

Iannis Xenakis, the Initiator of a New Phase in 20th Century Music: Aleatorism

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Abstract: *Observing the deadlock reached by serial music at the beginning of the 50's, especially in the music of Pierre Boulez - of an immense density - but obtained through an extremely exhausting compositional effort in order to respect the serial rules, Iannis Xenakis is realizing that these densities can be obtained through other techniques offered by mathematical approaches such as Markov chains and the calculation of probabilities. The idea itself can be compared to that of Schonberg, 50 years ago, when, noticing the huge coefficient of chromaticism and dissonance in Wagner's music, obtained (also with great effort) on the principle of tonal functionalism, he totally simplified the technique to obtain these chromatic melodies and dissonant chords on the principle of dodecaphonism. Relatively in the same way, Iannis Xenakis opens a new musical historical stage through these techniques by appealing to mathematical science for the calculation of the chances implied by the game of dice (alea). Xenakis's suggestion then inspired other ways for performing the game of chance, to composers who did not master the science of mathematics, unleashing the freedom of imagination, these composers being almost all in the generation 50s-80s till nowadays: John Cage, Krzysztof Penderecki, Gyorgy Ligeti, etc.*

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1. Directions in the 20th Century Music

The history of music records at the beginning of the 20th century a terrible fracture, unprecedented in its history. Arnold Schonberg (1905) declares *the tonal-functional system* exhausted from a compositional point of view and its replacement with another new system, which would totally repudiate the use of any intonation element of it.

The tonal-functional system lasted for three centuries, during which it went through three stages within the three styles: Baroque, Classic and Romantic. It was

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established in the 17th century (evolved from the modes of Renaissance music) having Claudio Monteverdi as its promoter, followed by a huge constellation in Italy, among which we mention some of the most important: Arcangelo Corelli, Antonio Vivaldi, Alessandro and Domenico Scarlatti, Girolamo Frescobaldi, etc., then expands in France: Jean Philippe Rameau, Francois Couperin, Jean Baptiste Lully, England: Henry Purcell and Germany: Dietrich Buxtehude, Pachelbel and ends with J.S.Bach and G.F. Handel, who represents the so-called High Baroque. The 18th century follows, when Classicism is established: J. Haydn, Christoph Willibald Gluck, W.A. Mozart, L. van Beethoven, and so on, the stage in which the tonal-functional system enters another (chromatic) stage.

The 19th century brought a huge proliferation of compositions in several European schools: the Italian school, especially opera composers (Rossini, Bellini, Donizzetti, Verdi); the French school (Leo Delibes, Charles Gounod, George Bizet, Saint Saens, Hector Berlioz); Russian school (M. Ivanovich Glinka, Modest Mussorgsky, Rimsky Korsakov, P.I. Tchaikovsky), Czech school (Smetana, Dvorak), Polish school (Fr. Chopin); Norwegian school (Edward Grieg), Hungarian school (Franz Liszt), German school (K.M. von Weber, Franz Schubert, Robert Schumann, Johannes Brahms and Richard Wagner).

I made this panorama to imagine the immense amount of music of inestimable value, which was composed within this *tonal-functional system*, to understand the terrible “shock” produced by Schonberg's statement, and consequently, the reaction unleashed in the world of music in that time. This determined (scared?) even Schonberg, causing him to return after a few years to write a treaty on tonal-functional harmony and to speak out, stating that the “old C major” still has a lot to say.

In fact, what determined Schonberg to produce this rupture? At that time there was a strong anti-Wagnerian current, due to its force of exploitation of chromaticism and the dissonance of the functional system, so that many felt the exhaustion of the resources of this system. The first to notice that he had reached a “dead end” were Eric Satie, Claude Debussy and Maurice Ravel, who sought another way to compose, avoiding the chromatic and dissonant load of the system, escaping into the Renaissance modal world, where they found a certain sound transparency and timbral refinement.

What did Schonberg notice? Using the method of obtaining leading note tones through chromatic alteration and their overlap with melodic notes (passage, exchange, anticipation, delay), often also altered, Wagner obtained very dissonant chords, but their sequence was thought through functional relationships based on the three functions: Tonic, Subdominant, Dominant (T-SD-D). So that any chord was

thought of in such a way that it would be resolved on the next one, which also had to be resolved (through alterations) on the next one, and so on.

Schonberg noticed that each individual chord was very dissonant, but determined to be resolved through functional thinking. Thus, the compositional process was very difficult, for which Schonberg found a simple solution: each dissonant chord should be followed by another dissonant chord, without stipulating any relationship between them. Functional conditioning has therefore been eliminated.

Schonberg's first works were composed with this (simplified) technique, but this extremely permissive compositional modality did not exclude previous functional relationships, so that Schonberg (after a silence of five years) returns with express anti-tonality (functional) regulations. Thus, the first rule (and relatively the only one) is that in the dodecaphonic series (of the twelve sounds of the chromatic range), each sound should be independent, and to strengthen this equality, in the melodic (and harmonic) process no sound should be repeated until the exhaustion of all the other eleven. Of course, there are other small prohibitions in order to eliminate (from the melody or harmony) everything that used the tonality more frequently (scale, chord, consonant intervals, etc.), recommending large and dissonant intervals. Of course, many of these prohibitions have disappeared over the years.

Meanwhile, the two disciples of Schonberg, Alban Berg and Anton Webern, appeared. Regarding respecting the basic rule of the series, there are differences between the three composers. Schonberg respects the rule only in a linear aspect (melodic), because under the vertical aspect, for example, three series are superimposed, as it happens for example in the Quintet for wind instruments, this prohibition is not imposed, therefore, repetitions of the sounds may appear. Then, in the composing process, the series was often partially used.

The most permissive was Alban Berg, who in his work *Wozzeck*, for example, the *dodecaphonic serialism* is used only in a free atonal manner, as in all his creations.

Anton Webern was the most radical, forcing himself to respect the dodecaphonic series, both horizontally and vertically. The most eloquent example appears in the Piano Variations op. 27, which was built from about 500 variations of the series. You can already see the effort of calculating these multiple variations, and thus, the limits of this dodecaphonic technique. It has been calculated that his lifetime work totals less than four hours of music. We will come back to the evolution of this dodecaphonic atonal current.

With all the (vehement) criticism that appeared in the era, Schonberg's action did not remain without an echo. Most of the composers of the first half of the 20th

century realized (tacitly) that Schonberg was right: the tonal-functional system was exhausted and had to be overcome. Therefore a multitude of composers appeared who searched for other tonal paths, each creating their own (tonal) system.

The first group will be the one that will find salvation in the folklore cultures from which they came. They are: Igor Stravinsky, Bela Bartok, George Enescu, Olivier Messiaen.

What the *tonal systems* (tonal - from tone-sound) of these composers will have in common is the latent modal and chromaticism of the respective folklore cultures.

Thus, Stravinsky found unexpected sources of archaic values in Russian folklore. The modalism of Russian folklore with *diatonicism* and specific *chromaticism* was strained by Stravinsky's techniques of *bi and poly modal overlap*. But Stravinsky's most powerful innovation is in the field of rhythm, through the new rhythmic systems that he introduced in his music, systems that were not in *tonal-functional music*, namely the *giusto-syllabic system*, the *aksak system* and the *Russian dance music system*. In fact, Stravinsky achieved in the rhythmic field, something similar to Schonberg in the melodic-harmonic field. As a result, he also caused a terrible public scandal in 1913, with the occasion of the "Sacre du printemps" ballet performance.

Bela Bartok built the clearest tonal system, according to musicologist Erno Lendvai, based on the combination of a principle extracted from the tonal complex of the tonal-functional system - the axis principle, with three other principles intuited in the immanence of folklore creation: the golden ratio law, the symmetry, acoustic modes. In spite of Hungarian musicologists contesting Erno Lendvai's Bartokian tonal system theory, the principles as such are recognizable in Bela Bartok's creation, the system being as coherent as possible. And in the field of rhythm, Bela Bartok introduced the *asymmetric systems* from folklore (just-syllabic, aksak, children's rhythm, distributive rhythm, dance rhythm).

George Enescu created a *modal-chromatic system* with great flexibility, throughout his entire creative period, with evolution from the tonal-functional harmonized folk quote, in the two Rhapsodies, to the hyperchromatic complexity of the opera *Oedipus* and *the Symphony chamber music for 12 solo instruments, op. 33*.

Everything, based on Romanian folklore, an extremely rich ancestral folklore, which Bela Bartok also cherished and loved and from which he collected over two thousand songs (vocal and instrumental), carried by him in America, and edited after his disappearance, by Benjamin Sukhoff in *The Hague Martinus Nijhoff*, 1967, in two volumes, with the title *ROMANIAN FOLK MUSIC*.

George Enescu's *tonal system* from the period of maturity, in the works First Piano Sonata in F sharp minor, Quartet II, op. 22, in G major, Sonata III for piano

and violin, Suite for violin and piano "Impressions from childhood", drama *Oedipus*, Chamber Symphony for 12 solo instruments, op. 33, reveals two concepts of the Enescian modal system: I - the stabilization of preferred intervals, II - diatonic and chromatic mobility in the process of connections that involve juxtapositions, transpositions, various repetitions, interferences of tri-tetra-pentachordal structures.

The First Concept:

Enescu's favourite intervals are the minor second, the minor third (major second), and the major fourth. From these intervals, Enescu constitutes musical motives, such as motive x, consisting of the minor second and minor third descending from the mi sound: mi, e flat, do, E (n) Es c(u) (Enescu), after the historical suggestion of the Bach motive. Cell as such is omnipresent in many musical themes.

The Second Concept:

Diatonic-chromatic mobility, wears many appearances:

- the chaining of small cells on wide modal frames: hexachord, hexatone, octavian heptachord, neo-octavian heptachord, supraoctavian;
 - chaining by transposition (with the interval axis, with the sound axis);
 - diatonic-chromatic intersection (internal, external);
 - handling the mobility of the steps (generated by the polar attraction) up to microintervals;
 - displacement of the modal center (modal centers) modal reunion (partial, total).
- Regarding verticality, the *ison*, the *multiplied ison*, the *figured ison*, etc., represent the modal solution as a sound background.

But the most surprising innovation in verticality, although unconscious, is *heterophony*. Simply defined, heterophony means singing a song simultaneously with its (melodic-rhythmic) variants. Starting from such an observation, the composer and musicologist Stefan Niculescu, created a complex musicological work entitled "Phenomenological analysis of the fundamental types of sound phenomena and their relationships with heterophony" in "Studies of musicology", vol, VIII, Ed. Music, Bucharest, 1972, page 135, bringing back this phenomenon that has always been present in Romanian folklore, as a result of group singing of a song.

The modalism of Olivier Messiaen, the one from the initial phase, is explained by the author himself, in the book "Technique de mon langage musical" published in 1955. In the same book, he also presents his rhythmic innovations. The modal system is presented with the so-called modes with limited transposition in their

melodic manifestation, but also with their verticality represented by a standard chord and cadence formulas. There are seven ways, three being more important, being transposable less times, and the other four showing less interest, being transposable more times. The melody and harmony of each mode is made up only of the sounds of the respective mode. The modes can be combined with the modes of any culture, with atonalism and even with microsystems. The sources of Messiaen's rhythmic innovations are Gregorian chant, Hindu rhythm and birdsong. From the ways of rhythmic construction, we note the most important ones: the rhythm with added values, the augmentation and diminution with different numerical values, the series of durations, height and intensity. Of course, in 1955, when he published the book, the techniques presented had long been exhausted and Messiaen was already in another creative stage, which includes serial techniques and some tangents with electronics through Ondes Martenot.

Olivier Messiaen is a prodigious composer and at the same time accessible to the great mass of listeners, as his motto was the primacy of the melody.

A special figure in the musical landscape that got rid of the tonal-functional system in the early years of the 20th century (1900-1918), is the American composer Charles Ives. His compositional innovations anticipate practices that were discovered much later in European music, such as: polytonality, polyrhythm, music distributed in space, cluster chords, sound collages and serial atonalism. But his creation (about 180 works) was not interpreted and known until the 1950s, when all his values were already discovered by others. Of course, his music will remain in the heritage of mankind, being able to fit into the notion of "polymusic".

Another direction of evolution in the music of the first half of the 20th century is represented by that of Paul Hindemith and Arthur Honegger, who continue the line of tonality (the functional system) but by overlapping tonalities (*bi and polytonalism*), a situation in which functionalism is "drowned". Hindemith will conceive a work entitled "Ludus tonalis" in which he unifies the major and minor tonality. Starting from the Bachian model from "Das Wohltemperierte Klavier", a prelude and a fugue for each tonality (major and minor), *Ludus tonalis* will contain only 12 fugues, that is, it has reduced (by merging major-minor) the 24 tonalities. To the same extent, A. Honegger writes music using the same technique as P. Hindemith. Both composers will produce invaluable creations, for example, P. Hindemith - "Mathis der Mahler"; A. Honegger - "Le Roi David" and "Jeanne d'Arc au bucher" Edgar Varese and Pierre Schaeffer represent two particular cases that we are going over, as they anticipate a future stage beyond *aleatorism*. However, we highlight Varese's exceptional contribution to enrich the timbral world of the traditional orchestra with all the (multiplied) percussion instruments, basically, Varese introduced noise into music.

Because in all the old treatises and textbooks on music theory, sound was defined like this: sound is of two kinds - musical sound and noise. So, noise was not considered musical and therefore, prohibited, except for the tympanum, some drums and piatti. The work that imposed the world of percussion was Ionization (for 37 percussion instruments), 1931, but the world of percussion itself developed from the 1950s. As far as Pierre Schaeffer is concerned, from his realm (of concrete music) we retain (beyond the use of electronic technology), the idea of creation without a score (he had no musical training), as in ancestral folk music, but the memory is no longer the collective one, but of the magnetic strip.

We return to the *atonal - dodecaphonic system* of Schonberg, A. Berg and A. Webern. They go through the first stage until the years of the Second World War, after which a new generation appears: Luigi Nono, Luciano Berio, Henry Pousseur and many others, but by far Pierre Boulez dominates, in the years 1948-1952. With these, atonalism enters the second stage, in which the series will no longer be mandatory of twelve sounds; instead, the rhythm and nuances and timbres, etc. will also be serialized. Everything will be included in the expression "integral serialism". It will be theorized in P. Boulez's book "Penser la musique aujourd'hui".

With the new writing technique, extremely severe, but very crowded, P. Boulez achieves high sound densities (sound canvases, sound masses). But the compositional effort was immense, by taking care to respect the serial conditions, especially rhythmic, (with micro-duration and hidden pauses - cache). Through a writing effort of 5-6 hours, 4-5 seconds of music were obtained (from personal experience).

2. Aleatorism

This is the moment when Iannis Xenakis's "attack" on serial music appears, he proposes another way to obtain these sound densities, simpler, through mathematical calculation based on stochastic logic, the logic of events to which probabilities are attributed.

At this moment, I. Xenakis opens a new compositional stage: *ALEATORISM*. Of course, in that period, all the compositional techniques had reached a phase of exhaustion, including the modal-chromatic ones, and everyone felt the need for a new one. That's how John Cage will appear, who cultivates special mathematics that, without mathematical culture, will open the total freedom to create music in any (random) way. This is how *Aleatorism* is generalized and a frenzy of musical creation is triggered all over the world.

We are witnessing an explosion of musical semiography (writing) invaded by a multitude of signs and indications, in which musical notes appear only by chance and even with other meanings.

Often the created works were accompanied by a legend, explaining the signs (drawings, etc.) for the performers, used by all the great composers Karlheinz Stockhausen, György Ligeti, Krzysztof Penderecki, Stefan Niculescu and so on.

We return to Iannis Xenakis as the one who conferred authority through the certainty of the mathematical logic of the music he composed, in the idea that the true beauty of art lies in the quantity and quality of intelligence poured into it.

3. Conclusion

Thus, as Schonberg triggered (in 1905) the end of the tonal-functional system, the same happened with atonalism, which died out in the 1960s, although Schonberg said around 1915 that he had invented a system that would ensure the supremacy of German music for 100 years. But, the same will happen with aleatorism, installed in the 1950s, that will be around for 25 years, disappearing at the end of the 1970s. What followed is still unfolding and will be called (at the moment): *electronic music* (which Edgar Varese envisioned in the 1930s and Pierre Schaeffer in the late 1940s).

At this moment we are the heirs of Ars Nova and Renaissance music (300 years) of the 14th-16th centuries with their mensural modes and rhythm; of the Baroque, Classicism and Romanticism (300 years), 17th-19th century with the tonal-functional system and the metric rhythm (binary - ternary); then, of the troubled stage in the first half of the 20th century, with *atonalism and modal-chromatic* music, plus the rhythms developed by the composers of that time; and finally, *aleatorism* from the 1950s-1980s. A huge musical heritage that we have to take care of!

At the moment, we are certainly witnessing a BIG beginning of a stage in the music history, which will produce a leap that we cannot imagine today.

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