The Ministry of Education, Research and Innovation
Romania

The University of Arts „George Enescu" Iaşi
The Faculty of Composition, Musicology, Musical Pedagogy and Theatre

Doctoral Thesis
Summary

Electro-acoustic Music - Technology and Composition

Implications in the Romanian Music

Scientific Advisor
Prof. Univ. Dr. Viorel Munteanu

Doctoral Candidate
Ciprian Lorin Jalbă

2010

Table of Contents

d. The condition of the work of art – music semiography

8. Seven reasons why electro-acoustic music is different

Chapter II. A history of electro-acoustic music

1. Forerunners of electro-acoustic music
    a. Alternative intonational systems and new musical scales
    b. Dodecaphony and the new structural principles
    c. Futuristic music and the art of noise
2. Pioneers of electronics in music
    a. Helmholtz and the new method of sound analysis
    b. The first musical experiments in the realm of electronics
    c. Telharmonium – the giant instrument
    d. Theremin – an electronic odyssey
    e. “Ondes Martenot”
    f. Trautonium – the beginning of subtractive synthesis
    g. Military technology and musical experiments
    h. Hammond, the electronic organ
3. Magnetic tape – scaffolding for musique concrète
    a. The tape recorder and magnetic tape
    b. The art of composing with tape
    c. The first methods of editing – tape splicing
    d. The manipulation of the magnetic tape in creating sound effects
4. Electro-acoustic music studios in the 1950s and 1960s
    a. Pierre Henry and Pierre Schaeffer – origins in France
    b. Elektronische Musik and the German school
        i. Ideological disputes between Paris and Cologne
        ii. Integral serialism
        iii. Technology and creation in the WDR studio from Cologne
    c. The Columbia-Princeton studio
        i. The first tape experiments
        ii. Vladimir Ussachevsky and Otto Luening
        iii. The RCA synthesizer
        iv. Works and composers
5. Electro-acoustic music’s visionaries: Cage, Varèse, and Stockhausen
    a. John Cage and the concept of aleatorism
    b. Cage’s live performance works
    c. Varèse and organized sound

i. Varèse's first experience with magnetic tape – Déserts

ii. Poème électronique and multimedia beginnings

d. Stockhausen – a cosmic music for a cosmic era

Chapter III. Electro-acoustic music in Romania

1. A non-exhaustive history
    a. Romanian political context of the years 1960-1970
    b. First initiatives in the Romanian electro-acoustic music
    c. Pioneering works – the years 1960-1970
    d. The 1980s
    e. After 1990
2. Statistics
3. Aesthetic influences
4. The electro-acoustic in Octavian Nemescu's vision
    a. Overview
    b. Three works of reference
        i. Combinations in Circles
        ii. Concentric
        iii. Natural-Cultural
5. Final considerations

Chapter IV. From avant-garde to entertainment

1. Robert Moog and the social construction of the first synthesizer
    a. Sociological aspects
    b. Voltage-controlled modular synthesizer
    c. General characteristics of modern synthesizers
    d. The Moog synthesizer
    e. The Buchla synthesizer
    f. Other commercial synthesizers
    g. Tendencies in the imitation of conventional instruments
    h. Conclusions
2. Swiched-On Bach and Wendy Carlos's diatonic music
3. Yamaha and the mass industry of musical instruments
    a. Reverse engineering
    b. Yamaha's role in the musical education of the public
4. The computer in music
    a. First efforts
    b. Computer musical applications today

Chapter I. Preliminary data

1. Technology – a catalyst of the 20th century music

Technology has always been inseparable from the development of music. However, in the 20th century, a rapid acceleration took place: a new 'machine' music appeared, electronic musical instruments were developed, and composers often became sound researchers.

The use of electronic technology to compose, organize, project, mix, expand, improvise, perform, and broadcast is now a constituent part of the context of modern experience. As digital visual effects have become so common in the film industry that often we do not notice them, so have we accepted the 'maturation' of electronics that has entered in any imaginable kind of music. Paradoxically, much of technology exists because of electro-acoustic music.

However fascinating exploring the technological universe may be, the present study does not address this area specifically, but rather focuses on the music that exists as result due to the use of electronics. Rock, pop, jazz, film, techno music, blues, and others alike, all use electricity, but they are not the types of electro-acoustic music that are the object of this research project.

Electro-acoustic music, a new genre that has now entered its sixth decade (1950-2010), resulted from technological developments in human civilization and drew in all the aesthetic currents that have existed along the history of music from this period. We will see that, initially, electro-acoustic music appeared in the area of classical music and was then assimilated by entertainment music which has also acquired the term 'electronic music'.

2. Electro-acoustic music – terminological history

Along the history of electro-acoustic music, a number of terms have been adopted which took into account the specific functions and the characteristics of the time: *musique concrète*, *electronic music*, *acousmatic music*, *environmental music*, *tape music*, *electro-acoustic music*, as well as newer terminology, such as *sonic art* or *computer music*.

3. The era of the timbre's emancipation

In the history of European music, the four parameters of sound – pitch, duration, dynamics and timbre – have asserted their full potential at different points in time. If *pitch* was emancipated during the flowering period of the Gregorian chant in medieval times, *rhythm* was emancipated during the Renaissance and the Baroque periods, *intensity* was emancipated during the classic-romantic period, starting with Debussy, the path towards modernism is opened by the emancipation of *timbre*. Why did the composers want to use electro-acoustic sound? Because it brought new timbres and timbral effects.

4. Electro-acoustic music's functionality

The genre of electro-acoustic music is given by the function which it possesses in a specific time and space in society. Over time, this music has had three important functions: radiophonic, environmental, and for the concert hall.

5. Electro-acoustic music's subgenres

Electro-acoustic music has had and still has various subcategories. The delimitations are made in order to give specificity to the ways of production and propagation of the sound, but also to distinguish between the different spaces and times of presentation, relative to the functions electro-acoustic music has in society. Holmes calls the 'electro-acoustic music' genre simply: 'electronic music'; and the delimitations are made towards these directions: 'pure electronic music' and 'electro-acoustic music'. 'Pure electronic music' is created by generating sound waves using electronic means. 'Electro-acoustic music' uses electronics in order to modify sounds from the natural world. In another subcategorical division, as viewed by the Grove Dictionary, the listener is faced with two electro-acoustic realities: that of 'acousmatic music' and that of 'live electronic music'. Today, on a larger scale, three subcategories or subgenres are used: *tape music*, *mixed electro-acoustic music*, and *live electronic music*, which includes the *ensemble of electronic tools*.

6. Ethics and electro-acoustic music

a. The environment and the electro-acoustic music

If along the history of music, the rythm, the dynamics, etc. were endowed with an ethical dimension, we ask ourselves rhetorically if the timbre has a similar ethical value for today's times. Electro-acoustic music picked up daily sounds, generating a reciprocal relationship by the influence of the environment on music as well as the influence of music on the environment.

b. The human voice – the sound machine

When referring to theological concepts about music, there are beliefs that consider the vocal chant as the most appropriate form of expression in a worship service, a direct and unmediated exposure of the human spirit. If the instrument invented by man has an ethically negative connotation, then how is the somewhat more artificial, more distant, electronic device perceived? From the vocal chant to the sound- producing electronic technique, there is a certain distancing as the distancing between man and the device producing the sound.

c. Ethics and aesthetics

If we generalize the aesthetical categories of art, namely music, we get to the antithesis between beauty and ugliness or aesthetic and non-aesthetic, but by no means to the dichotomy between good and evil. The creative musician, who is more concerned about aesthetics than ethics, does not create his own philosophy, but is the exponent of the time's philosophy, being compelled to assess the realities and to find optimal solutions to express himself musically.

d. The modern man between the absolute truth and the relative truth

Long before the mark time of the second half of the 20th century, people were starting from the assumption that if something was true, its opposite was false. In morality, if something is correct, its opposite is wrong. Thus, absolutes imply antithesis. Philosophers have finally realized that they cannot find this system of rational thinking unified, and thus, getting away from the classical methodology of the antithesis, they changed the concept of truth, namely, relative truth – and so was born the modern man.

e. Orientations towards a uniformity of culture

The statement that there is a totally uniform culture is false, but when we study the art and the literature of the past and those things which help us understand a culture, we discover the tendency of a unitary thinking. Today, as the world is 'diminishing', it follows the basic global methodology and way of thinking: the lack of absolutes and antithesis, which leads to pragmatic relativism.

f. The role of philosophy in the new thinking

By Hegel, Kierkegaard, and Sarte's examples, the orientations of relativism from the world of modern thinking are strengthened.

g. Music and the new reasoning

Starting with Debussy, the desire for the disaggregation of sound made itself felt rapidly, having among the main protagonists the composers of the serial music of the new Viennese school. Pausing at *musique concrete*, the message that is transmitted by distortion is the same as in modern painting. Everything is relative, nothing is certain, nothing is stable, everything is flowing. *Musique concrète* represents just one more way of communicating the same message of the modern man. The aesthetics which have succeeded one after another from aleatorim to abstractionism, bruitism, conceptual music, etc., have many times found their materialization by electro-acoustic means.

h. Modern age under the sign of informing and objectiveness

In the past, not only did music hold a cultural-esthetical function, but many other functions including magical, philosophical, therapeutic, etc. Here arises a natural question: why has music lost its original function? It was not music that lost its virtues mentioned by ancient men, but man was gradually veiled sensitivity to these virtues. Corneliu Cezar presents the history of mankind, through what seems an apocalyptic imagery, as a 'falling object'. "The closer it gets to the point of falling, the more its speed increases", an idea reinforced by Olivier Messiaen's observation, "We live in a terrible era."

7. Other problems of electro-acoustic music

a. Golém's myth

Golém's myth is used as a paradigm in the sense that the 'machine' could master the man. Electro-acoustic music is dependent on technology and often it is required to keep pace with the new achievements in the technological field. Also, the speed at which technology progresses leaves no time to the performer/composer musician to perfect his skills, being overwhelmed by ever new possibilities of creation and performance.

b. The condition of the creator / performer artist

Because the electro-acoustic sound is becoming more complex, the electro-acoustic music performer can no longer identify himself with a particular instrument, not to mention a school for perfecting that instrument. The creator artist is many times either the technician or the engineer, as was Pierre Schaeffer.

c. The condition of the listener

Electro-acoustic music has not yet come to be seen with the same objectivity as the inartificial, acoustic origin music. And yet, electro-acoustic music makes its presence felt ever more through various forms of presentation, especially through media sources. Consumer electronics allow music, especially electro-acoustic music, to be listened to in private environments.

d. The condition of the work of art – music semiography

Since 1930, Leopold Stokowski was making the following visionary remarks: "One can see coming ahead a time when the musician who is a creator can create directly into TONE, not on paper." His visions, to a certain extent, have been fulfilled, and if electro-acoustic music uses semiography, this makes use of methods of notation quite different from those of classical writing.

8. Seven reasons why electro-acoustic music is different

There are seven extensively developed claims, by which electro-acoustic music can detach itself from the rest of the musical genres that existed before.

Chapter II. A history of electro-acoustic music

1. Forerunners of electro-acoustic music

In the cultural effervescence of the 20th century, electro-acoustic music is a natural product developed from the major musical trends that have appeared in this period. Amid the emergence of a new avant-garde rejecting the old musical achievements vehemently, going in the direction of the experiment, the instruments of electronic origin appear.

a. Alternative intonational systems and new musical scales

Towards the end of the 19th century, certain composers have questioned the infallibility of the temperate system, which until then had been the main intonational support of the European classical music. Among the first modern composers who experimented new musical scales are Satie, Debussy, and Ives. A number of other composers and theorists began to suggest, in a sense – at the opposite pole – the exploring of the micro-tonal sound material. These trends paved the way to the electro-acoustic avant-garde.

b. Dodecaphony and the new structural principles

The beginning of the 20th century finds Arnold Schönberg detached from the traditional musical system based on the major and minor ranges of seven sounds, blazing the way to the chromatic space, named dodecaphonic. Webern raises the 12 tone technique to much higher altitudes, applying strict rules for determining the pitch, the timbre, and the rhythm, but this is only a step in the emancipation of sound organization. *Total serialism* is the first change, where the Viennese doctrine is applied to all sound parameters. The one who propels the new stage of serialism is Olivier Messiaen through his piano work *Modes des valeurs et d'intensités*. However, in the 1950s, the serial doctrine is strictly and dogmatically implemented by Pierre Boulez, Luigi Nono, and Karlheinz Stockhausen.

c. Futuristic music and the art of noise

In 1911, composer Francesco Balilla Pratella published a manifesto, *Futuristic Music*. A painter named Luigi Russolo was so deeply influenced that he wrote his own manifesto, "The Art of Noise" (1913). Russolo's ideas were much more extreme than those of Pratella's. With

the help of painter Ugo Piatti, Russolo designed and built various sound producing mechanical instruments.

2. Pioneers of electronics in music

Electro-acoustic music is the direct result of the composers' creation who have dreamt of new sound worlds, but also of the technological achievements that have born a true arsenal of means of sound production, recording and processing. The famous German physician, Hermann Helmholtz published in 1863 *"On the Sensations of Tone as a Physiological Basis for the Theory of Music"*, a book that lays the foundation of modern acoustics.

Some of the earliest mechanisms that produced sounds by electricity were the result of experimental accidents. Here we can remember the names of inventors Elisha Gray, Ernst Lorenz, and William Duddell.

Cahill runs what might be called the most ambitious project ever conceived for electro-acoustic music – the gigantic Telharmonium – weighing approximately 200 tons. Also, Cahill experiences one of the most ingenious ways of transmission of music produced by an electronic device – the network of leased telephone lines. The Theremin, *Ondes Martenot*, and the Trautonium are among the first electronic musical instruments that resonated in the first half of the 20th century.

"Military technology and musical experimentation" is a topic little explored. In the 1920s and 1930s, many physicians and engineers have conducted research on musical instruments, but also on military mechanisms.

Although it did not play a direct role in the development of electro-acoustic music, Hammond enriched the pallet of technological innovations used by the avant-garde and also, by the impressive number of models sold, contributed to the popularization of instruments that use electronic technology.

3. Magnetic tape – scaffolding for musique concrète

The next step in the evolution of electro-acoustic music took shape amid the emergence of the trivial tape recorder. Until its appearance, electro-acoustic music was just a means of live performance. The tape recorder transformed electro-acoustic music over night, becoming a medium for the composers. Since the first artisans (Cage, Schaeffer, Henry, and Varèse) who used the tape as a means of composition, the effect was to abandon the traditional writing of scores and parts. Even if the practice of composing with magnetic tape is outdated today, many of the basic effects associated with electro-acoustic music were initiated by pioneers who learned how to push the limits of this fragile medium. The first methods of editing were cutting and splicing the magnetic tape. Manipulation of the magnetic tape in creating sound

effects has been known since the first experiments in tape composition. Four sound effects are detailed: *the echo*, *the loop*, *the tape delay*, and *tape reversal*.

4. Electro-acoustic music studios in the 1950s and 1960s

Early electro-acoustic music made its entrance at the same time with the establishment of the major institutional studios. The music produced by these studios was considered somehow more legitimate than the music produced by those outside them. The studios in Europe were subsidized by the government as part of research programs or as national projects of radio experiments. In the United States, the studios were usually affiliated with universities or with private commercial recording companies, serving the entertainment industry. In 1966, only 18 years since the establishment of the first important electro-acoustic music studio – *Groupe de Recherches Musicales* (GRM) in Paris – there were about 560 institutional and private studios known in the world. Of these, approximately 40% were supported by various institutions.

a. Pierre Henry and Pierre Schaeffer – origins in France

The collaboration of the french Pierre Schaeffer and Pierre Henry generated a revolution in music, putting electronic technology in the forefront of classical music. In 1948, Schaeffer writes the first complete works of *musique concrète*, term invented by Schaeffer to denote the use of sound 'objects' from nature, 'concrete' sounds of the real world. In 1951, after further works and successful experimental transmissions, RTF provided funds for the establishment of the first sound studio in the world designed exclusively for the production of electro-acoustic music – the GRM. One of Schaeffer's achievements was to bring significant composers to the studio, including Luc Ferrari, Iannis Xenakis, and Edgar Varèse. There these composers created some of the most influential tape compositions of all times.

b. Elektronische Musik and the German school

Unlike the French, where the experiments were perpetuated by natural inertia, the Germans developed systematically, first by theoretical studies and then by musical practice. Meyer-Eppler, Beyer, and Eimert's collaboration led to the creation of the most famous electro-acoustic music studio in the world at that time – the WDR studio in Cologne – in 1953.

The establishment of the studio brought with it a series of ideological tensions between the WDR studio in Cologne and the RTF studio in Paris. Despite Schaeffer's reactions to the great power of influence of serialism after WWII, the new generation of young German composers, but also the remarkable non-German composers, Boulez and Babbitt, supported this trend. The German studio had a predisposition for electronic musical instruments.

c. The Columbia-Princeton studio

After WWII, the United States goes through a different path than Europe regarding electro-acoustic music, particularly due to the lack of institutional support in the first years. Cage, Ussachevsky, and Luening's experiments became known as *tape music*, based on the use of the tape recorder as a tool of recording and manipulation of the sound material. The RCA synthesizer, inaugurated in 1955, was the first sound synthesizer in the modern sense. Luening and Ussachevsky join forces with composers Babbitt and Sessions for experiments with tape music and with the *RCA Mark I* and *II* synthesizer. The chance of becoming owners of the RCA music synthesizer transformed the 'electronic music center' Columbia-Princeton into the leader of the main studios of the world.

Many composers associated with the *Columbia-Princeton Electronic Music Center* were absorbed by the American serialism in the 1950s-1960s. The RCA synthesizer was actually designed as a programmable machine of dodecaphonic music. This does not mean that there were no other types of music coming out of the studio. Varèse and Stockhausen's influence was apparent in the works composed there when the center opened its doors to the world in 1959.

5. Electro-acoustic music's visionaries: Cage, Varèse, and Stockhausen

a. John Cage and the concept of aleatorism

While many of his contemporaries, especially in Europe, seek serial methods of controlling any aspect of the written music, Cage is exploring the entire musical material using composing techniques whose outcome is not foreseen: composition 'indetermined of its performance'. Cage does not restrict his sound pallet to a certain number of musical scales, but he opens his ears to any sound and to all possible sounds, determined or undetermined. With *William Mix* (1952), Cage leads the way to using splicing techniques as a major compositional element of a musical piece, and not as a method to mask the transition from a recorded sound to another.

b. Cage's live performance works

Formal tape composition restrictions begin to not be positively assimilated by the public, and thus the Project of Music for Magnetic Tape "sets" around 1954. From here, Cage extends his interest in using electronic facilities for live performances, the tape being used only as source. Cage's live performances expand in the mid 1960s towards a cultural syncretism of theater, dance, film, and music creating new and unexpected situations. Cage pushes the creative efforts of electro-acoustic music from the elaborate and tape recorded kind to the one generated live, creating unique artistic events.

c. Varèse and organized sound

Edgar Varèse, like Cage, is one of the reference figures in modern music. Following electro-acoustic engineering studies, he was the first who wanted to make music with sounds, and not notes. If there had been electronics since 1916, he would have been the only musician able to follow it.

Déserts is his first tape composition, completed at Schaeffer's initiative in the GRM studio, in 1954. He also composed *Poème electronique* as an 'organized sound' work. This was, in fact, his version of *musique concrète* and he worked with many traditional editing techniques and tape effects, first used by Schaeffer and Henry. Although the electronic technology, which deeply marked the history of music, becomes an instrument for the composer later than he would have liked, he remains not only a precursor of the 20th century music, but one of its great creators.

d. Stockhausen – a cosmic music for a cosmic era

Stockhausen has unified time in music and this has many similarities to the unified field theory in physics; this was his attempt to find a basic element of control over all sound parameters. This attempt to exercise precise control over all sound elements is an obsession that appears in all of Stockhausen's most spectacular works. *Studie I* (1953) was the purest example of serial music from his early works. It was composed using sinusoidal waves, without harmonics, through an additive synthesis process. Years later, in 1971, he revised the way in which he had analyzed the electro-acoustic music composition in four reference principles: the unified structure of time, the fragmentation of sound, the spatial composition on many layers, and the equality between sound and noise. At first glance, this idea reminds us of Cage. However, Stockhausen gives noise a definition much different from that of Cage's. Stockhausen assigns to the electro-acoustic music means of controlling the continuity between sound and noise. In terms of electro-acoustic music composition, he prefers the 'construction' of noise – controlled sounds – and not to leave all natural sounds as they are. He became increasingly fascinated by the spatial projection of music, and in 1958 he composes *Kontakte*, using a four-track tape. Stockhausen's tape works in the 1960s were few in number, but influential. The most influential electro-acoustic music piece was *Hymnen*. It remains the most beautiful example of tape composition of the 1960s.

Chapter III. Electro-acoustic music in Romania

1. A non-exhaustive history

Electro-acoustic music in Romania starts in 1965, 15 years after its occurrence in the West. In an institutional context, the emergence of the genre in Romania is due to favorable technological conditions, at the Conservatory of Bucharest (UNMB), during Victor Giuleanu's rectorship.

a. Romanian political context of the years 1960-1970

In a short period of time (1964-1974), there is a 'cultural explosion', perhaps one of the greatest in the Romanian history of the 20th century. It is the period in which the national origins of culture are rediscovered and reappraised, when intellectual contacts with the western world are resumed; the arts and the cultural activities claim their rights and obtain a relative autonomy from the official political directives.

b. First initiatives in the Romanian electro-acoustic music

In the context of liberalization, an electro-acoustic music micro-studio opens at UNMB. The studio is designed after the Cologne studio from 1955. It is noted here a technological gap of about ten years. The equipment was not sufficient for making an electro-acoustic piece, as to which composers creating such pieces starting with 1965 had to travel between two or even three institutions which had the necessary equipment for creation. Of those who undertook the first efforts in achieving the UNMB studio are Dinu Petrescu, Sorin Vulcu, Aurel Stroe, and Iancu Dumitrescu.

c. Pioneering works – the years 1960-1970

The first electro-acoustic work completed under the specific conditions of the UNMB studio, the Radiotelevison, and the Buftea center, is *AUM*, a tape music piece by Corenliu Cezar, made after the model of many westerners, without a score. Meanwhile, *AUM* "is an electro-acoustic piece that inaugurates spectralism in the Romanian music". The second piece is *Combinations in Circles* by Octavian Nemescu, a *mixed electronic music*. The prolific composers of this period include Sorin Vulcu, Dinu Petrescu, and Aurel Stroe. In 1970, the first composer to write a piece in a studio abroad is Lucian Meţianu. Liviu Dandara also writes a series of three tape music pieces in two experimental studios of the Czechoslovakian Radio.

Technologically, Romanian electro-acoustic music experiments a new stage of emancipation: the first synthesizer created in Romania, by Erica Nemescu, in 1975. The same year, the Radiotelevision is equipped with an AKS synthesizer, and the UNMB studio

becomes increasingly uninteresting for composers starting with 1974.

d. The 1980s

The 1980s are very fruitful in terms of electro-acoustic music; Nemescu is the first Romanian to receive an award at Bourges. Another important international recognition is given to Nemescu, The Award of the International Confederation of Electro-acoustic Music, for *Natural – Cultural* in 1985. Technologically, after 1980, the Radiotelevision is equipped with a new synthesizer, a Korg, much better than the old Synthi AKS. Nicolae Brânduș and Călin Ioachimescu, both with computer music training at the IRCAM, distinguish themselves from the new generation of composers.

e. After 1990s

The year 1990 is marked by two important moments for the Romanian electro-acoustic music – both, initiatives of the Union of Composers and Musicologists of Romania (UCMR). Thus, the New Music Festival is organized and the proposal for establishing an electro-acoustic studio at UCMR is launched, both initiatives being designed to support and promote contemporary music creation. Starting with 1992, the Electro-acoustic Music and Recording studio (SMEI) of the UCMR begins to operate. It is the first studio in Romania that has all necessary equipment for the creation of electro-acoustic music. The studio consists of two types of equipment: one for the production of sound and one for the recording and the processing of the audio and MIDI signal.

The UCMR studio, after almost 20 years since its establishment, is unchanged, and therefore, slightly outdated. Although the institution made arrangements with the empowered state institutions for the improvement of the equipment, the worldwide tendency is that of 'privatization'. The UCMR studio comes at a time when the majority of the world composers create their own studios at home without a costly financial investment. As a result, major studios enter into a state of 'unemployment', and the GRM, IRCAM, Cologne, etc. studios become 'museums'.

In addition to those of the previous generations who still create electro-acoustic music, the great majority activating in the SMEI studio, include: Maia Ciobanu, Ulpiu Vlad, Mihaela Stănculescu Vosganian, and Irinel Anghel.

2. Statistics

For a more complete picture of the electro-acoustic music phenomenon in Romania, a statistical evaluation is necessary, both in terms of the number of composers who had an important contribution and the volume of electro-acoustic works, divided into subgenres.

For the evaluation in terms of the number of composers, it is found that this electro-acoustic genre is promoted and cultivated, almost exclusively, by composers of the generation of the 1970s, after which interest in electro-acoustic music decreases. The conclusion of this first assessment is that between the Romanian and Western electro-acoustic music there is a gap/delay of about 15 years. Both go through a similar route: a period of prosperity, which in the West is between the years 1950-1960, and for Romania in the 1970s, followed by a gradual, but certain, decline.

The second evaluation can be done according to the genre's subcategories: *tape music*, *live electronic*, and *mixed electro-acoustic music*. The latter is the subgenre which detaches clearly from the other two.

3. Aesthetic influences

The electro-acoustic genre, emerged internationally in the second half of the 20th century, absorbs almost all of the aesthetical trends and directions that exist in classical music over almost 60 years. If in the 1950s the aesthetical dominant is focused on total serialism, bruitism, and abstractionism, the following decades are marked, among others, by texturism, aleatorism, spectralism, minimalism, meta and poly-stilism. The Romanian electro-acoustic music inevitably bears the imprint of the Western influences, but it can be proud to also bear the vanguard of national aesthetical currents. Of the currents with national origins, the *spectralism* and *archetype current* are presented. Among the trends found in the Romanian electro-acoustic music, there are *non-evolutionary music* (as a reaction to serialism, structuralism and aleatorism), *world music*, *cosmic music*, *fusion* influences, *environmental music*, and the *oniric* trend.

4. The electro-acoustic in Octavian Nemescu's vision

An emblematic personality for the Romanian electro-acoustic music, Octavian Nemescu has a decisive impact on the emancipation of the avant-garde movement. The majority of his works falls within the subgenres of *mixed electro-acoustic music* and *live electronic*.

Three of Octavian Nemescu's works play an important role in terms of aesthetic ideas, as well as in terms of electro-acoustic music genre: his 'mixed' works *Combinations in Circles* and *Concentric*, and from the *tape music* subgenre, the work *Natural-Cultural*.

5. Final considerations

On the list of the most representative international works of the 1980s, there are no composers from the pioneering countries, but rather from the countries of 'the second wave', which, like Romania, registered a delay, especially a technological one. The lowered interest

of the composers from the initiating countries predict the 'fall' of this genre in its experimental vision. The mixed electronic music subgenre is used the most by Romanian composers; this subgenre presents some potential for the future. From the multitude of benchmarks that govern music in general, two important coordinates constitute the 'guide' for electro-acoustic music today: technology and aesthetics. If technologically, Romanian composers recover from the gap before 1990, aesthetically it is yet to be seen if the vanguard and post-modern paradigms are the future directions of electro-acoustic music.

Chapter IV. From avant-garde to entertainment

We cannot exactly delineate where the vanguard electro-acoustic music lost its energy, but the fact is that the giant technological arsenal served the entertainment music world successfully. This chapter presents some of the multitude of factors that have shifted the electro-acoustic music's center of gravity from the tight vanguard perimeter towards the largely accessible music.

1. Robert Moog and the social construction of the first synthesizer

For a clearer understanding of the emergence, development, and direction that given by synthesizers, it is necessary to make a correlation with the sociology of technology. It is important to understand how the development of a technological product is negotiated amongst many 'relevant social groups' involved in its production and the relevant social groups that share a certain understanding of technology.

Moog's synthesizers represent the gold standard of the electro-acoustic music industry, being the most used tool (in any of its forms) in the electro-acoustic music studios in the late 1960s and the 1970s. A small, curious, classical recording by Columbia Records produces the necessary success to propel the Moog synthesizer in the public awareness. This album is *Switched-On Bach*, by Wendy Carlos. Following the success of Moog and Buchla's systems, towards the end of the 1960s, many new producers entered the market with various forms of voltage-controlled modular synthesizers. Among the producers of instruments who have entered the war of synthesizers were *ARP*, *Oberheim*, *Korg*, *Yamaha*, *Roland*, *EMS*, and *Crumar*, of which some still continue to make products for electro-acoustic music. The synthesizer has evolved into the desired tool worldwide, but as it lost its initial indistinctness, it also lost its initial appeal to the instrumentalists, the composers, and the engineers bordering the limits of musical creativity.

2. Swiched-On Bach and Wendy Carlos's diatonic music

Carlos brought the synthesizers from the cold atmosphere of the academic electro-acoustic music studios into the light of public awareness. Furthermore, she brought back consonance into electro-acoustic music. In order to avoid opposition from the institutional guild, Carlos prefers to start her career on her own. Her music is experimental in that it restructures the tonality and the digital abstraction of acoustic sounds, however familiar to the sentimental and intellectual human core.

3. Yamaha and the mass industry of musical instruments

Just as with Robert Moog's synthesizers, Yamaha succeeds to make accessible to the public the purchase of electronic instruments, including high-performance synthesizers. Thus, the industrial giant opens new musical horizons directly involving the society in the most global sense. Yamaha, the most famous piano manufacturer in Japan, has developed a reputation by mass production, by wise marketing of electronic instruments, and by a system of popular music schools.

4. The computer in music

Computer technology exercises a powerful and ever increasing influence on society. The personal computer (PC) in particular holds the key to a variety of processing possibilities that were unimaginable less than a generation ago. Today's computer processors are used in a very broad range of musical equipment: composition and notation, MIDI control and sequencing, sound synthesis and manipulation, digital recording and mixing, and control and performance software.

5. Reflections on electro-acoustic music

Steve Reich said that "electronic music as such will gradually die and be absorbed into the ongoing music of people singing and playing instruments". It seems that we have reached this stage and today we should 'celebrate' both the appearance and the disappearance of electro-acoustic music.

Chapter V. Technological perspectives

The beginning of the 21st century finds electro-acoustic music at an impressive point, especially in its technology. The current availability of the processing power, prolific not only in the form of the omnipresent conventional PCs, but also in the nonconventional processing concepts, has opened new opportunities for both designers and musicians. The new technology offers the incredible possibility for music equipment designers to start from scratch. This

provides great freedom, but also great challenges. This stems from the fact that, probably unique in the history of music performance, it is possible to separate sound production entirely by the means used to control it.

1. Performance control devices

a. Control devices via MIDI

The adoption of the keyboard as the main input and control device for the commercial electro-acoustic music systems and computer music has a significant influence on the processes of composition and performance in the electro-acoustic environment.

***b**. Limitations and adaptabilities of MIDI*

The issues addressed here are potentially complex, as the physical detecting of the instrumental performance characteristics via MIDI cannot always provide all information necessary for a complete and accurate data capture, especially those nuances of expression.

c. Preliminary data about gestural controllers

With the emergence of the software synthesizers and the availability of faster and more affordable PCs, musicians started to use the computers as a musical tool. Software synthesizers allow more flexibility. A growing number of musicians and scientists have started to implement their own digital musical instruments and to create a requirement for controllers other than the keyboard. The study of gestures is a vast and complex area of research. Actually, the term ‘gesture’ can be used as referring to a number of things such as movements with the bare hand, movements involving the handling of an object, general movements of the body, dynamic contours in the perception and the production of music, and even the sensation of touch, taste, and smell.

When the performer and the acoustic instruments meet, the gestures can be captured in at least three different ways: directly, indirectly, and by physiological acquisition.

d. Tactile controllers

Any controller that uses manipulative gestures but does not resemble existing acoustic instruments can be considered a tactile controller.

e. Expanded-range controllers

This category of controllers may require little or no physical contact, in a limited field of gestures, meaning that the performer can at any time ‘exit’ from the control surface (to make moves without musical consequences).

f. Immersive controllers

This type of controllers has little or no restriction on the movements of the performers, which are in the detection field all the time without the possibility to 'exit' the control surface.

g. Other gestural controllers

i. For amplified flute, among the examples described in the literature, probably the oldest example is the MIDI flute, designed at IRCAM.

ii. Examples of controllers initiated to provide control variables using mouth movements (gestural interface controlled by the oral cavity).

iii. To control music by conducting gestures, a great number of systems was produced. Among the first systems associated with conducting are: the *Conductor* program from 1976 and the sequential drum from 1980, both by Max Mathews.

iv. Optical detection techniques also proved to be a productive line of research in developing controllers based on gestures.

v. The term *biosignal* refers to the electrical signals produced by the human body, such as signals from nerves, muscles, and the brain.

h. Comparison principles for control gestural devices

The examples given are just a few of the hundreds of gestural controllers and digital music instruments found in literature. The problem facing a musician who is thinking to perform with gestural cotnrollers is: How is a controller chosen over another for certain musical presentations? From the perspective of interaction, there is a collection of comparative features.

2. New horizons in synthesis and signal processing software

Over the years, electro-acoustic music has embraced a constantly developing repertoire of signal synthesis and processing technologies. An important factor in shaping the course of these developments has been the changing nature of the relationships between composers and performers, as well as of those responsible for the technical development of the medium. Among the directions of development are physical modeling, voice synthesis, and spatial sound projection software. The development of the Internet has transformed the world of communications and none the less its ability to distribute audio and video information in a multimedia environment.

3. Final considerations

With the arrival and early maturation of the new millennium, it is reasonable to suggest that digital technology now has the ability to meet almost any creative requirements. Opportunities for composers and performers, both amateurs and professions, have never been so broad and full of achievements in the existing medium of artistic expression. Only time will tell how profitably applied they will be.

Instead of conclusions

In addition to the important conclusions at the end of chapters III, IV, and V, it is necessary to add some final considerations: the purpose for which the thesis was written, information resources, and research methods.

Electro-acoustic music was born in the experimental context of classical, academic music moving towards a maturity which has led it to commercial, non-institutionalized territories, with a nearly indestructible destination towards entertainment; it is like a bridge linking the two dominant poles of music from a scientific, but also social, perspective.

Bibliografie (selectivă)

Dicţionarul explicativ al limbii române, Academia Română, Institutul de Lingvistică „Iorgu Iordan", Editura Univers Enciclopedic, 1998.

Dicţionar de mari muzicieni: Larousse, Univers Enciclopedic, Bucureşti, 2000.

Dicţionar de termeni muzicali, Editura ştiinţifică şi enciclopedică, Bucureşti, 1984.

Mic Dicţionar Enciclopedic, Editura Ştiinţifică şi Enciclopedică, Bucureşti 1986.

Noul dicţionar explicativ al limbii române, Litera Internaţional, Editura Litera Internaţional, 2002.

The Harvard Dictionary of Music, ediţia a patra, editat de Don Michael Randel, Harvard University Press, 2003.

The New Grove Dictionary of Music and Musicians, ediţia a doua, 2001, Oxford Music Online.

Cosma, Viorel – *Muzicieni din România: Lexicon biobibliografic*, Volumele I-IX, Editura Muzicală, Bucureşti, 1989-2006.

Timaru, Valentin – *Dicţionar noţional şi terminologic*, Editura universităţii din Oradea, 2004.

Anghel, Irinel – *Orientări, direcţii, curente ale muzicii româneşti din a doua jumătate a secolului XX*, Editura Muzicală, Bucureşti, 1997.

Appleton, Jon H. şi Perera, Ronald C. (editori) – *The Development and Practice of Electronic Music*, Prentice-Hall, Englewood Cliffs, 1975.

Armbruster, Greg (editor) – *The Art of Electronic Music*, W. Morrow, New York, 1984.

Attali, Jacques – *Noise: Political Economy of Music*, University of Minnesota Press, Minneapolis, 1985.

Austin, William W. – *Music in the 20th Century*, Norton, New York 1966.

Barela, Margaret M. (editor) – *Celebrating the Fortieth Anniversary of the Museum of Modern Art Tape Music Concert: Reflections on the History and Future of Electroacoustic Music* (CMS Report Nr. 11), The College Music Society, 1997.

Bijker, Wiebe E. – Hughes, Thomas Parke şi Pinch, Trevor J. (co-autori), *The Social Construction of Technological Systems: New Developments in the History and Sociology of Technology*, MIT Press, Cambridge, MA, 1987.

Brânduş, Nicolae – *Interferenţe*, Editura Muzicală, Bucureşti, 1984.

Braun, Hans-Joachim (editor) – *I Sing the Body Electric: Music and Technology in the 20th Century*, Wolke Verlag, 2000.

Cage, John – *Silence*, Wesleyan University Press, Middletown, CT, 1961.

Cezar, Corneliu – *Tratat de sonologie: Spre o hermeneutică a muzicii*, Editura Anastasia, Bucureşti, 2003.

Chadabe, Joel – *Electric Sound: The Past and Promise of Electronic Music*, Prentice Hall, Upper Saddle River, NJ, 1997.

Davies, Hugh – *Répertoire international des musicques électroaciustiques*, MIT Press, Cambridge, MA, 1967.

Davies, Stephen – *Musical Works & Performance: A Philosophical Exploration*, Oxford, New York, 2001.

Douglas, Alan – *The Electronic Musical Instrument Manual*, TAB Books, Blue Ridge Summit, PA, 1976.

Duckworth, William – *Talking Music*, Da Capo, New York, 1999.

Eisenberg, Evan – *The Recording Angel: Music, Records and Culture from Aristotle to Zappa*, Yale University Press, London, 2005.

Giuleanu, Victor – *Tratat de teoria muzicii*, Editura Muzicală, Bucureşti, 1986.

Glinsky, Albert – *Theremin: Ether Music and Espionage*, University of Illinois Press, Urbana, IL, 2000.

Holmes, Thom – *Electronic and Experimental Music: Technology, Music, and Culture*, ediția a treia, Routledge, New York, 2008.

Holmes, Thom – *Electronic and Experimental Music: Pioneers in Technology and Composition*, ediția a doua, Routledge, New York, 2002.

Iliuț, Vasile – *De la Wagner la contemporani*, vol. V, Editura Muzicală, Bucureşti, 2001.

Kock, Winston E. – *The Creative Engineer: The Art of Inventing*, Springer, New York, 1978.

Kostelanetz, Richard – *John Cage: An Anthology*, Da Capo, New York, 1991.

Laurel, Brenda (editor) – *The Art of Human-computer Interface Design*, Addison-Wesley, Reading, PA, 1990.

Lieder, Colby – *Digital Audio Workstation*, McGraw Hill Co., New York, 2004.

Luening, Otto – *The Odyssey of an American Composer: The Autobiography of Otto Luening*, Charles Scribner's Sons, New York, 1980.

Maconie, Robin – *Other Planets: The Music of Karlheinz Stockhausen*, Scarecrow Press, Inc., Lanham, MD, 2005.

Maconie, Robin (editor) – *Stockhausen on Music: Lectures and Interviews*, Marion Boyars, London, 2000.

Manning, Peter – *Electronic and Computer Music*, Oxford University Press, Cary, NC, 2004.

Manolache, Laura – *Amurgul evului tonal: conceptele consonanţă-disonanţă de la antagonism la complementaritate*, Editura Muzicală, Bucureşti, 2001.

Mattis, Olivia – *Lincoln Center Festival 2000 program notes*, Lincoln Center, New York, 19 iulie 2000, pag. 20B.

McLuhan, Marshall – *Understanding Media*, McGraw-Hill, New York, 1965 (re-editată în 2001 la Routledge, New York).

Mihuleac, Wanda – *Proiecte ecologice*, Uniunea Artiştilor Plastici din România, 1980.

Miranda, Eduardo R. şi Wanderley, Marcelo M. – *New Digital Musical Instruments: Control and Interaction Beyond the Keyboard*, A-R Editions, Inc., Middleton, WI, 2006.

Munteanu, Viorel – *Roman Vlad: modernitate şi tradiţie*, Editura Muzicală, Bucureşti, 2001.

Oliveros, Pauline – *Software for People: Collected Writings 1963-80*, Smith Publications, Baltimore, MD, 1984.

Preston-Dunlop, Valerie Monthland (editor) – *Dance Words*, Harwood Academic Publishers, Chur, Elveţia, 1995.

Rădulescu, Speranţa – *Peisaje muzicale în România secolului XX*, Editura Muzicală, Bucureşti, 2002.

Revill, David – *The Roaring Silence: John Cage: A Life*, Arcade, New York, 1992.

Roads, Curtis – *The Computer Music Tutorial*, MIT Press, Cambridge, MA, 1996.

Roads, Curtis (editor) – *The Music Machine: Selected Readings from Computer Music Journal*, MIT Press, Cambridge, MA, 1989.

Rogalsky, Matt – *Live Electronic Music Practice and Musicians of the Merce Cunningham Dance Company*, Wesleyan University, Middletown, CT, 1995.

Russcol, Herbert – *The Liberation of Sound: An Introduction to Electronic Music*, Prentice Hall Inc., Englewood Cliffs, NJ, 1972.

Sandu-Dediu, Valentina – *Muzica românească între 1944-2000*, Editura Muzicală, Bucureşti, 2002.

Schaeffer, Francis A. – *Trilogia*, Editura Cartea Creştină, Oradea, 2002.

Schaeffer, Pierre – *Machines à communiquer*, Editions du Seuil, Paris, 1970.

Schafer, R. Murray – *The Tuning of the World*, Alfred A. Knopf, New York, 1977.

Shapiro, Peter – *Modulation*, Caipirinha, New York, 2000.

Stockhausen, Karlheinz – *On Music*, Marion Boyars, London, 1989.

Stravinsky, Igor – *Poetics of Music in the Form of Six Lessons*, Vintage, New York, 1947.

Stuckenschmidt, H. H. – *Twentieth-Century Music*, McGraw-Hill, New York, 1970.

Teodorescu-Ciocănea, Livia – *Timbrul muzical. Strategii de compoziţie*, Editura Muzicală, Bucureşti, 2004.

Théberge, Paul - *Any Sound You Can Imagine. Making Music / Consuming Technology*, Hanover, London, 1997.

Tismăneanu, Vladimir (editor) – *Dobrincu, Dorin şi Vasile, Cristian* (co-editori), *Raport final: Comisia Prezidenţială pentru Analiza Dictaturii Comuniste din Romania*, Humanitas, Bucureşti, 2007.

Urmă, Dem. – *Acustică şi muzică*, Editura ştiinţifică şi enciclopedică, Bucureşti, 1982.

Vlad, Roman – *Istoria dodecafoniei*, Ediţie îngrijită şi adăugită, studiu, note şi comentarii de Viorel Munteanu, Editura Naţional, Bucureşti, 1998.

Wachsmuth, Ipke – Martin Fröhlich (co-editor), *Gesture and Sign Language in Human-computer Interaction: Proceedings of the II Gesture Workshop*, Springer-Verlag, Heidelberg, 1997.

Wanderley, Marcelo M. – Battier, M. (co-editor), *Trends in Gestural Control of Music*, IRCAM – Centre Pompidou, Paris, 2000.

Weidenaar, Reynold – *Magic Music from the Telharmonium*, Scarecrow Press, Metuchen, NJ, 1995.

Articole în jurnale, conferinţe

„Bourges Electroacoustic Music Competition 1998", *Computer Music Journal*, The MIT Press, vol. 22, nr. 4, 1998.

„Leonardo Da Vinci", *Art Gallery*, revistă de colecţie, vol. 2, Editura DeAgostini, Bucureşti, 2007.

Anghel, Irinel – „Consideraţie asupra conceptului de metamuzică", *Revista Muzica*, nr. 4, 1992.

Anghel, Irinel – note de album (CD), *Călin Ioachimescu, Around the Sound*, Nova Musica, ICD 1001, 1996.

Baltazar, Loredana – „Destinul operei deschise în contextul muzical românesc", *Revista Muzica*, Bucureşti, nr. 1, 1996.

Bran, Vasile – articol din ziarul *România liberă*, nr. 8, 1973.

Braun, Hans-Joachim – „Advanced Weaponary of the Stars", *American Heritage of Invention & Technology*, 1997, anul 12, nr. 4.

Cazaban, Costin – note de album, *Liviu Dandara* (LP), Electrecord, Bucureşti, 1977, ST-ECE 02037.

Dack, John – „Pierre Schaeffer and the Significance of Radiophonic Art", *Contemporary Music Review*, Harwood Academic Publishers, 1994.

Dandara, Liviu – „Program" la lucrarea *Affectus memoria*, Radioteleviziunea Română, 18 martie 1975.

Davies, Hugh – „Hammond organ", *The New Grove Dictionary of Music and Musicians*, ediţia a doua, 2001, Oxford Music Online.

Dhomont, Francis – „Pierre Henry", *The New Grove Dictionary of Music and Musicians*, ediţia a doua, 2001, Oxford Music Online.

Dhomont, Francis – „Pierre Schaeffer", *The New Grove Dictionary of Music and Musicians*, ediţia a doua, 2001, Oxford Music Online.

Dogaru, Anton – „Cu Octavian Nemescu despre muzica electronică", *România liberă*, nr. 32, 7 august 1980.

Dohnalová, Lenka – „Electro-acoustic Music in Czech Republic", capitol din dizertaţia *Aesthetic Models of European Electro-Acoustic Music and Electro-Acoustic Music in Czech Republic*, Universitatea Palacký, Olomouc, Cehia, 1998, publicat la adresa de internet, http://publib.upol.cz/~obd/fulltext/Aesthetica19/Aesthetica19_04.pdf

Duncan, Carol – „Who Rules the Art World?", *Socialist Review*, iulie/august 1983.

Eimert, Herbert – „How Electronic Music Began”, *Musical Times*, nr. 1550, aprilie 1972.

Elian, Edgar – note de album, *Dinu Petrescu, Ciclul „Cosmofonie”* (LP), Electrecord, Bucureşti, 1984, ST-ECE 02719.

Emmerson, Simon şi Smalley, Denis – „Electro-acoustic music”, *The New Grove Dictionary of Music and Musicians*, ediţia a doua, 2001, Oxford Music Online.

Florea, Anca – note de album (CD), *Interferenţe – Mihaela Stănculescu Vosganian*, Institutul Francez Bucureşti, 2005.

Georgescu, Corneliu Dan – note de album (CD), *Elektronische Ambientale Musik*, DOCOR Musikverlag, Berlin, 2000.

Gregory, Richard L. – „Perception of Knowledge”, *Nature*, nr. 410, martie 2001.

Henry, Pierre – interviu realizat de Ios Smolders, iniţial apărut în revista *Vital*, nr. 44, 1995, ESTWeb, din http://media.hyperreal.org/zines/est/intervs/henry.html

Husarik, Stephen – „John Cage and LeJaren Hiller: HPSCHD, 1969”, *American Music*, vol. 1, nr. 2, 1983. Publicat de University of Illinois Press, http://www.jstor.org/stable/3051496

Ioan, Rodica – „Nuova musica consonante”, *Actualitatea muzicală*, nr. 1, ianuarie 2004.

Jordà, Sergy – „Afasia: The Ultimate Homeric One-man-multimedia-band”, *Proceedings of the 2002 International Conference on New Interfaces for Musical Expression* (*NIME'02*, Dublin, Irlanda), Media Lab Europe, Dublin, 2002.

Keane, David – „The 1985 Bourges Festival: A Report”, *Computer Music Journal*, vol. 10, nr. 2, 1986.

Koenigsberg, Christopher K. – „Karlheinz Stockhausen's New Morphology of Music Time” (articol nepublicat), Mills College, decembrie 1991, http://www.music.princeton.edu/~ckk/smmt/serialism.3.html

Lewisohn, Leonard – „The Sacred Music of Islam: Samā' in the Persian Sufi Tradition”, British Journal of Ethnomusicology, vol. 6, 1997, publicat de „Forum for Ethnomusicology”, http://www.jstor.org

Lusted, H. S. şi Knapp, R. B. – „Controlling Computers with Neural Signals”, *Scientific American*, Octombrie, 1996.

Mondloch, Katie – „A Symphony of Sensations in the Spectator: Le Corbusier's Poème électronique and the Historicization of New Media Arts”, *Leonardo Music Journal*, vol. 37, nr. 1, MIT Press, Cambridge, MA, 2004.

Nemescu, Octavian – „Legendă pentru banda magnetică”, *Concentric* (partitura), Editura Muzicală, Bucureşti, 1996.

Nemescu, Octavian – „Program” la lucrarea *Concentric*, Radioteleviziunea Română, 13 februarie 1973.

Nemescu, Octavian – note de album, *Corneliu Cezar – Ziua fără sfârşit*, Editura Muzicală, Bucureşti, 2000, CD BIEM UCMR-ADA 0516153.

Nemescu, Octavian – note de album, *Gradeaţia – Natural* (LP), Electrecord, Bucureşti, 1983, ST-ECE 02330.

Nemescu, Octavian – Note explicative din partitura *Combinaţii în cercuri*, Editura Muzicală, 1997.

Orton, Richard – „Ring Modulator”, *The New Grove Dictionary of Music and Musicians*, ediția a doua, 2001, Oxford Music Online.

Orton, Richard și Davies, Hugh – „Ondes Martenot”, *The New Grove Dictionary of Music and Musicians*, ediția a doua, 2001, Oxford Music Online.

Palombini, Carlos – „Musique Concrète Revisited”, *Electronic Musicological Review*, vol. 4, iunie 1999.

Popovici, Fred – note de album, *Lucian Mețianu* (LP), Electrecord, București, 1977, ST-ECE 02038.

Pressing, J. – „Cybernetic Issues in Interactive Performance Systems”, *Computer Music Journal*, nr. 14, vol. 2, 1990.

Rațiu, Adrian – „Liviu Dandara – Spații”, Revista *Muzica*, nr. 9, 1971.

Rădulescu, Corina Antigona – „Muzica secolului XX în actualitate”, *Revista Muzica*, nr. 3, 1990.

Revista *Organised Sound*, Nr. 9:1, aprilie 2004, Cambridge University Press.

Rideout, R. – „Yamaha VL1 Virtual Acoustic Synthesizer”, *Keyboard Magazine*, vol. 20, iunie 1994.

Risset, Jean Claude și Mathews, Max V. – „Analysis of Musical-Instrumental Tones”, *Physics Today*, nr. 22, 1969.

Risset, Jean-Claude – „The Liberation of Sound, Art-Science and the Digital Domain: Contacts With Edgard Varèse”, *Contemporary Music Review*, vol. 23, nr. 2, iunie 2004.

Schaeffer, Pierre – „The Musical Object”, *The Musical Review*, nr. 212, 1952.

Schaeffer, Pierre – interviu cu Tim Hodgkinson, 2 aprilie 1986, revista *Recommended Records Quarterly*, vol. 2, nr. 1, 1987.

Secară, Constantin – „Uniunea Compozitorilor și Muzicologilor din România - istoric și devenire”, website-ul oficial UCMR, http://www.ucmr.org.ro/Istoric.htm#1div2

Stan, Radu – „Final de stagiune”, *România liberă*, nr. 11, iulie 1965.

Stan, Radu – „Zburătorii”, *România liberă*, 22 februarie 1973.

Stănescu, Irina – *Conservatorul în file de cronică muzicală*, Cronica muzicală on-line – Institutul de Memorie Culturală, 25 februarie 2009.

Stockhausen, Karlheinz – „…how time passes…”, *Die Reihe*, nr. 3, Universal Edition, Viena, 1957.

Vail, Mark – „Buchla’s First Modular System”, *Vintage Synthesizers*, Miller Freeman, 2000.

Varèse, Edgard – „Edgard Varèse”, *The New Grove Dictionary of Music and Musicians*, ediția a doua, 2001, Oxford Music Online.

Vartolomei, Luminița – „Combinații în cercuri”, Revista *Teatrul*, nr. 11, noiembrie 1975.

Vercoe, Barry – „The Synthetic Performer in the Context of Live Performance”, *Proceedings of the 1984 International Computer Music Conference* (*ICMC’84*, Paris), ICMA, San Francisco, 1984.

Vieru, Anatol – note de album, *Anatol Vieru* (LP), Electrecord, Bucureşti, ST - ECE 01410/01411.

Voigtlaender, Lothar – *Situaţia de azi a muzicii electroacustice din Germania, după trei ani de schimbări*. Seminar susţinut la Forumul Internaţional de Muzică Electronică (IFEM '92), Bratislava, Slovacia, 1992, www.artradio.sk/doc/ifem92

Wen-Chung, Chou – „Open Rather Than Bounded", *Perspectives of New Music*, vol. 5, nr. 1, 1966.

Web-bibliografie

http://120years.net/machines – „120 Years of Electronic Music", Index al instrumentelor muzicale electronice din perioada 1870-1990.

http://digitalmusics.dartmouth.edu/~wowem/electronmedia/music/eamhistory.html – „History Of Electronic And Computer Music Including Automatic Instruments And Composition Machines", lucrare compilată şi adnotată de Dr. Kristine H. Burns.

http://emfinstitute.emf.org/exhibits/rca.html – „The RCA Mark II Electronic Music Synthesizer", de pe website-ul oficial al Institutului „Electronic Music Foundation" (EMF).

http://ems.music.uiuc.edu/people/tipei – „Sever Tiperi", postat pe website-ul oficial al University of Illinois at Urbana Champaign (UIUC).

http://home.swipnet.se/sonoloco7/stockhausen/26.html

http://journals.cambridge.org – Website-ul oficial al publicaţiei „Cambridge Journal".

http://muse.jhu.edu – Portal pentru publicaţii academice.

http://pervegalit.wordpress.com/2008/03/25/the-passion-of-karlheinz-stockhausen/

www.aurel-stroe.de – Website-ul oficial „Aurel Stroe".

www.businessmagazin.ro – Website-ul oficial „Business Magazin".

www.caramoor.com

www.cimec.ro – Institutul de Memorie Culturală din România.

www.ebscohost.com – Portal pentru publicaţii academice.

www.electone.com/museum – Muzeul virtual al instrumentelor „Electone" ale corporaţiei Yamaha.

www.electronicmusic.com/features/interview/larryfast.html

www.elemental.org/ele_ment/said&did/schaeffer_interview.html

www.emf.org/tudor/articles/hultberg.html – Un interviu cu David Tudor, realizat de Teddy Hultberg în Dusseldorf, pe 17 şi 18 mai 1988, de pe website-ul oficial al Institutului „Electronic Music Foundation" (EMF).

www.furious.com/perfect/ohm/eimert.html – Revista de muzică online „Perfect Sound Forever".

www.interactivearchitecture.org/virtual-electronic-poem.html

www.jstor.org – Portal pentru publicaţii academice.

www.medienkunstnetz.de – Arhivă cu resurse pentru muzica electroacustică.

www.music.columbia.edu/cmc/history – Centrul „Computer Music" al Universităţii Columbia, New York.

www.muzicisifaze.com/interviu.php?id=28 – Interviu cu Adrian Enescu, în revista online „Muzici şi Faze".

www.oddmusic.com/theremin/theremin_cello

www.oskar-sala.de/oskar-sala-fonds/trautonium – Muzeu virtual cu instrumente muzicale electroacustice.

www.oxfordmusiconline.com – versiunea electronică a „The New Grove Dictionary of Music and Musicians", ediţia a doua, 2001.

www.rem.ufpr.br/REMv4/vol4/arti-palombini.htm – Palombini, Carlos, „Musique Concrète Revisited", *Electronic Musicological Review*, vol. 4, iunie 1999, UFPr Arts Department.

www.soundslikeburns.com

www.stockhausen.org – Website-ul oficial „Karlheinz Stockhausen".

www.synthmuseum.com/magazine/0102cw.html – „Wendy Carlos - Something Old, Something New: The Definitive Switched-On", interviu realizat de Carol Wright cu Wendy Carlos în septembrie 1999, articol publicat în *New Age Voice*, noiembrie 1999.

www.thereminvox.com – Publicaţie online despre instrumentele din familia Thereminelor.

www.tonbandmuseum.info – Muzeu virtual de aparatură cu bandă magnetică.

www.ucmr.org.ro – Website-ul oficial al Uniunii Compozitorilor şi Muzicologilor din România.

www.unmb.ro – Website-ul oficial al Universităţii Naţionale de Muzică Bucureşti.

www.vintagesynth.com/misc/buchla100.php – „The Vintage Synth Explorer", o expoziţie virtuală de sintetizatoare antice şi moderne.

www.wendycarlos.com – Website-ul oficial „Wendy Carlos".

www.zainea.com/PierreSchaffer1994.pdf – Dack, John, „Pierre Schaeffer and the Significance of Radiophonic Art", *Contemporary Music Review*, Harwood Academic Publishers, 1994.