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Electronics in Music: Preliminary Stages

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Abstract: *With a first recorded appearance dating around the 1950s, electronic music – the fruit of rigorous and tenacious labour by acoustician-researchers and composers who tried and succeeded in imposing a new sound-universe – channelled the evolution of the art of sounds as nothing before it.*
Prominent composers of the orientation – Pierre Schaeffer, Pierre Henry, Edgar Varèse, Herbert Eimert, Karlheinz Stockhausen, Vladimir Ussachevsky, Luigi Nono – had a determinant role in the way music expanded.
The literature mentions as early as the beginning of the 20th century the existence of creators with a true calling for identifying original solutions to permanently transform music, breaking its barriers and thus allowing it to develop, expression-wise, in a variety of directions.

Key-words: *electronic music, Ondes Martenot, electronic instruments, composers*

1. The Search for new Timbres

Francis Bacon (1561-1626) anticipated in his 1624 *New Atlantis* the existence of sounds with new timbres and their transmission via "tubes" over a distance, as well as Jean-Baptiste Delaborde (1730-1777), the inventor of the *clavecin électrique* (1761) and of many musical devices functioning on the basis of springs, weights, pneumatic pressure etc., such as the panharmonicon, a mechanical orchestra for which Beethoven would write his 1813 *Wellington's Victory* (Schwartz 1993, 107).

Electricity and sound once connected, that is, Graham Bell inventing the telephone and Thomas Edison, the phonograph, the literature mentions a series of appliances designed to transmit, record, and reproduce sound material on the spot or at a later time. The telharmonium, invented by Thaddeus Cahill in 1906 and considered by many the world's first synthesizer because of its electronically-obtained timbral register – made possible the "live" broadcasting of an instrumental concert over a long distance, that is, over several hundreds of

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kilometres. If we think that the telharmonium weighed more than 200 tons, that it was extremely voluminous, and that its possibilities cannot be compared to those of a computer today, we can appreciate indeed the spectacular leap that electronic equipment made in about 100 years (Schwartz 1993, 107).

2. Presentation of Electronic Music

2. 1. Beginnings of Electronic Music

Music began turning to electronics, at the beginning of the 20th century, not only because of the exceptional possibilities brought by the appearance and the diversification of the ways of broadcasting music, but also because of the facilities that electronics provided in the field of instrumentation, where it established itself two-fold: with regard to a simplification of the regular, classical mechanism - as is the case of organs -, and to the invention of new instruments. There were attempts, after 1925 (Dufourcq 1965, 42), to obtain both new timbres and a classical orchestral tone on electronics bases, that is, to obtain new sounds using devices which work due to the motion of electrons and ions, of magnetic fields, which can be made to amplify the electric signal and permit information accumulation and transmission (Chioreanu 1972, 325). The network-connected instruments (the vibraphone) to which such devices as the microphone or the amplifier are attached (the electric guitar), or those instruments with an electrical engine or whose registers are electromagnetically controlled, are electric instruments, and those featuring devices to transform electrical oscillations into mechano-acoustic vibrations by means of membranes (the speaker) are electronic instruments (Manuel 1963, 1420). Such a device is the triode, designed to transform a damped vibratory motion - the tuning fork or the piano strings - into a maintained vibratory motion, string instruments in the case of a sustained bow attack (Manuel 1963, 1422).

In 1907, composer and pianist Ferrucio Busoni (1866-1924) proposed, in his *Sketch of a New Esthetic of Music*, a style composed of "all experiences of the past and all experiments of today" (Goléa 2000, 79) and presented various innovations, some of which he would use himself, such as the telharmonium - also known as the dynamophone -, an electronic machine producing novel timbres. Busoni's remarkable prophecies came true right after World War II. The variety of tendencies, the multitude of the proposed solutions stimulated modern and contemporary composers to come up with their own language, technique, and style.

2.2. Electronic musical instruments

After many attempts by mostly music-loving scientists, new electronically-based instruments were invented – the trautonium, created by German Oskar Sala, for which Richard Strauss and Hindemith wrote, the electrophon, invented by his fellow countryman Jörg Mager (Dufourcq 1965, 42), and the Ondes Martenot, built in 1917 by Maurice Martenot and patented eleven years later, when the French pianist and composer presented it publicly at the *Opéra de Paris* (Dufourcq 1965, 364). This cuboid-shaped instrument connected to a speaker has a keyboard coupled to a gear consisting of accumulators (which supplies electrical energy), resistors, and potentiometers. By pressing the keys, the instrumentalist transforms electrical energy into mechanical oscillations, that is, into vibrations, and therefore into sounds. By sliding a *ruban* (a ribbon) attached to the right forefinger, microtones and various effects are obtained - one of the most frequently used is the *glissando* -, while the intensity is controlled by means of a pedal. The performer also has the possibility to change the timbral colour, by operating buttons placed in a drawer underneath the keyboard and connected to filters which absorb differentially the harmonics of the fundamental tone (Bărbuceanu 1999, 269). The particular timbre, the expressive capacities of this electronic musical instrument, and the fact that it answers to the exigencies of composers and performers is due to the perfected use, as compared to Martenot's predecessors inventors Hugoniot and Theremin, of the beat between two high frequency waves in order to obtain a third one, differential and audible when its frequency is larger than 20 periods.

If, for instance, Theremin's electronic instrument had an antenna and triodes to serve as oscillators, emitting high frequency current - fixed and variable frequency -, and the production of sound was quite toilsome, as the performer's very body was the connection to ground, I believe it would be interesting to explain, even briefly, Martenot's instrument. The Ondes Martenot obtains frequency variations by means of a device composed of an induction coil variably coupled to a second one connected to the grid of a lamp. To the terminals of the first coil a variable condenser is connected whose "armatures consist of the heads of several screws fitted onto a brass rod and a metallic tape. To each position of the tape a certain value for the condenser thus obtained corresponds, which results in a certain tuning of the lamp's oscillations" (Manuel 1963, 1429). A sinus wave - therefore lacking harmonics - type of sound is obtained whose shape the inventor succeeded in changing and which he enriched with harmonics. These harmonics, the result of wave interference, would have been parasitic in the case of a process of amplification, but in this case they are extremely beneficial and permit the obtaining of new timbres, either similar to those of classical instruments or wholly original (Manuel 1963, 1429).

Invented by a musician won over by electronics and its possibilities, the powerfully expressive Ondes Martenon was used by many composers, starting with French Greek-born Dimitrios Levidis (1886-1951), who wrote in 1928, the year the instrument was presented publicly, his *Poème symphonique* (Bărbuceanu 1999, 269). Olivier Messiaen (1908-1992) first used it in his *Fête des belles eaux*, commissioned for the 1937 *Exposition universelle* in Paris, and, appreciating the originality and crude beauty of its timbre, consequently included it in all his orchestral works (Goléa 2000, 312). The Ondes Martenot also features in Arthur Honegger's 1935 oratorio *Jeanne d'Arc au bûcher* (Goléa 2000, 232) as well as in several other works, among which the 1947 *Concerto for Ondes Martenot* by André Jolivet, who had already dedicated it his 1936 *Danse incantatoire* for orchestra, two Ondes Martenot and six percussionists (Goléa 2000, 246). In the *Concerto*, Jolivet makes use of its particular sound and effects, succeeding in revealing the whole expressive richness of this instrument turned "the medium of the invisible and the ineffable" (Manuel 1963, 1156). In the exceptional presentation of the work, Antoine Goléa sees the Ondes Martenot as a mysterious, ineffable voice, and concludes: "Thus treating the Martenot, Jolivet relies on the nature of the instrument's sources which take part, by their electric origin, in the universal vibration" (Goléa 1987, 277).

2.3. Composers

In the 1940s, the first attempts at composing electronic music using rudimentary devices appear. The cornerstones were represented by the opening of two specialized music studios: one at the *Radio France* in 1944 and the other in Cologne, the Studio für *Elektronische Musik des Westdeutschen Rundfunks* in 1951 (Schwartz 1993, 113). While Parisians started with the complex, raw sound found in nature, the Germans used the pure, electronic sound, the result of electrical oscillations transformed with the help of membranes (speakers) into vibrations. In 1954, electronic sound generators began to be used, under the guidance of Herbert Eimert, and the term "electronic music" appears. With time, in both cases, a material with artistic qualities was obtained, allowing for its integration "in works not as a new ornament, of a new independent musical thinking, but as an element of composition" (Manuel 1963, 1421).

During the 1950s and 1960s various artists, composers but not only, started developing interest in the new technologies and the possibilities that the concrete music studios and the electronic music studios offered in extending the sound palette with a new range of tones and timbres. Some of the most important personalities that composed concrete music and electronic music, or just used new

technology instruments together with the classic orchestra, small ensembles or soloists were mostly French, Germans, Italians and Americans.

The diversity of compositional solutions, often contradictory from one work to another, led to an accentuated phenomenon of rejection by the general public, which as a rule disown today's values and looks to the music of the past. Specialists show that if until the 19th century audiences understood and supported the composer, Romanticism brings that rejection which only became more accentuated with time, so that the divorce between audience and creator became a characteristic of modern and contemporary musical life (Manuel 1963, 1096). Composers of course react differently to this rejection. Some believe they will be understood years later, others give in and try to establish a bridge with the listeners, with the risk of diminishing the value of their work. I believe that the true artist will not change their course, but will go on their way, possibly trying to explain their music, to show what they intended, and how they came to the actual result. It is a complex and necessary process, especially when a work is the fruit of conjugated compositional methods and scientific discoveries and uses extremely sophisticated machines.

A short, narrow enumeration, mainly by the country where they worked, of the most renown artists of that period could be:

FRANCE	**GERMANY**	**ITALY**	**BELGIUM**	**U.S.A.**
Edgar Varèse (1883-1965)	Herbert Eimert (1897-1972)	Bruno Maderna (1920-1973)	Henri Pousseur (1929-2009)	Otto Luening (1900-1996)
Pierre Schaeffer (1910-1995)	György Ligeti (1923-2006)	Luigi Nono (1924-1990)	Louis De Meester (1904-1987)	Vladimir Ussachevsky (1911-1990)
Iannis Xenakis (1922-2001)	Karel Goeyvaerts (1923-1993)	Luciano Berio (1925-2003)		Milton Babbitt (1916-2011)
Pierre Boulez (1925-2016)	Gottfried Michael Koenig (b. 1926)			Louis Barron (1920-1989)
Pierre Henry (1927-2017)	Franco Evangelisti (1926-1980)			Bebe Barron (1925-2008)
François Bayle (b.1932)	Karlheinz Stockhausen (1928-2007)			David Tudor (1926-1996)
François-Bernard Mâche (b.1935)				Morton Subotnick (b.1933)

Table 1. *Electronic music composers*

3. Conclusions

The task of today's composer is obviously a difficult one, if we are to take into account the richness of the available resources, with exceptional technical means enriching the dowry of the past, already validated by remarkable works and working techniques.

I am persuaded that musicians are well aware of the fact that the evolution of music during the last 100 years places it, by the immensity of the sound material and the multitude of working methods accessible to composers, on so complex a level, that composing becomes quite difficult. Artists who have a true calling will do what has already been done throughout the history of music: they will combine to a lesser or a greater extent the inheritance left us by the past generations with what is new, this latter closely tied today to the amazing conquests of science, which composers will need to get closer to, understand and use.

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