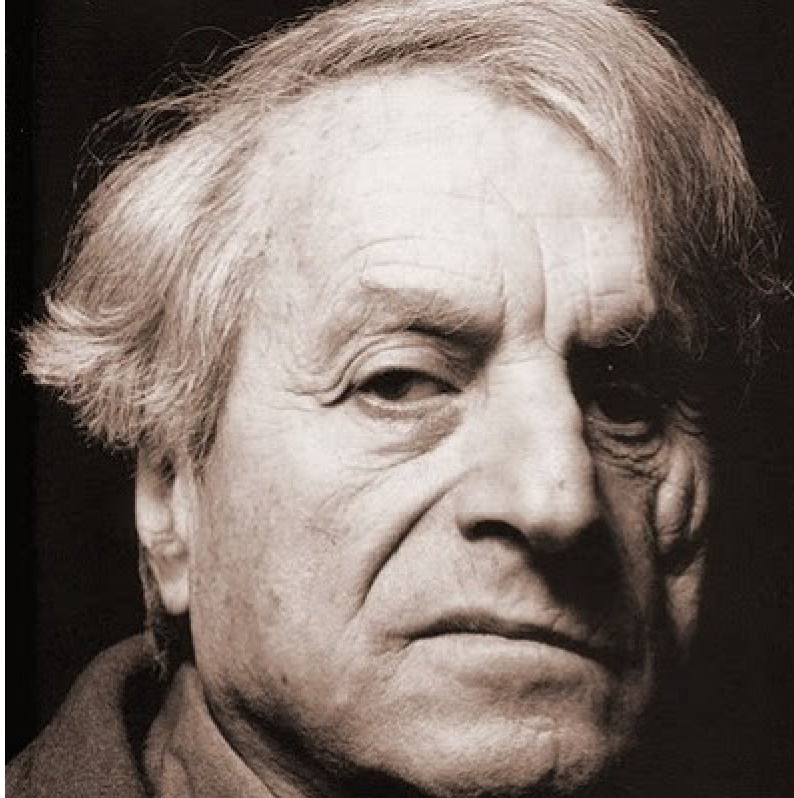

Iannis Xenakis

Form and Transformation

Avant-garde composer, architect and music theorist Iannis Xenakis consistently pushed the boundaries of music, mathematics, architecture and science in his work. From the early days of his career when he was a student of French composer Olivier Messiaen, Xenakis perfected his unique voice, which fused the similarities between concepts such as rational geometry and melody. Also during this time, he worked as Le Corbusier's assistant and later his chief collaborator in projects that include the Sainte Marie de La Tourette and the Philips Pavilion at Expo 58. After leaving Le Corbusier's studio, Xenakis worked for the remainder of his life as a composer, architect and educator in institutions ranging from the Sorbonne to Indiana University. Xenakis was a true hybrid, at home in a variety of creative roles whether it was working in Le Corbusier's architectural studio or collaborating in research environments such as he did with Pierre Schaeffer, et al. in the Groupe de Recherches Musicales (GRM). As an early composer of musique concrète and as a leading researcher in the field of avant-garde, experimental and computer music, works such as *Metastasis* (1953) and *Diatope* (1977) continue to influence artists working in a variety of mediums today. Xenakis gave an interview to the The UNESCO Courier in April 1986.[1] In the interview, Xenakis discusses the intersection of music, mathematics, architecture and science in his work, and gives many insights into both his practice and his creative philosophy.

When considering an artist's work, a study of the artist's treatment of the studio can often deepen our understanding of the work and provide critical insight into their creative process. When the artist in question is Iannis Xenakis, concepts like *studio* and *site* become blurred. Taking into account his novel approach to science, architecture and music, how can we properly address Xenakis' studio practice in any traditional manner? Xenakis was an unusual polymath and his creative process was correspondingly unique. It is difficult to debate the role of the studio in an artist's work without reading or hearing references to Daniel Buren's seminal essay, *The Function of the Studio.*[2] While Buren published the essay in part as a critique of his own studio practice, the argument Buren makes against the system of art being made in a studio and displayed in a museum helped to create a movement known as post-studio. Buren defines the traditional studio as "a stationary place where portable objects are produced" and also "the place where the work originates."[3] Buren in some ways was trying to expose the ills of the traditional art system and also pointing toward his evolving practice of the portable studio—one that is in varying places and takes numerous forms, depending on what he is making. But what do *studio* or *post-studio* mean in terms of an artist like Xenakis, who begins any project in a manner similar to any architect or composer? Architects are designers of ratios between negative and positive space in site-specific works. The architect must, from the beginning ideation to the final structure, dwell in a labor that is entirely site-specific. Likewise, the composer envisions their pieces from inception performed in specific places by predetermined orchestration. It is therefore difficult to place Xenakis in a studio or post-studio —he was, for his entire career, engaged in projects that were by their very nature site-specific. In this way, Xenakis' process is very much what we would expect from an architect: whether at home, dining or sketching on the train, he is engaged in a kind of virtual process with a specific place and structure. When on-site, he is conducting the kind of large-scale project that Frances Stark defines as a very male type of art practice, that she describes as having to do with "elaborate extensions, disruptions and transformations into and of material reality."[4]

When asked by The UNESCO Courier interviewer about his most recent project, Xenakis detailed some aspects of an experimental concert hall he was designing with architect Jean-Louis Veret for the Cite de la Musique music community centre at La Villette, in Paris. The brief description of this project sheds a great deal

---

1 "Science and Music: An Interview with Iannis Xenakis." *The UNESCO Courier: Music on the Move.* Apr. 1986: p.4-7.
2 Daniel Buren, *The Function of the Studio* (1971).

3 Buren, 1.

4 Frances Stark, *The Architect & The Housewife* (Bookworks, 1999), p.12.

of light on how Xenakis worked. Xenakis detailed a concert hall with a “potato-shape” and “a spiral gallery,” running around the inside of the walls, “which can accommodate the audience and also musicians, so as to produce a three-dimensional soundscape.”[5] From the beginning of the project, Xenakis shapes the environment of the concert hall around a specific piece of music, which he develops concurrently. Beyond the specific piece he might create, he envisions the hall as a modular, plastic environment, ideal for numerous experimental sonic applications. Although this project was never realized, in the context of the Courier interview it serves as a jumping off point to a deeper discussion about the connections Xenakis sees between science, architecture and music.

At this juncture it is useful to point out that Xenakis had studied architecture and engineering at the National Technical University of Athens and had simultaneously studied composition with a series of composers that culminated in his time with Olivier Messiaen. It is natural that Xenakis, through a deep study of all three fields, would become increasingly aware of the connections between them. The interviewer moved from the concert hall concept to ask Xenakis about his opinion on how the creative activities of music and architecture are involved. He responded with an example concerning the three-dimensionality of architectural space, and relates it to musical composition in this way:

Composers, for example, have used symmetrical patterns which also exist in architecture. If we want to discover the equal and symmetrical parts of a rectangle, the most informative way of proceeding is to rotate it. There are four directions in which a rectangle can be turned, and no more than four. Such transformations also exist in music: this is what was invented in the melodic field during the Renaissance. You take a melody: (a) you read it upside down; (b) you invert it in relation to the intervals; (c) that which rose towards the upper part of the scale now descends towards the lower, and vice versa. To this you must add (d) the recurrence of the inversion, which was used by the polyphonists of the Renaissance and which also occurs in serial music. In this example, we find the same four transformations carried out in architecture and in music.[6]

He also cited the Phillips Pavilion, designed with Le Corbusier, in which he was exploring ways to create a modular, changeable space. Influenced by Debussy, Bartok and Stravinsky and their use of experimental devices such as parallel fifths and octaves, Xenakis designed this malleable space using various displacements of a straight line. The effect was the production of curvilinear shapes known as hyperbolic paraboloids in architecture and glissandi in music.[7] He gives further examples of the convergence and coincidences of architecture and music, specifically Bartok's use of the golden section (which is typically a visual geometric proportion) to achieve certain harmonies.[8]

Referencing Goethe's famous statement that “Architecture is frozen music,” Xenakis provided a more concrete example of the relationship between the two. He points out the existence of rhythm in each:

What is rhythm? It consists of chosen points along an axis, namely, the axis of time. The musician measures time as the walker counts milestones. The same thing is found in architecture--with a facade, for example. And piano keys are also architecture. They are regulated in a constant manner. In one case it is a matter of time, and in the other, of space. So there is a correspondence between the two. And this is possible because there is an underlying mental structure which mathematicians call an "order structure".[9]

---

5 UNESCO, 4.
6 UNESCO, 5.
7 James Harley, *Xenakis: His Life in Music* (Routledge, 2005), p. 17.
8 UNESCO, 5
9 UNESCO, 5

So, we can see the natural way in which Xenakis would begin to see the many connections between architecture and music, but Xenakis did not stop there. Influenced by information theorist Claude Shannon, Xenakis, already comfortable with statistical information through the frequent use of tables to calculate stress and load, began to apply these principles to music. The result of this revolutionary transposition was what Xenakis called *stochastic* music, in which random sonic events are generated through mathematical processes.[10]

Today, stochastic music in the form of techniques such as granular synthesis have come to be associated with computers. Xenakis had experimented with computational processes in music from as early as 1962. However, inaccessibility of computers and limited computational power prevented much experimentation during that time period. By the 1970s Xenakis was creating multimedia events that utilized more modern computers. When asked by the Courier interviewer what role computers play in his process, Xenakis described *Le Diatope* (1977):

In Diatope (1977), the entire programme of laser beams and electronic flashes co-ordinated with the music, which was also produced by computer, had been devised by programming in computation centres. There were 1,600 electronic lights which could flash on and off individually in one twenty-fifth of a second. This cannot be done by hand: it is too fast and the numbers are too high. Furthermore, computers and other new technology available to us can produce light, so that it becomes possible to transpose the musical composition into the visual sphere and experiment with shapes and movements. The effects of light become like visible sounds. You can play with them just as you play with sounds, but in a spatial dimension instead.[11]

Le Diatope was commissioned for the inauguration of the Centre Georges Pompidou in Paris. A multimedia piece housed in a vinyl and steel pavilion, *Le Diatope* was comprised of a matrix of 1,680 flashbulbs and 4 lasers guided by 400 positionable mirrors, which were coordinated with *La légende d'Eer,* a 7-channel electro-acoustic composition.[12] Xenakis later in the interview cautioned that "it should be borne in mind that computer technology is just a tool," and that he only uses it where it is necessary. He saw it as a natural evolution in music, just as 10th century musicians invented musical notation to formalize composition.[13]

The interview concluded with a question about the central role of scientific thought in Xenakis' musical aesthetic. Xenakis described several sources:

I drew my early inspiration from the culture of ancient Greece, and especially that of Athens in the fifth and fourth centuries BC. This was a period of extraordinary creativity in the history of humankind. It saw the birth of mathematics as we now know it. From a structural point of view, this axiomatic, Euclidian science is still continuing today. There has been no break. Then there was philosophy. The other day, I was reading an article about the formation of the universe. It said that the whole of science up till now has been based on causality. But, today, we are starting to ask the following question: can the universe have emerged from nothing, without a cause? Astrophysicists are tending to think that it did. Accordingly, and this is the interesting point, the Parmenidean tradition is capable of changing and developing.

---

10 Harley, 13.
11 UNESCO, 6.
12 Harley, 110.
13 UNESCO, 6.

The impression of Xenakis left by this interview is that of an virtuosic artist very comfortable with the many ways architecture and music are related. From this place of comfort he is able to augment, transform, invert or rotate these forms simultaneously. A deeper study of Xenakis shows how unusual it was that he continued to develop as a composer while remaining innovative architecturally. For example, the form of the exterior structure of *Le Diatope* was designed to achieve the maximum interior volume with minimum outer surface area. A common solution to this structural dilemma would have been to create a spherical form a la Buckminster Fuller, but Xenakis rejected this shape as failing acoustically and visually.[14] Working brilliantly in projects that unite music, mathematics, architecture and science, Xenakis embraced new ideas as he invented them or as they came his way. Xenakis' process was truly hybridized and interdisciplinary; many aspects of his collaborative nature seem to echo modern ideas in the vein of the Open Source movement and Creative Commons. In his writing, he was often transparent in describing his techniques and conceptual framework, as is evident in his deeply influential 1971 work, *Formalized Music: Thought and Mathematics in Composition.* From the beginning of the preface he seems a positive source of information, willing to share his process with those who would listen and are eager to further the advancement of innovation in music:

The formalization that I attempted in trying to reconstruct part of the musical edifice ex nihilo has not used, for want of time or of capacity, the most advanced aspects of philosophical or scientific thought. But the escalade is started and other will certainly enlarge and extend the new thesis. This book is addressed to a hybrid public, but interdisciplinary hybridization frequently produces superb specimens.[15]

---

14 Harley, 110.
15 Iannis Xenakis, *Formalized Music: Thought and Mathematics in Composition* (Pendragon Pr; 2nd edition, 2001), Preface.