Meta-Xenakis

New Perspectives on Iannis Xenakis's Life, Work, and Legacies

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12. Activating Sound Phenomena in the Music of Iannis Xenakis

Mauricio García de la Torre[1]

> His approach to nature is extraordinary [...] For him, natural phenomena are the ultimate expression of primary energies. Hailstorms, hurricanes, storms, sandstorms, do not have a specific meaning for him, they are the manifestation of energy.
>
> Maurice Fleuret[2]

Orbiting Xenakis

This article reflects upon the musical contribution of Iannis Xenakis from a particular perspective which is different than that of the typical research about this composer: focusing on the role of acoustic energy in his artistic endeavors. Much of Xenakis's music invokes an overwhelming physicality, a by-product of powerful designs originating from his creative strategies and from his conception of original ideas in each project. Through a descriptive analysis anchored in my own perception, and guided by the references in *Xenakis: His Life in Music* by James Harley, this study associates the phenomena of physical energy with some iconic passages of Xenakis's works.[3]

Certain studies in perception drew my interest to inquire about physical energy and its musical manifestation. First came the notion from psychoacoustics known as "activating sound," one of the four mechanisms that enable an emotional response to music. For Hauke Egermann, this mechanism is the neurophysiological pathway of musical perception that deals with sound reception as physical energy.[4] This approach studies the influence that musical events have on the sympathetic system, and how they generate tension or orientation towards them, as well as subjective and

1 This article also appears in Spanish García de la Torre, 2022. Reprinted by permission in English translation by the author.

2 Commentary by Maurice Fleuret in Kidel, 1990; recording available at https://youtu.be/2p_uhmOIsnQ at Anthoney Hart, "Something Rich and Strange: The Life and Music of Iannis Xenakis" (14 February 2022), *YouTube*, https://www.youtube.com/watch?v=2p_uhmOIsnQ (c. 37′07″).

3 Harley, 2004.

4 See Egerman's TEDxTalk, recording at TEDx Talks, "Emotional Responses to Music | Hauke Egermann | TEDxGhent" (2 September 2014), *YouTube*, https://youtu.be/kzFgoaZ9-VQ

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even physiological arousals. Patrik Juslin and Daniel Västfjäll consider this kind of processing a reflex response by the brain stem:

> It is a process whereby an emotion is induced by music because one or more fundamental acoustical characteristics of the music are taken by the brain stem to signal a potentially important and urgent event. All other things being equal, sounds that are sudden, loud, dissonant, or feature fast temporal patterns induce arousal or feelings of unpleasantness in listeners [...] Such responses reflect the impact of auditory sensations—music as sound in the most basic sense.[5]

The embodied cognition approach presents affinities with such studies. Leman believes that musical communication is rooted in the relationship between musical experience (mind) and sound energy (matter):

> In this mind/matter relationship, the human body can be seen as a biologically designed mediator that transfers physical energy up to a level of action-oriented meanings, to a mental level in which experiences, values, and intentions form the basic components of music signification. The reverse process is also possible: that the human body transfers an idea, or mental representation, into a material or energetic form.[6]

In light of these references, and without intending to study the emotional effects of Xenakis's music, this chapter reviews the subject of physical energy to ponder this personal take on the composer, instead of discussing more usual topics such as the mathematical applications in his music, research that others have already conducted to a great extent. This approach constitutes a contrast from studies that portray Xenakis as a structuralist, hyper-rational, or scientific kind of artist, a view perhaps promoted in life by the composer himself if we consider the ways he sought to account for his creative procedures.

Metaphysical Approach: Potency

I recognize an outstanding quality while listening to the music of Xenakis: the musical experience is characterized by an open physicality. Works such as *Persephassa* (1969), *Jonchaies* (1977), or *Mists* (1980) are assertive, frontal, powerful; it is music that strongly impacts perception, sometimes overwhelmingly. Xenakis's music manifests itself in lived experience as potency. According to Baruch Spinoza (1632–77), "potency" (*potentia*) refers to the active essence by which a thing produces the effects inherent to its nature, that is, the capacity of preserving its own being.[7] This definition has three aspects of note: (1) the notion of active essence, (2) the idea that a musical work is capable of producing the effects inherent to its nature, and (3) the claim that the work's "own being" is preserved in the context of a creative act. Following the path of phenomenology, an active essence is a permanent and invariable constant of an

5 Juslin and Västfjäll, 2008, p. 564.
6 Leman, 2007, p. XIII.
7 Spinoza, 2007, p. 96.

object's structure, event, or process, that is updated as phenomena in each appearance in consciousness.[8] For this reason, musical experiences can be renewed in similar intensity and with a similar effect on mood; regardless of whether the same work has been heard dozens of times, music is updated in consciousness and is capable of moving the listener again and again, even if the piece is highly familiar. The second part of the definition refers to the fact that music is capable of producing the effects inherent to its nature. This relates to the composer's ability to translate perceptions, ideas, memories, emotions, and other facts into sound, giving rise and meaning to the creative process; thus, the creative drive produces inseparable impressions of its own features and qualities, in metaphorical terms, "its own nature."[9] Finally, the definition mentions one "being" that manifests itself in the work of art, not as a hidden or ethereal entity, or a product of the imagination, but as the ultimate and true expression of the artist in his own work or, taking our composer as an example, the way in which Xenakis makes his presence felt as an individual in his own music. I am thinking here of Eduardo Nicol's (1907–90) theory of human expression, that considers this "being" always as a "creative being," who moves with a certain direction and intensity to manifest and make himself present through his acts.[10] What better compliment can be paid to a composer like Xenakis than to recognize that his artistic being is revealed as potency and that his music produces the effects inherent in its nature?

However, the idea that certain music manifests itself in experience as potency has no shortage of challenges. Perhaps the first issue is establishing valid criteria with which to distinguish the necessary conditions for a piece of music to be considered powerful. We know that musical potency is not exclusive to Xenakis; works by other great composers share this extraordinary virtue. Musical potency is also not explained by the factors that articulate a large part of traditional musicological research: historical period, style, and musical system. It is clear that not all the works of the same composer emanate this quality. Recognizing the above, and from a philosophical scheme nourished by Spinoza's idea, I consider that musical potency depends on a basic condition: the ability to constitute meaning.

Construction of meaning is a classic subject in philosophy of music. It is the process by which people discover, in their interaction with music, the purpose of the phenomenon they are attending to, in order to achieve a certain degree of affinity or understanding. Leonard B. Meyer's (1918–2007) theory of musical perception argues that some

8 Edmund Husserl's (1859–1938) phenomenology can be considered as a philosophy of essences whose basic principle consists in detecting, without pre-conceptions, those stable structures that prevail in each manifestation of the experience of a phenomenon, with the purpose of carrying out a descriptive study that starts from intuition as a path to knowledge. See García de la Torre, 2018, p. 81.

9 For a broader exposition of the psycho-physical operations involved in the musical creation process see ibid., p. 134. The concept of drive refers to Freudian psychoanalytic theory. However, its use here, as a creative impulse, is more moderate. I think of the psychic impulse or intuitive tendency originated in an internal excitation—perceived as a state of tension—which is directed towards satisfying a creative need.

10 Nicol, 1957, p. 121.

epistemological positions that have explained the construction of musical meaning, such as absolutism, meaning built upon the structural relationships that a work establishes, and referentialism, meaning built upon allusion to concepts, actions, and emotional states, are not mutually exclusive.[11] Meyer believes that these positions can coexist in music perception; affective meaning can be configured from understanding the music's referential content, and, in addition, people can enrich their listening experience from intellectual and abstract comprehension of structures.[12] Based on Meyer, potency of music is attainable if 1) the work is capable of expressing immediate meaning and 2) if perception manages to adapt its processes without too much conflict while attending to musical events. Having to assimilate overly sophisticated codes, dependent on hyper-stylized and unbinding forms, loaded with complex symbols to decipher, reduces the probability of reaching a powerful experience. Any condition preventing the general meaning of music from being found in a limited number of auditions truncates the possibility of potency. The acquisition of meaning is facilitated if musical events emulate the iconic behavior of phenomena in the physical world, events related to factors such as movement: ascending-descending, accelerating-decelerating; space: events located in reference to something else, in front, in the back, from inside or from outside; or even tension: objects related or non-related, forming subtle or decisive oppositions between components. Given their perceptual forcefulness, anchored in the findings on sound activation already discussed, I argue that these types of phenomena embody musical potency.

Physical Approach: Energy

Discussing the ways in which Xenakis's music manifests physicality calls for clarification of the concept of energy, a notion from which several slightly separate meanings emanate. Without denying the importance of the daily and spiritual sense of the word, and especially since we deal with the figure of Xenakis, this article will focus on the scientific sense: physical energy.[13]

The cosmological vision of Heraclitus (540–480 BCE) pointed to the existence of something that drives the activity of nature: a "fire" which has a continuous flow or movement, structured by antagonisms and tensions. According to Werner Heisenberg (1901–76), this may have been the first indirect reference to energy in Western history.[14] Later, Aristotle proposed the concept of "energeia" (ἐνέργεια), which "implies act, actuality, insofar as it is opposed to possibility, in his explanation of change or movement in nature, is incumbent [...] on the prime principle or prime movement of all beings."[15] The definition of energy has been a classic problem for modern science

11 Meyer, 1956.
12 Ibid., p. 1–3.
13 For a detailed review of the most recurring properties of physical energy, see Jaffe and Taylor, 2018.
14 Heisenberg, 1958, p. 63.
15 "Energeia," *Encyclopedia Herder*, https://encyclopaedia.herdereditorial.com/wiki/Energ%C3%ADa

because the concept is described in the specialized literature more for what it *does* or *causes* and less for what it actually *is*:

> Energy is not easy to define [...] we observe that in any physical system free from outside influences, energy does not change with time. This fact is referred to as conservation of energy, and this is energy's most fundamental attribute.[16]

For researchers, energy is not a substance with causal agency, but the abstract measure of a property possessed by an object.[17] In *Energy, The Subtle Concept* (2015), Jennifer Coopersmith reflects upon the complexity of a simple definition: "Energy is [...] the ceaseless jiggling motion, the endless straining at the leash, even in apparently empty space, the rest mass and the radiation, the curvature of spacetime, the foreground activity, the background hum, the *sine qua non*."[18]

Acoustic Energy: Transmission and Reception

Considerable scientific agreement is found in the field of acoustics and psychoacoustics on the mechanisms of origin, transmission, and reception of sound.

> Sound waves in fluids involve local changes (generally small) in the pressure, density and temperature of the media, together with motion of the fluid elements. Fluid elements in motion have speed, and therefore possess kinetic energy. [...] In regions where the density increases above its equilibrium value, the pressure also increases; consequently, energy is stored in these regions, just as it is in a compressed spring. This form of energy is termed potential energy.[19]

Potential and kinetic energy created by the sound source are transported as a disturbance by the fluid medium, i.e. air, towards the human auditory apparatus. The tympanic membrane converts external acoustic pressure variations into mechanical vibrations that are transmitted to the oval window of the cochlea, which is responsible for converting mechanical vibrations into nerve discharges.[20] Thus, energy, as a fundamental element that animates sound, is present from the emanation and transmission mechanisms in different environmental conditions, as well as in the consequent bio-mechanical processing of hearing.

Acoustic theory holds that sound has four basic components: frequency, amplitude, timbre, and duration. Frequency, the rate of periodic movement of compressions and refractions of a sound wave, is expressed in pitch. In terms of energy, a higher frequency implies a faster vibration; hence a high-pitched sound contains more kinetic energy than a low tone. Amplitude is manifested as the distance from the rest point of the sound wave

16 Jaffe and Taylor, 2018, p. 3.
17 Feynman, 1966, p. 34.
18 Coopersmith, 2015, p. 362.
19 Fahy, 2002, p. 1.
20 For a detailed description of this process see Howard and Angus, 2017, p. 72–4.

to the moments of compression and maximum refraction. In simple terms, amplitude is perceived as the intensity of the sound.[21] An increase in sound pressure is perceived explicitly as acoustic energy, that is, as an increase in perceived intensity. The relative densities of the compression and refraction points are further apart in loud sounds and narrower in silent ones. This difference has a direct correlation with the energy applied in the attack that excites the sound source. Harmonic content is a constituent factor of timbre, the attribute of auditory sensation that enables the hearer to judge the difference between two sounds with the same pitch and intensity.[22] It also registers the spread of the available energy across the range of frequencies that are present. Timbre description depends on inter-sensory associations that have subjective ingredients, which lead us to qualify a sound as bright, smooth, or rough, adjectives related to the degree of complexity between its harmonic components. Energy is expressed in timbre primarily as perceived tension. Finally, duration is the temporal measure of sound; however, of all of the components of acoustic theory, duration is the element whose relationship with energy seems less significant. In any case, duration implies the presence of sound or silence, and the former enables all energy expressions described above.

Music and Energy in Perception

The manifestation of acoustic energy in musical perception seems to have multiple origins and involve several factors. However, any project intended to trace the energetic *qualias* of music must consider the aforementioned acoustic components as a starting point.[23] From this essential point of departure, the theory of macrotimbre by Julio Estrada (b. 1943) highlighted elements linked to the creation and execution of sound, such as pulse, attack, pressure, vibration, noise, space, and chaos.[24] Each element of Estrada's macrotimbre can be considered an independent magnitude with degrees of energy forming a conglomerate of audible factors which in a compositional process can be graphically expressed in trajectories of a system of Cartesian axes in two or more dimensions.[25]

21 The energy of the sound wave is a measure of the amount of sound present. However, in general, we are more interested in the proportion of energy transferred than in the total energy transferred. So we are interested in the amount of energy transferred per unit of time, the number of joules per second (watts). But sound is a three-dimensional quantity, so we have to consider that the sound wave will occupy space. Therefore, it is necessary to characterize the proportion of energy transfer per area unit. This quantity is known as "sound intensity." In Howard and Angus, 2017, p. 20.

22 ANSI, 1960, in Howard and Angus, 2017, p. 238.

23 The notion of *qualia* is used here in reference to the sensory data of perception. The idea of energetic *qualias* of the musical supposes the search for and identification of perceptual data that make audible some qualities of energy in acoustic terms.

24 For Estrada, the macrotimbre is the synthesis of the physical-perceptive fusion of the musical matter in which the treatment of rhythm and sound is generalized starting from a homogenization of their respective components, a set that allows showing a chrono-acoustic integration of musical matter. Estrada, 1994, p. 116.

25 Estrada writes, "With the UPIC, time becomes the x coordinate while the y coordinate represents the energy level of the pitch frequencies, envelopes, or waveforms [...] This energy, whether physical or even abstract, represents information as important as that of the specific component assigned to a

Another layer within the quest for perceived acoustic energy is added by considering rhythmic-metric design and harmonic strategies. Here, the axial organization of music comes into play. If the presence of sound is equivalent to a form of acoustic energy, then rhythm, the organization of durations of sound and silence, is a way of structuring energy signals in time. In a rhythmic-metric organization of music, factors such as degree of regularity, metric affinity, and speed of the unit of time constitute a particular modality of energetic-musical events. On the other hand, affinity or disparity of simultaneous sounds and their respective harmonic properties determine the resulting level of tension. The organization of harmonic space is a determining quality of musical energy. Intervallic, chordal, and scalar relationships have produced the principles of harmonic tension in music. Although the traditional dominance of pitch has diminished in the music of composers of the last century, it is clear that it continues to be a factor in musical composition of our day. Western musical systems have been built for centuries on intervallic, chordal, and scalar relationships to define the principles of harmonic tension. Although the traditional dominance of pitch has diminished in the music of composers of the last century, it is clear that it continues to be a factor in musical composition of our day.

For this study, the listener's relationship with the sound source in terms of location and distance, i.e., the aspect of physical space, is of primary interest when considering perceived acoustic energy. The spatialization strategies of multi-instrumental, electroacoustic, or electronic works consider the localization between the source and the public as an essential element for design. As such, composers of the last seventy years have found creative ways to explore space as an independent element in music. A piece exploring this approach can suggest distance, depth, laterality, orientation, and movement, all of which are achieved more easily than in conventional concert arrangements.

Texture is another stage of perception of musical energy. The concept has several meanings, often referring to the correlation between events of a piece, aspects such as density of objects, distance between objects, type of interaction established, rhythmic and harmonic affinity, and timbre correspondence. Among these meanings, degrees of density in time units are definitive in the perception of wide-ranged, global activity. Thus, the textural interactions allow perception to establish hierarchies, that allow the description of musical behavior; this, of course, is applicable to solo pieces as well as orchestral masses, or music made with media that support multiple layers of sounds.

All the factors discussed above make it possible to classify musical manifestations in terms of perceived energy. It is clear that creating music implies the organization of these elements according to strategies and resolutions, whether intuitive or deliberate. In *Art, Energy and the Brain*, Robert Pepperell claimed to recognize the essential role of energy in the aesthetic experience of Art and reviews the ways in which this type of

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macrotimbre. For musical thought, drawing becomes a dynamic alternative that extends the methods of assigning macrotimbric data. For example, a vector with the same amount of energy as another—at the level of the ambitus of each component—can always express itself with an equivalent value." Estrada, 2020, p. 317–23.

organization occurs. Pepperell refers to John Dewey (1859–1952), who considers artistic products and their lived experience as manifestations of "organized energy," based on a series of antagonisms such as rhythm and variation, beginning and end, or movement and rest. According to Dewey this organization is "vital, physiological and functional."[26]

Acoustic Energy Organization from a Gestalt Perspective

The way energy is organized, rather than its mere presence or pure measure, became an important subject for the aesthetics of the Gestalt school. Its adherents endorsed a general principle of perceptual organization in which aesthetic preference is directed toward the simplest and most efficient arrangement of elements.[27] Rudolph Arnheim (1904–2007), an art theorist with a background in Gestalt psychology, attempted to understand the function of visual art as the action of "exquisitely balanced perceptual forces." These are dynamic properties of shapes and patterns, energetically driven and suspended in relationships of mutual tension, reminiscent of the principles claimed by Dewey.[28]

Art perception—in this case, music perception—depends on the combination of energetic *qualias* as a Gestalt construction. The highest hierarchy of this Gestalt can be found in two fundamental aspects in the tracking of energy: perceived movement and perceived tension. Motion can be considered in its most general sense as change, whether in terms of an object's position, direction, continuity, regularity, activity, intensity, velocity, and acceleration relative to an observer or, in this case, the listener. On the other hand, tension can be considered as conflict between forces due to their relative position or configuration. Conflict between forces can occur in pitch, timbre, harmonic organization, contrapuntal and rhythmic-metric relationships, as well as in formal structures of music. The continuous updating of energy allows us to trace these instances, both at a macro-level of music, between contrasting sections, or in musical events at a micro-level, as interactions of cellular elements. In short, following Pepperell's idea, two primary factors facilitate the detection of musical energy in its kinetic and potential manifestations:

- Factors of change, in terms of movement, action, impulse, work, or excitement.
- Factors of conflict, in terms of tension, organization, structure, proportion, balance, and opposition.

The Gestalt structure formed by the energetic *qualias* of music is organized in a range of ascending layers of complexity. This could be represented by portraying the basic sound components in the lower levels up to the factors of change and conflict cited above (see Figure 12.1).

26 Dewey, 2008, p. 169.
27 Pepperell, 2018, p. 9.
28 Arnheim, 1969.

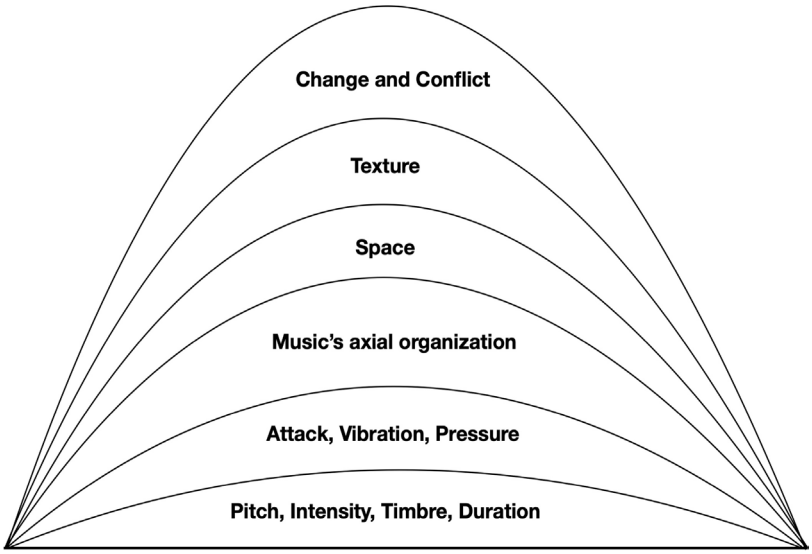

Fig. 12.1 Perceptual *qualias* of musical energy. Figure created by author.

Xenakis and Acoustic Energy

The primary sources of the work of Xenakis contain inconsistently scattered references to energy. This explains why the subject is not very visible in the research about the composer. Although researchers have not often noticed them, Xenakis mentioned energy many times in his writings and conferences. In *Formalized Music*, Xenakis, as someone well-versed in modern theories of physics, recognizes the importance of the principle of conservation of energy, following Einstein's findings:

> The principle of the conservation of energy in physics is remarkable. Energy is that which fills the universe in electromagnetic, kinetic, or material form by virtue of the equivalence matter-energy. It has become that which is "par excellence." Conservation implies that it does not vary by a single photon in the entire universe and that it has been thus throughout eternity.[29]

In the same text, in the chapter dedicated to time and space in music, Xenakis explains the origins of physical space, one of the topics that most occupied his reflections:

> As space is perceptible only across the infinity of chains of energy transformations, it could very well be nothing but an appearance of these chains. In fact, let us consider the movement of a photon. Movement means displacement. Now, could this displacement be considered an auto-genesis of the photon by itself at each step of its trajectory (continuous or quantized)? This continuous auto-creation of the photon, could it not, in fact, be space?[30]

29 Xenakis, 1992, p. 203.
30 Ibid., p. 257.

In *Conversations with Xenakis*, Bálint András Varga presented an interview with the composer in which a series of discussions about energy in the context of music appears.[31] Xenakis dedicated several lines to acoustic movement, achieved by designing the arrangement of the musicians and the use of non-traditional possibilities at concert venues. Works such as *Terretektorh* (1966) intended to explore kinetic energy in space. Varga explains:

> The most important thing is: if the musicians fill the space at their disposal we can exploit its kinetic properties. Instead of static music we can produce something mobile. Movement is an interesting means of expression, which can hardly be employed with traditional orchestras. Sometimes I have also used that limited possibility in an orchestra seated traditionally on the podium, making sound wander from right to left or from left to right. There's no depth, however, because the perspective of sound is insufficient. Genuine movement can come about only if the musicians surround the listener. We can therefore "tame" space.[32]

The energy radiation of the instruments was transcendental for Xenakis in the spatial design of his works; in this sense he was always careful to preserve the acoustic energy that emanates from the sound source in the context of a concert hall. The following comment is in reference to a performance of *Persephassa* (1969) at the Round House in London:

> The individual listeners don't hear a completely different kind of music, but they certainly do hear the same music from a different perspective. If the piece is good, it will be performed more than once, and it will thus be possible for everyone to hear it from different angles. This solution has another advantage as well: the physical proximity of the instruments makes their sonority much more alive than when you hear them at a distance, in which case the energy they radiate dwindles and components of the matter of sound are lost. If we are as near to the instruments as the conductor and the musicians then we find ourselves in the very middle of the sound.[33]

These references suggest that although Xenakis did not develop an explicit theory of musical energy, the subject was present in his thoughts. The primary source in which these phenomena seem to manifest most forcefully is, without a doubt, his music. In the following, I present generative aspects of some of his pieces from the perspective of energy. The focus will be on factors of change and conflict, as elements that facilitate the constitution of immediate meaning, which leads to a powerful listening experience.

Metastasis (1953–4): Initial Section, cc. 1–55

The first section of *Metastasis* famously features the unfolding of a single pitch into a cluster of forty-six pitches by means of string *glissandi*. The key to this process consists

31 Varga, 1996.
32 Ibid., p. 97.
33 Ibid., p. 98.

of the increase of energy in several features: density, intensity, harmonic tension, and activity of the continuous trajectories. The aim is to move from the simple texture of the opening to the harmonic complexity of the climax (mm. 55), which is emphasized by violent tremolos. Through careful design of dynamic processes, Xenakis achieved the transition from unity to mass, from immobility to change. The architectural origins of the piece are well-known, but from a listener perspective, the manipulation of these forces allows for a remarkable effect, never heard before: the imminent visualization of sound. The immediate meaning of this music and its expressive capacity could not be explained without the transformations of elements tending towards saturation, that is, the accumulation of acoustic energy.

Pithoprakta (1954–5): *mm. 52–9/mm. 60–104/mm. 105–8*

The construction of global sound entities is the compositional goal of *Pithoprakta*. I take mm. 52–108 as an example. The three textures that appear here depend on differentiated attacks and the internal activity of global events. The first texture (mm. 52–9) was conceived based on statistical models that were derived from one of Xenakis's most attractive sketches.[34] The strings form a cloud of *glissandi* with *pizzicati*, which, in its multiplicity, invokes a global behavior of a mass that widens, thins, or hollows out. A sense of unpredictability prevails, a kind of organized chaos. After a short pause, in mm. 60–104, a new texture of sustained sounds that cover the entire register appears; the sudden change towards the static and immobile is notorious. Furthermore, Xenakis emphasized the contrast by suggesting an ephemeral, metrical regularity with the pseudo-steady rhythm of the xylophone. A progressive stillness continues towards the awakening of internal activity when discontinuous trajectories of *pizzicati* and rapid attacks are heard on the percussion. A third texture opens from mm. 105 onwards, a typical passage with fast *glissandi* trajectories. The success of this contrasts lies in the handling of kinetic energy, manifested in the micro-interactions of each sound entity.

Terretektorh (1966)

Xenakis offered a radical conception of kinetic energy in *Terretektorh*. The exploration of space through the conception of sound movement and depth are key in the conception of the piece. The design of space calls for a circular arrangement of eighty-eight musicians around the conductor, with the public inserted between them. With this setup, Xenakis was able to build layers of complexity for the listener while keeping the harmonic-melodic environment static, in order to make way for percussion sounds

34 See blessing5150, "'Pithoprakta' by Iannis Xenakis" (2 Apr 2017), *Music 7703—Contemporary Compositional Practice*, https://music7703lsu.wordpress.com/2017/04/02/pithoprakta-by-iannis-xenakis/

like wooden blocks, whips, maracas, and whistles. Both directional and stochastic sound movement results through changes in intensity, register, density, timbre, and spatial localization.

Psappha (1976)

Psappha's compositional focus is the articulation of time through polyrhythmic patterns as independent layers in simultaneous interaction. The combination of timbres of percussion instruments, pitches, and attacks are the elements at play. Xenakis used a regular grid as a score to capture the rhythmic-metric organization. In general, three layers of percussion appear, each containing high, medium, and low pitches. The patterns presenting degrees of transformation lead the discourse progressively: accents, addition or subtraction of attacks, layers of rhythm, and timbre. *Psappha* has moments where a sense of transitory regularity seems to settle. Predictability is difficult to achieve due to the changes incorporated in each cycle. Some changes are due to systematic organization and others to intuitive manipulations of materials. Movement is manifested in terms of global behavior of passages in three forms: continuity, regularity and intensity of events, while changes in density are responsible for bringing tension. For example, there may be intense activity in a single layer (b. cc. 308–520), shared activity between layers (b. cc. 1410–1590), or horizontal saturation of activity in one or more simultaneous layers (b. cc. 2030–2170).

Mists (1980): First Two Sections

The first part of *Mists* opens with a series of scales displayed in continuous random walks.[35] A set of lines that overlap and intersperse gradually separate to find their individual culmination in the high register. Xenakis elaborated permutations of these arborescent events that are reminiscent of contrapuntal operations such as inversion or retrograde. Events with an upward trend are shown in different versions of density; sometimes they present high saturation while others spread out under probabilistic distributions. The second material, made up of stochastic clouds, marks a remarkable contrast, based on the opposition of densities, register, and intensities. The high register is explored as if the hands, as unpredictable springs, suddenly attack the piano with energetic impulses. Unlike the first material with a diagonal logic, the intermediate passage operates from a vertical beginning with non-simultaneous attacks poured into clusters.

The descriptions from this brief but representative collection of Xenakis's works have attempted to capture an overview of the dynamic transformations by which the composer articulates his music. On different structural scales, acoustic energy is manifested in each case as factors of difference and change, always in comparison

35 Squibbs, 2002, p. 91–108.

between the events that occurred—memory—and the present evolution—time—which establishes a complex system of cognitive interdependencies.

Final Considerations

From the perspective of physics there is enough evidence to affirm that music is a form of energy. However, traditional composition and even new forms of creation are usually considered as the organization of musical elements, and not as a process in which judgment and intuition regulate the energetic magnitudes of sounds in favor of meaningful constructions. The abstraction of this kind of musical phenomena, without considering the typical forms of compositional practice, seems adventurous, but Xenakis showed that is possible to take advantage of these resources. Within the framework of the complexity of his system designs, Xenakis treated the forces of the acoustic and musical fields with admirable freedom, managing to unleash his full power like few others. For this reason, and based on the Spinozian conception of *potentia*, I maintain that Xenakis was a creator of powerful listening experiences.

Much work remains to be done to elaborate the ideas of this article, especially since the subject of energy in musicology has been little addressed. For the moment, the proposal of a Gestalt formed by the energetic *qualias* of music is a first step towards greater instances; the exploration on the matter should lead towards further characterization and interaction of these qualities. The challenge of talking about energy in any discipline poses similar difficulties, such as its quantification, the qualities by which it manifests itself, monitoring its transformations, and the ways in which it is updated. It will be necessary to work on these paths to consolidate more research in this regard.

Anchored in his acute observation of nature and its phenomena, one of Xenakis's most extraordinary features is the regulation of energetic factors of change and conflict. Here lies the physicality of his music. By showing a particular interest in establishing criteria in the order-chaos polarity, Xenakis achieved structures of density of musical horizontality and verticality, building timbre categories to create contrast. He handled musical components as relational properties, constantly linked, whether as affinities, oppositions, or evolutions: as forces in interaction. From this perspective, the foundation for his aesthetics, in affinity with the Heraclitean vision, is to consider that what animates music is nothing else than energy.

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