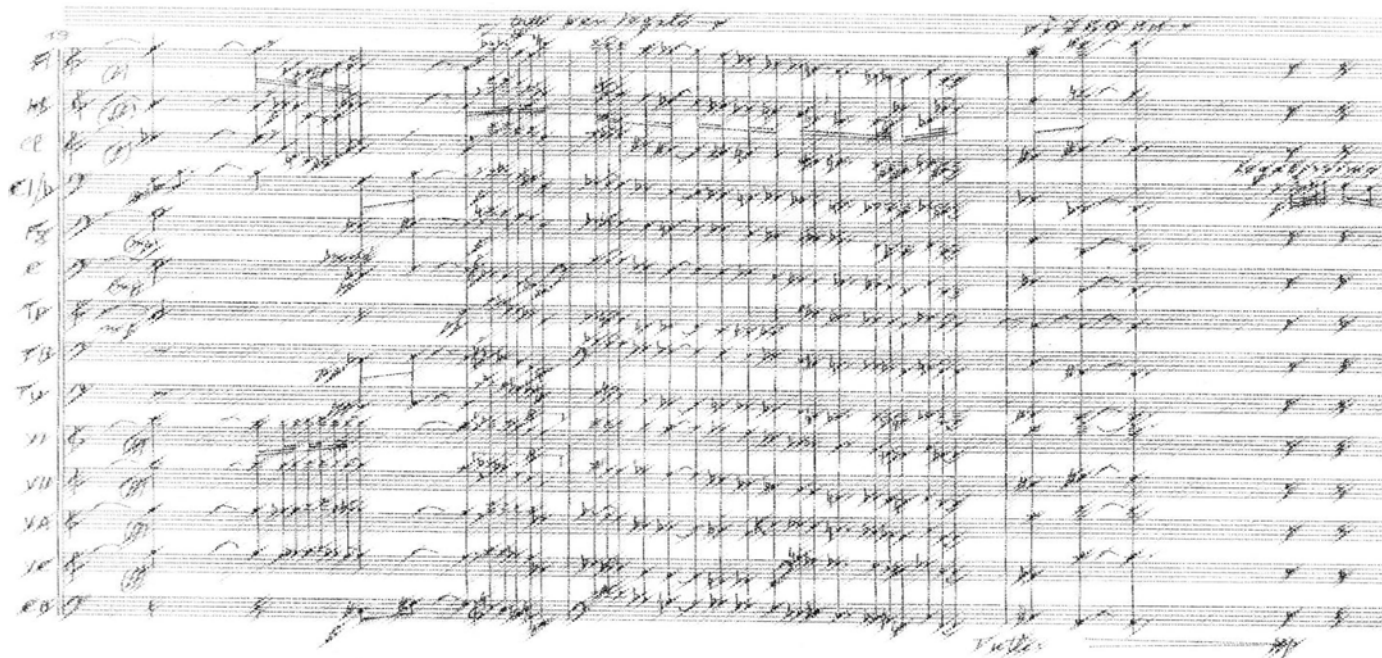
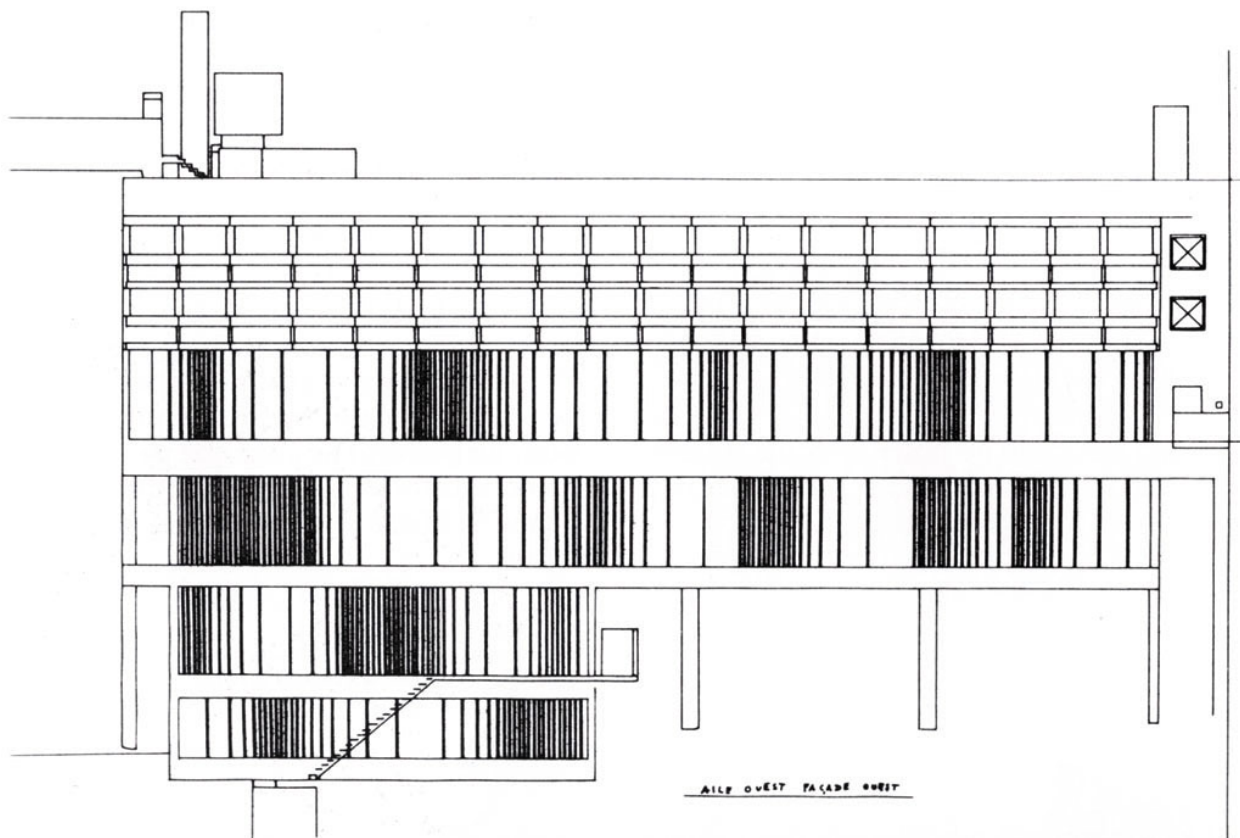




MOLLIFYING THE MUSES: AN EXPLORATION OF CONFLICT IN THE LIFE AND WORKS OF IANNIS XENAKIS

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Introduction

When asked about his happiness as a composer of music in a rare 1966 interview, Iannis Xenakis, already an accomplished composer and seasoned architect at the time, stated “You have no idea of the anguish that betokens, the difficulty of making, of abandoning, something of one’s self, to be judged and to be incapable of judging oneself, incapable of knowing what one is. Greeks are like that: they are a people continually in search of themselves, always ready to launch out into all kinds of rapid, violent sometimes fatal actions, and end up by not finding themselves” (Bois 22). Through such haunting words of a man so honest of his art, whose art was a window into the extraordinary life of the artist himself, one is given a small glimpse into the internal turmoil that comprised the life of Xenakis. This was indeed a man constantly searching throughout his life on so many levels, as evident not only from the diversity of his career as both a composer and an architect/engineer, but also from the extreme range of concepts, theories, and hypotheses addressed in his numerous compositional pursuits. Yet, despite such a wide spectrum of ideas, designs, and musical techniques that would eventually comprise his compositional and architectural portfolio, one quality evident in so much of his life experiences seemed to neatly characterize his creative voice and the reason for such internal struggle. Xenakis was a man haunted by conflict. Conflict invaded every aspect of his life, from his identity as both Greek and communist and his role in the Greek revolution, to an endless internal dispute over his chosen studies and profession between his two passions of engineering versus musical composition, becoming a man of music or a man of science. It is this lifelong exposure to conflict, resulting in part from the emotional and physical scarring of an early introduction to the horrors of revolutionary war, which fueled and inspired Xenakis and can be traced in much of his life’s work.

In providing an overview of Xenakis' contributions to the fields of music and architecture, it has become clear that one cannot simply travel chronologically through decades of his projects and collaborations in order to make sense of the many academic, musical, and architectural pursuits undertaken throughout his lifetime. Xenakis was particularly known to return to various undertakings repeatedly throughout his career, constantly borrowing and reworking ideas in order to influence later endeavors. Rather, by categorizing Xenakis' works and scholarly interactions with some of Europe's finest composers and architects, in regards to a strict comparison of influences and outlooks on music, architecture, and technology, we may better understand the many forces and disagreements that would direct him towards his highly diverse initiatives.

Influence of Le Corbusier

Approached from an architectural perspective, it becomes difficult to discuss some of Xenakis' most successful and progressive designs (as well as the musical compositions and thought which served as initial inspiration) without first delving into his highly influential relationship with the famed French architect, Le Corbusier. Arriving in Paris in 1947 after defecting from Greece and his nearly fatal role in the Revolutionary War, Xenakis would come to work for Le Corbusier's atelier as a structural engineer due to his degree from the Athens Polytechnic Institute.ⁱ (Xenakis, Kanach 3) During this highly productive period of twelve years, Xenakis would construct not only his famed design for the Philips Pavilion as well as develop the iconic windows of St. Marie de la Tourette, but also arrange the compositions *Metastaseis* (which would largely inspire the Philips Pavilion design), and *Pithroprakta* which marked his first use of stochastic theory in music. Commenting on Le Corbusier, Xenakis claimed "it was

the first time I had ever met a man with such spiritual force, such a constant questioning of things normally taken for granted... He opened my eyes to a new kind of architecture I had never thought of... This was a most important revelation, because quite suddenly, instead of boring myself with more calculations, I discovered points of common interest with music (which remained, in spite all, my sole aim)” (Bois 5). Stemming from his studies of Le Corbusier’s *Le Modulor*, Xenakis began to understand Le Corbusier’s theories of harmony and would thus apply such theories using his aesthetic of music.ⁱⁱ At this point in Xenakis’ career, scarred from war and looking for work simply in order to survive, the man suffered much over internal conflict of his ultimate desired profession, stating “I wanted to do two things: music and the study of mathematics and science. Music was something very important to me but not enough for me to live on” (Bois 5). Through Le Corbusier’s studio and *Le Modulor* system, Xenakis quickly discovered an outlet in which he could continue both passions, resulting most clearly in his design for the windows and chapel of Sainte Marie de la Tourette.

Emergence of War in Early Designs

When observing Xenakis’ input for the design of Sainte Marie, signs of a creative genius can be seen in the ways in which he cleverly incorporated Le Corbusier’s fundamental teachings (particularly his ‘reminders’ on mass, surface, plan, and regulating lines) within his early work. (Le Corbusier 25-83) Interestingly, Xenakis wove both conflicting references to music and war into the convent’s structural components while still strictly conforming to Le Corbusier’s structurally pure approach. In focusing on mass, Xenakis traced the curved shape of a grand piano, infusing what he referred to as “light cannons” aimed in three directions to the roof. (Xenakis, Kanach 68) Next, in regards to surface we may turn to the undulating glass panels

which would become an early signature of Xenakis' work. This design also marks one of Xenakis' earliest examples of the interweaving between architecture and music which fully embraced the teachings of Le Corbusier. While pre-existing the stochastic probabilities that would govern much of Iannis' later projects, the architect would follow a form of contrapuntal periodicity to develop the pattern of widening and shortening panes. Likewise, influenced by Le Corbusier's focus on regulating lines, Xenakis' method of calculation incorporated the golden section which served as a basis for *Le Modulor*, in defining the relationships between the horizontal divisions on each pane of glass, forming a series of proportionally congruent rectangles. While keeping to Le Corbusier's rectangular plan of the monastery's overarching design, Xenakis found that music added a naturally occurring variant which would provide added complexity and focus to the building's detailed window facades. Le Corbusier, according to Xenakis, "was so pleased that he wanted to call them 'musical glass panes' and asked me[him] to describe them in his book *Modulor II*" (65).

One can thus see how Le Corbusier's teachings (specifically in relation to his focus on mass, surface, and plan, while incorporating the strict use of regulating lines and the golden section to define proportion) not only shown in Xenakis' early work in the atelier, but more importantly provided the budding architect with a solid foundation through which he could channel his fascination for music. Likewise, one may notice the remnants of war which would influence not only Xenakis' structural designs (as seen by the "light cannons" in addition to "light machine guns" placed above the sacristy in the convent's central courtyard) but even his descriptive vocabulary. (50) It is this focus on war and Xenakis' creative methods of translating such striking brutality into his music which seems to reflect the unending internal struggle that may certainly have defined much of his thematic inspiration.

War as Inspiration for Musical Composition

A perfect example for the translation of the theme of war from architecture to sound can be unmistakably detected in the Xenakian composition, “Metastaseis”. Developed from 1953 to 1954 with Xenakis still working in the atelier, this composition would become his first of many breakthroughs in regards to the 20th century avant-garde, eventually serving as the signature form of musical inspiration for his most famous architectural designs. Stimulated by his work in the atelier, when describing the piece Xenakis claimed, “the role of architecture is direct and fundamental” (Harley 10). “Metastaseis”, for its pure originality as a composition, seemed to reflect the composer’s first major attempts to transform his creative methodology developed under Le Corbusier into tonal organization. In forming his own sonic language, Xenakis worked with an orchestrated technical vocabulary of glissandi, pizzicato, and cluster chords as building blocks for his composition. While such techniques had often been utilized for added peripheral effect by earlier classical composers, Xenakis would be one of the first to treat each technique as the foundation of his music. (11)

The way in which the composer both structured and scored each voice of the composition lent to the architectural element associated within the piece. Sketching on graph paper, Xenakis drew a series of interweaving lines (referring to each musician’s associated glissando) to form rather complex and varied shapes with little indication of exact pitch. Rather than focusing on the limitations of tonal harmony, or the atonal rules and chromatic regulations defined by 20th century Serialists, Xenakis claimed to be more interested in “moving beyond the limited tones of the chromatic scale” (Hewitt 45), the word ‘metastaseis’ meaning “beyond + stasis”. Thus, with the freedom of pitch and flexibility of 61 individual instrumental voices, Xenakis was able to create a set of visually pleasing, arcs formed from a series of rotating right angles, adding an

organized visual component to an otherwise chaotic mesh of sound. In doing so, “Metastaseis” would succeed not only in easily escaping the limitations of tonality and chromatic harmony, but also in developing a new sonic texture never before produced by an orchestra.

Whereas the piece’s premiere in Donaueschingen, Germany was, to put it lightly, a disaster, causing Xenakis to be excluded from the Serialist repertoire, it seems it was this new noisy orchestral texture that most interested the resilient composer. Perhaps a particularly grotesque description made by Xenakis in reference to his “mass sound” (a term he would use to coin this new sonic terrain) would best demonstrate his obsession with the natural, war-like sounds he had conjured. In reference to a subsequent composition, “Pithoprakta”, in which Xenakis would attempt to recreate “mass sound” using his newly conceived “stochastic approach” (a method involving the use of various mathematical probability formulas including Poisson’s Law of Rare Events, Bernoulli’s Law of Large Numbers, and the Maxwell-Boltzmann Kinetic Theory of Gasses), the composer writes, “The human river shouts a chant in uniform rhythm... [After] a whistle of bullets... The crowd is then rapidly dispersed, and after sonic and visual hell follows a detonating calm, full of despair, dust, death” (48). Clearly, the topic of war still appeared fresh in the mind of the young veteran, serving as both a source of inspiration for the composer to develop new and unmatched mathematical textures, as well as an analogy through which Xenakis could help others appreciate the context of his highly abstract compositions.

Music as the Foundation for Design

Rather than immediately delving into the mathematical concepts, theoretical conflicts, and resulting compositions that comprised much of Xenakis’ exploration of “mass sound”, it

seems fitting to first address the key architectural structures stemming from his original linear sketches of “Metastaseis” which would come to define his iconic style. In the context of growing tension between his work and that of Le Corbusier, one may surely see how Xenakis’ diverging ideas and eventual creative freedom would promote a greater mastery of his own unique architectural language: a language governed by mathematical principles yet reflective of musical variation and lyricism. Turning to the extraordinary process behind the controversial design and construction of the 1958 Philips Pavilion, part of the Brussels World Expo, we discover a key moment in which, amidst dispute, Xenakis finds the ideal opportunity and resources to directly merge his musical studies with his profession. Thus, given the intent of boasting both musical and architectural achievement, we see how Xenakis’ pioneering efforts to combine both fields pushed his design beyond the preconceived limits of architecture and spatial sound.

Disagreement within the Atelier

Perhaps the first indication of tension between Xenakis and Le Corbusier could be inferred from the major differences in their initial concepts of the Pavilion. Le Corbusier had of course been granted the project of designing the pavilion structure from Philips to demonstrate the sound and light possibilities of Philips’ technologies rather than simply displaying their products. (Treib 9) Yet, as he was soon preoccupied with work on the Center in Chandigarh, India, he would assign Xenakis with the task of developing the majority of the Pavilion structure. Nevertheless, in leaving his mark on the overall design, Le Corbusier would set several parameters based on his own preliminary ideas. Envisioning the pavilion as an enclosed space of scaffolding housing a looping electronic multimedia presentation, the French architect saw the

opportunity to promote the futuristic capabilities of Philips technology in paying homage to the progression of mankind. (Hewitt 49) This holistic image, coupled with a stomach shaped plan for the base, would be the defining elements preserved in Xenakis' work. However, in beginning to develop a style of his own, Iannis would differ greatly from Le Corbusier in his design of the building façade as well as use of materials, turning to his musical compositions for primary inspiration. According to Xenakis expert, Nouritza Matossian, "with a solid basis of ten years experience behind him Xenakis was primed for a free flight of imagination" (111). Seeing the pavilion as the ultimate display of creativity, visual simplicity would not come as an option to the ambitious Greek architect. Thus, Le Corbusier's "bottle-in-scaffolding" vision would be entirely rejected, keeping only the floor plan as the basis for the structural shape. (112) Instead, Xenakis saw a striking parallel between sketches of glissandi in his "Metastaseis" composition, and his recent studies of various stable conoids whose warped surfaces could be formed by a rotating series of straight lines. Thus, a conscious connection between his musical discoveries and architectural studies would spark an enthusiasm in the flexible conoid shape. Eventually coming across the properties of the hyperbolic paraboloid, similarly generated by a series of straight lines whose end points moved along two lines, Xenakis devised a surface that could be stretched to fit the freeform curved perimeter of the stomach shaped floor-plan. This design was certainly an architectural breakthrough, having yet to appear in modern construction, and would thus require an equally innovative construction method in order to maintain optimum structural rigidity. By adopting a method of precise, gravitational model making used by Gaudi in designing Barcelona's Sagrada Familia, Xenakis would not only develop multiple models of his hyperbolic shapes and surfaces using materials such as piano wires and string, but also a means to test the stability of the structure. (113)

A seamless plan with numerous scaled models and successful structural tests was enough to convince even Le Corbusier to follow Xenakis' visionary design. However, such a sign of deliberate independence within the atelier would spark a serious, eventually public confrontation between Le Corbusier and the Greek artist/technician, marking a sudden end to their fruitful relationship. In presenting the pavilion to the public of the Brussels World Expo, Le Corbusier was to take full credit for the design as well as the ingenuity of the pavilion's hyperbolic façade. While the composer, Edgard Varèse would be given full credit for the interior multimedia composition, "Poème Electronique", Xenakis would be completely removed from the lime light of the project. In an act of courageous retaliation, Xenakis would write to the director of the pavilion, "It is I who entirely conceived the form and mathematical expression of the Philips Pavilion. I now demand, very firmly, that your press services mention my name... at the side of Le Corbusier. It is the least gesture of justice and truth which Philips owes me for the intellectual and moral qualities which I placed at its disposal" (118). Proof of a strong commitment and understanding of his unique contributions and style, Xenakis would surprise and utterly infuriate the famed French architect, who had ironically suffered similar plagiarism himself throughout his career. Captured even in his writings to the conductor, Hermann Scherchen, with whom Xenakis had established a close connection, Xenakis would label Le Corbusier as a "miser, an egotist, and an opportunist capable of trampling upon the corpses of his own friends" (120). Infamously known as the "Xenakis incident", Iannis' valiant disagreement with Le Corbusier would lead to his unexpected resignation from the atelier seemed to indirectly influence much of Xenakis' later works.

The Philips pavilion project provided Xenakis with invaluable experience in discovering his own architectural voice. Moreover, it forced him to defend his work, solidifying the notion

that he had conceived of his own style. It seems that through such an early exposure to professional conflict and the scars of plagiarism, Xenakis would hold close to his signature, non-orthogonal hyperbolic paraboloid shapes throughout the remainder of his career in an effort to credit their use in architectural design as his own invention. Nonetheless, hyperbolic paraboloids would ultimately serve as a unique symbol of the musical essence and mathematical complexity of his architectural work.

Defining a Unique Style

Further examples of Xenakian architecture which each contain elements of the hyperbolic paraboloid would include his designs for the experimental performance halls of Hermann Scherchen and Cité de la Musique, his conceptual Cosmic City, and his famous Diatope structure (installed for the inauguration of the Centre de Pompidou in Paris). While only one of these designs would be constructed, it became clear that Xenakis held steadfast to his original hyperbolic discovery. Beginning with Xenakis' two conceptual designs, we see that the architect dreamt big when it came to the architectural capabilities in utilizing his characteristic shapes. The most extreme of these designs exhibited Xenakis' venture into the large scale perspective of urban planning, contributing to a book by Françoise Choay entitled *L'Urbanisme: Utopies et Réalité*. (Hewitt 81) Aptly named "Cosmic City" for its immenseness, Xenakis envisioned an ecological paradise of hyperbolic towers inspired from a flight over the city of Manhattan, each curving inwards in variable degrees to create the most structural stability. While such a plan was certainly conceived at a massive scale, Xenakis still considered minute details such as the translucency of each building's outer shell as well as the double-walled design of the building's metal framework. (81) Focusing on the contrasting non-orthogonal nature of the paraboloid in

comparison to the often rigid orthogonal urban designs of Le Corbusier, Xenakis seemed to disprove the “myth” of orthogonality with his utopian city design. He boldly states:

The solutions proposed by the so-called avant-garde urban planners and architects are, in fact, nothing but short sighted and rampant naivetes... Thus we continue to decentralize on paper by creating specialized cities with an absurd cubic architecture, all standardized... However, if concentration is a vital necessity for humanity, the present ideas of urbanism and architecture must be completely changed and replaced by others. (Xenakis, Kanach 137-138)

We find even greater detail invested in Xenakis’ plans for Cité de la Musique. This project would be entered by Iannis in a competition for the hall of the New National Music Conservatory in Paris, for which Xenakis had first been invited to judge himself. Clearly the task of designing a performance hall captivated the musically inclined architect, who would describe his proposed structure as a “jewel box of sound” for its revolutionary kinetic stage (comprised of one meter square cubes which could be individually raised or lowered to develop endless spatial configurations). (84) Yet, the pièce de résistance once again came in the form of a proposed vaulted hyperbolic paraboloid that would cover the entire complex, serving as an iconic roof for the cultural center similar to that of the Sidney Opera House.

Finally, we may turn to Xenakis’ most promising hyperbolic design after the Philips Pavilion. Constructed in 1974, the Diatope served as a complex non-orthogonal structure, once again exemplifying a correlation between the human experience of music and architecture, abstracting the aural and the visual. Commissioned as a temporary exhibit to incorporate alongside the abstract “inside-out” design of Renzo Piano’s Centre Pompidou, the Diatope would closely emulate the concept of the Philips Pavilion in consisting of an outer shell of three merged hyperbolic paraboloids in which a visually stimulating multimedia composition would take place. Yet, this time Xenakis would control not only the structural design of the temporary encasing, but also the multimedia work to be displayed inside. In this case, Xenakis seemed to

mimic the thematic elements of the Centre in his Diatope by constructing a portable architectural framework over which he would stretch a red vinyl covering. While such a simplified design would certainly boast his signature shape, the multimedia work it housed would become Xenakis' major focus during his later period of intense compositional progress. Incorporating advanced technology in the form of four lasers, 400 pivoting mirrors, and 1680 flash-style bulbs, each controlled by the most advanced central processing unit to date, Xenakis' composition, *La Légende d'Er* would not only outdo the visual splendor of Varèse's earlier *Poème Electronique*, but translate a series of sounds into an spatial spectacle, visually entrancing to the viewer. Of course, Xenakis' would hold true to his metaphorical themes of conflict and war associated within the piece, adapting his title from Plato's *Republic* in referencing the soldier, Er's return from the underworld, treating themes of death and rebirth in the process. (Hewitt 81) Still, the most significant aspect of Diatope consists of its seamless integration of the visual technological elements within a tailored space, thus stimulating one's perception of the musical composition as almost a total physical immersion into the dense sound.

A Process of Mutual Abstraction

At this point in our analysis, it seems fitting to address Xenakis' views of the effects of architecture on the musical listening experience, which may help decipher the way in which Iannis visualized the abstract relationship between his architectural projects and associated musical compositions. In an article written for the French weekly cultural magazine, *Nouvelles Littéraires*, Xenakis discusses the steps taken towards abstraction in defining the most basic elements of his architectural and musical composition, thus determining the requirements which his products must fulfill and ways in which they may relate. He begins with the concept of opera

as a prime example in defining the implications of architecture in a musical experience. Xenakis first lists a number of constraints which music places on a traditional opera theater setting. “It will always be necessary to construct a place such where the characters act, meet one another... The musicians’ presence is also a constraint. One can remove the orchestra from the pit, place it on the stage or elsewhere, but its presence in a given spot, once decided, is not transferable” (Xenakis, Kanach 156). Next, he goes on to describe the specifics of his design for Cité de la Musique, explaining the most basic components of the hall which would directly affect the musical experience imposed within his theoretical space.

The space, at first would be like an envelope, which would serve as the sound shelter. The acoustics of a space is linked to the way that space is formed, to the shape of its covering. The architectural form does not have to be conventional. Spheres, right angles, and plane surfaces are to be absolutely avoided. Instead, I would use a curved surface. That is what I did in the Philips Pavilion. A curved surface has the advantage of better reflecting and diffusing the sound. (157)

Not only do we see a step by step explanation of the components that form the basis of Xenakis’ unique style explained in this portion of the article, but also a direct refutation of the elements so often associated with that of Le Corbusier. Xenakis seems to refer indirectly to aspects Le Corbusier’s style as “architectural prejudices”, encouraging one to abandon such ideals in rediscovering what he coins as “fundamental questions of the lines of force” (157). Ideals such as the concept and overabundance of repetition as a result of industrialization are ruled as economic motives that limit the scope and capability of contemporary architecture in Xenakis’ mind, thus encouraging the promotion of continuity in construction. As seen in his hyperbolic paraboloids, despite their expensive construction methods, Xenakis seems to refute the economic limitations and efficiencies that often formed the basis for Le Corbusier’s urban projects including his various Unite d’Habitation. In order to lead to a solution, Xenakis states:

You must determine the basic necessities, and then you must seek to discover the elements that correspond to the emotions, to the imagination. In reality the universal is not so far removed; it is found in you since you are human. To find the difference between that which is of value diachronically and synchronically and that which is not, already provides solutions, expressions that are not petty. If you succeed, for example, in creating a space that gives the impression of flying, that's great. At Saint Sofia in Constantinople, one gets this impression... Only this way can you manage to create something universal in order for the result to be interesting. (158)

In other words, Xenakis seems to note that just as seen in Constantinople, one must, and is, capable of bridging the gap between that which is bound within the movement of time and that which is timeless by discovering basic elements in each that affect one's emotion (that which is universal in humanity) and potentially spark the imagination. As seen by his own concepts which incorporate curvature to imply movement and phrasing, Xenakis is able to achieve a spatial quality similar to that of musical expression, in which phrasing and varied momentum/movement are essential. Thus a sort of subconscious connection can be associated with the similar dynamic qualities of both elements, conversely linking the two through their shared effect on one's physical and/or emotional disposition.

Influence of Messiaen

While much has been said about Xenakis' timeless works, the architectural influences, experiences, and progressive structural designs that constituted one element of his artistic style, it seems only fitting that we transition now to a more focused discussion of the musical and technological compositions which comprised the majority of his later life and career. Even so, one cannot launch into the musical ingenuity of Xenakis without first addressing his most significant and transformational influence: his close relationship with Olivier Messiaen. Xenakis always quoted that Messiaen gave him "great moral support" throughout his compositional career, particularly during his rough beginnings as a budding, yet often discouraged composer.

(Bois 7) It was Messiaen's high regards for Xenakis and his many talents that seemed to encourage not only the composer in following his novel ideas, but also the rest of the advanced musical community in respecting such bold compositions. Naturally, it seemed the two figures would bond over similar views on music and the compositional process. In attending many of Messiaen's classes in 1952 at the Conservatoire in Paris, Xenakis would describe Messiaen as "having a very detached approach to music. He was not an epigone of any school like the serialists and neo-serialists. He produced his own rules... He was a free mind and was writing music freely at the time" (Matossian 49). Likewise, upon first meeting Xenakis, Messiaen would quickly become captivated by the Greek student's unique perception of music given his advanced mathematical and creative architectural skillset, regardless of a lack of musical foundation in theory and composition. In an interview with Xenakis, Messiaen quoted his first unique words to the inexperienced composer, which would greatly inspire Xenakis to pursue musical composition beyond his initial architectural profession with Le Corbusier. He states:

I did something horrible which I should do with no other student, for I think one should study harmony and counterpoint. But this was a man so much out of the ordinary that I said, 'No, you are almost thirty, you have the good fortune of being Greek, of being an architect and having studied special mathematics. Take advantage of these things. Do them in your music. (48)

It seems that Messiaen not only mentored Xenakis as a colleague and friend, but helped define his musical style and language, entirely promoting what Xenakis would sometimes refer to as "childish games... the mathematical expression of music which haunted me since my adolescence," to become a staple of his compositional output. (51)

Xenakis and Composition: Views on the Basis of Mathematics in Music

In preparation for analysis of a set of particular works by Xenakis which provide insight into his various methods of mathematical and musical fusion, one should be provided with a basic understanding of the composer's outlook concerning the relationship between mathematics and music. Particularly in the context of Western academia, mathematics and music have shared close ties in the evolution of compositional traditions, dating back to the Renaissance organization of the quadrivium and trivium. Thus, in consideration of the evolution of music through the Baroque, Classical, and Romantic eras (in which composition began to share more similarities with the trivium), many have believed Xenakis' deliberate pairing of mathematics and music as a movement back towards the mathematical and musical relations seen in the days of Pythagoras. Nevertheless, Xenakis, seemed to negate this assumption when asked whether music should go back to mathematics, stating:

Not at all. Music is by definition an art of montage, a combinatory art, and there is plenty to discover and formulate in this domain... Yet it isn't a refuge that music asks of mathematics, it is an absorption that it can make of certain parts of mathematics. Music has to dominate mathematics, and without that it becomes either mathematics or nothing at all. One should remain in the realm of music, but music needs a combinatory technique which is mathematical. (Bois 15)

In this sense, the composer seemed to emphasize the combinatorial powers of music (as seen with literature, poetry, painting, and of course sculpture/architecture) in discovering new interesting approaches and capabilities through a close relationship. Mathematics coupled with advances in technology, in Xenakis' mind, serve as the most powerful avenue through which one can make advancements in the field of musical composition. It is through this angle that we must make sense of the direction and experimentation Xenakis undertook with his diverse and often unusual compositions and compositional techniques.ⁱⁱⁱ

An Interpretation of Harmony and Tonality

Yet another concept to be addressed in the musical language of Xenakis would be one's interpretation, or desensitization to prior concepts of musical tonality and harmony. As addressed earlier in describing Xenakis' musical inspiration from experiences in war, much of the composer's musical and mathematical studies focused on the search for new sounds and sound densities, produced either by traditional orchestra or through advanced technological systems. In the context of modern composition, including the powerful influences of serialism, a growing school of thought believed that contemporary music was not composed for the masses, but rather for those educated in the advancements in music theory and composition who could thus appreciate its various complexities. While Xenakis certainly did not associate himself with serialist thought, one could agree that he, too, seemed to agree that his music was not designed to entertain the masses. When asked about public appreciation of his works at their numerous complexities, Xenakis explains:

As regards the listener, there are two categories: the one that listens with pleasure to contemporary music, and who will listen to and select certain works from the past... With the listener of the second category, his education belongs to the past. If he embarks on the contemporary he will have a bar to cross: either he will pass or he won't... I am not speaking merely of education in the family circle or in school, but of the education of the masses by those enormous distributors of propaganda and information, television and radio, at the disposition of the state or private organizations, whose activities are reactionary and baleful. (Bois 9)

Clearly, Xenakis did not seem to seek the appreciation of the masses for his compositions. While often criticized for his abstractness, or the "noisiness... craziness" of his music, the composer would claim "Why be frightened? Mathematical formulae are not monsters; one can tame them much more easily than one thinks, provided that one doesn't in advance create a blockage in one's mind" (7). It seems that Xenakis saw his compositions as advanced explorations that must be understood for their mathematical, as well as organizational purpose,

viewed without any preconceived notions of tonality as tonality seemed to be reinvented in each work.

Xenakian Gesamtkunstwerk

During Xenakis' most productive period of compositional output, namely after his ten years in the studio of Le Corbusier, it seemed that sound was simply one aspect of his all-encompassing compositions. Given his extensive architectural experience, Xenakis would often envision his compositions as an immersive experience for his listeners, constantly striving to develop new ways of utilizing structural, visual, or spatial environments to heighten the listener's total appreciation for the piece. One such example of the immersive qualities of his musical scenarios can be found in his piece entitled "Terretektorh" (composed in 1965). Translating to mean "an accelerator of sound particles" due to his use of stochastic probabilities^{iv}, Xenakis developed a new layout for the performing orchestra, in which audience members would be allowed to walk around sections of instruments during the performance. In describing the work, Xenakis states:

The orchestra is in the audience and the audience is in the orchestra. The public should be free to move or sit on camp-stools given out at the entrance to the hall... It puts the sound and the music all around the listener and close up to him. It tears down the psychological and auditive curtain that separates him from the players when positioned far off on a pedestal, itself frequently enough placed inside a box. (Matossian 182)

In redefining the space in which a traditional orchestral sound is heard, Xenakis was able to envelope the audience within jagged, shifting textures of the orchestra, simulating the effect of one being attacked from all sides (as in combat). To add to this sharp, scattered effect so common for stochastic music, each musician would be given a whip, wood blocks, and maracas to be used periodically, engulf listeners within the unpredictability of the piece. Xenakis' boundless creativity and multilayered intricacy in developing new ways for one to experience his

music would become a staple of his compositional style. Moreover, one may note an evolution in later works towards an idealistic music performance reflective of Richard Wagner's operatic "Gesamtkunstwerk".^v

A perfect example of Xenakis' crowning achievement in light of such idealism can be seen in his "Polytopes", a series of works which were incorporated into a particular physical environment, combining sound, technology, and performance to create an experience that would stimulate both the visual and aural senses. "Polytope", meaning 'many sites' involved the concept of architecture in motion, whether through the use of shifting laser lighting patterns, or even the use of groups of individuals organized to form into different "optical architectures" in time with a particular piece of music. (Hewitt 70) Xenakis' *Polytope de Cluny* (1972), set in the Roman thermal baths of Paris, incorporated laser lights and moveable reflective mirrors controlled in a meticulously planned fashion to create various polygonal shapes within the ancient Roman structure. Audiences would lay on the ground, staring up into the fray of layered, multicolored light beams as they produced timed patterns to a 24 minute composition of changing sound textures. Given the proximity of the space, the synchronization of light and sound, and the abundance of polygonal architectures formed in one's mind from various perspectives in the performance space, such a work engaged listeners in a new and exciting form, unmatched by contemporary music or performance art of late 20th century.

Yet another example of Xenakis' "Polytope" compositions would take performance and sound production a step further by incorporating music and movement within a natural, outdoor environment. Staged on four separate evenings, *Polytope de Mycénes* (composed in 1978) took place at the foot of Mt. Elias in Greece, adding a mythical component to the work due to the ancient history of its chosen performance location. (Harley 115) Involving the positioning of

spotlights, masses of children carrying torches, as well as projected lights on the walls of the ruined citadel, Xenakis seemed to outdo himself in adding not only a more humanistic element to his work, but a synchronized complexity of events unseen in his previous performances. Whether inspired by the chaotic simultaneous events of battle, or the logical progression in experimenting with the capabilities of a Polytope composition, one must agree that Xenakis surely found himself entranced by the direct influences of nature in his compositional process. Such experimentation with nature indeed can be seen to have encouraged Xenakis to bring such earthly observation into further study, specifically within his technological explorations.

Music and Technology: A Question of Originality

In reflecting Xenakis' earlier mentioned strategy concerning the rightful authorship/originality of his architectural hyperbolic paraboloids which he would showcase in most of his later structural designs, one may note a consistency with the development and promotion of technology within his musical compositions. In an effort to maintain authorship of his work, Xenakis' abstract Polytopes often served a dual role of expanding the limits of musical perception to incorporate the physical and visual along with the aural, while also becoming an opportunity to premiere his cutting edge experimentation in music technology and composition. For instance Xenakis' *Polytope de Cluny* introduced the use of synchronized laser light within an electroacoustic, stochastically generated composition much like his *Concrete PH*, developed for the Philips Pavilion. While the use of lasers certainly boasted a futuristic approach to musical performance, it was the computer programming developed to control countless changes in lighting and adjustable mirror angles which truly represented the cutting edge of programming technology. It seems that Xenakis hoped to create works so boldly original in their creativity and

abstraction, that their use of new technological algorithms would undoubtedly be viewed as his own.

The same strategy can be seen in Xenakis' first use of his original UPIC device, an early form of touch screen technology developed as a way for the composer to translate his sketches directly into computer generated sound. (Harley 115) Constructed with help through a collaborative effort with his founding organization, Centre d'Etudes Mathématiques et Automatique Musicales (CEMAMu), *Polytope de Mycénes* would introduce Xenakis' breakthrough UPIC device in the 10 min. composition, *Mycénes Alpha*, well integrated within the originality of his grandest Polytope to date. It seems that the composer immediately took full credit for his technological feat by incorporating it into his most complex and involved composition, thus emphasizing its true collaborative capabilities within a scenario fully developed by the composer himself.

A final instance of computer generated musical compositions which Xenakis would coin during his lifetime are documented in his "ST works", a series of pieces generated in 1962 with the help of the state of the art IBM machine. (Harley 27) Such works served as numerous examples in which Xenakis showcased his original stochastic theories and algorithms, writing for various sized ensembles of classical instrumentation. Even the title, which simply designates the piece as a part of the ST compositional series, followed by the number of players required, reflects the pure mathematical conceptualization of each work. Thus, it seems Xenakis aimed to demonstrate the flexibility of his new process of automatic music generation by creating a series of works applicable for most any standard sized ensemble, from quartet to orchestra, in order to successfully promote his original technological feat.

Depicting Conflict in Composition

In much of our analysis thus far, focus has been placed on the literal presence of conflict and confrontation in Xenakis' structural works. While references have been identified in many architectural designs (for example in noing the light canons and turrets of St. Marie de La Tourette), not surprisingly Xenakis brought the same literal inspiration to his musical composition, specifically in his pieces entitled "Strategie" and "Duel". Composed in 1959, "Duel", followed by "Strategie" in 1962 (which would incorporate larger ensembles), could be described as more of a musical game involving two competing orchestras, each lead by an opposing conductor. (Harley 25) Introducing the idea of game theory into musical composition, Xenakis would impose a set of musical modules (or tactics), of either short sounds, long, or glissandi, for each conductor to relay to his orchestra, taking turns to choose tactics based on the opposing conductor's choices. The resulting competition would produce a continuous, unique composition while both battling orchestras would attempt to collect the most points based on their strategic choices. One could not imagine a more literal translation of conflict into composition, put on display for audiences to witness the excitement and energy of instantaneous composition. Likewise, this composition seemed to follow a direct trend with 'chance music' as popularized by esteemed composers such as John Cage. (Matossian 140) Unlike the music of Cage, Xenakis saw chance music as an opportunity to explore the mathematical precision that could produce a seemingly automatic, yet highly predictable composition. Yet, as summed up eloquently by Matossian:

These concepts evoke a situation described by Xenakis- his recollections of the war-time demonstrations in Athens. Here was the psychological root of his own preoccupation with chance. For it was by chance too that his life had been saved. At the peak of his youth and physical powers, engaged in daring action, exercising intelligence and courage, he was fired by beliefs which could have led him to a willing death. The heightened self-awareness of that moment imprinted upon his consciousness the experiences of shared

emotions, the extremes of group dynamics with the people immediately surrounding him and spreading out beyond to the thousands taking part in the demonstrations. The focus of tension sharpened, not through his personal confrontation with the unknown, but in his relationship to the mass of people whose collective action acquired a definite identity and intention... Xenakis' way of acknowledging the emotional power of this situation is the artist's way... Instead of accepting the experience in terms of psychology, the mechanism of sublimation enriched it generously by transposing it into a form acceptable to his consciousness. (141)

Xenakis was a man of math and music, a combiner and creator, who found it unbearable to lead a life so dictated by chance without voicing it in his work. Through these two works, we see Xenakis sublimely reliving his experiences of war while simultaneously unraveling the very fabric of a traditional orchestra performance, thus giving audiences yet another new and exciting musical experience in which to appreciate organized sound.

Closing Thoughts

For his gifts of abstraction and unforeseen collaboration, Xenakis has been often noted as “a symbol against tradition and the status quo... inspiring those seeking music that transcended the limits of tradition and nationalism” (Harley 68). Iannis was a man haunted by his past, yet continuously inspired to create and transform the future, serving as a role model for the creative mind, one constantly searching for progress among that which is continuously produced. With a fascination in technology, a strong foundation in history and tradition, and a rebellious youthfulness that often shown in his most audacious work, Xenakis not only laid the first stones in finding new opportunities for the collaboration of music and architectural design, but in doing so, demonstrated the capabilities of an observant, intrepid mind, interested in discovering connections between two lifelong passions.

ⁱ Before beginning work for Le Corbusier, it is important to note Xenakis' premature exposure to the harsh realities of war which would inspire much of his work with the master. Not only had Xenakis acquired a lasting facial scar from severe injuries, but found himself a foreigner in Western Europe. Although this foreign identity certainly was not unfamiliar to Xenakis, having grown up in Romania before receiving his education in Greece (and thus suffering from early bouts of an identity crisis due to a distanced relationship with his national Grecian culture), his first years in Paris only seemed to strengthen his conflicting insecurities over national identity. (Hewitt 20)

ⁱⁱ See *Towards a New Architecture* "The Engineer's Aesthetic and Architecture" p. 15

ⁱⁱⁱ See *Formalized Music: Thought and Mathematics in Composition* Ch. 7

^{iv} See *Formalized Music: Thought and Mathematics in Composition* Ch. 1

^v Gesamtkunstwerk: meaning "whole art's work", signifies a work of art that makes use of all or many art forms or strives to do so

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