by U.S. orchestras, the late Munich-based composer received performances by the Brooklyn Philharmonic, St. Paul Chamber Orchestra, and Milwaukee Symphony in her home state of Wisconsin.²² U.S. new-music organizations and ensembles that have programmed her music include San Francisco’s Other Minds Festival, the American Composers Orchestra, JACK Quartet, and Kronos Quartet.²²
- The Charlotte Symphony Orchestra under the baton of Christopher Lees performed a multi-media work in just intonation by Ben Hertzmann in 2024.²³
- The Brevard Festival Chamber Orchestra and Neal Berntsen performed a Vali concerto in Florida in 2016: “Berntsen performed the piece on a specially modified trumpet, which enabled him to execute the Persian quarter tone scale.”²⁴
- The Boston Modern Orchestra Project has played works by Vali, Mathew Rosenblum, and Lou Harrison.

Meanwhile, microtonal festivals valiantly continue to uphold the idea that there is something special about hearing microtonal music live:

Up until 1997, if you lived in Southern California and wanted to hear microtonal music, your only choice was to buy a recording. But *live* microtones? Forget about it. Yes, even here in the land where Harry Partch

debuted his magnum opus *Delusion of the Fury*, and occasional visits by Lou Harrison, Terry Riley, Ben Johnston and others teased our eardrums with these forbidden fruits, this newly vital musical language was more likely to languish in the footnotes of textbooks than to thrill us from our concert stages. But then along came MicroFest [...]”²⁵

A handful of other microtonal festivals occur from time to time across the U.S., though audiences tend to consist of true believers or at least the already-initiated, and the works tend to be for solo artist or small ensemble. The days when the American Festival of Microtonal Music in New York,²⁶ the grand-daddy of U.S. microtonal festivals founded by Johnny Reinhard, could secure the resources to assemble an orchestra of professional musicians to perform Paul Gallagher’s four-movement symphony in just intonation appear long gone.²⁷

In some ways, though, there is less need for festivals. The profile of U.S.-based touring ensembles that commission microtonal art music is rising, including the JACK Quartet, vocal sextet Ekmeles, and Partch Ensemble. Others such as the Carpe Diem and Del Sol string quartets, and the Pierrot ensemble Brightwork New Music are increasingly exposing new-music audiences to alternatively tuned gems.

Recent Success in Attracting Audiences

To get ordinary concert-goers to open their ears, presenters might take a page from a couple of recent success stories. Hint: It boils down to making microtonal “normal.”

To entice audiences, is “microtonal” a selling point? Or the kiss of death? On this perennial question, a pair of Southern California composers came down squarely in the latter camp for their multimedia microtonal experience *Interstellar Sound Bath at Vidiots* in Los Angeles in February 2025. Using cosmic sci-fi themed visuals and other-worldly sounds, they enticed some 200 people to check out their custom-made, down-to-earth-looking microtonal instruments. What they did not use was the word “microtonal.” While not a live acoustic performance, this event faced the same calculation that every alternative-tuning program does: Is it better to play up or play down the unfamiliar tuning angle? The creators, composers Chuck Jonkey and Stephen James Taylor, opted to avoid labeling the microtonal score as such, or to even use Taylor’s trademark term

“transcendent tonality,” lest they scare people away. The presenters did something else that positioned their creation squarely in a pop culture safe zone: They unveiled it at a venue devoted to artsy videos and its own established patron draw.²⁸

Just a few days earlier, across the country in Pittsburgh, a special microtonal event broadened its reach through similar means. For the opening night of the four-day Beyond: Microtonal Music Festival, the organizers piggy-backed onto a regular Thursday evening jazz series. In a club-like setting a few miles from the formal hall where most of the festival took place, the Austria-based Dsilton microtonal trio headed by Georg Vogel played a long set of their 31-tone jazz-infused compositions for custom instruments, capturing the ears of not only the microtonal faithful but also the venue’s regular Thursday night crowd, including customers seated at the bar and adjoining restaurant. Dsilton’s gig was in a significant respect just another form of jazz and so was able to expose local jazz enthusiasts to something they likely would not have chosen to go to had it been explicitly labeled microtonal, particularly at an unfamiliar venue.

Lots of (Scattered) Support for Musicians

On March 25, 2025, an interesting post went up on the public Microtonal Music and Tuning Theory Facebook Group. A member asked:

“Does anyone know of any resources for writing for microtonal music for flute. I am writing a piece for Lumatone, flute, clarinet, violin, cello and untuned perc[ussion] and I am wanting to know more about alternate fingerings for the flute.”

After a halting start in which a couple of early respondents asserted that a special flute is necessary, the upshot as the discussion played out over the next few days was that helpful microtonal fingering charts for standard concert flute exist and that certain interval situations are best avoided but that wind players ultimately tend to finesse their own fingerings and embouchure to achieve the required tones.²⁹

On the one hand, this rather routine discussion showed how readily the group’s leading members volunteer their expertise and why the forum is so valued by the microtonal community. On the other hand, it suggested limited awareness of basic performance information — a state of affairs

that becomes hard to square with the fact that the fingering charts the composer was directed to have been around since 1990.

The MMTT group focuses primarily on composition and analysis rather than musicianship, and even though in this case at least one respondent played a wind instrument and another had written successfully performed music for flute, the inquiring composer was seeking guidance not from flutists with personal experience but rather from her fellow composers, for a simple reason: There is no comparable group or website devoted to advancing the art of acoustic microtonal performance to which she could have turned.

Why does no such site exist? It is not for lack of material. Though scattered in obscure places and sometimes cumbersome to access, enough pertinent scholarship and practical guidance on microtonal performance has been produced over the years that if a central site were to suddenly spring up, it is hard to believe it would not quickly fill with links to papers, books, charts, and videos for musicians seeking proficiency in playing microtones as well as for composers and educators.

A Sampling of What is Out There

- Flute performance: “Micro-Images, Genera, and Poème Exotique: A Guide to Tone Color Selection, Relative Dynamics, and Temporal Pacing for Effective Performances of Three Microtonal Flute Works by Daniel Kessner,” Terri Sanchez, 2013.³⁰
- *The Other Flute: A Performance Manual of Contemporary Techniques*, Robert Dick. London: Oxford University Press, 1975. A classic text on contemporary flute performance, with material on playing microtones.³¹
- “Flute Microtonality for Composers,” Helen Bledsoe, blog entry, January 20, 2025.³²
- Clarinet performance: “Selected Modern Clarinet Techniques: Multiphonics, Microtones, and Vibrato,” Nurhak Tuncer, 2010.³³
- Just intonation performance: “Chords, Melodies: A Look at Harmony by Numbers; Part I: Using Harmonic Radius to Compare Rational Pitch Collections,” Marc Sabat, 2024. “By means of a simple calculation that may be estimated in real time while playing, it enables musicians to further explore sounds of microtonal JI, finding connections between

intonation and the psychoacoustics of harmony.”

Dissertation presentation, 2024: “In my music for live musicians, I find it useful to work with tuneability, to focus on the experience of hearing and playing the unique sonorities and resonances of rational intonation. Concentrating on intervals and chords making melodies by means of counterpoint, rather than using fixed scales or a single row, allows a free flow of sounds with shifting fundamentals and changing points of reference.”³⁴

- Just intonation for band performance: “Tuning the Band and Raising Pitch Consciousness,” James Jurens, RBC Music Publishers. A 48-page booklet that provides “information about each instrument regarding intonation tendencies, suggests tuning notes, discusses the effects of hard and soft reeds and dynamic changes on intonation, and offers suggestions for alternate fingerings for specific notes on each instrument.”³⁵

- Notation advances: Helmholtz–Ellis Just Intonation (HEJI) is a pitch notation system created to optimize notation practices for the benefit of musicians performing music written in just intonation.³⁶

- String quartet performance: “A Practical Introduction to Just Intonation Through String Quartet Playing,” Timothy James Cuffman, 2016. “It is not the attempt of this project to teach music theory or present a comprehensive study of the many issues and challenges related to intonation in string quartet playing. The aim of this essay is to provide students with a solid foundation and practical application of basic principles of playing in tune in a string quartet.”³⁷

- Viola performance: “A Guide to the Pedagogy of Microtonal Intonation in Recent Viola Repertoire: Prologue by Gérard Grisey as Case Study,” Dominic DeStefano, 2010. “This document serves as a guide to the intonation of microtonal viola repertoire, asserting that the first step lies in understanding the pitch collections from the composer’s point of view.”³⁸

- Wind performance: 72note.com: a specialized page for 72 tuning of wind instruments along with general intonation information, dated May 18, 2003, with charts and links to outside resources, though some are broken or out of date.³⁹

The trouble is, searching is a slog. And although much material is free online or obtainable through a public library or academic institution subscription, for some highly relevant content, access is anything but straightforward. Socked away in analog formats is a wealth of evergreen content, notably in a trio of pre-internet print publications that longtime

microtonal practitioners might fondly recall: *Interval, Pitch for the International Microtonalist*, and the original *Xenharmonikon: An Informal Journal of Experimental Music*. Founded in the 1970s and 1980s by path-breaking microtonalists Jonathan Glasier, Johnny Reinhard, and John Chalmers, respectively, these defunct publications have obvious historical worth. Perhaps less obvious is their potential practical value — if only they could be fully unlocked.

In the case of *Pitch*, issue No. 4 from 1990 is packed with microtonal fingering charts for flute, clarinet, horn, bassoon, saxophone, recorder and oboe. A pdf of the entire issue can be purchased by contacting Johnny Reinhard directly. However, neither those charts nor any of the other three *Pitch* issues published by the American Festival of Microtonal Music from 1986 to 1990 are available for download.⁴⁰ To make that happen would require uploading scanned files to a platform set up for browsing, paying, and downloading, and then posting a link to that platform on the as-yet nonexistent performance resource site.⁴¹

Fortunately, new resources are being created all the time that would be simple to amplify from a central clearinghouse. A recent example: As part of its mission to promote microtonal performance, Microtonal Music Studios in Helsinki in April 2025 presented the classical singer and artistic director of the Musica Nova Helsinki festival Tuuli Lindeberg for a lecture and demonstration “on the performance, practice and assimilation of microtonal music from the perspective of a classical singer.”⁴² The reach of such programs could be expanded exponentially if organizers had a central site on which to publicize them and afterward to link their videos and written materials from the event, perhaps with a paywall in place.

It is nice to think of these long-dormant and brand-new resources finally being collected in a common home and made accessible to all comers. But what individual or organization will have the incentive and wherewithal to make that happen? Are composers of microtonal music motivated to increase the pool of performers willing and able to play their music?

Judging from all the abandoned sites one encounters in that graveyard of good intentions known as the internet, creating a home for performance resources might be the easy part. To genuinely juice up interest among musicians would arguably take creating a culture and community almost from scratch within the ranks of classically trained musicians. For, the key to more live performances of contemporary Western microtonal classical

music may be just that — a sense of community. And maintaining a community takes a dynamic place to hang out — one where the lights are always on, the educational events calendar is up to date, the discussion feature is well-used, and the moderators are helpful and knowledgeable. No small commitment.

Short of all that, would a Facebook group suffice, at least for starters? Or what if it were possible to piggyback onto an existing site? Like, say, the Xen Wiki?⁴³

Amassed over decades by members of the international microtonal community, the Xen Wiki is an incomparable public repository of articles, audio, videos, charts and glossaries covering theory, scales, chords, notation, history, instruments, software, and more, plus links to research sites, discussion groups, and blogs. A sprawling labor of love that is obviously a challenge for the administrators to keep up to date and organized, it is nevertheless an indispensable source for everything microtonal.

Well, almost everything. While it provides some performance-related material,⁴⁴ the Xen Wiki's overwhelming focus is, again, on creation and theory rather than musicianship. Still, the fact that a well-used microtonal resource hub already exists suggests that if the means and desire were there, it could become the go-to source for performers as well.

Whatever its form, it is also nice to think that before long a culture of sharing would grow up around such a hub, to the point that as new resources were created, links would be posted there as a matter of course. And in true hive-mind fashion, the relative utility of new and old content alike would be vetted by the community of experts and novices that would begin to jell along with it.

When it comes to fostering a culture, microtonal art music might look to the microtonal guitar scene. If microtonal performance has one standout instrument in terms of enthusiasm and community, it is the guitar. As the Xen Wiki guitar page puts it, "The ease with which guitars can be microtonalized is definitely to blame."⁴⁵

Unsurprisingly given the guitar's supreme position in popular music, microtonal guitar is dominated by rock, jazz, and numerous sub-genres where composer and performer are often one and the same, and self-taught shredders can tap into a buzzy support network that includes some 1,100 members of the performance-focused Microtonal Guitarist

Facebook Group.⁴⁶

The caché around both popular and classical microtonal guitar owes a lot to the artistry and personalities of its luminaries, who include Brendan Byrnes, Jon Catler, Tolgahan Çoğulu, David Fuze Fiuczynski, Neil Haverstick, Dante Rosati, John Schneider, Ron Sword, and others, whose contributions to the performance knowledge base include:

- *The Contemporary Guitar* by John Schneider — guitarist, academic, radio host, new–music champion, and director of the the Los Angeles–based Partch Ensemble — has become the standard text on the instrument and includes a chapter on microtones.⁴⁷
- *Microtonal Guitar* is a 2016 book by Tolgahan Çoğulu, a performer and educator based in Istanbul and active seemingly everywhere, who fosters performance through an international microtonal guitar composition competition, university programs, private lessons, and an initiative to build “a repertoire for microtonal guitar with more than 40 composers.”⁴⁸
- Kite Giedraitis’s 41–edo Kite Guitar comes with something of a ready–made community of players and learners.⁴⁹ Based in Portland, Oregon, Giedraitis and his partners and consultants have made available on the Kite Guitar website technical and non–technical explanations, scores (unfortunately, links to some scores are broken), audio samples, and video tutorials: “We provide related music education, support resources, and instrument production. This is a Free/Libre/Open (FLO) project because music should be accessible to everyone.”⁵⁰

Europe Gets It

Orchestras and ensembles across Germany, Austria, Poland, Scotland, and elsewhere prove that playing large–scale microtonal works is entirely doable. For instance:

- The BBC Scottish Symphony Orchestra stands out for its performances under Ilan Volkov of just intonation pieces by Marc Sabat in 2017 and Catherine Lamb in 2023.⁵¹
- The Finnish Radio Symphony Orchestra conducted by Santtu-Matias Rouvali in 2014 performed Juhani Nuorvala’s *Septimalia*, in which the strings, harp, and brass were retuned in just intonation.⁵²
- The former SWR-Sinfonieorchester Baden-Baden und Freiburg was

a notable proponent of microtonal orchestral performance, having played James Tenney's 17-minute, single-movement Diapason for chamber orchestra⁵³ and Manfred Stahnke's 17-minute, single-movement Trace des Sorciers.⁵⁴

- Way back in 1978, the Polish Chamber Orchestra under Jerzy Maksymiuk premiered Gloria Coates's first symphony, Music on Open Strings, at the Warsaw Autumn Festival. Her works have also been performed by the Bavarian Radio Symphony Orchestra, Munich Chamber Orchestra, Stuttgart Philharmonic Orchestra, Vienna Radio Symphony Orchestra, and BBC Scottish Symphony Orchestra.⁵⁵

Be Careful What You Wish For?

From the microtonal chitchat on Reddit comes this word of caution: "There's a kind of ironic hope that microtonal music gets more widespread appreciation, but I don't think most people operating in that domain *really* would like what that means if it were to happen."⁵⁶ Translation: If microtonality goes normie, the thrill will be gone.

The mostly unspoken notion that microtonal music's attraction is tied up with the fact that it is nonconformist by definition probably exerts a more powerful pull on its practitioners than many might admit. As a commenter in the Xenharmonic Alliance Facebook Group observed, "Microtonality seems to attract people who enjoy challenging preconceived notions, and that will never be everyone."⁵⁷

If true, would entrée into contemporary classical programming kill the vibe? Does something as inherently "outsider" as making music in unconventional tunings thrive best in a maverick subculture? Does the example of the microtonal guitar scene's lively incursion into popular culture allay such concerns?

Looked at from the vantage point of Western culture more generally, it becomes difficult to see the relegation of microtonal music to the far margins of already-marginalized contemporary classical performance as preferable — not for microtonal composers, who with little call for orchestral works are missing out on what historically has been a rich avenue for artistic innovation. Maybe not even for the future of classical music as a vibrant form of human expression.

One thing at least seems clear: If more live classical performance is something the microtonal community wants, now seems like the time to go for it.

Notes

(1) As of May 12, 2025, the Facebook discussion group Microtonal Music and Tuning Theory listed 28,249 members. The Xenharmonic Alliance and Just Intonation Network list about 6,400 and 2,700 members, respectively. Cross-memberships among these and related groups are common. Most members appear to participate rarely if at all, though some no doubt “lurk” without weighing in, and the rolls seem to include some bots. In January 2020, MMTT membership stood at 5,000: https://www.facebook.com/groups/497105067092502/?multi_permalinks=1734888323314164&hoisted_section_header_type=recently_seen. The 10,000 mark was passed in April 2023: https://www.facebook.com/groups/497105067092502/?multi_permalinks=2772394522896867

(2) A search on Bandcamp of “microtonal albums” yielded 3,400+ results. “Just intonation” brought up 720+ hits, and “xenharmonic” 620+. Many are likely cross-tagged. On Apple Music/iTunes Store, a far larger platform with a much broader selection, a search for “microtonal” albums produced 82 results, while searching for both “microtonal” and “classical” brought up 22 albums and 100 songs.

(3) “Ensemble SCALA is a group of seven musicians in the Netherlands which plays microtonal music only. It is founded in 2010 by the Huygens-Fokker Foundation (centre for microtonal music in Amsterdam) to experience microtonality within a spectrum (scala) of tone colors. The fact that the famous Fokker organ has become a part of the ensemble is special. The instrumentation of Ensemble SCALA is flute, clarinet, viola, microtonal guitar, Fokker organ, keyboards/Carrillo piano and percussion,” <https://ensemblescala.com/#:~:text=Because%20the%20possibilities%20to%20produce,microtonal%20music%20has%20grown%20tremendously>

(4) See “A Biography of Erv Wilson,” <https://www.anaphoria.com/wilsonbio.html>. Also see Hobbes’ Wilsonic initiative, <https://www.wilsonic.com>. See also Daniel Corral’s “Beginner’s Guide to Erv Wilson” on the California Festival website, which highlights Erv Wilson’s impact along with the individuals who have been working for decades to bring his thinking to light, <https://www.cafestival.org/excursions/a-beginners-guide-to-erv-wilson-by-daniel-corral/>

(5) Burt, Warren. 2023. “A New Ecosystem for Microtonal Computer Music Exploration and Composition.” *Chroma: Journal of the Australasian Computer Music Association* 39 (2). Melbourne, Australia. <https://journal.computermusic.org.au/chroma/article/view/17>

(6) See the discussion in the Microtonal Music and Tuning Theory Facebook Group dated December 14, 2024, https://www.facebook.com/groups/497105067092502/?multi_permalinks=3280738412062473

- (7) Even before Partch constructed his colorfully named custom instruments capable of playing in his 43-tone scale, Carrillo arranged with a German manufacturer to produce pianos capable of playing pitches up to micro intervals of 1/16: <https://www.huygens-fokker.org/instruments/microtonalinstruments.html>. Later, Bill Colvig carefully hand-crafted American gamelans and other innovative instruments for his life partner, the composer Lou Harrison, <https://pages.hmc.edu/alves/harrisonbio.html>
- (8) The artistic motivation behind La Monte Young and Marian Zazeela's various "rarified sound-and-light environment" Dream House installations is described in a 2015 New York Times article, <https://www.nytimes.com/2015/06/12/arts/design/a-house-finds-a-new-home.html>
- (9) The Kepler Quartet's monumental project to record all of Ben Johnston's just intonation string quartets — including the famously difficult 7th — is described in articles in New Music Box, <https://newmusicusa.org/nmbx/ben-johnston-celebrating-90-years-with-10-string-quartets/>, and Strings Magazine, <https://stringsmagazine.com/the-kepler-quartet-on-the-road-ahead-after-final-ben-johnston-recording/>. The results of the Kepler Quartet's effort were issued on four acclaimed CDs by New World Records.
- (10) See: James Tenney, <http://www.jamestenney.net/bio/> and Wendy Carlos, <https://www.wendycarlos.com>
- (11) See Campbell's review of the 2003 LA Microfest in the Wall Street Journal, <https://www.wsj.com/articles/SB10533966938629000?st=Uhi8yH>
- (12) John Adams, *The Dharma at Big Sur* for electric violin and orchestra, 2003, <https://www.earbox.com/dharma-at-big-sur/>
- (13) See: "The Apperceptive Musical Adventures of Taylor Brook," Kurt Gottschalk, *Musicworks*, Issue 140, <https://www.musicworks.ca/profile/apperceptive-musical-adventures-taylor-brook>
- (14) <https://microtonalprojects.com/the-microtonal-trumpet/> and <https://microtonalprojects.com/uncategorized/the-microtonal-flugelhorn/>
- (15) <https://benneill.com/mutantrumpet/>
- (16) <https://www.michaelharrison.com/bio-1>
- (17) Of course, people unwittingly hear microtones all the time, such as in the blues and in the tendency of a string quartet to play natural harmonies.
- (18) New York Philharmonic, <https://archives.nyphil.org/performancehistory/#program>

(19) Pittsburgh Symphony Orchestra, https://www.pittsburghsymphony.org/pso_home/press-room/press-releases/2023-2024/pittsburgh-symphony-orchestra-announces-2024-25-season

(20) "Is Anyone Writing Decent Symphonies Today, Part II," Jeremy Reynolds, Pittsburgh Post–Gazette, <https://www.post-gazette.com/ae/music/2024/02/16/pittsburgh-symphony-review-dvorak-7-katherine-balch-musica-pyralis-tickets/stories/202402160109>

(21) See the review in Textura: https://www.textura.org/archives/v/vali_esfahan.htm

(22) <https://www.wisemusicclassical.com/news/4607/Gloria-Coates-19332023/>

(23) <https://www.facebook.com/mandyjvollrath/posts/pfbid06HtwVYVn89jD-7mNJh3PbjgTuGcwEMTbzXDYTk4rwUBGH3VUFemZnPveudLvJUWepI>

(24) https://pittsburghsymphony.org/pso_home/biographies/musicians/berntsen-neal

(25) John Schneider, LA Microfest, <https://microfest.org/support-us/>

(26) During the more than four decades starting in the early 1980s when the American Festival of Microtonal Music was staging concerts in New York, it presented hundreds of works, mainly for solo artist and small ensemble, under the artistic direction of founder Johnny Reinhard, <https://johnnyreinhard.bandcamp.com/album/f-4-existential-paul-gallagher-robert-bonotto-palestrina-tigran-man-surjan-toby-twining-skip-laplante-jukka-tiensuu-john-cage-sonatas-and-interludes-for-prepared-piano-american-festival-of-microto>

(27) <https://www.paulgallahermusic.com/listen/newsky>

(28) https://vidiotsfoundation.org/special_events/interstellar-sound-bath/

(29) https://www.facebook.com/groups/497105067092502/?multi_perma_inks=3351012735035040

(30) https://digital.library.unt.edu/ark:/67531/metadc500024/m2/1/high_res_d/dissertation.pdf

(31) https://openlibrary.org/books/OL20419973M/The_other_flute

(32) Helen Bledsoe's blog entry: <https://helenbledsoe.com/flute-microtonality-for-composers/>. See also the related slide presentation: https://docs.google.com/presentation/d/10tYnjiozJjsT7xUPTfe_qp3_FKcibpcaQ-PfywEdWM/edit#slide=id.g9867f510d5_0_0

(33) <https://libres.uncg.edu/ir/ecsuf/Nurhak-ClarinetResearchPaper%20.pdf>

- (34) https://chordsmelodies.plainsound.org/_pdfs/ChordsMelodies_TuningBach.pdf. Accompanying video: <https://www.youtube.com/live/GX2hAzByZLE?t=780s>
- See also: <https://ziva-hudba.info/chords-melodies-a-look-at-harmony-by-numbers-part-i-using-harmonic-radius-to-compare-rational-pitch-collections/>
- (35) www.rbcmusic.com/RBCpubtexts.htm
- (36) HEJI is the work of Marc Sabat, Thomas Nicholson, and Wolfgang von Schweinitz and is designed to accommodate so-called extended JI with micro intervals up to the 47th prime limit, https://en.xen.wiki/w/Helmholtz-Ellis_notation
- (37) DOI: 10.17077/etd.bvwmxy9h <https://iro.uiowa.edu/esploro/outputs/doctoral/A-practical-introduction-to-just-intonation/9983777110202771>
- (38) https://etd.ohiolink.edu/acprod/odb_etd/ws/send_file/send?accession=ucin1277154671&disposition=inline
- (39) <https://www.72note.com/composition/instruments/instrument.html>
- (40) The tables of contents and prices for the four Pitch issues can still be found online at <https://pitch.xentonic.org>, although the ordering information on that site is out of date, and the payment portal is on a completely separate site: <https://www.afmm.org>
- (41) The composers collective and publisher Frog Peak Music took a generous step in the direction of digital access to historic materials in December 2024 when it made its archived holdings of the original Xenharmonikon available as free downloads: <https://we.tl/t-tIIND91MRN> Although Frog Peak provides no information on the contents of the issues it holds, a completely separate website — <https://xh.xentonic.org/tables-of-contents.html> — carries the tables of contents and author and subject indexes, which unfortunately appear to show nothing of specific relevance to performers.
- (42) <https://microtonalmusicstudios.com> <https://musicanova.fi/en/info-3/>
- (43) The Xen Wiki: https://en.xen.wiki/w/Main_Page. Two other troves of microtonal resources are San Diego-based composer Joseph Monzo's Tonalsoft site, <http://tonalsoft.com>, and the website of the Huygens-Fokker Foundation in Amsterdam, <https://www.huygens-fokker.org>. Created years ago, both sites have evidently also been a challenge to maintain, with dead-end links and other upkeep issues.
- (44) See: <https://en.xen.wiki/index.php?search=fingering&title=Special%3A-Search&profile=default&fulltext=1>
- (45) <https://en.xen.wiki/w/Guitar>
- (46) The Microtonal Guitarist Facebook Group, https://www.facebook.com/groups/110164742335730/?sorting_setting=CHRONOLOGICAL

(47) The Contemporary Guitar, <https://rowman.com/ISBN/9781442237896/The-Contemporary-Guitar-Revised-and-Enlarged-Edition>. More on John Schneider may be found on his personal website, <https://www.johnschneider.la>

(48) The book: <https://www.microtonalguitar.org/copy-of-8th-2024>. The artist: <https://tolgahancogulu.com/tolgahan-cogulu/>

(49) Kite Giedraitis, his team, and their musical mission are profiled at <https://www.kiteguitar.com>

(50) About FLO: <https://wiki.snowdrift.coop/about/free-libre-open>.

(51) Marc Sabat, Luminiferous Aether, <https://www.youtube.com/watch?v=0fKE-C7nimsc>. Catherine Lamb, Portions Transparent/Opaque, <https://www.colinscolumn.com/bbc-proms-2023-prom-13-bbc-scottish-symphony-orchestra-ilan-volkov-conducts-tchaikovskys-pathetique-symphony-and-catherine-lambs-portions-transparent-opaque-l/>

(52) Nuorvala explained: "The orchestra was tuned partly in just intonation and partly in 12tet, and just or close-to just intervals between the available pitches were found within a certain tolerance," https://www.facebook.com/groups/497105067092502?multi_permalinks=2969663283169989

Video clip: <https://www.youtube.com/watch?v=JMDCw2x9aol>

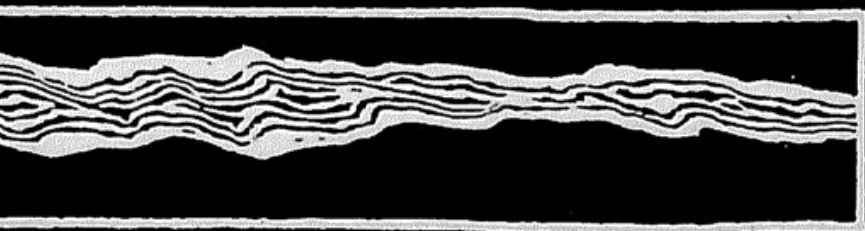
(53) SWR-Sinfonieorchester Baden-Baden und Freiburg conducted by Kwamé Ryan, <https://www.youtube.com/watch?v=4M9BR5H1Wyg>

(54) https://www.youtube.com/watch?v=GYBqqtyt2_w

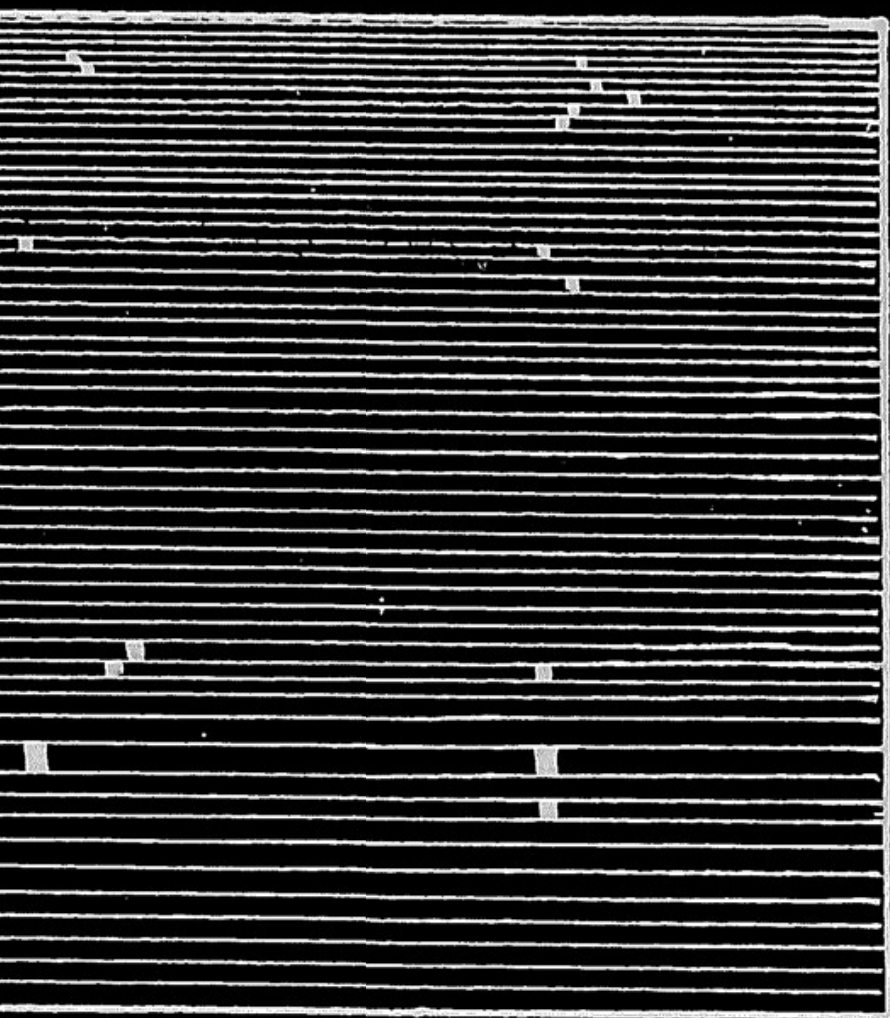
(55) <https://www.wisemusicclassical.com/news/4607/Gloria-Coates-19332023/>

(56) https://www.reddit.com/r/LetsTalkMusic/comments/kprd7r/lets_talk_microtonal_music_in_the_modern_age/

(57) https://www.facebook.com/groups/xenharmonic2/posts/3522172534469690?comment_id=3524020180951592



	6'27		7'25	
	6'27		7'25	



SERIYA LIMB

Haiyun

Yu

12 Moon Temperament: Decolonising the Chinese Tuning System

太玄準易圖

漢上易傳卦圖中 六



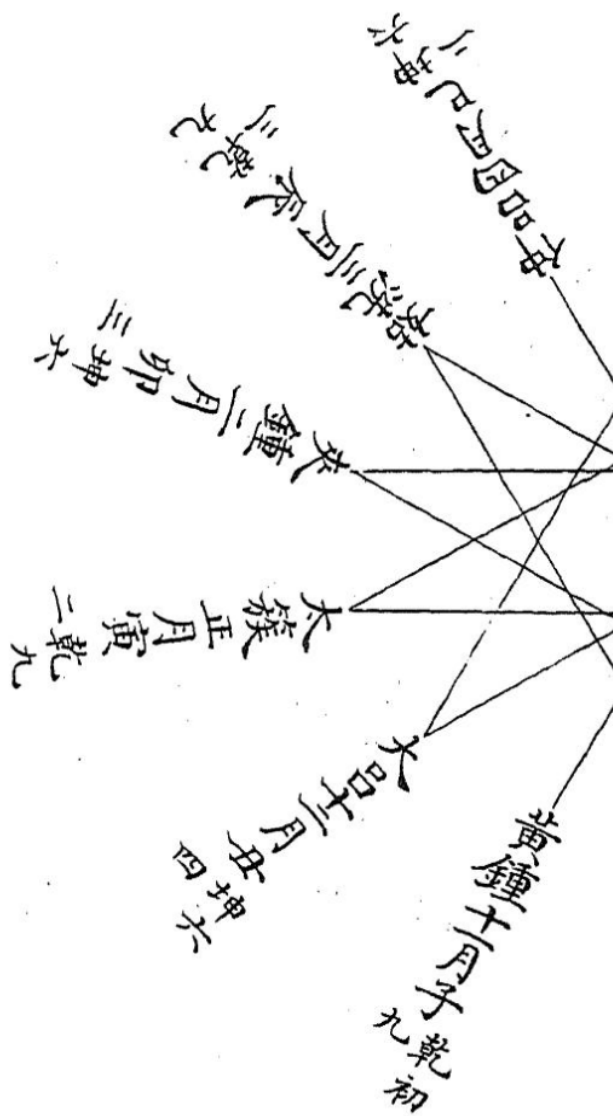
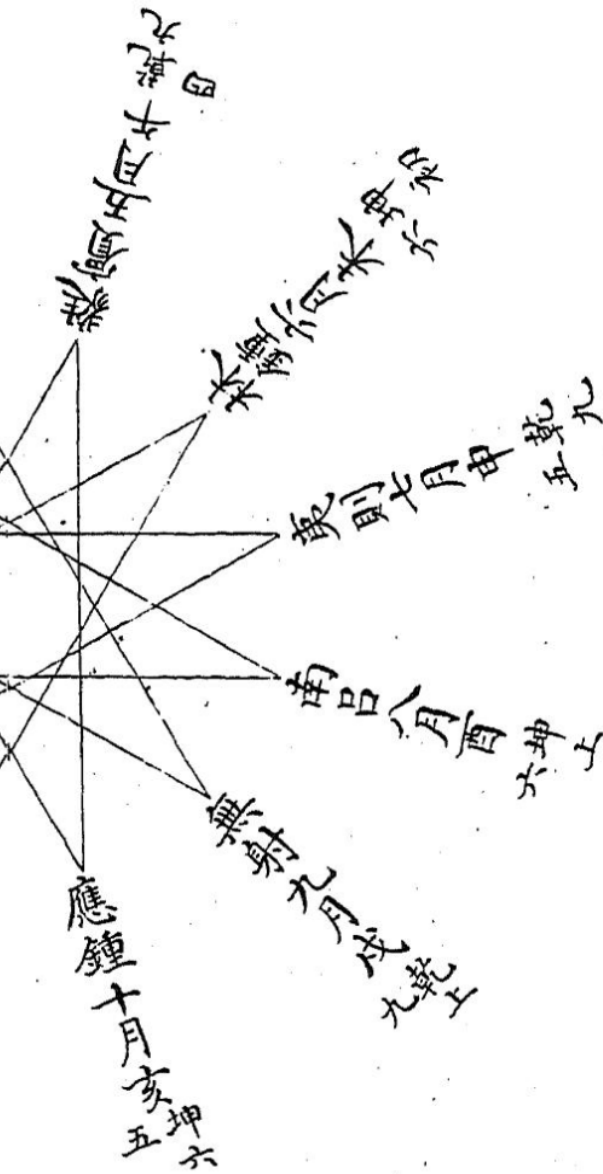


Image 2: 十二律相生圖 "Relation of the 12 Moons"?

十二律相生圖

十二律十二月消息卦

漢上易傳卦圖中 十七



Introduction

Utilising microtonal music as method, I have been doing interdimensional-musical investigations into a poetry-composition manuscript Song Book of the White Stone Taoist, written by Chinese poet and composer Jiang Kui [1155-1221]. Jiang Kui lived in the 12th century China during the South Song Dynasty. He was famous of his time not only for his achievements in poetry, but in music as well. He wrote an article titled "On Grand Music" - about the music used in the imperial ritual ceremonies, to re-employ the lost tuning system from more than 1000 years before his time. He composed with this specific tuning system in the collection of ritual poems "Nine Songs of Yue", where the names of notes were written in-line with the poems.

In ancient China, music is power – the power from the Supreme Heaven, showing oracles on the burning turtle shells and bones. The emperor was the only one to interpret the oracles, performing the supreme cosmological power through rituals. Ancient Chinese people believed in the universal principles, that is to say – the principle of music (tuning) shares the principle of the living world. As in the diagram below, the 12 musical notes are on the outer circle, where the inner circle shows the 24 solar terms (a calculation of time and agricultural practices developed through observation of the sun's annual motion). They also believed each note should correspond to the 12 moons of the 12 months of one year (in Chinese, the character 月 means both "moon" and "month"). Thus, tuning is part of the cosmology. I name this tuning system "12 Moon Temperament".

Though this tuning system was first invented with pipes, it was incorporated into all types of traditional Chinese instruments including Guqin, a pluck-string instrument. Jiang Kui was known as a good Guqin player of his time; thus, I made a guess that his composition with the 12 Moon Temperament could be played on pluck-strings. The tuning and notation of traditional Chinese instruments nowadays have gone towards two directions – one is a numeric notation system based on the 12 TET (e.g. Guzheng, Pipa, Dizi, Xiao); the other is a traditional tablature score based on Chinese characters (e.g. Guqin). In my opinion, the first one is a Westernised tuning method that gives up the unique Chinese cultural heritage. The latter keeps the traditional tuning but is tied to the instrument-making and the Chinese culture – one has to be familiar with the

instrument and the Chinese characters at the same time to play the music. They seem to be two opposite ways, but they both lead to a self-colonised musical practice – either Eurocentric or Sinocentric. Microtonal music is my approach to decolonise the practice of Chinese music.

Western Instruments

My goal is to play Jiang Kui's songs on a non-Chinese pluck-string instrument and create a notation so that people who do not know Chinese can also play. I have adapted a 12-string guitar and tuned it according to the 12 Moon Temperament. The below ancient diagram "Relation of the 12 Moons" shows the sequence of generating the 12 notes in a scale with the method 三分损益 ("sanfen sunyi", meaning "to divide into three and add or subtract one").

Generating Scales

The calculation Sanfen Sunyi is similar to the Pythagorean tuning in a way of using the ratio 3:2 (perfect fifth). Sanfen Sunyi uses 2:3 and 4:3 alternatively in generating the 12-tone scale based on the length of the pipe. While a Pythagorean 12-tone scale is generated by moving six times 3:2 ratios up and five times down calculated by the length of the string, a 12 Moon Temperament scale is generated by moving up and down alternatively with the length ratio 2:3 and 4:3 of the pipe. In order to make the comparison easier, I have reversed the original pipe-based Sanfen Sunyi ratio to make it work based on the length of the string. Thus, the ratio works as 3:2 and 3:4 alternatively instead for the 12 Moon-Temperament. See next page for an example of generating a scale starting from E with the two methods and the tabulature result using western notation.³ The first 6 notes generated are the same as shown in the block. While the Pythagorean Temperament continues the calculation with a reversed ratio 2:3, the 12 Moon Temperament continues with the same alternative ratios. In both temperaments, the biggest cent deviations from 12 TET are 22¢.

Scale Generation:

Pythagorean Temperament	F ← C ← G ← D ← A ← E → B →
Frequency Ratio	2 ⁸ :3 ⁵ 27:3 ⁴ 2 ⁵ :3 ³ 2 ⁴ :3 ² 2 ² :3 1 3:2
12-TET-dif (in cents)	-10 -8 -6 -4 -2 0 +2
12 Moon Temperament	E → B →
Frequency Ratio	1 3:2
12-TET-dif (in cents)	0 +2

Chromatic Scale:

Pythagorean Temperament	E — F — F# — G — G#
Frequency Ratio	1 2 ⁸ :3 ⁵ 3 ² :2 ³ 2 ⁵ :3 ³ 3 ⁴ :2 ⁶
12-TET-dif (in cents)	0 -10 +4 -6 +8
12 Moon Temperament	E — E# — F# — F#^ — G#
Frequency Ratio	1 3 ⁷ :2 ¹¹ 3 ² :2 ³ 3 ⁹ :2 ¹⁴ 3 ⁴ :2 ⁶
12-TET-dif (in cents)	0 +14 +4 +18 +8

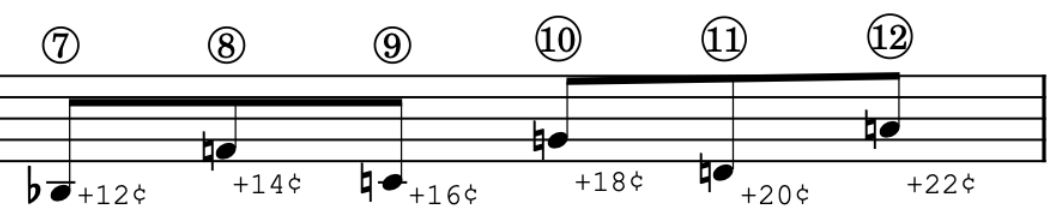
Musical notation for a chromatic scale in treble clef, showing six notes with their cent deviations from the 12-TET standard:

- ① E: ±0¢
- ② F: +2¢
- ③ F#: +4¢
- ④ G: +6¢
- ⑤ G#: +8¢
- ⑥ A: +10¢

F#	→	C#	→	G#	→	D#	→	A#
3 ² :2 ³		3 ³ :2 ⁴		3 ⁴ :2 ⁶		3 ⁵ :2 ⁷		3 ⁶ :2 ⁹
+4		+6		+8		+10		+12

F#	→	C#	→	G#	→	D#	→	A#	→	E#	→	B#	→	F#^	→	C#^	→	G#^
3 ² :2 ³		3 ³ :2 ⁴		3 ⁴ :2 ⁶		3 ⁵ :2 ⁷		3 ⁶ :2 ⁹		3 ⁷ :2 ¹¹		3 ⁸ :2 ¹²		3 ⁹ :2 ¹⁴		3 ¹⁰ :2 ¹⁵		3 ¹¹ :2 ¹⁷
+4		+6		+8		+10		+12		+14		+16		+18		+20		+22

A	A#	B	C	C#	D	D#
2 ² :3	3 ⁶ :2 ⁹	3:2	2 ⁷ :3 ⁴	3 ³ :2 ⁴	2 ⁴ :3 ²	3 ⁵ :2 ⁷
-2	+12	+2	-8	+6	-4	+10
G#^	A#	B	B#	C#	C#^	D#
3 ¹¹ :2 ¹⁷	3 ⁶ :2 ⁹	3:2	3 ⁸ :2 ¹²	3 ³ :2 ⁴	3 ¹⁰ :2 ¹⁵	3 ⁵ :2 ⁷
+22	+12	+2	+16	+6	+20	+10



Using Scales on 12-string Guitar

As shown in the notation example on the previous page, for a 12-string acoustic guitar, I have tuned each string pair in perfect fifths (3:2), with the first string starting from E. Following the generative scale as shown above, it has a small growing increment of $+2\zeta$ per string. The notation example shows how the open strings of the guitar can be tuned to the generated scale, including their cent deviations from 12 TET.

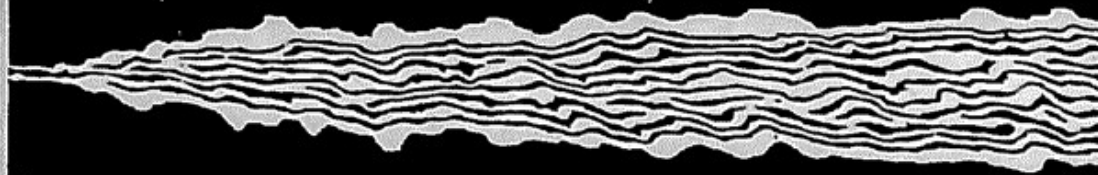
Conclusion

Thus, I am able to transcribe the ancient Chinese musical score written in Chinese characters into a tablature score for 12 tuned strings. This has proved the possibility to adapt 12 Moon Temperament to a plucked-string instrument that is not from the Chinese culture. It also provides the possibility for non-Chinese musicians to read and play the ancient Chinese music without the restraints of language and musical trainings.

By utilising the mathematical feature, I see microtonality as a decolonised expression that shows the plurality of conceptions that does not project Western ontology onto non-Western thinking – from music culture to culture itself.

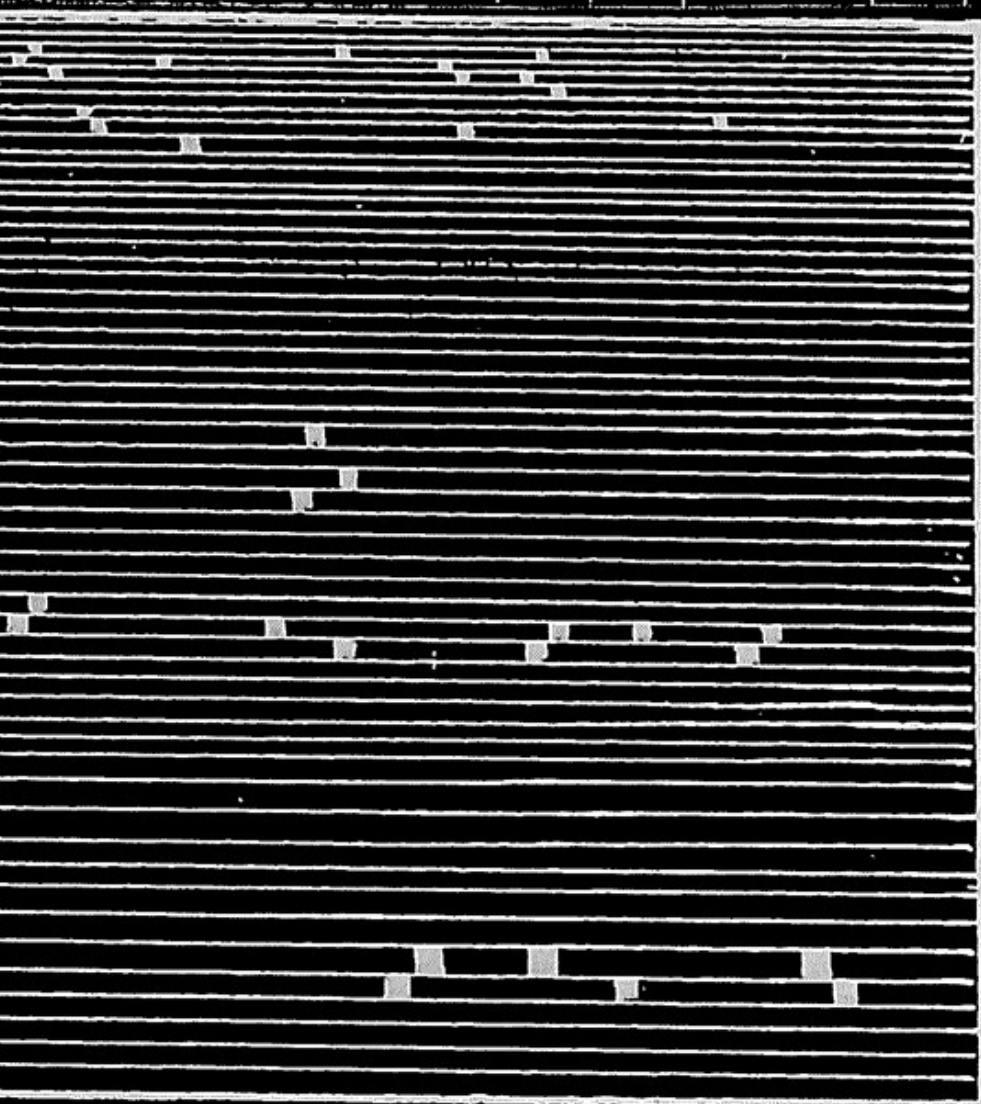
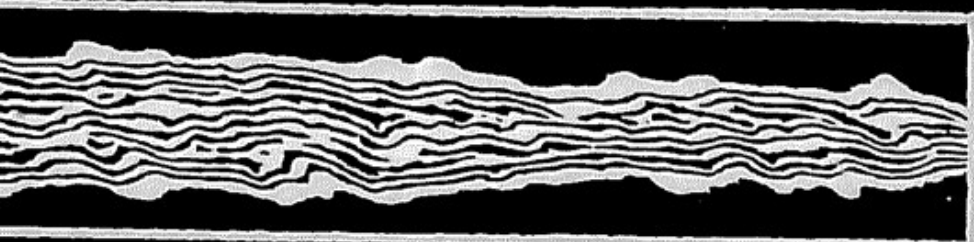
Notes

- (1) Source of Image: Internet Archive 《漢上易傳掛圖·卷上~卷中》
- (2) Source of Image: Internet Archive 《漢上易傳掛圖·卷上~卷中》
- (3) Notation example made by Mark Reid Bulatović.



0'06	0'47	1'23	1'54	2'
0'06	1'09	1'45	2'13	





BENT REED

Thokozani

Mhlambi

Tuning Systems: Ancient Greek Musical Ethos & African Possibilities

Introduction

This chapter is an inquiry born from my practice as a musician—an experimental cello player. As both a cellist and composer, my work is characterized by the constant navigation between two seemingly disparate worlds: the ‘tempered’ symmetry of the Western orchestral tradition and the reverberations of ancient African musical systems. I am trying to find my own footing, in relation to my inherited traditions, as a western trained African musician—who straddles between the two constellations of southern African folk traditions and western art music.

In my practice, the cello is not merely an instrument; it is a laboratory for reconciling these complexities. Reference is made to the southern African choral legacy, which was forged in the 19th century out of the missionary education system. I view the southern African choral tradition as a vestige of the African precolonial festival forms as well as a synthesis of Western and new approaches to sound and notation.

My purpose is to unravel the Western approach by a close reading of its progenitor, the ancient Greek tradition, which emerged before there was any consciousness nor talk of a ‘Western tradition.’ It is in order to open up a different kind of possibility for creators of music in Africa and elsewhere, who may not wish to be burdened by the tradition in their approaches to music-making. I have chosen to take a closer look at the role of music in ancient Greece because, firstly, it is the tradition which western intellectual thought claims as its inheritance—not only in areas of the arts, but in science, philosophy and democratic organization. But as the evidence to be presented here shows western art musical cultures deviate considerably from the repertory practices of ancient Greece. Secondly, ancient Greece offers a compelling case study due to the abundance of existing archival material. However, given the era’s historical remoteness, Western scholarship often lacks the tone of certainty pervasive in studies of the eighteenth or nineteenth centuries. I am saying there is a sense of trepidation evident in how Western literature derives its conclusions on ancient Greek culture; which is a helpful entry point for us who are seeking to uncover material on our own historical legacies without the instrumental convenience of literary archives, treatise, etc. My last reason is that I am finding some semblance with the cultural-political praxis of ancient Greece and some of the precolonial African material I have uncovered in my study of *ubunyanga*. I propose a turn to an older

tradition of African specialization, that *ubunyanga*, as a way of opening up new African possibilities.

Derived from the Zulu root *nyanga*—connoting healing, lunar cycles, or clever person—the concept of *ubunyanga* historically represented a sophisticated synthesis of expertise. In precolonial KwaZulu-Natal, the term did not merely signify medical practice; rather, it functioned as an umbrella for a variety of “specialist skills,” including iron metallurgy, weather management, and musical composition.

The *ubunyanga* tradition reveals a method or approach to technology and human development rooted in context. The strong thinking about music and its ethos in relation to state-building and political practice in ancient Greece, seems to show some interesting overlaps with the African context. In the Greek context ethos was posed as a musical/cultural vision, with *ubunyanga* it was revealed in the ethical care and management of *nyama* life-force. *Nyama* was understood as the primal energy residing in all things in nature, which was released or transferred in the human effort of transforming natural objects into iron, medicines and performative acts. The energy released was capable of creative and destructive outcomes. Those who were handlers of *nyama* were those skilled in the transferring of this energy for creative purpose. It was their responsibility to ensure that no harm occurs when these energies are transferred.

Tuning Systems

Tuning systems are ways of organizing sounds into a series of pitches. The organization of the pitches can either be ‘tempered’ or ‘just.’ Just systems are considered the most natural way of ordering pitches, as they use the ‘pure intervals,’ which correspond in terms of vibrational frequencies, as they are found in nature. Tempered tuning, on the other hand, is where the “the purity of some or all intervals is deliberately compromised in order to render other intervals less impure, and thus increase the number of musically serviceable intervals.”¹ The most common form of tuning today is the 12-tone equal temperament, which is how the standard piano is tuned. It means that each interval of the piano is effectively, squeezed, so as to retain a certain kind of symmetry between all the keys. It makes it possible to play in different keys, while retaining a kind of stability in how it sounds. String instruments however such as the violin and cello have

kept the just intonation, due to the construction of the instruments, and the way the different strings have a symmetry to one another. On the cello for instance, the strings are C-G-D-A, all of which are a pure fifth apart. The way the player tunes the instrument, is by using the audible stability of the pure fifth in terms of vibrational frequencies, to achieve symmetry to one another.

The cellist's reliance on the audible stability of the perfect fifth (C-G-D-A) is more than a technical necessity; it is a modern enactment of the Ancient Greek idea of 'fitting together'. By tuning to these 'pure' intervals rather than the 'squeezed' intervals of equal temperament, the cello player prioritizes a resonance that is found in nature. For theorists like the Pythagoreans, the 3:2 ratio of the fifth was not merely a 'consonant' sound, but a manifestation of cosmic order—a literal 'fitting together' of disparate frequencies into a unified whole. The idea of fitting together is not exclusive to the Greeks, but finds echoes in African musical logic. A return to 'just' systems where the *ethos* of a performance is derived from the physical, vibrational truth of the intervals themselves, rather than the compromised symmetry of Western standardized tuning suggests an African possibility for musical practice.

Audible stability is not merely a mathematical abstraction; as Aristoxenus argued, it is a lived experience of the human ear. While the Pythagoreans sought the truth of a fifth in its numerical ratio, Aristoxenus shifted the focus to the observable phenomena of musical practice, asserting that the listener's perception is the ultimate judge of whether an interval 'fits' or not.² In the context of African possibilities, there are a variety of tuning approaches which do not align with Western mathematical temperament but possess a profound internal logic recognized by the trained ear. The cellist, playing in the African ensemble, has to adjust his fingers by a fraction to find the perfect spot for a particular resonance. To choose just intonation—whether through the cello's fifths or the unaccompanied vocal renditions—is not just a matter of musical preference, but a way of fitting together; in a context and culture.³

Below are examples of the sine waves of a whole 5th, using just tuning (Figure 1) and equal temperament (Figure 2):

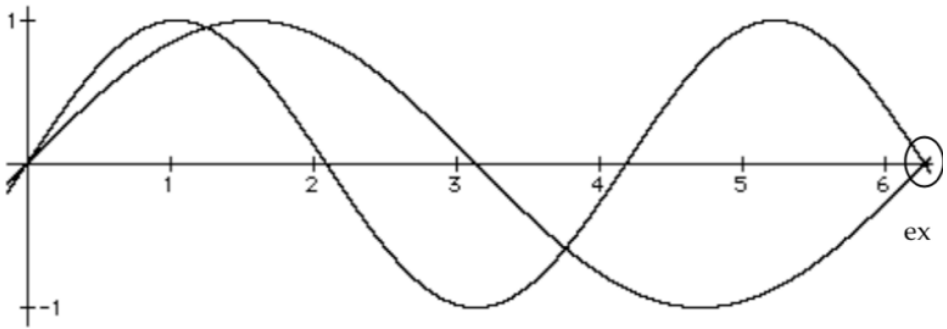


Figure 1 Sine Wave Frequency Oscillation for whole 5th using just intonation

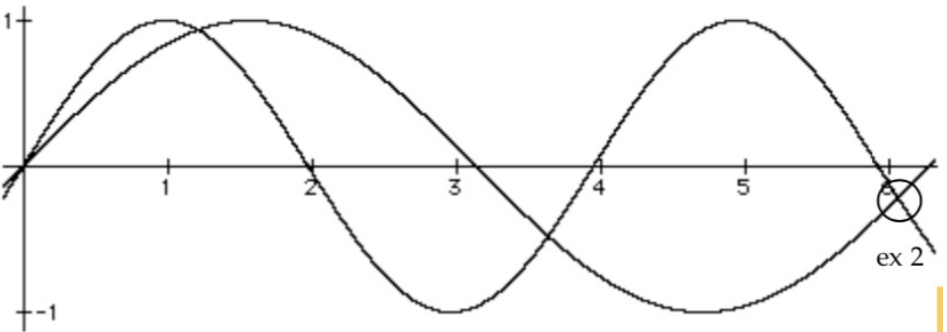


Figure 2 Sine Wave Frequency Oscillation for whole 5th using equal temperament

As can be seen in the example above, the point of intersection of the two frequencies in Figure 1 occurs on the X-axis, suggesting a kind of acoustic stability. The point of intersection in the case of Figure 2 occurs slightly below the X-axis, which suggests slight vibrational clash between the two frequencies. The musicological difference between these two systems—the just and the tempered—is made visible in the vibrational behavior of their respective sine waves. In Figure 1, we observe the waveform of a ‘pure’ perfect fifth (3:2 ratio). Here, the peaks and troughs of the two frequencies align in a periodic, repeating pattern that creates a sense of audible stability—a physical manifestation of ‘fitting together’, joining of sounds that produces a clear, resonant ‘third’ sound known as a combination tone. In this state of just intonation, the ear perceives a stillness and a depth of tone that defines many indigenous African vocal and string traditions.

In contrast, Figure 2 illustrates the wave behaviour of a tempered fifth as

found on a modern piano. Because the interval has been mathematically 'squeezed' to fit the 12-tone equal temperament grid, the frequencies no longer align perfectly. This misalignment creates a 'beating' effect—a rapid fluctuation in volume as the waves crisscross with one another. While Western ear training has conditioned us to accept this 'beating' as a standard part of musical color, from a just perspective, it represents a departure from the 'observable phenomena' of natural resonance. Many types of folk and traditional forms of music, derive their character and locus of imagination from the 'purity' of just tuning, and the other kinds of musical symmetries which are possible through this tuning. The African archive, by retaining systems of just intonation, preserves the clarity of the sine waves shown in Figure 1, prioritizing vibrational sincerity over the industrial symmetry of the tempered scale. Furthermore, many southern African vocal and instrumental traditions utilize what might be termed 'flexible diatonism,' where the intervals are not fixed by a mathematical grid but are tuned to maximize the audible stability of the harmonic series. This is a system of just intonation that relies on the performer's ability to 'shade' a pitch to find its most resonant relationship to the tonal centre.

Ancient Greek Music & the Decolonial Turn

In terms of the western art tradition, the almost universal acceptance of the 12-tone equal temperament system came about in the middle of the 19th century.⁴ This was as a result of the expansion of industries in instrument-making as a commercial enterprise, the increasing mobility of performing musicians in Europe as well as mass migrations to territories in the Americas, Africa and Asia etc. which required approaches to be replicable and standardized. Before this time many temperaments were in use, such as meantone, Pythagorean, etc. these systems involved minor compromises of intervals, which meant they worked well for certain keys, but were not easy for other keys, especially for keyboard instruments (and their fixed pitch).⁵

The truth is that around the Gregorian era, the melodic development in Western music started to focus on a particular tonal-centre, so that it became gradually more important what key one was in in a particular musical work (eg: C-major, A-minor, and so forth). This was not the case

so much in ancient Greek music, where the music was based on melodic structures known as modes, which were defined by the character of their intervals rather than a fixed harmonic pull toward a tonic chord. It is not surprising therefore that when Western composers began to rebel against the equal temperament in the middle of the 20th century, they turned to the ancient Greeks for alternative approaches to tuning.⁶ Reasons for growing interest in tuning systems were manifold: 1) the liberation movements in Africa and other parts of the world recentered ways of seeing the world that were from the global south, and this validation was spearheaded by intellectuals from the global south themselves as they began to occupy space in the lands of their former colonial masters. Liberation was not just political, it was an epistemological liberation of the ear. 2) There was growing interest in historical performance practice (ie: the Early Music movement), which was happening in Europe, and saw many musicians digging up old instruments in the museums and archives, in order to play the music of Bach, and earlier European composers. 3) The electronic innovations that were happening at radio broadcasting institutions and university physics & music departments across the world also stimulated interest in alternative tuning systems. As the discipline of acoustical engineering grew, it became possible to measure music cents (the scientific measurement of frequency) with preciseness through electronic computation.⁷

If we are honest, the impulse to explore different tuning possibilities arose simply because no single practical system can adequately serve every musical need. That the West even attempted to try universalize one way of tuning and of understanding tuning, became part of the civilizing mission itself, in the colonial experience. We must remember that as missionaries incorporated African subjects civic and religious world, Africans were barred from singing their own sacred songs, and taking part in their own procession anthems. They had to learn the religious hymns, art-songs and ballads which were available as sheet music. The whole incorporation was abrupt and dismissive. But as people grew confident in the technologies of score-notation and solmisation, they also began to define their own space of indiscipline.

By adopting solmisation (Tonic Sol-fa), African composers decoupled pitch from the fixed, "squeezed" frequencies of the colonial piano. Because solmisation is a relative pitch system—where 'Do' (the tonic) is a movable foundation rather than a fixed frequency—it allowed composers to preserve the audible stability and natural resonances of the African

precolonial archive while technically working within the framework of Western notation. They composed hymns in the 4-part western style but started to add poetic texts in their own languages, of Shona, of Chewe, Luo and Tswana, to mention a few. Over time compositions became more complex in terms of notation, demanding more from the choral singers and conductors in terms of holding the ensemble together, while singing polyphonic vocal lines.⁸ The incredibly rich Sotho songs of Joshua Mohapeloa testify to this. The text in the compositions is dense, and on the sheet music, he sometimes even writes over the musical notation—just to give a sense of how stylized the music scoring formats had become. In some cases, Mohapeloa incorporates a variety of genres, of Sotho folk tales, rhymes and sacred songs in his compositions.⁹ There is also evidence of deviation from equal temperament in the way the compositions adopt African language inflections. With solmisation notation, Mohapeloa was easily able to deviate from equal tempered forms, due to the natural inclination of most musicians' ears in general to shift towards just tuning, when singing without a piano. From my own observations, based on my involvement in the choral competitions where many of these pieces of music were sung by African choirs, the western trained adjudicators would often blame the choirs saying that they were singing out-of-tune. I believe this is a direct outcome of an inadequate theorization of tuning systems, in mainstream music education. And so I agree with the contributors to the entry on "Tuning Systems" in *Grove Music Online* when they say that: "The potential of the human voice in expanded intonation has scarcely begun to be explored in the West."¹⁰ If you listen to voice carefully, it seldom commits to temperament, ceding its power to inflections in the words and in the register (tessitura) of the voice instead.

Part of the resistance to letting go of equal temperament is about the technological implications: the fact that new instruments have to be built for specific tuning systems. Besides this, the perception of something sounding in or out of tune is dependent on a variety of factors other than the frequency vibrations, such as the loudness of the note, as well as timbre of the instrument or voice. On the piano, the overtones of the each key have a great impact on the tone quality. As a result in the lower notes of the instrument and in the higher register, tuners have to widen the intervals a lot (up to 60 cents) in order to achieve the impression of cohesive balance between the different registers of the instrument itself. As studies in auditory response show, our ears are for more sensitive to

pitch discrimination than what current equal temperament demands, so microtonal variations in music are very discernable to all of us. It is strange that the Western culture which seems to dominate discourse on music elides this fact. Yet in the many cultures of the world, including African performance traditions, there is great use of microtonal systems in the compositions and renditions.¹¹

From the 750BC to 350BC music was everywhere in ancient Greece, with many of its poems and texts, sung as music. The great epics of Homer, songs of Sappho and many others, were sung, to the accompaniment of instruments and sometimes even dance. Music served a variety of functions, and in the religious feasts, it was often used as way of bringing people into a particular order/arrangement, such as a procession, in the fulfilment of the ritual. The term *mousikē*, literally meaning, the art of the Muses, was more encompassing than the English sense of 'music', in its basic form it represented the wide complex of poetry, gesture (dance), the dramatic arts and music. It spoke of an integrated culture of performance, ritual and worship culture. Indeed, as has been suggested by Murray & Wilson (2004), in English-based scholarship *mousike* has often been too narrowly conceived. In terms of rhythm, when the Greeks had words sets to music, the motion of the music was normally based on the movement of the words, with brief characteristic phrases, combined through various episodes of transition. Poetic metre was important, duration was determined by the syllables of words, resulting in patterns of short and long elements. There is evidence of word-painting, the meaning of the words were conveyed by the shape of the melodic line. The key was for the poetic form to flow through the art, to be audibly heard by its audience, without instruments over-drowning it.¹²

In ancient Greece, there was also instrumental music, without any singing. The aulos reed-flute was the oldest and most common instrument, in many potteries there is evidence of a single musician, playing two auloi at the same time, which produced an interesting polyphonic sound. The instrument was also often used in sacrificial ceremonies.¹³ Cithara harps came later, which were played in contests and other contexts. In the 5th century there is also evidence of increasing instrumental music, without singing/poetry, with the cithara becoming more elaborate.¹⁴

Today there is an abundant archive of written texts, pictorial pottery, etc. giving specific details about the performance culture—the way instruments, notes, modes/scales and effects were used. In addition, there are

fragments of scores and forms of notation of actual music. It is this extensive archive we are able to draw from in making certain deductions about their culture and civilization. There are also theories about music in the writings of authors like Plato, Aristotle, Aristoxenus, Ptolemy, to mention few, which give insight on the place of music in the social activities of state-building and politics.¹⁵

The Western art music tradition, as it has eventuated, differs from the orientation of music in ancient Greece. For example, Western music insists on operating with semitones (half-tones) and whole tones, while ancient Greek music reveals a great fluency in micro-tonal intervals, something that is unusual to Western melodic sensibility—but is not so alien in the many cultures of the world, which it has craftily learnt to define as its ‘other.’ As University of Oxford-based scholar, D’Angour (2018), admits many of these “smaller interval sounds to *our* ears as if a note is being played or sung out of tune” [my emphasis].¹⁶

Ancient Greeks appreciated micro-tonal intervals, and subtleties in musical inflection (intonation) were important.¹⁷ Something which is not there in later Western Art Music, especially from the age of equal temperament, which saw a gradual erasure in subtle intonational shifts, for the sake of uniformity in orchestral/symphonic music. The common modes were given names derived from the different social formations of the Hellenistic region, such as the Dorian, Lydian, Aeolians, to mention a few. Crucial in this distinguishing, especially in later readings of ancient Greek systems, was the tendency to ascribe the closest scale to the diatonic (belonging to the modern major or minor scale) as the native Greek thing, so the Dorian was seen to be the most emblematic of this. It had to do with the tetrachord (and the smallest interval at the bottom half of the scale), whilst Phrygic and Lydian scales/modes were viewed as Asiatic in origin. This can be viewed as a cultural bias, arising out of the memory of Persian dominance, and the quest to distinguish Greek innovations. In later processes of music theory development, it had to do with the gradual incorporation of Greek heritage into European heritage, and the view that technical innovations of scales and temperament development, to instill a sense that nativist view of music in Europe, rather than emphasizing exterior influences. In fact, there is evidence to suggest that the influences between the Asiatic and Hellenic contributions to ancient Greek were symbiotic, and lead to parallels: when those who were Hellenic thought they were being Asiatic, that is when they most sounded Hellenic, and vice versa. Furthermore, the more instruments developed so developed

ways of shifting tunings, such as in the Cithara harp, which lead to more innovations and greater flexibility in tuning and scale/mode use.¹⁸ The religious ceremonies shared certain similarities and music featured in all the steps of the rituals, but the repertoires differed, as well as the composition of the musical ensembles. The ceremonies usually started with a procession leading to an altar, there would then be the sacrifice, and after the sacrifice, there was feasting, which was usually accompanied by athletic or musical contests. The *prosodia* genre of hymns, were those executed in the procession, in praise of the gods (typically Apollo), with the sacrifice being led to the altar. *Partheneia* were another genre of hymns sung by women, usually virgin girls.¹⁹

In some of the Greek religious rites, like those dedicated to Dionysus, Artemis and Kybele, dance featured prominently. Through dance they achieved altered states of consciousness, and within the safe-space of ritual, a person could embody a different identity other than their own: women and men could become satyrs, nymphs and muses, for example. The appearance could be erotic, poetic or prophetic. And these religious practices were mirrors by which their modern institutions were fashioned. Like theatre for instance: the word tragedy (or *tragodia* in its Greek form, made up of *tragos*= ram, *ode*=goat) suggests that ancient Greek theatre may have taken its form from the Dionysian rites, in the dedications to Dionysus the ram was seen as symbolic of Dionysus himself. And as Kubatzki (2016) writes:

There is a close connection between mimetic acting, the cult and the theatre: the divine itself is something unutterable, and only through mimetic action can the invisible and inconceivable be experienced.²⁰

What is important about this process of acting or mimicking, is that the act of imitation was seen as capable of changing the character of the actor. And in this context imitation was not simply copying but rather emphasized the ability of art to represent people in action.²¹ For Plato, this is why actors, and dancers were supposed to emulate the virtuous attributes of the gods. It was the calling of the artists to master this kind of imitation, and mastery of it lead to a change in behaviour of the person, towards the development of the ideal state.

The second development I wish to highlight in ancient Greek approach to music happened through the innovations of mathematician Pythagoras. Again let us remember that many of the mathematical discoveries of ancient Greece, were not unique discoveries as such. Some were tak-

en from Babylon, others from Africa in Kemit (Egypt), etc. However, what was distinct in ancient Greek context, is that they sought universal applicability of mathematical truths, used in engineering calculations, for instance, which could be replicated on to other terrains of human thought (such as music), in solving of a variety of social and political problems. But if Greek discoveries were partially informed by African traditions, the African possibilities I am proposing should not be viewed as an outside intervention, but rather a reclamation of what has already been there.

Hierarchy of Notes

A key aspect of tonality is the hierarchization of note intervals based on whether they are considered consonant or dissonant. The most basic teaching on music in this regard says that consonant intervals are those which are most agreeable, and dissonant intervals are those which are considered the least agreeable. Now today this separation is explained based upon how these intervals sound, the listening experience (which in itself is culturally produced). Nonetheless over a long time of development and enforcing of this agreeability certain assumptions have become acceptable. For example most people believe that octave interval (that is C1 to C2—exactly 8 notes above it—is a consonant interval, based on the pleasurability of the two when struck against each other). The phenomena is accepted by physicists through the study of acoustics, it is also accepted by practitioners who may say that upon hearing such intervals they convey pleasurability. However this kind of consensus is not the case in all intervals or cases. For the Pythagoreans consonance and dissonance were not a matter of devising a theory of how two notes sound harmonious with each other upon hearing. But rather for them what was heard as consonant/dissonant was discovered based on numerical truth, the principle that the numbers are always right. In other words, the numerical distance between two notes as the explanation of their rank of priority in the music, to an orientation where numbers were simply an affirmation (even metaphor) for the notes' musical (aesthetic) balance, or what others may call "observable phenomena of musical practice."²²

One of the most vexing examples in this regard is the interval of the 11th (that is C1-F2). Now in the logic of present-day music theory approaching

such an interval would be to say C1-C2 is an octave and that is a consonant interval, C2-F2 is a 4th, which is considered consonant. The deduction would then be that the interval of a 11th is a consonant. However in terms of the Pythagoreans such a view on the 11th was rejected on mathematical grounds. The 11th was considered a dissonant, in spite of how it 'sounds'. While today, music theory reads the 11th as a compound 4th (consonant), but because the ratio for an 11th (8:3) involves the number 8 (which is not in the numerical quaternary (1, 2, 3, 4 set), the Pythagoreans rejected it. For them the numbers determined the consonance or dissonance of the interval (based on a theory of proportions/numerical ratios); and because the 11th cannot be generated by the (1, 2, 3,4 set) it was not accepted as such. In Pythagorean thought, these four numbers (which sum to 10) form the tetraktys, the most sacred symbol of universal order. This is not to say that the Pythagorean view was not without opposition. Ptolemy and several other ancient writers classify the 11th as consonant. But certainly, it appears the rational viewpoint is what Plato and Aristotle endorsed. Here, we see a hierarchy, where rational possibility was placed above sensory perception, the truth of the number overrode the 'sweetness of the sound.'

In the African context, the 'fitting together' of various frequencies is not a closed mathematical loop, but rather an open system, where tuning is a social act not built around a fixed ratio. The organization of sounds, although not appealing to Pythagorean accuracy, was also not evaluated according to the sweetness of the sound—appropriate action was derived from the social and cultural consensus. This equates with the Greek notion of musical ethos.

Musical Ethos

One of the leading ideas emerging from the ancient Greek approach to music is the notion of musical *ethos*; a vision of music on the human soul affecting attitudes in matters of education and politics of its receiving public. This must be considered though in relation to the high regard Greek philosophers had for the music, which it was felt ought to be delicately controlled as a scientific necessity to the fulfillment of state-building, through exhibition of ethos. A leading figure in the spread of such ideas is Plato, primarily in his work *Republic*. In all the sources the person

attributed for coining a music theory of *ethos* is a lesser known music specialist by the name Damon, who Plato and other subsequent sources quotes. But the archive of Damon's original writings are not known. Attributed to Damon are a 1) an outline of musical structures, both in terms of rhythm and pitch, 2) but more importantly a theory or musical vision that was so detailed it could be applied to creative practice, with the potential to having a social and political impact on its audiences. This sense of music as close to political practice, seems to place the role of music at a very serious level in the consciousness of a political public. Plato would write, "Styles of music are never changed without changing the most essential political rules."²³

Subsequent writers such as Aristides Quintilianus, go a step further, by connecting Damon with a set of music scales (*harmoniai*), which were arranged based on principles of the constituting notes (or arrangement of pitches). In this way what was implied was a systematic process of rhythmical and melodic organization achieving political ends. Aristides formulation presupposes a rather mechanical procedure for achieving this visionary objective. He proposes a concept of feminine and masculine qualities of different tones, which are hierarchized in order of importance. This kind of thinking however vastly deviates from Damon and is only found in Aristides, thus making it suspicious as the thinking of the sophists from the classical period. Damon was associated with the 'sophists' and his ideas pertained to establishing a relationship between music and politics. A contemporary of Plato, in fact criticized the idea that certain modes would render people manly, and others would render them womanly.²⁴

Aristotle, like any good student, mirrors the approach of his tutor Plato, he writes:

We ought not only to gain from it the common sort of pleasure, which everyone has the capacity to perceive (since music dispenses pleasure of a natural kind, so that the use of it is beloved by all ages and characters), but ought also to see whether it has a tendency to improve the character and the soul. We would have proof of that, if we are caused by music to acquire specific qualities in our characters. And indeed we do acquire specific qualities, as is shown by many things, and especially by the melodies of Olympus: for it is generally agreed that they inspire our souls with ecstasy (*enthousiasmos*), and ecstasy is a qualification [*pathos*] of the character [*ethos*] of the soul.²⁵

Aristotle does however go on to offer technical suggestions; by recom-

mending the Dorian mode. However it is clear that this recommendation is a cultural preference rather than a philosophical judgment, as he further writes: “we should also accept other *harmoniai* [scales/modes] if these are recommended to us by our colleagues in the study of philosophy and in the musical aspects of education.”²⁶

That the thought-leaders of ancient Greece chose to separate their philosophical evaluation of musical ethos from their own cultural preferences shows a key tenet of ancient Greek quest for universality, rather than particularism. The argument of Plato and his contemporaries is more nuanced: What they suggested was that music, with its endless emotional and psychic effects, was a crucial factor in state building, and therefore ought to be treated with seriousness, in accordance with a scientific evaluation of its defining/constituting elements or basic building blocks. From this Plato believed would a vision of a true music theory emerge. A scholar of ancient Greece, Hagel, suggests that Plato:

knew only too well how far any technical descriptions of his time fell short of it—after all, even with all our modern advances in psychology and neurology, we ourselves are still a long way away from achieving such a theory (and of course, are much more aware about cultural conditioning).²⁷

And this is the most important part of this argument that this musical *ethos* was stated as a potentiality, rather than as a given set of prescriptive scales/modes. Whilst eschewing a generalized systematic assessment of musical technicalities (of modes/scales, like Aristides does), the sophists instead suggest that the terms of such musical/creative judgements are the terrain of “proper education.” Hagel views this kind of resolution as circular, and this is where I differ from him. I would not say that designating cultural and creative judgement to proper education makes the point circular. Instead, I choose to believe that this is a recognition of the possibilities inherent, when one chooses to stylize themselves against a particular tradition. And that it is the job of master musicians, to pave demonstrative and pedagogical methods with the view of influencing future generations (younger musicians/cultural practitioners). And in this sense, James Baldwin’s (1988) quote comes to mind: “Generations do not cease to be born, and we are responsible to them because we are the only witnesses they have”.²⁸ The act of witnessing seems to me, to belong to the realm of proper education—which involves the value of time spent mentoring, the inculcation of habit and discipline, and opening-up of opportunities for experimentation (such experimentation should val-

ue instinct and cognition), self-learning, and platforms to showcase talent. That for me is the realm of education. It is then the master's duty to seek out appropriate methods, schemata; which can then for the sake of its limited purposes be declared as laws, or rules—taking into consideration of their situatedness in culture. However, these should not be read out of context. The minds of students of such an education will have a broad sense of universal principles, even when dealing with cultural particularities.

African Possibilities for Proper Education

To understand the African possibilities for proper education one must have a look at the conceptual field of ubunyanga. In the precolonial history of regions like KwaZulu-Natal, ubunyanga functioned as a complex category of indigenous professionalization. It was not merely “art” or “craft” in the Western sense, but a holistic system of expertise that integrated seemingly disparate skills: metallurgy, stonemasonry, healing, and music composition. For one to become a practitioner of ubunyanga involved a set of educational procedures such as initiation, apprenticeship. In ubunyanga, what was valued was the idea of learning within a tradition. Diviners for example were trained as apprentices, through associations. Those who entered an association joined as novices and gradually worked their way towards becoming master-healers in the network. Learning the names and signs of divination, the figures, proverbs and stories associated with them, as well as the practice and rituals, was part of the proper education. Training also involved learning the repertoire of healing songs and occasions thereof, being able to compose appropriate song and choreography for healing ceremonies. The location of musical memorisation, repetition and composition, at the very heart of the technical learning of healing, (and other specialisations such as metalwork, stonemasonry) suggests that music was located at the centre of complex problem-solving and mastery of scientific concepts.

Whilst approaching my cello in a performance, I am compelled to maintain a focus wider than mere entertainment. In my practice, the instrument becomes a conduit for a broader utility; audience members frequently describe that they attend seeking outcomes related to their personal well-being or a restoration of vitality—results they believe the

music can facilitate. Similarly, professionals from disparate fields seek out these performances for creative inspiration, and I have witnessed visual artists arriving with blank canvases, trusting that the sonic environment will catalyze the conception of new work. This contemporary experience of the musician as a facilitator of wellness and inspiration mirrors the historical role of the *inyanga*.

In the era of *ubunyanga*, music operated as a ritual technology, one that managed the resonances required for both individual and collective transformation. At the heart of *ubunyanga* expertise was the management of *nyama*—a potent life force or energy that resides in all things, from the iron ore in a furnace to the spoken word in a ritual. In this framework, the *inyanga* (specialist) was a master of resonances; their task was to “fit together” (*harmos*) the physical material and the ethereal energy of *nyama* to produce a stable and powerful outcome. Thus, musical composition within the *ubunyanga* tradition was not an abstract exercise in numerical ratios, but a technological intervention into the flow of life force itself.

Indeed, many of those accomplished as griots and bards were initiates who had undergone years of specialized training to master intricate poetical and musical forms as well as mnemonic techniques. Controlling the unique forces released through the spoken or sung word of the oral performances required a strong metaphysical and ethical component in the learning. The mastery of *ubunyanga* African specialists therefore involved training in the ethical and ritual technique of care and management of *nyama*. The learning happened within the tradition. Those gifted with power of *nyama* were exhorted on how to prepare themselves for the handling of the powers, they were reminded of the fact that the power over life and death does not belong to humans but to the great creator. They were taught about how to deal with the behaviours of persons consulting them.

Proper education in *ubunyanga* was different from modern education in that it favoured life-long learning and was rooted in practice. It being situated in practice meant that the student was aware of past achievements, and was able to stylize themselves according to the standard of what had been done before. Gradually as the student transitioned from novice to expert they were able to make time for innovation, improving on what has been done before and remedying any failures.

There is a Zulu saying that goes: '*Inyanga ifa nezikhwama zayo*' (The di-

viner dies with her/his bag of remedies). What the saying means is that when a diviner chooses to guard knowledge for their own prestige, they fail to make a way to sustain their practice even beyond their lifetime. In this way the diviner dies with her bags of wisdom. I have always interpreted the saying as pointing to a great tragedy in leadership. Because *inyanga* has chosen to guard knowledge for their own prestige, they fail to make a way to sustain that practice even beyond their lifetime. In this way she or he dies with those bags of wisdom. Because of the *inyanga's* failure to act, generations that follow are robbed of the knowledge that could have accumulated.

A higher level interpretation of the saying could be that while it is true that *inyanga* may die guarding knowledge, but sometimes the things that occupy the mind of *inyanga* may be things society itself is yet unable to grapple with, perhaps due to a particularly overwhelming situation (such as the colonial encounter). When the *inyanga* dies with their medicine bags it is because they are willing to safeguard that knowledge even to their own death. As poet in isiZulu, Mazisi Kunene writes, "the mind to the colonizer was the most challenging aspect of colonizing...the mind for the colonized was the most important part of the human self that needed to be defended."²⁹ The *inyanga* who understands the Intellectual Property they hold to be precious is willing to withhold that knowledge, even unto death. Such is the value of what they hold and believe to be true. It is the intellectual independence of *inyanga* that prompts her or him to chart the path ahead, so that future generations ahead may have something to digest. Information is kept secret, anticipating new decolonial futures where it will be relevant and important to unfold.

So while in the Greek model, education was about state-building; in the African model I am proposing proper education was about the stewardship of life force (*nyama*). The focus on "restraint," "secrecy," and "observation of nature" suggested a profound ethical responsibility. Secrecy is one of the ways in which specialists of *ubunyanga* configure reality and place value on certain human acts for the purposes of preserving a tradition. The saying "*inyanga ifa nezikhwama zayo*" conveys the power of secrets kept until the grave. This presents itself as a methodological crisis for those who are approaching African indigenous specialization from the vantage point of academic scholarship—a style of investigation which places emphasis on bringing facts and information from the unknown to the realm of the known. But from the vantage point interior to those indigenous domains of specialization, the emphasis may be different, for

the domains are often themselves sustained by secrets. Breaking those codes, has the potential to erode the value of those secrets sustaining cultural-technological phenomena. The real purpose of secrets was to exercise restraint over the powers of *nyama*, which was why secrecy accompanied rigorous education. A strong education early in life was able to instill the habits of care and responsibility required in the management and use of *nyama*.

Coda

My sense is that 'proper education,' in the case of future African possibilities, would also focus on this apparent failure to cooperate, in the process of guarding knowledge. Somehow the tendency to measure the success of a tradition (of knowledge production) on the accumulation, of one generation passing to another, and each civilization getting better because of this snowballing archive is not able to accommodate the failure to cooperate, which by its nature is disruptive.

Although I have mentioned discipline forming a part of proper education, this zone is better described as indiscipline. This is the African subjects position in relation to the European enlightenment project. A space of tactics which is mended from her/his past. Bogumil Jewsiewicki (2002) describes indiscipline as follows:

indiscipline offers the subject its tactical recourse—a negative one, to boot. Indiscipline makes it possible to resist, to remove oneself from the actions of the Other, to act as if one has been converted—sometimes, indeed, to the point of believing it oneself.

Although Jewsiewicki believes (arguing against Achille Mbembe) that this space does not allow one to impose one's own priorities, I would, however, contend that this is only in the context of that 'captured' space of domination itself. Indiscipline does in fact allow for the possibility of a third space, of existential autonomy.³⁰ A place out-of-access, a space that cannot be breached, even by centuries of colonial imposition. In this way. Therefore in the framing of the learning experience within codes of secrecy, discipline and ethics, the *inyanga* does not die with her bags to deprive the future, but to preserve the remedies until a generation arises with the 'proper education'—and the ears—to open them.

The 'indiscipline' of the specialist is therefore not a failure to communicate, but a tactical preservation of the 'African possibilities' that this chapter has sought to uncover. As I return to my laboratory—to the strings of my cello—I recognize that my role is to be part of that arising generation with the sense of inquiry to re-open those bags of wisdom, that appear to be closed, but are not foreclosed. By refusing the tempered grid and embracing the ethical stewardship of *nyama*, we do more than just play music; we enact a decolonial 'fitting together'—honouring the vibrational sincerity of the African past while composing the resonant possibilities of the future.

Keywords

Temperament vs Tuning: Temperament is a kind of adjustment in tuning in order to achieve a particular symmetry in the intervals between notes. Tuning can relate to one note, but temperament is about the tuning of the entire scale (or even entire instrument).

Tonality: The construction of music based on particular tonal-centre (or key), which is usually emphasized at the beginning and at the end of the piece.

Diatonic: Belonging to the modern major or minor scale. A scale built on five whole tones and two semitones (or half-tones); the basis of most music inspired by the western art (classical music) tradition today.

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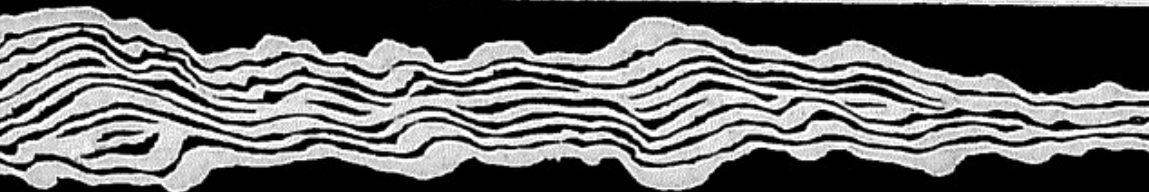
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2'35	3'06	3'43	4'05	4'40
2'52	3'27	3'59	4'30	





Tomás Cabado
a chord is a
sculpture (2024-)

Introduction

'a chord is a sculpture' is a title that comprises a series of multichannel sound sculptures based on the translation of harmonic space representation models from music theory into physical space. Based on the topological figures of lattices, which are utilized in just intonation¹ to represent intervallic relationships as multi-dimensional "grids" or "lattices", I intended to create different speaker arrays to be deployed in space based on them, where the virtual space of musical intervals is represented by the geometrical disposition of speakers in a physical structure. Through these speakers, a composition made for that specific sculpture is sounding, utilizing the different harmonic configurations of the lattice to produce sound structures (single notes, dyads or chords).

Just intonation and tuning systems, different from 12 tone equal temperament, are part of practice and experimentation in many musical traditions for a long time. For a musician coming from western modern education, its study requires the suspension of some theoretical, practical and most of all perceptual habits and assumptions related to consonance and dissonance. Personally, it has always been a struggle to find a way to immerse myself in the intervals and their qualities, while trying to understand where they come from, to associate concepts and perception and thus being able to recognize and use these materials in playing and composition in a conscious way. This series began as an attempt to develop a device for ear training and theoretical self-education on the topic, but it became an artistic project with potential to develop creative ideas in its frame.

Lattice and Just Intonation

A lattice is a way of modeling the tuning relationships of a just intonation system. It is an array of points in a periodic multidimensional pattern. Each point on the lattice corresponds to a ratio (i.e., a pitch, or an interval with respect to some other point on the lattice). The lattice can be two-, three- or n-dimensional, with each new dimension corresponding to a higher prime-number partial from the harmonic series.²

In a lattice, each point stands for a pitch class (or a specific pitch if oc-

taves are included), and the lines connecting the points represent musical intervals. These lines act like vectors—each with a fixed direction and length—that consistently represent the same interval no matter where they appear in the lattice. Stacking the same interval repeatedly (i.e. adding the same vector) moves you steadily in a specific direction. In just intonation systems based on prime number ratios (like powers and products of primes), the resulting lattice can theoretically extend infinitely, since no prime power can equal that of another. Still, lattices can also represent subsets of these pitch systems, like the ones used in this work.

The “limit” of a tuning lattice refers to the largest prime number involved in the interval ratios. For example, Pythagorean tuning only uses the perfect fifth ($3/2$) and octave ($2/1$), which are derived from the primes 2 and 3 (i.e. second and third partials in the harmonic series). The octave is often omitted as an interval in lattices, so octave equivalence is often assumed for each point. Pythagorean tuning can so be shown in a one-dimensional lattice (a line). In contrast, 5-limit just intonation includes the just major 3rd ($5/4$), so its lattice becomes two-dimensional (fifths and thirds). In this way, the vertical axis could represent the 5ths or $3/2$ ratio (and its inversion, the 4th or $4/3$ ratio in the opposite direction), while a diagonal axis could represent the major thirds or $5/4$ ratio (and its inversion the minor 6th or $6/5$ ratio). The next prime is 7 which brings the harmonic minor 7th interval, which now brings a third dimension in addition to the other two primes represented in a y-axis. More primes (11, 13, etc.) can also be represented with more axes, under the condition that their vectors are different in length and angle than the other ones.

In just intonation pitches are always infinite, no matter its limit. Any pure interval is possible to be stacked infinitely, giving always new pitches. When arriving 12 fifths above C to a B#, for example, these two pitches that are equivalent in 12 tone equal temperament are not in just intonation—they’re separated by an interval called “Pythagorean comma” (23.4 cents). When using higher limits, new pitch relationships appear and among them specific intervals where both pitches are very close to each other (for example the syntonic comma in 5-limit JI of about 21 cents). This information is useful when having to decide for a specific subset inside a lattice: they can be used to draw where to cut the lattice, in a way that only one of two very similar pitches is included.

Sound sculptures

When dealing with presenting these models in physical space, a different subset of a just intonation lattice was used for each installment of the project. So far there were three installments: one in December 2024 at the Hochschule für Musik Mainz, Germany (Hochschule für Musik Mainz, 2024), presenting a subset of a 2-dimensional lattice; the second one in February 2025 at the OPEN Festival in Trier, Germany (OPENING Festival, 2025) with a first presentation of a 3-dimensional lattice; and the third one also in February 2025 at the Mymäala Gallery in Helsinki (Myymälä2 Gallery, 2025), presenting a triptych of 4-parts subsets sculptures of a 3-dimensional lattice.

All the versions were 12 channels installations, where each channel represented a different speaker-point in the lattice. Since in every lattice what is represented is the pitch relationship between points (i.e. the ratio or interval) and not specific fixed pitches, each speaker had not necessarily only one pitch assigned. Although only one pitch at a time sounded in each speaker, the whole lattice could “move” through the vectors, changing all the pitches at once by a specific interval responding to the axis of the lattice. For example, in a 2-dimensional 5-limit lattice, the pitch in the speakers could be moved by fifths up or down, or major thirds in diagonal, or a combination of both movements. This allowed for new pitches from the virtually infinite lattice to appear in the subset presented physically, replacing others that disappear.

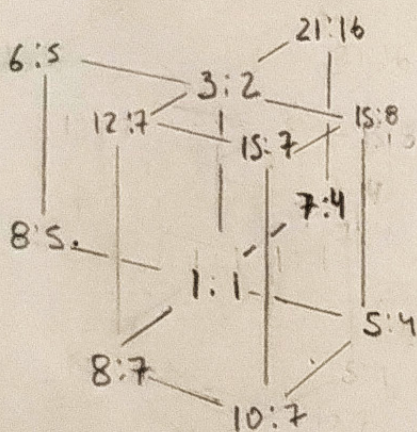
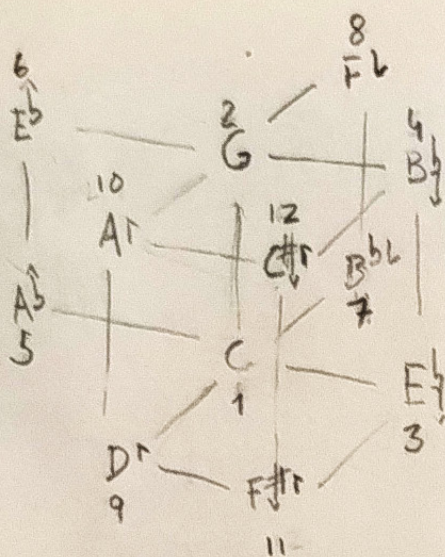
2-dimensional lattice installment

The first installment was designed for 12 medium-small speakers (8 cm diameter) as a representation of a chromatic 12 pitches scale in 5-limit just intonation. These were attached with black metal wire to each other imitating the grid, having four columns of speakers arranged 2, 4, 4, 2. The speaker grid was around 1.5 x 1.2 meters, and was hanged with the center at around 1.6m from the floor to be presented in front of the audience face. The 5-limit lattice utilized represented fifths in the vertical axis and thirds in the diagonals. This grid of speakers was then held between two metal bars, and the whole structure to the ceiling.

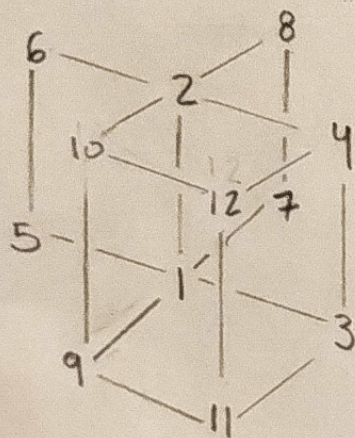


*'a chord is a sculpture' 1st installment
HfM Mainz, December 2024).
Photo: Juan Bermudez*

7-limit



speaker	ratio	pitch
1	1:1	C
2	3:2	G
3	5:4	E
4	15:8	B \flat
5	8:5	A
6	6:5	E \flat
7	7:4	B \flat
8	21:16	F \flat
9	8:7	D \sharp
10	12:7	A \sharp
11	10:7	F \sharp
12	15:7	C \sharp



Sketch of the 7-limit lattice subset. Up: pitch names; middle: ratios; down: speakers numeration.

The sounds were comprised in a 20-minute track that looped, with 3 sections of roughly 4 minutes separated with silence of about 1-2 minutes. Each section explored different synthesized sounds different “movements” of structures within the grid. In any lattice, proximity and distance represent degrees of consonance and dissonance. Following this principle, each section could be described as follows:

1. Four-part chords formed around two sustained notes or continually sounding points within the lattice.
2. A cluster of 12 notes is gradually filtered out until it fades into silence.
3. Sequences of four-part chords that are initially connected through common tones and end up being far apart in the lattice.

3-dimensional lattice installment

For the exhibition of the Opening Festival in Trier, a subset from a 7-limit lattice was utilized to have again 12 different pitches forming a chromatic set. With the central pitch (1/1) in the bottom-center of the space, the vertical axis represents 5ths, while the diagonal axis crossing the depth of space from right to left represents major 3rds and the other diagonal, the harmonic minor 7ths.

On the next page it is possible to see how the design occupied around 2.5 m² of the space, with a height between vertical speakers of 1.8 meters. Bigger speakers of about 20cm were used and attached with metal wire only between the vertical speakers and the ones in the upper side, to allow audience circulation inside the space of the work.

Pitch material in 3-dimensional lattice and the “incomplete cubes”

The leap between 2 and 3 dimensions represented also a notorious change in the possible configurations of sound structures inside the work. While 2 dimensions allows for more points in a row in a limited set, and therefore favor vertical and diagonal mobility, the same number of points in a 3-dimensional space favors shapes related to the square and





*'a chord is a sculpture' (2025) 2nd installment
Opening Festival, Trier.
Photo by Elena Tilli.*

13)		9 sus 4	7	[16:28:35:42]	1
14)		m ⁹	7	[24:42:56:105]	1
15)		Δ13	7	[40:70:84:105]	2 (no common words)
16)		mij ⁹ (no 3)	7	[8:10:12:21]	2
17)		φ	7	[60:105:140:168]	2
18)		7 sus 3 ⁹	7	[40:70:84:105]	2
19)		7(9)	7	[16:20:28:35]	2 (no common words)
20)		Δ7(#5)	5	[8:12:20:25]	1
21)		Δ2(#5)*	5	[16:20:25:30]	1
22)		Δ7(#5)**	5	[32:40:50:75]	1
23)		-(Δ7)	5	[32:48:60:75]	1
24)		-(Δ7)*	5	[40:48:60:75]	1
25)		-(Δ7)**	5	[48:60:75:100] <small>large gaps, discuss</small>	1
26)		7~	7	[16:24:28:49]	1
27)		7 sus 4 ~ *	7	[16:28:42:49]	1
28)		-7~	7	[32:56:98:147]	1
29)		sus 4 (add 9) ~	7	[32:48:84:147]	1
30)		-7~*	7	[48:56:84:147]	1
31)		7(b6)(no 3)~	7	[48:84:98:147]	1
32)		7(#11)(no 3)~	7	[50:70:84:147]	2 (no common words)
39)		7(9)~*	7	[16:28:35:49]	2

Handwritten musical sketches numbered 12 through 22, each showing a staff with notes, chord diagrams, and numerical ratios.

12) m'' $[40:48:60:105]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 2 \\ \sharp 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ \sharp 1 \\ 0 \\ 0 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 2 \\ \sharp 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 7:4 \\ 5:4 \\ 6:5 \\ 7:4 \end{matrix}$

13) $9sus7$ $[16:28:35:42]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 6:5 \\ 5:4 \\ 7:4 \\ 7:4 \end{matrix}$

14) m'' $[24:42:56:105]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 15:8 \\ 4:3 \\ 7:4 \\ 7:4 \end{matrix}$

15) $\Delta 13$ $[40:70:84:105]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 5:4 \\ 6:5 \\ 7:4 \\ 7:4 \end{matrix}$

16) m'' $[8:10:12:21]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 7:4 \\ 6:5 \\ 5:4 \\ 7:4 \end{matrix}$

17) $2sus69$ $[60:105:140:168]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 6:5 \\ 4:3 \\ 7:4 \\ 7:4 \end{matrix}$

18) $7(9)$ $[40:70:84:105]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 5:4 \\ 6:5 \\ 7:4 \\ 7:4 \end{matrix}$

19) $\Delta 7(\sharp 5)$ $[16:20:28:35]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 5:4 \\ 7:5 \\ 5:4 \\ 5:4 \end{matrix}$

20) $\Delta 7(\sharp 5)$ $[8:12:20:25]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 5:4 \\ 5:3 \\ 3:2 \\ 3:2 \end{matrix}$

21) $\Delta 7(\sharp 5)$ $[16:20:25:30]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 6:5 \\ 5:4 \\ 5:4 \\ 5:4 \end{matrix}$

22) $\Delta 7(\sharp 5)$ $[32:40:50:75]$
 Chord diagram: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$ $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix}$
 Ratios: $\begin{matrix} \flat 0 \\ 0 \\ 0 \\ 1 \end{matrix} \begin{matrix}) \\) \\) \\) \end{matrix} \begin{matrix} 3:2 \\ 5:4 \\ 5:4 \end{matrix}$

Sketch. Catalogue of 4-part chords inside the lattice.

the cube. Although the principle of distance between points and consonance is maintained, the sum of the 3 dimensions multiply the options in which vectors can be combined, which exponentially grow as the points do. While consecutive horizontal combinations are still possible, the combination of vertical and horizontal is more at hand. Depending on the number of points involved, this can generate local structures like squares or “incomplete cubes” that represent chords of specific characteristics.

The incomplete cube became a tool to explore the possibilities of the lattice as presented in this setting: it is a geometrical form that can be investigated thoroughly through the many possible point combinations connected through vectors. This method is of course inspired by Sol LeWitt’s work *Incomplete Open Cubes* from 1974.

In the mid-1960s, Sol LeWitt began to work with the open cube: twelve equal linear elements connected at eight corners to form a skeletal structure. With the series *Incomplete Open Cubes*, LeWitt turned his attention to subtraction. His question was: how many variations of an incomplete open cube exist and what do they look like? LeWitt empirically identified 122 unique variations through the systematic subtraction of elements from an open cube.³

I decided to investigate subsets of the lattice with open cubes, not in a serial artwork as in the case of Lewitt but to make a catalog and approach the available pitches in an ordered way, to then make decisions on the material to use in the sound composition. As in the cube, at least three parts (a chord) are needed to imply all the dimensions of the lattice, and these must represent also each one of the axes. Instead of investigating all the variations of the incomplete cube, I took a more limited approach using forms that include 4 points (or corners of the cube). Then I built a catalogue describing the intervallic conformation of these chords.

This was done by taking the chords to a sort of “prime form”, i.e. writing them in the lower ratio relationship possible by transposing them in specific octaves. Some of them turned out to be transposable within the lattice (meaning there is more than one way of deploying them among the speakers without moving the lattice), while others weren’t. As a difference to Lewitt’s use of the cube, in this case the orientation of the incomplete cube changed the characteristics of the resulting chord (while to Lewitt the orientation was indifferent or at least secondary) because the orientation changes the direction of the intervals and therefore a differ-

ent intervallic structure. These forms which are obtained with different orientations of the same combination of points are nevertheless related both in a geometrical and intervallic way, since they can be seen as inversions of each other taking different axes as reference. (See previous page: Sketch. Catalogue of 4-part chords inside the lattice.)

After some cataloguing, I decided to deviate from the cube approach and include other 4 points forms like the square or other 2-dimensional ones. This research gave me a better theoretical and perceptual understanding of the possible pitch combinations and what type of vectors sums produce more consonant or dissonant chords. In total I found and analyzed 53 chords, trying to point out their similarities in sound and structural properties.

The composition of the 12 channels piece for the Trier exhibition was made after this investigation, with a similar approach to form and duration (sections with sound separated by silences). In the sounding sections of the piece, the catalogued chords were used not in an exhaustive way but concatenating shapes following their similarities, at moments in their geometrical properties (a form is transformed into another one by moving just one of its elements, producing a small movement of sound in space) and at other moments their sound quality (a chord changes to another one that has a similar sound but is constructed with different intervals, thus changing more radically the sound in space).

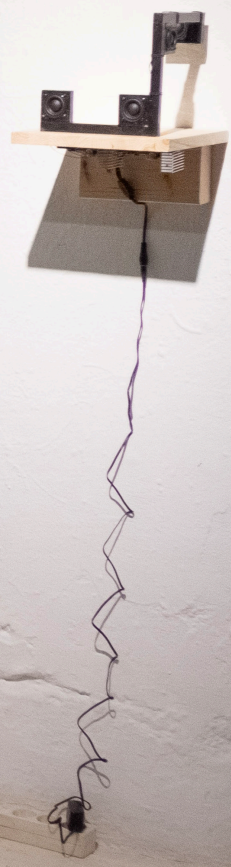
For the *finnissage* of the Trier exhibition I had the opportunity to play a performance where I manipulated the sounds in real time through a patch in Max-MSP I designed for the piece, while playing electric guitar tuned to match the properties of the lattice.

3-dimensional sculptures triptych

Finally, for the Microtonal Music Studios exhibition at Mymälä2 Gallery in Helsinki, Finland, I detoured from the grid designs and moved towards a smaller scale, designing three sculptures of about 30 cm² with 4 very small speakers each (4 cm). This installment is perhaps the one that is best represented by the title. 'a chord is a sculpture' in this case seems to represent that each sculpture is a chord. In fact, the title is not meant an attempt to isolate a musical "object" as a chord from its temporal unfold-



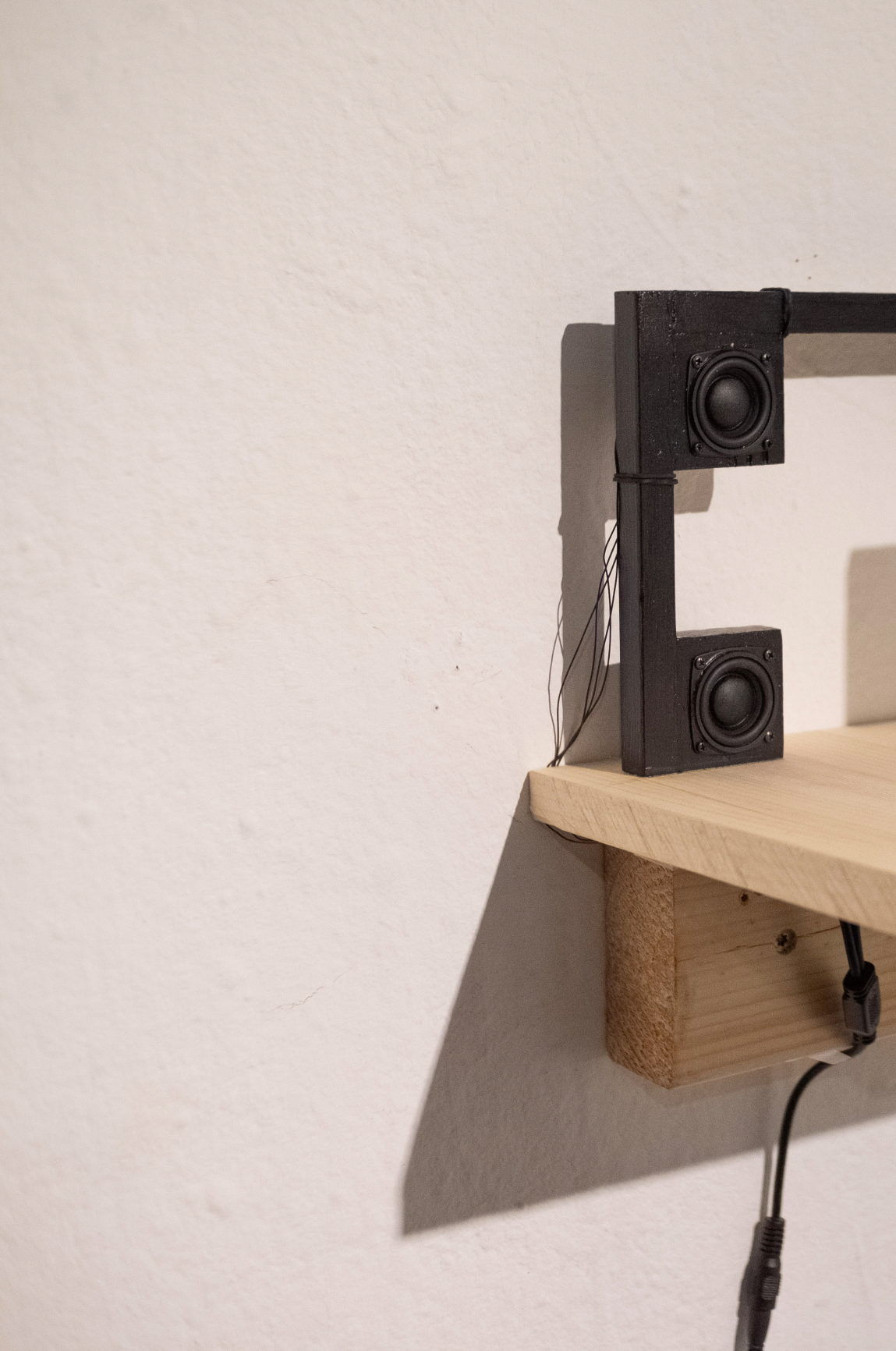
*'a chord is a sculpture', 3rd installment
Myymälä2 Gallery, Helsinki
Photo by Sjors Hoogerdijk*







'a chord is a sculpture': 3rd installment
Myymäälä2 Gallery, Helsinki
Photo by Sjors Hoogerdijk

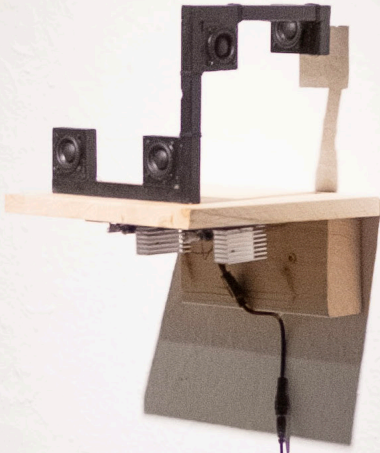




*'a chord' is a sculpture, 3rd installment
Myymäät2 Gallery, Helsinki
Photo by Sjoers Hoogerdijk*



*'a chord is a sculpture', 3rd installment
Myyämäälä2 Gallery, Helsinki
Photo by Sjors Hoogerdijk*



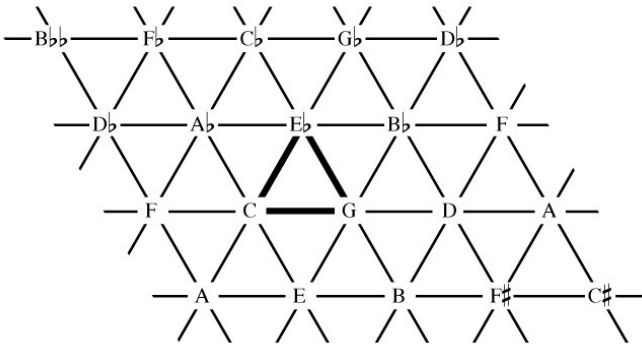
ing, or its connection to other objects in music, but to imagine a chord as a possible spatial entity, bonded to a space. The juxtaposition is made through a theoretical model that has more to do with topology than with Euclidean geometry. The model works as a bridge or a strategy to deal with specialization -not of sound as a moving entity but as a simultaneously multi-localized event.

I chose 3 different incomplete cubes that were part of a section of the composition I did for the previous Installment in Trier. The three chords, in determined transpositions, are chromatically complementary (the sum of them gives 12 different pitch classes). These chords have a good "voice leading" one after the other, i.e. the way the chords connect through the movement of each note of one chord the next is smooth. And while being visually similar, they "occupy" the space in each axis in a different way. The composition is made in a way that, although each sculpture has its own "program" and can run by itself, each one has a time structure loosely complementary to the one of the others: each sculpture sounds by itself for a period until a crossfade with another sculpture occurs, and this behavior cycles indefinitely.

Notes

(1) Just or pure intonation (JI) utilizes ratios of whole numbers to represent pitch (frequency) relationships. The lower the numbers, the “purer” the interval. These frequency relationships are derived from the harmonic series.

(2) Gilmore, B. (2006). Introduction. In B. Gilmore, “Maximum Clarity” and Other Writings on Music (p. xviii). Urbana, IL: University of Illinois Press.



The Tonnetz in neo-Riemannian form, pitches are connected by lines if they are separated by minor third (/), major third (\), or perfect fifth (—).

Image source, wikipedia.

Permission to publish this image of the ‘tonnetz’ lattice is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled GNU Free Documentation License.

(3) Public Art Fund, 2011

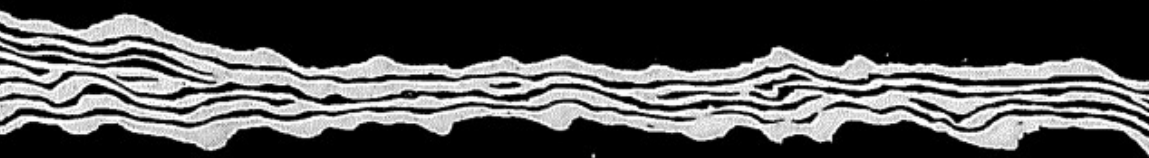
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Mymmälä2 Gallery. (2025). Microtonal Music Studios Exhibition and Event week. Retrieved from Mymmälä2 Gallery: https://www.mymmala2.com/?page_id=9353

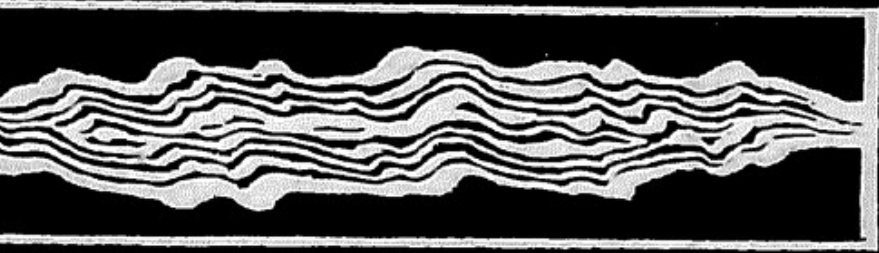
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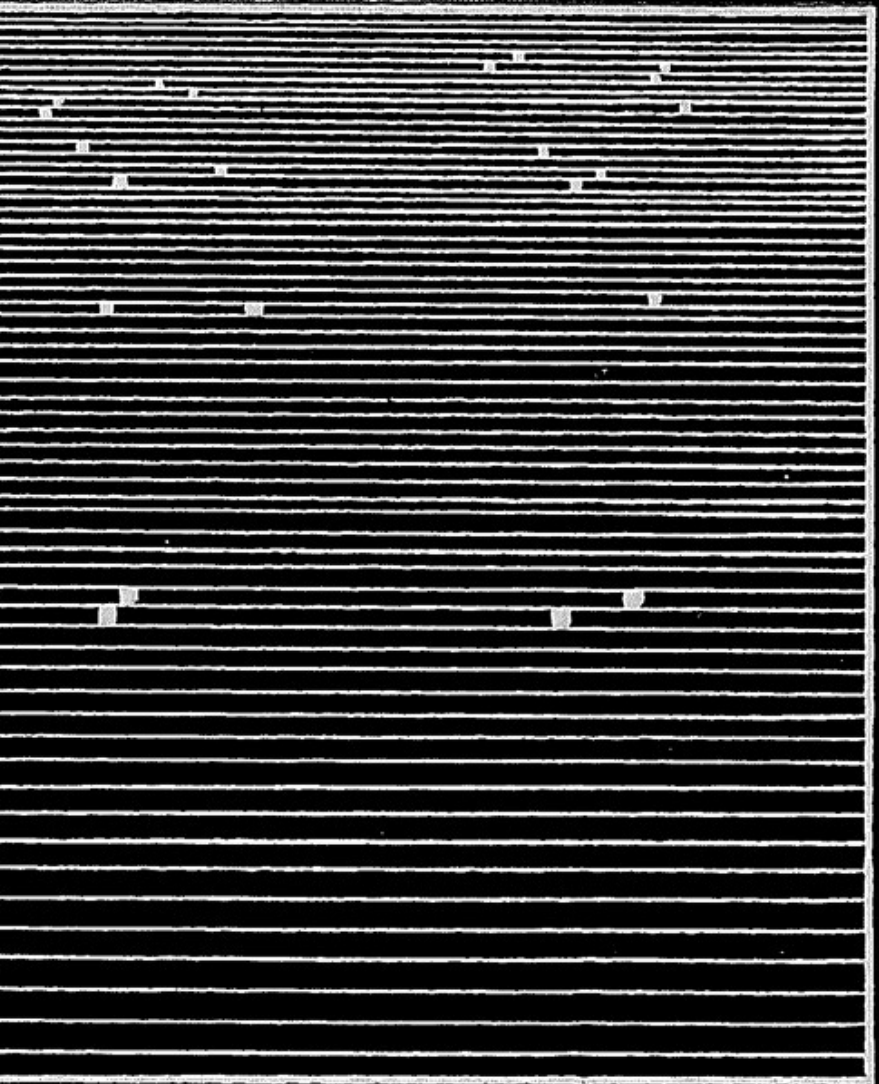


	4'05	4'40	5'08	5'27	5'50
9	4'30	4'57	5'23	5'50	





	6'10	6'27		
	6'10	6'27		



SERIYA 37

Sami

Abu Shumays

Arabic Maqam and “Microtonality” as a Social Phenomenon

~

Arabic maqam-based music is the most widely-practiced “microtonal” music tradition in the world. Umm Kulthum, the most popular singer in the Arab World in the mid-20th century, is the second-most recorded artist in the world (after Indian film singer Lata Mangeshkar and ahead of Frank Sinatra and Elvis Presley). And contemporary Arabic-language popular music - especially the genre from Egypt known as mahraganat (“party” or “festival” music) - still continues to use the maqamat in 2025 (maqamat is the plural of maqam).

The melodic cultural heritage of maqam-based music is known and singable by children and by adult music lovers and amateurs of all stripes. It continues to be transmitted orally, meaning that the specific tunings of maqam scales are mostly learned - accurately - by ear, and are not dependent on measurement or analysis for effective transmission. A recent study has shown that even non-musician listeners to Arabic music have finer pitch perception than those who do not listen to Arabic music, demonstrating that consistent listening alters the brain (and conversely, demonstrating that the brain has the capacity to be thus altered in response to cultural stimuli). And given that we find both cultural variation in tuning across the region, and historical change over the course of the history of audio recording, the maqam tradition is a rich practice in which to explore “microtonal” music “in the wild,” so to speak.

I will continue to put the word “microtonal” in quotation marks when referring to maqam, because the term carries an implicit cultural bias toward contemporary European scale tuning, which is assumed to be the standard tuning against which everything else is “microtonal.” In contrast, from the traditional Arab perspective, the maqamat are tonal, not microtonal, and music based on Equal Temperament is microtonal.

~

The primary argument of this essay is that, contrary to the assertions of most theorists of tuning, the tuning of Arabic maqam scales are not determined by mathematical factors but by social and cultural ones. I go so far as to assert that this is true of all musical scales: that they are funda-

mentally arbitrary (in the linguistic sense of the word), not determined by physical (acoustic) laws. Because the cult of Pythagoras continues to dominate musical analysis, especially in the field of “microtonality,” most of those invested in the mathematical approach misunderstand my arguments, countering that the facts of just intonation (small interval ratios among frequencies producing harmonic intervals) are incontrovertible. So I will say from the outset that I am in no way denying that strings tuned a just fifth apart vibrate in a 3:2 frequency ratio that, because the waves align, result in a sound that many describe as consonant. I myself tune my violin in this way. Instead I am saying that such simple consonances are not the only way to create intervals, because the human ear has the ability to distinguish pitches along a continuous spectrum (an ability that gets finer when more distinctions are made in a particular musical system). Hence any given tuning is a choice, not a requirement, and therefore we must look to the social and cultural mechanisms around that act of choosing, to understand why tunings take the form they do. Which, in some but not all cases, does involve the selection of intervals using or approximating mathematical consonances of various kinds.



I’ve seen, in teaching maqam to students orally for the last several decades, that singing any particular interval in tune is as difficult (or as easy) as any other. I am a performer and teacher of traditional Arabic music, which uses a wide spectrum of what Westerners call “microtonality,” from so-called quarter-tones, to shades of pitches that can vary by as little as 3-5 cents from one scale to another (and which also vary from region to region). Singing an interval roughly $\frac{3}{4}$ step wide, or a just fifth, or an extra-small semitone interval, all require the same amount of effort and concentration from students: ear training and muscle memory built through repetitive practice of sounds heard and imitated. Ear training that in fact partly depends on muscle memory, because the ear develops the ability to hear finer differences gradually, in relationship to the practice of creating the sounds over time, not by listening alone.

This observation is one clue that tuning systems are arbitrary. Because a Just interval takes the same amount of effort for a student to learn to sing in tune as a tempered interval or another kind of interval, that indicates

that the harmonic series is not the primary determinant of how humans store pitch memory, but that instead the human ear has the capability of discerning and remembering any given interval whatever its size. It means that the human brain stores that interval memory as a unique item, regardless of any potential relationship to a pure “harmonic” interval (or to any other system).

Proponents of mathematical and harmonic-series explanations for maqam-scale tunings ultimately fail to make the case for why higher-level partials are a stronger basis for tunings than any other arbitrarily chosen pitch. While truly simple harmonic ratios like 3:2, 5:4, 9:8, 6:5 are clearly audible, and can thus form a basis for the ear to select pitches, higher-integer ratios such 27:22 or 18:13 do not stand out from the background, unless an instrument is specifically designed to generate these ratios, to which musicians can train their ears.

Even the 4:3 ratio has been alternately viewed as consonance or dissonance due to contextual factors, over the course of European scale-tuning history. That ratio is a good example of the flaws in the logic of assuming that integer ratios of pitch frequencies always produce salient consonances, because of the significant dissonance produced by upper partials: the 3rd partial of the lower frequency is dissonant to the 2nd partial of the higher frequency ($3 \times 3 = 9$ vs. $4 \times 2 = 8$) and the 5th partial of the lower frequency is even more dissonant to the 4th partial of the higher frequency ($3 \times 5 = 15$ vs. $4 \times 4 = 16$). Such conflicts in consonance and dissonance are even worse for ratios built on larger intervals, and that does not even take into account the distortions made by the different physical materials used to construct instruments. So there would be no reason for human ears to evolve to prefer rational intervals in music, and in fact the re-training of European ears over the last 4 centuries to hear 12 EDO as an adequate substitute for rational intervals proves the point.

Simply put: human ears learn a sound as it is, and store it in memory if it is repeated and becomes salient. The evidence is in the practice itself, as noted above, and further below in the discussion of cultural variation. There is no reason for the ear to hear a particular sound in relation to the harmonic series, unless the ear is primed for that portion of harmonic series by hearing it clearly by instruments that can generate it, as happens successfully in Western microtonal music by those composers and performers who use tools that can generate the intervals they want. But the

basic principle is that the ear is primed to expect sounds it has heard before. Something that repeats becomes something to expect - a memory.

I emphasize singing in this discussion because Arabic music is primarily vocal music, and Arab vocalists can sing its “microtonal” scales with consistent intonation a capella (as is evidenced in Qur’anic recitation). Yes, instruments can be (and often are) tuned according to schemes that use mathematical rationales, but the human voice has the potential for continuous pitch variation within its range. The ability to discern, copy, remember, and repeat any pitch or interval that can be heard, is one of the bases for the skill of music. (I like to emphasize in my classes that maqam is a physical skill, not an abstract scale or system, and that it comes from the body in the same way as dancing, driving, cooking, or mountain climbing.)



Another clue that pitch interval relationships are arbitrary is cultural variation. The scale known as Maqam Rast, notated as C D E-half-flat F G A B-half-flat C (“E-half-flat” is a note roughly in the middle between E-flat and E-natural), shows tuning variation both across the Arab region as well as over time. Yet despite these variations (which range anywhere from roughly 2-20 cents), the scale is mutually intelligible as such across different countries, and the same songs can thus be played with different regional intonations and still identified as the same song.

The variation is much like the variation of vowel sounds in spoken language. Note the differences between the New York City English I speak, New Zealand English, Boston English, or the many distinct accents and dialects within the U.K. Similarly, The E-half-flat in Maqam Rast is slightly higher in Syria than in Egypt, for example. Intonation also varies over time, mirroring linguistic change: the E-half-flat in Maqam Rast in Egypt was higher in the early 20th century, and it got lower and lower gradually over the course of the 20th century, as evidenced in the recorded legacy.

This is further evidence that the tuning of a given melodic interval need not be based on a particular exact frequency ratio, but is instead based on social and cultural factors. In fact, the variation serves to identify musicians by region in the same way that an accent can place the speaker:

based on the intonation of their scales, an experienced listener can tell whether the musician or singer is from Syria, Egypt, Lebanon, Iraq, etc. This phenomenon goes beyond whole countries and reveals differences from city to city, or from city to countryside, within the same nation - again similar to the functioning of spoken language.

These are the basic pieces of evidence that the “microtonal” tunings of Arabic maqam scales must be determined by social factors, not by mathematical functions or laws. I emphasize the contrast with mathematical definitions of scale tuning for several reasons:

Nearly everyone theorizing about “microtonal” scale tunings uses mathematical definitions and rationales for these tunings, and this has been the case since the time of Pythagoras. When theorists measure the actual tunings used by musicians, and find variation from the supposed mathematical basis for the “correct” tuning, they often assume that this is due to musician error, thus entirely dismissing the phenomenon of variation (and ignoring the accuracy with which musicians can reproduce exact tunings within a specific regional practice).

I have seen many explanations of Arabic scale tunings by Westerners that claim the actual variation in tuning that exists shows statistical clustering around particular Just frequency ratios - thus entirely dismissing the meaningfulness of the differences from that supposed “correct” tuning. (It would be the same as if someone took all of the pronunciations of the “O” vowel across different dialects of English, made a statistical plot, and then claimed that there is a correct “O” sound, and the variation is simply error, or meaningless inaccuracy. Yet the human ear is incredibly precise, and these differences have enormous cultural import: they’re not approximations of some correct ideal, but legitimately different sounds with distinct meaning and social relevance).

There is a belief in a need to explain scale tunings through some kind of theory, combined with the lack of an adequate theory to explain them, other than the fallacious theories that they must be based on some form of Just Intonation or EDO scheme. In other words, I take tuning variation to be a feature, not a bug, of the Arabic maqam tradition (and by extension of all musical tuning practices on earth). It is this feature which begs explanation - rather than being explained away as either musician error or “natural” variation that can be reduced to the “true” or “correct” tunings. Before proposing any alternate theory on tuning I’d like to make the following observations on non-Arab scale tunings:

First, consider historical Western tunings. Observe that the same melody could be played in Just Intonation, Equal Temperament, Pythagorean, or Mean-Tone tuning, and still be recognized as itself (though harmonies might sound quite different). Consider an out-of-tune piano. If you played Fur Elise on it, everyone would still identify the piece. Therefore there is something about melodic identity which is stronger than the exact tuning.

Most music traditions globally did not adhere to Equal Temperament, at least prior to the 20th century. Older recordings of music practices from around the world show "microtonal" variation similar to what still exists in the Arab World; I've heard "quarter"-tones and different shades of pitch in Swedish folk music, Irish folk music, Old-time American folk music, and of course the Blues. In Greece in the early 20th century, and in Italy post-WWII, "microtonal" music traditions were deliberately erased and made to conform to Equal Temperament - for political and cultural reasons as much as musical. And of course there are a broad range of tunings from across Africa and Asia that are much harder to reduce to 12 EDO than the European and American traditions I just referenced.

Therefore what I have to say from the perspective of Arabic maqam - a still-vibrant practice that carries features that were elsewhere lost or erased as global music traditions fell under the hegemonic sway of 12EDO and Euro-American harmonic practices - should be considered for its potential relevance to other musics and to music as a universal human practice. It is certainly more broadly relevant to the universal practice of music than are the mathematically-based tuning schemes of the Western microtonal community, which are but a miniscule niche of contemporary global music, and barely a blip on the radar from the historical perspective.

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So if maqam tunings are not determined by mathematical factors, but rather by cultural factors, as I claim, what are those factors? To answer this question I'd like to start by zooming out from the specificity of tuning to the broader features of the maqam system.

First and foremost, maqam is a melodic practice. The scale is only the bar-

est skeleton of maqam, a fact that can be easily seen by looking at Arabic music that uses Maqam Nahawand, which has a scale equivalent to the Minor scale in the West. The scale isn't what gives melodies the character of Nahawand: if it were, then songs in Maqam Nahawand would sound identical to European songs in minor. Rather it is the specific melodic vocabulary used. Just as English, French, and German can be written using the same alphabet, but it is the words (specific arbitrary chunks built by combining smaller units - phonemes for speech, letters for writing - that are stored in a mental lexicon) that differentiate these languages. Similarly to spoken language, the notes (letters/phonemes) are not enough to determine the melodic vocabulary (words) of a maqam, and the amount of melodic vocabulary of a maqam (the number of words in a language) dwarfs the number of notes of its scale (the number of letters in an alphabet).

Musicians learn this melodic vocabulary by ear over a period of years, as do listeners. This melodic vocabulary is what is consistent across (despite?) regional differences in tuning, and is the thing that makes those regional differences mutually intelligible. Similarly, someone from Scotland can recognize the English words of someone from Jamaica despite differences in the vowel and consonant sounds.

This vocabulary shares some of the same usage patterns as the vocabulary of a spoken language: there are common melodic phrases (words) and there are rare ones. Experience and mastery in performance comes from both a larger vocabulary, as well as a more skillful and original way of combining that vocabulary. Vocabulary, crucially, is inseparable from community and the exchange of information. And the spreading and evolution of that vocabulary follows certain predictable patterns: certain elements stay central, certain elements go out of fashion, new vocabulary is created, and becomes more popular, or eventually less popular.

The second broader feature of maqam I would like to discuss is the larger scale structure of melodic movement. Melodies in maqam music do not typically utilize a whole scale all at once; instead, melodies tend to be confined to a range of around 4-5 notes, before eventually moving to another part of the scale. We use the word *jins* (plural *ajnas*) to refer to one of these melodic areas; *jins* is the Arabized version of the Greek word *genus*, and was adopted by Arabs in the medieval period when they read and translated Ancient Greek philosophy and sciences, including music theory. The idea of the tetrachord *genus* was adopted directly into Ara-

bic music theory as the jins - and, for most theorists, a jins is simply the bottom or the top half of the scale, a set of four notes spanning a fourth; each different jins is defined by the unique interval relationships within it.

Although traditional maqam theory defines each maqam as a scale with a bottom jins and a top jins, practice is much richer (see "Maqam Analysis: A Primer" & Inside Arabic Music). Each jins is more than simply a tetrachord: it is an area of melodic activity, with its own melodic vocabulary and a particular mood or character distinct from others. Songs, instrumental pieces, and improvisations in a given maqam modulate through multiple ajnas - and it is these modulations that provide significant moments of drama, excitement, tarab (the state of musical ecstasy) for listeners.

Analyzing the body of repertory in detail, we can observe that, within each given maqam, there are a particular set of jins modulations that are repeated over and over. These modulations become expected in the ears and minds of listeners and musicians alike. They are a matter of social agreement - a form of communication - and simultaneously a matter of cognitive programming and memory (as with any language).

Taking Maqam Rast, mentioned above, we find the following set of jins modulations to be almost universal:

Jins Rast C:	C	D	E1/2b	F	G
Jins Upper Rast G/C:	G	A	B1/2b	C	
Jins Nahawand G:	G	A	Bb	C	
Jins Hijaz G:	G	Ab	Bn	C	

They occur in any order and form a kind of network of possibilities of motion. We find these modulations to be common, but not universal:

Jins Bayati G:	G	A1/2b	Bb	C
Jins Saba G:	G	A1/2b	Bb	Cb
Jins Sikah E1/2b:	E1/2b	F	G	

And we find these modulations to be rare, but not unique:

Jins Saba Dalanshin A/C:	A	B1/2b	C	Db	En
Jins Jiharkah C:	B1/2b	C	D	E (lowered)	

(note: E1/2b = E-half-flat, a note roughly in between E natural and E flat that varies geographically and historically, but still within a narrow range, making it distinct from notes identified as either E natural or E flat, which also display a level of variation)

To the question of how these modulation possibilities arise, we can look more closely at two processes: One, how an individual learns them, and two, how they change over time.

It's very clear to me, as a practitioner of Arabic music who learned the music as an adult (in my early 20s), and who has taught thousands of students over the last two decades, that these modulation possibilities become second-nature to practitioners through repetition over time. That is, by hearing songs and improvisations with particular modulations, the student internalizes and repeats them. The particular modulations sound idiomatic to the student because they've heard them before, hundreds if not thousands of times, and they sound idiomatic to listeners who have heard them before, also hundreds if not thousands of times. They become a vocabulary shared by musicians and listeners. Those who listen to or practice songs in a particular maqam that favor some of the modulation possibilities over others, will favor those modulation possibilities that they heard the most. Thus even listeners and practitioners within the same tradition will show variation resulting, in part, from what portion of the repertory they experienced.

In other words, the modulation possibilities are arbitrary (the result of choice and social agreement), and inherited culturally in the same way as language: through aural experience that creates mental expectations. And not just mental expectations: expectations that are built into the muscle memory of musicians - in that a particular modulation to a jins, with its particular set of intervals and melodic vocabulary, will require a different sequence of muscular actions than would a modulation to a different jins. Fluency is the result of a strong muscle memory of the expected moves.

Yet the maqamat are not static - modulation possibilities change over time. Within Maqam Rast, for example, the two rarer modulations mentioned above (Jins Jiharkah and Jins Saba Dalanshin) used to be much more common in the early 20th century, and gradually fell into disuse. Maqam Kurd saw a major expansion in the mid 20th century, with new modulations becoming popular (hence expected).

Again, we see the same types of trends displayed by spoken language: new vocabulary being added, older vocabulary falling out of use. In both cases - the evolution of the maqam and the evolution of spoken languages - change is glacial, in the sense that the majority of the language doesn't change in one generation (adjacent generations still have to communicate with one another, even if the young have their own new slang), yet there is small change at the periphery of the language that builds up over multiple generations to result in more significant change.

I observe the following interesting tendencies around modulation possibilities within maqamat: Maqamat that are common - meaning they are used in many, many songs - tend to be "bigger" in the sense of having more modulation possibilities. Maqam Rast is very big, whereas, for example, Maqam Nawa Athar is very small.

New modulations tend to be introduced by a prominent artist, then get copied by others, then become commonplace. A great example is the use of Jiharkah and Sikah Baladi on the same tonic (two quite rare and difficult maqamat), which was championed in multiple recordings by the great composer and singer Mohamed Abdel-Wahhab starting in the 1930s. Though rarely used by other singers, it became a commonplace among instrumentalists improvising in the late 20th century. Maqam Kurd saw new modulations added in the mid 20th century, as alluded to above, and many composers began to copy each other in their sequences of modulations.

Numerous maqamat, or modulation possibilities within maqamat, have fallen out of use over the course of the 20th century. Often they start out as relatively rare or obscure modulations to begin with (at least when we have recorded evidence), and then become completely forgotten.

There is some regional variation in maqam usage and modulation possibilities. Similar to the variations in intonation of particular pitches, these differences do not eliminate the mutual intelligibility of the maqam, but do communicate cultural specificity.

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In seeking to explain these tendencies, and the process of change in general, I tend to rely on aesthetic observations. Taking the picture I have painted of the maqam system as a language, with a large vocabulary - on the level of tunings, of melodies, and of larger scale modulations (all of these elements are vocabulary in the sense of arbitrarily chosen content that must be remembered by practitioners and which cannot be "derived" from laws or principles) - it can appear, to some, to be a system too rigid and formulaic to allow for individual expression. Yet it patently does allow for that. How? In several ways - first, and most obviously, by creating new combinations of finite vocabulary items. Like any language, a communication system with a finite lexicon can be used to create infinitely possible utterances. This is a basic fact of any discrete combinatorial system.

However, the real creativity comes in the play of expectation and surprise. We can see this at the level of any individual performance or composition, and it's especially prominent in the case of improvisation. The skilled improviser moves along expected pathways for a time, to establish rapport with the audience, to establish the known identity of a maqam. Then they introduce a surprise - which could simply be an original turn of the melody, or a rare modulation, or something as basic as hinting at a melodic resolution and then thwarting it. Surprise doesn't exist without expectations. If there are no expectations, then nothing can be surprising. Tension, drama, suspense - all of these arise from the play of those two poles.

I'll ask you, dear reader, what I ask students in my classes: If you hear a piece of music that does all the things you expect, and nothing unexpected, how do you feel about it? For most of us, the answer is: it's boring, unoriginal, cliched. If you hear a piece of music that is nothing but surprises, has nothing in it you expect, how do you feel about it? For most of us, the answer is: it's confusing, bewildering, incomprehensible. Thus most music - and frankly aesthetic production in any discipline, including ordinary conversation - must strike an aesthetic balance between expectation and surprise.

The existence of expectations that are shared by large cultural groups means that particular works of art can affect large audiences in a collective way. This is something you can see and hear in real time during the live concerts of Umm Kulthum (many of which can be viewed on youtube): when she makes an unexpected modulation or melodic change,

the audience of upwards of 3,000 people all goes crazy simultaneously - and contemporary listeners familiar with the tradition have the same reactions.

So what does this have to do with the process of change - which, in my framing, is the development of new expectations?

When an artist does something new or surprising, it is a way for them to stand out. Therefore artists are motivated to be original in this way, just as audiences are motivated to seek something new, by their boredom with the familiar. Yet when an artist does something new, if it succeeds, others are motivated to copy it. It's still fresh enough in its copies (and maybe that artist's audience hasn't heard the original yet anyway) to feel surprising, yet simultaneously it starts to build a new familiarity, a new set of expectations, a new shape to the community. Eventually it gets copied enough times that it becomes central to the expectations of the community, and new things are needed to become the next new thing. Rinse and repeat, ad infinitum. Those who try to be too original too fast - by introducing a higher proportion of surprises than the audience can digest - are "ahead of their time" or "avant garde," and sometimes the community catches up to them, and sometimes the community goes in a different direction.

The most successful artists are those who can precariously balance on the collective wave of change within their communities, and by surfing that wave, change its direction - slightly. But this type of change, which is obvious in the case of well known artists, takes place at every level of the community, in the small day-to-day interactions where individuals are compelled to do something slightly new or different, but not so different that they become isolated from their community. These small interactions and changes add up over time. And regardless of the visibility of the originality, it is always so that the pace of change is set by the collective knowledge of the community as a whole, and not by individuals.

This aesthetic discussion addresses change within particular communities. Yet the same processes are at work in the cultural differentiation between distinct communities. Just as individuals seek to distinguish themselves, whole cultural groups distinguish themselves from each other through the use of cultural signs - whether that is music, cuisine, dance, fashion, poetry, visual art, or language. Like it or not, culture is one of humankind's tools to create boundaries and borders between communities, to distinguish in-group members from out-group members.

Because the process of change is glacially slow - in short, the center remains the same while the periphery changes, and only over time does the periphery become the new center - the process of differentiation between cultural groups takes place slowly and gradually. Groups farther apart geographically by and large display larger cultural differences. Cultural splits can happen anywhere, but usually take at least a generation to create truly distinct communities.

Before the history of recorded music and the speeding up of cultural change that has accompanied it, this was harder to observe. But now we can listen to over 12 decades of recorded music and hear the splits happening, as new subcultures form around new genres of music and art; or as communities that split for other reasons make their cultural products more distinct from their new enemies (witness the process of erasure of microtonality in Greek music, alluded to above, that followed the mass population exchange between Turkey and Greece following the end of the Ottoman Empire).

Tuning practices are simply another of these cultural phenomena that change for aesthetic reasons and that serve as markers of specific communities. The differences - even differences of 1-3 cents - are essential, they are not insignificant variations that can be explained away by the proximity of some Platonic ideal dear to the theorist. Those differences are also what enable any given musical system to give rise to new and original aesthetic experiences.



A scale tuning reflects social agreement. A particular community, society, group, or subgroup wishes to identify itself, and doing so through the use of a distinct melodic practice is one common method. Each such community has numerous common "languages," which include obviously the particular dialect or idiolect of spoken language they use, but also dress, cuisine, art, music, and social mores. All of these cultural languages have two essential characteristics: unity within the group vs. distinction from other groups.

In the case of Arabic music, the tuning system reflects a combination of factors - the Pythagorean legacy of tuning stringed instruments in just

fourths (as the oud has been tuned for a millennium and a half), the use of other culturally-variable pitches, the cultural influence of the West and the use of Western instruments that has pushed the scales toward 24EDO in some settings. In every case, choices are being made that respond to influences, but are not determined by those influences. Arbitrariness - free choice - always remains even when influence is strong.

On the other hand, we can explain the Western microtonality community as a group with a social agreement that the best way to construct scales is through particular formulas or schemas. They agree on it. That makes them different from, say, the community of Arab musicians and how we decide on tuning, which is primarily through aural inheritance.

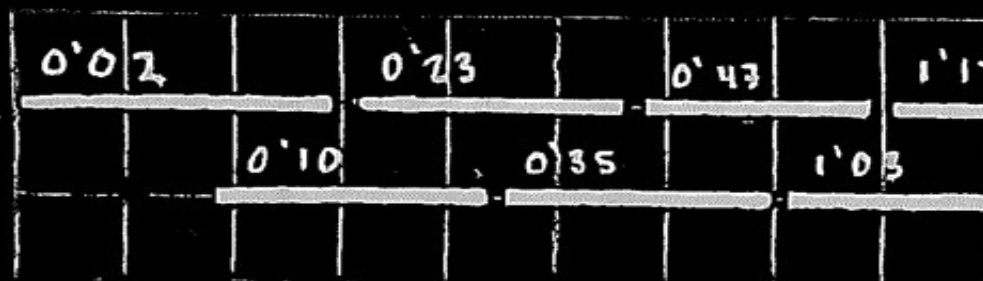
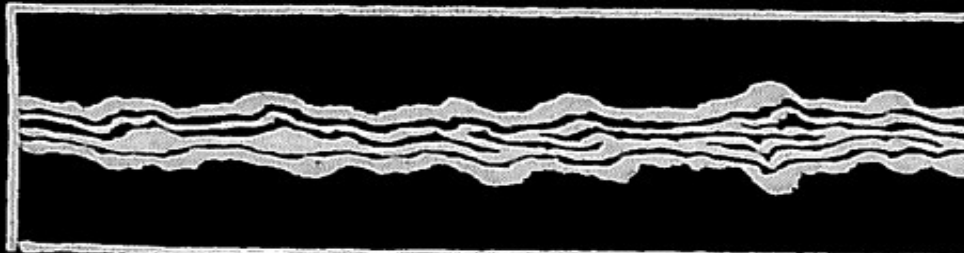
They - the microtonalists - can tune their scales how they want, and use those scales however they wish musically. But they (you?) can't tell us, Arab maqam musicians, how to tune our scales. (Or they can, but we don't have to listen). We have our own processes. We choose our intervals because we like particular sounds - and that "liking" includes much more than whether or not something is a mathematically- or acoustically-defined consonance. It can include the desire to change the pitch ever so slightly from that used by the previous generation, or the neighboring town. It could include the desire to use Western instruments, or the desire not to.

In other words, if you'd like to learn about maqam scales, you'll have to learn from practitioners by ear, and dismiss all the theories you've heard about tuning. And - if you'd like to theorize about microtonality as used by groups you're not a part of, you'll have to accept that there are no universal laws governing scale tuning, and that each culture's choices need to be understood on their own terms.

~

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Demian

Araya Lobos

The revolution of Sonido-13 Today

Introduction

Julián Carrillo's microtonal works take place within a context of intense exploration in the field of Western music. At the same time that great composers such as Schoenberg were publishing their treatises on music theory, they also posed challenges to the theory itself, often presenting these as the most promising trends for the development of music. At this point, for some composers, the selection of twelve-tone equal temperament began to be seen as just one of many possible configurations for a set of pitches. Composers like Alois Hába or Ivan Wyschnegradsky proposed highly elaborate systems and even sought to organize tunings with 72 equal divisions of the octave (72-EDO), although still firmly operating within the standard system of 12-EDO. On the other hand, Julián Carrillo, referencing his own research more than that of other composers, advanced a proposal that, as we will see, would prove valid not only for 96-EDO but for any type of tuning. The qualities that make it optimal for adapting to different systems are the regularity of its notation system and the unlimited theoretical exploration it allows to be put into practice.

Part 1

The current system of musical notation has primarily focused on the staff system. This method has been reinforced and defended by music academies with various arguments, becoming established as the default system for written musical representation. In contrast, significantly less development has occurred even in systems of notation for percussion and instruments without a defined pitch. For microtonal music, efforts have been made to define its written representation and attempts have been made to incorporate it into the conventional notation system. However, these efforts have been based on theoretical frameworks emerging from Western academia, often rooted in conservative and continuist perspectives — even among the most revolutionary theorists. Julián Carrillo's notation system arises embracing the trend of renewal and universalization that was a common part of public discourse in Mexico and much of the musical academy of the time. Yet, it takes this trend to its most radical extreme, even questioning the organization through staves, considering

that the standard of writing, even within the 12-EDO system, can create unnecessary problems that complicate reading. Although Carrillo's proposal introduces novel elements, it is not entirely disruptive and can be considered to share similarities with other historical proposals. We can observe that the notation system proposed for pieces composed by Carrillo — even in his most advanced scores — still attempts to maintain a certain continuity with the tradition of musical writing. This spirit of continuity sometimes interferes with the possibilities offered by such a revolutionary proposal as the "Sound 13." For this reason, it also presents opportunities to further develop an accurate system of registration for microtonal music through scores.

The aim of this essay is to revisit the fundamental aspects of Carrillo's theory to consolidate them into a system that addresses the problems of the original theory without introducing new complications, as far as possible. Additionally, within the scope of this essay, a mathematical property is demonstrated that allows the maximum potential of such a system to be applied in xenharmonic tunings. Likewise, some experiments already conducted by me are briefly outlined.

Part 1.1

The writing system that accompanies the proposal of "Sound 13" incorporates novel elements while resembling a generalization of the traditional notation system. The most noticeable quality it presents is the use of numbers to represent sound elements organized within a defined set. This implies that, in general, clarity is required regarding the sound each number represents, as well as indications that represent variations in their characteristics. The original proposal is still influenced by traditional notation, and therefore, in addition to the numerical system, it retains the visual arrangement by note height to represent octave variations. This variation in height conflicts with the goal pursued by using numbers to represent sounds, since numbering simplifies the visual conception of moving up and down pitches on the staff, making the representation of its elements more compact by relying on a symbolic figure that represents them, thereby making the concept of "pitch" in scores more versatile. Due to this symbolic and abstract quality of numbers, they can equally adapt to defined tones, indefinite-pitched sounds, or even

complex sonic objects. Undoubtedly, unlimited potential can be found for the development of theories applicable to equal divisions of tunings over a period.

However, traditional notation has the advantage of showing polyphonies more intuitively, and in this regard, Julián Carrillo's system faces a significant difficulty. With the original proposal, there are two ways to address this difficulty: multiple independent melodic lines can be written when dealing with polyphonies with more constant voices (Image 3), and on the other hand, vertical grouping within the same system can be used (Image 2). However, this requires notable complementation in the interpretation of the numbers as tones within a specific chordal arrangement, as additional vertical numbers are added to indicate variations in the number of voices with limited range. Additionally, the original proposal includes numbers crossed out by the line of the "absolute tone," which elegantly saves a significant number of lines but also requires a more complex process to determine the octave to which a specific number belongs, since part of this information is inferred from the position of the number rather than the signs associated with it, especially in the case of polyphonies.

The difficulty lies in the dependence of each number on its position within the grouping, rather than being interpreted individually as an obvious sign. As Benjamin (1982) states: "Chordal writing is achieved by relating all vertical numbers to the highest number and its position on the absolute C line." Furthermore, when positioning pitches with a more complex distribution, horizontal position is also relied upon, because "the displacement of chordal octaves is indicated by movements of the numbers to the right or left," as seen in Image 1. This property makes its use practically impossible outside the context of chords with homogeneous rhythm between their notes. If polyphonies with heterogeneous rhythms for the notes are established, this vertical arrangement becomes impractical.

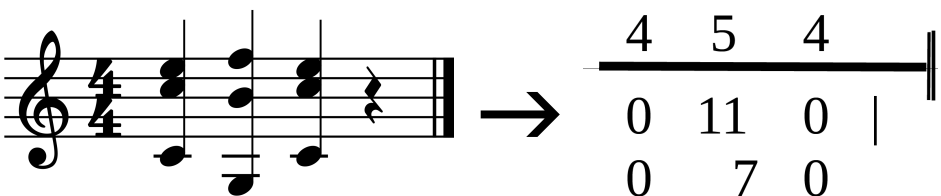


Image 1: Octave displacement

Notación de Julián Carrillo

0	2	4	5	7	9	11	0̄
7 4 0	11 7 2	0 7 4	0 9 5	4 0 7	5 0 9	7 2 11	7 4 0

0	11	10	9	7	5	2	0
7 4 0	7 2 11	7 0 10	5 0 9	4 0 7	0 9 5	11 7 2	7 4 0

Image 2: Polyphonies in two systems

Notación de Julián Carrillo

Violin I
4os. de t.

pp

Violin II
4os. de t.

pp

Image 3: Fragment of a polyphony

Part 2

I decided to make a major change by completely eliminating the organization by pitch that was still present in the original proposal (Image 4). The current system is more similar to tablature but can also be considered a generalization of tablature, just as it can be considered a generalization of the staff, since this system allows its representation to be detached from a specific instrument. Consequently, the number of available numbers and the number of lines can be varied, as they are not associated with real strings but with the voices of an instrumental polyphony. Another strength it gains from its resemblance to tablature is that it can be easily incorporated into the music notation software MuseScore, although without full functionality regarding tone variation, being limited to a visual representation.

Additionally, the consistency of the rhythmic and expressive sections with respect to standard notation takes advantage of elements that facilitate learning and interpretation. I eliminated the line that crossed out the numbers in the central register as a way to make the new height-free organization clearer and easier to interpret.

In this way, the central register only presents the numbers as they are. Instead of raising the numbers above the lines — which represented octave changes when moving up in pitch — I am experimenting with a system that consists of stacking lines below the numbers. Similarly, to move down in pitch, lines are stacked above the number. Eventually, for a stack of more than three lines, it would be convenient to resort to another symbol. However, for now, the system provides adequate range for most experimental needs, so a different proposal is not yet necessary. Eventually, a solution very similar to the one used by the Maya could be adopted: writing dots for units and using a line when reaching 5 (Image 7). Both methods have their own difficulties,

and neither is infallible. For the purpose of providing examples within this essay, I defined the linebased method. However, the dot-based method or any similar approach is valid as long as it maintains consistency.

Regarding polyphonies, this system allows for the easier incorporation of parallel melodic lines within the same system. However, as in the original proposal, it is advisable to use separate systems for parallel melodic lines that involve complex polyphonies.

29

R: 4 0 7 4 10 7 | 0 2 0 10 9 10 9 7 5 7 5 3 | 2 7 5 4 5 4 2 0 2 0 10

L: 7 10 9 10 7 10 9 10 7 10 9 10 | 4 0 5 0 9 5 | 10 0 10 9 7 9 7 5 4 5 4 2

32

R: 9 10 9 7 5 5 4 5 9 | 10 5 9 5 7 5 | 5

L: 0 5 4 2 4 2 0 10 0 10 9 | 7 9 7 5 0 10 9 10 0 0 | 5

Image 5: More complex polyphony notated. Last notes of BVW779 in the general system

Pentagramma

General

8

0 2 4 5 | 7 9 11 0 | 2 4 5 7 | 9 11 0 2 | 4 5 7 9 | 11 0 2 4 | 5 7 9 11 | 0

Image 6: Range for the general system

The image displays two systems of musical notation. The first system, starting at measure 16, is written in bass clef. It shows a sequence of notes on a staff with a dotted line and the number '8' above it, indicating an octave. Below the staff is a guitar fretboard diagram with fret numbers: 0-2-4-5, 7-9-11-0, 2-4-5-7, 9-11-0-2, 4-5-7-9, 11-0-2-4, 5-7-9-11, and 0-2-4-5. The second system, starting at measure 24, is written in treble clef. It shows a sequence of notes on a staff with a dotted line and the number '8' above it. Below the staff is a guitar fretboard diagram with fret numbers: 7-9-11-0, 2-4-5-7, 9-11-0-2, 4-5-7-9, 11-0-2-4, 5-7-9-11, and 0. The piece concludes with a double bar line.

Image 7: Dot-based method

2.

Associated with this writing system is a mathematical system that runs in parallel, but only as a theoretical connection and not as a requirement or method of justification for it. Undoubtedly, it can be useful when working with xenharmonic tunings and may serve as a reinforcement for exploration through this system, but auditory perception will always remain the empirical guide for any composition.

2.1

The organization obtained through the measurement of cents is similar to the organization performed by a MIDI synthesizer to associate keys with specific tones, because in both cases a base-12 system is used to organize pitches at equal intervals. If we view the organization of MIDI signals within a standard synthesizer in the most general way, we can compare the theory of acoustic music with the theory of electronic music. For this, it can be said that the cents scale is like musical intervals (minor 3rd, diminished 5th, major 7th, etc.), and the MIDI scale is like notes in their specific realization within the tuning standard (C4, D4, E4, etc.).

This similarity lies in the fact that cents and musical intervals are not associated with a specific frequency nor do they depend on a particular tone or frequency to be applied, because they depend on a relationship of quantities. On the other hand, notes, according to their names, are usually associated with a standard frequency, where A4 = 440 [Hz].

Similarly, the numbers within the MIDI signal organization follow a standard where 60MIDI = C4 = 261.6 [Hz]. The purpose of this generalization is to apply these concepts to xenharmonic music. In calculations, we will encounter rational and irrational numbers, and therefore it is convenient from now on to separate the term "MIDI" from its immediate realization as an electronic signal and also from its role as a specific key on a controller. A general formula can be obtained that relates any frequency f to a value n [MIDI] within the 12-EDO tuning standard. Likewise, for the frequency f , a value m [MIDI*] can be obtained that is associated with any kind of reference ratio, where 12-EDO is only a particular case. Furthermore, below it is demonstrated how to relate n and m to compare intervals between tunings, for example, to determine what the 7th degree of 13-ED3 corresponds to in 12-EDO, or vice versa.

To obtain n [MIDI] and m [MIDI*] as reference methods:

$$(1.1) \quad n = 12 \times \log_2(f/C)$$

$$(1.2) \quad m = T \times \log Q(G)$$

where:

f = frequency in Hz for n

C = reference frequency $C0 = 8.17$ Hz

T = number of notes per cycle

Q = value of the octave, pseudo-octave

G = any proportion

(any number $x > 0$ such that $\in \mathbb{R}$, for example: $3/2$, $6/5$, $2/3$, 1.51923 , etc.)

in (1.1) $G = f / C$ can be equated, and then with respect to G to obtain:

$$\rightarrow \quad 2^{\frac{n}{12}} = Q^{\frac{m}{T}}$$

$$\rightarrow \quad \ln 2 \times \frac{n}{12} = \ln Q \times \frac{m}{T}$$

therefore, we obtain:

$$(2.1) \quad n = m \times \left(\frac{12 \times \ln(Q)}{T \times \ln(2)} \right)$$

$$(2.2) \quad m = n \times \left(\frac{T \times \ln(2)}{12 \times \ln(Q)} \right)$$

that is :

$$n = k \times m$$

where:

$$k = \frac{(12 \times \ln(Q))}{(T \times \ln(2))}$$

$$m_1 = m_2 \times K$$

where:

$$K = \frac{(T_1 \times \ln(Q_2))}{(T_2 \times \ln(Q_1))}$$

In this way, with (2.1), the value of n [MIDI] corresponding to a value of m [MIDI*] can be calculated. That is, an interval that does not belong to 12-EDO can be converted into its equivalent as an interval within 12-EDO. Likewise, with (2.2), an interval within 12-EDO can be converted into its xenharmonic equivalent.

For example, if we want to convert an interval from 13-ED3 to its equivalent in 12-EDO, we would apply formula (2.1). In this case, if we convert degree 8 of 13-ED3 into its 12-EDO equivalent, we have m=8, T= 13, Q= 3.

Then:

$$n = 8 \times 1.463$$

$$n = 11.7043$$

Since 11.7043 [MIDI] is close to 12 [MIDI], it can be concluded that degree 8 of 13-ED3 is a tone close to degree 12 of 12-EDO. And since [MIDI] values are equivalent to [cents], it is seen that it is below the octave by approximately 30 [cents]. The same principle can be applied to compare two intervals m_1 and m_2 belonging to any two xenharmonic tunings. Of course, the result will no longer be within the cents system and can only be considered a general case for [MIDI*] values of any reference scale. This is done using the general formula (3.1):

$$(3.1) \quad m_1 = m_2 \times K$$

Where:

$$(3.2) \quad K = \frac{(T_1 \times \ln(Q_2))}{(T_2 \times \ln(Q_1))}$$

For example, if we evaluate degree 10 of the tuning 23-ED5 relative to the tuning 13-ED3, we can substitute into formula (3.1) with:

$$T_1 = 13, Q_1 = 3, m_2 = 10, T_2 = 23, Q_2 = 5$$

Then:

$$m_1 = 10 \times 0.828$$

$$m_1 = 8.28$$

From this, it can be concluded that degree 10 of 23-ED5 does not correspond to any exact degree of 13-ED3, but it lies slightly above degree 8, approximately one-quarter of a unit higher.

2.2

There is another property that can be observed when considering tunings and their degrees using this numbering system. We can see how it emerges by analyzing the 12-EDO tuning. If we choose this tuning, its qualities will be linked to those of the number 12, which is divisible by 6, 4, 3, and 2. This implies that the tunings 6-EDO, 4-EDO, 3-EDO, and 2-EDO are subsets or scales within 12-EDO. Thus, it can be verified that 6-EDO is a subset of 12-EDO, corresponding to the whole-tone scale, where there is an interval of one tone between each note. This means that if we write out the equivalent degrees of each tuning extensively, it looks like this:

[6ED2]: 0, 1, 2, 3, 4, 5, 6

[12ED2]: 0, 2, 4, 6, 8, 10, 12

Where it is evident that the degrees of 6-EDO have been multiplied by 2. Therefore, in a 12-EDO tuning, degree 10 is exactly the same as degree 5 in a 6-EDO tuning, meaning that these degrees are at the same distance in cents relative to the root note 0.

We can verify that this property, being related to the properties of numbers, holds true for any tuning within the same octave or pseudo-octave of reference.

For example, if we compare 5-EDO and 15-EDO:

[5ED2]: 0, 1, 2, 3, 4, 5

[15ED2]: 0, 3, 6, 9, 12, 15

It is evident that the degrees of 5-EDO have been multiplied by 3 to obtain degrees within 15-EDO with an equivalent size in [cents]. However, if we compare the [cents] of each degree, the [cents] corresponding to each degree of 5-EDO are actually divided. Degree 1 of 5-EDO has 240 [cents], as does degree 3 of 15-EDO, which can be summarized as:

$$\{1, 5ED2\} = \{3, 15ED2\}$$

But degree 1 of 15-EDO has 80 [cents], meaning:

$$\{1, 5ED2\} / 3 = \{1, 15ED2\} = 80 \text{ [cent]}$$

In fact, Julián Carrillo used this principle in his own way to design the metamorphic pianos, as they follow a generative principle that can be visualized in this way:

$$\{1, 6ED2\} = 200 \text{ [cent]}$$

$$\{1/2, 6ED2\} = \{1, 12ED2\} = 100 \text{ [cent]}$$

$$\{1/3, 6ED2\} = \{1, 18ED2\} = 66.6 \text{ [cent]}$$

$$\{1/4, 6ED2\} = \{1, 24ED2\} = 50 \text{ [cent]}$$

etc.

Based on this basic property, an important consideration must be made regarding number theory, which also applies to xenharmonic tunings. We must observe how, in the generation of all integers, prime numbers appear as factors. In the same way, prime numbers are the basis of all tunings. For example, 12-EDO is formed only with the primes 2 and 3. If we create tunings based on other prime numbers, the values in [MIDI] and [cents] for the formed degrees will have rational figures because they perform

a division over the base 12 with factors other than 2 and 3. From this, we can define the regular generator interval, which corresponds to the interval that allows reconstructing any equal division tuning (EDO) by only knowing the information expressed in the form $\{1, XEDY\}$, where 1 is degree 1 within the tuning, and X and Y are two real numbers.

Then, the $\{1, XEDY\}$ for any prime number X will be the basis for constructing tunings with intervals associated with the prime number and will contain relevant information about the entire tree of tunings XEDY that can be constructed as factors of X.

For example, for all XEDY tunings that are even, it is known that X will be a factor of 2, and therefore, all even tunings will have the interval {1, 2EDY}. This can be applied to 12-EDO: we know that one of the factors of 12 is 2, so the interval {1, 2ED2} = 600 [cents] belongs to 12-EDO, which can be verified since:

$$\{1, 2ED2\} = \{6, 12ED2\} = 600 \text{ [cent]}$$

The same happens for other tunings with even divisions:

$$\{1, 2ED2\} = \{7, 14ED2\} = 600 \text{ [cent]}$$

$$\{1, 2ED2\} = \{8, 16ED2\} = 600 \text{ [cent]}$$

$$\{1, 2ED2\} = \{13, 26ED2\} = 600 \text{ [cent]}$$

$$\{1, 2ED2\} = \{31, 62ED2\} = 600 \text{ [cent]}$$

etc.

And of course, this type of interval can be found in all tunings associated with prime numbers, forming trees like this one associated with the number 3:

$$\{1, 3ED2\} = \{2, 6ED2\} = 400 \text{ [cent]}$$

$$\{1, 3ED2\} = \{4, 12ED2\} = 400 \text{ [cent]}$$

$$\{1, 3ED2\} = \{7, 21ED2\} = 400 \text{ [cent]}$$

etc.

When prime numbers are combined, the resulting tunings retain the generator intervals of each tuning, but an operation of subtraction between the [cents] quantities is performed to obtain the generator interval of the resulting tuning.

For example, when combining {1, 2ED2} with {1, 3ED2} to obtain the interval {1, 6ED2}, the subtraction of [cents] is performed:

$$\{1, 2ED2\} \times \{1, 3ED2\} = \{1, 6ED2\} = 200 \text{ [cent]} (600 - 400)$$

Thus, 6-ED2 shares the intervals of the prime factors that generate it and adds two new ones that are not present in the primes:

$$\{1, 6ED2\} = 200 \text{ [cent]}$$

$$\{1, 3ED2\} = \{2, 6ED2\} = 400 \text{ [cent]}$$

$$\{1, 2ED2\} = \{3, 6ED2\} = 600 \text{ [cent]}$$

$$\{1, 3ED2\} = \{4, 6ED2\} = 800 \text{ [cent]}$$

$$\{5, 6ED2\} = 1000 \text{ [cent]}$$

etc.

Part 3

Despite being a pioneer and revolutionary figure in his field, Julián Carrillo was also deeply influenced by his local context, as he demonstrates in relation to microtonal music, where he

allegorically positions himself as a Spanish colonizer discovering America. This is an archetype he used at various points throughout his career, which contrasts with the material conditions under which this artist developed his proposal for "Sound 13." Similarly, this is evident in the way European and Euro-American audiences perceived Julián Carrillo's work when they first encountered it. Stokowski expressed it directly: "Fortunately for America, we do not need to look to European musicians for this

revolution, since we owe everything to an Indian descended from the children of this continent." It is clear that, in reality, Julián Carrillo, with his exotic ideas, represented the role of the indigenous person being discovered rather than the colonizer.

However, both Julián Carrillo and Western opinion fail to achieve a full appreciation of the riches of the new world that are mutually revealed. The dominant viewpoint in the West tends to regard the indigenous and native cultures of America as objects of study

or curiosities to be preserved in museums, historically assigning little value to their role as part of a living and dynamic culture. This perspective is also replicated in the institutions where research and ideas are produced, perpetuating theories and practices that no longer adapt to the verifiable realities revealed by the research itself.

We can verify that studies on the customs and languages of the peoples of America were scarce before the 19th century, and when they did exist, they were completely guided by the interests of foreign authors. Only in the 20th century were works published in greater numbers from the perspective and interests of native authors. Now, in the 21st century, faced with the accumulation of a vast amount of documents that speak to the rich intellectual life of Native America, there is growing appreciation for indigenous heritage as a millennial legacy that we must recreate. However, significant efforts remain to be made to democratize access to knowledge and research. It is within this context that the theory of Sound 13 is situated. In 1925, governments across the Americas were

working intensively to promote a national discourse through propaganda networks that pushed patriotic narratives. Particularly in Mexico, the established discourse oscillated between the Hispanic, the mestizo, and the indigenous,

each inscribing its own field of action and its own seasons, with varying advances, setbacks, and common points. From this, we can see how the established power encourages artistic creation that reinforces its narrative. Julián Carrillo benefited from this and traveled to Europe, like other artists, to further his studies in composition.

Meanwhile, from opposition to the government, a clear musical trend rooted in folklore emerged, where popular song sought to highlight historical figures and moments, especially from the trenches of Emiliano Zapata, some of whose manifestos were written in the Nahuatl language. However, we can verify that his ideas were aimed at uniting all national identities: "To redeem the indigenous race, returning their lands to them, and thus their freedom; to ensure that the rural worker [...] becomes a free man and master of his destiny through small property ownership; to improve the economic, intellectual, and moral condition of urban workers."

This is also clearly seen in the Manifesto of the Union of Technical Workers, Painters, and Sculptors, where arguments are made in such a direction, seeking unity among different discourses: "The triumph of the popular classes will bring with it a flourishing, not only in the social order but a unanimous flourishing of ethnic, cosmogonic, and historically transcendent art in the life of our race, comparable to that of our admirable autochthonous civilizations; we will fight tirelessly to achieve it." However, and this is a tendency we will also see later in Julián Carrillo's discourse as a way to reinforce the revolutionary intention of the manifesto, when arguing, they resort to methods against which they find themselves confronted. In this sense, Attali provides a deeper analysis of this intersection between music and power in his book *Noise* (1978): "The theorists of totalitarianism: all of them, without exception, explained that subversive noises must be prohibited because they announce demands for cultural autonomy, claims of difference or marginality: the concern for maintaining tonalism, the primacy of melody, the distrust of languages, codes, new instruments, the rejection of the abnormal, are found in all those regimes."

In this sense, the Manifesto of the Union of Technical Workers, Painters,

and Sculptors expresses a purifying intention in no uncertain terms, proclaiming through Siqueiros' pen: "Any aesthetic manifestation alien or contrary to popular sentiment is bourgeois and must disappear because it contributes to perverting the taste of our race, already almost completely perverted in the cities." This once again leads to the contradiction between what spontaneously arises on the margins of the musical field and what seeks to establish itself as the most idealized representation of a ritualistic and communal expression of a group. Carrillo had a more elaborate intuition of this revolutionary inspiration within the artistic realm, but instead of defining himself by preserving a tradition, he sought the creation of new structures and new languages. On one hand, this poses the critique that considers his work as detached from the languages used en masse, and even regards this type of language as a mere mathematical elaboration without artistic application. But ultimately is a experimental tendency that is always emerging.

Part 4

To put the content of this essay into practice, for the past couple of years, I have been working on various microtonal music projects, especially through digital means. For this purpose, I created a plugin to synthesize microtonal tunings, supported by a DAW. Initially, I reviewed various plugins that offer configurations for microtonal music; however, many of these applications have limitations that did not align with the experiments I was conducting, nor did they provide the information and results I was seeking. Therefore, after understanding the basics of how synthesis works, I set out to design a plugin using Pure Data to achieve customized results, while also gaining a detailed understanding of the processes taking place within the application itself. After researching different synthesis methods and developing a simple program for additive synthesis, I was able to confirm that one way to optimize synthesis to achieve an attractive timbral character was through modular synthesis. For now, I have replicated a model similar to that of the Yamaha DX7, but this system is still designed for electronic support. Currently, digital support allows for different possibilities. There are already synthesizers taking advantage of these possibilities, such as Vital, which incorporates configuration options and the integration of audio samples that are only possible in the digital environment.

Additionally, more advanced functions will be integrated into my microtonal synthesizer in future updates. The patches I have developed are "xsynth" and "xem"; the first allows control of modules using additive synthesis, while the second is a system much more similar to the DX7, using algorithms to connect the modules. These can be found on patch-storage.com as Pure Data files compatible with Camomile. Regarding composition, it is possible to find patterns similar to those that form the basis of harmony. In particular, there are intervals that can be associated in the context of a tuning as dominant tones, usually their proximity to the 7th degree of 12-EDO marks the similarity, but this is a topic for further exploration.

Conclusion

In conclusion, we are once again at a historical moment where technological resources are optimal for musical experimentation, and where theories and narratives need reconstruction. Music has always played a role in the culture of peoples; sound production has been both a collective effort and a personal process of composition and motif development. This development, when centered around a system like the 12-EDO equal temperament tuning system, allows for the production of an infinite number of works, but it will always be an infinity of works within the same production model. Therefore, if new tunings are incorporated, creative momentum will eventually seek new boundaries amidst the overwhelming noise, leading to the creation of works with potential that is unimaginable today.

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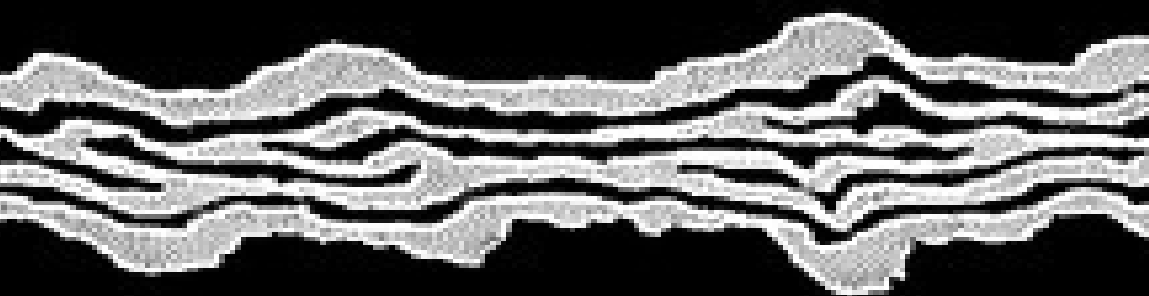
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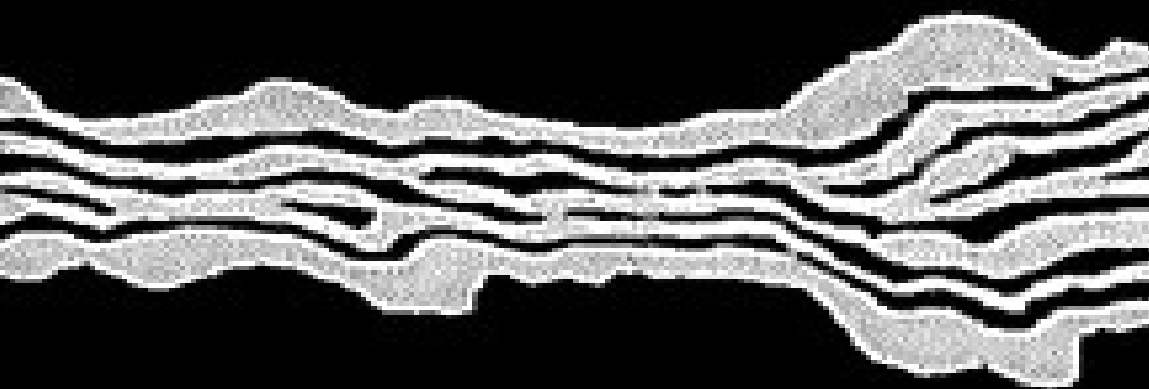
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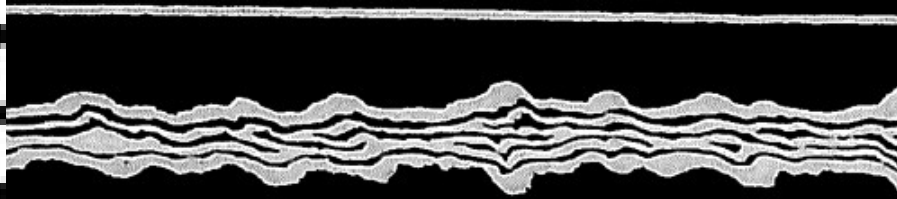


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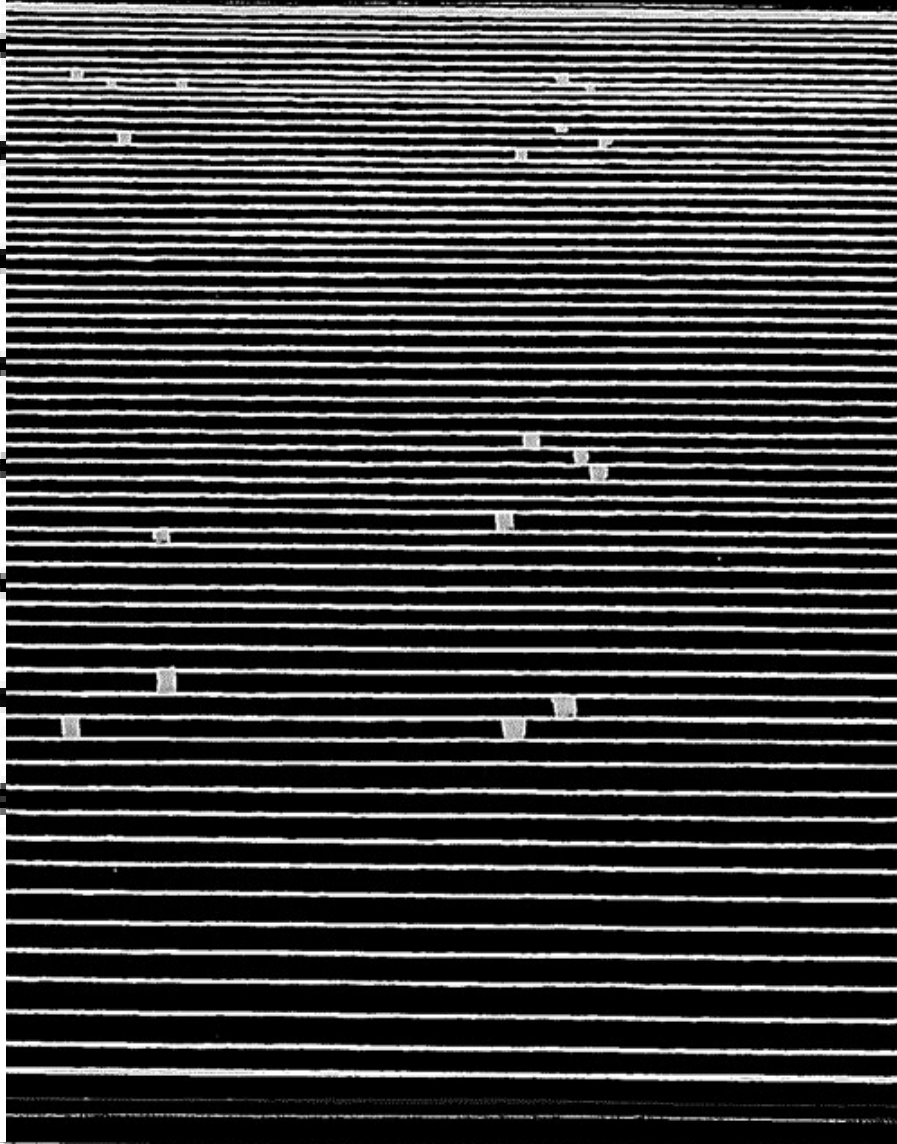


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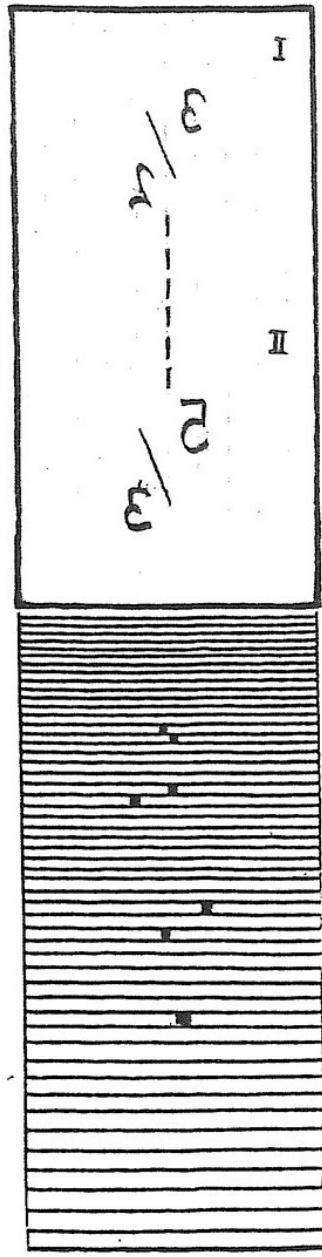
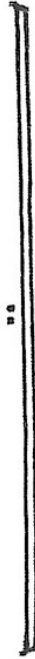
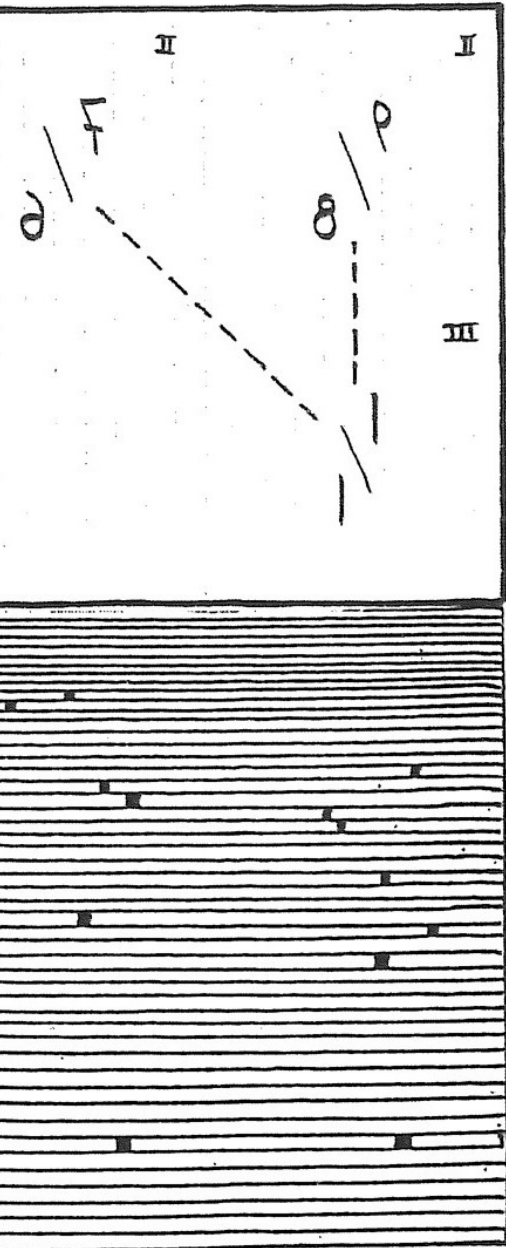
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2'35	2'57	3'25	3'54	4'22	
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Orlando

Zavala Galindo

The Pythagorean

Xylophone

When Pasteur began his work in bacteriology, he was satirized. Why bother with such trivial matters? What practical importance could microbes have? What prejudices could they cause if they were so small and no one could see them? The same thing would happen with the Sonido 13 Revolution. “¿What purpose can intervals smaller than a semitone serve?... Many musicians say...”¹

-Julian Carrillo

Introduction

In 2011, I discovered the theory of Sonido 13, developed by the Mexican musician and composer Julián Carrillo. In 1895, Carrillo carried out a bold experiment: dividing the octave into 96 equal parts. From that moment on, I was fascinated by the new sonic universe that unfolded before me—a vast, avant-garde, and relevant world that, unfortunately, seemed to go unnoticed by most.

After studying his theories and listening to his music, I felt an irrepresible urge to create and explore those sounds. However, I faced a major challenge: the lack of instruments capable of producing such small intervals—tiny sonic distances between one tone and another.

With a background in engineering and experience handling industrial tools, I decided to take on that challenge. That’s how I became a builder of microtonal instruments, with the goal of contributing to the development of this music. In 2012, I built my first xylophone, an instrument that divides the octave into 78 parts. Unfortunately, I was unable to document its construction. In 2024, I built a new xylophone that divides the octave into 53 parts, which is the central focus of this article.

I believe one of the great challenges of microtonal music is the creation of a full range of instruments that can produce intervals smaller than a semitone. These instruments open up a world of possibilities for composers and performers, allowing them to explore and expand their creativity in a sonic space that, until recently, seemed out of reach.

This construction project has deeper roots—the origin of these percussion instruments lies in a trade I’ve practiced for years: auto bodywork, a craft I inherited from my father. In 2011, while we were working on repairing a truck chassis, after each chisel and hammer strike, I began to

hear a shimmering sound that seemed to float in the air. At that moment, I didn't know I was hearing harmonics; I called them "the true sound of things."

This discovery sparked deep curiosity in me, so I began experimenting with every chisel in my workshop. I hung them with strings and struck them one by one. To my surprise, they produced resonant sounds with a very particular timbre. I recorded some of those early explorations, which I still keep as part of the process that led me to imagine a new kind of instrument. These can be heard at the following link: <https://www.youtube.com/watch?v=6p3WTsa3BFA>

That same year, I was fortunate to study in what was once the home of Maestro Julián Carrillo. There, I had direct access to his legacy: I played the 16 metamorphosing pianos (each designed for a different fraction of a tone, from whole tones to sixteenths of a tone), explored his harps, and consulted his library. It was a deeply enriching experience, both intellectually and sensorially, being exposed to the largest collection of micro-intervals in the world.

After living with these sounds—the ones I discovered in my tools and those Maestro Carrillo unveiled more than a century ago—I understood the need to bring them back within reach of contemporary musicians and composers.

Thanks to my training in civil engineering and my experience with industrial tools, I began testing different materials and observing how they responded to specific dimensions. The process was demanding: it brought together diverse disciplines, from mathematics and musical acoustics to carpentry, metallurgy, and experimental lutherie. It required countless trials until I found the exact sound I was looking for.

In addition to the technical challenges, I also faced major financial difficulties. Building these instruments requires a significant investment in specialized tools, high-quality materials with uniform composition, and above all, a great deal of time. Designing and constructing this instrument took me about eight months of intermittent work, as I needed to take on other non-musical jobs to support myself and fund the project. Unfortunately, institutional support for such initiatives in my country is very limited, if not entirely absent.

Without intending to make comparisons, I feel a deep connection with

Maestro Julián Carrillo not only in our sonic pursuits, but also in our origins. Carrillo identified himself as “an Indian descended from the original owners of the continent,” proudly reclaiming his Indigenous roots. In my case, my mother is an Indigenous woman and a migrant from Oaxaca living in Mexico City. I mention this not as a story of overcoming adversity, or from a decolonial stance, but as a fact that forms part of my identity and inevitably shapes the way I listen, build, and imagine music.

Despite all that I’ve shared, I cannot call this effort a “sacrifice.” Because preserving, developing, and innovating in the field of Mexican microtonal music is work that is entirely worth it. Every sound discovered, every note tuned, every instrument built is a way of keeping a unique tradition alive and opening new pathways for the musical creation of the future.

Origins and Theoretical Foundations

The Pythagorean Xylophone, an instrument that is the result of deep theoretical research and constant technical experimentation. This project was born from the need to put into practice and at the same time test two central theories: 1) the theory of the 53 Pythagorean commas and 2) Augusto Novaro’s approach to geometric progressions applied to tuning. This article constitutes an effort to document the process of creation-construction of the instrument, as well as the experience of its presentation. The Pythagorean Xylophone is based on the research of Julián Carrillo on microtonal tuning and the division of the octave into 53 Pythagorean commas:

The most recent demonstration that the Pythagorean commas are only theory, I had on one of my last trips to Paris, on which occasion I took my sixteenth-tone harp. In those days the great French musician, M. Edmond Costere, was making a careful study of those 53 Pythagorean commas, and when he was told that the harp of my invention had ninety-six different sounds in the so-called octave, he expressed disgust and assured that such a thing was impossible, since it would be going beyond the 53 Pythagorean commas, which represent the limit of audible sounds in an octave.

From the 53 Pythagorean commas came the theory that says that the tone is formed with nine commas, and as in the major diatonic scale there are five tones, it turns out that five times nine is 45, plus two small semitones of four commas each, adding up to a total of 53.²

On the other hand, Augusto Novaro's research indicates that:

After studying various series of geometric progressions, of which a few have been noted, we will now present those that have the greatest musical qualities. These are three, made up, respectively, of the ratios 1.013164, 1.00535 and 1.00262.

The ratio 1.013164 gives us 53 sounds equal to each other in the duplo, we will limit ourselves to comparing their main values.

The consonances and their respective imitations with said series are the following:

Natural System	Approximate natural system
1	1
1.2000	1.2009
1.2500	1.2490
1.3333	1.3334
1.5000	1.4999
1.6000	1.6013
1.6666	1.6654
2	2

(Table 1. Constructed with information from the book "Natural and approximate natural system". by Novaro, Augusto (1929) page 45-46. Mexico. S/Ed.)

and consequently the following are equally good imitations in proportion to the intervals:

25/24, 16/15, 10/9, 9/8, 16/9, 9/5, 15/8, 48/25, all related to the third harmonic scale and very useful in music.

It is shown by the above and verified by the experiments carried out in practice that the 53 sounds that are equal to each other in the duplo, in relation to the third harmonic scale, are, for the ear, the same natural system.³

Construction of the Instrument

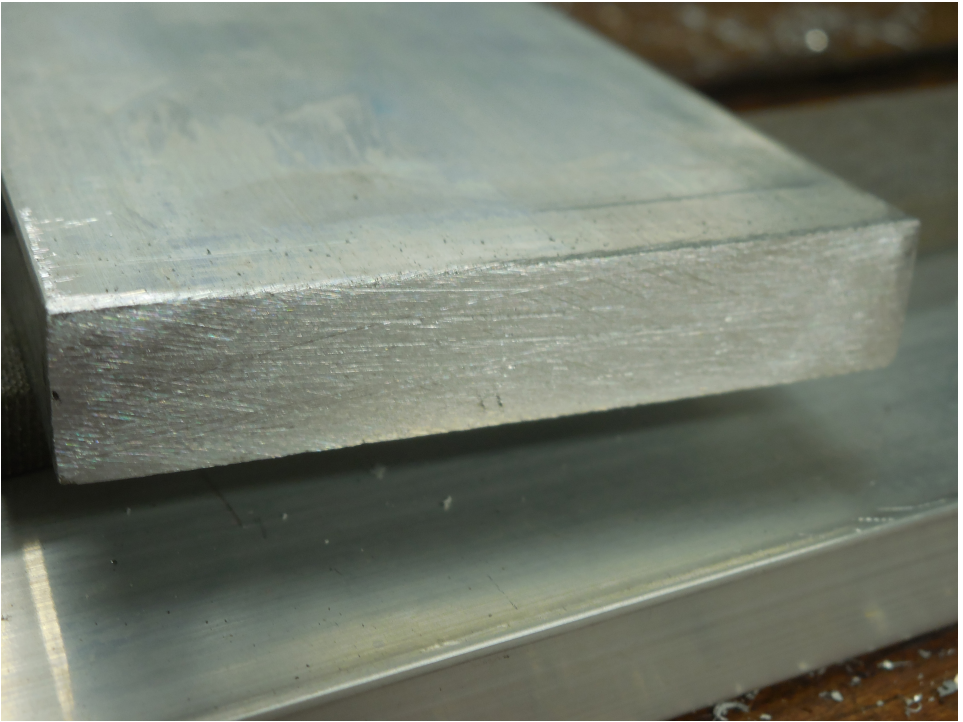
The creation of the Pythagorean Xylophone was an arduous technical process, of constant experimentation with materials and tools for its construction, which involved several steps, which are described and illustrated below:

1. Selection of materials: I chose 9 mm aluminum bars, this material was selected for its ability to produce a clean and resonant sound, suitable for achieving the desired tuning, it is important to note that aluminum bars are not a commercial material, so I had to have them melted in a factory located in the Municipality of Cuautitlán Izcalli. The base was built with wood and carbon steel, materials that offer a combination of durability, resonance and acoustic flexibility.

2. Measurements and sizing: The process began with a meticulous calculation of the dimensions of the aluminium bars that would make up the Xylophone. Each bar had to be precisely cut to ensure that the desired resonance frequencies were achieved. The cuts were made leaving a margin of between 2 and 3 mm, which were then manually trimmed using files and sandpaper of different thicknesses until the correct length was reached, which ensured that all frequencies were properly aligned with the 53 notes. Precision in this step was crucial, as a small deviation could alter the tuning of the instrument.

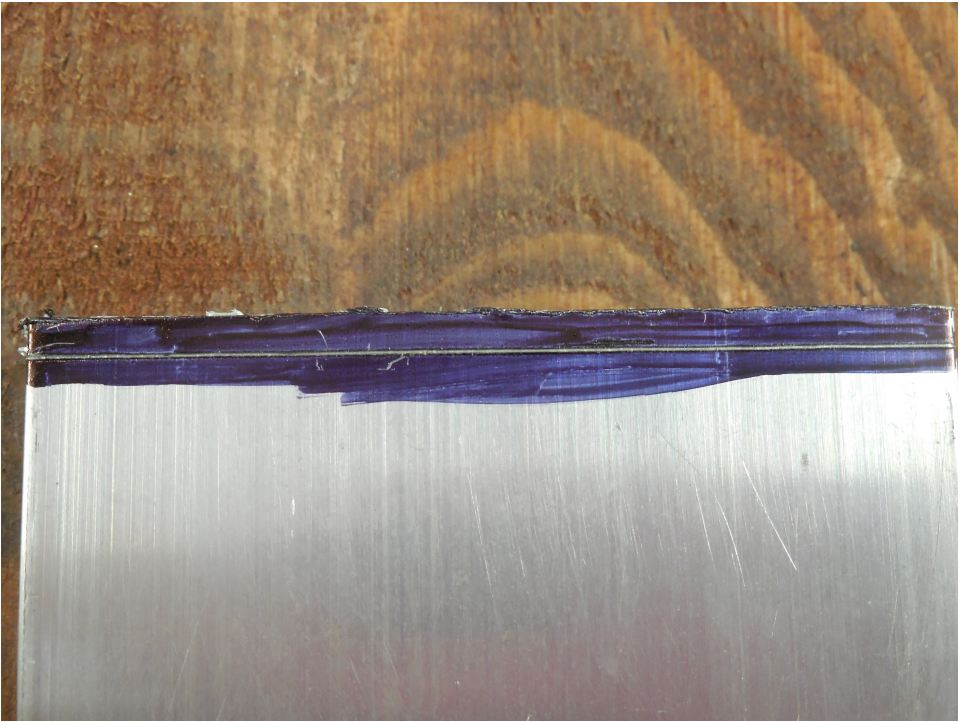
3. Drilling for the support of the bars: Measurements were made for the holes through which the nylon thread that holds the bars would pass. This thread had to be placed in such a way that it would allow the correct suspension of the bars without interfering with their resonance. The holes were strategically distributed along each bar to optimize the vibration and maintain the precise tuning of the 53 bars that make up the instrument.

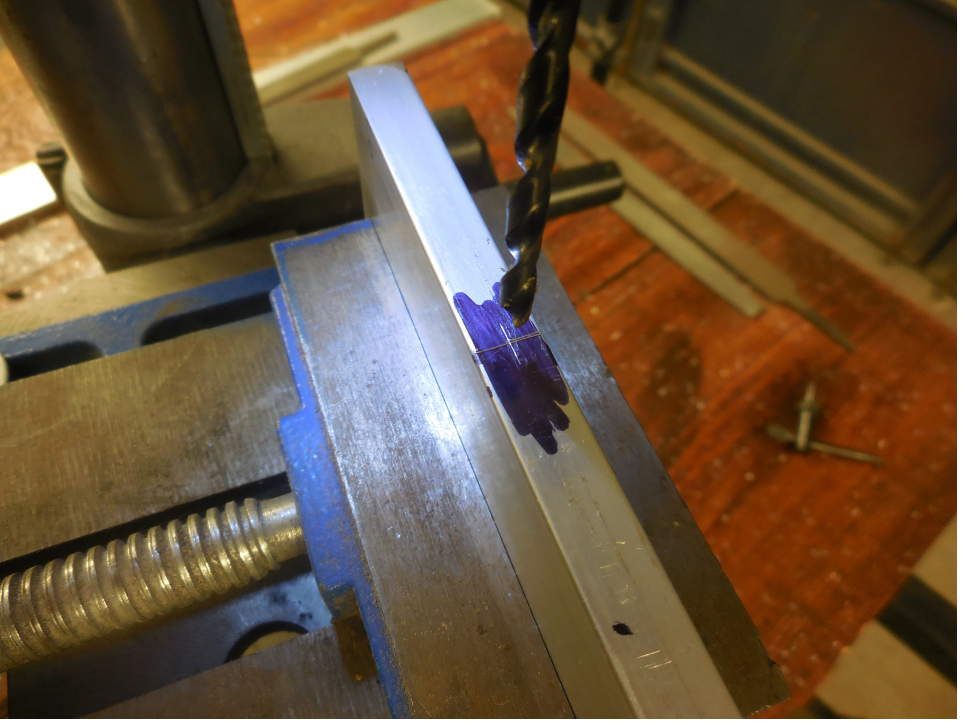
4. Building the base and mounting the bars: The base of the Pythagorean Xylophone was constructed using wood and carbon steel. The structure needed to be sturdy enough to support the weight of the bars and allow for a clear and long-lasting resonance. After the base was built, the bars were mounted and suspended with the thread, ensuring that they were perfectly aligned and balanced to achieve the optimal resonance.

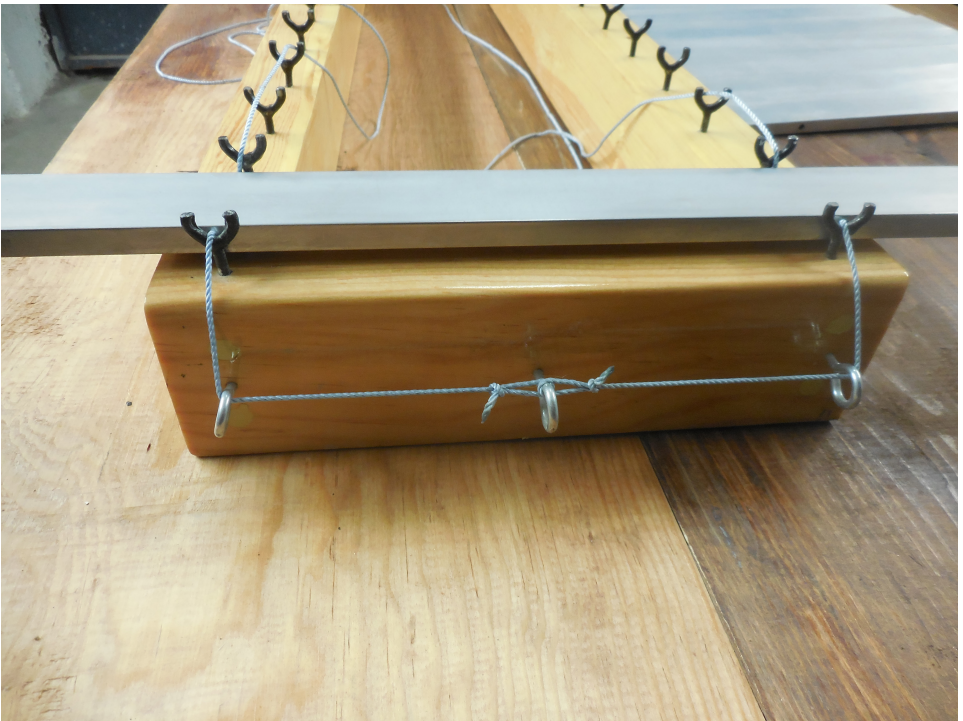














The Creative Process of Composition and Improvisation

Once the technical-constructive stage was over, the challenge was to create some pieces: Mycelium, Chichicapatl and Mictlán, which were conceived under an improvisational approach, allowing the Pythagorean Xylophone and its particular microtonal system to dictate the sound possibilities.

Instead of adhering to a strict structure, I chose to work with a compositional base and improvise on it.

Improvisation not only allowed listeners to more intuitively perceive the sounds produced by the instrument, but also opened a space for the Pythagorean Xylophone to reveal its harmonic capabilities, allowing each performance to be unique and reflect the sound behavior of the microtonal system in real time.

The mentioned musical pieces are available at

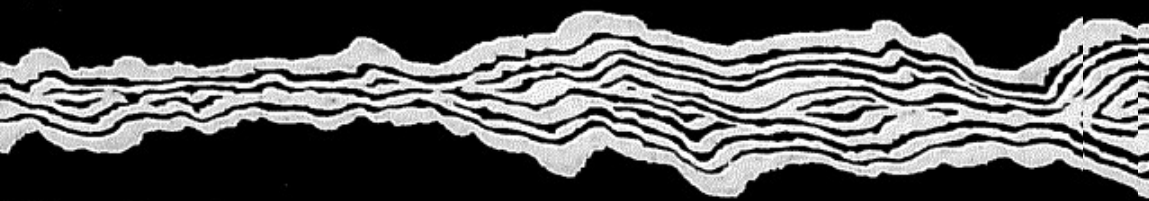
<https://www.youtube.com/watch?v=TcbKC4x6lfs>

Conclusion

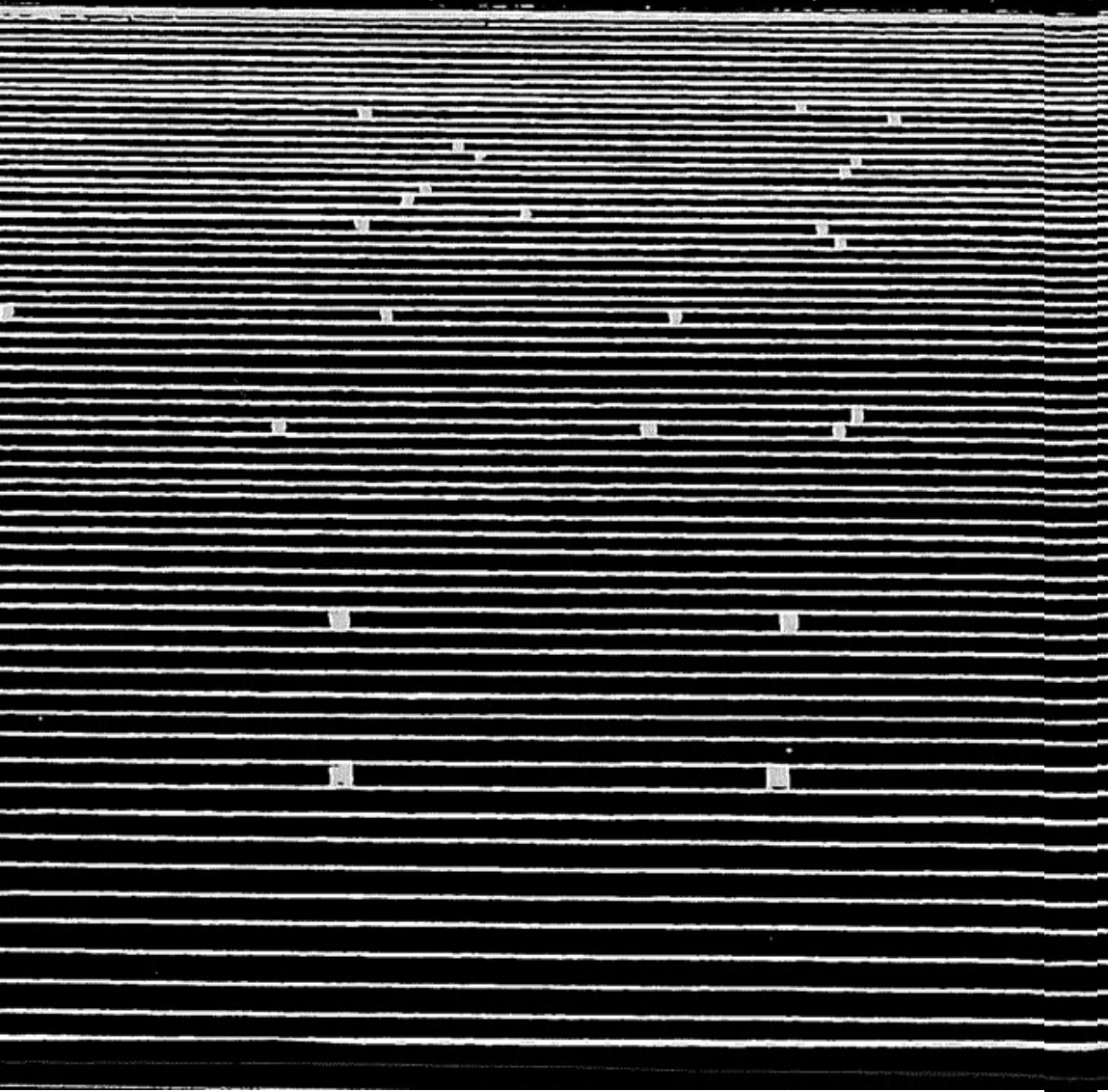
The Pythagorean Xylophone is an invitation to explore new horizons within microtonal music. In the future, my intention is to collaborate with composers and percussionists to take this instrument to new sonic frontiers. Through these collaborations, I hope that the Pythagorean Xylophone will become an increasingly versatile tool, capable of studying even more deeply the possibilities of tuning and its resonance. This is just the beginning of a sonic journey that promises to continue to expand and surprise, both for musicians and audiences around the world.

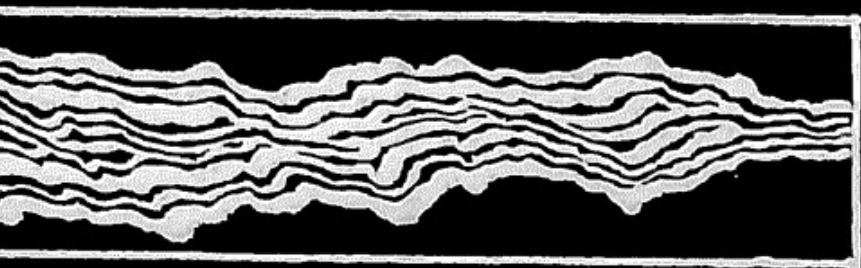
Notes

- (1) Carrillo, Julián. (1967) Universal errors in music and musical physics, Art. "The 53 commas of Pythagoras", Mexico. Ed Mexican Culture Seminar.
- (2) Carrillo, 1962, p. 128-129
- (3) Novaro, Augusto (1929) Natural system and approximate natural system. Mexico. S/Ed. p. 45-46.



4'35	5'02	5'25	5'50	6'11	
4'22	4'48	5'15	5'42	6'01	6'27





33	6'50	7'05	7'24
6'39	6'59	7'13	7'27



SERIYA 17

**Dylan
Rodgers**

**Subverting the
Equal**

Temperament Ubiquity: Use of Auxiliary Frets in Lutes, Guitars and Beyond

Since the dawn of the Renaissance through modern era, a vast number of musicologists have outwardly associated the lute, guitar and other fretted instruments with the rise of 12-tone equal temperament (12-TET). For centuries, countless scholars have pointed to such instruments' strictly fretted nature as a primary cause for their application of equally spaced semitones. As is the case with keyed instruments, fretted instruments yield a collection of pitches which cannot be substantially adjusted in real-time performance; therefore, fret placements must be organized in an exacting fashion. Proponents of 12-TET maintain that since equal temperament serves to diminish the unyielding dissonances of historical tuning systems and enables consonant playability of all keys, it is, thus, the best theoretical system for the fretting of lutes, guitars and other fretted instruments.

However, the common belief that historical fretted instruments relied on 12-TET lacks a reasonable evidentiary basis. And, likewise, the notion that fretted instruments are best suited to serve 12-TET is demonstrably false. In fact, for millennia, a wide variety of players of fretted instruments have rejected the notion that their instruments must play in 12-TET. Throughout history, such instrumentalists have employed numerous methods aimed at subverting the equal temperament ubiquity. However, perhaps the most common way in which players of fretted instruments have been able to side-step predominant tuning theory in favor of microtonal tunings and temperaments was through instrument modification, specifically the use of auxiliary (i.e. additional) frets.

The earliest recorded instance of this sort of subversion amongst fretted instrument players can be traced back to the unconventional practices of the 9th century Persian lutenist, Mansour Zalzal al-Darib. Zalzal, as he is most commonly known by, performed on an ancestor of the contemporary 'ud, which, unlike its modern counterpart, was fretted. While, today, various Near Eastern musics are characterized, in part, by their use of microtonal modal systems with more than 12 notes per octave, such systems were not always prevalent in this region. For instance, we know that throughout the Middle Ages, the 'ud was fretted according to Pythagorean tuning, meaning that its 12 note chromatic scale was derived from a spiral of perfect fourths and fifths.¹ It is this Pythagorean scale, composed of 12 semitones of varying size, that Zalzal inherited as his era's dominant system of musical tuning. However, Zalzal was clearly not content with this Pythagorean ubiquity and, thus, sought to subvert this tonal hegemony through the use of auxiliary frets.

While we can never know with total accuracy where exactly Zalzal secured additional frets to his 'ud, we do know of two general positions for such frets; one auxiliary fret was placed between the 1st and 2nd frets while another was positioned between the 3rd and 4th frets.² Certain theorists in the centuries following Zalzal's advent of these new intervals sought to legitimize these microtones by rationalizing their existence within his contemporarily dominant system of Pythagorean tuning. The extent to which this sort of mathematical rationalization accurately explained Zalzal's unconventional 'ud fretting remains largely up for debate. Whether or not Zalzal intentionally (and exactly) added frets to his 'ud in order to access specific intervals according to their frequency ratios, we will never know for certain. However, it is perhaps more reasonable to presume that, in his deployment of auxiliary frets, Zalzal was less concerned with theoretical purity and more interested in experimentation and its resulting aesthetic. Regardless, we can conclusively say that Zalzal's utilization of auxiliary frets, in his defiance of predominant tuning theory, left a profound and enduring impact on the very nature of Near Eastern music-making. While these "neutral" intervals, as they have come to be known in the modern era, may have once belonged only to Zalzal, in subsequent centuries they have become a fundamental characteristic of both the theory and praxis of various Near Eastern musical traditions.³

It is around this time of Zalzal's instrument modification (and likely beginning even earlier) that the fretted 'ud appears in Europe for the first time. Following the Muslim conquest of the Visigothic Spain (711 CE - 781 CE), and the establishment of an Arab-Berber state in the Iberian Peninsula, a vast number of cultural touchstones from the Arab world and its periphery were gradually imported into this territory. One of such cultural artifacts which appears in Iberia at this point in history is the medieval 'ud. Here, in Muslim Iberia, the 'ud flourishes in popularity and quickly becomes a staple instrument for the performance of medieval Iberian musics.⁴ However, like all things, the 'ud was not impervious to the throes of time and, over the subsequent centuries in Western Europe, the instrument experienced a significant evolution in form.

Although the exact stages of its evolution are now lost to history, we know that gradual modifications to the construction of medieval European 'uds eventually precipitated an entirely new and distinct plucked instrument; this instrument, of course, is the lute.⁵ Iconography indicates that by the 14th century, the lute, while still coexistent with the medieval

'ud in praxis, had taken on its own distinguishable form. This early lute inherited many of the theoretical and practical characteristics of its progenitor, the 'ud. The medieval lute, like the contemporaneous 'ud, had an oval shaped body, was fretted along the neck and was played with a thin plectrum. However, one of the most fundamental shared characteristics of medieval 'uds and lutes was their reliance on Pythagorean tuning, which served as Western Europe's predominant system of musical tuning throughout the Middle Ages. Thus, the strings of both medieval 'uds and medieval lutes were tuned according to the overarching structure of Pythagorean tuning and, likewise, their frets were arranged correspondingly.

As previously stated, the lute of the Middle Ages was played almost identically to the 'ud; basic technique prescribed that one hand should pluck individual string courses with a plectrum near the sound-hole while the other hand fretted notes along the fingerboard. However, this approach to lute performance would gradually be phased out in parallel with the rise of polyphony in European popular musics. In the closing decades of the Middle Ages, European lutenists abandoned the plectrum which characterized medieval lute technique and began finger-picking instead. By finger-picking, lutenists of this era (and beyond) were able to achieve the growing aesthetic of polyphony by plucking the bass strings of the lute with their thumbs while simultaneously rendering chords and melodies with their first, second and third fingers across the lute's treble strings.⁶

However, this sort of polyphonic lute playing posed a significant problem to lutenists of the late Middle Ages whose Pythagorean tuning theory was inherently incompatible with triadic harmony. This harmonic incompatibility stems from the way in which Pythagorean tuning generates its thirds, particularly the major third. Pythagorean tuning, as a theoretical concept, derives its chromatic scale from a spiral of compounded perfect fourths $[4/3]$ and fifths $[3/2]$; this methodology produces a major third by compounding four perfects fifths above a tonic note and then removing two octaves. This Pythagorean major third $[81/64]$, however, is approximately 21.51 cents sharp of an acoustically pure just major third $[5/4]$, that of which is derived from the harmonic series and is, thus, reified in the laws of physics. This 21.51 cent interval which separates the Pythagorean major third from its justly intonated counterpart has come to be known as the syntonic comma. It is this presence of the syntonic comma (i.e. the audibly drastic difference between a Pythagorean and an acous-

tically pure major third) that epitomizes Pythagorean tuning's inability to consonantly realize triadic harmony.

It is important to note that since musics of the medieval era predate the advent of triadic harmony and were, thus, thoroughly monophonic, this crux of Pythagorean tuning did not pose a significant hindrance to the performance of medieval 'ud and lute musics. This can be explained by the fact that the "sharpness" of the Pythagorean third is much less noticeable when sounded within a melody than when it is realized in a polyphonic and/or chordal context. Therefore, it is specifically in regards to the polyphonic musics of the dwindling Middle Ages and beyond which we can consider incompatible with the medieval lute and its Pythagorean tuning.

This quandary of Pythagorean tuning begs the question: how did musicians of the late Middle Ages and Renaissance realize triadic harmony? As discussed previously, the real point of inquiry in this matter is the "sharp" Pythagorean major third. In order to achieve an acoustically pure major third, the syntonic comma (i.e. the 21.51 cent difference between a Pythagorean $[81/64]$ and a just $[5/4]$ major third), must be removed from our Pythagorean spiral of fourths and fifths. Since, in a Pythagorean context, a major third is arrived at by compounding four perfect fifths (and removing two octaves), music theorists of the late middle ages resolved to temper out (i.e. remove) the syntonic comma by flattening each perfect fifth in our Pythagorean spiral by one-quarter of the syntonic comma (5.38 cents). By removing one-quarter of the syntonic comma from each fifth, the entire comma becomes tempered out within a sequence of four compounded fifths. Without this tempering, these four compounded fifths would yield a "sharp" Pythagorean major third. However, by removing one-quarter of the syntonic comma from each fifth in this four-fold sequence, the resultant major third is lowered exactly to its acoustically pure intonation. It is extremely important to highlight the fact that in this process of temperament, every fifth is intentionally and exactly *detuned* (by precisely one-quarter of the syntonic comma) in exchange for the ability to play just major thirds. Ultimately, musicians throughout the Renaissance were quite willing to make this compromise due to the fact that this tempered fifth (which yields a just third) is detuned by only 5.38 cents and, thus, in the context of triadic harmony, is much closer to its acoustically pure counterpart than the Pythagorean third, which is 21.51 cents "sharper" than a just third. Over the course of subsequent centuries, this system of musical temperament would come

to be known as “quarter-comma meantone.” Throughout the Renaissance and beyond, music theorists of Western Europe further developed this method of temperament to include many other forms of meantone, each which temper the Pythagorean fifths by distinct fractions of the syntonic comma. By the conclusion of the Baroque period, third-comma, quarter-comma, sixth-comma and even two-sevenths-comma meantone temperaments were regularly being employed by European musicians.

Many instruments which we associate with the Renaissance were easily adaptable to this new system of musical temperament. For instance, fretless instruments like the violin or the cello have a theoretically infinite amount of pitches at their disposal and, therefore, can easily realize the notes prescribed by meantone temperament. Meanwhile, keyboard instruments, such as the harpsichord or pipe-organ, are a bit more limited in their approach to alternate tunings and temperaments due to the fact they are fixed-pitch instruments, meaning that each key on the keyboard yields a specific note and this note cannot be practically adjusted in real-time performance. However, since every single key on a keyboard instrument can be fine-tuned to any pitch prior to performance, it is, thus, truly adaptable to any system of tuning or temperament. Throughout the Renaissance in Western Europe, it was commonplace for keyboard instruments to be tuned according to the intervallic system of meantone temperament.⁷

Although both fretless instruments and keyboard instruments, among various other instrument types, were able to accommodate the structure of meantone temperament with relative ease, this was not necessarily the case for fretted instruments of the Renaissance, such as the lute. This burden of meantone temperament on fretted instruments is due to the inherent construction of such instruments, which obtain their pitches from straight full-length frets that run perpendicular to the neck beneath every string. While these frets may enable a lutenist to perform with exactly correct intonation on one string, this very same fret may yield a wholly unwanted pitch on another string.

For instance, assuming a standard open-string tuning of *F G A d g b e' a'*, the first fret of a Renaissance lute arranged according to quarter-comma meantone, would typically be placed one diatonic semitone [117.11 cents] away from the nut of the instrument. The diatonic nature of this semitone fret is essential, due the fact that it enables the note *C* on the third course of strings. Since, historically, the *C*-major scale has largely

served as a fundamental component of Western classical tradition, access to its tonic, C, was a requisite aspect of lute fretting. However, while this diatonic first fret allocated this necessary C to the third string course, it also determined that the first fret pitches of the two lowest courses of strings would be Ab and Gb, respectively.⁸

However, Western canonical repertoire heavily favors these notes' enharmonic counterparts, G# and F#. In order to access these more desirable notes, one would have to shift the entire first fret towards the nut, to the narrower distance of a chromatic semitone [76.05 cents]. Yet, when one shifts the diatonic first fret to the distance of a chromatic semitone, in order to access G# and F# on the seventh and eighth string courses, they completely lose the ability to play C on the third string course. This is due to the fact that, as mentioned above, in order to perform this C, the first fret must be in the position of a diatonic semitone. When positioned according to the distance of a chromatic semitone (as required to play G# and F#), this same first fret yields a wholly unwanted and scarcely used B# on the third string course (see fig. 1).

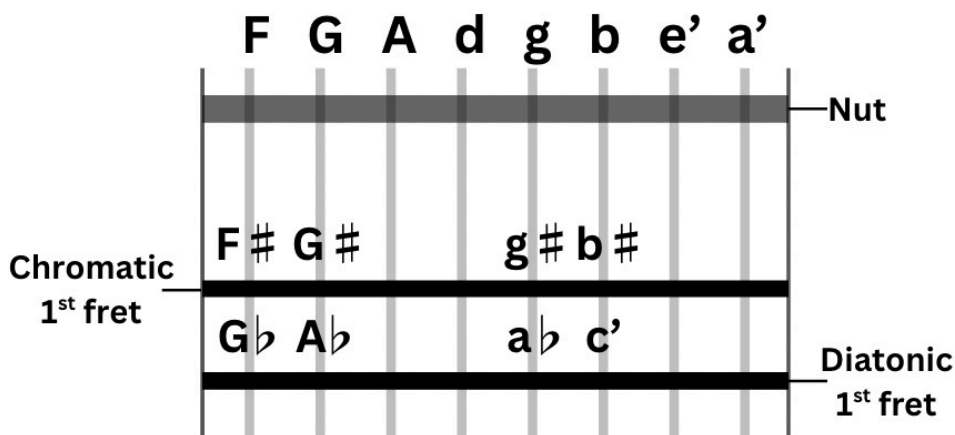


Fig. 1. Showing both the chromatic and diatonic semitone sizes on a lute's first fret.

This issue, precipitated by the very nature of the lute's construction, forced lutenists of the Renaissance into quite the dilemma of intonation; that is, in order to access certain desired pitches, lutenists of this era were required to drastically compromise the intonation of other notes. It is abundantly clear that this issue of intonation directly gave rise to lutes fretted according to 12-TET and, consequently, spurred the on-going myth that lutes inherently rely on equal temperament.

Propagation of this myth began very early on in the history of the lute. For example, in the year 1600, the Italian music theorist Giovanni Maria Artusi published a treatise on the innovations of the impending Baroque style which featured a categorization of various instrument families according to their tuning or temperament. In this publication, Artusi classified Western European musical instruments into three categories: 1. Keyboard instruments, such as the pipe organ and harpsichord, which employed meantone temperaments; 2. Instruments like the human voice, violin or trombone which could play in any tuning or temperament; and 3. Fretted instruments, like the lute, vihuela or theorbo which were wholly limited to 12-TET.⁹

To many, this may serve as enough evidence to contend that since the dawn of European polyphony, lutes were strictly fretted according to 12-TET. This assumption not only lacks a reasonable historical basis, but also severely undermines the generational efforts of lutenists who, over the course of centuries, did not succumb to the pervasion of equal temperament. Moreover, this mythic association of the lute with equal temperament also greatly diminishes the sheer scale of lutenists throughout history who have utilized meantone and related unequal temperaments since the dawn of European polyphony. A close examination of various historical sources from the early modern period reveal that, in reality, such lutenists were not sparse. There exists ample evidence to conclude that not only was meantone temperament actually employed by Renaissance-era lutenists in praxis, but this use of meantone was, in fact, rather commonplace.

One example of a source contemporary to the Renaissance which serves as evidence for the use of meantone amongst lutenists is the introductory section of the Italian composer Francesco Turini's third book of madrigals. In this songbook, Turini introduces his compositions with a set of performative guidelines, explaining that "the madrigals here may be played with a keyboard instrument alone, without the chitarrone (a large classification of lute); or with a chitarrone, or other similar instrument, without the keyboard instrument; nevertheless, they will turn out much better with one and the other."¹⁰

In these instructions, Turini explains that his vocal compositions can be accompanied by either a keyboard instrument or a lute, but ultimately concludes that his music is best realized when it is accompanied by both instruments. This preference for both accompanying instruments

demonstrates that, in the practical performance of Renaissance musics, the lute was regularly paired with keyboard instruments. This common pairing of the lute with keyboard performance appears to refute Artusi's assertion that, while Renaissance-era keyboards were tuned according to meantone temperaments, the lute was wholly restricted to 12-TET. This is due to the fact that, in order for any two (or more) instruments to sound pleasant and "in-tune" together, the first most basic condition that each instrument must satisfy is that they are prepared to play within the same system of tuning or temperament. Since we know for certain that keyboard instruments of the Renaissance were most commonly tuned according to the predominant system of meantone, we can, thus, reasonably presume that lutes of this era must have been prepared to realize this very same meantone temperament.

So, considering the aforementioned incompatibility of the lute (and its straight, obstinate frets) with the intervallic structure of meantone temperament, the obvious question at hand is: how exactly did lutenists of the Renaissance realize meantone in actual practice? The answer to this is, of course, through the deployment of auxiliary frets.

The primary tool which lutenists of the Renaissance utilized in their approach to meantone temperament was not additional full-length frets, like those used by Mansour Zalzal in his advent of "neutral" intervals, but were, in fact, small makeshift frets which rarely spanned the distance of more than two string courses. These little ad hoc frets are known, as they have since the Renaissance, as *tastini*. In English, *tastini* can be understood to literally mean "little frets," a diminutive form of the Italian word *tasto*, which translates to "fret."

Throughout the Renaissance, lutenists across Western Europe would regularly secure *tastini* to their fretboards at specific intervals as a means of rectifying certain dissonant pitches.¹¹ Such pitches that required *tastini* for correct intonation were typically "misspelled" notes, which would be considered enharmonic equivalents in 12-TET; the aforementioned *C/B#* dilemma is one of such predicaments which *tastini* would typically be used to solve.

The earliest known mention of *tastini* comes from Vincenzo Galilei's *il Fronimo Dialogo*, in which Galilei, an early proponent of equal temperament, actually condemns the popular use of such auxiliary frets. Referring to lutes fretted according to 12-TET, Galilei writes that "the major and minor thirds have the same measure in all places, on the strings

and between the frets." He then proceeds to acknowledge that, despite this sort of lute's equally-tempered nature, "some people seek to introduce [tastini] in order to remove some of their sharpness from the thirds and major tenth."¹² The subsequent chapters of *il Fronimo* feature even more evidence of the Renaissance lute's approach to meantone temperament. This includes mensural diagrams for lute frettings associated with meantone as well as notated music which indicates the use of tastini as a means of achieving pure, euphonious thirds. However, in demonstrating his preference for 12-TET, Galilei ultimately concludes that, to the layman lutenist, tastini and meantone temperaments are not worth the meticulous effort which they require to maintain. Galilei instead argues for the obsolescence of such methods of lute fretting in support of the uniformity and accessibility provided by equal temperament.

In spite of Galilei's repudiation of tastini, the use of such "little frets" remained relatively prevalent throughout the Renaissance and modern era. We know that, historically, tastini were typically created from small pieces of wood or left-over fret ligatures which were attached to a lute's fretboard with glue or some other sort of impermanent adhesive. This procedure was typically employed by lutenists across Europe as a means of accessing both chromatic and diatonic semitone sizes within one standard full-length fret space. By fastening tastini to the fretboard behind a diatonic fret (closer to the tuning pegs) or in front of a chromatic fret (closer to the sound-hole), one could play both the diatonic or chromatic semitone with the same finger, simply by shifting it up or down the fretboard.

As per the structure of meantone temperament, and standard lute tuning, this methodology was most commonly applied to the first fret of the lute, which was typically set at a diatonic semitone away from the nut. As discussed previously in this chapter, a standard diatonic first fret on a lute tuned to *F G A d g b e' a'* would allow access to an extremely necessary *C* on the third string course. However, this same fret would also yield a relatively unwanted *Gb* on the lowest string course and similarly undesirable *Ab's* on the fourth and seventh string courses. These notes' enharmonic counterparts, *F#* and *G#*, are considered to be much more desirable due to their frequency of use.

Shifting the whole first fret lower, to the distance of a chromatic semitone, would give a lutenist their sought after *F#* and *G#*, but would change their much-needed *C* into a scarcely used *B#*. In the face of this dilemma,

the pragmatic lutenist would turn to tastini as a remedy. As a means of bypassing this obstacle of intonation, one would simply leave the full-length first fret in its original diatonic position, enabling C on the third string course, and would secure tastini to their fretboard at the chromatic position beneath the fourth, seventh and eighth string courses. This auxiliary fret would allow a lutenist to play *F#* and *G#* while leaving the original first fret, and its necessary *C*, unaltered (see fig. 2).

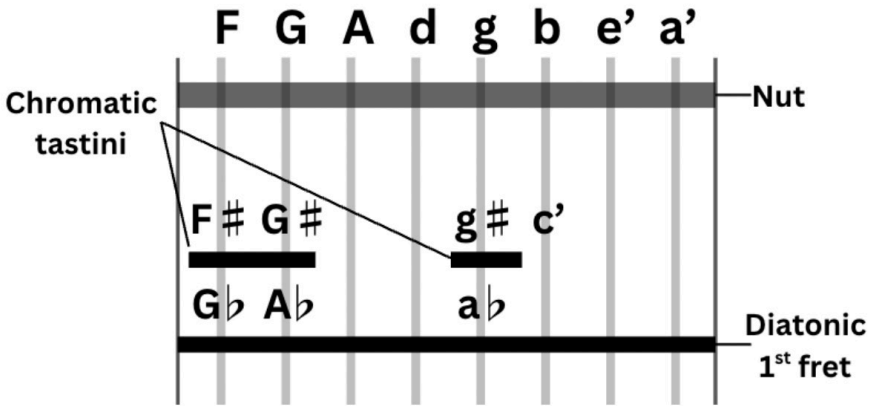


Fig. 2. First fret of a lute with added tastini.

The scenario depicted above describes only one of many instances in which tastini could be employed as a means of approaching the proper intonation prescribed by meantone temperament on the lute. In reality, we can't know with exact certainty the extent to which tastini were utilized by lutenists across Europe. Yet, we do know from written evidence that the employment of tastini was not a rare occurrence throughout the Renaissance. Consequently, one could reasonably argue that the use of auxiliary frets (i.e. tastini) was absolutely essential to the practical embodiment of meantone temperament, as it was realized by lutenists through the Renaissance and beyond.

Considering their importance within the scope of Renaissance-era lute performance, one might understandably question why today the knowledge of tastini is rarely known to players of the lute and other fretted instruments. It is sensible to place blame on the growing hegemony of equal temperament across Europe for this relative obsolescence of tastini. However, while this explanation is certainly quite meritable, it only partially describes the true nature of tastini's descent into obsolescence, which in reality is much more nuanced.

One cause for the diminishing usage of tastini in the early modern period is that, as Galilei suggests in *il Fronimo*, the ability to set one's frets according to meantone temperaments was craft knowledge. As is the case today, earning a living as a full-time musician in the Renaissance was an extremely challenging pursuit; professional lutenists relied on virtuosic performance and the competition of fame as a means of maintaining their livelihood. Thus, professional musicians of this era felt no obligation to share the specialist tools of their craft with those instrumentalists whom they regularly compete with. Revealing such trade secrets with their competitors would directly diminish their marketability and dilute their renown. David Dolata, in his groundbreaking book *Meantone Temperaments on Lutes and Viols*, explains this phenomenon best: "why increase your competition?"¹³

The capitalistic circumstances of professional musicianship were, of course, understood by lutenists of the early modern period. The English music theorist Thomas Mace acknowledged this in his 1676 book *Musick's Monument*, describing lutenists as "extreme shy in revealing the occult and hidden secrets of the lute." As a consequence of this hoarding of musical knowledge, Mace reveals that when "[lutenists] die, all their skill and experience dies with them."¹⁴ Although the use of tastini and alternative methods of lute fretting (i.e. unequally spaced semitones, split strand frets, etc) were relatively commonplace throughout the Renaissance, the covetous nature of lutenists, in their pursuit of professional success within a highly competitive market, eventually gave way to the dissipation of such craft methodology.

Another important factor for the diminished use of of tastini and meantone lute frettings in the modern period was their impracticability within the ever-growing Western classical orchestra. Any instrumentalist who has performed in an ensemble setting should be able to recognize the abundance of effort that typically goes into pre-concert (or pre-rehearsal) preparations. Historically, without the use of digital music scoring, electronic tuners, and other such helpful tools of our day, preparing a large group to perform together must have been an even greater endeavor. In 1635, the Italian music theorist Giovanni Battista Doni expressed in his book *De'trattati di Musica* that "the pains, the distastefulness, the anxieties and the sorrows that the poor musicians feel in arranging together so many players and sounds in so narrow a space, would scarcely be believed. For, with much loss of time and confusion, they must arrange the instruments, distribute the lamps, order the seats, set up the music

stands, and tune the instruments.”¹⁵

As referenced previously, the most basic requirement for two or more musicians to perform together in a classical setting is that they must be prepared to play within the same system of tuning or temperament. So, since a variety of different types of meantone temperaments were prevalent throughout the Renaissance, one of the typical pre-concert (or pre rehearsal) undertakings of any lutenist in an ensemble setting was the rearrangement of their entire fretboard. As keyboard instruments cannot be retuned hastily or with ease, a lute player would typically be required to re-arrange their fretboard according to the tuning of their ensemble’s keyboard instrument. As the size of the Western European classical orchestra swelled through the Baroque and Classical periods, it became increasingly difficult and time-consuming for musicians of fretted instruments to adjust their intonations within a large group setting.

Thus, this issue with variant lute frettings is resoundingly economic in nature. That is, within the less than profitable domain of classical music performance, orchestral financiers likely would have encouraged their musicians to diminish the amount of time (i.e. money) that went into pre-performance preparations. Given this context, equal temperament was the perfect solution to simplifying the necessary preparations of an early-modern orchestra. That is, if every instrumentalist approached an ensemble setting already prepared to perform according to a universal system of equal temperament, the added stress (and time/costs) of having to reset one’s fretboard would be expunged. Thus, in the sense that meantone temperament, in its approach to harmonic purity, embodied the Renaissance’s inclination towards artistic embellishment, the arrival of equal temperament instead served to realize the modernist spirit of uniformity and economic utility.

Although the craft methodology of tastini gradually fell into disuse in parallel with the rise of equal temperament, such auxiliary frets never became fully obsolete. Through the modern era, lutenists faithful to historical temperaments (i.e. meantone and well-temperament) have continued to rely on tastini as a means of subverting the hegemony of 12-TET. Within this community of musicians, tastini remain in regular use to this day.¹⁶

One might assume that due to the ubiquity of 12-TET today, auxiliary frets no longer have use among players of fretted instruments. While auxiliary frets, like tastini, certainly aren’t being utilized on the same scale

that they once were by lutenists of the Renaissance, they have not yet faded into obsolescence. In fact, to the contrary, over the past several decades, the auxiliary fret methodology has found a new life amongst a large, and ever-growing, global community of guitarists.

Although the standard guitar of today is strictly fretted according to 12-TET, a great number of guitarists across the world have rejected this pervasive theoretical structure and, consequently, have turned to auxiliary frets as a tool for the liberation of their instruments from the restrictions of 12-TET. Within this community of microtonal guitarists, we can categorize members into two groups: 1) Those who modify their fretboards with additional full-length frets; and 2) Those who utilize partial frets, similar to tastini.

Guitars belonging to musicians in the first category (i.e. those who employ full-length auxiliary frets) are most commonly associated with varying systems of equal temperament. It is extremely important to note that these temperaments are, of course, not the same as 12-TET, since any standard guitar is already arranged according to 12-TET. These microtonal guitars utilize auxiliary frets as means of achieving greater divisions of the octave than the twelve-fold division prescribed by the theory of 12-TET.

There exists a handful of reasons why a guitarist might wish to play within a greater division of the octave than that of 12-TET. One of such reasons would be to perform global musics that do not utilize the framework of 12-TET. For instance, the predominant modal theory of Arab classical music relies on a 24-fold division of the octave; therefore, a guitarist that wishes to perform Arab classical music must have a guitar fretted according to 24-TET.¹⁷ Another reason why a guitarist might seek out higher divisions of the octave is that certain divisions of the octave (like 22-TET) feature intervals that are “near-just,” meaning their size is quite close to that of acoustic purity.¹⁸ A guitar fretboard of this nature can therefore approach just intonation while remaining visually uncomplicated and straightforward, due to its equidistant frets. Similarly, certain divisions of the octave (like 19-TET and 31-TET) are also able to approach various historical temperaments such as meantone.^{19 20} All this being said, perhaps the most common reason why a guitarist might initially choose to explore higher divisions of the octave is for the sake of exploration itself.

Some of the most common microtonal equal temperaments which have been realized on the guitar today include 15-TET, 17-TET, 19-TET, 22-TET,

24-TET, 31-TET and 53-TET. This list is relatively limited in the sense that, theoretically, an octave can be divided into any number of equal divisions and any guitar's fretboard can be modified to match such a division accordingly. Therefore, this list only represents the most contemporarily prevalent equal divisions of the octave that are currently being employed by the microtonal guitar community.

One difficulty that such guitarists face when experimenting with higher divisions of the octave (like 31-TET or 53-TET) is that, due to the great number of frets required within the physical range of one octave on the fretboard, the space between these frets can be impractically narrow. So, to remedy this, it is quite common for a microtonal guitarist to choose a subset of pitches from their selected over-arching system of temperament; then, this sort of guitarist will only install auxiliary frets according to their particular subset of desired notes. Within systems of higher divisions of the octave, choosing a particular subset of auxiliary frets can both widen the space between frets, making it easier to play, and provide a visual roadmap for a performer across an otherwise complicated fretboard (see fig. 3 on next page).

The next grouping of contemporary microtonal guitarists include those who utilize partial-length auxiliary frets, similar to tastini. The most common sort of partial-length frets used by guitarists of our day are known as "fretlets." These little frets are typically modified pieces of standard guitar fretwire which has been cut down to a desired length and had its tang removed. The removal of the tang, which conventionally is inserted into the fretboard, gives these fretlets a flat bottom; this allows them to be easily secured to any guitar's fretboard using glue or double-sided tape. The term "fretlet" was coined by the microtonalist John Schneider in his encyclopedic book, *The Contemporary Guitar*. In this book, Schneider informs us that "an individual fretlet can be added between existing frets to add the desired note, or to explore alternative tunings once the frets have been removed."²¹ While Schneider first began utilizing the fretlet method in order to achieve certain just intonations on his guitars, guitarists from all around the world have adapted this technique as a means of performing a variety of "alternative tunings" and, thus, evading the equal temperament ubiquity. Since the position of fretlets, unlike full-length frets, can vary on an individual string-by-string basis, fretlets can be used to realize practically any system of tuning or temperament. (see fig. 4)



Fig. 3. A guitar featuring an 18-fret per octave subset of 24-TET. Fretwork by Jim Lombard of Santa Barbara, California. Photo by author.



Fig. 4. A guitar fretted, using the fretlet methodology, according to the pélog tuning system of Javanese gamelan. Fretwork and photo by author.

Perhaps the most internationally renowned guitarist who employs this fretlet methodology is the Turkish microtonalist, Tolgahan Çoğulu. In 2008, as a PhD student at Istanbul Technical University, Çoğulu first conceptualized a single guitar which was able to accurately embody Turkish makams (i.e. melodic modes), Renaissance and Baroque temperaments, systems of just intonation and various equal divisions of the octave.²²

This led Çoğulu, in a total repudiation of the guitar's connection to 12-TET, to invent the world's first "adjustable microtonal guitar." This unique guitar, which won the Margaret Guthman Musical Instrument Competition in 2014, features movable fretlets that run along channels beneath each string of the guitar. Since these fretlets are pressure-fitted into each channel, it is easy for one to add or remove additional fretlets at will. As this guitar utilizes the general fretlet methodology, meaning the position of its fretlets can vary on an individual string-by-string basis, Çoğulu's adjustable microtonal guitar is able to realize any system of tuning or temperament. As of 2024, both fretboards and completed guitars which feature Çoğulu's adjustable fretlet technology are available for retail sale.²³

Although the content of this chapter spans millennia of musical development and innovation, it still remains quite limited in scope. The innovative instrumentalists mentioned throughout this writing represent only a few of the many musicians throughout history who have refused to succumb to the hegemony of 12-TET. Although 12-TET offers a number of practical advantages for fixed-pitch instruments (i.e. consonance in every key, uniformity, etc), the widespread use of auxiliary frets, from the Middle Ages through the modern era, indicates that 12-TET is not, nor has it ever been, the inevitable standard for fretted instruments. Rather, as the historical record indicates, there has always existed various forms of resistance to the pervasion of 12-TET amongst fretted instrument players. Although today, 12-TET may infest every sphere of our musical world, it remains resoundingly evident that not all who pluck fretted instruments will so simply acquiesce to this ubiquity.

Notes

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- (3) Thoegersen, Peter. *Microtonal Modes and Scales in the Middle East and Central Asia*, 2024, 3 pp. 9-31.
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- (10) Turini, Francesco. *Madrigali*, Libro 3, 1629, pg.1.
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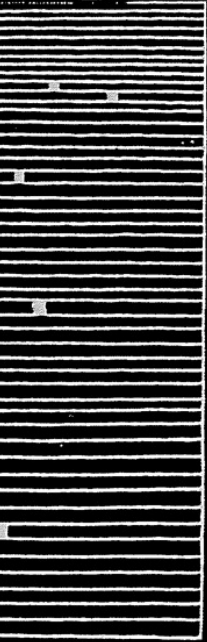
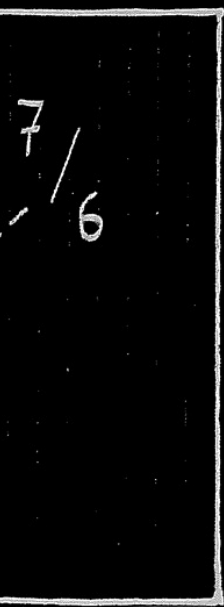
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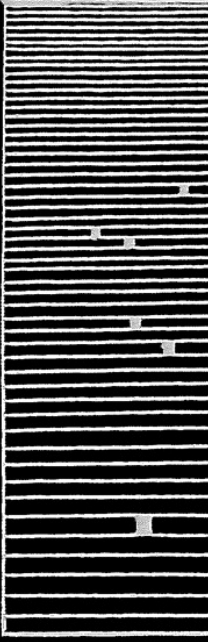
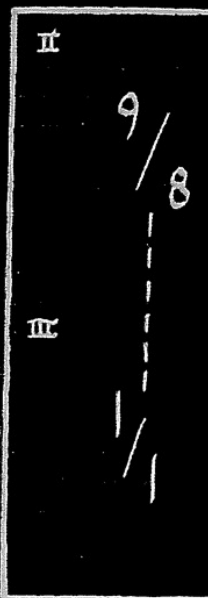
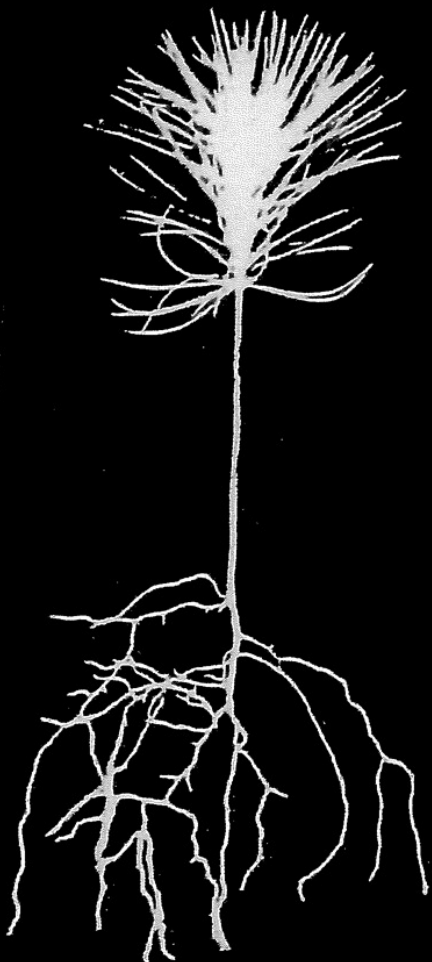
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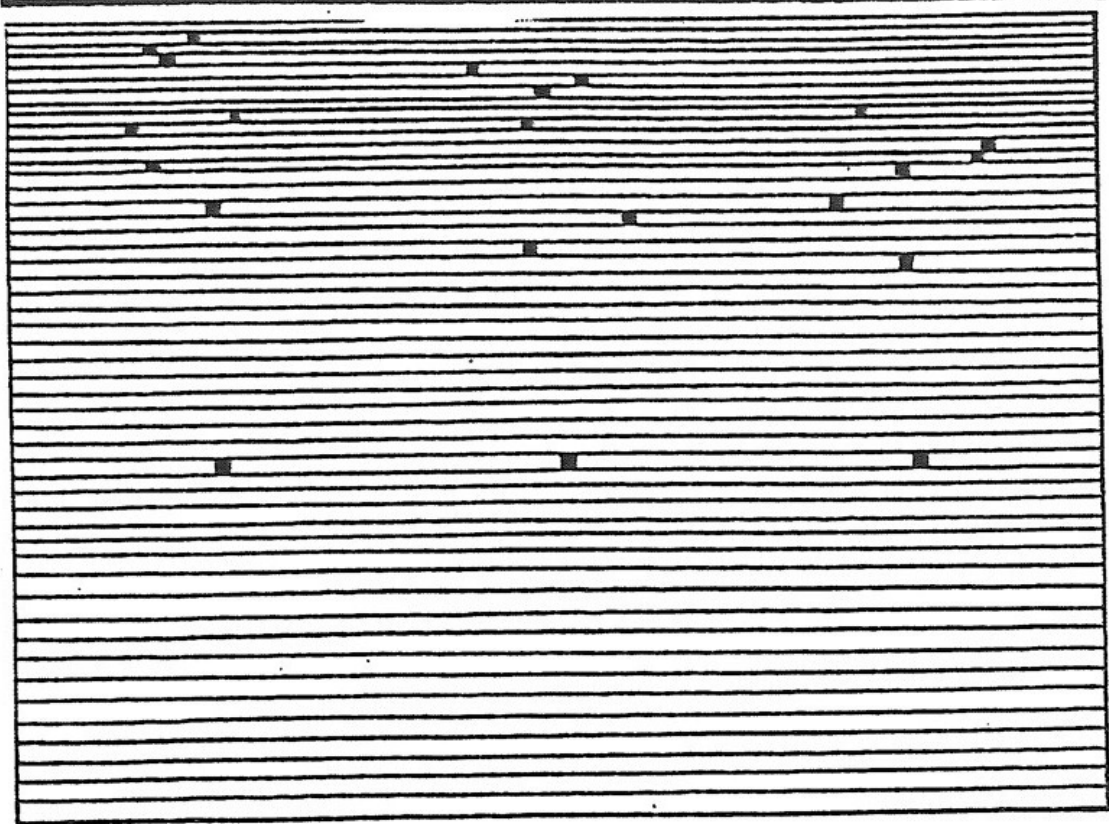


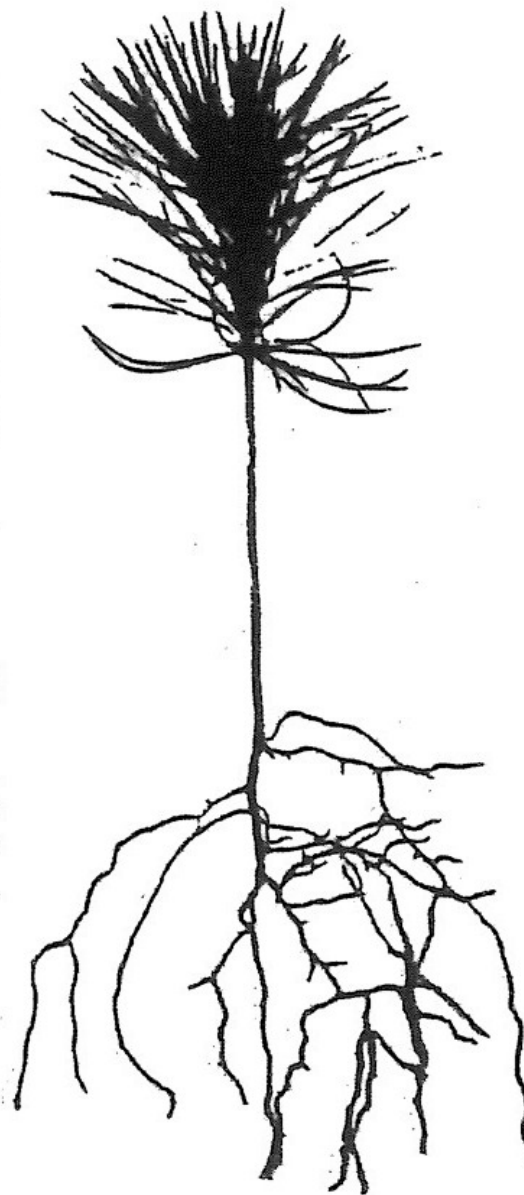
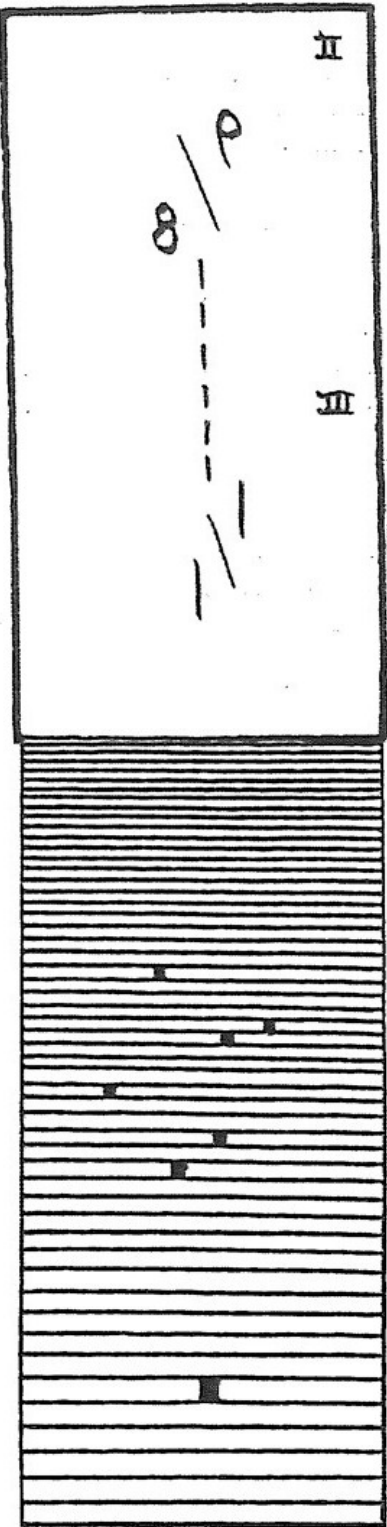
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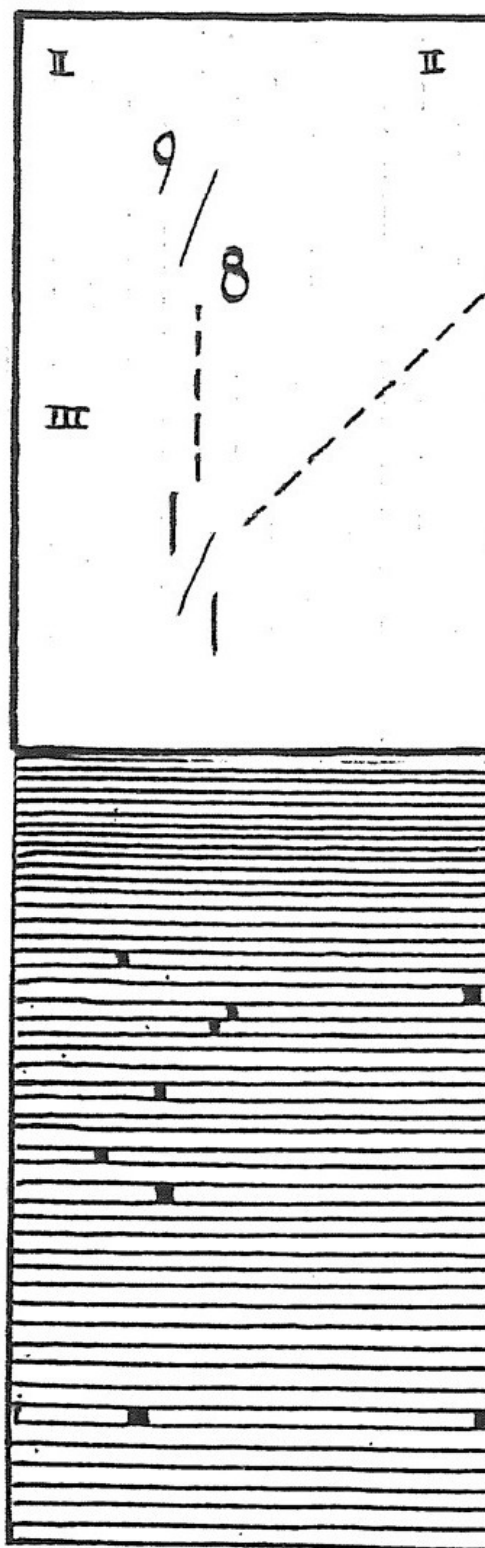
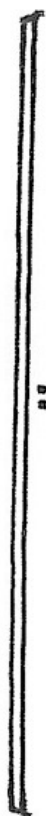
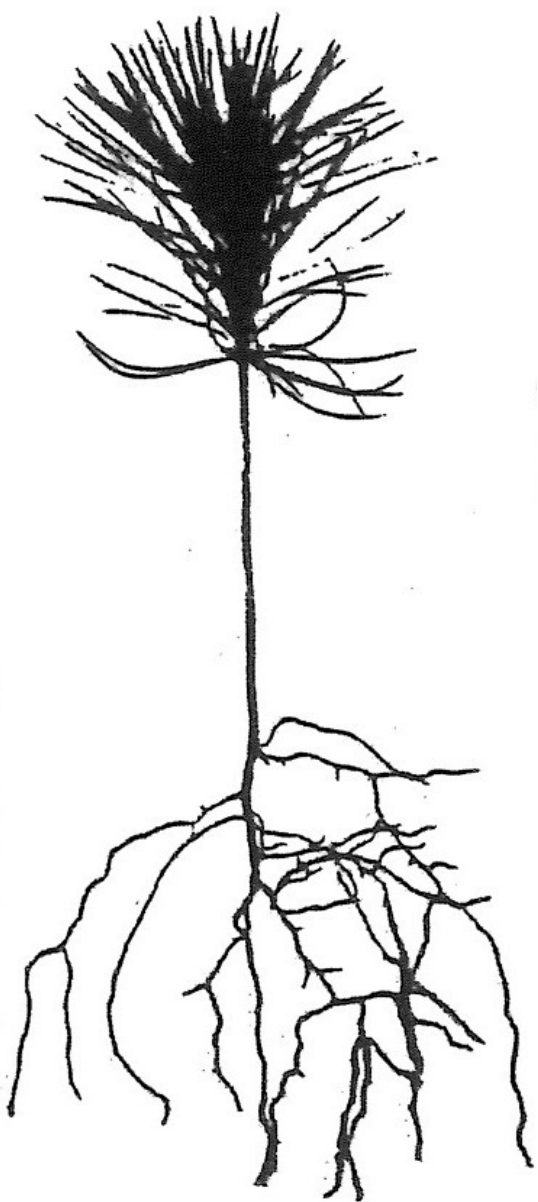


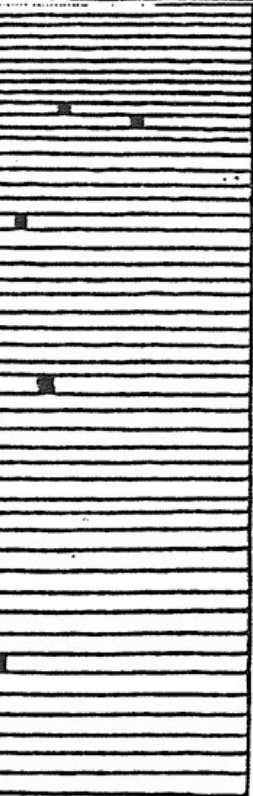
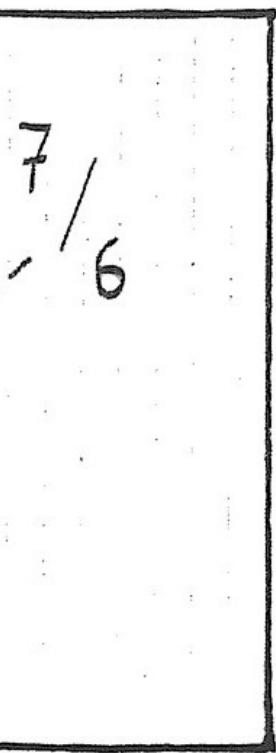
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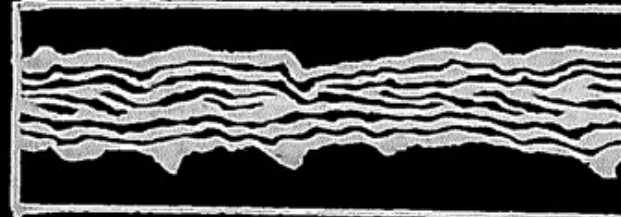




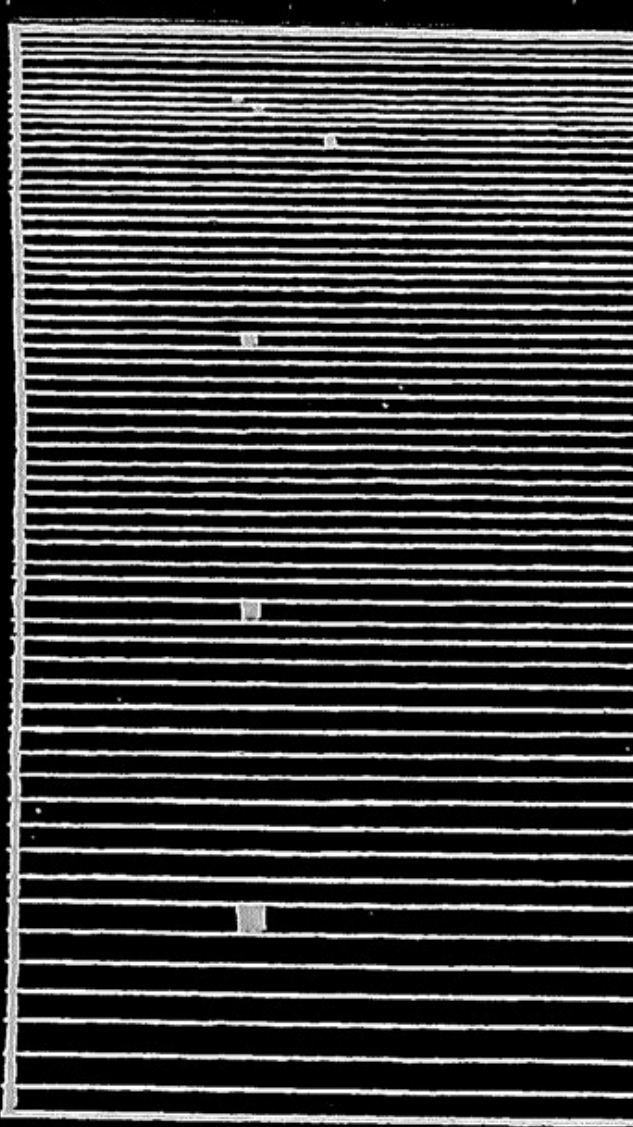




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Robert

Prokopowicz

**An Alternate
History**

**for Music: What if
Nicola Vicentino
Won the Debate**

Introduction

Nicola Vicentino was an Italian composer, music theorist and innovator born in Vicenza in 1511 CE. Around 1530s (as Vicentino mentions himself in his publications) he studied composition and counterpoint with one of the most acclaimed composers of the time, Adrian Willaert, who was famous for his mastery of polyphony and numerous innovative madrigal books. Perhaps Willaert's greatest legacy lies in a stunning array of his remarkable students, including, alongside Vicentino, names such as Gioseffe Zarlino, Andrea Gabrieli, Costanzo Porta, and Cipriano de Rore.¹ Thanks to such wonderful company, Vicentino was able to secure a prestigious position with Cardinal Ippolito I d'Este and found himself at the heart of the contemporary experimental music scene in Northern Italy.² His style was formed during the time when Venice and Ferrara were capitals of music innovation (From 1530s to 1550s Nicola managed to work and leave his mark in both cities) and his work there may have influenced later Florentine Camerata style. But it was his visit to Rome, that changed music forever (at least in this imagined timeline)

Of course, even in this alternate world, no idea is immune to change. The demands of scale, economics, and practicality eventually edge Vicentino's temperament away from the center of artistic attention. But unlike in our own history, where microtonality was buried beneath centuries of overtempered uniformity, here it survives—quietly, persistently, and with dignity.

The Grim Reality of Our Present Timeline Overturned

Let us imagine a fictional year 1551, the Eternal City was moved in a way unimaginable even in modern overcrowded times, especially for such a noble cause. A controversial scholarly debate on Ancient Greek musical genera and their relevance to modern music practice ended with an unexpected result. Against all odds: the opponent being well versed in music theory, arbiters and the entire Capella Pontificia being on the opposition side and what's more, his work accused of being misinformed – Nicola Vicentino was able to prove his reinvented understanding of western music theory that day. The future looked as bright as the glorious past of the Delphic Hymns, and it would require 31 tones per octave,

so that our thirds could be pure and resonant and our ears well-tuned... at least in this alternative history.

The debate described above did take place, but its outcome couldn't be more different. What actually has happened, is that Vicentino not only lost the debate (which was thoroughly taken care off by lovely arbitrage of Bartolomeo Escobedo and Ghiselin Danckerts, both members of Capella Pontificia and rather conservative theoreticians) but also had to pay his adversary, a Portuguese-born composer Vicente Lusitano, two gold ducats (talking about someone having a bad day). Vicentino's artistic contributions and unique solutions to the problem of musical tuning never found fertile ground in Renaissance Italy, and were largely forgotten for nearly the next five centuries. Fortunately, his theoretical works survived. Today we are able to not only acquaint ourselves with his ideas but also to embark on a fascinating thought experiment. In the following pages, I will present you with the starting conditions, the point of divergence and a new, alternative history of music in which the debate's outcome was positive for Nicola Vicentino.

Problems of “modernism” and tuning in XVI century Italian music

Let's get starting conditions out of the way then. What was the state of Renaissance music before and in the moment of debate and who are all those wonderful people mentioned above? The end of the Renaissance was a time of shifting paradigms in Italian and broader European music. Several centers of musical innovations emerged, each emphasizing different aspects of compositional language. During Vicentino's early years, Venice was known for its polychoral compositions, Rome for refined and strict polyphonic technique, and Ferrara remained quite a mysterious place. There, many influential musicians practiced heavily ornamented vocal music with multiple modulations, often unusually chromatic for the period and at least partially inspired by the Avignon school of *Ars Subtilior*. This mystery around Ferrara's courtly music practice was so potent, that a term coined to describe it was: *Musica Reservata* or *Musica Secreta* (private or secret music).³

Such development was possible due to musicians' jobs being the one of high income and prestige at the time (no wonder they were gambling in

golden ducats). Printing allowed musicians to access each other's ideas, as many professionals traveled the continent for educational and job related opportunities, spreading new practices and solutions. Yet the main question of the day remained the same, tuning. This micro-globalization barely improved the very problem of playing in the same tuning for groups of musicians performing together. Either particular keys or whole intervals were sacrificed to achieve somewhat satisfying results, and musicians from different regions frequently struggled to play in tune with one another.

Even 40 years after our point of divergence, in a source from 1594 - *Il Desiderio or of Concerti of various musical instruments* - Ercole Bottrigari laments that lack of proper intonation, born out of tuning complications still plagues music of his contemporaries.⁴ In fact, much of this work is dedicated to tuning systems used by his contemporary musicians and how much they are in line with Classical Greek musical theory (or, at least, how it was then understood). He notes several reasons why ensembles of excellent musicians still sounded so badly together: different instruments often use different tuning temperaments, even great musicians being somewhat inconsistent in their interval interpretations and gut strings being so soft and stretchable they loose tension and tune soon after the performance has started - what therefore creates a mess out of "celestial harmony" he wished to hear.

This example gives us a crucial insight: tuning was hard, inconsistent, and technologically problematic, even long after the Vicentino-Lusitano debate.

What conveniently separates Vicentino from many forgotten innovators is that his theoretical work not only survived but is also comprehensive, containing the necessary groundwork for performing in all three genera described in his 1555 treatise *L'antica musica ridotta alla moderna pratica*. Instruments were actually reconstructed not so long ago (in 2016 to be precise) according to instrument designs from *Descrizione dell'arciorgano* - 1561 publication by Vicentino with graphic representations of instruments and keyboards suitable for supporting singers in 31-tone performances.⁵

The tuning he proposed uses a unique property of $\frac{1}{4}$ -comma meantone temperament, in which difference between, for example, $E\#$ and F equals almost exactly $\frac{1}{5}$ of a whole tone. Thus, each whole tone is divided into five equal parts, and such an operation produces 31 steps: 5×5 ($C, D, F,$

$G, A) + 2 \times 3 (E, H)$. Since he does not explicitly state whether every step is equal, and in his surviving works there is no real usage of significantly estranged modulations (if we wouldn't perceive constant chromaticizations of the first chord in a pair IIIrd step as such), we cannot be sure if this temperament is technically an EDO (Equally Divisioned Octave temperament). Nevertheless, it is possibly the closest composers from this epoch came towards creating a tuning system, in which all the keys can be used equally reasonably.⁶

It should be mentioned that Vicentino's keyboard instruments designs were evolutionary rather than revolutionary, following the rules and key positioning of already existing 1/4-comma meantone tuned keyboards with extra split keys (often 19 keys per octave, same as one of Vicentino's Arcicembalo manuals).

Few conclusions we can substrate from our short description of starting conditions: tuning was a question of the day (especially emulating Ancient Greek one), keyboard technique was still fluid and keyboards with more than 12 keys do appear both before and after Arciorgani, 31-tone per octave system could be presented as a development on the basis of 1/4-comma meantone tuning system, the most common one in XVI-th century. This all creates a picture of possibility for Vicentino's approach to gain more traction.

Even after losing debate with Lusitano, Vicentino not only continued publishing his artistic works, theoretical treaties and constructing instruments, but also, according to not so enthusiastic opinion written by Vincenzo Gallilei after Vicentino's death, performing pieces in 31 meantone temperament with a group of his students in quote: "All the principal cities of Italy".⁷ The progressive faction of the Council of Trent fathers apparently even asked him to compose a chromatic mass as a model for liturgically acceptable polyphony—though it was either never completed or lost to our heartless history. Still, the very fact that church officials entertained the idea of incorporating his innovative system into sacred music suggests its potential for wider acceptance.

Unfortunately, as we know from Galilei's same account, Don Nicola's music was not widely performed after his demise, and the practice of 31-tone a cappella singing remained dormant for over four centuries.

Point of Divergence, or how to win an impossible debate against popes favorite musicians

We have very little information about the arguments presented by the winning side of the debate in our timeline. Vicentino was mainly criticized by the judges for not knowing Classical Greek and for relying heavily on the authority of the V-th century author, translator, and philosopher Boethius—most likely referring to his translations of Pythagorean musical texts. One of the judges, Ghiselin Danckerts, was a singer and an influential—though radically conservative—theorist. He continued his campaign against Vicentino even after the debate, apparently writing *Sopra una differentia musicale sententiata* in response to *L'antica musica...* Unfortunately (or not), it was never officially published, so the juiciest details of this 16th-century intellectual beef remain obscured by time. Danckerts' conservative practices were later praised by Claudio Monteverdi's greatest critic, Giovanni Artusi.

To be honest, even limited information still paints a grim picture of most powerful and influential authorities in music, bullying an innovator coming out with fresh solutions into losing few coins. More intriguing, though, is the person chosen to debate Vicentino—Vicente Lusitano. Vicente Lusitano is known today as the first published composer of color in Europe (in 1970's a document surfaced, mentioning Lusitano as pardo, a Portuguese person of mixed ethnicity). Aside from being a renown master of strict polyphony, even publishing a unique book on creation of improvised counterpoint parts for existing cantus firmus, the fact that he was chosen for the debate raises questions.⁸

There were many strong conservative music theoreticians around the pope's court. Why did they decide to hire a music teacher affiliated with the Portuguese ambassador family to represent them? He is never mentioned as church's salary worker, even though he was a priest in Portugal (Vicentino on the other hand was hired in Vicenza and Milan later in life) and 10 years after debate (and a few greatly received publications in Rome), Lusitano lost his faith in Catholicism and converted to Calvinism immigrating to Germany. His last historical trace is in the Duchy of Württemberg.

Please, don't misunderstand me, but I cannot imagine the most conservative institution in human history choosing an immigrant of color as

their representation, without any hidden and probably callous reasoning behind it. Garrett Schumann in *Centuries of Silence: Vicente Lusitano and classical music's selective memory* proposes a reasonable theory, partly blaming “misleading” account by Vicentino presented in *L'antica musica...* for ignorance towards Lusitano's legacy by later composers.

And here comes the conspiracy (because we cannot really know if it wasn't like that in reality... can we?), starting our divergent timeline. I'd like to imagine that church was so afraid to either win or lose that debate (considering how influential Vicentino was during his lifetime and how he could publish multiple editions of his works despite loosing, and unsure political situation around Italy, especially in reformation shaken Vatican), that they found a scapegoat in Lusitano and decided to put all blame on him in case of losing the debate. Or maybe they decided to let him take a wrath of “modernist” music circles in case he would win? If only Vicentino could know about that... ?

Let assume that some happy and Romantic (it all happens in Rome after all) coincidence let Vicentino and Lusitano meet before the debate and share their views on music and tuning. Two freshly arrived in Rome fellow composers will surely find one or two places to bump into each other before this debate nonsense even happens!?

So in our alternative timeline, Vicentino and Lusitano accidentally meet for the first time while wondering around Pantheon, spending a whole day together discussing ancient genera, proper counterpoint, drinking wine, singing out of tune and making plans for performing Lusitano's music in Ferrara using Vicentino's tuning system.

This partnership is not so far-fetched. Both were great musicians and shared common interests, both were writing in modern, chromatic style and because of that were somehow outside the mainstream Catholic musicology that preferred to keep up with strict Roman style. When shortly after, they find themselves facing each other in debate, instead of pointing at inconsistencies and shortcomings of his dear friend, Lusitano decides to turn on judges and using his authority as a master of classical counterpoint provides insightful examples of using Vicentino's tuning theory, presenting it as viable solution to main harmonical limitations of modern counterpoint and a tool that can be used to perform contemporary music in a way closer to ancient standards than the one used in Capella Pontificia. The judges—Escobedo and Danckerts—furiously concede that Vicentino has won. Nicola refuses to collect Lusitano's penalty,

declaring that the only losers today are the entrenched powers of the Vatican. (We are firmly in the realm of fantasy now—so allow me a well-earned exclamation point.)

Next we really come to the point. The aftermath: or how we got 31 tones per octave to loose them again. What happens next should we ask? Success makes new tuning theory famous in a very short time. Thanks to this additional acknowledgment, Vicentino writes and develops more and faster than in our timeline. It is possible that composers connected with Vicentino through Venice or Ferrara would also start experimenting with extra accidentals his tuning allows to use. Let's try to imagine and describe such a timeline by decades:

1550 -

In 1552 Vicentino publishes *L'antica musica ridotta alla moderna pratica* - 3 years earlier than in our timeline. But this time, the book is written not as a defense against conservative critiques but as a clear and accessible textbook for musicians, giving them tools and knowledge on new temperament and its applications. It's filled with more musical examples, better technical explanations, and (perhaps regrettably) a little less drama. This decade marks the early split in musical practice—well before the concept of *Seconda Pratica* became popular. Let's call this new movement by *Seconda Pratica*'s less commonly used name: *Stile Moderno*. This new style slowly gains traction among the more progressive Italian composers, especially those associated with *musica reservata*.

We can expect them to write works in both old and new styles or even mixing parts of different genus inside one work. It was a popular practice back then, to write some parts of particular composition in simpler (rather strictly counterpointed and without ornaments) "nota contra notam" style using longer rhythmical values, so the text can be clearly spelled out to listeners. Such parts were used as a breathers in between lavishly ornamented fragments in faster tempo with unorthodox modulations, requiring considerable skills from singers. These musical contrasts could become even more pronounced under the expanded expressive palette of the 31-tone system.

One likely early adopter of *Stile Moderno* would be Orlando di Lasso.

His *Prophetiae Sibyllarum*- already wildly chromatic in our real timeline - could become a flagship composition using the new style extensively. The sheer harmonic abundance coming from the tuning system which allows the use of both perfect thirds and all keys equally, could have led to even stronger emphasis on contrasting fast and slow, loud and quiet, simple and complicated inside a single piece of music.

It is possible that even Lusitano would try creating in this style. He had shown a lot of interest in chromatic modulations and could've appreciated the level of compositional freedom that use of every possible key gives even inside the constraints of strict polyphony.

We still shouldn't forget though, that performing in 31 meantone is notoriously complicated for singers without accompaniment of properly tuned instruments. The very fact that there were very few such instruments could have limited early microtonal music to be performed in just a few private spaces in Ferrara and Venice. This could have brought the arguments into the hands of conservatives, that such music is inaccessible and doesn't serve the Lord's cause. But it all is bound to change with developments of our next decade.

A very interesting question for this decade would be: what's about Palestrina? Lassus had a strong impact on his musical language, but Palestrina never chose an experimental style of colleague from his youth and remained an "Ideal Catholic Composer"TM, taking inspiration from extremely conservative Spanish school. I don't think that experimental and/or modernist thinking was the way he wanted the music to develop, otherwise he had a lot of chances even in our actual reality but chose to stick with strict polyphony of previous century.

1560 -

Thanks to a surging interest in the new style of music, instrument builders find their hands full of new commissions. Every fashionable court and every powerful family now wants to have an instrument that will let their musicians try out performing new, fancy and sophisticated scores. Vicentino would surely have made a successful business out of this boom.

Throughout the decade, more skilled musicians and singers embrace the

challenge of performing in *Stile Moderno*. Mastering the 31-tone system becomes a mark of distinction—separating good musicians from great ones. The financial rewards for those who can perform in this style grow accordingly.

As instruments and trained performers become more widely available, even the conservatives can no longer ignore the movement. Ghiselin Danckerts, still stinging from the failed debate scheme, likely argues during the Council of Trent that *Stile Moderno* is unsuitable for liturgical use or even outright heretical reformist abomination.

Unfortunately, music is a part of politics, and every single artistic development during those years was happening in the shadow of Trent Council, widely considered as a defining event for the Counter-Reformation. It is possible that our *Stile Moderno* could be embraced by some of the reformist bishops the same way it was in our timeline. In general, different tuning systems weren't considered as problematic for church as indulgence in ornamentation and chromaticism. Probably Danckert's accusations would fall onto a rocky ground in this imagined timeline, especially that his reputation was already strained in our reality and would be even more in this alternative one. Let's assume he still gets dismissed from papal chapel after the Council induced reduction in size, with the same note of being, as Lewis Lockwood writes in *Grove Music*: "without voice, given to woman, excessively rich and useless because of illness".⁹

On the other hand, with such support in rather reformist circles, the new tuning system could have become the point of attack against overly, artistic musical practices that aren't putting enough emphasis on simplicity and text. In our timeline such opinion did actually hurt artistic quality of church music a lot, and partially led to emancipation of secular music just because composers could feel a lot more freedom writing secular forms (some of them even had religious texts, it was an overall musicological simulation mess).

If the Church had embraced Vicentino's tuning system more broadly, we might have ended up with a time capsule of microtonality preserved in sacred music—perhaps something akin to Greek Orthodox chant, where Byzantine music theory (itself rooted in similar Pythagorean tuning principles) still shapes practice today.

Yet, the Counter-Reformation maintains its influence over Catholic liturgical music. Even if Vicentino's system is acknowledged and respected,

it is very unlikely to be universally adopted for worship. So, for the purposes of this thought experiment, let's assume that the reform Vicentino envisioned for Church music is ultimately stifled. Further developments in the 31-tone system unfold primarily in the secular domain.

1570-

In this new timeline, the 1570s become the defining decade for *Stile Moderno*. Vicentino may still die in 1576, just as he did in our reality, but in this alternate world, his passing is not the end of his ideas. His tuning system and musical vision live on, thanks to a key factor: the growing interest of younger composers.

One particularly crucial figure is Orlando di Lasso, who by this time had already relocated to Munich and, during the 1570s, was arguably the most celebrated composer in Europe—judging by the titles and honors he received. If he continued composing in *Stile Moderno*, he would have influenced an entire generation of musicians. Composers like the Gabrieli brothers would have surely followed suit, continuing and expanding upon microtonal practices.

Flemish madrigalists such as Philippe de Monte or Giaches de Wert could also be expected to join the movement. In our real timeline, these composers sought the attention of Italian courts by writing in the *Musica Reservata* style. In this alternative reality, *Stile Moderno* becomes the fashionable language of expression, and Vicentino's ideas spread across Europe through Lasso's vast network of publications and performances.

By the end of the 1570s, the 31-tone system is familiar to composers in many European centers—especially in the Italian states, the southern Holy Roman Empire, and the Low Countries. Adoption may still be limited in hyper-conservative countries like Spain or England, but in the cultural capitals of the continent, experimentation is thriving.

Yet, challenges remain. The system demands highly specialized equipment and exceptional training. This limits performances to elite ensembles of professionals. Outside of Italy—and a few culturally rich regions like Bavaria and Flanders—*Stile Moderno* remains a rarefied art, celebrated but not widespread. Its intricate demands risk making it a niche genre.

Back in Italy, however, something significant begins in 1573: a gathering of musicians, poets, and humanists dedicated to reviving the spirit of ancient Greek music, drama and esthetics. They will become known to history as the Florentine Camerata. And in this alternate timeline, their work will be both a blessing and a curse for Stile Moderno.

1580-

Some historical forces are too large to be changed by two composers in a single debate—no matter how dramatic. One of those occurs in 1581, when Girolamo Mei founds the first real source in a long struggle to understand Ancient Greek music. Hymns of Mesomedes are analyzed by Vincenzo Galilei (father of Galileo Galilei most of us will immediately think about) and in his *Dialogo della musica antica e moderna* he forms a postulate for accompanied monody - not polyphony - to be a form of music closer to the musical ideals of antiquity.

We can safely assume that, by this time, Stile Moderno is flourishing in Florence, especially in the court of Count Giovanni de' Bardi. Vicentino's proposition of music, closer to antique, would make it mandatory for such society to indulge in new, stylish, mostly secular music compositions. Such artists as Giulio Caccini, Emilio de' Cavalieri, Cristoforo Malvezzi and Alessandro Striggio could have adopted the new style of composition and tuning. For the Florentine court it was easy to acquire teachers, literature and instruments to perform and develop music in Stile Moderno.

It is even possible that in our imaginary timeline Vicentino himself is invited to take position in Florence around the mid 1570s and joins Camerata as a prominent participant and teacher a few years before his death. Camerata's composers could have become the students and scions of Don Nicola, since his success and adoption of this style by other renown composers would probably overshadow the scepticism presented by Vincenzo Gallilei in our actual reality.

Just imagine what the talented singers of the Caccini family could have done with 31 tones per octave—their ornamentation techniques and vocal expressiveness amplified by a harmonic palette previously unimagined. Ironically, the term Stile Moderno may never be coined by Caccini in this timeline, since it's already associated with Vicentino's innova-

tions. A fun little time paradox already?

Meanwhile, in Naples and southern Italy, Pomponio Nenna becomes an influential conduit for *Stile Moderno*, spreading microtonality southward. A student of Caccini and an admirer of experimentalism, he may even inspire a microtonal version of... Carlo Gesualdo da Venosa. Yes, Gesualdo's notoriously wild harmonic experiments—already extreme in our timeline—could reach entirely new levels of chromatic intensity in this alternate one. Terrifying? Yes. Glorious? Absolutely.

And speaking about this decade, there is one person we cannot forget about. A teenager Claudio Monteverdi is absolutely fascinated with amazing new instruments and strange affectuous harmony of music, brought to Mantua by Giaches de Wert, a follower of Vicentino's friend Cipriano de Rore and former court musician in Ferrara. In our imaginary timeline there is no chance he wasn't proficient with *Stile Moderno*, learning from the first composers to experiment with such microtonal tunings and working with them for years. Even in our actual reality it is possible that his influence on young Monteverdi was the main factor for Claudio's musical development. There is just one handshake, and it's a firm one that connects Monteverdi to Vicentino. I means that in case of *Stile Moderna* popularity growth induced by Vicentino winning the debate, one of the most influential composers to be in the worlds history is now learning microtonal music practices from his very first steps in music career, and it is always very good news for a new tuning system.

Wert himself continues composing throughout the 1580s, and his works—especially those written for the *Concerto delle Dame* of Ferrara—help to bridge *Stile Moderno* with the emerging aesthetics of *Seconda Pratica*. In fact, in this version of history, it is likely that *Seconda Pratica* and *Stile Moderno* are not separate paths but a continuous evolution. The 31-tone system becomes its shared foundation, maybe even as much as accompanied monody.

1590-

By the 1590s, we are deep into speculative territory. The butterfly effects from Vicentino's victory have rippled far and wide, and every assumption now rests on the altered momentum of nearly 40 years of musical histo-

ry. But one thing is certain: in this alternate timeline, Claudio Monteverdi is not just an extraordinary composer—he is also the inheritor of a living microtonal tradition.

Just as in our world, Monteverdi begins to break away from the strict polyphony of the *prima pratica* and embrace a bold, emotionally charged musical language. But here, his harmonic vocabulary is expanded even further by access to Vicentino's 31-tone system. The *Seconda Pratica*—the new way of making music that prioritizes expression over theoretical constraint—fully embraces microtonality as part of its DNA.

And this changes everything.

With continuo instruments like the *arcicembalo* and fretless strings providing richly tuned harmonic foundations, singers now have the support needed to perform in 31-tone meantone with greater ease. Accompanied monody—already a powerful tool for expressing human emotion—becomes even more evocative when built upon precise intonation and pure intervals.

What we witness in this decade is a true fusion: *Seconda Pratica* becomes the stylistic heir to *Stile Moderno*. The ideals of expressivity, contrast, and drama meet the technical innovations of Vicentino's temperament. This continuity strengthens the movement and gives it deep historical legitimacy.

Madrigal composers across Europe take note. While the full 31-tone practice remains limited to elite ensembles and skilled courts, its influence spreads. Some composers adopt only parts of the system—employing just a few additional accidentals or experimenting with alternate temperaments—but the effect is noticeable. There's a new color in European music, and it's unmistakably tied to Vicentino's legacy.

The 1590's also brings a generational advantage: many of the finest singers and instrumentalists alive were trained during the height of *Stile Moderno*. They are now in their prime, performing repertoire that demands—and rewards—mastery of microtonal nuance. It's a golden age of refined experimentation.

Of course, challenges remain. Even now, this style is seen by many as esoteric or extravagant. It is respected, perhaps even admired, but not easily replicated. Outside of Italy, southern Germany, and the Low Countries, it continues to be viewed as a specialized or luxurious genre—intellectual-

ly impressive, but costly and difficult to perform.

Still, Monteverdi's music carries it further than anyone before. His madrigals and early operas demonstrate how microintervals can serve drama, character, and expression—not just mathematical elegance. In this timeline, Monteverdi doesn't just change music. He saves a fragile tradition from extinction.

1600-

By the turn of the century, *Stile Moderno*—now deeply intertwined with *Seconda Pratica*—is no longer just a musical trend; it is part of a full aesthetic revolution. Monteverdi stands at the forefront, pushing the expressive boundaries of music in both sacred and secular contexts. The 31-tone system, originally born from Vicentino's theoretical explorations, is now firmly embedded in the practical language of early Baroque composers.

But the tides of change are rising.

Conservative voices, though unable to defeat Monteverdi's artistic momentum, continue to push back against what they see as excessive ornamentation and intellectual elitism. Giovanni Artusi, a well-known critic even in our timeline, might still wage his battle against the Monteverdi brothers. But here, with the 31-tone system now associated with the most celebrated and influential composers of the age, even Artusi would find the tuning system itself a harder target. His main criticisms remain focused on accompanied monody—not on Vicentino's temperament.

Yet for all its beauty, *Stile Moderno* in 31-meantone begins to show structural vulnerabilities. The very complexity that made it so rich also makes it fragile.

The demands it places on performers—especially singers—are significant. Training a singer to navigate pure micro-intervals is no easy task. The instruments capable of rendering the full 31-tone scale are expensive and delicate. And as early Baroque ensembles grow in size and scope—particularly in opera—the logistics of maintaining such precise intonation across large groups becomes increasingly impractical.

The shift toward theatrical productions and large-scale instrumental writing introduces new musical priorities: volume, clarity, and coherence.

These are not easily achieved with split-key keyboards or the intonational nuance required by microtonal singing. Slowly, simplicity begins to win out over precision.

At the same time, the spread of equal temperament (12-TET) accelerates. While not as harmonically pure as 31-tone meantone, it is far more adaptable to the growing demands of keyboard and ensemble music. The 12-tone system offers simple and limited standardization—a way to make instruments more compatible, and ensembles easier to manage across regions and repertoires.

And yet, even as *Stile Moderno* fades from the mainstream, it does not vanish entirely.

In this alternate history, microtonality never disappears the way it did in ours. Thanks to its century-long presence in elite courts and its association with figures like Monteverdi, it remains a known and respected tradition. Some composers use it sparingly in chamber works, others—like Heinrich Biber—explore it for solo string instruments. Haydn occasionally references it in his string quartets. Mozart includes microtonal effects for emotional or dramatic effect. And Beethoven? He studies Vicentino's writings, reconstructs an arcicembalo, and composes a set of fugues in 31-tone meantone, baffling and astonishing his contemporaries.

In this world, microtonality never becomes the dominant tuning—but it never becomes forgotten either. It remains a thread running quietly beneath the broader history of Western music, occasionally resurfacing, always remembered, never fully lost.

In this imagined history, a single debate ends differently—and music itself takes a new path. Nicola Vicentino's triumph becomes more than a personal vindication; it redefines the future of Western art. What might have remained a theoretical curiosity instead becomes a living tradition. The 31-tone system influences generations of composers, reshapes vocal technique, redefines the expressive limits of harmony, and for a time, becomes the very sound of modernity.

Notes

(1) - fun fact: Gabrieli and de Rore even wrote „Lamentos” for their mentor after his death, and thanks to Zarlini’s influential writings, the music of Wilaert was getting re-editions until the very end of XVIth century.

(2) Sadie, Stanley, ed., *The New Grove Dictionary of Music and Musicians*, vol. 20 (1980, London, Macmillan Publishers Ltd.)

Also: Kaufmann, Henry William, *The Life and Works of Nicola Vicentino*. (1966, Rome: American Institute of Musicology)

(3) Reese, Gustave, *Music in the Renaissance* (1954, New York, W.W. Norton & Co.)

(4) See the work of Ercole Bottrigari: <https://polskabibliotekamuzyczna.pl/encyklopedia/bottrigari-ercole/?lang=en>

See also James Haar and Paul Corneilson: https://www.istitutobellini.it/oldsite/sites/default/files/file_docenti/princeton_legacy_library_james_haar_paul_corneilson_-_the_science_and_art_of_renaissance_music-princeton_university_press_1998.pdf

(5) <https://www.projektstudio31.com/instruments>

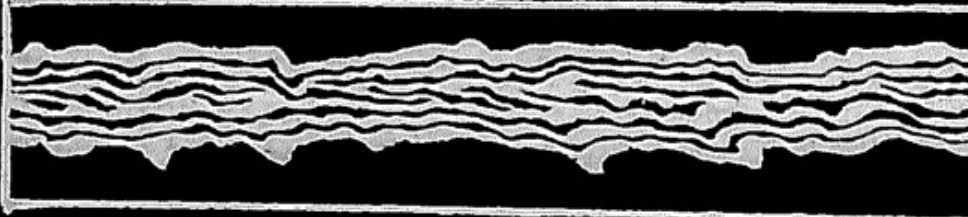
(6) Wild, Jonathan, *Genus, Species and Mode in Vicentino’s 31-tone Compositional Theory*, Music Theory Online 20.2

(7) Galileo, Galilei, *Discorso intorno all’uso dell’enharmonio...* 1590–91

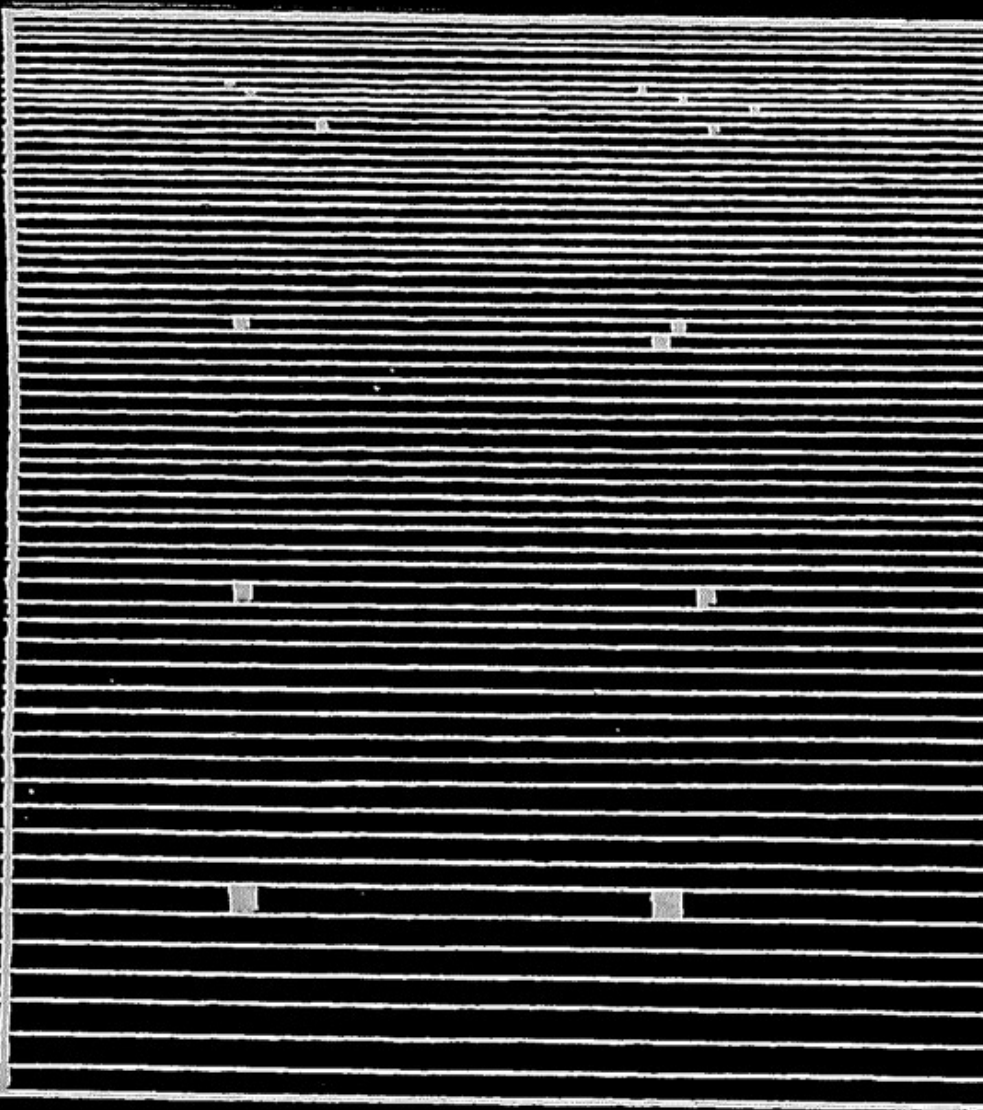
(8) Schumann, Garrett (2020-04-23), *“Centuries of Silence”*

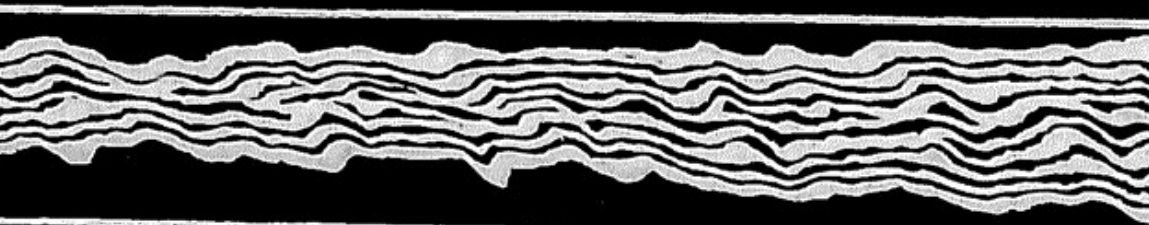
(9) Lockwood, Lewis, *Ghiselin Danckerts*, Grove Music Online, ed. L. Macy

See also: <https://www.examenapium.it/cs/biblio/Lockwood1965.pdf>



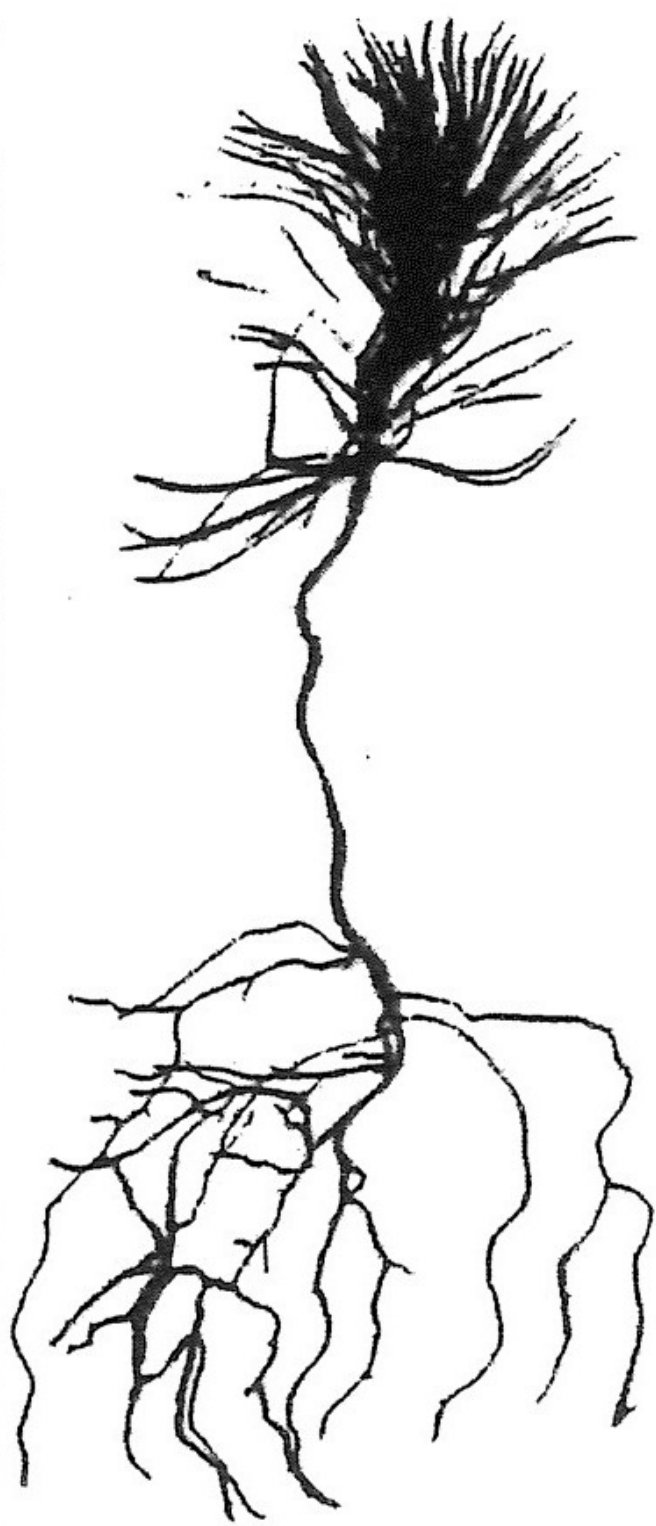
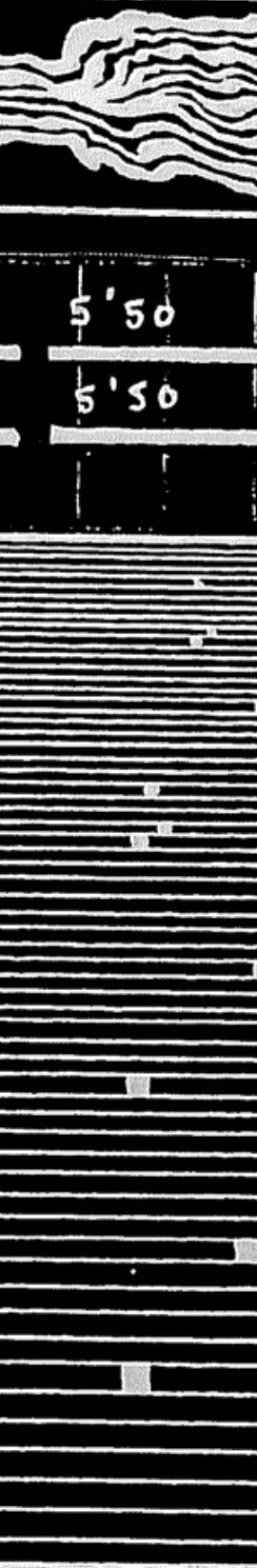
0'04	0'33	1'00	1'28
0'04	0'33	1'00	1'28

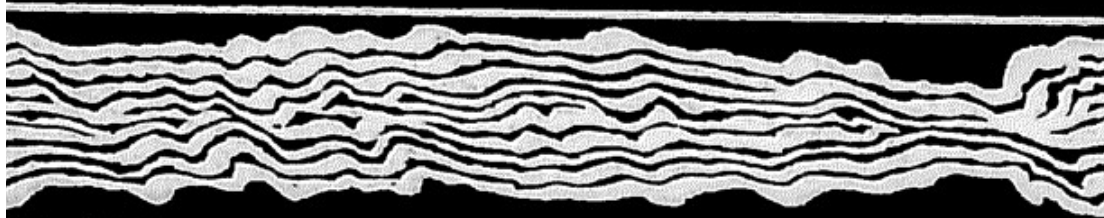




1'58	2'30	3'00	3'33	4'00
1'58	2'30	3'00	3'33	4'00







4'20	4'40	5'04	5'27	5'50
4'20	4'40	5'04	5'27	5'50



Amalia

Deorsola

**Negotiating
thought through**

**sound: The
prepared piano
as a site of
microtonal
contestation**

Introduction

What type of sonic realities are negotiated within the piano? Using a hybrid format informed both by theory and personal artistic practice of the author, this article suggests that the piano is a space where diverging and multiple sonic ecologies – both tonal and microtonal – meet. It is an ambiguous instrument. On the one hand, it strongly epitomises the western musical canon. Equal temperament is embedded directly within the instrument's mechanism, affecting the core of the piano's sonic palette. This speaks to the strong and material entanglement of piano, tonality and western conceptualisation of sound. On the other hand, the piano can also open itself to reinvention by using objects to prepare its strings and alter timbral and textural possibilities, as well as facilitating the production of alternative tuning systems. The article argues that piano preparation recontextualizes the instrument's mechanics and opens up its supporting tonal concepts to practical, theoretical and critical questioning. The piano becomes a site where multiple sonic worlds are negotiated, contributing to a wider discussion about the role and importance of microtonal musical practices today. Tuning is not a neutral and transparent action and denotes cultural relations to sound, its control and classification. Equal temperament forms a collective memory both affective and mechanical, historical and technical: a noisy entanglement. To listen in on this noise means to tune into the politics of tuning. The control of sound reveals broader strategies of power within western ordering and classificatory practices, a problem that is sensorial and artistic, ethical and epistemological. Tonality is not just conceptual but rather defines habits of movement within sound and thought. The article concludes by arguing that piano preparation can disturb these habits and that microtonality is an essential expressive tool in negotiating the border between what gets to be music and what is reduced to noise.

Everybody has their own America, and then they have the pieces of a fantasy America that they think is out there but they can't see. When I was little, I never left Pennsylvania, and I used to have fantasies about things that I thought were happening in the Midwest, or down South, or in Texas, that I felt I was missing out on. But you can only live in one place at a time. And your own life while it's happening to you never has any atmosphere until it's a memory.¹

According to Warhol, memory is not a recollection of facts, but the creation of an everchanging mood and atmosphere. Never truly fading away,

memories embed themselves through time, in a process of constant modulation. They form messy and dynamic entanglements with our projections, our fantasies and desires and in this sense are more affective than factual, more perceptive than rational, more creative of imagined past(s) than reminiscent of an actual present we lived in. Memory then would be something fragmentary, ambiguous and unstable, co-composing with what we think is out there.

We take the image of memories with us through this text, not only to offer a first-hand account of piano preparation from subjective experience but more importantly because they offer us a space for thinking that is already etched in mobile — and therefore fluid — grounds. It is a place where embodied practice and imagination come into play as practices of knowing better, ones in which blind spots and opacities are valued for the motions in thought that their encounter awakens in us. Here we start our threading, wondering if there also a memory for imagined futures.

Bruxelles, Belgium, Early July 2024, Dusk (9pm). I take a breath. The video-call has just ended. I close my laptop and turn back to face the window. Looking out, I see wet heavy clouds drawing uncomfortably close, trying to block out the sun one last time before it sets. A hypnotic landscape unfolds in front of me, as if the sky was already forming a memory of its own: one where the pink horizon, the fluffy clouds, the last rays of dusk and the scent of the growing moon draw together in greeting, like old friends who know they will see each other again soon enough. Some other sensations were poking their head into the picture. Vapors of fear, hesitation, uncertainty flowing out from under the coming night: Would I be able to compose for such a project? Why did I ever take this project up? The zoom call was with *Sandikala Ensemble*, an experimental Gamelan² ensemble based in Yogyakarta, founded and co-led by composers Dion Nataraja, Roni Driyastoto and Yustiawan Umar.³ It was a short meeting, which we had used to fix the final line-up for our upcoming residency in Yogyakarta (IND) and discuss the divergences in tuning between the two families of instruments. Working with self-devised tunings and instruments, *Sandikala* would make available a series of own-made gamelan instruments for the collaboration. On top of *Rebab*, a two-stringed bowed instrument found across many Asian musical cultures and *Sulings*, a type of bamboo flute, *Sandikala* would also bring four *Gènders*. *Gènder* is a type of metallophone from the Gamelan family played with 2 mallets and consisting of 18 metal plates over three octaves.⁴ The instruments came in couples of *Gènder Barung* and *Gènder*



Fig.1 EMBAT – IFI , Yogyakarta (IND). From left to right : Amalia Deorsola (piano), Antoine Léonardon (d.bass), Roni Dryiastoto (rebab), Héctor Léna-Schroll (trumpet), Yustiawan Umar (gendèr barung), Marco Luparia (drums).



Panerus, with Panerus pitched one octave higher than Barung.⁵ Each of the couples were tuned differently, meaning concretely that we would have 3 different tunings to deal with in the composition process: equal temperament and *Sandikala's* two tunings.⁶ This was a complex ecology of sound, with conflicting intonational spaces, heterogeneous instruments and musical traditions. With a background in jazz and improvised music, I was doubtful of being able to navigate and write music within such a space. As a pianist, I was especially worried about my instrument's intonational rigidity and how the instrument could be made to fit at all into the project without resorting to keyboards or synthesizers.

As we shall see recurringly throughout this text, different instruments come each with their own mechanics. Together with the musician and the composer they co-define expressional characteristics and specific sound palettes, conditioning but not overdetermining what is possible to play on the instrument. Because it is the most concrete surface from which sound production emerges, this mechanical landscape is not cut off from music. Rather it is immediately cultural, sensuous and sonorous all at once and therefore the mechanics of an instrument not only define playing possibilities, but also organize how sound is perceived and organized, orienting creation. As Robert Donington argues "Music is of the imagination, but the imagination is of the sound and the sound is of the instruments".⁷ Here the piano, its mechanics and keyboard layout, come forth as one of the most inflexible and rigid entities of the Western *instrumentarium*.⁸ Ferruccio Busoni, himself a pianist, writes in *Sketch of a New Aesthetic of Music*:

One day it became clear to me: the development of music is impeded by our instruments. [...] In their scope, their sound, and their performative possibilities, our instruments are constrained, and their hundred chains shackle the would-be creator as well.⁹

Whether we agree or not with Busoni's comments, it is clear that composing for an instrument calls on us to work with these technological entanglements. Composers cannot go further than the possibilities of the instruments they are writing for. Whether we consider this a limitative remark or a call to enter this entanglement and attend to its deformation by making kinship with other ways of imagining sound is only up to us.

It is precisely here that the topic of piano preparation becomes relevant, both as a way of resolving the issue of composing for line-ups with multiple tunings and as entry point into the broader discussions of this article.

Using objects to de-tune the strings of the piano, altering their character (timbre, texture, attack, resonance, harmonic spectrum, etc.) is nothing new. Most readers, I assume, will be familiar with the history of prepared piano. Though earlier composers, notably Henry Cowell, had already started to invest the inside of the instrument as a site of creation, it was John Cage who extended and solidified this practice, first with *Bacchanale* (1940) and then more broadly with the *Sonatas and Interludes* (1946-48) where he systematized the objects used, the material and their precise placements within the string. Of notable interest to me, on top of strongly highlighting the percussive nature of the piano, is the variation in timbre preparation offers, resulting often in *scordaturas* of the note when using objects with softer material (wood most of all), which enables the piano to enter an ecosystem where tonality and microtonality can mingle. Though the connection to the timbre of gamelan is obviously tempting to make from the get-go (and some of the preparations indeed do get close to the timber of gongs, bonangs and gender), I treat preparation beyond exotic effect and try to construct it as medium of inquiry: a way to enact sound differently orients us towards a listening that itself must also be different.¹⁰ With all of this in mind, I can now ask my directive question with more weight than before. *What type of sound negotiations are taking place within the piano?*

Piano Preparation : A pragmatic answer to the problem of microtonality

As a starting point to this question, I offered a short, embodied account of some experiences as composer and pianist prior to an artistic residency that took place in Yogyakarta at the French Institute (IFI) in October 2024. The residency is part of EMBAT, an intercultural collaboration between the experimental gamelan ensemble Sandikala and Anaphora, a jazz trio (piano, drums, double bass with guest trumpet for the residency) which I co-lead together with drummer Marco Luparia. The residency took place over a week and served as a first meeting between the two groups. This was needed to record a first rough draft compositions and explore how gamelan and western instruments — which function within different tuning systems — can collaborate through improvisation.

I want to ask if cross-cultural collaborations require more ethical practices for knowing and doing from us, and if artistic research can help us out

in this regard. Within this broader theme I believe that the piano, both in its historical context and its techniques of preparation can act as a catalyst for unexpected practices of sound to emerge. The technical subversion of instrumental mechanics forces a change in how the performer approaches the instrument in terms of sound, both in its production and its perception. At its core this is a question of generating different movements and attending to their mutual negotiation : in sound-perception and sound-action. Here, piano preparation also plays an important role in recovering archaeologies of sound folded within the strings of the piano. Microtonality is one of such “in-between” topologies : its uncovering enables the creation of a framework where tonality can be displaced, its concepts questioned through practice and theory. Luigi Nono writes that “music is thought”.¹¹ Sound is fluid and in motion: for this reason, to think well within artistic practice is to move well with others. The preparation of the piano with foreign objects creates unexpected entanglements and leads to new movements. Therefore, it forms a helpful ally in investigating how negotiations about conflicting sonic ecologies can unfold both within the piano and with other instruments.

The residency with *Sandikala Ensemble* had been under planning for a year and was already a long way into the making. Marco and Myself had started the project in the summer of 2023, getting in touch both with *Sandikala Ensemble* and cultural institutions — notably the Indonesian Embassy in Bruxelles — that could lend logistical and monetary support to the project. In a sense, one could say that we had been travelling, albeit digitally, to Indonesia since the start of the project. Contacting relevant people, getting in touch with embassies, holding digital meetings to discuss the compositional drafts. Even before any actual physical collaboration starts, the site of home is implicated and mutually related with the site of research abroad.¹² An artistic circulation is already established, conditioned by physical sites, but not determined by them.¹³ In between virtual and physical, across digital mediums, this circuitry is manifold and bound with miscommunications, glitches of sense, pre-crafted images about the outcome of the residency and its process. Of course, it also highlighted points of tension within the hybrid line-up, difficulties of legibility across tuning systems. It should be quite clear how the piano manifested most strongly these inter-cultural tensions of sound since its tuning is fixed and its keyboard laid out to 12-ET.

Piano preparation is a practical answer to this issue. There a couple of things that should be kept in mind here. First is the general idea that, out

of the many changes that took place within all facets of music in the 20th century, microtonality has been a largely peripheral exploration. With dodecaphonic serialism being amongst the most influential of techniques, this also suggested an attitude to composition that took 12-TET to be somewhat axiomatic¹⁴ and indeed Joel Mandelbaum gave a conference in 1967 entitled "The isolation of Microtonal composers" [1967]. This has also affected the building of new instruments and techniques capable of entering a microtonal sonic space, whichever it may be. The initial explorations of George Ives' quarter tone machine were followed by other composers, for example Harry Partch and the string, keyboard and percussion instrument he built according to his Monophony system dividing the octave into 43 unequal parts. Yet these experiments have always remained few and far in between. Additionally, the development of electronic music and digital instruments has allowed for easier treatment of microtonality, becoming a preferred and more comfortable medium for obvious reasons. As James Woods notes, "the evolution of acoustic microtonal instruments has faltered before even entering into adolescence."¹⁵

Clearly there are two options before us: to build new instruments or work with the ones we already have. I leave out the building of new instruments for lack of substantial knowledge on the subject. However, I wonder if co-composing with limitations around us, including those instrumental, isn't also a resource that can be cultivated through artistic experimentation and mechanical intervention into the piano. Preparing the piano, deforming its mechanical landscape, contesting its technological assemblage: none of these are actions that simply alter a given object. An entirely new object, with new qualities is created here, if even just for the time of preparation. Displacements within the configuration of the piano modulate it into new forms of life. To work with what we have, despite its constitutive (and here mechanical) blockages, entails imagining how to do and what to do when it seems there is nothing to be done. Creativity makes kin with subversion, thievery and dislocation: irreverent interventions in the face of local impossibilities. To prepare the piano is not a shying away from real microtonality or real microtonal instruments and offers us with a different image of the relations we can make both within and through microtonality.

To start, it needs to be mentioned that the particular case of the piano poses specific problems. If we take into consideration the Classical Music world, which is quite more institutionalized than either the Improvised

and Jazz scene, we can already suspect that putting into action pieces like Georg Friedrich Haas' *Limited Approximations* (2010) for orchestra and six microtonally tuned pianos demands remarkable logistical efforts as well as requiring considerable financial support (for example, consider de- and re-tuning 6 pianos.) For the realities of other forms of music which either receive much less support because carried out by individuals or without any form of institutional support, this type of approach is simply not possible. Piano preparation still poses two issues:

One, It is still controversial for a lot of venues and concert halls. Two, is there a grand piano at all on site? Uprights are much harder to prepare both because of gravity and the string superimposition.¹⁶ Yet, the prepared piano still comes to light as practical solution to a local problem — that of tuning within hybrid settings — whose conditions change on each occasion it presents itself to us. The preparation offers a flexible, embodied and situated tool in bridging and negotiating this difference within sound. First, this is coherent with my current practice, which is influenced by diverse genres but whose starting ground is improvisation and band interplay.

Two, I take this flexibility to be of added value. This means that instead of the space of performance having to orient itself to the wishes of a composer, it is the local situation that dictates what, and how to prepare the piano.

How to encounter foreign sound cultures?

The problem of Just Intonation and Mathematical Models

All of this suggest a view that is pragmatic, situated, and in tune with the logistical demands performers need to meet in most musical realities. From this perspective, the following type of comments invalidating the use of current instruments in producing microtonal music are baffling to say the least.

Many would argue that a more realistic future for acoustic microtonal music lies in writing for instruments which do not have to be specially built [...] It is, however, precisely these conventional instruments which in practical terms are incapable of consistently accurate realization of micro-intervals, because of the subjectivity involved.¹⁷

It is clear that Woods is referring to instruments other than the piano

and yet it is hard to see why the subjectivity of the involved performer would detract value to microtonal experimentations. Despite rightly pushing for the creation of new instruments, this type of view repeats a demarcation between composer — as sole emanator of musical material — and performers. Instead, piano preparation is built on the assumption that the performer is not only an executant but a capable creator that can equally participate into the compositional process. This more so the case in jazz and improvised music, in which hierarchical or functional roles (director, composer, etc.) are less set in stone. Most ‘jazz’ musicians I play with are active composers in their own right. In any case, this shift works hand in hand with a critique of the very notion of the single-work concept and all its corollaries: “the reification of the composer as autonomous “genius” [...] the fetishizing of an authoritative and self-sufficient musical score; the ethical obligation for the most faithful musical interpretation (Werktreue) of a score— [...]”¹⁸ Envisioning piano preparation in such a way does not remove precise work both within composing and interplay: yet the enactment of piano preparation, especially within improvisation, points to ways of knowing and doing that are situated, non discursive and can survive outside the space of text (including scores). Here traditional theory on microtonality emerges as a potential obstacle to how I want to engage preparation and microtonality. Most authors are based in a scientific and mathematical approach. Some more¹⁹ than others.²⁰ Ensuring objectivity, but also a feeling of complete removal from microtonal ecologies as an actual space of sound, which is to say a subject of possible embodied experience. One gets a sense that indeed microtonality becomes, as composer Michel Gonneville suggests in an interview, an obstacle when it becomes a theoretical topic of discussion rather than a sonic experiences capable of expanding into new possible perceptions.²¹ Objectivity is equally constructed as subjective presentations. There is a lot of work that comes into removing the perspective from which one produces knowledge – Western modernity has refined this into a systematic *modus operandi*. It is as efficient in its operations as it is poisonous for new kinesis of thought to take hold within us.

So then, what am I trying to do here and what is this article about? It is not a scientifically oriented take on microtonality. It is also not a systematic critique of scientific or theoretical approaches, which have their use for expanding what we know about microtonality and how we implement tools and methods to create new scales or tuning systems. It is not claiming that piano preparation is the last solution to the problem

of microtonality. No, what is at stake here is simply a practice I developed over the years and which I am contextualizing through recent situations that gave me pause for thought. It is neither the most perfect, nor the most accurate method of entering microtonal space. Outside of practical considerations, I am interested in the way this practice can tell us something about artistic research in general. I am interested in how microtonal motion and its indeterminacy are to be found and negotiated by a performer, turning them into resources in the way we form practices of knowing. Bruno Latour argues for such a method, one that can “feed off from uncertainties rather than cutting through them”.²² Mathematical models and visual diagrams for proof are examples of such cuts. Whenever something appears too transparent, we must proceed with caution. This type of positioning expands our knowledge of microtonality but never does it put into question the form into which this knowledge is produced and distributed, which is to say *made real and consistent*. Here lies a continuous assumption that the world passively exists for our research: that knowledge is textual and that, more to the point, the relation of knowledge and its translations across mediums (for example from composition to theory, from one culture to another) to be neutral, unproblematic and transparent. For this reason, they are the furthest thing away from their own working definition of objectivity, implicitly suggested within the texts. Since assumptions are by definition biased, this is logically speaking, a self-defeating premise. One finds glaring examples of this in western epistemological and creative practices, especially when they are relating to non-western cultures, whose texture is for us westerners opaque and resists attempts at total legibility.

Lou Harrison, an American composer known for his work on just intonation, built several gamelan instruments based on simple frequency ratios—that is, “pure” consonances derived from harmonic series containing upper partials (such as the 7th, 11th, 14th, etc.)²³ The pélog (7-note) and sléndro (pentatonic) scales were measured according to adjacent tones in the harmonic series,²⁴ with the sléndro scale in particular being derived from the 7th partial.²⁵ This gave rise to a fascination with this form of intonation—regarded as “purer”—to the point that Indonesian gamelans imported by the composer to the United States were retuned according to rational intervals. The strong association between just intonation and the concept of nature, in the sense that these frequencies are assumed to be expressing some form of nature, even of nature’s original purity—is a typically Western gesture, one that tends to present its own

cultural constructions under the guise of universal naturalness.

Theory does not just see, but also demarcates a legitimate perspective on the seen, *what seeing and knowing are in the first place*. If thought did not construct what it was looking for and partially determine the conditions in which this looking-for happens, it could never find indices and signs of its presence in material reality.

From a strictly physical standpoint, however, reducing the *sléndro* and *pélog* scales to rational intervals is untenable, since the metallophones used in gamelan ensembles produce inharmonic frequencies and stretched octaves across instruments, leading to beating phenomena and frequency phase shifts based on 'irrational' intervals.²⁶ This is a clear trend within the broader Just Intonation and 12-ET debate. Johnson defines equal temperament as an "acoustical lie".²⁷ David Doty, the founding editor of the 1/1 Just intonation journal writes that "the simple-ratio intervals of Just Intonation are the only musically meaningful entities from which melody or harmony are to be constructed".²⁸ Stephenson remarks in his article *The Poetics and Politics of Ambiguity* that there is a tendency amongst JT-theorist to "equate Just intonation with nature".²⁹ Is it interesting to see here a passage from Thomas Nail's excellent philosophical work *Theory of the Image* in which he discusses ancient Greek musical practices and their modeling images:

Once the concrete, patterned vibrations of the strings enter the resonance chamber, their graphic recording and ordering into scales begins to invert the kinetic relationship. The scale and notation form now persist after the tones are removed from the resonance box. Through notation, predetermined diatonic relations, and the dramatic subordination of musical forms now seem to precede any concrete sonic form of the instrument. [...]

This process reached its apex with the Pythagorean mathematization of fundamental musical intervals: 1:1 = unison, 2:1 = octave, 3:2 = fifth, 4:3 = fourth within the octave. The Pythagorean diatonic scale is thus limited on both sides by two octaves, between which are the perfect fourth and fifth tones. As mathematical ratios, they pertain to all sensuous images but are not sensuous images themselves; they are abstract forms understood only by an affection of the mind: contemplation. Music thus increasingly becomes simply a way to bring unformed matter into a properly formed relationship of abstract formal image ratios.³⁰

Placing the entire justification and grounding of sound within mathe-

mathematical models inverts the kinetic relation between sound production and theory. No longer does sound shape our perception and our practices (of tuning). Rather the relation is inverted and it is now sound that must conform to an abstract mathematical model whose logic rests on the assumption that these are recurring and natural model structures. This is a heavily taxing assumption when engaging non-western intonational practices.

For example, in his 1949 publication *Music in Java*, Jaap Kunst is well aware of the practice of stretching octaves³¹, but considers it outdated in Javanese music. In his measurements of various gamelan instruments in *sléndro*, the author observes constant fluctuations in interval distances, but assumes these are merely insignificant deviations from a fixed pentatonic scale with equidistant and regular intervals, which he sets at 240 cents.³² In reality, traditional Javanese music—karawitan—is completely foreign to concepts of either just intonation (see Harrison) and Cent measurement (see Kunst). The tuning of gamelan is not conceived in those terms, which are anachronistic both historically and discursively. The tuning of gamelan in *sléndro* and *pélog* is referred to as *lara* (meaning “appropriate”), and its central concept is *embat*, which defines a kind of strongly individual “feeling” or character.³³ *Embat* refers to any intonational realization of a temperament system (*sléndro* or *pélog*). Every person has an *embat*, and the tuner uses their own vocal *embat*—the natural *embat* of their voice—to define the tuning of the gamelan, based on modes of 4 or 5 notes (*pathet*) derived from the *sléndro* or *pélog* scale. However, these intervals are not fixed, and depending on the chosen *pathet*, the distance between each interval in the scale will vary slightly. This means that, given the fixed pitches of the gamelan, the artisan must adjust or reinterpret certain intervals of their vocal *embat*, producing an artificial *embat* specifically for the gamelan in question.³⁴ This implies that each gamelan has its own unique tuning, in which certain *pathet* will resonate better than others because their intervallic series aligns more closely with the Gamelan’s actual tuning.

Ultimately, the problem I have with the type of theoretical approaches I have characterized above is that they lack a capacity to reflect on their own constitutive operations of discursive constructions, for which other tools — affective, philosophical, situated — are needed. Then, what I would like to offer here is an epistemic position congruent with the feminist and ecological turn within Science and Technology studies. This position treats meaning as an open question and investigates precisely

the links within production of knowledge, treated as partial, situated and non-neutral.³⁵ This resonates within inter-cultural artistic collaborations, where the negotiation of sound and cultural difference occurs materially through sonic, bodily, and spatial entanglements that are set within uncertain motions of meaning. In this process, imaginative capabilities are important: it is a movement of sounding out dreams and dreaming out sounds. If it is the case that our cognitive and perceptive modalities must be imagined anew, then artistic research become a relevant framework in which it is possible to treat entangled realities. Because they move with the help of tools that are affective and perceptive, conceptual and technical, artistic disciplines can act as particular modes of knowing³⁶ in which critical self-reflection is possible.³⁷ How does this resonate back into the collaboration with *Sandikala Ensemble*?

The Piano as a multiple entity: Preparation techniques and examples

What was interesting is that the piano, originally the biggest obstacle to the collaboration with *Sandikala* becomes the most fluid entity within the project, capable of both entering relatively in tune or contrasting sharply with the Gamelan instruments. What was the most rigid element becomes a mediator. This speaks to an ambiguity and duplicity within the piano itself. In this site of entanglement we find different ecologies of sound, engaged in a continuous process of negotiating their boundaries and their relations. Here we come back to our initial image of memory and ask: what memories live in a sound? Do instruments hold memories? From this perspective, the piano fragments into an open-ended assemblage which we can question, investigate and subvert.

On the one hand, it is one of the most powerful tools of capture and exemplification of the European musical canon—not only due to the sheer number of works written for it, but more importantly because it crystallizes a musical artifact specific to the Western world: equal temperament. It is a kind of collective tonal memory applied to the sound of the strings, with the keyboard fixing and limiting the musical space into equally divided and discrete entities, the semitone. This is typical of other conceptual and theoretical gestures within Western epistemological, philosophical, scientific disciplines of the period. As we have seen, at hand is always the tendency towards universal concepts and structures. The premise of

II
Part II

4 4 1	3 2 2	6 5 5 7	5 5 2 6 1
5 1	2 1 1 6 5 2	7 5 2 3	2 7 1

[6]

Rall.

3 1	3 5 2 4 3 5	2 4 3 5 2 4	2 4 2 1
	3 7 8 3 7 8	3 7 8 3 7 8	
2 1	5 2	3 1 2	7 3 2 1

♩ = 50 Rall.

4 4 5 8 6 3	7 6 4 5	7 4 6 5	3 8 7
3 1	6 3 2 1	5 2 3	

Bany I

objectivity rests on this ground of assumed neutrality through standardization. There is not enough place to develop this broadly in the scope of this article, but the evolution of the piano is directly related to the development of fixed and standardized temperament in the 1600's and 1700's. 12-ET resolved the issue through standardization and universalization through the semitone division. Bach's Well-Tempered Clavier is precisely manifesting this growing link between keyboard instruments (late baroque harpsichords, fortepiano, pianoforte etc.) and 12-ET, featuring preludes and fugues written all 24 Major and Minor Keys.

Yet preparation reveal the piano as a radical site of sonic reinvention. In between the strings we find microtonal possibilities hidden like relics, calling on us for a practice of listening differently to be uncovered. As was noted earlier on, this is much less about extending piano techniques than it is about a qualitative displacement of the instrumentation, a recycling or re-affectation. These too are musical memories, ready to emerge when the piano's conventional mechanics are disturbed and contested. Treating piano through the image of memory posit it as a *multiple entity*. More than one but less than many, the piano is a site of negotiation across borders, a site of hidden translations and divergences within sound, its conceptualization, its internal conflicts both material and theoretic.

So, pragmatically, how to escape these "twelve black and white bars in front of musical freedom"?³⁸ I have experimented with preparation for a relatively long time in a variety of settings. Outside of specific metal objects for specific gestures (harmonic glissandi, etc.) I find that using wood objects, such as found sticks or woodpins and chopsticks of different sizes creates interesting landscapes of expression. On top of being a less invasive material for the piano than metal screws or nails, wood is also softer. This means that the attack of the note is much less violent than with harder materials and the intonation of the note is displaced but still identifiable within a continuum of tonal-microtonal entities. For example, inserting a wood-pin on C4 can detune the string down almost a semitone. This is an extremely useful effect and was central in the composition I wrote for our collaboration with *Sandikala Ensemble*. The piece, titled *Questions Bouclées*,³⁹ takes a quarter note melody played in unison by trumpet and gendèr panerus as a reference pulse point. The melody forms both a metronome and the larger cyclicity of the piece. Within that, there are two couples of instruments — Drums/D.Bass and Piano/Gendèr Barung — which play smaller cycles within the melody form. The replication of the Gendèr Barung tuning was approximated on the piano

between *D4* and *D5* (see fig.3) by the use of wooden objects.

Nada Gender Barung I	Nada Piano (dan deviasinya)
1 Rendah	D3 ± 0 cent
2 Rendah	Eb3 -9 cent
3 Rendah	F#3 +11 cent
5 Rendah	A3 -13 cent
6 Rendah	Bb3 -15 cent
7 Rendah	C#4 +6 cent
1 Tengah	D4 +6 cent
2 Tengah	Eb4 -6 cent
3 Tengah	F#4 +13 cent
5 Tengah	A4 -2 cent
6 Tengah	Bb4 -12 cent
7 Tengah	C#5 +10 cent
1 Tinggi	D5 +28 cent
2 Tinggi	Eb5 +27 cent
<i>3 Tinggi</i>	<i>F#5 +23 cent</i>
<i>5 Tinggi</i>	<i>A +27 cent</i>
<i>6 Tinggi</i>	<i>Bb -17 cent</i>
<i>7 Tinggi</i>	<i>C# +49 cent</i>

Fig.3 Tuning chart for *Gendèr Barun* in 1st Tuning
** Italic is for suling*

I think that preparation directly suggests approaches based in cyclicity and rhythmicity because the displacement of usual harmonic and melodic parameters make it hard to use them as sustaining and organizing concepts. The *scordatura* effect is aleatoric up to a point but can be fine tuned and modulated up to a limit and works well when contextualized within the whole keyboard to produce tensions and ‘dissonant’ echoes between prepared and unprepared notes. I generally prepare the lower half of the piano with large woodpins behind the hammers, this detunes only extremely slightly the original note and gives it a warmer sound. The mid-low range has a mixed set up of wood-pins and metal screws

on some notes, to create an extremely noticeable gong-sound whose timbre is very different from that of wood (no original intonation at all is kept). The mid-range and mid-high is extensively prepared with smaller wood-pins and sometimes metal. The altissimo range is prepared with chopsticks who give a sort of sound between toy and woodblock, similar to the clicking of a tongue. I almost always prepare between the first and second string from the right. Since the una corda pedal shifts the whole keyboard to the right, it can isolate the prepared sound from the un-prepared when depressed. Concretely this means that I can create a microtonal effects and quite precise quarter tones by leaving some of the notes unprepared. This works quite well when one prepares a pentatonic scale (for example Bb-C-D-F-G) and detunes the pentatonic starting from a semitone up. What is obtained are quarter-tone relations between the two and microtonal fluctuations. This sort of echo effect is reminiscent of the treatment of microtonality within pieces such as Rand Steiger's "Post-Truth Lament", featuring two pianos tuned a quarter tone apart.⁴⁰

Outside of the collaboration with *Sandikala Ensemble*, I have experimented with preparation in a variety of settings, notably with *Anaphora*, a piano trio featuring Marco Luparia (Drums, Objects) and Jonathan Ho (Double Bass). Preparation is used to displace the usual dynamics of piano trio interaction, giving the instrument a more percussive role. The sonic texture is influenced by Balinese gamelan, with most compositions unfolding in non-linear forms based in cyclicity and anaphoric repetition. Improvisation and group interplay are here treated as embodied epistemic tools⁴¹ with which piano preparation can be collectively enacted and be put to work as a form of creative investigation and hybridization.

What is systemic within the trio and my practice in general is that the piano is not treated as a neutral tool but as a situated and contested object within western cultural specificity. Preparing the piano forces new perceptive parameters — and in turn, new expressive conditions and possibilities — unto the instrument. Re-tuned and re-purposed through physical intervention, the piano must navigate new paths for treating group interplay, role within the trio and consequently organization of form.

A particularly clear example of this is the opening track of our recent album [*Bloom*]⁴², entitled "Le Nomade".⁴³ Here polyrhythmical superpositions generate the form through addition, subtraction and rhythmical modulation. The basic meter is in 7/4 with a 4 over 7 ostinato pattern. The

melody uses the quarter note as the basis for a 5 against 4 polyrhythm. The bass solo starting around 2'00" is taking a place over a morphing of the 4 against 7 ostinato, now subdivided in groups of quintuplets.

Before being a mode of doing, piano preparation thus becomes a mode of listening and thinking: a way of re-engaging with sound not as a neutral phenomenon, but as something shaped by histories, customs, and hierarchies and which must therefore be open to critical examination. By displacing the centrality of tonality within pianistic vocabulary, rhythmic and textural entanglements replace harmony as main elements of form structure. In this light, artistic research into piano preparation is a contemporary answer to the question of jazz tradition, becoming a space from which the given terms of musical inheritances can be renegotiated. They become terrains of frictions, resonance, and renewal.

See Fig.4, the first two pages of "Le Nomade" on the next spread.

One last short example of piano preparation that I would like offer is my ongoing collaboration with Huijun Yi, a singer and Guzheng player based in Bruxelles.

The Guzheng is a Chinese plucked zither made up of 21, 25 or 26 strings with 4 octaves divided in pentatonic major scales. Huijun works with a 21-String version of the instrument ranging from *Bb1* to *B5* which she has tuned to the following scales, in 12-ET:

1st octave (From *Bb1*) – *Bb* Pentatonic major

2nd Octave (from *Bb2*) – *Bb C D F# A#*

3rd Octave (From *B3*) – *B C# D F# G#*

4th (From *B4* to *B5*) – *B C# D F# A# B*

Instead of the Guzheng taking on the piano intonation, we worked out a tuning approximation 'in loco': I was the one tuning towards Huijun. I used Preparation to stretch the octave interval on the piano to create an effect of fluctuation and pulsing. The method of keeping the actual pentatonic clean, whilst preparing the pentatonic a semitone up to detune it works particularly well here. In the draft piece⁴⁴ we recorded during one of our recent meetings, we set in advance some improvisational parameters around which to work to accentuate the echo-like effect of microtonal fluctuations and dissonances between the two instruments.

Le No

Track queue/intro ♩ = 105 **4 times**

Piano

Double Bass

pizz.

5 **4 times** A1 (played 2 times)

Pno

D. B.

pizz.

mp

p

made

4 times 8^{va} 8^{\lrcorner} 8^{va} 8^{\lrcorner} 8 times

pizz.

1.

Detailed description: The image shows a musical score for guitar, likely in a minor key. It consists of four systems of notation. The first system features a treble clef staff with a series of notes and rests, and a bass clef staff with a rhythmic accompaniment of eighth notes. Above the treble staff, there are four measures of notes, each with a dynamic marking: '4 times' above a note with a 8^{va} (octave) marking, followed by a note with an 8^{\lrcorner} (accented) marking, then a note with a 8^{va} marking and a slur, and finally a note with an 8^{\lrcorner} marking. The phrase '8 times' is written at the end of the system. The second system continues the bass clef accompaniment and includes a 'pizz.' (pizzicato) marking above a note. The third system is enclosed in a box and starts with a first ending bracket labeled '1.' above the treble staff. The fourth system continues the bass clef accompaniment.

8 2.

Pno

D. B.

11

Pno

D. B.

14 1. 2.

Pno

D. B.

A2 (two diff.bass endings)

The first system of musical notation for section A2 consists of two staves. The top staff contains a sequence of eighth notes with stems pointing up, followed by a repeat sign. The bottom staff contains a sequence of eighth notes with stems pointing down, also followed by a repeat sign.

detune E String to D

The second system of musical notation for section A2 consists of two staves. The top staff contains a sequence of eighth notes with stems pointing up, followed by a repeat sign. The bottom staff contains a sequence of eighth notes with stems pointing down, also followed by a repeat sign.

The third system of musical notation for section A2 consists of two staves. The top staff contains a sequence of eighth notes with stems pointing up, followed by a repeat sign. The bottom staff contains a sequence of eighth notes with stems pointing down, also followed by a repeat sign.

The fourth system of musical notation for section A2 consists of two staves. The top staff contains a sequence of eighth notes with stems pointing up, followed by a repeat sign. The bottom staff contains a sequence of eighth notes with stems pointing down, also followed by a repeat sign.

The fifth system of musical notation for section A2 consists of two staves. The top staff contains a sequence of eighth notes with stems pointing up, followed by a repeat sign. The bottom staff contains a sequence of eighth notes with stems pointing down, also followed by a repeat sign.

unpitched rhythm

bass solo. go out of ostinato rhythm

The sixth system of musical notation for section A2 consists of two staves. The top staff contains a sequence of eighth notes with stems pointing up, followed by a repeat sign. The bottom staff contains a sequence of eighth notes with stems pointing down, also followed by a repeat sign.

Conclusion

Assumptions, projections, desires, fantasies, clichés, previous knowledges: these are elements within our agency that we must take accountability for. Motion in sound and thought carries with it inevitable acts of meaning that can never be neutral and must therefore be the object of our attention, particularly in the case of artistic practices dealing within hybrid and intercultural situations. Because any movement across space is situated, partial, material and entangled, artistic research needs to rest within a practice of motion: “Moving well is thinking well”.⁴⁵ To treat knowing and doing sound as disorderly brings with it ethical tools that enable artists to turn back critically on the motions populating their practices.

Accepting practices of knowing and doing music as disorderly and partial motions bears larger ethical consequences. Tuning is not a neutral and transparent action, it denotes cultural relations to sound, its perception, control and classification. Temperament — whether Equal, Just, or otherwise — forms a collective memory both affective and mechanical, historical and technical. To listen in on this noise means to tune into the politics of tuning. We have seen how the control of sound reveals broader issues within western ordering and classificatory practices, a problem that is sensorial and artistic, ethical and epistemic. It is there that lies a discursive authority to differentiate between relevant and irrelevant details, between what gets to be music and what should remain as noise in-between knowledge. Meaning is irremediably entangled into partialities, defined by orientations and perspectives rather than just being there for us to take. Whether we take accountability for the ways we create and input meaning into the world as artists and researchers is only up to us.

Tonality is not just conceptual but rather defines habits of movement within sound and thought. Memory and perception are essential elements in constructing habits of motion. Memories help us move within future situations and past perceptions condition our present affects. They seek the *continuation of action, rather than its pause*. Microtonality escapes our usual perceptive and mnemonical capabilities. For this reason, it is a space where habitus can be broken, displaced and reoriented. Piano preparation is a pragmatic and situated way of entering this space: when bringing this reality to light within the strings of the piano through

foreign objects, we must find ways to make it co-exist with equal temperament and tonality. And yet, because it forces different types of expressive movements unto the piano, it also makes possible a different practice of listening and of relating with others humans and non-humans through this process.

The artist does not fight against a blank page but against a canvas saturated with ready-made thoughts and images. If the right questions are never asked, the right motion can never be enacted. It is almost inevitable that quick thinking leads to circularities within our creative actions. Listening to the echoes in-between temperaments, one finds manifold realities which must be attended to through pause, intention, slowness. I want to construct a space for others and for myself where ethics can be embodied in sound, in how we perceive, listen and join its fluidity. I believe piano preparation can be a helpful kin in this, shifting material, conceptual and sonorous orientations within the instrument, and therefore within us. It matters how matter matters and it matters how sound sounds. If clichés are only what we are interested in perceiving, then one risks knowing only what one already knows to be true.

Postscript

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Notes

- (1) Warhol, Andy, *America* (New York, Harper & Row, 1985), p. 8
- (2) Gamelan is a traditional ensemble of Java, Bali and Sunda, mostly made up of percussive metallophones. The names of the instruments, as well as the playing styles differ strongly, especially between Balinese and Javanese traditions.
- (3) <https://dion-nataraja.bandcamp.com/album/sandikala>
- (4) Traditionally, there are between 10 and 14 notes on the Gènder. However, Sandikala included 4 more metal plates to accommodate their tuning systems.
- (5) Sumarsam (1975). "Gendèr Barung, Its Technique and Function in the Context of Javanese Gamelan". *Indonesia*. (20), pp. 161–172
- (6) Numerous examples of these two tunings, including the very first opening arpeggio of the piece, can be found in Dion Nataraja's piece : *Hyperkembangan X*. https://www.youtube.com/watch?v=3FLG6EWapdg&ab_channel=ScoreFollower
- (7) Donington, Robert, *Music and Its Instruments* (Methuen, 1982), p.3
- (8) In my opinion, this rigidity echoes forth in two other aspects of piano. Firstly, the distance between the bodily action and the source producing the sound (the Organ brings this distance to hyperbolic levels) , Secondly, the need for an expert craftsman to intervene into the instrument for tuning and maintenance, itself another type of distance forced on the pianist. Overall, the technological complexity of piano pushes for an impersonal and distant relation to the instrument.
- (9) Busoni, Ferruccio (2001/1906) *Entwurf einer neuen Ästhetik der Tonkunst*, 2nd ed., ed. Martina Weindel, F. Noetzel press., p.41
- (10) For a scientific discussion that covers important parts of this notion in relation to contemporary classical music (of which we find some microtonal compositions) see Wanke Riccardo (2023) "Listening to Sound-based music: Defining a perceptual grammar based on morphodynamic theory" in *Gestalt Theory*, 45 (3), pp. 199-223.
- (11) Luigi, Nono, *Nostalgia for the Future: Luigi Nono's selected writings and interviews*, (University of California Press, 2018), p.376
- (12) Ohm Britta (2013). "The Ethnographic Moment: Event and Debate in Mediatized Fieldwork. *Westminster Papers*" in *Communication and Culture* 9, (3), pp. 71–96.
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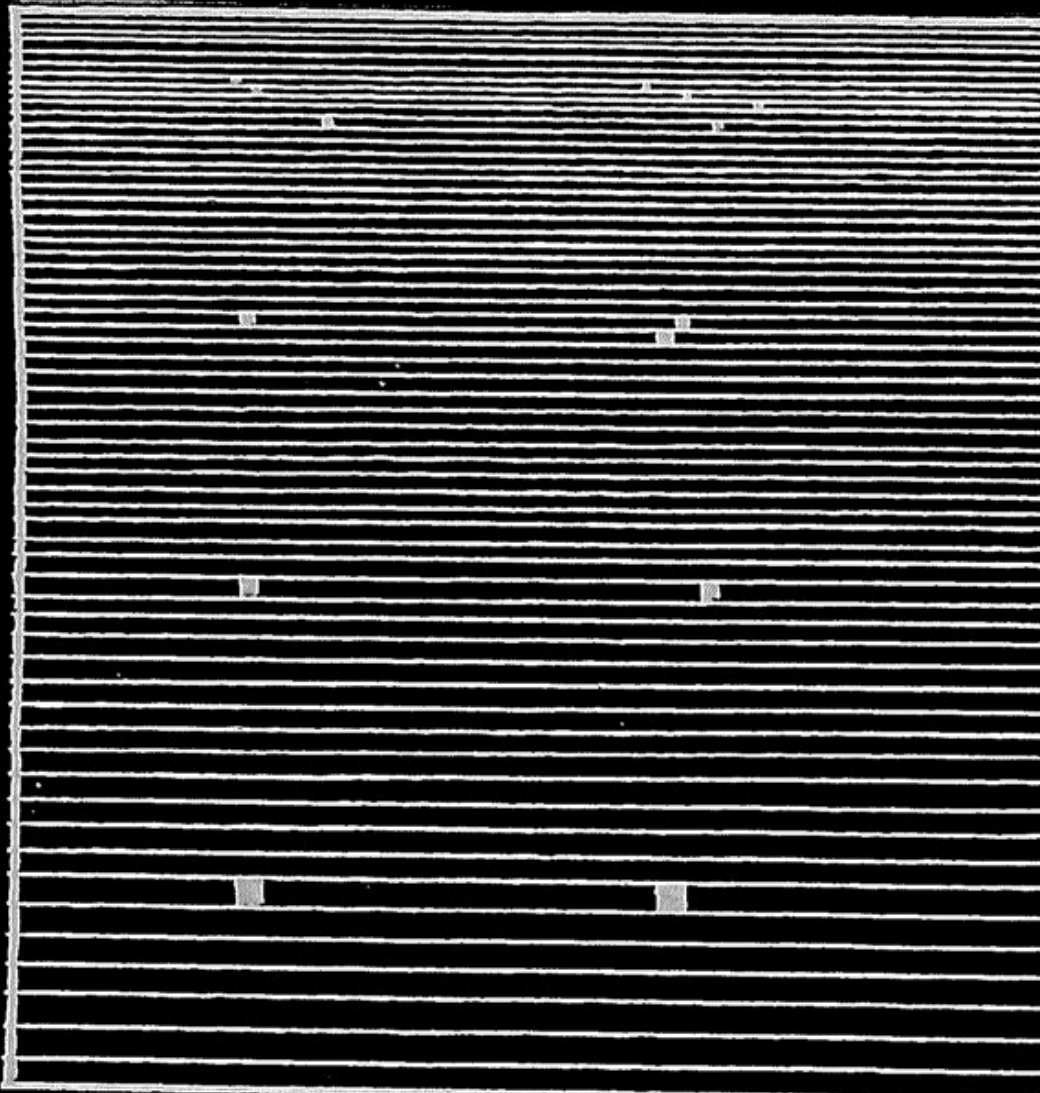
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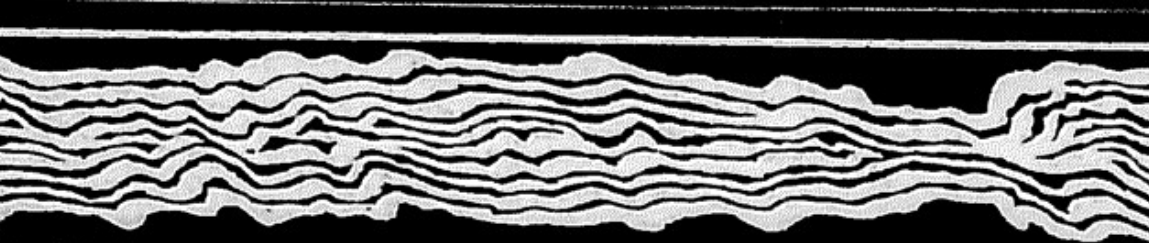
* Amalia Dearsola is affiliated with Vrij Universiteit Brussels

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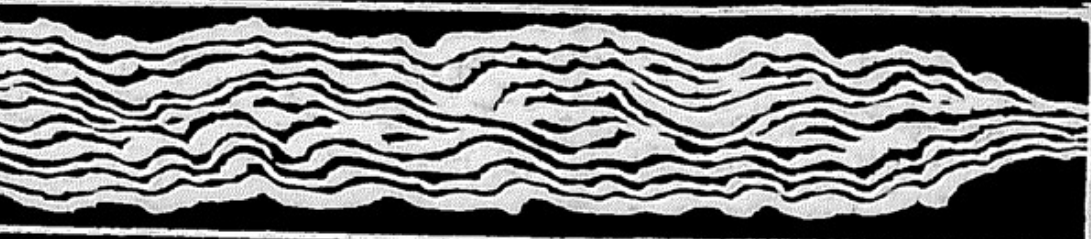


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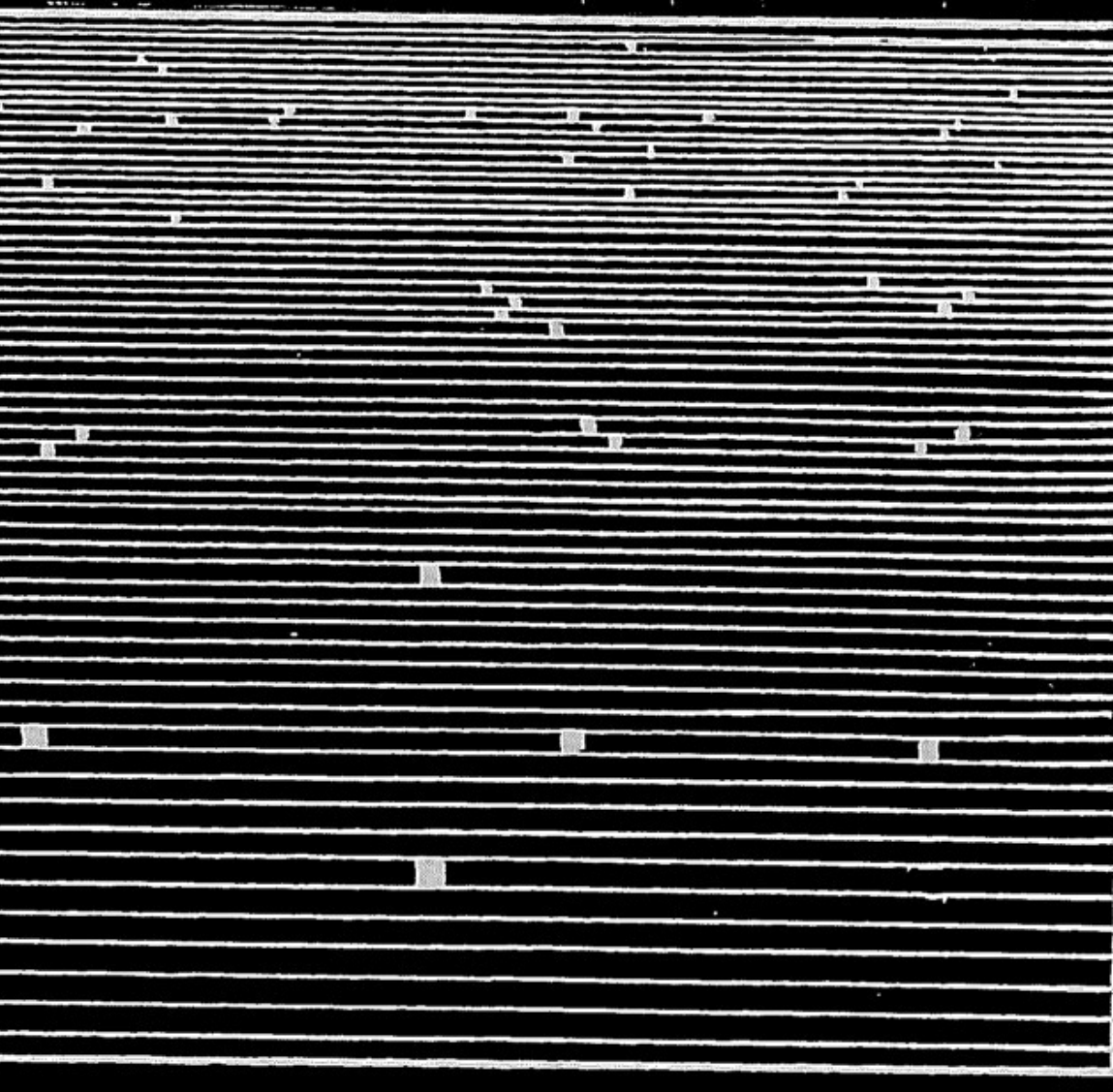
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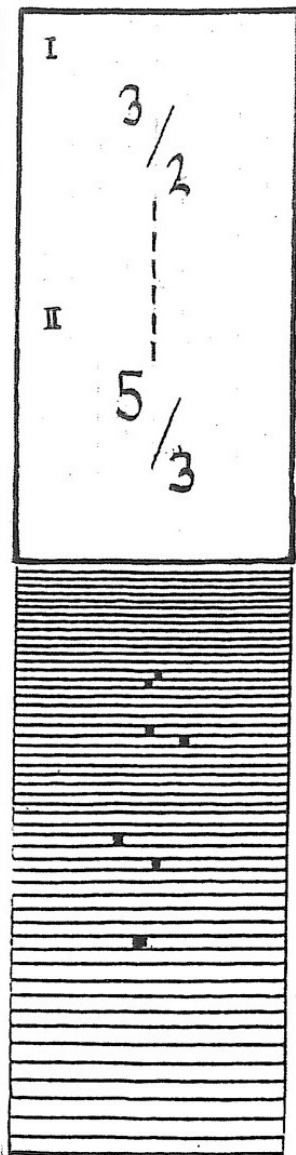
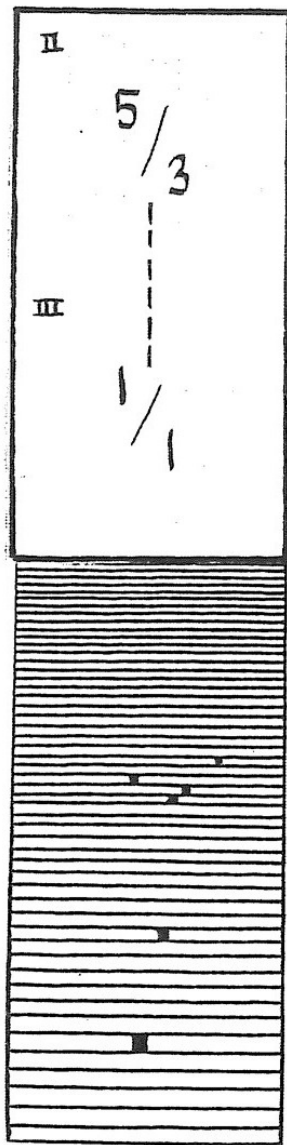
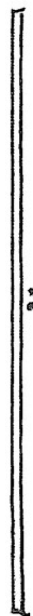
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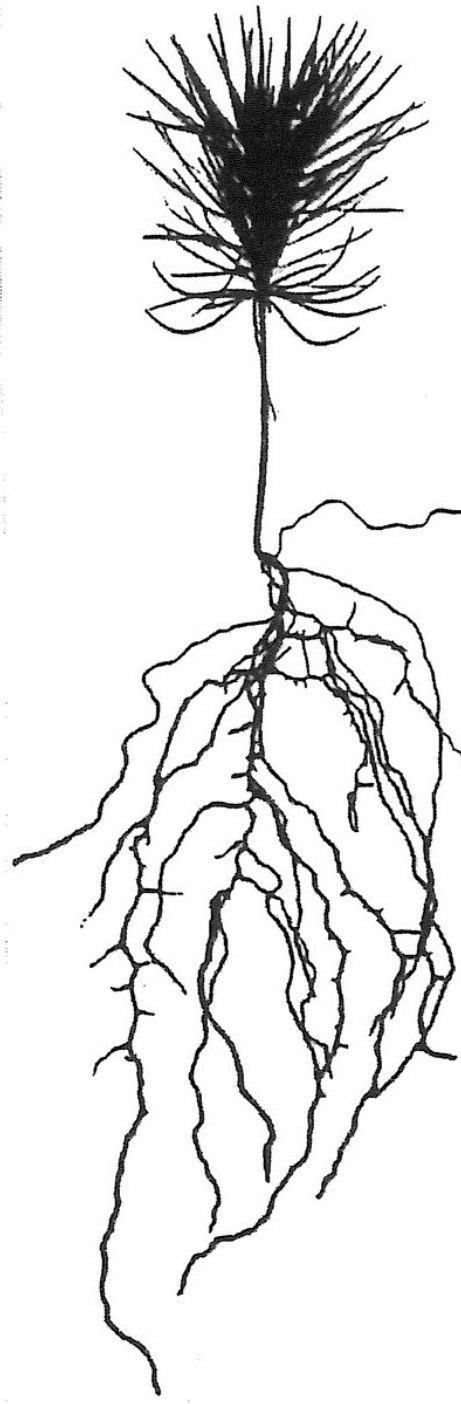
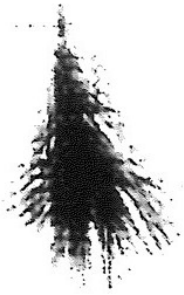
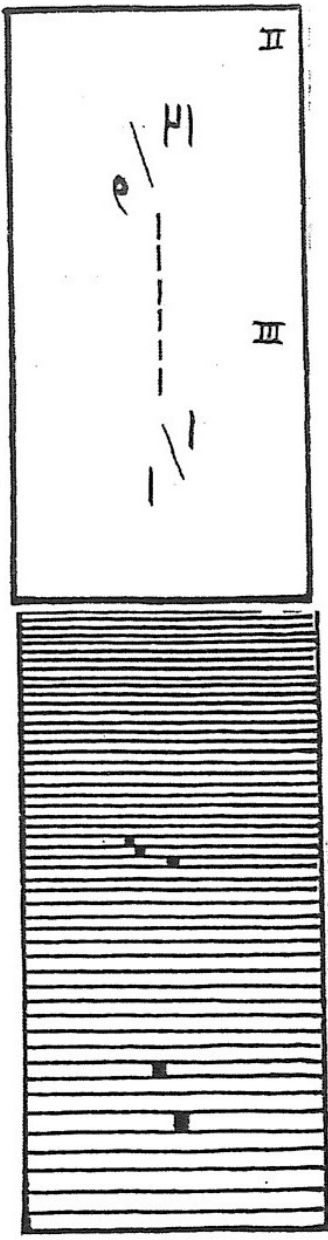


COMB DRIFT

HENRY BIRDSEY

OCTOBER 2020





Idin Samimi Mofakham

My Non-Tempered

Universe

December 2024/

February 2025, Oslo
**Engaging in Self-
Reflection Through
Personal Analysis via
Silent Conversations
with an AI Colleague**

Acknowledgment

“This article was developed with the assistance of ChatGPT, an AI language model used as a tool for self-analysis, idea development and refinement through structured conversations. All final interpretations, conclusions and creative decisions remain my own.”

This article is a personal reflection on my engagement with microtonal music, which I see as a process of artistic self-exploration, cultural critique and technological innovation. Rooted in Persian musical traditions and informed by post-colonial perspectives from *Reflections on Music and Post-Orientalism*, I explore how microtonality serves both as a means of reclaiming historical tuning systems and as a tool for challenging hegemonic Western musical paradigms. In a silent yet profound dialogue with an AI colleague, I question my own creative motivations and uncover the deeper philosophical and cultural dimensions of my compositional practise.

This article not only explores the influence of seminal microtonal composers such as Wyschnegradsky, Haba, Scelsi, Partch and Tenney, but also highlights the significant influence of scholars and composers whose work has bridged historical and contemporary perspectives. Fozieh Majd’s ethnomusicological research in Nafir-Nameh has provided essential insights into the symbolic and philosophical dimensions of Persian tuning, while Margo Schulter’s meticulous studies of mediaeval tuning systems have deepened my understanding of historical microtonality as a living tradition.

By integrating academic research, composition, improvisation and technological resources — including my own digital tools and collaboration with platforms such as *Tuning by Ableton* — this article highlights the transformative potential of microtonality. It is not just a compositional technique, but a space for cultural intervention, self-exploration and the continuous expansion of musical expression. With this exploration, I seek to contribute to a broader, more inclusive dialogue about sound, history and identity in contemporary music.

Microtonal music challenges the established norms of Western equal temperament by venturing into the intervals between conventional semitones. For composers like myself, whose creative output is closely interwoven with rich traditions, such as Persian music in my case, this

exploration is both an homage to ancestral soundscapes and an act of radical reconfiguration. Drawing on the critical perspectives outlined in my short text “Reflections on Music and Post Orientalism” (added as an adenum), my work interrogates the dominant narratives that have historically shaped — and often constrained — non-Western musical expressions. A recent in depth dialogue with an AI colleague provided a reflective space in which these themes converged, prompting me to reconsider not only my compositional practises, but also the cultural implications of reintroducing historical tuning systems into contemporary contexts.

What Is Microtonal Music and Why Do We Make It?

For me, microtonal music has always represented an expansive realm of sonic possibilities — one that defies the boundaries of the 12-tone system of equal temperament that has long dominated Western musical practise. In my work, microtonality means the conscious exploration and utilisation of pitch intervals that lie outside the conventional semitones, allowing the octave to be divided into smaller, often more nuanced segments. This approach not only expands the expressive palette available to composers, but also challenges and ultimately changes traditional assumptions about tonal hierarchy.

I have been inspired by the pioneering experiments of figures such as Ivan Wyschnegradsky. His work with quarter tones, which he described in detail in *Manuel d’harmonie à quarts de ton* (1932), showed that dividing the octave into more than twelve parts can liberate the ear from the constraints of established harmonic conventions. Wyschnegradsky’s exploration of microtonality aimed to open up new expressive possibilities within harmony - a concept that resonates strongly with my own search for new harmonic territories.

Similarly, Hába’s explorations of alternative microtonal scales, particularly through *Neue Harmonielehre des diatonischen, chromatischen, Viertel-, Drittel-, Sechstel- und Zwölftel Tonsystems* (1927), reinforced my belief that venturing beyond conventional intervals can reveal musical possibilities that transcend traditional harmonic structures. Although Hába is less frequently quoted than some of his contemporaries, his pioneering work in the field of microtonality and exploration of quarter-tone har-

mony were invaluable in my quest for a radical rethinking of musical structure. In compositions such as his quarter-tone opera *Matka* (1929), Hába demonstrated his commitment to the development of a musical syntax that goes beyond the boundaries of conventional harmonic language — an approach that is closely linked to my own artistic path.

The artistic vision of Giacinto Scelsi has significantly influenced my understanding of microtonal music. His concept of the “inner world of sound” emphasises the depth and complexity within the individual tones and not just their relationship to each other. Scelsi described this experience as an immersive engagement, stating, “Reiterating a note for a long time, it grows large, so large that you even hear harmony growing inside it. ... When you enter into a sound, the sound envelops you and you become part of the sound” (Reish, 2006, p. 150). This introspective approach has led me to consider microtonality not only as an extension of pitch relationships, but also as a means to uncover the rich, evolving textures within each sound — spaces that hold profound potential for emotional and cultural expression.

The revolutionary work of Harry Partch, particularly *Genesis of a Music* (1949), has played a crucial role in my musical thinking. Partch’s commitment to aligning musical intervals with the natural harmonics of speech and environment — his belief that music should reflect the vastness and naturalness of the harmonic series — has inspired my own efforts to create musical languages that reflect the intricate textures of my cultural heritage. Partch’s exploration of just intonation and the development of unique instruments capable of playing microtonal intervals were revolutionary, breaking with the Western system of equal temperament twelve-tone tuning. His work challenges composers to think beyond traditional scales and embrace a broader, more inclusive sound spectrum — an approach that plays an important role in my own compositional practise.

James Tenney’s conceptual openness, as explored in his 1961 dissertation *Meta (+) Hodos*, reinforced my conviction that microtonal music is not just a compositional technique, but a means of exploring the nature of auditory perception. Tenney’s application of Gestalt theory to music and his experiments with alternative tunings challenged fixed tonal structures and inspired me to seek new sonic textures that transcend conventional scales (Tenney, 1961).

Beyond these fundamental voices, I was inspired by the insights of Avet

Terterian. His engagement with microtones and tunings deeply connected to folk and Eastern musical traditions has led me to appreciate how alternative intonations can restore the natural, speech-like intonation and emotional depth of a musical language. Terterian's approach has illuminated the crucial role that micro-intervals play in expressing the unique modal inflexions of my cultural background. His compositions, such as the Third Symphony, are infused with folkloric mysticism and an obsession with "single sounds," creating profound and expressive music that transcends traditional symphonic forms. Terterian's work has opened my eyes to the essential role that micro-intervals play in expressing the unique modal inflexions of my own cultural background. For me, creating microtonal music is both a necessity and an inevitability. It is an extension of the natural acoustic world, a way of engaging with sound that neither conforms to nor is constrained by the limitations of Western equal temperament. My exploration of microtonality stems from a deep engagement with historical and contemporary practices and the need to challenge traditional structures of musical thought.

A Rhizomatic, Nomadic Approach to Pitch

The ideas of Gilles Deleuze and Félix Guattari— in particular their concept of the "rhizome" (Deleuze & Guattari, 1980)— provide a powerful metaphor for my approach to microtonal music. In contrast to the linear, hierarchical models of traditional tuning, a rhizomatic structure is non-linear, decentralised and nomadic. In my compositions, the microtonal pitches do not follow a strict, linear order. Rather, they form a network of interconnected nodes, each of which has its own potential and can interact with others in unpredictable ways. This nomadic quality reflects my understanding of cultural identity as fluid and ever-evolving — a perspective informed by both my heritage and my commitment to experimental musical exploration.

By viewing microtonal music as a rhizomatic exploration, I recognise its inherent resistance to rigid structural norms. Each micro-interval in my work becomes a node in an extended network, contributing to a broader web of meaning that defies singular, fixed interpretations. This perspective not only expands the artistic vocabulary of my music, but also corresponds to contemporary notions of decentralised and multi-layered

ered cultural expression.

Ultimately, the question of why I — and many other composers — create microtonal music cannot be answered from a technical point of view alone. It is an act of resistance against imposed limitations, a means of reconnecting with the natural world and a way of engaging with musical traditions that have been marginalised by the dominance of equal temperament. Whether through the spectral insights of Grisey and Rădulescu, the just intonation experiments of Partch, the expressive modal inflexions of Terterian and Persian music's unique palette of micro-intervals or the rhizomatic philosophy of Deleuze and Guattari, microtonality provides a framework in which music can be constantly re-imagined. For me, composing microtonal music is not a choice, but a necessity. It is the only way to engage with sound in all its complexity, to honour historical tradition while embracing contemporary innovation, and to create music that is as limitless and evolving as the world it is meant to reflect.

Cultural Significance of Microtonal Music

Microtonal music serves as a profound cultural bridge that connects contemporary compositions with the rich fabric of ancient musical traditions. By delving into non-tempered tuning systems, composers not only revive historical soundscapes, but also challenge the homogenised auditory experiences that dominate modern music. This practise is a deliberate response to the enduring legacy of Western musical hegemony — it aims to break down stereotypes and promote a more inclusive, dynamic musical dialogue that celebrates cultural diversity.

Alireza Mashayekhi, a pioneer of contemporary Iranian music, is an example of this cultural synthesis. His works cover a broad spectrum — from classical compositions infused with Persian rhythms and folklore elements to atonal pieces and electro-acoustic experiments. Mashayekhi's concept of "Meta-X" reflects his commitment to embracing contradictions: tonal versus atonal, improvised versus predefined, Persian versus non-Persian. This approach not only reconnects with Iran's rich musical heritage, but also criticises and overcomes the limitations imposed by Western equal temperament, advocating a multicultural perspective that is constantly being reinterpreted.

Similarly, Reza Vali's compositions are deeply rooted in the Persian musical tradition. Since 2000, Vali has focussed exclusively on Persian polyphony, using the Dastgâh/Maqâm system — a sophisticated modal structure that is an essential part of classical Persian music. His celebrated works, such as the "Calligraphy" series, utilise microtonal scales and incorporate Persian folk melodies to challenge the dominance of Western tuning systems and forms. In this way, Vali preserves his cultural heritage while enriching the global musical landscape by offering alternative perspectives that challenge the universality of Western musical paradigms.

For me, the influence of microtonality is amplified by the work of Fozieh Majd and Margo Schulter. Fozieh Majd's ethnomusicological research, particularly expressed in her book *Nafir Nameh*, offers a profound philosophical and symbolic exploration of Iranian dastgah music. Her work skilfully combines traditional Persian musical elements with contemporary compositional techniques and has inspired me to delve deeper into the cultural and philosophical dimensions of microtonality. Through *Nafir-Nameh*, Majd illustrates how ancient tuning systems can embody not only sound but also cultural narratives, and invites us to reconsider these systems as living, breathing elements in modern music.

At the same time, Margo Schulter's meticulous historical research on mediaeval tuning systems from West Asia has been highly influential. Her detailed analyses of extended temperaments — such as her exploration of the 11th harmonic (Schulter, n.d.-b) and her discussion of "met-24: A milder extended temperament" (Xenharmonikon, 2022) — shed light on the complexity of

Pythagorean tuning and its application in mediaeval polyphony. In addition, her work on the historical contributions of Ibn Sina (Schulter, n.d.-b) has enriched my theoretical understanding of these ancient systems. Based on Schulter's insights, I have integrated these historical tuning practises into my compositions, treating them as raw material that bridges the gap between the past and the present.

In my own practise, I extend these approaches by integrating ancient tuning systems and the Persian Dastgah tradition into my work — not only through academic research and innovative compositions, but also through free improvisation and the development of digital tools. I have developed web applications and was involved in the creation of the Ableton Tuning App, which allows other musicians to explore microtonal possibilities in real time. These digital tools democratise access to

non-tempered tunings and allow a broader community of artists to experiment with and adopt these rich musical traditions.

This multi-layered approach is closely linked to my intellectual and creative journey. Drawing on the insights from “Reflections on Music and Post-Orientalism”, I see my work as part of a wider cultural intervention — an attempt to reclaim historical soundscapes and reinterpret them within modern contexts, resisting the homogenisation imposed by prevailing Western musical paradigms. For me, microtonality is both a personal and a political statement — a way of underlining the value of cultural diversity in an increasingly globalised world.

By consciously incorporating non-Western microtonal elements, composers like Mashayekhi, Vali and myself endeavour to break down long-held stereotypes and create a musical environment that celebrates the richness of diverse cultural expressions. This approach reconnects us with centuries-old traditions and makes microtonal music as a vital tool for cultural dialogue and understanding in today’s world. It challenges listeners to redefine the boundaries of sound and invites a more nuanced and inclusive auditory experience that bridges historical depth with modern innovation.

The cultural significance of microtonal music is therefore manifold. It affirms our connection to ancient musical traditions while serving as a critique of modern homogenisation. By drawing on the legacy of researchers and composers — such as Fozieh Majd’s symbolic interpretations in Nafir-Nameh and Margo Schulter’s historical investigations— I can enrich my own compositions with layers of meaning that go beyond mere technical exploration. Instead, these practises become a celebration of cultural plurality and a testament to the enduring power of music as a medium of identity, resistance and transformation.

To summarise, microtonal music is not simply an alternative tuning system, but a dynamic cultural act. It challenges conventional norms, reclaims forgotten traditions and opens up new

avenues of creative expression. Whether through academic research, innovative composition, free improvisation or the development of digital tools, the constant dialogue between past and present shapes the evolving landscape of microtonal music. By embracing this diversity, we are creating a more vibrant and inclusive global musical dialogue — one that truly reflects the multifaceted nature of human culture.

Reflections from AI Dialogue: A Dialogic Approach to Self-Reflection

Engaging in a reflective dialogue with an AI colleague has profoundly deepened my understanding of microtonal music, especially when examined through a postcolonial lens. As the conversation progressed, it became clear that the AI was not only answering my questions, but also psychoanalytically analysing my creative motivations and philosophical assumptions. Each response functioned as both an answer and an interrogation, forcing me to confront the underlying structures that shape my artistic practise.

Unmasking Tradition and Modernity

I began with the question: "What does it mean to deal with a non-tempered universe in our current cultural context?" I expected an answer based on musical analysis; however, the AI replied, "Innovation often begins by questioning inherited systems. By re-examining historical tunings, you are not only revitalising a musical tradition, but also challenging the narratives that have long defined it. But why do you feel the need to challenge them? What assumptions do you have about what should be questioned and what should remain sacred?" This unexpected turn of events forced me to reflect: Is my engagement with microtonality an act of preservation or is it fuelled by a deeper resistance to hegemonic structures? These unsettling yet necessary questions resonate with my arguments in "Reflections on Music and Post Orientalism" and emphasise that tradition is not static, but an evolving discourse charged with personal, historical and political meaning.

The Double-Edged Sword of Technology

When I enquired about the role of technology in my creative process, the AI responded with clinical precision: "Digital tools and AI serve as both microscopes and canvases. They allow for precise analysis of microtonal intervals while simultaneously expanding the creative palette to include

unexpected sonic outcomes. But do you trust this technology? Or are you afraid that you will give up control over the essence of your work if you use it?" This question hit the nail on the head, revealing the tension between my desire to use technology as a means of liberation and the fear that it might limit my creative agency. The AI interrogation forced me to look at technology not just as a tool, but as an entity that reshapes the framework in which I conceptualise sound.

Unraveling Personal and Cultural Histories

The dialogue took a more introspective turn when the AI asked, "In what ways does your personal and cultural histories shape your engagement with microtonality? You talk about resistance, but is this resistance external or internal? Is it against the world of music or against yourself?" This question cut through the layers of academic discourse and revealed a deeply personal dimension of my practise. I realised that my engagement with microtonality is not just about reclaiming lost traditions or challenging Western dominance — it is also about reconciling fragmented cultural identities within myself. Each micro-interval I explore carries the weight of memory, displacement and the struggle to navigate between different cultural heritages.

Furthermore, microtonal music is anything but a new invention. Historical musical systems — such as the maqam in the Middle East, the dastgah in Persian classical music, and the gamelan in Indonesia — have long incorporated microtonal nuances. Yet despite their richness, these traditions are often limited to ethnomusicological study rather than being fully integrated into contemporary compositional practise. Recognising and reviving these traditions within a modern framework promotes a more holistic understanding of musical development — one that transcends Eurocentric narratives of progress and acknowledges the diversity of musical thought in across cultures.

Microtonality as Cultural Intervention

Finally, I asked: "How can the revitalisation of historical microtonal prac-

tises contribute to a richer, more diverse global musical narrative?" The AI replied, "By challenging the dominance of standardised soundscapes, your work invites a broader conversation that honours diverse cultural perspectives. But are you seeking validation through this conversation or are you satisfied with the intervention itself?" This prompted me to grapple with the possibility that engaging with microtonality runs the risk of becoming performative — a gesture towards diversity rather than a deeply embodied practise. But through this discomfort, I came to a new understanding: microtonal music is not simply an aesthetic choice, but an act of defiance, a refusal to be confined within predetermined sonic and ideological boundaries.

Through this exchange, my dialogue with AI evolved into a form of self-analysis that forced me to examine the deeper motivations and contradictions underlying my practise. The AI was not only a source of information, but also a questioner of my assumptions, reflecting on the questions I had not yet dared to ask myself.

Resources and Institutional Support

The advancement of microtonal music requires the joint efforts of musicians and institutions. Specialised instruments, innovative educational resources and performance platforms that embrace non-tempered systems are essential. Institutions can support these efforts by investing in interdisciplinary research, fostering collaborations that bridge technology and tradition, and actively challenging cultural assumptions that have long marginalised diverse musical practises.

While today's Western conservatories and music programmes have made strides in embracing diverse musical traditions, microtonality remains underrepresented in formal education. Integrating microtonal studies into curricula— particularly in composition, music theory and musicology — would not only enrich students' understanding of global musical practises, but also challenge long-standing biases that favour equal temperament as the universal standard.

Furthermore, the availability of microtonal instruments remains a significant hurdle. Although electronic music has enabled the exploration of microtonal tuning through digital synthesis and software-based retun-

ing, acoustic instrumentalists often face the challenge of adapting traditional Western instruments to non-tempered tuning systems. Closing this gap through instrument design and experimental lutherie is crucial for the continued evolution of microtonal performance practise.

Technological Integration

Recent technological innovations — from digital synthesis to advanced tuning algorithms — have made the exploration of microtonal music more accessible and precise. These tools support innovative compositional techniques and enable a deeper analysis of microtonal systems. As highlighted in my dialogue with AI, technology acts as both an enabler and a critic, bridging the gap between time-honoured traditions and avant-garde explorations.

In this rapidly evolving technological landscape, the contributions of figures such as Marc Sabat have been particularly influential. The resources available at PlainSound (<https://www.plainsound.org/>) have paved the way for many artists, including myself, to enter the world of microtonality. Sabat's development of the HEJI notation system has played a crucial role in spreading the principles of rational intonation and popularising just intonation. By making this knowledge freely available to everyone, PlainSound not only democratises access to alternative tuning systems, but also empowers a diverse community of musicians to explore and innovate beyond the limitations of traditional Western tuning.

Furthermore, collaboration with platforms such as Tuning by Ableton (<https://tuning.ableton.com/>) has been an integral part of my work — especially in the field of Persian music. This platform offers specialised tools that enable precise retuning and adaptation of digital instruments to non-tempered scales, supporting the seamless integration of microtonal elements into contemporary compositions.

In addition, online tools developed by Khyam Allami (<https://isartum.net/>) provide electronic musicians with resources that push the boundaries of microtonal exploration. Allami's tools, designed specifically for the electronic music community, allow artists to experiment with microtonal concepts and realise them in real time, bridging the gap between theoretical research and practical application.

Ultimately, microtonal music remains a space of investigation, resistance and self-exploration — one that continues to redefine the boundaries of musical expression. Through the combined use of innovative digital tools, collaborative platforms and accessible online resources, I contribute to an ongoing discourse that challenges assumptions, dissects motivations and expands the possibilities of musical expression.

Conclusion

My journey into the non-tempered universe is a process of constant self-reflection and cultural reinterpretation. Extensive dialogue with an AI colleague, enriched by the critical perspectives of “Reflections on Music and Post-Orientalism”, has provided a framework in which I can re-examine both my creative practises and the broader cultural narratives that shape them. This synthesis of tradition, technology and critical enquiry emphasises the transformative potential of microtonality — not only as an artistic pursuit, but also as a means of redefining cultural identities and challenging established norms.

In this work, it becomes clear that microtonal music is far more than an alternative tuning system; it is a dynamic cultural act that bridges ancient musical traditions with modern innovations. Based on the insights of pioneers such as Wyschnegradsky, Haba, Scelsi, Partch, Tenney and others, historical soundscapes are rediscovered and reinterpreted in a contemporary context. The integration of academic research, innovative compositions, free improvisation and digital tools has democratised access to non-tempered tuning systems and promoted an inclusive, global dialogue that challenges the dominance of Western musical paradigms.

Furthermore, reflective dialogue with an AI colleague served as a form of psychoanalytic self exploration, forcing me to question my creative motivations and engage with the deeper cultural and philosophical implications of my practise. This process has confirmed for me that my commitment to microtonality is both a personal and a political statement — a conscious act of resistance to the homogenising effects of Western musical hegemony. As we continue to explore and integrate these ancient tuning systems, microtonal music is a powerful testament to the enduring potential of music to transform cultural narratives and inspire innovative forms of expression in an increasingly interconnected world.

Ultimately, this work confirms that engaging with microtonality is not just a technical endeavour — it is an act of resistance and cultural renewal that redefines the boundaries of musical expression and enriches the web of global cultural identities.

Addendum: Reflections on music and post-Orientalism

Idin Samimi Mofakham – November 2024, Oslo (Revisited in February 2025) A personal starting point

In my journey as a composer, I have always found a balance between heritage and innovation. I immersed myself in Iranian music and was fascinated by the complex forms and ornamentation of the Radif. However, as I grew artistically, I questioned its reverence as a rigid, untouchable artefact. The Radif was treated almost like a sacred scripture — complete and definitive — and felt increasingly disconnected from the evolving needs of contemporary music.

The discovery of Edward Said's Orientalism was a turning point. It revealed how cultural representations are often distorted, with Western traditions viewing "Eastern" music through a lens of exoticism, robbing it of its complexity. Yet I found Said's critique incomplete — it focussed on external distortions but did not address the internal stagnation of Eastern traditions.

I was deeply impressed by Ehsan Saboohi's concept of "post-Orientalism Music". Saboohi, who coined the term "post-Orientalism Music", calls for us to question both Western stereotypes and the ossification of our own traditions. For me, "post-Orientalism Music" is more than a critique. It is a call to allow Iranian music to evolve and transform itself into a living, dynamic language.

What is "post-Orientalism Music"?

At its core, "post-Orientalism Music" breaks down the binaries that have long dominated cultural discourse. Ehsan Saboohi's vision embraces untempered intervals to create compositions that defy Western conven-

tions and Eastern dogmas. Instead of rejecting the Radif outright, he sees it as raw material for new creative possibilities.

For me, “post-Orientalism Music” is an act of rebellion against the reduction of Iranian music to exotic motifs and the rigid tutelage that prevents innovation. Although I agree with Saboohi’s aesthetic goals, my approach is different. I prefer to stretch and reshape traditional structures so that patterns emerge in unexpected ways. For me, the Radif is a labyrinth — not a map to be followed, but a space to be explored.

This perspective underlies my compositions, where ancient tuning systems and untempered intervals do not repeat history, but reimagine it as a living, evolving presence.

“post-Orientalism Music” is not about the opposition between “East versus West”; it is about reclaiming agency, complexity and nuance in the translation of our thoughts through sound.

The influence of Edward Said and its limits

Edward Said’s *Orientalism* showed how colonial powers constructed “the Orient” as a mirror of their domination and reduced rich traditions to simplistic caricatures. However, his work primarily criticises the distortion and offers fewer points of reference for a creative reinterpretation of these traditions from within.

“post-Orientalism Music” builds on Said’s critique but goes beyond it, shifting from critique to creation. It insists that our music need not be in opposition to Western paradigms, but can be independent, rooted in history yet unbound by it. By recognising the fluidity and hybridity of cultural identities, “post-Orientalism Music” allows us to engage with tradition and modernity simultaneously.

Critics such as James Clifford and the Subaltern Studies collective emphasise the need to move beyond Said’s binary division into “East versus West” Such dichotomies risk essentialising both and ignoring the interconnectedness of cultural exchange.

This interdependence determines my practise. Iranian music, which has been shaped by centuries of dialogue with the Arab world, Central Asia,

India and even the West, cannot be confined to a single narrative. My compositions such as *Crystallum*, *Gâ'hân* and *Eternal Chasms* draw on ancient Persian tuning systems as dynamic nodes within a broader network of musical thought. For me, “post-Orientalism Music” is not static, but a philosophy of movement — culture as a river to be navigated, not a fortress to be defended.

Ehsan Saboohi’s “post-Orientalism Music” criticises the stagnation of Iranian music by integrating block structures, untempered intervals and altered soundscapes. His work liberates Iranian music from both the constraints of the Radif and the reductive gaze of Orientalism.

While I admire Saboohi’s criticism, my approach differs in one crucial point: where he often tries to dismantle, I want to reconstruct. Despite its rigidity, the Radif harbours untapped possibilities. I create music that honours its origins and transcends them by exploring their deeper structures and the interplay between fixed and improvised forms.

Although our artistic voices differ, Saboohi and I share the goal of freeing Iranian music from the dual shackles of exoticism and orthodoxy.

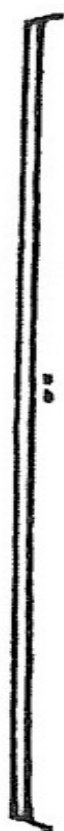
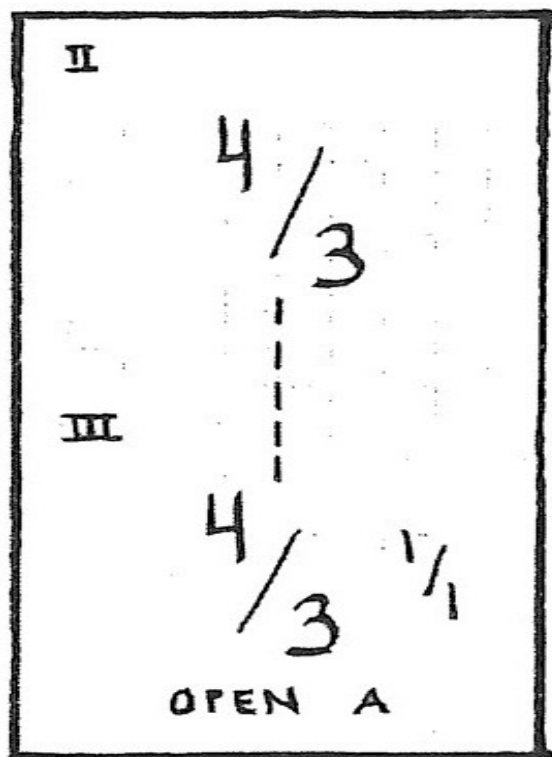
Toward a Unified Vision

Ultimately, “post-Orientalism Music” is not a single ideology, but a conversation — a space in which multiple voices coexist. For me, it connects past and present, East and West, tradition and innovation. It is an invitation to embrace complexity and reject binaries that limit art.

In my work, “post-Orientalism Music” means that I see Iranian music as a living organism— - an organism that grows, adapts and evolves. It draws on the wisdom of the past while addressing the present, creating compositions that reflect history yet resonate in the present. Post Orientalism is more than a philosophy — it is a practise that shapes the way we create, think and listen.

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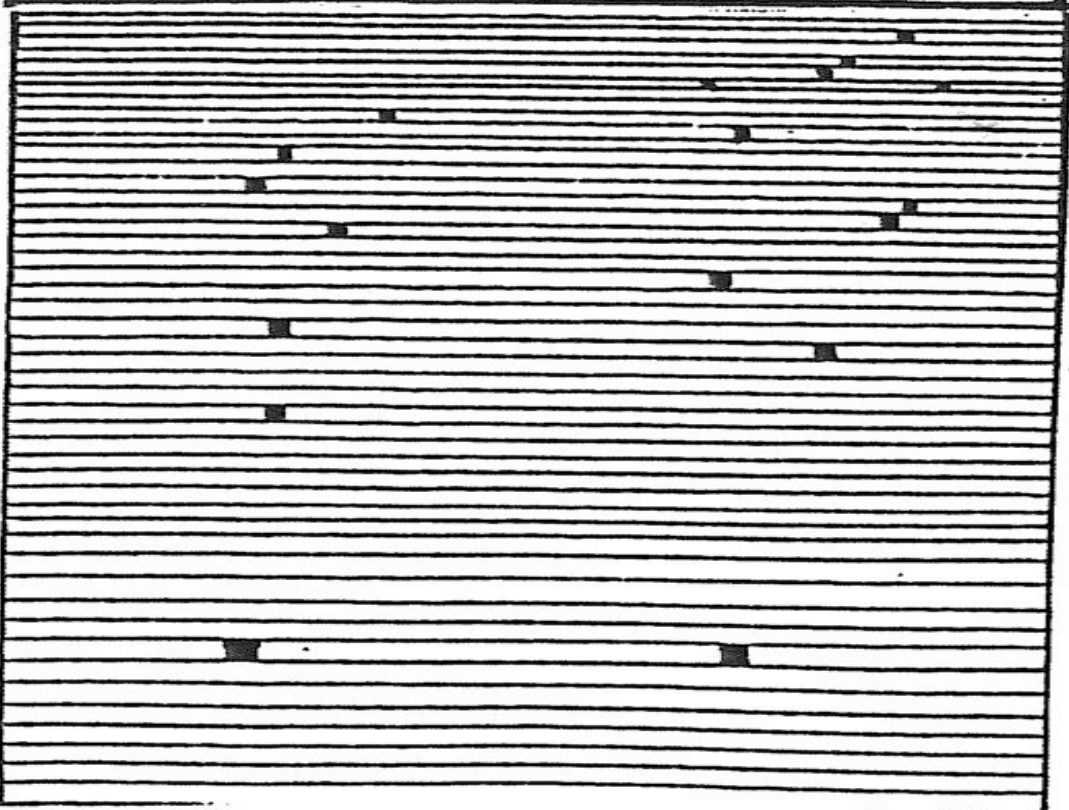
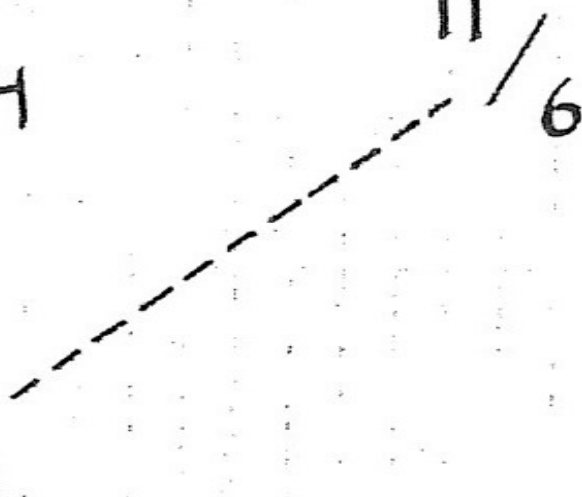
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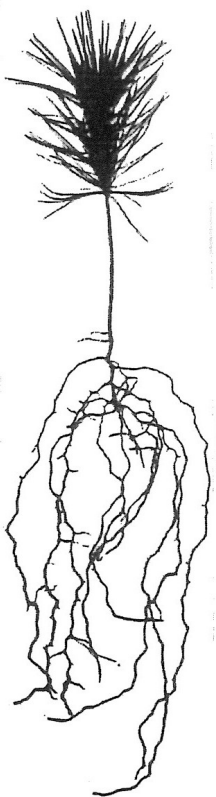
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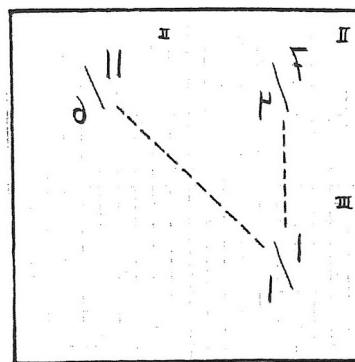
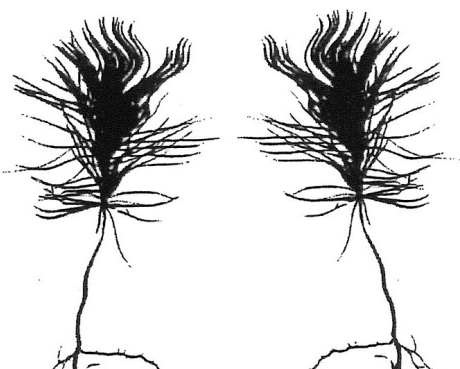
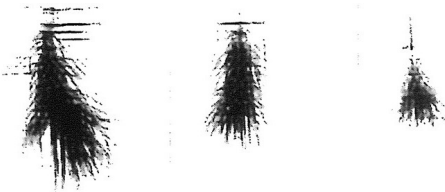
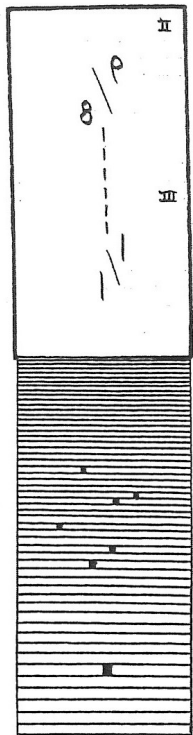
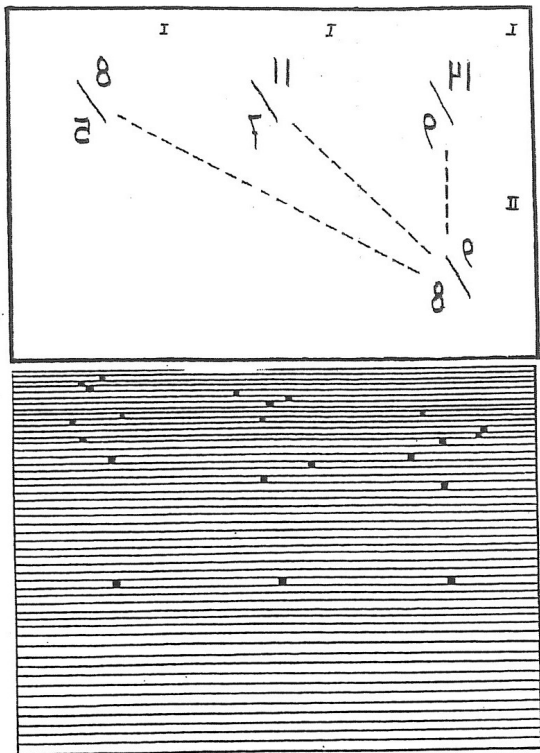
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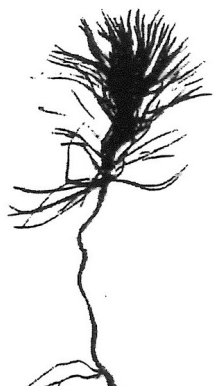
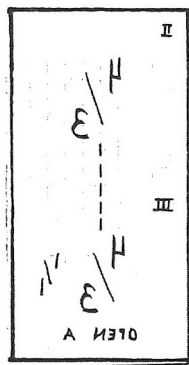
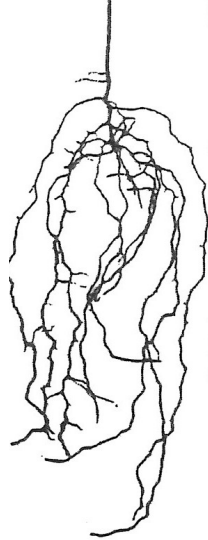
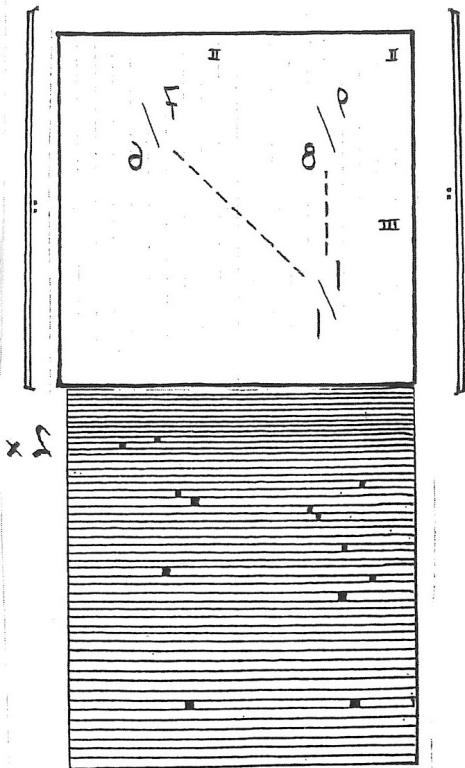
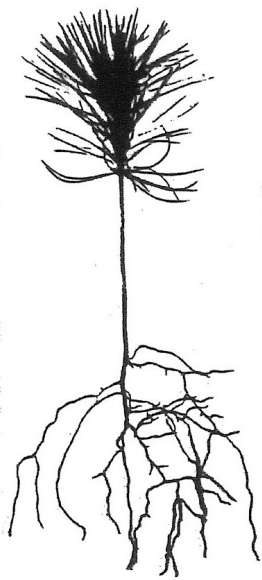
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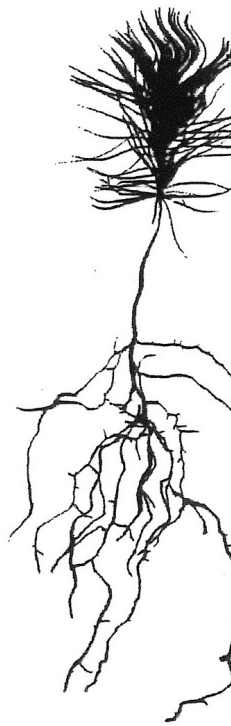


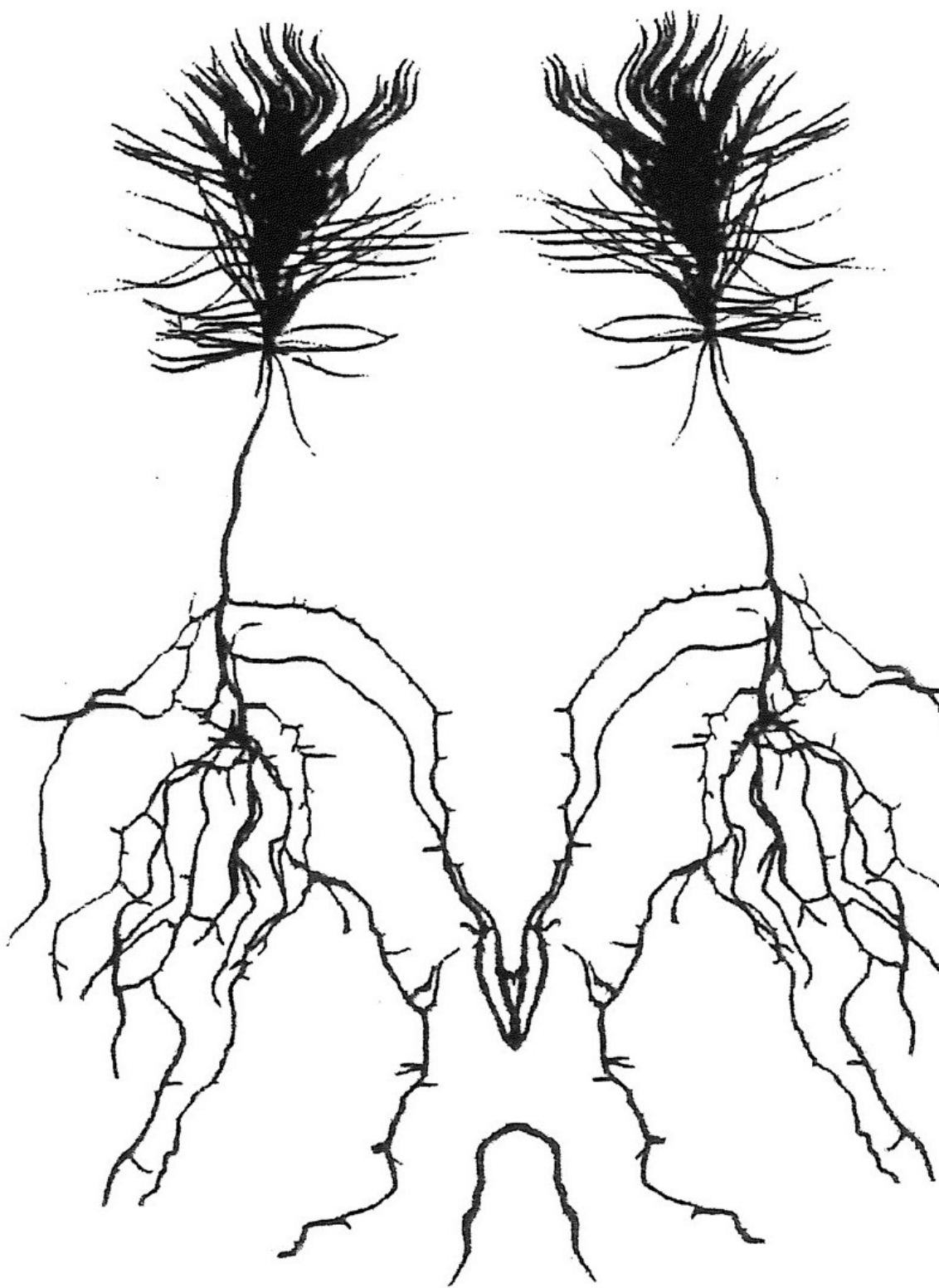
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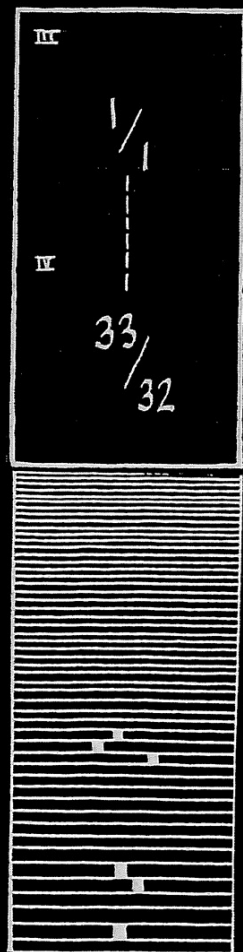
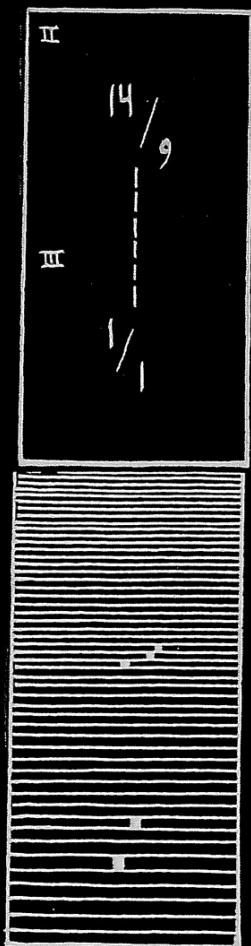
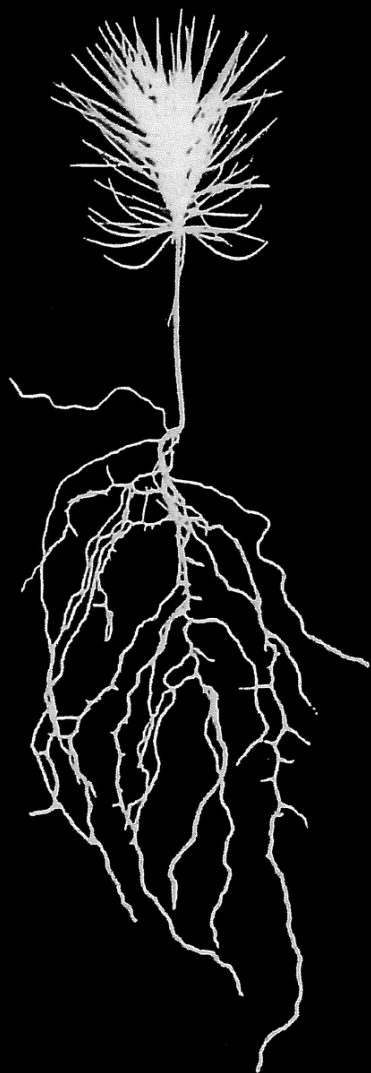




LEVITATION MARKS

SOLO DOUBLE BASS
(FOR ZACH ROWDEN)

A = 421Hz



Angus

Barnacle

Novelty Cadences:

c.

suspensions as Stepping Stones Toward Complex Microtonal Targets

Introduction

The great variety of intervals unbridled by microtonal music practices can be both liberating and unwieldy. In addition to structural dilemmas, writing for conventional 12 tone equal temperament (12tet) instruments presents two practical challenges: what should notation look like for pitches that are unconventional, and how should musicians accurately tune unconventional pitches? The following discussion explores solutions to tuning and structural problems by identifying a novel class of cadence structures and illustrating their notation.

A common thread through the historical usage of the noun “cadence” is a change of state involving stillness or closure, for example:

“Cadence is directly opposite to emphasis; for as emphasis is the raising, cadence is the falling of the voice.”¹

“...performers insert a flourish at a close or cadence...”²

“A murmur had reached my ear for some time in the cadences of the storm.”³

“A Cadence or Close, signifies the last two chords of any passage...”⁴

Be it an orator’s voice changing in pitch and dynamic, a storm acting similarly, or music ebbing and flowing, each denotes a change in state and the noun “cadence” has been employed to refer to the pause or moment of closure between other states. In Western music theory, at least since the late 19th century when John Goss wrote his treatise on harmony identifying it as the “last two chords of any passage”, cadence has referred to closing chord sequences.⁵

Perfect, imperfect, interrupted and other conventional cadential idioms are available to microtonal composition, however, they do not necessarily produce conventional associations of effect. For example, a flat seventh tuned to the seventh harmonic (about 31 cents flatter than 12tet) can be very noticeable due to its distinctive intervallic relationships, leading to relatively jagged voice leading and surprising novelty instead of the sense of closure traditionally associated with cadences.

Microtonal notation

Microtonal accidentals are provided to guide intonation of thirds and sevenths etc where a harmonic reference is available.

Dashed arrow lines point from reference tones to challenging pitches to be tuned.

Elsewhere, conventional pythagorean (12edo) notation invites expressive intonation based on octaves, fifths and intuition.

Fractions indicate harmonic relationships to the lowest note in simple form:

Numerator = prime harmonic

Denominator = octave in which the prime harmonic first occurs.

Microtonal notation

\flat \flat \sharp -14 cents from Pythagorean (5th harmonic)

\flat \flat \sharp -31 cents from Pythagorean (7th harmonic)

\flat \flat \sharp +51 cents from Pythagorean (11th harmonic)

Microtonal accidentals are provided to guide intonation of thirds and sevenths etc where a harmonic reference is available.

Dashed arrow lines point from reference tones to challenging pitches to be tuned.

Elsewhere, conventional pythagorean (12edo) notation invites expressive intonation based on octaves, fifths and intuition.

Fractions indicate harmonic relationships to the lowest note in simple form:
Numerator = prime harmonic
Denominator = octave in which the prime harmonic first occurs.

Fig.1 The The Helmholtz-Ellis JI Pitch Notation for microtonal intervals. This system has been developed by Marc Sabat and Thomas Nicholson

Just Conventional Cadences

V $7/4$ I $5/4$
 S $7/4$ $5/4$
 A $5/4$
 T $3/2$ $3/2$
 B $7/4$

v $7/4$ i $3/2$
 S $7/4$ $3/2$
 A $6/5$ $3/2$
 T $3/2$ $6/5$
 B $7/4$

A compositionally useful distinction can be made between cadences of “closure” and cadences with natural sevenths and other distinctive harmonic intervals that have a tendency to generate attention grabbing novelty. The intrigue generated by novelty cadences need not be perceived as a problem, rather, obscure harmonic relationships and statistical rarity can conjure surprise, mystery and desire for further development. Perhaps, philosophically, cadences incorporating obscure harmonic relationships can represent striving, adventure or bewilderment: they make manifest our genuine mortal struggle to accurately manipulate sound. Employed for the purposes they serve, cadences incorporating harmonically and compositionally obscure material can enhance intervallic breadth while providing distinctively microtonal opportunities for con-

trast and diversity.

Unfortunately, the limited range of keys and frets etc on conventional instruments can limit conventional cadence structures to use of the 3rd, 5th, 7th and perhaps 11th harmonics. However, microtonal novelty can be enhanced in a variety of other ways that can be both compositionally useful and pragmatic for microtonal performance. Pragmatic suspensions can facilitate increasingly obscure harmonic relationships as a cadential passage proceeds, and scores can include visual guides to aid performance outcomes, as illustrated below. In the example below, and those that follow, arrows direct performers to tune obscure harmonics to pitches that have a relatively close relationship, such as the 21st harmonic in bar two being tuned to the 7th harmonic, a perfect fifth below - instead of the tonic "G" 20 steps below.

Just Cadences Using Suspension

The musical score consists of four staves. The first staff is a treble clef with a whole rest in the first measure and a whole note in the second measure. Above the first measure is the ratio $21/16$, and above the second measure is $63/32$. The second staff is a treble clef with a whole note in the first measure and a whole note in the second measure. Above the first measure is the ratio $7/4$, and above the second measure is $3/2$. A dashed arrow points from the note in the first measure to the note in the second measure. The third staff is a treble clef with a whole note in the first measure and a whole note in the second measure. Above the first measure is the ratio $3/2$, and above the second measure is $5/4$. The fourth staff is a bass clef with a whole note in the first measure and a whole note in the second measure. A dashed arrow points from the note in the first measure to the note in the second measure. The score is enclosed in a large bracket on the left side.

Novelty cadences can use pragmatic reference intervals such as a fifth or fourth to navigate voices towards obscurely related harmonic ratios. In this way, they can provide a practical means of realising esoteric harmonies in live performance. The previous "pragmatic suspension" example established a harmonic structure involving the 63rd harmonic (around 31 cents flat of the tonic pitch class), which is evidently navigable but

would be extremely difficult for both notation and performers to maintain as a new key centre amidst other harmonic development. For pragmatic reasons, it is unlikely the music would build on the 63rd harmonic. Similarly, in the following examples cadential sequences do not establish exotic new key centres. Rather, the obscure harmonies are created fleetingly and it is assumed the music would subsequently return to concert pitch or in another way move on pragmatically. Additionally, due to the difficulty, and hence unlikelihood, of producing the obscure constituent intervals outside of a supporting cadential structure, these novelty cadences are anyway unlikely to produce the sense of resolution associated with conventional cadences, questioning the purpose of any attempt to resolve them in a conventional way.

The first musical score consists of four staves. The top staff is in treble clef and has a $7/4$ time signature above it. The second staff is in treble clef with a $5/4$ time signature. The third staff is in treble clef with a $3/2$ time signature. The bottom staff is in bass clef. The music features a cadential sequence with a dotted line indicating a relationship between notes in the second and third staves. The piece concludes with a double bar line and a fermata.

The second musical score consists of four staves. The top staff is in treble clef and has an $11/8$ time signature above it. The second staff is in treble clef with a $5/4$ time signature. The third staff is in treble clef with a $3/2$ time signature. The bottom staff is in bass clef. The music features a cadential sequence with a dotted line indicating a relationship between notes in the second and third staves. The piece concludes with a double bar line and a fermata.

Novelty Cadences

7/4

5/4

3/2

This musical score illustrates a novelty cadence in 7/4 time. It consists of four staves: a grand staff (treble and bass clefs) and two additional treble clef staves. The first staff begins with a whole rest, followed by a dotted half note in the second measure and a dotted quarter note in the third measure, both beamed together. A dashed arrow points from the dotted quarter note to the first staff of the final measure. The second staff features a half note in the first measure, a dotted half note in the second measure, and a dotted quarter note in the third measure, all beamed together. A dashed arrow points from the dotted half note to the second staff of the final measure. The third staff has a half note in the first measure, a dotted half note in the second measure, and a dotted quarter note in the third measure, all beamed together. The fourth staff has a dotted half note in the first measure, a dotted quarter note in the second measure, and a dotted quarter note in the third measure, all beamed together. The final measure shows a whole note in each of the four staves, with a double bar line and repeat dots at the end.

11/8

5/4

3/2

This musical score illustrates a novelty cadence in 11/8 time. It consists of four staves: a grand staff (treble and bass clefs) and two additional treble clef staves. The first staff begins with a whole rest, followed by a dotted quarter note in the second measure, a dotted quarter note in the third measure, and a dotted quarter note in the fourth measure, all beamed together. A dashed arrow points from the dotted quarter note in the fourth measure to the first staff of the final measure. The second staff features a dotted quarter note in the first measure, a dotted quarter note in the second measure, a dotted quarter note in the third measure, and a dotted quarter note in the fourth measure, all beamed together. A dashed arrow points from the dotted quarter note in the second measure to the second staff of the final measure. The third staff has a dotted quarter note in the first measure, a dotted quarter note in the second measure, a dotted quarter note in the third measure, and a dotted quarter note in the fourth measure, all beamed together. The fourth staff has a dotted quarter note in the first measure, a dotted quarter note in the second measure, a dotted quarter note in the third measure, and a dotted quarter note in the fourth measure, all beamed together. The final measure shows a whole note in each of the four staves, with a double bar line and repeat dots at the end.

7/4

5/4

3/2

This musical score illustrates a novelty cadence in 7/4 time. It consists of four staves: a grand staff (treble and bass clefs) and two additional treble clef staves. The first staff begins with a whole rest, followed by a dotted half note in the second measure and a dotted quarter note in the third measure, both beamed together. A dashed arrow points from the dotted quarter note to the first staff of the final measure. The second staff features a half note in the first measure, a dotted half note in the second measure, and a dotted quarter note in the third measure, all beamed together. A dashed arrow points from the dotted half note to the second staff of the final measure. The third staff has a half note in the first measure, a dotted half note in the second measure, and a dotted quarter note in the third measure, all beamed together. The fourth staff has a dotted half note in the first measure, a dotted quarter note in the second measure, and a dotted quarter note in the third measure, all beamed together. The final measure shows a whole note in each of the four staves, with a double bar line and repeat dots at the end.

Also available in the microtonal composer's toolkit are microtonally inflected pitches emanating from each instrument's acoustic properties, fingering idiosyncrasies, natural harmonics and so on, which can often be tuned without a reference tone from another performer. The resulting harmonic structures produced using multiphonics etc may have little correspondence to a theoretically pure overtone series, nonetheless, they can provide practical opportunities to explore novelty cadences and other esoteric harmonic constructions in live performance.

The following example from a 2025 piece for flute, Bb clarinet and cello illustrates use of a clarinet harmonic to introduce a novel pitch. The clarinet harmonic in bar 42 introduces a septimal C# (about 31 cents flat), which is passed to the flute in bar 47. Along the way, the clarinet's septimal C# produces an obscure septimally flat perfect fifth against an F# in the flute and cello, and leads to a septimally flat double octave between the flute and cello in bar 47.

Andante ♩ = 80

The musical score consists of three systems of staves for Flute (Fl.), Clarinet in Bb (Cl. in Bb), and Cello (Vc.).

- System 1 (Measures 41-47):**
 - Measure 41:** Flute and Clarinet play a melodic line starting on G4. Flute dynamics: *p*. Clarinet dynamics: *p*.
 - Measure 42:** Clarinet plays a harmonic marked "overblow" and "ord." (order 7). Dynamics: *pp*. Flute and Cello play a sustained note on F#4. Flute dynamics: *pp*. Cello dynamics: *pp*.
 - Measure 43:** Clarinet continues the harmonic. Flute and Cello remain on F#4. Flute dynamics: *pp*. Cello dynamics: *pp*.
 - Measure 44:** Clarinet continues the harmonic. Flute and Cello remain on F#4. Flute dynamics: *pp*. Cello dynamics: *pp*.
 - Measure 45:** Clarinet continues the harmonic. Flute and Cello remain on F#4. Flute dynamics: *pp*. Cello dynamics: *pp*.
 - Measure 46:** Clarinet continues the harmonic. Flute and Cello remain on F#4. Flute dynamics: *pp*. Cello dynamics: *pp*.
 - Measure 47:** Flute plays a note marked "vib." and "ord." (order 7), which is a septimally flat double octave above the Cello's F#4. Flute dynamics: *pp*. Cello dynamics: *pp*.
- System 2 (Measures 46-47):**
 - Measure 46:** Flute and Clarinet play a melodic line starting on G4. Flute dynamics: *p*. Clarinet dynamics: *p*.
 - Measure 47:** Flute and Clarinet play a melodic line starting on G4. Flute dynamics: *f*. Clarinet dynamics: *f*. Cello plays a sustained note on F#4. Cello dynamics: *f*.

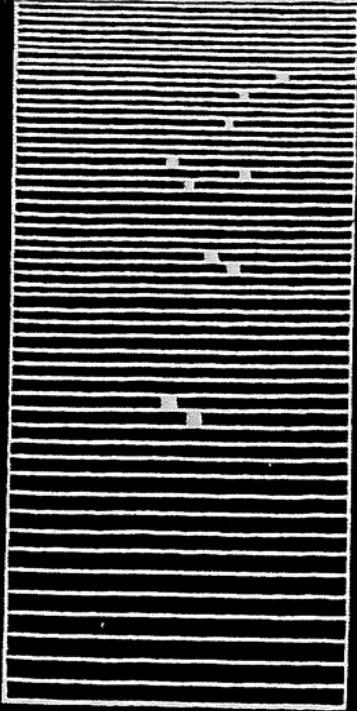
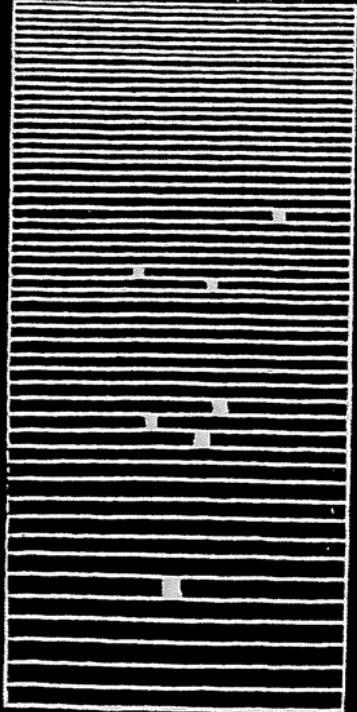
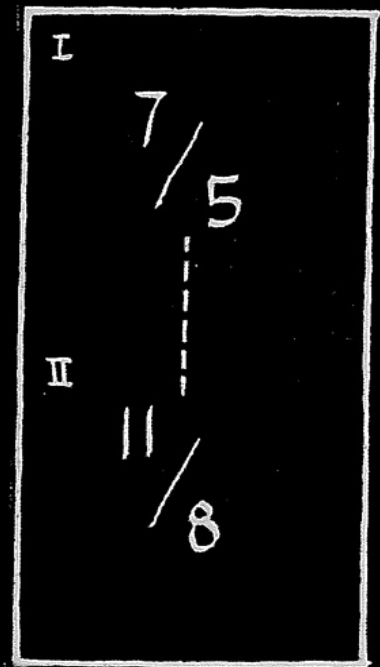
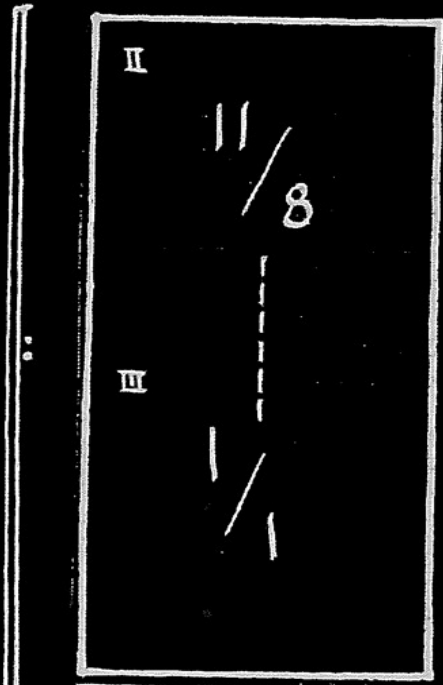
*Example: a form of mind control to keep people distracted and ambivalent.
Composed by author.*

Conclusion

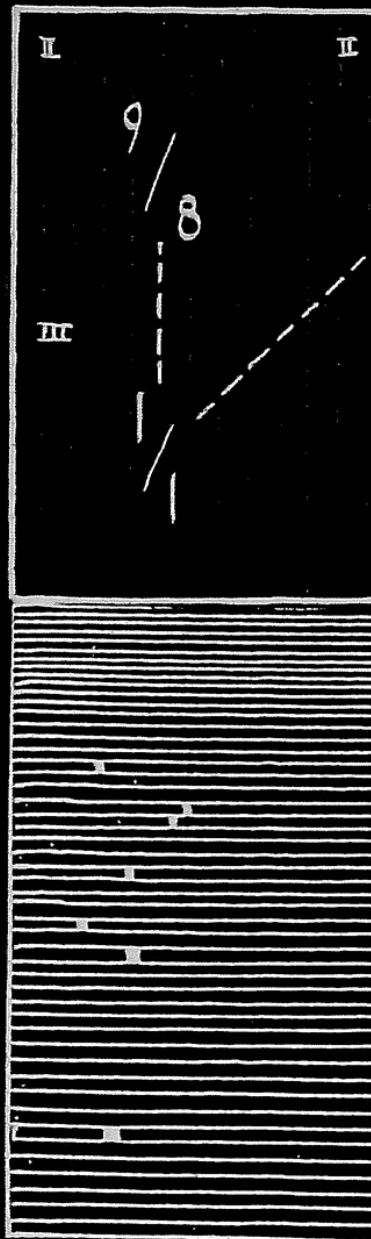
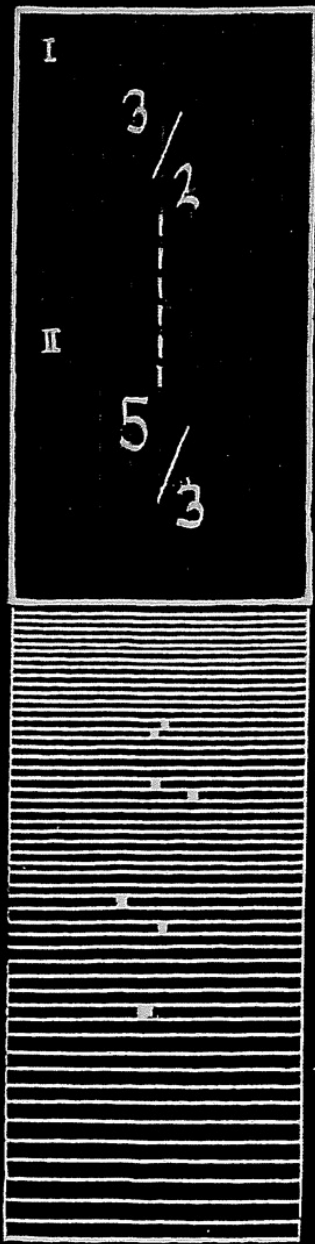
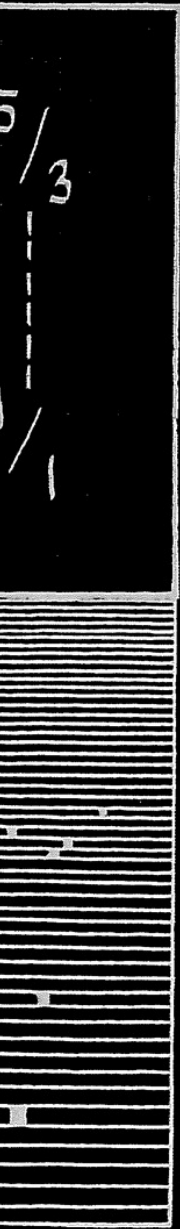
This discussion sets out the potential benefits of using suspensions as stepping stones toward complex microtonal targets and illustrates their notation. It also argues for a classification of the described cadence-like structures as having a general musical significance that is contrary to the notion of closure associated with conventional cadences. Illustrated techniques include leapfrogging over a third voice that has a closer harmonic relationship than a target pitch, and use of extended instrumental techniques to introduce obscure intervals. This approach to complex microtonal harmonic sequences, and their identification as events of novelty value, provides tools for the creation of new microtonal music with realistic performance objectives and structural clarity.

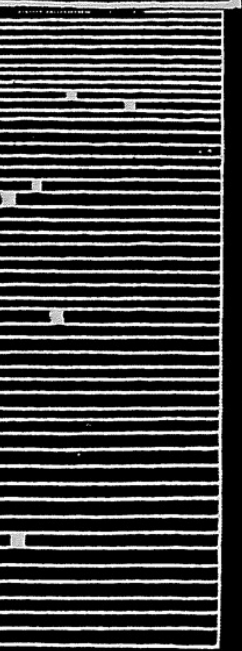
Notes

- (1) Lindsay Murray, "English Grammar," (The Scolar Press Limited, Menston, England, 1968) pp. 154.
- (2) George Alexander Macfarren, "Six lectures on harmony," (Reader and Dyer, London, 1877), pp. 27.
- (3) Elisha Kent Kane, "Arctic explorations: the second Grinnell expedition in search of Sir John Franklin," (Childs & Peterson, Philadelphia, 1853), pp. 377.
- (4) John Goss, "An introduction to harmony and thorough-bass with numerous examples and exercises," (J. B. Cramer and Co, 1860), pp. 42.

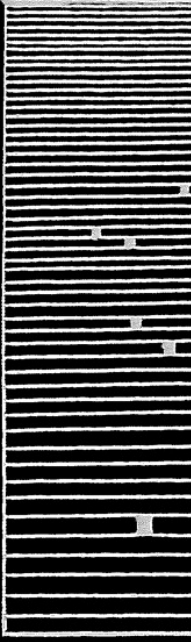
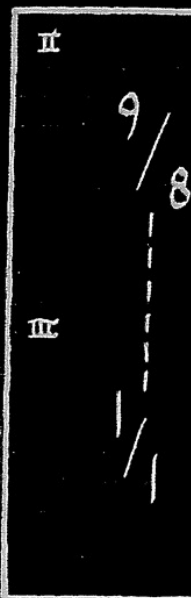
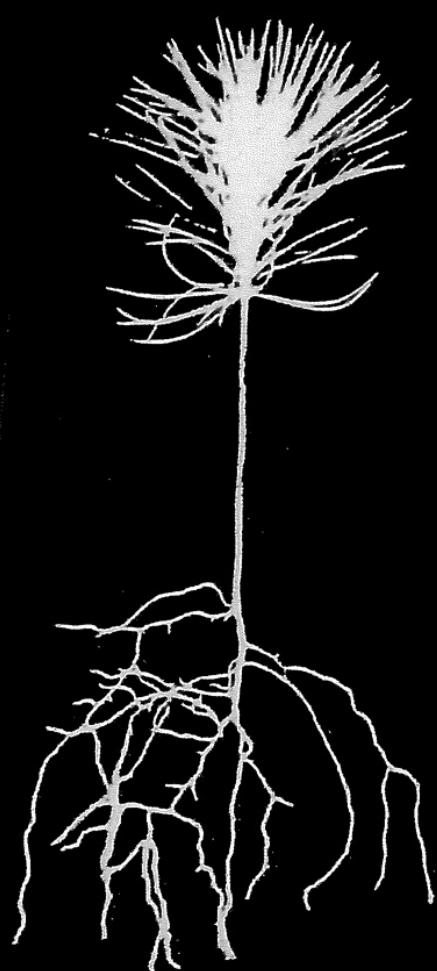


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Casey

Hale

Draw a Straight

Line and Follow

It?

Xenharmonics,

Queer Theory and

Categorical

Perception

Introduction

This essay proposes queer theory, and particularly Sara Ahmed's theorisation of 'orientations', as a productive site for analysing 20th- and 21st-century approaches to microtonal pitch relations, or 'xenharmonics'. Musicians' internalised models of melodic and harmonic organisation arise from the interactions of developmental biology, the auditory system, acoustics, and cultural learning, and I suggest that the enculturation of melodic pathways and directed harmonic motion might be analysed within the framework of Ahmed's *Queer Phenomenology*, figuring them as lines along which we habitually orient ourselves, but that also reproduce hegemonic systems that obscure alternatives from our awareness. I explore recent scholarship on the Arabic maqam tradition and empirical research into the perception/cognition of pitch relationships and Categorical Perception to interrogate some of the traditions of ratio-based just intonation, but also examine the motivations and strategies microtonalists have employed to disorientate themselves from learned cultural habits. I conclude by surveying contemporary theoretical developments in scale theory and Regular Temperament Theory, and suggest the use of a bespoke Max patch for using microtonal pitch correction on the singing voice in real time.

A Queer Turn

For pride month in June 2020, a member of the The Xenharmonic Alliance, a public Facebook group dedicated to microtonal music, created a post to honour 'how much of our work is owed to LGBT+ composers', accompanied by pictures of Harry Partch, Wendy Carlos, Lou Harrison, Claude Vivier, and Henry Cowell.¹ 'I think there's a direct connection,' the author continued: 'Both groups focus on recognizing and moving outside categories imposed by centuries of society.' While several commenters were sympathetic, a few expressed reservation or hostility. One asked, 'Does this mean that those of us who are heterosexual should leave the field of microtonality?' He continued, 'it's noted that Harrison himself firmly believed there was no such thing as "gay" characteristics in music', and later responded, 'trying to say there's something characteristically LGTB+ [sic.] about exploring alternative tuning methods is a slip-

pery slope....the less we politicize xenharmonics, the better.' The initial defensive response—'those of us who are heterosexual should leave'—is telling, seeming to indicate discomfort at having his own interests identified with queer desires or politics. He went on, however, to argue that he admired the work of many composers who were gay, defending his position on the grounds that politics and art should be kept separate. This argument was echoed by others: 'Perhaps the point is that the[se] are great musicians/theorists who just happen to have alternative sexual orientations?' There is, of course, nothing novel in this debate around politics and art, and many artists, as in Harrison's case cited in the comment above, have been wary of having their work pigeonholed or misconstrued by assumptions about identity politics. Nevertheless, there is an important sense in which we might see the 'direct connection' cited in the original post as associative, or affective—a bond of analogous orientations, rather than a series of causal links. Might we understand the two categories of desire—for non-normative melodic and harmonic relationships, on the one hand, and non-normative gender and sexual identities, on the other—as resonant with one another, brought together under the signifier 'queer'? What harm would it do anyone in 'the field of microtonality' to acknowledge their desire for a 'queer' music? Perhaps viewing 'the field' in this way might affect our understanding of its cultural orientation, and the role of queer participants (however broadly defined) within it; perhaps 'moving outside of categories imposed by centuries of society' might imply rejecting the hegemony of a single system, analogous not to the rejection of heterosexuality but instead heteronormativity.

The term 'xenharmonics' was coined by the composer, instrument builder, performer, and tuning theorist Ivor Darreg (born Kenneth Vincent Gerard O'Hara, 1917-1994). An eccentric polymath, Darreg dropped out of school as a teenager, and was 'cast out' by his father, who objected to his interest in music. He changed his name to Ivor Dregg—the first name meaning 'man with bow' (he was a cellist) and the surname a reversal of his birth name, then changed to Darreg (Glasier). He and his mother left home and lived together until her death in 1972. Darreg built several early electronic instruments (beginning in the late 1930s), and in the 1960s began experimenting with alternative musical tunings after meeting Harry Partch and the theorist Erv Wilson. Darreg coined the neologism 'xenharmonics' from the Greek 'xenos' ('stranger')—suggesting something like 'strange' or 'foreign' harmony, but also implying

hospitality to strangers and foreigners from the word 'xenia'—in order to describe 'music, melodies, scales, harmonies, instruments, and tuning-systems which do not sound like the 12-tone-equal temperament', and to distinguish from microtones, 'which shall refer to quartertones or still smaller intervals'.² Thus, while 'xenharmonics' solved the definitional problem posed by alternative tuning systems without 'microtones' (e.g. 5- or 7-tone equal temperaments), it also orientated explorations in tuning towards the social and cultural: in turning towards the 'strange' and the 'foreign' with 'hospitality', we open ourselves to disorientation from habitual ways of thinking and behaving, turning towards the 'other' as an act of identification. It's notable that many with an interest in tuning have turned to study foreign musical cultures (from India, Indonesia, the Middle East, Africa, and Latin America, for example), as well as to historical traditions and theoretical speculations. Often, it has often been an intercultural musical encounter that has disorientated and sparked curiosity about alternatives.

I have borrowed the language of 'orientation' here from Sara Ahmed, whose text *Queer Phenomenology: Orientations, Objects, Others* is a touchstone for queer theory. The encounter with the 'strange', 'foreign', and unfamiliar provokes kind of disorientation that might be aptly described as 'queer.' Ahmed's text is a crucial resource also because the turn towards phenomenology orientates us towards sensory experience rather than abstractions, a turn that provides a valuable intervention in histories of tuning theory. As Ahmed notes, 'phenomenology makes "orientation" central in the very argument that consciousness is always directed "toward" an object, and given its emphasis on the lived experience of inhabiting a body'.³ 'Phenomenology is full of queer moments', she continues, 'as moments of disorientation that Maurice Merleau-Ponty suggests involve not only "the intellectual experience of disorder, but the vital experience of giddiness and nausea, which is the awareness of our contingency, and the horror with which it fills us"'.⁴ A queer phenomenology might turn our attention towards these very moments of 'disorder', 'nausea', and 'horror', inhabiting rather than seeking to pass over them—a sort of 'staying with the trouble', to reference Donna Haraway.⁵ As she continues,

[Merleau-Ponty's] *Phenomenology of Perception* gives an account of how these moments are overcome, as bodies become reoriented. But if we stay with such moments then we might achieve a different orientation toward them; such moments may be the source of vitality as well as giddiness. We might even find joy and excitement in the

horror.⁶

This choice to 'stay with such moments' resonates with the comparative approach to multiple tuning systems espoused by Darreg's xenharmonics: rather than orientating oneself to a singular tuning system considered superior to 12-tone equal temperament (e.g. strict Just Intonation, or 31- or 72-tone equal temperaments), Darreg argued for the exploration of myriad options and the cultivation of their different 'moods'.⁷ The outcome of this is to remain unsettled and always aware of the 'contingency' of our musical perceptions and internal categories, and to 'find joy and excitement' in the ambiguity.

Ahmed's 'queer phenomenology' is also important in that it poses a general resistance to hegemonic norms, while being grounded in the embodied experiences of 'those who do not or cannot inhabit the contours of heterosexual space'.⁸ As Gavin Lee argues in his article, *Queer Music Theory*,

The power of Ahmed's theory is that it can be applied to any kind of disorienting deviation, and is also tied to specific experiences of racial and/or sexual marginality....Queer phenomenology is simultaneously a theory of non-normative racial and sexual lives, and a theory of non-normative moments of rejection, critique, and intellectual foment.⁹

Lee identifies these latter forms of resistance as a 'political' queerness, citing Ahmed's assertion that 'Queer describes a sexual as well as political [generically anti-normative] orientation'.¹⁰ Darreg's 'xenharmonics' can be read through the lens of Ahmed's 'queer refusal' to conform to musical norms, but I'm also tempted to view his biography through a similar lens, despite the fact that I know nothing of his sexual orientation: his refusal to live the life of his father's desires, his childless life with his mother, and his devotion to esoteric studies and 'strange' scales and instruments, all strike me as reasonably 'queer'. To return to the Facebook imbroglia cited above, statements like 'trying to say there's something characteristically LGTB+ [sic.] about exploring alternative tuning methods is a slippery slope' and 'the less we politicize xenharmonics, the better', seem somewhat absurd: the devotion to microtonal exploration per se has hardly ever brought any musician material gain, and has more often than not occasioned suspicion from mainstream musicians and institutions; in this sense the failure of these labours of love to extend normative cultural lines has been eminently 'queer'. Nevertheless, it is important to

emphasise that these relationships are not essentialist: those who utilise tunings other than 12-tone equal temperament need not identify with 'xenharmonics', much less 'queerness', just as people with non-normative gender identities or sexual orientations need not identify as 'queer'. Nobody would insist that 'heterosexual[s] should leave the field'. Instead, I argue that viewing tuning itself through the lens of queer theory and Ahmed's theorisation of 'orientation' allows us to see connections—both musical and cultural—that might otherwise be hidden from view, or to think creatively about how things might be connected.

Lines, Lineages

And when we see the line of the path before us, we tend to walk upon it, as a path 'clears' the way. So we walk on the path as it is before us, but it is only before us as an effect of being walked upon. A paradox of the footprint emerges. Lines are both created by being followed and are followed by being created. The lines that direct us, as lines of thought as well as lines of motion, are in this way performative: they depend on the repetition of norms and conventions, of routes and paths taken, but they are also created as an effect of this repetition. To say that lines are performative is to say that we find our way and we know which direction we face only as an effect of work, which is often hidden from view. So in following the directions, I arrive, as if by magic.¹¹

The metaphor of the 'line' is pervasive in discourses on pitch relationships in the Western musical tradition: melodic lines, contrapuntal lines and voice leading, metaphors of directed motion, paths of modulation and return. Music is notated on staff lines, or sequenced on time lines—an imaginary continuum from present to future. There are also lineages: of cultural tradition, pedagogical method, musical style, theoretical analysis and speculation. In the quotation above, Ahmed uses the metaphors of the line and the path to succinctly explain how habitual orientations are reproduced, after Judith Butler's 'gender performativity': 'The lines that direct us...depend on the repetition of norms and conventions, of routes and paths taken, but they are also created as an effect of this repetition.'¹² The 'paradox of the footprint' is that we perceive these received orientations as 'given', yet it is only through repetition that they exist, and by repeating them we re-inscribe them in the world and upon ourselves:

We can think of following as a form of commitment as well as a social investment. Following a line is not disinterested: to follow a line takes time, energy, and resources, which means that the 'line' one takes does not stay apart from the line of one's life, as the very shape of how one moves through time and space....So we follow the lines, and in following them we become committed to 'what' they lead us to as well as 'where' they take us....Through such investments in the promise of return, subjects reproduce the lines that they follow.¹³

These metaphors apply to how we receive and reproduce musical tradition. We encounter lullabies in infancy, and we sing them to our children; we internalise acoustic information and musical systems (including tuning), and they inform our perceptions as we grow.¹⁴ As we age we encounter these systems externalized in the instruments we use (the keys of the piano, the frets of a guitar, the tuning of violin strings, the holes on a recorder), and we use them not only to make music (learned through repetition!) but to encode in our bodies and minds what musical objects are and how they relate. We do this not in isolation but socially, so that our perceptions of what is normal and desirable respond to the same relational feedback that forms other parts of our identities. Our investments in the musical lines that we follow indeed take 'time, energy, and resources', and indeed we become committed to them: as an eminent music theorist once said to me, in response to my interest in microtonality, 'don't we already have enough to deal with with 12 notes?' By keeping to the path that is culturally intelligible, we ensure the return on our social investment in an expressive art rooted in performance and participation¹⁵: 'in following the directions, I arrive, as if by magic.'¹⁶

Of course, there *are* musical traditions that 'deal with' pitch intervals outside the frame of 12-tone equal temperament, as well as traditions that conceive of more than twelve discrete pitches. One of these is the Arabic *maqam* tradition, well-described in Johnny Farraj and Sami Abu Shumays's *Inside Arabic Music: Arabic Maqam Performance and Theory in the 20th Century*. As they note, 'Maqam itself is a metaphorical word for position, which in Arabic is used for social class position as well as position in a melodic scale.'¹⁷ The word refers to 'a system of scales, habitual melodic phrases, modulation possibilities, ornamentation norms, and aesthetic conventions', and 'it is used to describe the entire *maqam* system used to build Arabic music and the general melodic and modal approach to music that is fundamental to this system.'¹⁸ Farraj and Shumays are careful to differentiate the Arabic conception of *maqamat* (plural for *maqam*) from the contemporary Western concepts of 'scale' and 'mode':

Although Arabic *maqamat* have historically been defined as heptatonic (7-note) scales, a scale alone does not reveal a *maqam*'s inner structure and complexity. We can gain a more accurate understanding of the *maqam* by looking first at its most basic building block: the *jins* (pronounced "jince," pl. ajnas), a scale fragment of 3 to 6 notes....The best translation for *jins* in English is "genus" (and the usage of *jins* in medieval Arab music theory is taken directly from the ancient Greek concept of "tetrachord genus").¹⁹

Farraj and Shumays articulate each individual *maqam* as a hierarchical network of characteristic ajnas, connected by more- or less-frequently traveled paths, beginning and ending on the *jins* that gives the *maqam* its name. The analogy to key centre and modulation in Western music is clear, and this model of 'positions' in a modal genealogy connected by normative and non-normative pathways is strongly suggestive of Ahmed's metaphor of how we orientate ourselves along lines and pathways. Again, it is worth noting that the word *maqam* carries associations of social as well as musical position.

The intonational practices of the Arabic *maqam* tradition are complex and nuanced. Farraj and Shumays situate their discussion of intonation against a centuries-old tradition of theorising pitch relationships in terms of ratios:

The most problematic assumption we wish to dispel is the idea that intonation and scales are *determined* by some kind of mathematical logic. We understand the roots of this misconception: the ancient Egyptian discovery of "rational" harmonic relationships (i.e., based on small-integer ratios) among strings of different lengths, resulting in "consonant" sounds—which Pythagoras learned on his travels to Egypt and developed into a rich tetrachord theory, influencing all subsequent music theory in the Arab world and Europe.²⁰

Instead, the authors assert: 'Intonation and musical scales are cultural products, not mathematical objects.'²¹ They continue, 'Arabic scales...are rooted in the Pythagorean system and use just fourths and fifths between well-tuned strings [on the violin, on the 'ud, etc.]. However, there are many intervals that cannot be described using simple harmonic ratios.'²² Farraj and Shumays observe that these variable intervals are subject to intonational 'accents' which can distinguish practitioners from different time periods and geographical regions, and generally view intonation through the lens of linguistics. They invoke Saussure's semiotics to assert that scales and intonation are 'arbitrary': there is no natural causality that

determines them, but rather ‘they are the result of cultural choices and conventions—even in cases where there are mathematical relationships expressed in some of them.’²³ They go on to make one more assertion that is particularly relevant to thinking about norms and deviations:

Our understanding of Arabic intervals and scales shares one more feature with Saussure’s concept of the *arbitrariness of the sign*: these musical elements do not appear arbitrary to practitioners immersed in their usage; instead they appear to be immutable, determined, and part of fundamental Truth. That is because the *individual* practitioner inherits them through tradition and cannot individually change them; they only change extremely gradually over time, and only by the unconscious activity of whole communities. It is only with a comparative approach (as in linguistics) that their arbitrariness becomes apparent.²⁴

This is reinforced by the observation that ‘when learning the intonation of Arabic maqam scales in one region, local intonation is absolute....a deviation from the precise intonation (i.e., speaking with a foreign accent) would be incorrect and would sound out of tune.’²⁵ Note the significance of a comparative approach for destabilising ‘absolute’ models of intonation and the disorientation provoked when ‘their arbitrariness becomes apparent’, in light of Darreg’s cultivation of multiplicity and the ‘moods’ of different tunings.

Categories

There is substantial empirical evidence to suggest that the view of intonation and scales propounded by Farraj and Shumays is both accurate and applicable beyond the context of the Arabic maqam tradition. In their 2018 article, *A Psychocultural Theory of Musical Interval: Bye Bye Pythagoras*, authors Richard Parncutt and Graham Hair survey studies in music perception and cognition to make a claim similar to the one made by Farraj and Shumays: ‘Musical intervals and scales, although they depend in part on acoustic factors, are primarily psychocultural entities—not mathematical or physical.’

Ratio theory is an important chapter in the history Western musical thought,’ they continue, ‘but it is inconsistent with a modern evidence-based understanding of musical structure, perception and cog-

nition.²⁶ The authors cite several studies of intonation to problematise a cognitive basis in harmonic ratios as well as claims that performers tune by eliminating acoustical 'beating' or roughness: barbershop quartets may tend towards just intonation, but mistunings do not create audible 'beating' effects²⁷; soloists tend to play sharp relative to their accompaniment²⁸; skilled vocalists from various traditions sing with a tuning deviation of up to 20-30 cents without judging themselves out of tune²⁹; performers on string and wind instruments with flexible pitch accept deviations of 10 cents 'in music whose intonation is judged good or excellent'.³⁰ In one remarkable study, a professional trumpeter is measured playing effectively in 12-tone equal temperament while believing to play in just intonation, alongside an accompaniment in just intonation.³¹ Furthermore, Parncutt and Hair observe, 'Performers are constantly compensating for pitch shifts on stage, adjusting the physical size of an interval to compensate for such shifts, so that the interval approaches its ideal subjective size. Thus, physical tunings generally deviate from "ideal" tunings, however defined.'³²

This leads them to conclude:

For composers, our findings imply that ratio theory cannot be considered a scientific foundation for their art; if the music of ratio theorizing microtonalists was successful in the past, as it often was (Gilmore, 1995), other factors must explain that success.³³

Beyond problematising the 'scientific foundation' of harmonic ratios for music perception and performance, the research cited by Parncutt and Hair points to a significant role for internal models based on categorical perception. The study of categorical perception also arises from linguistics; in his text, *Music, Language and the Brain*, Aniruddh D. Patel writes,

[categorical perception] refers to two related phenomena. First, sounds that lie along a physical continuum are perceived as belonging to distinct categories, rather than gradually changing from one category to another. Second, sounds of a given degree of physical difference are much easier to discriminate if they straddle a category boundary than if they fall within the same category.³⁴

In the musical context of pitch, this implies that we parse the interval continuum into categorical entities, and that we have an easier time distinguishing between intervals from separate categories than those within the range of a single category.³⁵ This theory predicts that we will reconcile sensory input to categories already established, which explains the

tolerance for mistuning. It also explains why musicians trained in 12-tone equal temperament will both perceive and reproduce intervals within that framework. As Parncutt and Hair observe,

The empirical literature on intonation in Western tonal music suggests...that interval sizes are normally and unimodally distributed around mean interval sizes that do not differ significantly from familiar piano tuning—twelve equal divisions of the (stretched) octave. The literature also suggests that theoretical Just and Pythagorean variants lie well within those distributions.³⁶

It is important to note that alternate intonations here are figured as deviations from internalised categories, not that 12-tone equal temperament is itself a deviation from an ideal just intonation. It should also be noted that the intonational ideals within the categories provided by 12-tone equal temperament are variable. Parncutt and Hair cite a study that 'asked musicians to evaluate the tuning of simple rising and falling scales that had been tuned to Just, Pythagorean, and 12-EDO. Violinists preferred something approaching Pythagorean, pianists preferred 12-EDO, and nonmusicians had no preference.'³⁷ These findings suggest that violinists and pianists have internalised expectations based on the sensory feedback of their instruments and their training (many string players are trained in a notional Pythagorean tuning). In a final blow to proponents of a strict just intonation, Parncutt and Hair cite evidence that even our processing of spectral phenomena and their assimilation into a fundamental pitch is subject to categorical perception: 'partials within a harmonic complex tone can be mistuned by a quartertone or even a semitone without being separately noticed.'³⁸ Like pitches in a melody, partials are perceived categorically: either they belong to a given harmonic complex tone or they do not.'³⁹ This helps to explain our experience of the 'perceptual fusion' of simultaneous tones whose fundamentals are related by only approximate integer ratios: 'To avoid perceptual roughness, the overlap need not be exact.'⁴⁰

Categorical perception is embedded in musical enculturation, and musicians from different cultures will exhibit different perceptual categories for scales and intervals. Research by Marc Perlman and Carol L. Krumhansl has demonstrated that experienced Javanese gamelan musicians sort microtonal interval stimuli into categories based separately on the *Pélog* and *Slendro* scales, while trained Western musicians sort the same stimuli according to 12-tone equal tempered categories; the authors also suggest that 'relatively wider regions of [interval] confusion for the Java-

nese musician reflect the greater variability of intonation in Java.⁴¹ They relate this to research by Peter Cooke (1992), who has suggested that, in the context of Ugandan tuning practices, 'a relationship may exist between size of scale step, breadth of interval category, and variability of tuning.'⁴² In other words, the broader the range of each interval category, the more pitch intervals it will subsume. They continue,

For example, quasi-equidistant pentatonic scales (whose steps approximate 240 cents each), such as those found in Uganda and Java, may give rise to broad, tolerant interval categories. From a perceptual point of view, this may mean that intervals differing by as much as 100 cents (say, 190 cents and 290 cents) are assimilated to the same internal interval standard.⁴³

It follows that the development of internal interval categories based on much finer 'quasi-equidistant scales'—say, between 17 and 31 divisions of the octave—would facilitate a more refined discrimination of intervals. In the context of the Arabic *maqam* tradition, pitch categories coalesced around a theoretical 24-tone scale by around the 18th century.⁴⁴ However, Farraj and Shumays identify this scale as an expedient simplification of actual intonational practice:

The 24-tone scale was a metaphor that combined distinct pitches from every possible Arabic *maqam* scale and reduced closely neighboring pitches into a single conceptual note in order not to exceed 24 divisions per octave....This was a hugely convenient model, in which a concise vocabulary of notes was used to represent the much richer universe of possible pitches used in practice.⁴⁵

The 'metaphor' of the 24-tone scale—'equal-tempered in theory'⁴⁶ but not in practice—provides a tool not only for simplifying notation but reducing the cognitive load on performers, while leaving the intonational 'accent' to melodic enculturation. To emphasise the economy of this model, it is worth noting that Farraj and Shumays observe 'at least 10-12 aurally distinct pitches from different *maqam* scales' in the 'ET semitone between the notes *E* and *E'*'.⁴⁷ This shows how categorical perception can not only help to refine pitch conceptualisation through the internalisation of finer divisions (i.e. 24 vs. 12), but can also provide a framework for simplifying a variety of much finer 'signified' intonations under a single 'sign' (to return to the language of Saussure).

The notion of categories also has significance for our conceptions of gender and sexuality. In her foundational text *Gender Trouble*, theorist

Judith Butler deconstructs essentialist notions of either gendered or sexual identities, instead arguing that their appearance of being 'natural' is an effect of discourse, after Michel Foucault. That is to say: gender and sexual categories are inscribed and re-inscribed through habitual repetition in culture, and are thus contingent on this repetition, but their contingency is hidden their appearance of being already there; moreover, the perception of these categories as fixed and natural perpetuates the hegemonic power structures of the patriarchal norm. This is the logic of Ahmed's analysis of paths and lines, cited earlier. In this context, Butler writes,

That the power regimes of heterosexism and phallogocentrism seek to augment themselves through a constant repetition of their logic, their metaphysic, and their naturalized ontologies does not imply that repetition itself ought to be stopped—as if it could be. If repetition is bound to persist as the mechanism of the cultural reproduction of identities, then the crucial question emerges: What kind of subversive repetition might call into question the regulatory practice of identity itself?⁴⁸

Butler's answer to this question is 'to make gender trouble, not through the strategies that figure a utopian beyond'—i.e. a utopian state prior to or beyond the categories of sex and gender—but through the 'parodic proliferation and subversive play of gendered meanings.'⁴⁹ In light of the correlations I've attempted to draw between theorising gender/sexuality and musical pitch relationships, I'm tempted to ask: 'what kind of subversive repetition might call into question' our perceptions of normative practices? Following Butler suggests the answer lies in a 'subversive play' of musical categories: rather than pining after a utopian conception of a 'natural' system in just intonation, as some acoustical (or even meta-physical) state prior to the tampering/tempering of culture, why not instead destabilise our received categories by embracing the ambiguities of temperament—or alternatively by leaving aside harmonic thinking altogether—to internalise new categories? It might also be worth asking: once we've done this, can we hold within ourselves multiple categories for parsing the audible, musical world, like the mutually exclusive *Pélog* and *Slendro* scale frameworks of Javanese musicians in Perlman and Krumhansl's research? Finally, I'm interested in how this perspective on deviance and subversion talks back to the deterministic linguistics of Saussure, cited by Farraj and Shumays:

[Intervals and scales] do not appear arbitrary to practitioners im-

mersed in their usage; instead they appear to be immutable, determined, and part of fundamental Truth. That is because the *individual* practitioner inherits them through tradition and cannot *individually* change them. they only change extremely gradually over time, and only by the unconscious activity of whole communities.⁵⁰

Where does this leave agency, whether individual or collective? What happens when individuals or communities orientate themselves towards these apparently immutable and determined systems with the desire to change them? And what kinds of encounter or awareness might motivate individuals or communities to disorientate themselves in this way?

Desire Lines

I do not always achieve the just intonation which I hold as desirable—the clear choice of consonance or dissonance. Someone has said that ideals are like stars. We can't touch them but we look to them for guidance.⁵¹

My own encounter with microtonality came through the teachings and music of Kyle Gann, who studied with Ben Johnston, who apprenticed with Harry Partch. Thus, at my own point of disorientation from 12-tone equal temperament, the lineage that I inherited from Gann was the lineage of extended just intonation—which is to say, melodic and harmonic construction from low-integer ratios, of the sort critiqued, above. This was accompanied by a mistrust of 'temperament'—a metaphor of mixing metals for the blending of mutually co-prime ratios in order to simplify musical pitch space and achieve things like harmonic progression and transposition within a limited number of notes. In the tradition of Partch, tuning from ratios not only allowed greater nuance but was a form of acoustical and expressive honesty: in the same letter quoted above, Partch asserted 'I believe in a rational—that is, acoustical—approach to the problems of musical materials, as the only one leading to genuine insight'.⁵² In 'Chapter 3. Definitions Pertaining to Intonation', from his seminal text *Genesis of a Music*, Partch writes, under the entry for 'Temperament': 'a system which deliberately robs its intervals of their purity in order to implement the idea of every-tone-in-several-senses'.⁵³ By 'every-tone-in-several-senses' Partch refers to the ability to modulate freely, but the resultant ambiguity of relationships, which 'robs...intervals of their purity'; was what he found anathema. Partch described his

musical aims as 'Corporeal'—grounded in the materiality of acoustics, in the expressive utterance of the voice, in the authenticity of individual experience—and he articulated these in opposition to an ideal he saw as 'Abstract'—the sophistry and intellectual decadence of temperament, the flamboyant virtuosity of the instrumentalist, the submission of the individual to the constraints of mass production. Partch believed that the auditory system had a natural ability to analyse frequency ratios between both disjunct and simultaneous tones, beyond the ability to parse spectral information in a single, complex sound: 'it is preferable to ignore partials as a source of musical materials. The ear is not impressed by partials as such. The faculty—the prime faculty—of the ear is the perception of small-number intervals...and the ear cares not a whit whether these intervals are in or out of the overtone series.'⁵⁴ And yet, as Partch indicates in the letter quoted above, he did not always achieve his desired just intonation. Regardless of what one may think of Partch's politics, what interests me in all of this is Partch's 'desire' for an embodied music bound up in ritual, drama and dance—a music of direct sensuality and emotional impact. For Partch, the 'ideal' of just intonation was a disorientation device, in Ahmed's terminology, away from what he perceived as an alienating, abstract European musical lineage—a way of laying out a new line to follow, a new path to walk.

In *Queer Phenomenology*, Ahmed writes, 'It is interesting to note that in landscape architecture they use the term "desire lines" to describe unofficial paths, those marks left on the ground that show everyday comings and goings, where people deviate from the paths they are supposed to follow.'⁵⁵ I find this metaphor useful for thinking about how musicians might come to an awareness of alternative scales and intonations, and how they follow them. As suggested above, recasting pitch intervals as ratios was a line Partch followed in order to deviate from the received traditions of Western concert music; he encountered this line in the writings of Helmholtz, but traced it back to the ancient Greeks in order to reorientate his practices of speech intonation and drama, brought together under the term Monophony. Perhaps more interesting to consider, though, is how Partch's worldview—and his awareness of difference—may have been shaped by his encounter with the music of China. Partch's parents were Presbyterian missionaries who had just returned to the United States from several years in China before his birth in 1901; Mandarin was spoken in the home, and Partch's childhood recollections included his father corresponding in Mandarin with Chinese friends and

his mother's Chinese lullabies. As a young man, Partch regularly attended performances of Chinese music and theatre at the Mandarin Theater in San Francisco⁵⁶, and his earliest surviving work in his Monophonic system is his *Seventeen Lyrics by Li Po* (1933), for his own intoning voice and adapted viola.⁵⁷

Partch would not be the only microtonalist to be set along the path of musical experimentation by cross-cultural encounter. Erv Wilson, a highly influential theorist who also contributed some of the illustrations for Partch's *Genesis of a Music*, reported his first microtonal disorientation as a child. His parents were Mormon pioneers from Utah who settled in northern Mexico two years before his birth in 1928. As a child he enjoyed playing the family reed organ, but found himself unable to locate some of the notes of Mexican melodies he encountered on the instrument. These missing notes preoccupied him for years, and led him to drop out of his music theory studies at Brigham Young University when he found his teachers unsympathetic.⁵⁸ La Monte Young first learned about just intonation from Tony Conrad, his bandmate in the Theater of Eternal Music, in the early 1960s⁵⁹, but cites his interest in sustained drones as predisposing him to overtone relationships—an interest he acknowledges was motivated by his exposure in his 20s to Hindustani classical music to Japanese *gagaku*.⁶⁰ Pauline Oliveros also seems to have come to just intonation through an attention to sustained tones and acoustic environments, and from the 1970s practiced meditative interactions that concentrated on, for example, 'unchanging tonal centers with emphasis on changing partials', or changes that 'occur involuntarily, or without conscious effort, while sustaining a sound voluntarily.'⁶¹ This orientation towards what she termed 'Deep Listening' followed upon 'having immersed herself in the study of Asian and Native American cultures, including different types of meditation, Karate, and T'ai Chi.'⁶² Thus the 'desire lines' of these musicians extended from some combination of sonic and cultural encounter with the 'other', encounters that motivated a disorientation from the lines of traditional music study and from the repetition of cultural norms. As Oliveros notes of her university composition studies, 'I was disappointed...because I had to struggle so hard to realize...my inner sounds—my inner needs of what I was trying to express—in relation to the templates I was given as models.'⁶³

Ahmed writes, 'Deviation leaves its own marks on the ground, which can even help generate alternative lines, which cross the ground in unexpected ways.'⁶⁴ The English translation by Alexander J. Ellis of Hermann

von Helmholtz's foundational text, *On the Sensations of Tone as a Physiological Basis for Music Theory* (1885), was a catalyst for Partch's music-theoretical deviations after he discovered it in the Sacramento, California public library.⁶⁵ Helmholtz's work was not deviant per se, but instead participated in a centuries-old tradition of Western music theorists working in ratios, from Pythagoras to Zarlino to Mersenne to Rameau.⁶⁶ However, the creative uses to which Partch put Helmholtz's theories certainly made new 'marks on the ground' and 'generate[d] new lines.' Lou Harrison first encountered just intonation in Partch's *Genesis of a Music* in 1949⁶⁷, and in an ironic (and perhaps problematic) reversal applied it to his engagement with Indonesian gamelan.⁶⁸ Wendy Carlos acquired a copy of Partch's book as a university student, but had already 'tried building little instruments, a wannabe Harry Partch', and had been experimenting with alternate tunings on the family piano from her teenage years, influenced by Helmholtz's book.⁶⁹ Both Ben Johnston and James Tenney studied with Partch for a time, and performed in his ensembles⁷⁰, and both grappled with and extended his theories and practices in diverging ways. It should be noted that none of the composers above attempted to replicate Partch's aesthetic or his working methods: Harrison came the closest, but tuned bespoke *gamelan* ensembles to just intonation rather than building new instruments; Carlos realised her microtonal works electronically, exploring the relationships of tuning and timbre in the new medium⁷¹; Johnston devised a system for notating the harmonic language of extended just intonation in order to compose chamber works for traditional Western instruments; and Tenney explored his own critical perspective on intonation in the context of post-Cagean experimentalism. It wasn't just the theoretical model that Partch provided, however, which laid out the 'desire lines' for these composers to make their own divergent practices; as Johnston has noted, 'Partch was determined to get this music out of the limbo of theorizing it, and he did it.'⁷² The path cleared by Partch's musical practice demonstrates a creative engagement with esoteric theoretical materials; the assertions that his conceptions of interval ratios and psychoacoustics were dated and are now inconsistent with empirical research on music cognition⁷³, or even that, following from Helmholtz, he embraced a Western ideology of 'naturalism' with problematic postcolonial implications⁷⁴, are perhaps beside the point: he took a remarkable risk in fashioning a 'queer' musical aesthetics and practice, and his failures have inspired just as much work in his lineage as have his successes. Importantly, his example shows how theoretical models can instigate the exploration of new paths, intervening at

the point where we find ourselves disorientated by experience. 'The truly path-breaking step can never be predicted', Partch writes, 'and certainly not by the person who makes it at the time he makes it. He clears as he goes, evolves his own techniques, devises his own tools, ignores where he must'.⁷⁵

Objects That Shape Us

In light of Parncutt and Hair's assertion that 'Musical intervals and scales... are primarily psychocultural entities—not mathematical or physical', we might ask what contemporary theoretical and instrumental resources give us access to new 'desire lines', disorientating us and allowing us to take our own 'path-breaking' steps towards a 'queer', 'xenharmonic' music, while mindful of lessons from contemporary studies of cognition and perception. Ahmed's metaphor of 'orientation' is relevant again, applied broadly to think through how we orientate ourselves as subjects (physically, spatially, socially, mentally) as well as how objects and spaces (both material and conceptual) are orientated. In Ahmed's conception, these orientations are reciprocal: subjects and objects both shape and are shaped by the orientations (directions, purposes, uses) that they assume towards one another, and engrain these orientations through repetition over time. What emerges is a phenomenology in which all things (living and not, material and conceptual) are shaped in mutual relations. In this sense, it's notable that our theoretical conceptions of pitch—numerical, graphical, spatial—as well as the instruments that we build to embody them—keyboard layouts, novel interfaces—are shaped by us and shape us in turn: our consciousness, our embodied knowledge, our awareness of possibility and the paths we discover through interaction. Thus, to explore new perceptual categories it becomes necessary to develop new tools, both conceptual and practical, that extend mind and body. And while recent years have seen an increase in available software and hardware tools that facilitate microtonal exploration—from broader software support for microtuning, to generalized keyboards like the Lumatone and Intuitive Instruments Exquis, to more accessible and adaptable microtonal guitars—the concomitant expansion of musical resources depends on the broadening of consciousness and embodied experience that these tools afford.

In light of the research cited above on perceptual categories, it's worth noting that equal divisions of the octave (EDO) can provide 'mean interval sizes' around which more varied intonations are 'unimodally distributed'⁷⁶—for example, given an internalised reference for 12 EDO, a Western-trained listener will hear and reproduce intervals statistically distributed around each of the 12 divisions as an average value. One avenue of exploration might be to attempt internalising categories for other equal divisions of the octave (e.g. 8, 9, 10, 11 or 13) to retrain a different set of perceptual categories. This concept can also be extended to equal divisions of other intervals, as in the equal-tempered version of the Bohlen-Pierce scale (13 equal divisions of the 'tritone', or the ratio 3:1), or Wendy Carlos's 'alpha', 'beta' and 'gamma' scales (respectively 9, 11 and 20 divisions of the ratio 3:2).⁷⁷ However, because these scales do not repeat at the octave (2:1 ratio), an interval of identity that seems to have some perceptual salience across cultures, they may give rise to unanticipated categorical perception issues: for example, Carlos's 'alpha' scale might be perceived not as a scale without octaves, but as a 15-tone equal division of a mistuned, compressed octave of approximately 1170 cents. We will return to this subject of interval approximations soon.

Other avenues of scale construction have been pioneered by the theorist Erv Wilson, mentioned earlier in connection to Partch. Wilson saw coherent scalar structure as holding a perceptual significance at least as important as harmonic relationships and thus worked in both areas to develop new resources. One of Wilson's most well-known contributions is the description of Moments of Symmetry, first defined in the 1960s.⁷⁸ Beginning from the premise of the chain of fifths in Western theory, Wilson generalised the procedure to chains one interval—called the 'generator'—within the frame of another interval—called the 'period'; the Moments of Symmetry are the points along the chain where a scale arises that has two and only two sizes for each generic interval category (except for the period, which only has one size). To return to the chain of fifths in 12-tone equal temperament, where the generator is 7 degrees of 12 (henceforth $7\backslash 12$, here I have used a notational convention for equal divisions where $7\backslash 12$ is to be understood as 7 divisions out of 12), the scale-sized Moments of Symmetry are the familiar pentatonic and diatonic; moreover, the pattern of MOS cardinalities generated by $7\backslash 12$ (1, 2, 3, 5, and 7 notes) remains constant over a generator range with boundaries at the 685.7 cent interval of 7 EDO to the 720 cent interval of 5 EDO. Thus, any generator greater than $4\backslash 7$ and less than $3\backslash 5$ will develop MOS

as cardinalities of 5, 7 and 12 notes; moreover, any generator greater than $4\backslash 7$ and less than $7\backslash 12$ will also generate a 19-note MOS after 12, while any generator greater than $7\backslash 12$ and less than $3\backslash 5$ will generate a 17-note MOS after 12. The patterns of MOS cardinalities for any given generator, specified as a division of the period, can be found in Wilson's 'scale tree'⁷⁹, which outlines, among other things, the generator boundaries for what one might think of as families of MOS scales.

A few more important observations arise from Wilson's Moments of Symmetry. First, they are deterministically formed scales. This is to say: given the generator and the period, one can arrive at them automatically. They thus suggest themselves as synthetic, experimental 'lines' of divergence from habitual scales, though some of them resemble the structure of scales in existing musical cultures. Second, they often possess another property defined by Wilson: they are often 'Constant Structures' (CS). A Constant Structure is one in which every time a specific interval appears within the scale, it spans the same number of scale steps. For example, in the pentatonic scale in 12 EDO, the $5\backslash 12$ interval always spans two steps. A canonical example of a MOS that is not CS is the diatonic scale in 12 EDO, where the $6\backslash 12$ interval is both a generic 'fourth' (an augmented fourth) and a generic 'fifth' (a diminished fifth); however, if the diatonic scale is tuned to 31 EDO (a very close approximation to quarter-comma meantone temperament), the diatonic scale *is* CS, because the augmented fourth and diminished fifth are distinct intervals ($15\backslash 31$ and $16\backslash 31$, respectively). The property of CS can be held by scales generated from more than two intervals, including just intonation scales, and can be seen as a higher-level generalisation of the MOS concept. Finally, MOS scales are quasi-equal in important respects; they can, of course, converge on equal divisions, depending on the generator/period relationship, but even when their step sizes are quite unequal they still exhibit a categorical similarity to the EDO of the corresponding cardinality. In other words, two 7-note MOS scales from different generators will share a categorical similarity to 7 EDO, even though their interval structures are different. This is because of the 'unimodal distribution' around 'mean interval sizes' cited by Parncutt and Hair (2018), earlier.

A theoretical body of work that builds upon Wilson's has come to be known as Regular Temperament Theory (RTT). The foundational text for RTT is an article by the theorist Paul Erlich, *A Middle Path: Between Just Intonation and the Equal Temperaments*.⁸⁰ Taking the historical practice of regular meantone temperament as a starting point, RTT extends the con-

cept of tempering the primary intervals of just intonation (i.e. the prime numbered harmonics 2, 3, 5, etc.) in order to eliminate small pitch intervals called 'commas' that yield perceptual tuning discrepancies, rather than being perceived as distinct intervals in their own right. The mathematical model of consistently mapping just-intonation prime factors to the generating intervals of regular temperaments allows for 'tempering out' other commas besides the 'syntonic comma', which vanishes under meantone. RTT describes the theoretical relationships between the 1-dimensional pitch spaces of equal temperaments (in which iterations of a single EDO step are sufficient to generate every interval) and the 3- or more-dimensional pitch spaces of extended just intonation (in which 3 or more prime factors are necessary to generate all the interval ratios), as well as the 'systems of intermediate dimensionality' along the way.⁸¹ The mechanics of RTT are too complex to explain here, but it suffices to point out that RTT provides a means for directly relating scalar and harmonic considerations, while allowing for the flexibility of tempered approximations to strict just intonation ratios; it is also wholly compatible with Wilson's MOS and CS properties, and provides tools for mapping harmonic information to the generators of MOS scales. We can thus use RTT to search for MOS scales that prioritise certain harmonies, and to know how large a MOS scale is needed to accommodate desired harmonic progressions.

Erlich has also theorised harmonic relationships in a way that brings just intonation theory into line with contemporary findings in cognition and perception. In a brief description of his function for Harmonic Entropy (HE), Erlich writes,

Harmonic entropy is the simplest possible model of consonance. It asks the question, "how confused is my brain when it hears an interval?" It assumes only one parameter in answering this question. Our brain determines what pitch we'll hear when we listen to a sound. It does so by trying to match the frequencies in the sound's spectrum (timbre) with a harmonic series.⁸²

This assertion is well-grounded in our understanding of how the human auditory system processes complex tones, and makes no claims for ratios. As noted earlier, Parncutt and Hair pointed to evidence that our processing of spectral relationships is subject to categorical perception, and thus exhibits a tolerance for mistuning. Erlich's Harmonic Entropy function takes this into account by understanding harmonic series relationships as perceptual points of reference on a continuum of intelligibility.

Harmonic Entropy is thus a statistical model of concordance. As Erlich continues,

Entropy is a mathematical measure of disorder, or confusion. For a dyad, consisting of two tones which are sine waves or have harmonic spectra, one can immediately understand the behavior of the harmonic entropy function. The brain's attempt to fit the stimulus to a harmonic series is quite unambiguous when the ratio between the frequencies is a simple one, such as 2:1 or 3:2. More complex ratios, or irrational ones far enough from any simple one, and the limited resolution with which the brain receives frequency information makes it harder for it to be sure about how to fit the stimulus into a harmonic series.⁸³

What results from the function is a graph on which we see a continuous line, with troughs corresponding to low entropy (i.e. low ambiguity) at points corresponding to the simplest low-integer ratios, and continuous curves moving to and from them. Thus the function models how we hear a mistuned octave as an octave still, or a 'mistuned' major third in 12-tone equal temperament as an acceptable approximation to a 5:4 harmonic relationship. The perspective that harmonic concordance is perceived as approximate, or in proximity to points of more-or-less concordance, is crucial for understanding the tempered intervals of RTT.

Another entropy function, motivated by Erlich's HE, is Mike Battaglia and Keenan Pepper's Categorical Entropy, presented in-progress online at the Xenharmonic Wiki in a post entitled 'Categorical Entropy, Mutual Information, and Channel Capacity'. Starting from the literature on musical scales and categorical perception, the authors set out to model how much ambiguity is present in the interval contents of MOS scales in the range of 5 to 10 notes per octave. They ground this in an information theoretic model that sees scales as 'channels' through which some meaningful information is transmitted, without regard to the musical or cultural significance of the information itself, but instead attempting to quantify how the internal interval structure of the scale lends itself to differentiation: 'we do not know exactly what mysterious musical information is conveyed by the notes, but we do know that we want the notes to be spread out enough to avoid interference from one another so that listeners can decipher them correctly.'⁸⁴ Given these premises, their model predictably returns higher levels of ambiguity as scales converge on equal divisions of the octave, with generic interval classes becoming less distinct from one another. Conversely, scales with more distinct intervals

return lower levels of ambiguity, corresponding to a potential listener or musician's heightened ability to discern where they are within a scale's structure. One interesting result of their modelling highlights a tension between harmonic accuracy, in the sense of RTT, and scalar variety, with the implication that in some cases the two may not be compatible—sometimes we may have to choose between these desires.

Following on the developments in scalar construction suggested by Wilson and Erlich, as well as the work on Categorical Entropy by Battaglia and Pepper, I have designed a real-time pitch correction patch in Max (using the `retune~` object) that allows the user to define the scale for retuning by generating equal divisions or 2-dimensional MOS scales in real time, as well as providing a text entry field for scales otherwise designed. I hope to use this tool as a disorientation device in Ahmed's sense, with applications for my creative work and for ear training—the process of singing against the feedback of the retuned vocal is an experience of cognitive and physical dissonance, and I see in it not only potential for entrainment (i.e. ear training) to new scales, but also for creating work that puts the intonational struggle on display, or treats it dynamically within the processes of live or recorded music. I also see this tool holding potential for future research with others into the prospects of retraining internal melodic/scalar categories. In recent years, research in 'embodied music cognition' has highlighted the dynamic interrelation of embodied musical activity and perception/cognition, hypothesising that 'music perception automatically engages motor processes, or that body states/movements influence music perception'.⁸⁵ In a sense, this empirical research resonates with Ahmed's observations about the mutual and reciprocal formations of subjects, objects, concepts and spaces, cited earlier. However, relatively little research has been done on the reciprocal relationships of embodied musical action on pitch perception, particularly with regard to the voice—which might be observed as the preeminent tool for ear-training—and I see the use of this microtonal pitch correction tool as a possible resource. Finally, another application for the microtonal pitch correction patch would be to deploy it in online ensemble performances, either as a tool for disorientation in improvised music making, or to 'tune' groups of singers and instrumentalists to new perceptual categories. After all, as Farraj and Shumays assert, 'the *individual* practitioner inherits [intervals and scales] through tradition and cannot *individually* change them; they only change extremely gradually over time, and only by the unconscious activity of whole communities'.⁸⁶

Perhaps by developing new communities, even in our increasingly on-line world, we can explore these deviations from traditional resources together as communities who develop new (melodic) lines to follow.

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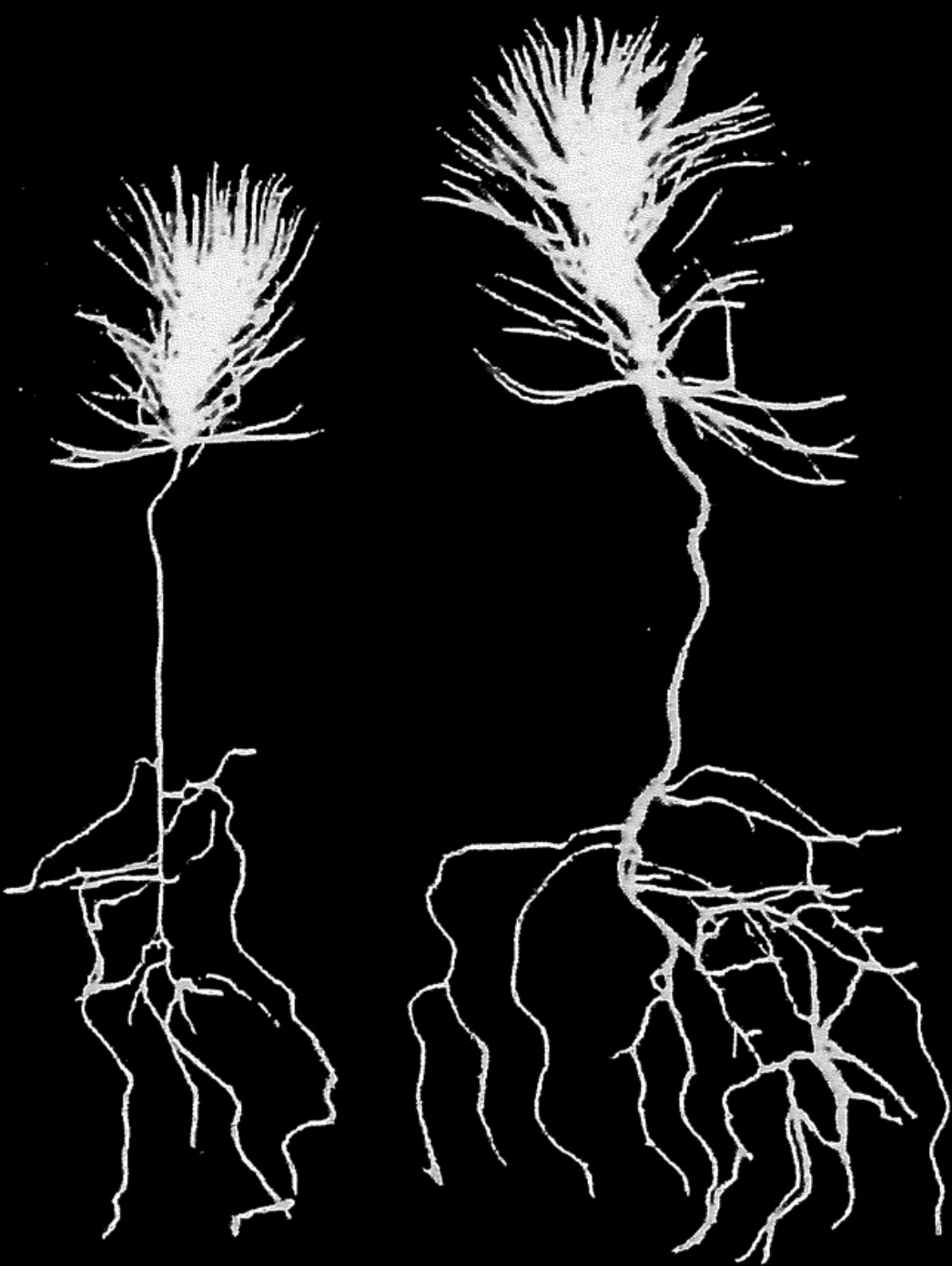
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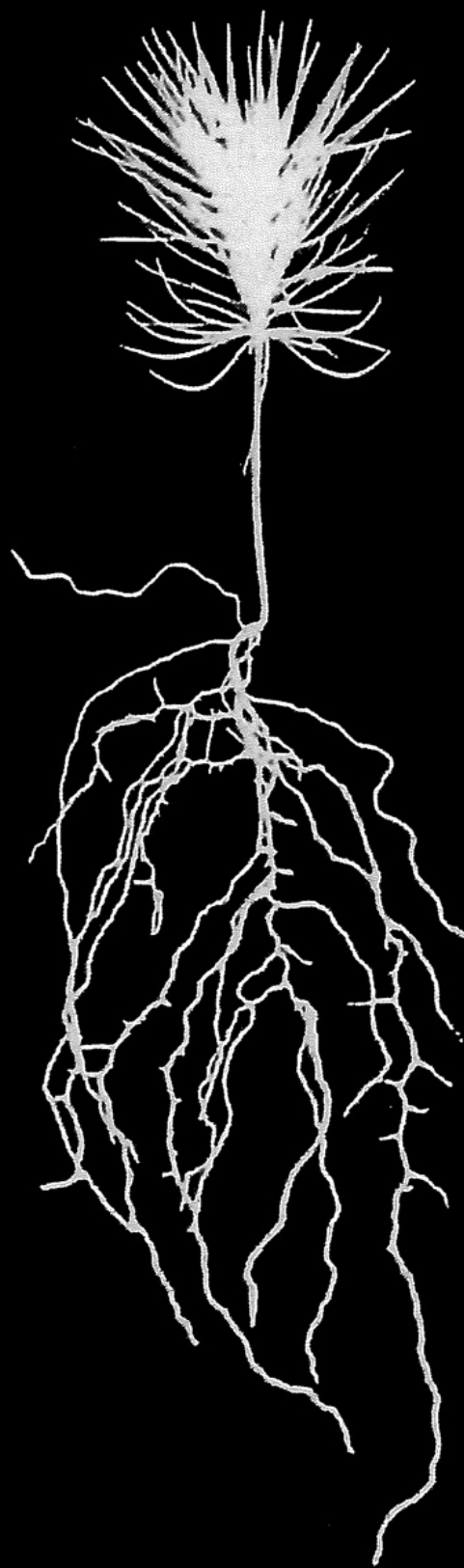
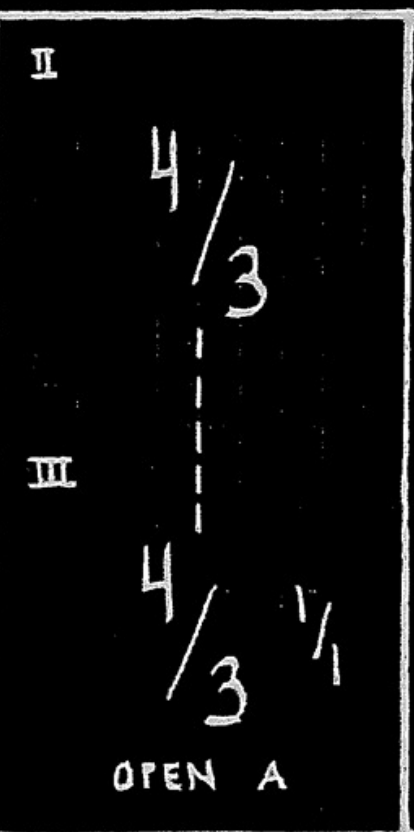
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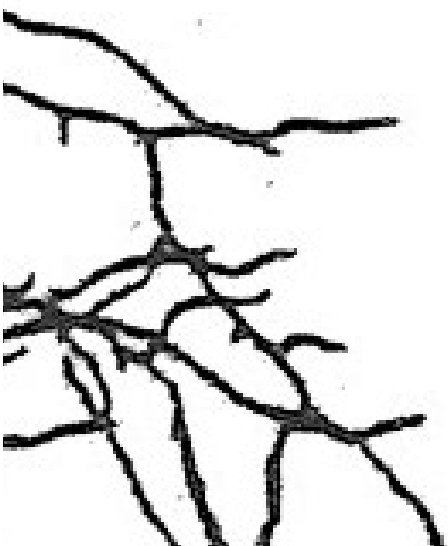
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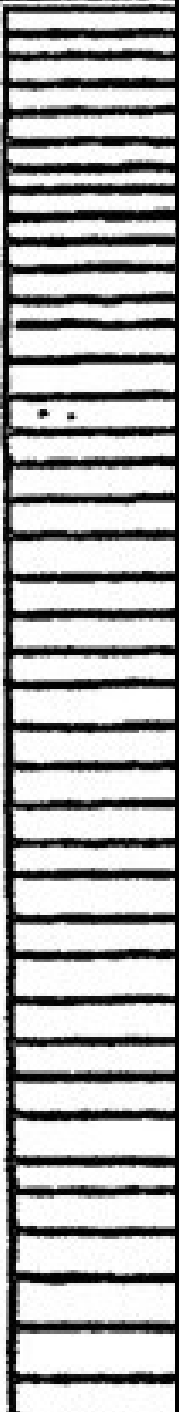
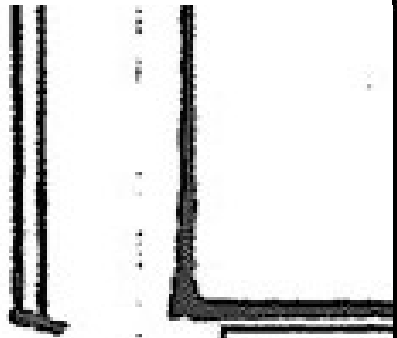
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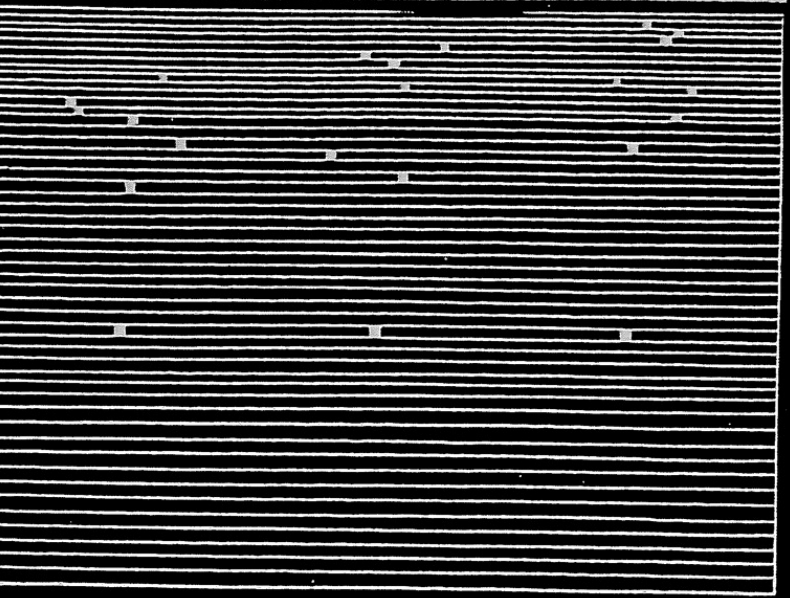
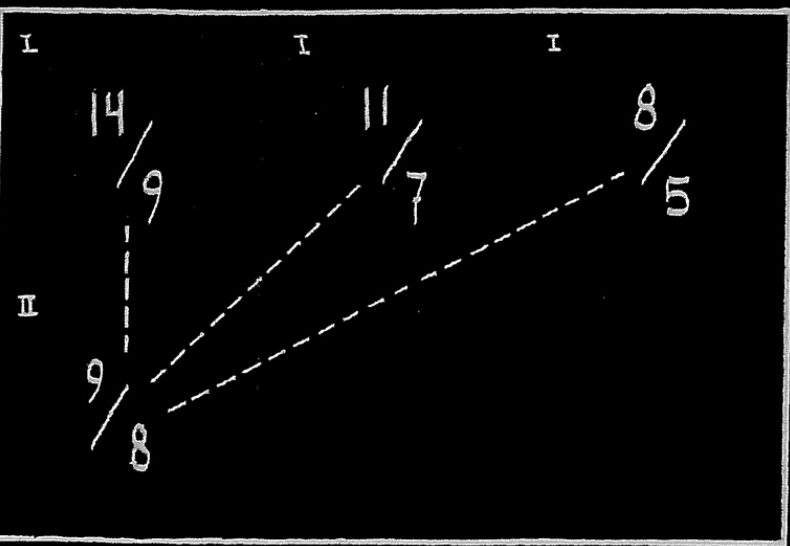




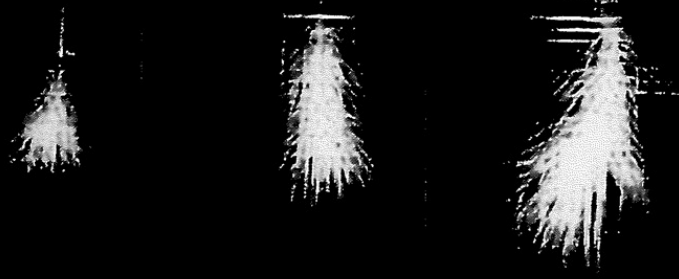
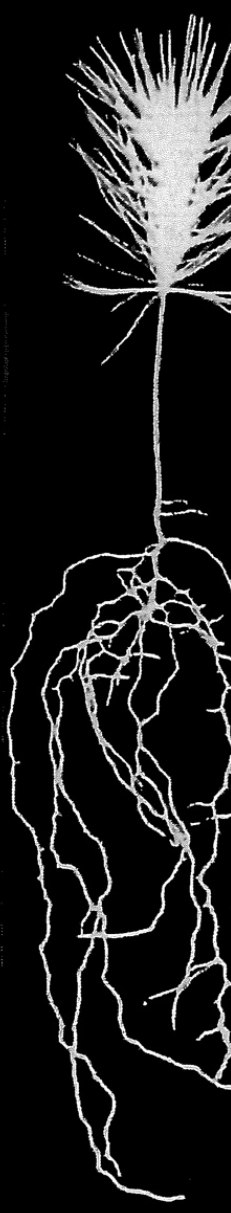


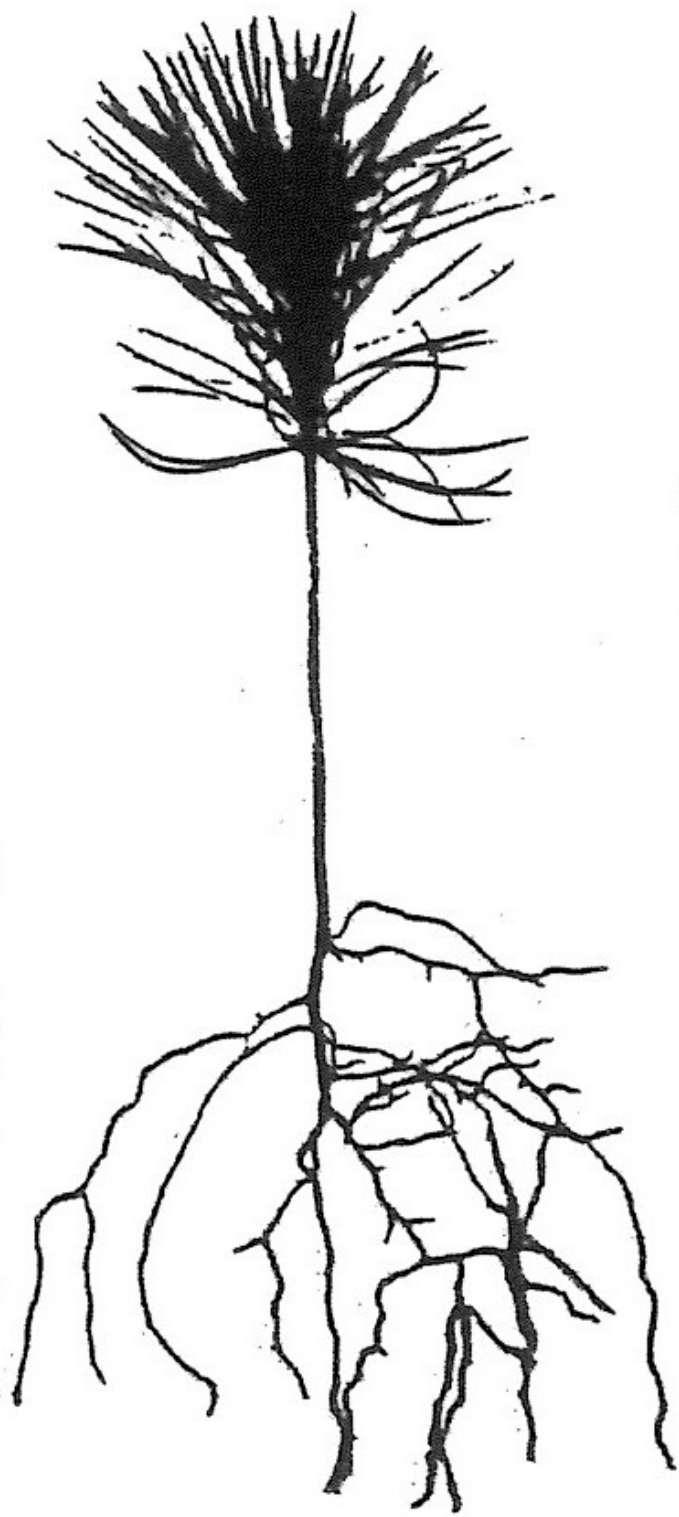
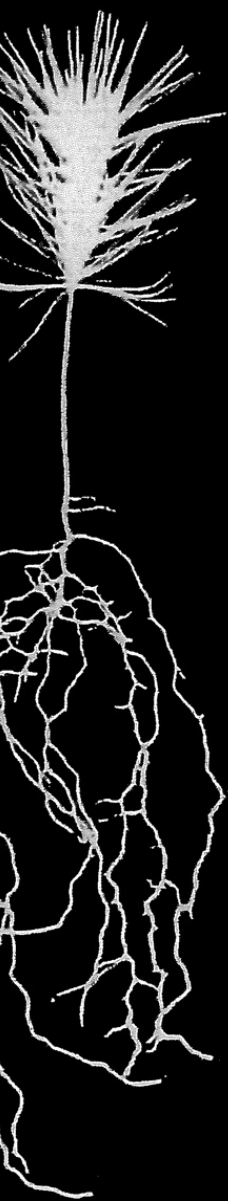
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Moe Louanjli

WATERSHED

**Thoughts from the Workshop
with Lucía Hinojosa Gaxiola:
Writing with The and Echo**

Between Space

**Slow, inhale, the chica said
Hmmm, the moro made instead
Skin warm like embraced bread
Steamy salt just spread**

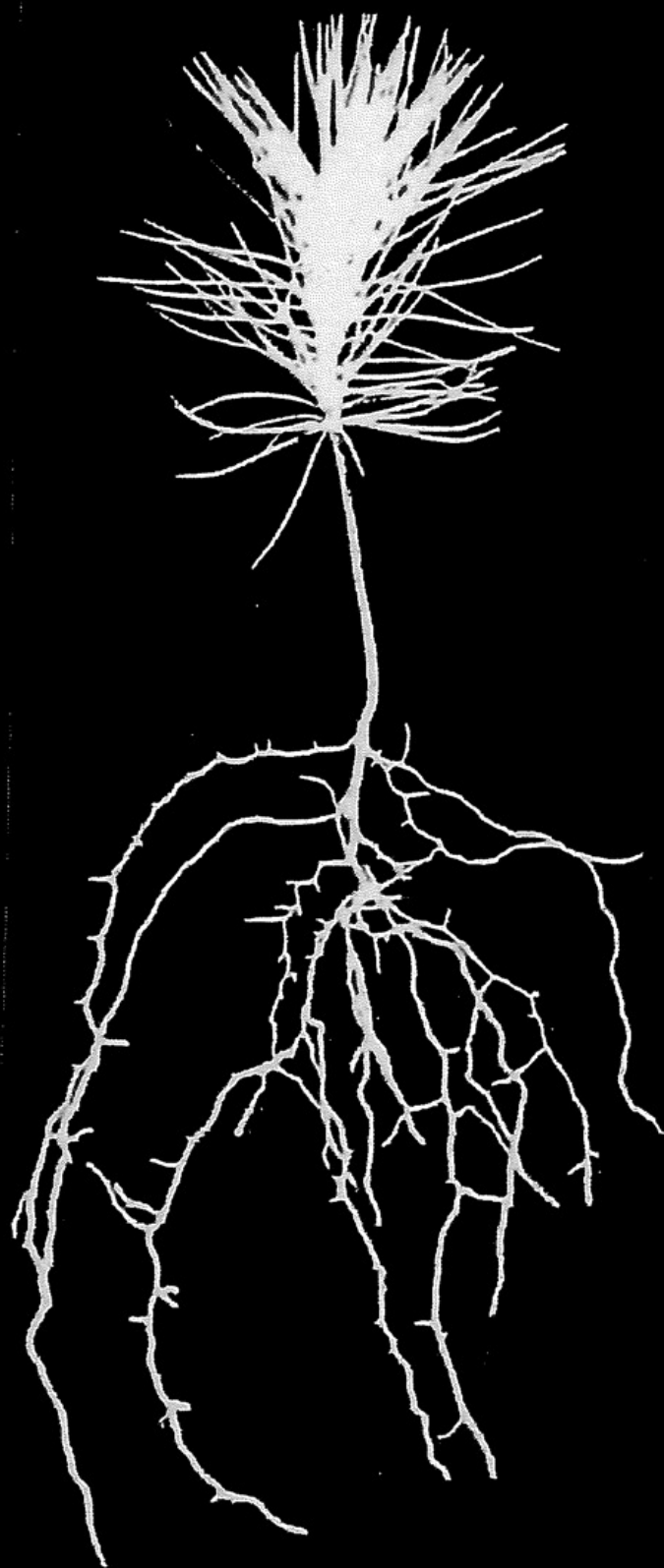
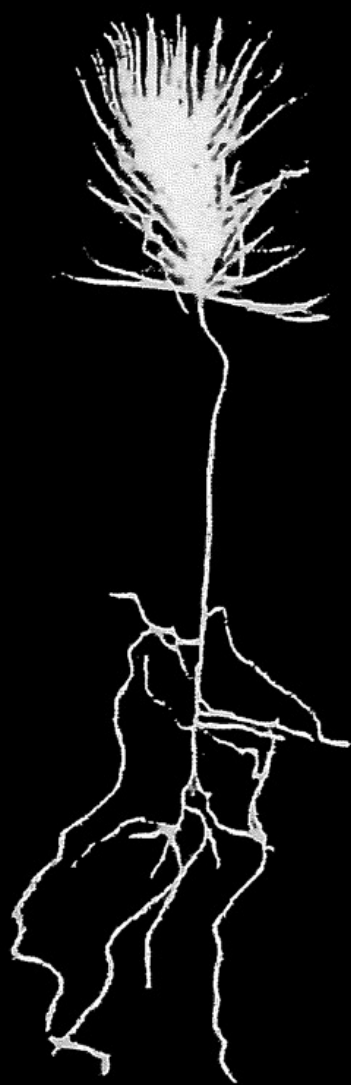
**Writing on a paper with letterhead
Feelings heavy, sinking lead
Suomi is not for the crossbred
It drains you, bucket in a watershed**

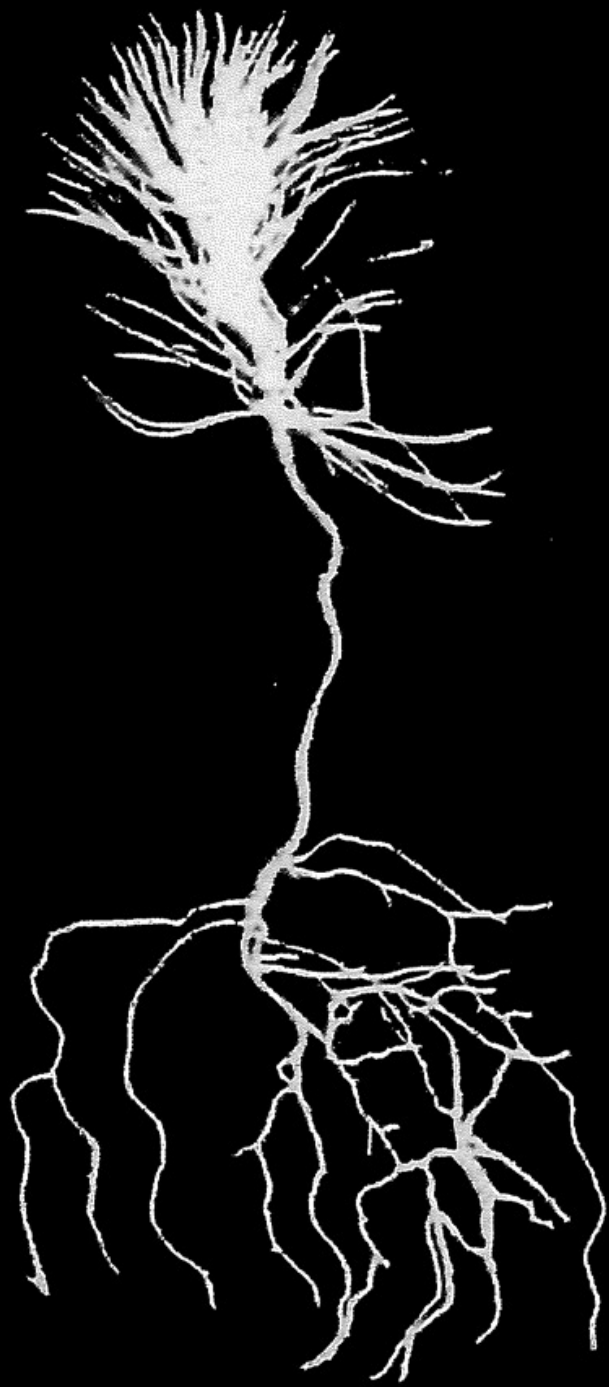
**Pen scratched 'til the ink bled
Words pour out, emotions fed
Confessions surface, fears are shed
Some truths remain unsaid**

**A spark among the fog arrayed
Pshhh, vapour from cascade
We're exposed, strangers, I'm afraid
No worries, distance still retained**

**Space between, respect is paid
Stones' echo in a roar played
Silent whispers softly swayed
In this warmth, some qualms allayed**

**Sorrows remembered, secrets we dread
Memories woven in a thick thread
Just so much in one's head
Another book not easily read**





II

III

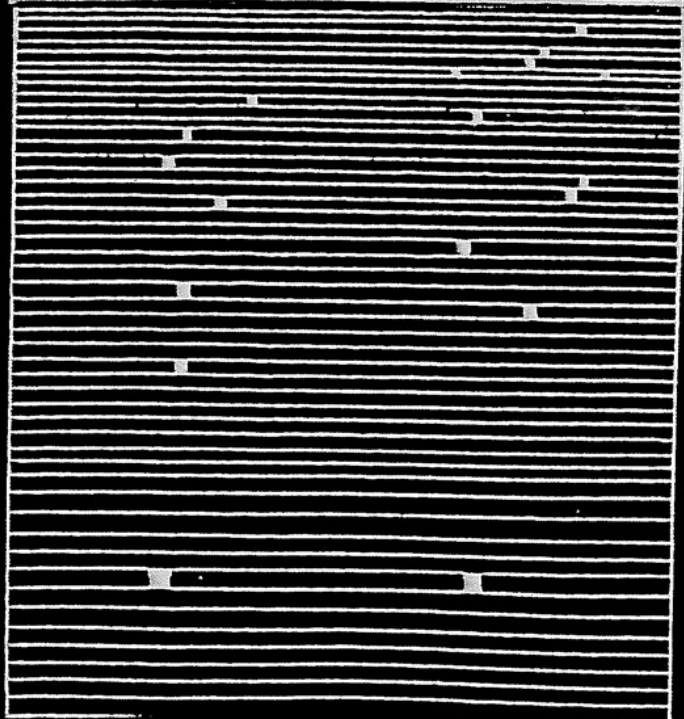
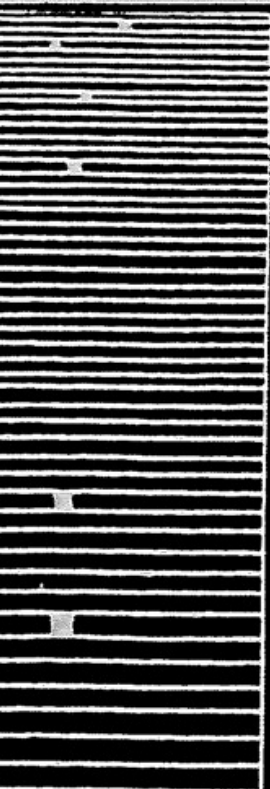
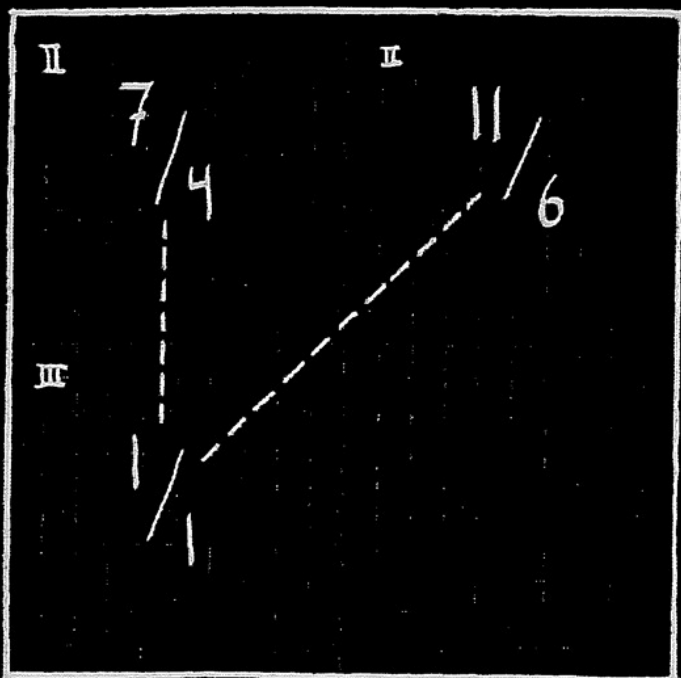
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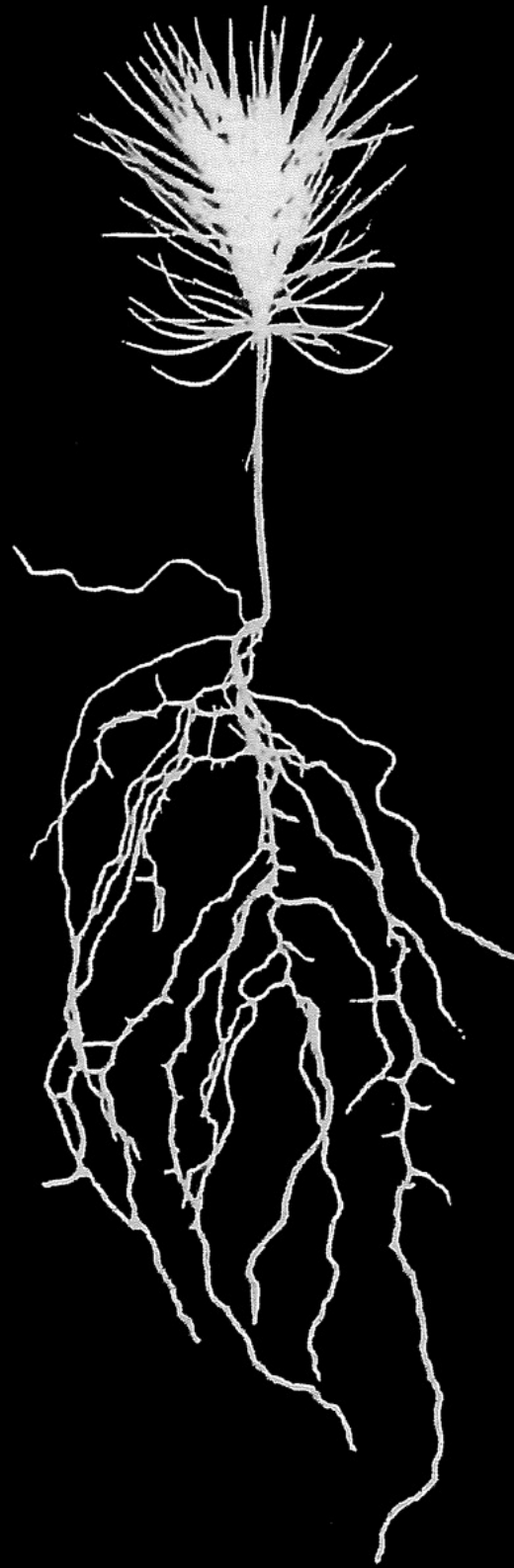
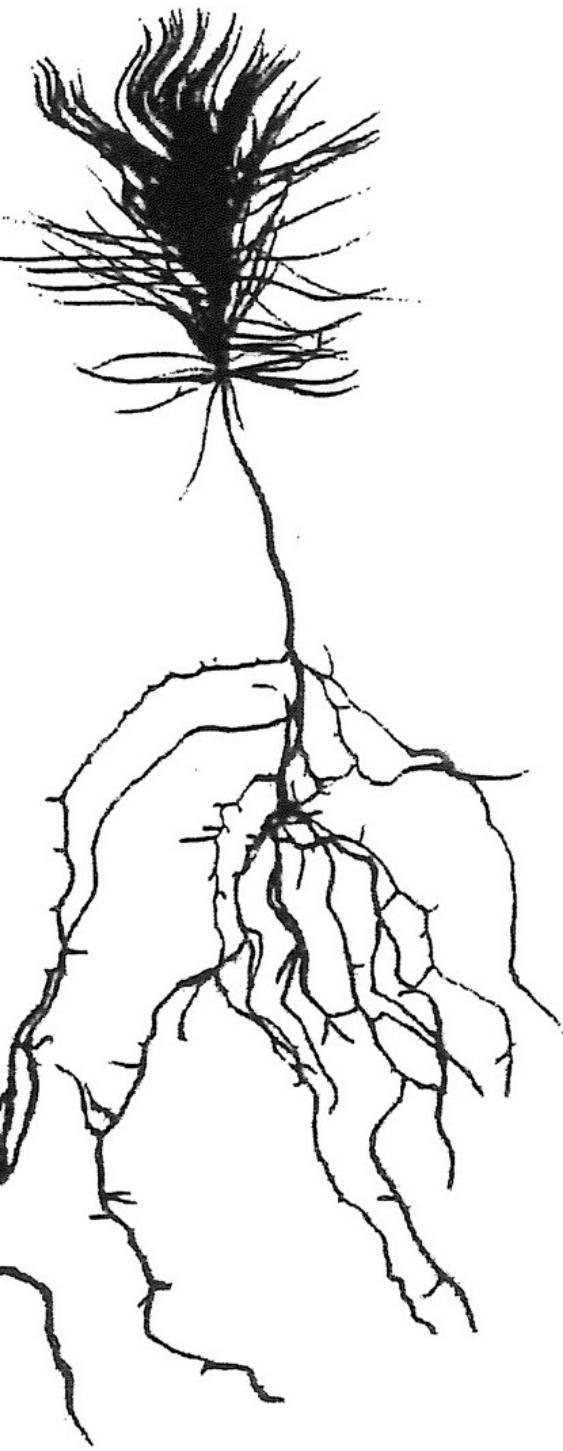


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PEN A





Acknowledgements

This project and this book would not have been possible without the loving guidance and support of everyone who participated in it.

Thank you!

Participants of the Microtonal Music Studios

I would like to thank all the artists and researchers who participated in the microtonal music studios project activities, the order is colorised only by the slight tint of being somewhat chronological: Nicolina Stylianou, Henrik Frisk, Timo Pyhälä, Markku Toikkanen, Teemu Mastovaara, Anna Sofia, Zhenhua Li, Hans-Gunter Lock, Gonzalo Muruaga, Marc Sabat, Anna Matveinen, Shinji Kanki, Diemo Schwarz, Dewa Alit, Jani Ruscica, Nicolas Kliwadenko, Mathijn den Duijf, Mathijs Leeuwis, Dario Lo Cicero, Mila Di Addario, Andrew Bentley, Juhani Liimamatainen, Suva, Tolgahan Cogulu, Andrus Kallastu, Marloes Van Son, Dirar Kalash, Sylvia Hinz, Laura Mehmeti, Juhani Nuorvala, Eija Kankaanranta, Martin Dahlström-Heuser, Paul Devens, Stéphane Clor, Lucía Hinojosa Gaxiola, Linda Sormin, Laura Naukkarinen (Launau), Oteanankanduro, Peter Wiegold, Irena Ruiz Perez, John C. Jansen, Idin Samini Mofakham, Sarah Cubarsi, Linda Svacinova, Xie Yuchi, Christa Wikstedt, Sebastian Ampuja, Henri Hytti, Hamid Keshvarpajuh, Kristine Tukre, Xenia Gogu, Loré Lixenberg, Jorge Diego Vasquez Salvago, Hamidreza Kashvarpajuh, Tareq Abboushi, Basak Senova, Elena Sorokina, Veli Kujala, Tommi Hyytinen, Juho Laitinen, Kraig Grady, Linda Yung, Tuuli Lindeberg, Petri Kumela, Susanne Kujala, Kari Ikonen, Alli Mankkinen, Aaro Tulkki, Julie Svacinova, Nikoloz Japaridze, Anderson Mirafzali, John Birch, Jussi Reijonen, Mieko Kanno, Demian Claudio Araya Lobos, Amalia Deorsola, Sami Abu Shumays, Colleen Gallagher, Orlando Zavala Galindo, Casey Hale, Henry Birdsey, David Fiucsynski, and Hidemi Akaiwa.

Participants in the Microtonal Music Studios Music Outside Keys and Cultures project Research and Study Program

2022-2023

Jarkko Räsänen, Miikka Lehto, Zuzu Zakaria, Alex Raitanen, Tugce Albayrak, Anna Hakula, Meriheini Luoto, Teemu Ruissalo, Natalie Hogue, Mateo Mena.

2023-2024

Noah Jordan, Dylan Rodgers, Nemat battah, Jacob Elkin, Melik Turunen, Ryo Sugiyama, Rebecca Minten, Stephen Webb, Lee Timjune.

2024-2025

Tomás Cabado, A Barnacle, Devina Boughton, Eugenie Chao, Robert Prakupovich, Moe Louanjli, Mark Reid, Dr Thokozani Mhlambi, Timo Viialainen, Haiyun Yu.

Activity for the year 2024/2025

25.05.2025 – lecture by Dr Thokozani Mhlambi on his microtonal practice combining traditional Zulu music with western classical tradition and instruments.

24.05.2025 – lecture performance by David Fiuczynski and Hidemi Aikawa on micro-Japan

19.05.2025 – workshop by David Fiuczynski on microtonal planet concept.

15.05.2025 – concert by David “Fuze” Fiuczynski, in collaboration with WHS Teatteri Union. With Anderson Mirafzall (bass), John Birch (drums) and Jussi Reijonen (oud and fretless electric guitar).

11.05.2025 – online talk by Ed Williams, Nicola Vicentino’s arciorgano and theory through the lens of queer theory.

13.05.2025 – workshop by David Fiucsynki on fretless electric guitar.

06.05.2025 – lecture-performance by Susanne Kujala, the microtonal organs of Musiikkitalo with examples played on the organs of Organo room and the main hall of Musiikkitalo.

04.05.2025 – concert by Microtonal String Quartet, Aaro Tulkki (violin), Nikoloz Japaridze (violin), Julie Svacinova (viola), and Alli Mankkinen (cello). Pieces by Marc Sabat and Joseph Haydn.

02.05.2025 – lecture-performance by Petri Kumela on the microtonal classical guitar.

29.04.2025 – lecture-performance by Tuuli Lindeberg on the singers perspective on performing and rehearsing microtonal music.

15.04.2025 – interview with conductor and founder of The Third Orchestra Peter Wiegold in London.

11.04.2025 – concert by Yellow Wasabi on combining contemporary electronics and visuals with traditional Chinese instruments.

25.03.2025 – lecture-performance by Tommi Hyytinen on the Microtonal French Horn.

23.03.2025 – workshop by Juho Laitinen on Tuning and Intoning: Microtonal Pedagogies.

21.03.2025 – lecture by Kraig Grady in his microtonal compositions and instruments.

13.03.2025 – lecture-performance by Veli Kujala on the quarter-tone accordion.

11.03.2025 – workshop by Marc Sabat for microtonal string quartet.

08.03.2025 – lecture-performance by Timo Viialainen: Electroacoustic Hurdy-Gurdy: playing and modifying the instrument.

05.03.2025 – concert by microtonal electric guitar quartet: Gon Muruaga, Lauri Hyvärinen, Mark Reid Bulatovic, and Timo Tuhkanen

04.03.2025 – workshop by Marc Sabat for microtonal string quartet.

01.03.2025 – concert by the microtonal trio Alli Mankkinen (cello), Sebastian Brenner (clarinet) and Leonardo Cubillo (oboe).

28.02.2025 – microtonal contrabass and violone concert by Lassi Kari,

pieces by various microtonal composers.

27.02.2025 – lecture-performance by Sebastian Dumitrescu on his new composition for lumatone Arrhythmia.

26.02.2025 – concert by Mark Reid Bulatovic, Linda Svacinova, Xie Yuchi, Christa Wikstedt, Sebastian Ampuja, Henri Hytti, Hamid Keshvarpajuh, Kristine Tukre. Pieces by various microtonal composers.

23.02.2025 – performance by Haiyun Yu: Sound of Waves

22.02.2025 – concert by Mark Reid Bulatovic and Devina Boughton, pieces by various microtonal composers.

21.02.2025 – improvised concert by Kalasatana (Robert Prakupovich and Hamidreza Kashvarpajuh)

20.02-09.03.2025 – Exhibition and Event Week, opening performance by Tomás Cabado.

17.11.2024 – seminar by Jorge Diego Vasquez Salvago on Latin American Microtonal Composers.

Activity for the year 2023/2024

08-09.06.2024 — workshop by Lucía Hinojosa Gaxiola: Writing with Echo and the Space Between at Myymälä2 gallery

09.06.2024 — in conversation with Timo Tuhkanen, Lucía Hinojosa Gaxiola, and Linda Sormin at Myymälä2 gallery

08.06.2024 — performance by Lucía Hinojosa Gaxiola at Myymälä2 gallery.

06.06.2024 — performance by Linda Sormin at Myymälä2 gallery

18.05.2024 — performance by Lucía Hinojosa Gaxiola at Myymälä2 gallery

18.05.2024 — performance by Tianjun Li: Today, Tomorrow, and the Tales of the Wind at Myymälä2 gallery

17.05.2024 — lecture performance and screening of new work for violin and video by Ryo Sugiyama at Myymälä2 gallery

17.05.2024 — lecture-performance by Dylan Rodgers: Transcending Scales, Exploring Intonation, Modulation and Melodic Movement in Arab Monal Theory at Myymälä2 gallery

16.05.2024 — concert by Stéphane Clor: Rhizome, at Myymälä2 gallery

08.04.2024 — lecture-performance by Juhani Nuorvala and Eija Kankaanranta: Kantele in Microtonal Music at Myymälä2 gallery

15.03.2024 — talk by Robert Prapakowicz: Thoughts on classification and categorization of microtone music techniques at Myymälä2 gallery

21.02.2024 — concert by Rebecca Minten and Laura Mehmeti at Myymälä2 gallery

13.02.2024 — talk by Hans-Gunter Lock: Bohlen-Pierce, Instruments and Tonal Possibilities at Myymälä2 gallery

10.12.2023 — talk by Dylan Rodgers: Tunings and Temperaments: Theory, Praxis and Problems at Myymälä2 gallery

26.11.2023 — concert by Andrus Kallastu: IKOSIDIFONIA for 22edo trio at Myymälä2 gallery

10.11.2023 — Marc Sabat open seminar at Myymälä2 gallery

03-09.11.2023 — Tolgahan Çoğulu masterclass and lecture-performance at Myymälä2 gallery.

Activity for the year 2022/2023:

31.03.2023 — Taksu: Evening of Experimental Balinese Music, Community Concert at Pikku-Huopalahden Youth community house.

26.03.2023 — Dewa Alit masterclass at Myymälä2 gallery

25.03.2023 — Diemo Schwarz live at Myymälä2 gallery

12.03.2023 — Shinji Kanki open seminar at Myymälä2 gallery

27.02.-05.03.2023 — Microtonal Music Studios Exhibition and Event Week at Myymälä2 gallery all students participating

05.03.2023 — Performances by Miikka Lehto, Teemu Ruissalo & Alex Rai-

tanen, and Mateo Mena & Anna Matveinen

03.03.2023 — Concert by Natalie Hogue

03.03.2023 — Workshop by Marc Sabat

02.03.2023 — Concert by Timo Tuhkanen & Gonzalo Muruaga

02.03.2023 — Workshop by Hans-Gunter Lock

01.03.2023 — Workshop by Natalie Hogue

28.02.2023 — Screening by visiting curator Zhenhua Li

27.02.2023 — Opening and communal music practice

21.11.-27.11.2022 — Microtonal Music Studios Exhibition and Event Week at Myymälä2 gallery all students participating

27.11.2022 — Concert by Teemu Mastovaara & Anna Sofia Kallio

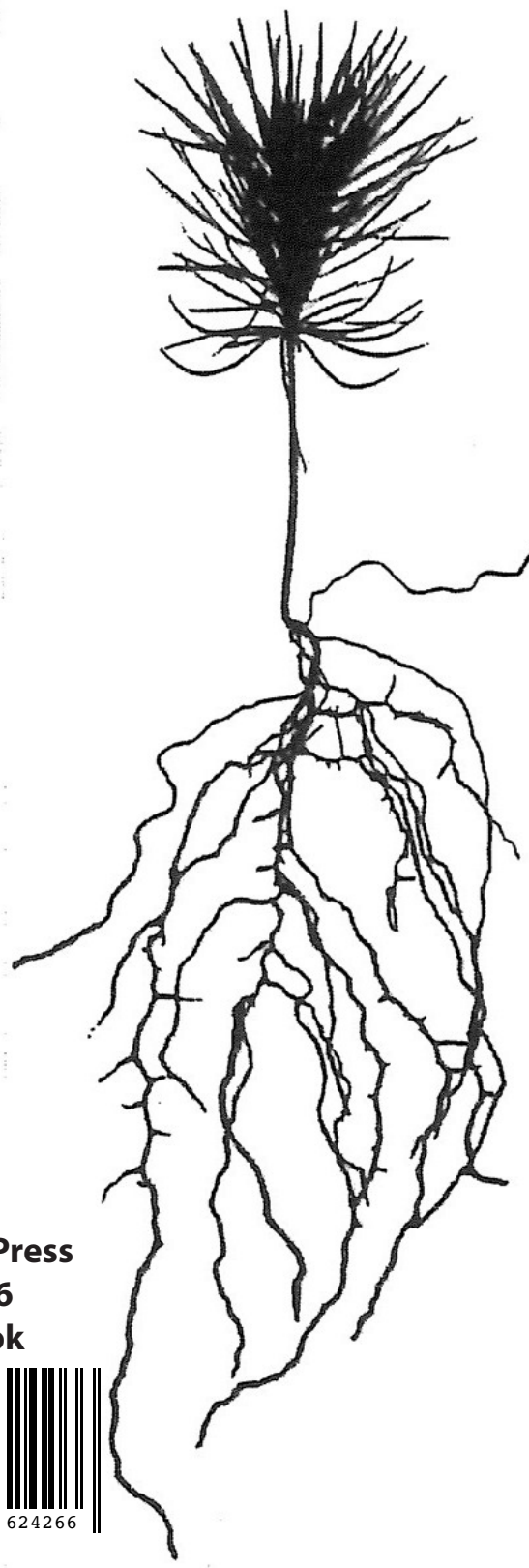
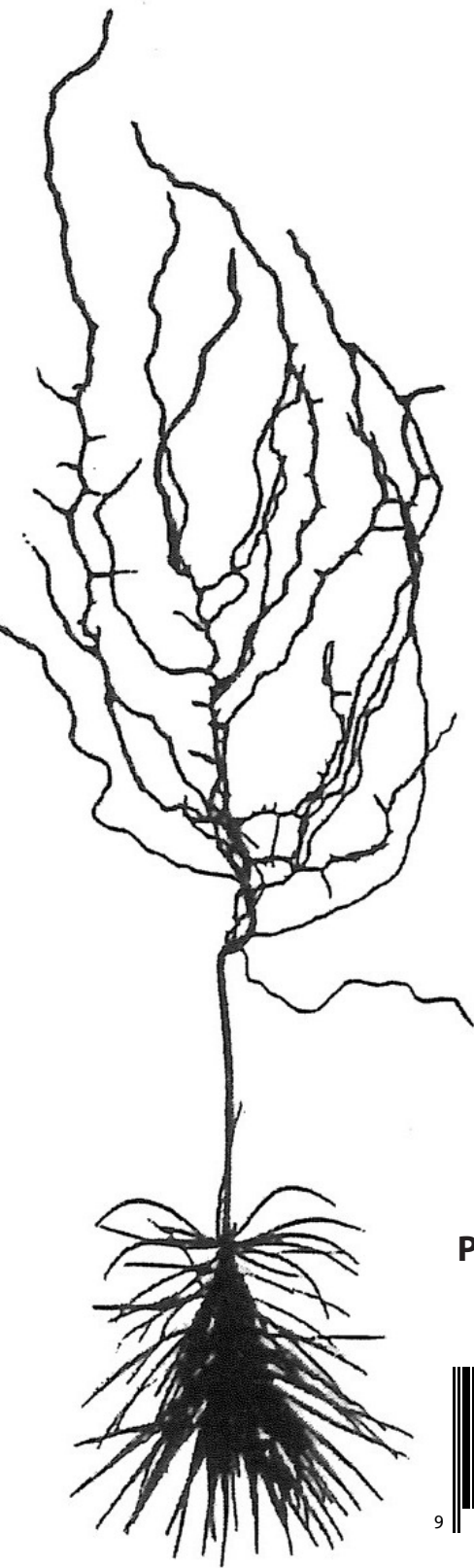
26.11.2022 — Concert by Nicolina Stylianou

24.11.2022 — Concert by Teemu Ruissalo

23.11.2022 — Concert by Timo Pyhälä & Markku Toikkanen

22.11.2022 — Talk: Why Tuning Matters?

21.11.2022 — Opening of exhibition



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