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ABOUT ELECTROACOUSTIC MUSIC: FROM THE BEGINNING UNTIL OUR DAYS

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SUMMARY. In this article, we will follow the development of electroacoustic music. This article focusses especially on the instruments that contributed to the apparition of this genre of music, starting with the beginnings, before the twentieth century. This will help us understand the evolution of musical instruments and how important they are when it comes to making music. What is more fascinating about electro acoustic music will be presented in the article, focusing on some of the pioneers of this type of music, and how electro acoustic music turned into what nowadays we call techno music. Also, we will follow the development of the instruments used back in the days to the processor which we use in the creation of electronic music.

Keywords: electroacoustic, technology, musique concrète, Theremin.

Electroacoustic music appeared from the XX century tendency to bring something new in the vast world of music. This genre represents the bridge between classical music, as we know it, and some of the genres of music these days, facilitating more than a century of original classical music. From concrete music to audio samples, from *electronische Musik*, from Telharmonium to laptop, electronic technology represented the conventional. Its incursion with other arts allowed it to reach a new audience and to become an accomplice in many forms of expression.

This article has the purpose to follow the evolution of this music genre, for a better understanding of what it meant for the XX century world, and also the contribution to the music of this century.

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Electroacoustic music: New instruments

The origin of electronic music comes from the creativity of the imagination. The technology used in the creation of this music genre is the effect of the human nature to produce something original, to record and to manipulate sounds. Although the term electronic music refers specifically at music made with the help of the electronic machines and some mechanism, the musical possibilities that this technology opened are a recurrent theme in literature, art, engineering and philosophy. But, starting with the twentieth century, electronic and electromechanics instruments began to be a physical reality, that futter composers transformed in new possibilities already imagined by others.

The earliest electronic instrument was Denis d'or (1748), invented and constructed by the Czech theolog Vaclav Prokop Divis, also known for his invention, the lightning rod. The Denis d'or consisted of 790 iron strings struck like a clavichord. These, in various combinations, enabled the imitation of a bewildering range of instruments. A development like the Denis d'or appeared ten years later with the electric harpsichord by Jean-Baptiste Thillais Delaborde, a French physicist, mathematician and Jesuit priest. Invented in 1759, it is one of the first electric instruments to have survived to the present day. [2]

In 1836, American scientist Charles Grafton Page demonstrated a way of producing sound using electricity, by placing a magnet close to a coil connected to a battery. The magnet vibrated, producing an audible frequency.

In the mid-1800s, Prussian physicist Hermann Von Helmholtz designed what is generally recognized as the first synthesizer. The instrument, built by his pupil Rudolf Koenig, consisted of several tuned tuning forks held in continuous vibration by a series of electromagnets.[3]

One of the factors that encouraged the emergence of electroacoustic music was the revolutionary field of one of the great inventions of the twentieth century: long-distance communication, first by telegraph and then by telephone. By analogy, the early 20th century was marked by a vertiginous development thanks to new sound transmission technologies (e.g., radio).

In 1874, American inventor Elisha Gray demonstrated the first instrument designed to transmit musical sounds over electric wires, called the Musical Telegraph. The idea of music at a distance found its first practical realization in the Telharmonium by Thadeus Cahill, another American inventor, which somehow anticipated radio transmission.[4]

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[2] N. Collins, M. Schedel, S. Wilson, *Electronic Music*, Cambridge University Press, 2013.
[3] Ibidem
[4] Ibidem

Cahill's idea was to develop a keyboard instrument capable of producing a variety of sounds and transmitting music via special telephone lines to homes and businesses. With his partner Oscar Crosby, they set up the New England Electric Music Company and later the New York Electric Music Company to collect donations and produce the instrument. In 1905 they negotiated an agreement with the New York Telephone Company to build special lines for the transmission of music produced by the Telharmonium, and in 1906 special rooms were set up in buildings on Broadway and on 39th Street in Manhattan.

In 1906, inventor Lee De Forest, also an American, made a definitive breakthrough by patenting the first triode, the Audion, a vacuum tube capable of causing amplification of an electrical signal. This moment represented a crucial development for radio, in that it enabled the tuning circuit to operate with greater precision than before, with importance also in music.[5]

In 1915 De Forest filed a patent explaining how the Audion could be used as an oscillator to produce musical sounds. The same year, he created an instrument called the Audion Piano. This had one Audion per octave. It was the first instrument to use a heterodyne oscillator.

In 1916, Russian Futurist painter Vladimir Baranoff Rossiné invented a new instrument called the Piano Optophoniste. Beneath the traditional appearance of an upright piano with keyboard, this piano (donated by his widow to the Centre Georges Pompidou in Paris) concealed a mechanical device consisting of glass disks painted by the artist, complemented by a set of prisms, lenses, mirrors and a light source. Colored images were projected to the rhythm of the music emitted by the discs.[6]

The junction between music and visual art is now complete.

Ether, created by Nikolai Obukhov in 1918, was perhaps the most extreme. Obukhov was a Russian experimental composer whose music embraced mysticism. Ether was an electrically powered wind machine. Although described as inaudible, its inventor claimed that it produced sounds five octaves above and below what the human ear perceives, to subliminal effect on the listener.[7]

A more practical instrument, still in use today, is the Theremin, originally called the Etherophon. Invented two years later, it perceives the performer's movements in the surrounding air. Russian researcher Léon Theremin (or Lev Termen) designed a new interface consisting of two antennae protruding from a box containing sound-producing electronic components.

[5] Ibidem
[6] Ibidem
[7] Ibidem

The first antenna, the vertical one, controlled the instrument's height, while the horizontal one controlled its volume.[8]

Like the Theremin and more practical than the Ether was Nikolai Obukhov's Sonorous Cross. It took the form of a 175-centimeter-high brass cross with an ornamental star at its apex protruding from a flattened globe. An artist could vary the pitch by moving the hand closer to or further away from the star. Unlike the Theremin, the volume was controlled by a device hidden in the artist's other hand.[9]

Around 1928, while working at Berlin's Hoschule für Musik, German physicist and musician Friedrich Trautwein invented the Trautonium. He was soon joined by his pupil, the physicist Oskar Sala (who created the soundtrack and music for Alfred Hitchkock's film *The Birds*). The Trautonium was a monophonic instrument but designed with a particular emphasis on expressivity. Instead of using a keyboard, the performer placed his or her finger along a wire to control pitch, enabling microtonal variations. A pedal was used to control volume. In 1934, Trautwein added a second key to his invention, so that two notes could be played at the same time.[10]

Another instrument that became more popular was created by Maurice Martenot in France at the same time as the previous one, Les Ondes Martenot. This cellist had worked as a radio telegraphist during the First World War. Like Trautwein and Sala, Martenot had the idea of trying to extend the range of expressivity with electronic instruments. In the original version of this instrument, the performer pulled a ring attached to a ribbon to the left or right to vary pitch, while the other hand manipulated various controls affecting dynamics and timbre. Martenot continued to improve his instrument over the decades, adding a six-octave clapper and a lever at the bottom to vary timbre.[11]

Probably one of the most popular inventions was that of Laurens Hammond in 1935. The Hammond organ was the first practical electronic organ. It was mass-produced for use in churches and homes, where it rapidly replaced reed organs. Throughout the 1960s and 1970s, the Hammond organ became ubiquitous in musical genres such as blues, gospel, jazz and progressive rock. It was also used to a lesser extent by avant-garde composers such as Karlheinz Stockhausen, the famous German composer.[12]

The original design of this organ lies in the use of 96 wheels that rotate in front of the electromagnetic pickups instead of coming into contact with the wire brush. Five phonic wheels are included solely to maintain mechanical

[8] N. Collins, *Introduction to Computer Music*, Wiley 2007.
[9] Ibidem
[10] Ibidem
[11] N. Collins, M. Schedel, S. Wilson, *Electronic Music*, Cambridge University Press, 2013.
[12] Ibidem.

balance, so that a total of 91 different frequencies are produced. As with the Telharmonium, these were not precisely positioned, and compromises regarding tuning were accepted. A series of sliding sliders, labeled to correspond to the organ stops, allowed the performer to vary the strength of each harmonic.[13]

The Hammond organ was one of the first keyboard instruments to reach many homes.

Many others followed, such as the Clavioline, invented in 1947 by French engineer Constant Martin. It consisted of a three-octave monophonic keyboard producing, using a single oscillator, sounds imitating the timbres of acoustic instruments (trumpet, violin, oboe, etc.) and a separate amplifier. It was recognized for the wide range of sounds it could produce.[14]

Another kind of music: the famous electroacoustic music compositions.

While early electric instruments influenced the emergence of synthesizers and interfaces, they did not contribute to the creation of new musical genres.

John Cage was a pioneer in the use of electronic devices on the concert stage: Imaginary Landscape (1939-52)) includes the first use in live performances of electric sound devices and recordings, sometimes combined with sounds that, without amplification, would have remained barely audible.[15]

In the 15 years since the creation of electroacoustic music, two approaches (not three acousmatic music, mixed music, soundscape) have emerged to combine electroacoustic resources with live performers. In 1948, the music consisted of combining live instrumental and vocal performers with pre-recorded tapes, such as *Orphée 53* (a concrete opera for three voices, harpsichord, violin, and tape) by French composers Pierre Henry and Pierre Schaeffer, and Musica su due dimensioni, for flute, timpani, and tape by Italian composer Bruno Maderna.[16]

The music has embraced divergent aesthetics, from works focusing on the relationship between extended or non-expanded, standard instrumental sounds and the sound world opened up by the acousmatic approach, to works exploring the tonal and rhythmic complexity of serialism, with electronic sounds recorded on a band that acts as an accompaniment for the performer. *Kontakte* by German composer Karlheinz Stockhausen (1959-60) embodies elements of both approaches.[17]

Composers have also surrounded performers with ambient sounds, sometimes to articulate social and political arguments, as in Italian Luigi

[13] Ibidem
[14] Ibidem
[15] S. Emmerson, *The Language of Electroacoustic Music*, Palgrave Macmillan, 1986
[16] M. Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, Continuum, 2004.
[17] S. Emmerson, *The Language of Electroacoustic Music*, Palgrave Macmillan, 1986

Nono's *Fabbrica illuminata* (1964) for female voice and tape, or as part of larger sound environments and installations.[18]

Musique concrète is a pioneering genre of electroacoustic music that emerged in the mid-twentieth century. It represented a revolutionary departure from instrumental vocal music, focusing on the manipulation of recorded natural or electronic sounds rather than the use of conventional musical instruments.[19]

Often considered the father of musique concrète, French radio engineer and composer Pierre Schaeffer began experimenting with recorded sound at Radio France in the late 1940s. His work laid the foundations for musique concrète. Throughout his career, Schaeffer composed numerous works, including *Etude aux chemins de fer* (1948), Symphonie pour un homme seul with Pierre Henry (1950) and *Etudes de bruits* (1952). These compositions push back the boundaries of instrumental vocal music and highlight the artistic potential of everyday sounds. Symphonie pour un homme seul, one of the most famous works of musique concrète, was conceived in collaboration with Pierre Henry, the French composer considered to be the artistic father of musique concrète (known to the general public for his work *Psyché Rock* from the suite *Messe pour le temps présent*, danced by the Ballet Béjart).[20]

Similarly, the Romanian-born Greek - French composer Iannis Xenakis, known for his revolutionary work in the field of electronic and concrete music, pushed back the boundaries of sound manipulation with pieces such as *Concret PH* (1958).[21]

Morton Subotnick, an influential American figure in this field. Silver Apples of the Moon was his first electronic work commissioned by a record label. His works often combined Buchla synthesizers with live instruments.[22]

Trevor Wishart, English composer known for his innovative use of technology. His song Tongues of Fire explores the human voice through electronic manipulation.[23]

A new era of electronic music: technological advances

In 1980, a group of musicians and synthesizer designers got together to standardize an interface that would enable new instruments to interoperate, to communicate control instructions to other instruments and computers. This standard or communication protocol and file format was named Musical

[18] Ibidem
[19] D. Smalley, *Spectromorphology: Explaining Sound-Shapes,* In *The Language of Electroacoustic Music,* edited by Simon Emmerson, 1996.
[20] M. Chion, *Guide to Sound Objects: Pierre Schaeffer and Musical Research*, Continuum, 2004.
[21] C. Roads, *Composing Electronic Music: A New Aesthetic,* Oxford University Press, 2015.
[22] Ibidem
[23] Ibidem

Instrument Digital Interface (MIDI). MIDI is the result of collaboration between leading manufacturers, initially Sequential Circuits, Oberheim, and Roland. They were later joined by other engineering participants from Yamaha, Kong, and Kawai. Dave Smith of Sequential Circuits wrote an article and proposed it to the Audio Engineering Society in 1981, and in August 1983 the MIDI 1.0 specification was finalized.[24]

This technology allows a simple keystroke, joystick movement, pedal movement or command from a microcomputer to remotely activate every device in the studio. This is done synchronously, with each device responding according to the conditions defined by the composer.

Also in 1980, Yamaha launched the first digital FM synthesizer, the Yamaha GS-I, but at a high price. In 1983, the same company introduced the first stand-alone digital synthesizer, the DX-7, which also used FM synthesis (invented by Stanford University professor John Chowning) and became one of the best-selling synthesizers of all time. The DX-7 was known for its recognizably bright tones, due in part to an oversized sampling frequency of 57 kHz. This new technology, along with current techniques such as electronic music creation programs accessible to anyone with a laptop, led to growing popularity.[25]

But the most important invention to bridge the gap between old and new is the MIDI Theremin.

We've spoken of the Theremin as the electronic instrument that has survived the test of time, but the new MIDI technology has contributed to its development.

One example is the Altura MkII+. The Altura MkII+ is a MIDI controller/ sequencer/arpeggiator that emulates a Theremin. When you move your hands in the air, the Altura MkII+ transmits MIDI data to your synthesizer to control pitch, volume, velocity, bend, modulation, portamento and much more! Save presets. Program an 8-step sequence, play it up and down the scale, enter a tap tempo, switch to double time or half time.[26]

To conclude, and to better understand this link between technologies, let's evoke the work of Russian composer Vladimir Komarov, *Voice of Theremin*.

Vladimir Komarov is a composer whose main interest is the Theremin and the sounds it produces.

Composed in 1996, *Voice of Theremin* is a biographical sound collage depicting the Theremin - its personality, invention, and history. The piece is built around synthesized sound extracts of Theremin's voice, recorded by the

[24] C. Roads, *Composing Electronic Music: A New Aesthetic,* Oxford University Press, 2015.
[25] S. Emmerson, *Living Electronic Music,* Ashgate Publishing, 2007.
[26] https://zeppelindesignlabs.com/product/altura-mkii-theremin-midi-controller/

composer himself. Although the impression is that the piece features a large amount of computer-generated sound, it seems that no other sound, apart from Theremin's voice, has been added.[27]

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