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Introduction to Microtonal Music

Microtonal music is one of the key components of the contemporary composer's language. The history of microtonal music is old and young at the same time. Some may dare to use this term when referring to the non-tempered system epoch of the sixteenth and seventeenth centuries, while others will say it begins in the twentieth century. Microtonal music was widely discussed in the last century in terms of theory, practice, composition, and performance. This paper raises numerous questions, focusing on the microtonal music pathway in the beginning of the twentieth century. What is microtonal music? What defines it? How did it originate and what were its influences during the century?

Microtonal music has always been a counterpoint to musical history. This phenomenon has never disappeared from the point of view of Western European music, but its role and mode of existence in the global context are subject to reassessment. Strengthening and domination of equal temperament in the eighteenth century was historically predetermined (Reinhard 2009). Although at all historical stages of the evolution of European music the formal equalization of tones in the octave did not correspond to the acoustic nature of sound, the relative "purity" of intervals over three centuries began to be perceived as the only representation of what was true and accurate. Within the equally tempered system, subsystems based on the form of subordination of sounds and their hierarchy appeared. *Microtonality* was formed first as the multiplication of twelve sounds in the octave by two, three, four and more, and later as a phenomenon of a new order, canceling out the equality of halftones. Thus, we face *metatonality*, a term coined by Claude Ballif (1924–2004), which combines the features of tonality with serialism and contains fixed and free sounds ("invariants *harmoniques*" and "variants *mélodiques*" as the composer described them) (Ballif and Galliari 1992, 30).

The idea of microtonal music attracted the attention of musicians, physicists, and acousticians from the second half of the nineteenth century. In an effort to expand the twelve-tone equal temperament, a fundamentally new approach to sound emerged. If in the pre-Bach epoch the plurality of temperaments was a natural phenomenon, then with the acquisition of a system in which each octave is divided into twelve mathematically equal intervals

(halftones), a new axis of coordinates was established. This division was absorbed and confirmed for centuries in creative practice. Microtonal music appeared as an alternative to the mainstream soundscape at a time of satiety. As a result of the historical disposition of the principles of sound organization in Western tradition, microtonal music was understood as a pitch system rather than a system of twelve-tone equal division. Further, in connection with the extensive practice of dividing a tone into parts, the term "microtone" appeared as contrary to "semitone."

In the last century, the twelve-tone equal temperament began to experience a crisis that continues to this day. Many composers agree that the system has almost exhausted its resources and today cannot be a creative tool, because the boundaries of this temperament have always been quite arbitrary. The interest in other temperaments in the middle of the nineteenth century was natural and was the result of scientific and technological progress in the fields of physics and acoustics. By this time, extensive works studying the features of musical sound were originated by Jean le Rond D'Alembert, Daniel Bernoulli, Joseph Fourier, Hermann von Helmholtz, etc. Parallel to experiments conducted in scientific laboratories, there was a music laboratory for elaboration of sound perspectives. As a result of growing dissatisfaction in the composer's environment with existing temperamental constraints, timid attempts appeared to split the tone into parts, introducing sounds into the music that are not included in the twelve-tone equal temperament system. At the same time, musical theorists focused on the notion of "temperament" and began to substantiate the principles of calculating the true height of sounds. By the beginning of the twentieth century, favorable conditions developed for the emergence of composers and theoreticians who transformed timid experiments into more convincing level. Some results were hidden, and some were in the shadow of more vivid mainstream phenomena and were thus marginal.

Regarding microtonal music, it is difficult to talk about an organized group of composers, physicists, or acousticians who would purposefully develop this phenomenon. Microtonal music has been created by composers, who acted alone. Examples of such composers include Ivan Wyschnegradsky in Paris, Alois Hába in the Czech Republic, Jörg Mager, Richard Stein and Willi Möllendorf in Germany, Georgy Rimsky-Korsakov, Arthur Lourie, and Arseny Avraamov in Russia.

Microtonal music has no clear historic beginning or end. It has always existed, hiding behind different concepts or terms, or having no definition at all. It is impossible to find the reference point for its emergence. Rather, it is

possible and it is necessary to talk about the new understanding and perception of this phenomenon that emerged at the beginning of the twentieth century. Microtonal music has become part of a phenomenon that the Spanish philosopher Miguel de Unamuno y Jugo calls "intrahistoria." History is a collection of transient and vanishing events and is the face of life, whereas there is always a parallel intrahistoria – an inconspicuous life with deep layers of memory. I suggest that microtonal music is submerged in such layers.

Microtonal music has never been at the forefront. Being parallel to the main artistic trends of the music of the twentieth century, it could not adhere to them, nor to new composition techniques. Microtonal music focused on the development of the primary element of sound as such.

1 Terminology

In recent years musicians and scientists have not arrived at a single definition for microtonal music. Surprisingly, the term is not discussed even in the most authoritative encyclopedic source, *The New Grove Dictionary of Music and Musicians*, which includes an article on "microtone" but not on "microtonal music." *Microtonal*, *microchromatic*, *microdimension*, *ultrachromatic*, *infrachromatic*, *ekmelic*, and *xenharmonic* music, among others, are all variants of the same phenomenon. Let us turn to each of these concepts.

The term *ekmelic music* has its origins in ancient musical theory. In Greek, *ekmelos* means "beyond the series," that is, those pitches that were not in Greek modes. When two professors, Franz Richter Herf and Rolf Maedel, started to systematize microtonal music within the framework of the Institute for Basic Music Research at the Mozarteum in Salzburg in 1970, they decided to name the results of their work *Ekmelic Music* (*Ekmelische Musik*) (Maedel and Herf 1972). Thus, at present the term is associated with works in which the composer uses new sounds compared to the twelve-tone temperament. One could also find a seventy-two-tone system under this definition, where each step is equal to $16^2/_3$ cents whereas a semitone is equal to 100 cents. As their research has shown, our hearing is capable of perceiving a difference of, at minimum, five cents. Furthermore, the originators of this term insist that it unites 24, 36 and 72-tone temperaments, as well as other musical modes, including Arabian or Indian music, and the non-equal temperament.

The term *ultrachromatic music* arose in the works of Russian composer and theorist Arseny Avraamov and was supported by the writings of Ivan

Wyschnegradsky. Ultrachromatism, as Avraamov (after Leonid Sabaneev) stated, signifies a break with the modern system of tones, and a deviation from it towards more subtle, diverse (and, undoubtedly, more harmonious) chords, as if materializing or concretizing the natural row of numbers in their relations. The system of equal temperament negation turns into two points (Avraamov 1916, 157):

a) the restoration of exact tone relations (return to the natural tuning) at the base of the tone-row and
b) the expansion of its 'effective' limits by inclusion of tones corresponding to higher-order prime numbers (seven, eleven, thirteen, etc.).

Thanks to Ivan Wyschnegradsky, who lived in Paris from 1920 and often visited Germany, this term was used even outside Russian-language literature and is still in use with regards to "super-chromatic" scales. Wyschnegradsky proposed that ultrachromatics and infrachromatics be distinguished, dividing them according to the following principle: ultrachromatics contained systems in which the shortest distance between adjacent steps was less than a semitone, and infrachromatics denoted an interval larger than a semitone.

In 1963 American composer, inventor and theorist Ivor Darreg proposed the term *xenharmony* for music that sounds different from the music written in a twelve-tone temperament. This word comes from the Greek *xenia* (open, hospitable) and *xenos* (stranger). The xenharmonic system includes five-, seven- and eleven-tone temperaments (and further higher-numbered divisions) and expanded natural tuning. This term arose in contrast to "microtonal music," according to the creator, and was often associated with quarter-tone music and equal temperaments.

The term *microdimensional music* (from the English word dimension, applicable in mathematics and physics) is used by most researchers to denote not only the smallest distance between tones but also to describe substructures that extend to all the parameters of the organization of musical texture.

Finally, we have come to two categories that have become the most commonly used in research literature lately.

Microchromatic music is a term developed by Russian theorist Yuri Kholopov in works on harmony, a counterbalance to "microtonal music." In the article "Micro and Consequences," Kholopov discusses the imperfection of the term "microtonal," which has become widespread in the German language as well

as in global literature. The author is concerned with the deep meanings of the concept, which lie in the composite structure of the word: "micro" and "tone." On the one hand, the term does not stand up to criticism from the point of view of its possible connection with the definitions of mode, as a kind of tonic of the lowest order. On the other hand, the term microtone refers us to "micro-tonality," which has no relation to tonality itself. The confusion came from the literal translation from the German *Mikrotonale musik* as "microtonal music," although in German the noun *Tone* means "sound" (Kholopov 2000, 27). Kholopov, however, does not explain the advantages of the term, which he used widely to describe non-European modes or Greek music and for any temperament except the twelve-tone one. Kholopov said:

> Microchromatics stands on the verge of refined tonal and sonorous music. (Kholopov 2009, 127)

This idea of sonority is picked up in the research by Russian musicologist Elena Polunina, who characterizes the microchromatics of the late Renaissance as an acoustic form "through which the functional musical organization of musical art is expressed and developed in the given historical period" (Polunina 2010, 11). Polunina indicates two types of microchromatics: the category of the type (in determination of steps with a distance less than a semitone) and the result of zone intonation (the term by Russian scientist Nikolay Garbuzov).

Until now, there is no clear definition for the concept of microtonal music. Some researchers are inclined to attribute to this phenomenon all unequal tempered systems, respectively, all music of the pre-Bach era and experiences of the twentieth and twenty-first centuries with sound – aleatoric or neofolk music as examples. Others intentionally state that the music of the past is built on other laws and is not a reflection of the idea of microtonal sound. The only thing that all researchers agree on is the definition of a microtone as an interval or distance between neighboring sounds, other (less or more) than a semitone of a twelve-tone equal temperament.

So what is microtonal music?

In the conditions of modern music, when the axis of coordinates is still a twelve-tone equal temperament, under microtonal music we will understand musical systems based on those other than the twelve-tone temperament. It is important to take into account that the emphasis in this definition is on the presence of a *system* of organizing sounds.

The word *microtone* itself contains main the directions. Firstly, it is a "tone" as a characteristic of the genus of the phenomenon. This is a tone as a source, source material or tone, as a sounding substance. Next to it is the concrete part – "micro." In connection with this concept, many additional definitions appear, in particular "microscopic," which often arises in articles and reviews. Since microtonal music has passed several stages of mastering a musical texture, I would conditionally refer the first experiments in this direction to this phenomenon, timidly introducing microtones into the generally accepted system.

2 Fragmentation in the art of the early twentieth century

The Russian futurist team led by Mikhail Matyushin, Alexei Kruchenykh, and Kazimir Malevich, warned:

> The crackling after an explosion and the cutting of scarecrows will stir up the coming year of art! (Matyushin et al. 1999, 233)

Ivan Wyschnegradsky, who heralded the future importance of microtonality, stated:

> Now we are on the eve of the greatest musical revolution of the introduction of a quarter of the tones into music. (Wyschnegradsky 1992, 138)

Discussing the phenomenon of microtonal music as a whole, it is necessary to analyze the numerous prerequisites for the idea of splitting sound into micro-components at the beginning of the twentieth century, to reveal the general cultural and social processes that have become the impetus for its development and dissemination, and, finally, to pay attention to the parallel experiences of splitting the whole into parts.

The idea of splitting the whole into parts first clearly manifested itself in the art of the 1900s–1920s. In Russia it was modern to the avant-garde currents and was their component. In Europe, the idea was actively developed by "modernists" – all who tried to move away from tradition. Without claiming to be the main representative of the era, the principle of division, splitting, stratification, or fragmentation allowed science and art to branch out. Since artistic and scientific results based on this principle were achieved rapidly and in areas disparate from each other, it is hardly possible to speak about their continuity. Rather, they were the result of the so-called *Zeitgeist* – the spirit of the time.

Nikolay Berdyayev drew attention to the distinctive fascination with division and fragmentation in a 1917 public lecture called *The Crisis of Art:*

> The corporeal world is shaking in its foundations. (Berdyayev 2006, 361)

Using Pablo Picasso as an example, the philosopher stated that: a "mysterious cosmic spreading" was taking place, the analytical dismemberment that artists used in order to explore the skeleton of things and hidden solid forms behind the frame. Berdyaev called this phenomenon "dematerialization, the disembodiment of painting." (Berdyayev 2006, 361)

The process of fragmentation also affected two types of art, which were often combined into a synthetic whole: literature and music. Here artists searched for special principles of text formation. There was a separation of phoneme and sound, and they were fragmented and dissected. Poets and musicians turned to science to find an instrument to understand the world and matter. They drew inspiration from science; they enthusiastically split the whole into pieces.

In poetry the tendency to split a word into phonemes was clearly traced, and on the basis of sound parameters they used phonemic combinatorics. In music, on the contrary, the process of searching for the shortest distance between two adjacent semitones led to a deepening of the structure of sound as such. This is how artists sought out radical ways to find "free art." In poetry and music the process of fragmentation was not confined to the phoneme and sound. In music, the integrity of construction is split into parts, like the dissection of an object and space in painting. The composition is divided into tiny fragments; there is no music stave as such, and only sound, splashes, or spatters remain. Such, for example, are *Forms in the Air* by the Russian futurist composer Arthur Lourie, first performed in 1915.

In the 1910–1920s, the idea of using an overtone sound series for the purpose of forming new tuning systems was born. The idea was picked up by composers who were interested in the structure of sound, those who listened to harmonics, overtones, and different-frequency formations. At the origins of the phenomenon, which in the 1970s acquired the name spectral music, were composers, music theorists, and acousticians of the beginning of the twentieth century – all who developed questions of temperament. The new understanding also received the term caesura, which originates from the Latin meaning "dissection" and has been recategorized from an applied tool to a structure and text-formation tool.

In 1921, in one of his poems, Andrey Bely described events accompanying the futuristic explosion:

> "The world – will burst!"
> Exploding, Friedrich Nietzsche said…
>
> The world's been bursting in Curie's experiments
> As an atomic bomb exploding
> Onto electron streams
> Like an unconsummated hecatomb;
> I am – a son of ether, Man,
> Down from the superterrestrial path
> I coil world after world, age after age
> With my ethereal royal purple.
>
> Andrey Bely, *The First Encounter* (1921)

According to Bely, a person's mind was overflowing with physics: Moscow University Professor Umov applied what he called philosophical "perplexity" to the natural laws of physics. Umov tried to discover the mystery of the beginning of the world, and Rutherford and Soddy formulated the theory of atomic disintegration. The energy stored in the motion of atoms and the strength of particles was important for them. Such energy of sound, world, and object in art atoms forced artists again and again to work on examining their internal selves.

"Everything is analytically decomposing and dividing," Russian philosopher Nikolay Berdyayev in his article "The crisis of the arts" stated. The rapid development of mathematics, physics, chemistry, and microbiology in the 1900s marked a triumph of science. Positivist feelings in the creative environment of that time assigned the natural-scientific method a potential role in the future of artistic development. Musicians, artists, and poets addressed science in order to find a common ground. Their creation was "radioactive," as the poet Sergey Bobrov stated. According to his opinion and that of many other poets, their works consisted of "inseparable explosions" (Bobrov 1999, 202–3).

The consideration of such processes in literature and music related to the splitting of the whole can only become the first approximation to an analysis of the general trend for different sciences and arts of this epoch. Let us observe some characteristic tendencies that allow us to speak about parallels and about general and different features in the aesthetics of fragmentation.

Many artists, poets, and musicians were in the mainstream of the idea of the convergence of the arts. Russian futurist writer Boris Kushner, for example, in his work "On the Sonic Side of Poetic Speech," published in 1916, created categories for the sounds in poetic material: sonic and discordant; tonic and detonic, analyzing only consonant sounds. In 1925 his colleague, poet and theorist Mikhail Malishevsky made an attempt to analyze poetry in terms of rhythm, meter, strength of the syllable, length of syllables, and syllable height. Malishevsky used a term from ancient prosody, *mora*, which denotes syllable weight, that is, stress or timing. Some may attribute to it the time taken to pronounce a short syllable. It is symbolic that in the same year the collection of articles *De musica* included one by Georgy Rimsky-Korsakov, a pioneer of microtonal music in Russia, entitled "The Justification of the Quarter-tone Music System" in which *mora* was chosen as the definition of the smallest distance between neighboring tones (Rimsky-Korsakov 1925).

In the 1900–1920s the manifesto became separated from creativity. From then on, two strategies worked: theory (verbal statements, declarations, written pamphlets, manifestos) and practice (creative works). This process of separation showed the intrinsic value of each alone. Artists sharpened the tip of their pen, rehearsed the slashing of expressions, and tried unpredictable ideas. Manifestoes went ahead, while practice appeared *post factum*. Poet and futurist Benedikt Livshits recalls:

> Typing... poems in *A Slap in the Face of Public Taste* Mayakovsky made the same mistake as I did by putting things in the fighting program book in which an old symbolist's hops had not yet been fermented... (Livshits 1991, 125)

In other words, intuition was much ahead of erudition, as Arseny Avraamov noted (Avraamov 1917, 148). This correlation of theoretical theses and artistic practices generated attempts to reorganize creative systems.

The principles for the organization of the whole throughout the centuries existed in each of the arts, and adherents to the new ways saw signs of "consciousness enslavement" in such traditions. The object of attack on traditional poetry was all the parameters of versification: the text, its parts, rows, and boundaries of given segments. In the new poetry, the division into measures was often leveled, and the fundamentals of versification were subjected to careful analysis and modernization. There was no element that innovation would not touch. According to Roman Jakobson, a Russian-American linguist and literary theorist:

> [Art] destroys such truths that have never been expressed by anyone, were not emphasized, because they seemed self-evident. (Jakobson 2009, 410)

In turn, the reform instituted by Andreas Werckmeister, a German organist and music theorist, in music was the starting point for the study of the basic elements of temperament. The new system was initially closed by twelve mathematically equal steps in the octave. It is this equality that became an obstacle to the expansion of the system, to the appearance of endless rows of tonalities:

> The 'Faustian' spirit in music was always eager for new sounds, and then was temporarily enslaved in a closed twelve-tone system and was temporarily satisfied with it [...] now it feels crowded. (Wyschnegradsky 1992, 138)

Similar systems in literature and music formed a basis, which was built up by facultative elements in accordance with the arrival of increasing currents and trends. It is the "whole" which is the totality of all its constituent parts that has become the creative and theoretical target of musicians and writers. Futurists saw the objective properties of things as one of the sources for the idea of fragmentation. Russian poet and artist David Burlyuk, appealing to children's philosophy, pointed out that:

> [C]hildren do not like whole objects; their parts (fragments) give them a complete idea of the whole. (Burlyuk 1930)

The smallest unit, obtained as a result of division, became a primary language (elements, sounds, letters). The whole was treated as a secondary substance, derived from basic being (primary elements) by poets and musicians (Burlyuk 1930). The whole in art was not perceived as an abstract entity, but as a concrete object that could be subjected to practical and theoretical research. Artists approached it with different analytical tools. Since most manifestos were written by writers and poets, it is necessary to trace some of the most characteristic methods of fragmentation and the model of constructing the whole on this basis.

The word (as a unit of poetic text) and sound (as a unit of the musical text) were studied with the aid of an auxiliary system, an artificially constructed structural model. The purpose of such analytic decomposition was to search for the criteria of a new art, an attempt to express them with the "language of mathematical formulas" (Livshits 1991, 114) and the

disclosure of patterns subordinate to human logic (Avraamov 1917, 146). The objects of research were considered in the context of their general structure or mechanism of functioning and were subjected to "strict scientific analysis" (Avraamov 1917, 146). Let us consider the options for usage of such tools in a more detailed way by looking at Russian literature and experience.

1. In literature, the word is equated with a physical body. Russian philosopher Pavel Florensky proposed that the body be considered an external form of the word. Various properties of the real object were applied to it. First, without the body the inherent individual characteristics would disappear from the word; second, the body is the primary element given initially outside any conditions; and further, without the body, the full functioning of the word is impossible, and if it is limited to narrow limits, "its life force … only molders" (Florensky 2009, 48). On the contrary, the inner form of the word is intangible and constantly updating. It, according to Florensky, should consist of atoms. The philosopher speaks of the trichotomous structure of the word, representing it as circles, among which the phoneme is the main nucleus, passing into the morpheme, and after it into the sememe (Florensky 2009, 48).
2. Another category of concepts is connected with the definition by Russian futurist poet Velimir Khlebnikov of the whole as a molecule consisting of atoms (letters, sounds): the atom of the text, as the smallest part, which is the bearer of its properties and the atom of judgments, that is, a primary element of the concept or notion, of an object containing the connection, the subject, the predicate. As Mayakovsky observed, Khlebnikov created the "periodic system of the word" (Mayakovsky 1959, 25). He advocated the necessity and viability of new words and the inevitability of their appearance.
3. A scheme similar to Khlebnikov's was developed by Andrey Bely. He reflected on what the art work is and what its coordinate system is. In his theory, the finished poetic text is an organism in which the brain is the thought itself, the nerves are experiences, breathing is the assonance and harmonic combinations of the vowels, the glands are gradation of the vowels, and the connective material is sound texture (Bely 1917, 178).
4. In manifestos, there is also another important concept, the "grain." It occurs in different contexts, but more often it means sounds as "the seeds of the tongue." In this connection, a whole system of agro-literary relations arises: "word seeds" as elements of the alphabet, from which

> a whole variety of words comes, or "sower of languages" as an abstract mechanism that should "fill a palm with the twenty-eight sounds of the alphabet." (Khlebnikov 1999, 63) The entire system goes back to an attempt to recreate a mechanism of any living organism structure on literary grounds, an attempt to acquire a new principle of word formation ("to extract a fruitful grain from the word"), which could be "let through the world," and design word systems by analogy with the laws of Dmitry Mendeleev and Henry Moseley (Khlebnikov 1999, 63).

In addition to mathematical, chemical, and biological analogies of the structure of the word, they developed rules for word formation. The most important features of creativity in the 1910s were stated by Mayakovsky in his obituary of Khlebnikov in 1921. They can be formulated as an algorithm method and with "infinite variance." The first part of the formula represents a model where the whole and parts were constructed according to a chosen pattern. It is quite typical to see instructions from Khlebnikov himself:

> Reading, he broke off sometimes in mid-sentence and simply pointed out: 'and so on.' (Mayakovsky 1959, 24)

Not only the unit was subjected to division and distortion. Poets, painters and musicians reviewed and reconstructed the notion of the work model, its composition. They attributed a new role to us, making it a part of general disintegration process. "After reading, tear it up!" – Alexei Kruchenykh and Velimir Khlebnikov advised readers. This appeal is not only a protest against the "eternal" in general. Another important thing is that a potential reader will be able to extract from the book the method of constructing it and the principle of word formation, and then he or she will join the word-creation process (Kruchenykh and Khlebnikov 1999, 49).

In 1910s and 1920s they also changed strategies of the reconstruction of the whole fragmented into parts. Poet Nikolay Burlyuk believes that "the word and the letter (sound) are only random categories of the indivisible elements." (Burlyuk 1999, 58) Burliuk reflects on the boundaries of word-making, on criteria for the beauty of a word and for resources of its formation. The poet wrote:

> Should the creation of the word come from the root or accidentally? (Burlyuk 1999, 57)

He sought to develop a new, common for all, algorithm for the configuration of the fragmented word, and makes a choice in favor of aesthetics random, because "the root word has less future" (Burlyuk 1999, 58).

3 Evolution of auditory sensations

The idea of fragmentation arose largely as a result of special attention to the "word as such,"[1] to the sound as such, that is, to the unit of the text. Let us focus on sound and its philosophical shift. This is how we go back to Debussy's music, who from the 1880s became a symbol of a new attitude towards sound and emerging sonoristics. The song *Mandoline* (1884) is indicative. In the introduction and conclusion of this work the composer uses only one note, g^1, imitating fading sound, the standing vibration of the string. Debussy shows a full dynamic scale from interrupted silence tone to barely audible sound. Due to the lower-octave grace note, which precedes fermata sound, the pedal generates a whole spectrum of sound, well auditioned in this context. Thus, creative and theoretical research, listening to the nature of sounding body, and attention to sounds ran parallel to the process of developing the structure of sound as such. It is interesting that the idea of analysis and its implementation applies only to the beginning of the nineteenth century.

Jean Baptiste Joseph Fourier (1768–1830), a French mathematician and physicist, founded a theory of harmonic analysis. His discoveries were preceded by those of Jean le Rond d'Alembert, who was known for his works in the exact sciences as well as for his philosophical works. In 1747, he founded the mathematical expression of wave processes, and in 1753 the Swiss scientist Daniel Bernoulli, one of the developers of mathematical physics, put forward the first version of the division of each movement of the string as a sum of elementary sinusoidal oscillations. This was the impetus for the development of Fourier's theory of the harmonic analysis of sound.

The Fourier analysis made it possible to extract the physical characteristics of any continuous sound signal. The sound was perceived not as an atom, but as a fractional whole. The signal was deconstructed into parts – a series of harmonics – and the sound was thus represented through a mathematical formula.[2] The discovery led to the understanding of *sound* as a working material for composers. It was a process that attracted those creators who developed

1 A futurist declaration.

2 A more detailed description of Furie's method could be found in Prestini 2004.

microtonal music, and later, spectral music, who made this method the basis of compositional technique.

No research or history of physics and acoustics could overlook the importance of German physicist Hermann von Helmholtz (1821–1894), who was engaged in physical research of the sound structure. He and Georg Simon Ohm had the idea of applying Fourier's analytical method to sound as such, which is described in the monumental work by Helmholtz *On the Sensation of Tone as a Physiological Basis for the Theory of Music* (1863).

Experiments in the field of temperament relied on the achievement of technical progress. The invention of instruments fundamentally changed the consciousness of people and became crucial in the process of working with sound as such. "Any art begins with the establishment of the boundaries of its elements," German psychologist Albert Wellek (1904–1972) argued in an article on quarter-tones. In any language there is a limited number of words and in painting a limited number of color shades. Both words and shades of color can be infinite, but no one intends to use them all in one work (Wellek 1926, 231). A similar selection takes place in music, forming a system of tones. Experiments on the structure of sound have moved the horizons apart: a choice of sounds for a particular musical coordinate system was expanded and a new problem arose: what were the guiding rules? Where were the boundaries of division and fragmentation? What was human hearing capable of perceiving?

Wellek noted a detail important for the process of tone division: the modern human ear is brought up on a twelve-tone equal temperament. Imagine the situation when a person listens to microtones incorporated into an equal scope: he or she will perceive all the same twelve sounds as an unconscious adjustment takes place. This problem was encountered not only with respect to extended temperaments. Any deviation from the usual sound even inside the equal temperament causes resentment and rejection, whether this refers to the emergence of special conditions for dissonances, or legalization of aleatory. In this respect, the increase in the number of sounds was only one of the stages of evolution. However, such an evolution took another fifty years for adaptation.

The greatest popularity among composers and theorists of the early twentieth century was obtained by two temperaments: fifty-three and twenty-four. In the first one, the octave was divided into fifty-three equal parts, each corresponding to a frequency of 21/53 or 22.6415 cents (the so-called Arabic comma). The second one was obtained by dividing twelve-tone

equal temperament into two. Musicians perceived the fifty-three equal temperament as more innovative, closer to the natural system, while the twenty-four-tone system only strengthened the position of halftones.

Arnold Schoenberg in the *Theory of Harmony* associated the acceptance or rejection of micro-division of the octave with the evolution of auditory sensations. In his opinion, in the modern situation, ordinary musicians would laugh, having heard serious arguments in favor of the fifty-three-tone temperament. For them it must seem excessive and unnecessary, whereas the succeeding generation, as Schoenberg predicted, would be narrowed to twelve tones: this system would be considered incomplete, because it did not use the hidden possibilities of sound, and the sound did not have depth or perspective.[3] Discussing the reasons for such changes, explicit or hypothetical, Schoenberg believed that fragmentation does not result from the imitation of a prototype, not through material, but as a result of comprehension and development of thought and spirit (Schoenberg 2010, 424). As for the technical side of the matter, the *Theory of Harmony* refers to Robert Neumann's observations, with which Schoenberg was personally familiar. According to Neumann's theory, the fifty-three-degree temperament most corresponds to the requirements of just intonation and to properties of natural intervals. This indicator was decisive for Neumann. Schoenberg also agreed with him in the matter of temperaments that are multiples of twelve: twenty-four, thirty-six, forty-eight. Any other divisions would not be able to provide a perfect fifth, he believed.

Most experiments before the end of the nineteenth century were associated with fifty-three-tone temperament. The shift occurred in the 1890s, when musicians and researchers began a study of twenty-four and forty-eight-tone temperament possibilities. The reasons for this change were evident. First, they wanted to preserve and enrich the twelve tones in the octave. This was due to the desire to find a compromise between the overly laborious fifty-three divisions and the traditional twelve-tone system. The search for a balance between structures was not only related to the need to simplify and make innovations more accessible; it was necessary to accustom hearing to a multitude of tones. And if the fifty-three-tone temperament almost lost its connection with the twelve-tone system, then the twenty-four-tone systems supported usual tuning. The evolution of hearing went a more conservative but more reliable way.

3 Speaking on the perspective, Schoenberg compares this situation with European experience of Japanese painting understanding (Schoenberg 2010, 423).

4 Systems

Microtonal music is multifaceted in its basis. In connection with the fact that heterogeneous phenomena fall under this definition, it is important to build a hierarchical system and determine the criteria for analyzing works. The multiplicity of research efforts made in this time period allows us to conditionally distinguish two properties of microtonal music – basic and applied. In this observation I chose a type of material to use as the main criteria. On the one hand, there are works in which fragmentation is a systematic element, the basis of art work, and texture organization tool. On the other hand, there are applied (creative and research) purposes.

Let us consider the most typical examples of each of these categories.

4.1 Basic features

By basic features of microtonal products, we mean systems in which microtones are a systemic unit and the relations between tones are formalized into a harmonious system. Here we could develop a system of mutual subordination between tones. Within the framework of basic features, I would like to point out three general methods: systemic, authentic, and imitative.

The systemic method (single-system, mixed, polysystem) is distinguished by the presence of one, two, or more alternative systems which are the basis of the musical composition. With the development of microtonal music, elements of musical text became more complex and composers invented new, more sophisticated systems of music organization. Thus, they used successive or simultaneous temperaments in the same work.

The authentic method is associated with appealing to ancient modes and original folklore elements. In substantiating their ideas, microtonal composers kept nature as a symbol of the primordial, native language and scientific theories in their arsenal. All this was their defensive weapon in opposing conservative-minded people – all those who did not want to accept the expansion of twelve-tone system. When it became clear that those three options did not justify the innovations, the revolutionary musicians used one more important argument: ancient modes, which contained quarter-tones as an integral part of tone-scale. The enharmonic scale, described by Aristoxenus, a music theorist from Ancient Greece, inspired many musicians and became an important tool for modern music development. According to Aristoxenus, listeners are reluctant to perceive such scales, but those tones are a sign of the development of art.

In the history of European music, examples of the emergence of the quarter-tone enharmonic scale are singular. In Paris in 1849, the cantata *Prométhée enchaîné* (lyric scenes) by Jacques-François-Fromental-Élie Halévy (1799–1862), inspired by the tragedy of Aeschylus, premiered. It was one of the first known concerts in the nineteenth century when quarter-tones were presented to public. Their appearance in musical composition is more than justified. The composer's brother, Leon Halévy, the librettist of this work, pointed out that:

> It was fundamentally important to show the results of insertion of quarter-tones in one part of the composition – an element characterizing the Greek enharmonic scale. (Halévy 1863, 47)

The enharmonic scale in Greece was considered a kind of chromatic scale, different from the traditional European understanding of this term. The specificity of such scales consisted in lowering the pitch of the fourth and seventh strings in the lyre. For the enharmonic version of the mode, these strings were lowered to a whole tone so the pitch of the third and sixth tones was a quarter-tone lower. This scale was first presented in the fifth movement of the cantata in *Okeanides' Choir*. The three-section form with middle section, full of contrasts, and developing recapitulation contributes to the creation of modal and thematic contrast. The mode that interests us appears in the first and third sections. It is indicative of how the composer cautiously treats the new material. An appearance of Okeanides is accompanied by a dialogue between the flute, violin, and viola. Strings insinuating intonational melodic lines consist of trichordal cells, including quarter-tone steps. Fettered at first, the melody in the third section "straightens."

Alexandre Vincent, a professor of mathematics at the Sorbonne, philologist, and essayist, advised the composer to address such an original musical source. Vincent's main work is a 600-page monograph containing a translation of two anonymous Greek treatises, individual manuscripts, and a thirteenth-century treatise on harmony by George Pachymeres into French (Vincent 1847). One of the results of this work was a musical instrument designed by Vincent and his colleague, organologist Jean-Joseph-Auguste Bottée de Toulmon, and demonstrated at the academy. This instrument could reproduce any harmony from Ancient Greek music, although it was much simpler than the archichembalo by Nicola Vicentino. There was one flaw in it: it was impossible to perform any works on it. Nevertheless, following the Ancient Greek theoretical works, Vincent achieved unprecedented accuracy in dividing intervals by calculating acoustic logarithms. Part of Vincent's work is devoted to the theory of Aristoxenus, who perceived sound as a continuum

subjected to endless modifications and divisions. In one of the anonymous treatises, sound is likened to a point in geometry, the unity of numbers.

> The tone is divided into two halftones [in diatonic], three sharps of triental or one-third of the tone in chromatic music, and a quarter [sharps of quadrantals or] quarter-tones […] in the harmonic genre. (Anonime 1847)

It was this moment, obviously, which most interested the translator and his colleagues. What was obvious to the ancient Greeks but forgotten in European tradition struck the minds of musicians and scientists. The translator, commenting on the terminology, noted that in the Pythagorean system names were provided for halftones, thirds, and quarter-tones. The unknown author of the treatise adhered to the system of Archytas of Tarentum, which did not allow any division within these three genres. Vincent did not stop at the translation of treatises. A few years later, two of his works appear in print: "The use of quartet tones in Gregorian singing" and "The use of quarter notes in liturgical singing" (Vincent 1854, 362–72; Vincent 1854a, 670–76). Both articles, published in the appendix to the journal *La revue archéologique*, attempt to reveal the system and methods of applying quarter-tones in the indicated traditions.

Greek scales were historically closer to European music than Chinese and Indian, an interest in which was awakened at the end of the nineteenth century. One of the earliest known cases of microtone use in the imitation of the ancient system dates back to 1760, when French flutist and composer Charles Delusse composed *Air à la grecque* (Delusse 1984). Here quarter-tones are used as an ornament, introducing a characteristic color. It was not the only experience of using smaller gradations of tone in Delusse's works.

Okeanides' Choir by Halévy historically is not the first example of using quarter-tones in European music, and although it is very laconic in comparison with the previous movements, he drew the attention of all the critics. The introduction of quarter-tones into musical text, which spread into orchestral texture (despite the fact that they are only actually heard in the string group), did not go unnoticed. There were different reasons for that. The exact reproduction of the enharmonic scale was very rare in the European tradition. Despite the use of original harmony, quarter-tones were apocryphal for European musicians. This is explained simply: they were a hindrance, recalling an out-of-tune performance. Hector Berlioz as the author of regularly published feuilletons devoted to symphonic evenings even wrote in an article in the *Journal des débats* in March 1849:

> The use of quarter-tones in Halévy work is episodic and very brief, and generates a type of squeaking sound on the strings, but this strangeness seems to be completely justified here and greatly improves the melancholy prosody of the music. (Berlioz 1849)

Berlioz's similar ambivalent attitude to this music was caused by a cautious attitude towards Halévy music in general, and to the work described in particular.

At the end of the nineteenth century, composers also paid a special attention to folklore. Alois Hába, in substantiating new systems, often pointed to the true nature of microtonal music:

> From early childhood I heard (in particular from my mother) folk songs in which there were 'uneven' intervals. I listened to them both at festivals and home. Therefore, it is not surprising that later, when I started composing, I was thinking about the possibility of using just these intervals. [...] I emphasize: the effect of fragmentation of tones for me is not an abstract, but a real phenomenon in the songs of Eastern Moravia. (Kaczyński 1974, 112)

Arseny Avraamov, developing microtone systems, primarily paid attention to the features of the folk song and its untempered nature. For the accurate reproduction of folklore, he invented a special instrument.

Many researchers and critics who discussed the evolution of musical art at the beginning of the twentieth century noted the composers' special interest in Eastern music or music of non-European cultures, which the Europeans themselves called exotic. I will give some examples.

Richard Stein, an enthusiast of the new music, who published the result of his experiments in 1906 – a microtone composition for cello and piano – talked about the origins of musical systems. After just over ten years, he published an article in which he gave an overview of contemporary musical life in the context of the introduction of a microtonal current into it. Summarizing a cursory review of different cultures' traditions, Stein insisted that:

> Quarter-tones in no way are an invention of the speculative minds of the newest time, but on contrary, they were used in all parts of the world thousands of years before us. (Stein 1923, 12)

That is, "modernism," with respect to quarter-tones, is a revival of old systems. Concerning this matter, Stein referred to the Arabian and Persian systems, characterized by the division of minor third (three semitones – six

quarter-tones) into two three-quarter-tones, and in the melody a third tone. He explained further:

> Hindus have long known third and quarter-tones, the Turks use quarter and eights, and the Modern Greeks use quarter-tones in their religious music. Similarly, the Gregorian chant had, as it has now been unquestionably established, quarter-tone intervals (compare the works of Gregorian Academy in Freiburg, published by Professor Dr. P. Wagner). Finally, quarter-tones disappeared from Western music only with the development of polyphonic singing. (Stein 1923, 12)

This statement is very important in the context of the formation of microtonal movement. In 1906, neither Stein, Busoni, nor other seekers of micro dimensions of tone thought that their experiments led to the modes of Eastern cultures. However, history knows particular cases of mastering the Eastern non-tempered systems by musicians of the nineteenth century.

Hector Berlioz, as already mentioned, knew about the modern experience of using quarter-tones. In a letter to Joseph d'Ortigue dated June 21, 1851, he mentioned his meeting with a Chinese singer and her accompanist. This happened during the composer's stay in England, marked by a colossal shock from the St. Paul Cathedral's choir, in which 6,500 children sang ("It was, without comparison, the most imposing and tumultuous ceremony it has ever, up to present time, fallen to my lot to witness") (Berlioz and Bernard 2010, 201). At the end of his letter, Berlioz observed:

> You will see how we ought to estimate the stupid inventions of certain so-called learned theorists in connection with a pretended system of music in quarter-tones. There is no fool like a *savant*. (Berlioz and Bernard 2010, 201–2)

D'Ortigue had "to see" an article in the newspaper *Journal des débats*. Berlioz published another feuilleton there on May 31, 1851, devoted to a review of musical life for the past month. Almost half of the article's volume was devoted to the composer's communication with Chinese musicians, which became a rare auditory experience of contact with non-European cultures for him. Comparing Chinese with Indian music, Berlioz noted with surprise different musical roots and manners of performance. In a detailed description of all the pieces heard, Berlioz's most tormented question was about their mode:

> My interest in the matter related to the divisions of tones and Chinese tonality. (Berlioz 1851)

The composer noted:

> In fact, an external similarity of the scale with the European one does not allow us to speak about the same results. The melody of the song was not sufficiently deterministic. It did not consist of quarter-tones or half-quarter-tones, but from simpler diatonic sequences. (Berlioz 1851)

It is important to raise the question about awareness of European musicians of so-called "oriental music." It is known that the stereotype of the "Eastern" was in existence for a long time, and a complex of means for its musical embodiment was universal. However, publications of anthropological and sociological works containing reliable information about the Eastern countries and often, more importantly, musical samples of national folklore, should have remedied this situation (Bougainville and Forster 1967). Jean-Baptiste Du Halde, describing China, published five supposedly authentic melodies, one of which was used by Weber and Hindemith. Barrow published his *Travels in China* a year before the first version of the *China Overture* by Carl Maria von Weber.

One of the ideologists of the real East was German composer and organist Georg Joseph Vogler, who regularly made expeditions to the countries of the Middle East, Spain, and North America. In *Polymelos* for violin and pianoforte with cello accompaniment, he presented folk songs from Africa, Morocco, and Greenland, and "The Chinese theme deciphered from the notes of missionaries in Beijing." The significance of Vogler's activities for European musicians is difficult to overestimate. Even Beethoven was intrigued by his experiments (Hamburger 1960). Nevertheless, the transcription of melodies was limited to a twelve-step system and did not bring composers closer to real sound.

That is why Berlioz's experience of contact with a new harmony, a new method of dividing the octave should be regarded as a certain interpretation of the oriental system, attempts at its implementation and adaptation in European consciousness. Most likely, Berlioz owes his knowledge in temperament to his teacher Antoine Reicha (1770–1836), a prolific composer more widely known as a theorist and teacher who taught in Austria and France and had his own composer school. During 1824–1826 he worked on the *Treatise on the highest compositional technique*, which was published in 1832. However, many of his ideas were already formulated in 1814, in the *Treatise on the Melody*, in which Reicha demonstrated methods of unfolding melodic and harmonious material and gave examples of experimentation with rhythm

and, most importantly, of usage of quarter-tone notation for recitation. In these two works Reicha gave vent to the most daring ideas of those times.

In particular, he shrewdly noticed that in the future, quarter-tones would become a natural phenomenon. In the *Treatise on the Melody* he described how one famous singer once made a transition in the quarter-tones from the second to the third period of the vocal exercise.

> This had an exceptional effect on the public; the experienced singer deserved a grandiose applause. (Reicha 1893, 45)

Reicha indicated that professional performers should be in such form that they could perform ascending or descending quarter-tones, because among all musical instruments the voice can do it with sufficient ease. In his example he shows a segment of melody based on a quarter-tone descending third. In order to perform this exercise, the author believed it was necessary to build a monochord with the octave divided by twenty-four tones, and in order for them to be accurately tuned, it was important to tune this instrument with two tuning forks with a quarter-tone difference, and the task would not be difficult.

These ideas would be partially reflected in a four-volume treatise on musical composition, the last book by Reicha, which was completed in 1826, when Berlioz and Liszt entered his class. Despite an apparent independence of musical ideas of both composers from those of their teacher, some features of their works indicate otherwise. Thus, we can note the frequent appearance of fugated passages in Berlioz's music, re-harmonization of musical themes at every new appearance, often asymmetric metric – all described and declared in the theoretical writings of Reicha (Bücken 1919, 156–169).

It is important to note that not all microtonal composers developed their systems based on the idea of imitating modes of other cultures. This rather served as an auxiliary impulse for creativity, and most importantly, the justification for experiments.

The latter – the imitative method – is a basic method, associated with an attempt to depict the properties of nature with the help of microtonal music. Artur Holde, an acoustician and physicist, who followed the research of microtonal composers, indicated that quarter-tones had special success in depicting nature. This was largely due to the creation of new instruments (Holde 1938, 533). A ground for experiments was required even by futurists, who having thrown out all the artistic baggage of the past from the "modern steamer," faced the problem of finding objective principles. They were seen in nature, whereas art was its continuation, the development of the process,

"initiated by nature" (Solovyev 2001, 12). Ultimately, "all arts, resources, and forms ever aim at the one end, namely, the imitation of nature and the interpretation of human feelings," concluded Italian composer Ferruccio Busoni (Busoni and Baker 1911, 3). For him, a system of tones, frames and tonalities was "a part of a fraction of one diffracted ray from that Sun" (Busoni and Baker 1911, 28).

The categories of "nature" and "music" were approaching. Arguing about Bach, Busoni noted that:

> His Organ Fantasias (but not the Fugues) have indubitably a strong dash of what might be overwritten as 'Man and Nature.' (Busoni and Baker 1911, 8)

Nikolay Kulbin enlarges this logical chain to: nature – music of nature – free music. In this triad nature was a primary source: music should inherit its naturalness because the music of nature is "imitating the sounds of Nature" (Kulbin). Such arguments allowed composers and theorists to come to the necessity of splitting the tone into quarters and eighths. Due to their introduction into the structure of the octave, the advantage over the twelve-tone temperament, the author believed, would be felt immediately: first, there would be the pleasure of unusual sounds; second, the musician would deal with the complicated and refined structure of chords and melodies; third, a new quality of dissonance would appear, which would color the usual sound for the ear. In addition, Kulbin believed:

> [T]he power of musical lyrics grows, and this is the most important thing, since music is primarily lyric poetry. Free music also has great opportunities to influence the listener and cause him emotions. (Kulbin 2006, 547–48)

Significantly for Kulbin, there was an appeal to nature:

> The whistling of the wind, the splashing of water, and the singing of birds are free in their choice of sounds. A nightingale sings not only on the notes of current music, but also on all convenient ones. (Kulbin 2006, 547)

The singing of a nightingale (of course, untempered) becomes that indisputable argument by which Kulbin armed himself, arguing about the closeness of music to nature.

Attempts to imitate birdsong in music were carried out in all epochs. However, the approach to onomatopoeia was changing. If during the Baroque

epoch the rhythmic basis of themes and their general intonational orientation were important, then by the end of the nineteenth century the composers' attention shifted to a detailed study of intonational segments of musical material. A typical example of the search for a "correct," that is, reliable intonation, close to the original source is an open appeal by the reader F. R. C., published September 1, 1893, in *The Musical Times* (F. R. C. 1893, 556). His letter entitled "The song of the yellow-hammer" was a reaction to a special newspaper issue that appeared in December 1892 dedicated to Beethoven's music. This gentleman, obviously possessing some musical education, questioned the correctness of the facts set forth in George Grove's article (Grove 1892, 14–5). Birds in the *Pastoral Symphony* became a subject of the debate originating from Anton Felix Schindler's book *The Life of Beethoven* (Schindler et al. 1840). According Schindler, Beethoven admitted that in addition to three birds identified in the symphony (the nightingale, the quail, and the cuckoo), there was one more hidden in the depths of the score, namely, the *Emberiza citrinella* (yellow-hammer). The composer pointed out that in the scene at the stream he depicted these birds first (an ascending passage on G major sixth chord). George Grove, doubting the validity of such an *arpeggio*, turned to the dictionary in which the bird song was deciphered as follows:

> [O]ne note is repeated four or six times at a rapid tempo, followed by two others, the last of which is elongated. (Grove 1892, 15)

The F. R. C. objected to this example. He stated that he had never noticed that the last sound of this "recitative" was a perfect fifth higher than the main one. On the contrary, most often it was lower, and lower by an interval of less than a semitone. It is important to note that a century after the creation of the symphony, the process of analyzing sounds was associated with a new level of comprehension of nature and understanding and that there was a big gap between justified systems and real sounds.

A typical example of a quarter-tone measurement of nature's voices can be found in the case described by Russian futurist composer and violin player Mikhail Matyushin. As early as 1904–1905 Matyushin tried to imitate birdsong on the violin:

> Birds sang like that in the spring [...]. It was so amazingly beautiful and alive. The intonations of the voices simultaneously audible sounded like the most wonderful melodies and I listened, trying to catch the melody rising and descending in simultaneity. (Matyushin n. d., 70)

At the same time, Matyushin recalls, his desire was realized when he managed "to double [...] the chromaticism, i.e. to split a halftone into

two" (Matyushin n. d., 70). Matyushin believed that the use of quarter-tones in stringed instruments would lead to the appearance of "amazing combinations, extraordinary approximations to nature" (Matyushin 1915, without page numbers). For composers and theorists, nature served as a standard as well as uncompromising proof of the strict regulation of all, even the most radical experiments. Who would dare to argue with nature?

Thus, the search for the correspondence between music and nature was brought to life by deep reflections on the role of art and its position in the universe. Experimental attempts to reach the depth or the essence of things, that is, the primary elements of sound, were aimed at the return of primordiality to music and its liberation from "architectonic, acoustic and esthetic dogmas" (Busoni and Baker 1911, 34).

4.2 Applied features

At the same time, the idea of the applied nature of microtonality was developing. A separate technique developed by musicians is the juxtaposition of new and old systems and the comparison of whole and split words and sounds. As a rule, composers use the additive method.

For this musical system, the experience of Arthur Lourie is a good example, who in the impressionistic *Prélude*, Op. 12 No. 2 (for grand piano with higher chromatism), built an algorithm for appearance and disappearance of extended-tempered sounds: pure (halftone) and microtonal (quarter-tone) blocks appear alternately. Sometimes such blocks have one consonance, sometimes the sum of several.

With the introduction into the use of tone splitting and of new uniform and non-tempered systems, the modernization of musical texture systems was required. This is how experiments comparing different types of systems based on the smallest gradation of tone and the study of the spectrum of a single sound developed.

Wyschnegradsky was one of the first composers in Russia to systematically develop new spectral features (1916–1920). His Opus 5 – *Four Fragments* for two grand pianos is an example of a quarter-tone combination of instruments. The composer tried to find support in a new quarter-tone measurement. Microtones, like a shadow, chase the chords highlighting them; thematic grains (an integral structure is absent) are distorted in a curved mirror, and relatively large segments are refracted by the echo.

Yuri Kholopov, analyzing String Quartet by Alois Hába, suggested distinguishing between two types of microtones (Kholopov 2000, 128):

1. Over-alteration (inner-degree microtones) as sharpening of intonation by approaching the target sound by a quarter-tone. Possible variants are micro-passages from the main (diatonic) degree through the microalteration to the target degree, as well as auxiliary microtones.
2. Degree of microtonal system.

We can accept this gradation of microtones with only one remark: that alteration as a term denoting a change does not correspond to our basic concept of microtonal music, as music not associated with the twelve-step uniform temperament. Nevertheless, the first microtonal experiments rejected this system, multiplying it by dividing a semitone. Therefore, the term alteration is possible only in the case of explicit or indirect support for a twelve-tone system.

The auxiliary method of using microtonal music can be interpreted as experiments conducted in the field of acoustics and mathematical calculations of temperaments and their subsequent use in musical works. As a rule, such an association of mathematics and music was of an experimental nature. Nevertheless, mathematical analysis and calculation in the 1920s was particularly popular in the artistic environment. Velimir Khlebnikov wrote as a "teacher" in one of his articles:

> Only the growth of science will make it possible to guess all the wisdom of the language, which is wise because it was part of nature itself. (Khlebnikov 1999, 34–40)

This was due to the desire for absolute accuracy and justification of all the experiments produced by the creators of new art. The exact sciences were applied in substantiating a process of crushing and calculating the smallest units of a system.

A program of a future musical system was outlined by Avraamov in his article "In the wilds of aesthetics" in 1917: the natural row of numbers plays a large role in the construction of musical scales and is "the basis of all arithmetic operations" (Avraamov 1917, 148). This was the starting point for the research of following decades. In parallel to the way composers and physicists-acousticians tried to solve the problem of the boundaries of sound division in music to build their musical "alphabet," linguists talked about the infinity

of the number of sounds in the language. The experience of writers in the related problem, an approval of a new alphabet based on a new idea of its phonetic component, is no less fruitful.

Nikolay Yakovlev, a Russian linguist and linguistic specialist, worked out the mathematical formula for the construction of the alphabet (starting in 1926) in the Institute for the Study of Ethnic and National Cultures of the Peoples of the East. His case is an example of scientific research in phonology, which is very revealing in relation to the experiments that took place in the 1920s. The system he invented was to create a limited alphabet (in terms of the number of letters) based on the revision of the old alphabets. Unlike Jan Baudouin de Courtenay, he treated a phoneme as a minimal sound unit used for differentiation of meanings. Using the formula, Yakovlev calculated the number of letters to which you can shorten the alphabet of any language due to its phonetic features. To avoid the infinity of sounds in the language (from the point of view of acoustic function, outside the relation to their social and linguistic function), Yakovlev recognized behind the phoneme "those sound differences that stand out in speech as its shortest sound moments in relation to distinction of language significant elements" (Yakovlev 1970, 129). According to the linguist, the system of practical writing should graphically reflect all the phonemes of the given language. Yakovlev applied his theory to the Russian alphabet, making proposals for its modernization, simplification, and reduction. However, being a specialist in the field of Caucasian linguistics, he applies this method of calculation to the Finno-Ugric languages. He headed a scientific commission engaged in the creation of a written language for the peoples of the North Caucasus, Dagestan, and Abkhazia, and for the Turkic, Finno-Ugric, Mongolian, and Tungusic-Manchurian languages, as well as for the languages of the peoples of the Soviet Far North. Thanks to the phonemic principle of writing formulated by Yakovlev, writing appeared in more than 70 languages (spoken by various peoples of the USSR).

The appeal of musicians and writers to the exact sciences was not accidental: humanitarian knowledge in conjunction with science (the primacy of fact over hypotheses and theories) was considered all-powerful in those years. Therefore, the use of methods based on formulas and models played a large role in the evidence base of new creative concepts.

In addition, the ethnographic method achieved a new level. Microtonal notation was used for extremely accurate fixation of sounds in folk music. In 1876 a landmark event took place: The Magician of Menlo Park, the American

inventor and entrepreneur Thomas Alva Edison, presented to the world an unusual device capable of recording and reproducing sound. The phonograph, a prototype of which was studied back in 1857, struck the public consciousness and became a guide to a new sound world. The phonograph underwent many changes, and due to the use of a cylinder with a wax coating, the replacement of a cylindrical sound-carrier with a flat disc, the gramophone appeared in 1887. Musicians became some of the first to use the gramophone's capabilities. This discovery coincided with the growing interest in folklore. Refinements to the gramophone made between 1904–1906 improved the quality of recording and playback of music. Therefore, the beginning of the century saw a new stage of interest in folklore. The need for such an instrument had grown over a long period of time: from the end of the nineteenth century, folk song collectors began to note the greater conventionality in the existing tradition of musical notation. It was necessary to pull individual sounds up to the stage from the prevailing uniform scale. This greatly coarsened a melody and differed from the original version.

Russian ethnomusicologist Eduard Alekseyev, followed by Ivan Matzievsky, more than once expressed the idea of a universal sign for "microalteration" in his studies and stressed that:

> [T]hese signs must be specified every time in transcription process, and in addition, similar double signs are used by some folklorists (and composers too) to notate quarter-tone intervals (semiflats and semisharps), which, in order to avoid misunderstandings, must be taken into account, since quarter-tone relations are also not uncommon in folklore music. (Alekseyev 1990, 61)

As early as 1904, the issue of an extremely clear fixation of sounds was discussed at meetings of musical and ethnographic commissions. Alexander Listopadov organized an experiment by recording wedding songs of the Don Cossacks on the phonograph and asked the most authoritative members of the Moscow Musical and Ethnographic Commission to notate the record and determine its mode. All six experts, among whom were Sergey Taneev, Alexander Grechaninov, Viktor Paskhalov, Boris Yavorsky, and Evgeniya Lineva, transcribed the song differently. Taneev summed up:

> Here we are most likely dealing with a special, traditional for the given locality manner of performing the most ancient ritual songs. (Listopadov 1909, 5–6)

The applied features of microtonal music – that is, elements, additional sounds and imaginary systems – calculated mechanically show another way

microtones were applied. Either in music or theory they helped to perfect results, making the result exact and useful for future work with them.

5 Marginal culture

Microtonal music as a phenomenon modern to late romanticism, expressionism, and neo-folklore, has always been in the shadow of these trends, but in combination with other artistic initiatives created an atmosphere of searching for a new, unexplored sound. It never came to the forefront of the evolution of musical art. Existing in parallel with the main artistic trends of the twentieth century, microtonal music could not join to one of these trends nor to the new techniques of composition. It focused on the development of a primary element, sound as such. There are several reasons for the marginalization of microtone experiments.

First, the practice did not keep up with the theory. The necessity for the evolution of sound was caused not by musical factors, but rather by aesthetic and historical ones. Although on paper, in theory, most radical innovations looked convincing, in real life, in creative practice, the existence of new sounds needed to be persuasively proven. The experimenters sought to push back the twelve-tone temperament, to go beyond it, or at least to expand its content. In this regard, an experience of dividing a halftone into microcomponents, called microtones, was one of the main trends.

Second, composers sought a path of compromise between the defiant-revolutionary theory and their own creative possibilities. Most of those who worked in a new technique and who possessed a fundamental academic musical education looked for artificially justified results in splitting of the tone, but most of their compositions were nothing more than an enrichment of a major and minor system or an atonal piece often losing individual style. The well-known critic Boris Shlözer, the author of several reviews of microtonal music concerts, noted in one of his detailed articles on quarter-note composers:

> We do not have the need for this multiplication of sounds, for this expansion of musical scale, but taking into account indifference or hostility it is impossible to make any conclusions about the future, even nearest future. It is very possible that some genius composer will 'make us' feel this need and the need for this reform. (Shletser 1924)

These "genius composers" were required by that time. Only with rare exceptions did individual musicians and amateurs use microtonal music in their

professional activity. Especially rarely did composers whose work was unconditionally accepted by a wide audience deal with it. Several generations of composers, performers, musicologists, inventors, physicists, and acousticians worked on the problems of microtonal music. The period of the early twentieth century characterizes the most individual and bright projects. Some of them have sunk into oblivion, while others have been continued.

Catching up the newest trends, microtonal specialists thought and rethought how transformed microtonal music could be simply turned into a universal language. During the twentieth century they ruined and broke, planned and designed, argued and agreed, and finally constructed and reconstructed. In 1938, English composer Alan Bush, commissioned by the Russian magazine *Soviet Music*, wrote an article about contemporary musical trends in Europe. Revealing the very characteristic property of modernity – the lack of uniformity in the prevailing styles in music and compositional techniques – he noted as a negative feature the predominance of antitonal phenomena. He was confused by new scales borrowed (transformed) or invented, or arbitrary or totally controlled:

> Contemporary Western composers use 'new' scales – either borrowed from folk music (and heavily deformed) or 'invented' by the composer himself, usually from twelve semitones of the tempered octave. (Bush 1938, 93)

To the group of "folk composers" he attributes Bartók, Bloch, Stravinsky, Vaughan Williams, and partly Ravel. The group of "inventors" included Casella, Hindemith, Schoenberg, and Hába. The latter "suffered" for the arbitrary use of a number of twenty-four well-tempered quarter-tones in an octave.

Of course, it was difficult to expect logical harmony and order in the innovative field. Eclecticism reflected only the diversity of approaches to the use of resources. Chaotically appearing systems, inventions, and revolutionary concerts were part of the microtonal movement and united in an idea.

Bibliography

ALEKSEYEV, Eduard. 1990. *Notnaya zapis' narodnoy muzyki: Teoriya i praktika*. Moscow: Sovetskiy kompozitor.

ANONIME. 1847. *Traité de musique.* Traduction française: M. J.-H. Vincent. De la Bibliothèque du Roi et autres Bibliothèques, publiés par l'Institut royal de France, faisant suite aux notices et extraits lus au comité établi dans l'Académie des Inscriptions et Belles-lettres. Tome seizième. Paris: Imprimerie Royale. http://remacle.org/bloodwolf/erudits/anonyme/musique1.htm.

AVRAAMOV, Arseniy. 1916. "'Ultrakhromatism' ili "Omnitonalnost'?" *Muzykal'nyy sovremennik. Zhurnal muzykalnogo uskusstva* 4–5: 157–68.

AVRAAMOV, Arseniy. 1917. "V debryakh estetiki (Intuitsiya ili eruditsiya?)." *Skify* 1, edited by A. Ivanchin-Pisarev, R. Ivanov-Razumnik and S. Mstislavskiy, 140–54. Petrograd: Skify.

BALLIF, Claude, and Alain GALLIARI. 1992. *L'habitant du labyrinthe: entretiens avec Alain Galliari*. Isles-lès-Villenoy: Pro Musica.

BELY, Andrey. 1917. "Zhezl Aarona (0 slov v poezii)." *Skify* 1, edited by A. Ivanchin-Pisarev, R. Ivanov-Razumnik and S. Mstislavskiy, 155–212. Petrograd: Skify.

BERDYAYEV, Nikolay. 2006. "Krizis iskusstva (Publichnaya lektsiya, prochitannaya v Moskve 1 noyabrya 1917 g.)." In *Semiotika i avangard: Antologiya*, edited by Yury Stepanov et al., 359–71. Moscow: Akademicheskiy Proyekt; Kul'tura.

BERLIOZ, Hector, and Daniel BERNARD. 2010. *Life and Letters of Berlioz*, vol. 1. New York: Cambridge University Press

BERLIOZ, Hector. 1851. "Feuilletons." *Journal des débats* (May 31, 1851). http://www.hberlioz.com/feuilletons/debats510531.htm.

BOBROV, Sergey. 1999. "From an oratorium "Lira Lir." In *Russkij futurism. Teoriya. Praktika. Kritika. Vospominaniya*, edited by V. Terhina and A. Zimenkov, 202–3. Moscow: IMLI RAN.

BOUGAINVILLE, Louis de and Johann Reinhold FORSTER. 1967. *A Voyage Round the World.* Translated from the French by J. R. Forster. Amsterdam: N. Israel.

BÜCKEN, Ernst. 1919. "Anton Reicha als Theoretiker." *Zeitschrift für Musikwissenschaft* II: 156–69.

BURLYUK, David. 1930. *Entelekhizm: Teoriya. Kritika. Stikhi. Kartiny: (1907–1930)*. New York: Izdaniye Marii Nikiforovny Burlyuk.

BURLYUK, Nikolay. 1999. “Poeticheskiye nachala. Supplementum k poeticheskomu kontrapunktu.” In *Russkiy futurizm. Teoriya. Praktika. Kritika. Vospominaniya*, edited by V. Terekhina and A. Zimenkov, 56–8. Moscow: IMLI RAN.

BUSH, Alan. 1938. “Sovremennyye techeniya zapadnoy muzyki.” *Sovetskaya muzyka* 12 (December): 93–101.

BUSONI, Ferruccio and Theodore BAKER. 1911. *Sketch of a New Esthetic of Music.* Translated from the German by Dr. Th. Baker. New York: G. Schirmer.

DELUSSE, Charles. 1984. *Air à la grecque: for flute and bass in the diatonic, chromatic, and enharmonic genres* (1760), edited by Rudolf Rasch. Corpus microtonale (Ser. No. 22).

F. R. C. 1893. “The song of the yellow-hammer. To the editor of *The Musical Times*.” *The Musical Times and Singing Class Circular* 34, no. 607 (September 1): 556.

FLORENSKY, Pavel. 2009. “Stroyeniye slova.” In *U vodorazdelov mysli: Cherty konkretnoy metafiziki*, edited by Pavel Florensky, 232–51. Moscow: AST.

GROVE, George. 1892. “The birds in the Pastoral Symphony.” *The Musical Times and Singing Class Circular* 33: 14–5. Beethoven Supplement.

HALÉVY, Leon. 1863. *Halévy, sa vie et ses oeuvres. Récits et impressions personelles, simples souvenirs*. Paris: Heugel et G^{ie}.

HAMBURGER, Michael (ed.) 1960. *Beethoven Letters, Journals and Conversations*. New York: Pantheon.

HOLDE, Artur. 1938. “Is There a Future for Quarter-tone Music?” *The Musical Quarterly* 24, no. 4: 528–33.

JAKOBSON, Roman. 2009. “Futurizm.” In *Russkiy futurizm: Stikhi. Stat’i. Vospominaniya*, edited by V. Terekhina and A. Zimenkov, 407–10. Saint Petersburg: OOO “Poligraf”.

KACZYŃSKI, Bogusław. 1974. “Poslednyaya vstrecha s Aloisom Khaboy.” *Sovetskaya muzyka* 7 (July): 112–13.

KHLEBNIKOV, Velimir. 1999. “Nasha osnova.” In *Russkiy futurizm. Teoriya. Praktika. Kritika. Vospominaniya*, edited by V. Terekhina and A. Zimenkov, 63–69. Moscow: IMLI RAN.

KHLEBNIKOV, Velimir. 1999. “Uchitel’ i uchenik. O slovakh, gorodakh i narodakh.” In *Russkiy futurizm. Teoriya. Praktika. Kritika. Vospominaniya*, edited by V. Terekhina and A. Zimenkov, 34–40. Moscow: IMLI RAN.

KHOLOPOV, Yury. 2000. “Mikro i posledstviya.” In *Muzykal’noye obrazovaniye v kontekste kul’tury: Voprosy teorii, istorii i metodologii muzykal’nogo*

obrazovaniya. Materialy nauchno-prakticheskoy konferentsii 27–29 October 1998: 27–38. Moscow: Rossiyskaya akademiya muzyki im. Gnesinykh.

KHOLOPOV, Yury. 2009. "Mikrokhromatika." In *Garmonicheskiy analiz*, vol. 3, edited by Yury Kholopov, 587–89. Moscow: Nauchno-izdatel'skiy tsentr "Moskovskaya konservatoriya".

KRUCHENYKH, Alexei and Velimir KHLEBNIKOV. 1999. "Slovo kak takovoye. O khudozhestvennykh proizvedeniyakh." In *Russkiy futurizm. Teoriya. Praktika. Kritika. Vospominaniya*, edited by V. Terekhina and A. Zimenkov, 46–9. Moscow: IMLI RAN.

KULBIN, Nikolay. 2006. "Svobodnaya muzyka. Tezisy svobodnoy muzyki." In *Semiotika i avangard: Antologiya*, edited by Yu. Stepanov, N. Fateyeva, V. Feshchenko and N. Sirotkin, 547–8. Moscow: Akademicheskiy Proyekt; Kul'tura.

LISTOPADOV, Alexander. 1909. "K voprosu o zapisi narodnykh pesen." *Muzyka i zhizn'* 1: 5–6.

LIVSHITS, Boris. 1991. *Polutoraglazyy strelets. Vospominaniya*. Moscow: Khudozhestvennaya literatura.

MAEDEL, Rolf and Franz HERF. 1972. *Ekmelische Musik: Möglichkeiten der Erweiterung unseres Tonsystems*. Salzburg: Institut für Musikalische Grundlagenforschung an der Hochschule für Musik und Darstellende Kunst Mozarteum in Salzburg.

MATYUSHIN, Mikhail, and Alexei KRUCHENYKH, Kazimir MALEVICH. 1999. "Pervyy vserossiyskiy s"yezd bayachey budushchego. 20 iyulya 1913 g." In *Russkiy futurizm. Teoriya. Praktika. Kritika. Vospominaniya*, edited by V. Terekhina and A. Zimenkov, 233–34. Moscow: IMLI RAN.

MATYUSHIN, Mikhail. 1915. *Rukovodstvo k izucheniyu chetvertey tona dlya skripki: Printsip obshchey sistemy izucheniya udvoyennogo khromatizma*. Petrograd: Zhuravl'.

MATYUSHIN, Mikhail. n. d. "Moi muzykal'nyye kompozitsii (Matyushin M. Moya zhizn')." Manuscript department of Pushkin House of Russian Academy of Science. Fond 656, opis 1, no. 94.

MAYAKOVSKY, Vladimir. 1959. "V. Khlebnikov." *Mayakovsky V. V. Polnoye sobraniye sochineniy*, vol. 12: *Stat'i, zametki i vystupleniya (November 1917–1930)*: 24–9. Moscow: Khudozhestvennaya literatura.

POLUNINA, Elena. 2010. "Mikrokhromatika v muzykal'nom iskusstve pozdnego Vozrozhdeniya: voprosy istorii, estetiki, teorii." PhD diss., Dal'nevostochny State University of Technology.

PRESTINI, Elena. 2004. *The evolution of applied harmonic analysis: models of the real world*. Boston: Birkhäuser.

REICHA, Anton. 1893. *Treatise on melody. Considered apart from its relations to harmony, followed by observations upon the art of accompanying the melody with harmony when the first ought to predominate*. Translated by Edwin S. Metcalf. Chicago, Ill.: E. S. Metcalf & Co.

REINHARD, Johnny. 2009. *Bach and Tuning*. New York: American Festival of Microtonal music.

RIMSKY-KORSAKOV, Georgy. 1925. "Obosnovaniye chetvertitonovoy muzykal'noy sistemy." *De musica: Vremennik razryada Istorii i Teorii muzyki* 1: 52–78.

SCHINDLER, Anton, Ignaz Moscheles and Heinrich Döring. 1840. *The Life of Beethoven*. Boston: Oliver Ditson.

SCHOENBERG, Arnold. 2010. *Theory of Harmony*. Translated by Roy E. Carter. Berkeley; Los Angeles: University of California Press.

SHLETSER, Boris. 1924. "O chetvertitonovoy muzyke." *Zveno* 22 (September).

SOLOVYEV, Vladimir. 2001. "Obshchiy smysl iskusstva," *Literaturnyye manifesty. Ot simvolizma do "Oktyabrya"*, edited by N. Brodskiy and N. Sidorov, 11–23. Moscow: Agraf.

STEIN, Richard. 1923. "Chetvertetonnaya muzyka." *K novym beregam* 3: 10–5.

VINCENT, Alexandre. 1854. "Emploi des quarts de ton dans le chant grégorien." *La revue archéologique* 2 (October): 362–72.

VINCENT, Alexandre. 1854a. "L'emploi des quarts de ton dans le chant liturgique." *La revue archéologique* 2 (October): 670–76.

VINCENT, Alexandre-Joseph-Hidulphe. 1847. *Notice sur divers manuscrits grecs relatifs à la musique, comprenant une traduction française et des commentaires*. Paris: Imprimerie royale.

WELLEK, Albert. 1926. "Quarter tones and Progress." *Musical Quarterly* XII(2): 231–37.

WYSCHNEGRADSKY, Ivan. 1992. "Raskreposhcheniye zvuka." *Muzykal'naya akademiya* 2 (February): 137–39.

YAKOVLEV, Nikolay. 1970. "Matematicheskaya formula postroyeniya alfavita (opyt prakticheskogo prilozheniya lingvisticheskoy teorii)." In *Iz istorii otechestvennoy fonologii. Ocherk. Khrestomatiya*, edited by A. Reformatskiy, 41–64. Moscow: Nauka.