The Architectures of Iannis Xenakis
Elizabeth Sikiaridi

Abstract
Iannis Xenakis (1922-2001), composer, architect, engineer and media artist, designed together with Le Corbusier the Philips-pavilion for the 1958 Brussels World Fair. This pavilion is an early example of (“hybrid”) combined media and architectural space as it contained a Poème Electronique, an electronic synthesis of visual projections (conceived by Le Corbusier) and acoustic events (composed by Varèse). The pavilion’s architecture with its hyperbolic-paraboloid shells had a dynamic expression. Xenakis continued this research into complex material architectural forms. He also worked on the complex ephemeral architectures of light and sound events. What is specific to Xenakis is the way he used forms in different fields and transferred them from one field to another, from engineering to music, from music to architecture and visual events. This experience of working simultaneously and applying the same (mental) structures in different fields opened him the way (partly supported by the universal computer instrument) for the practice of transferring mathematical-scientific structures into artistic production. In this context Xenakis pleads for the development of a “General Morphology”, a research concerned with the understanding of form and its generation. Xenakis’s ‘material’ architectural work is to be seen in continuity with his architectures of music and light.

In the aesthetic production of the twentieth century, there is a fascinating moment of artistic synergy. An architect, Le Corbusier, conceives an Electronic Poem, an electronic synthesis of visual and acoustic events, and a ‘vessel containing the poem’ [a pavilion] for the Philips corporation presentation at the 1958 Brussels World Fair. Le Corbusier himself works on the visual part of the Electronic Poem, the projections within the pavilion: a film, consisting of associative stills, representing the development of humanity, superimposed on to projections of light and colour. The composer Edgar Varèse contributes with the acoustic part, the ‘spatialized’ piece of music called Poème Électronique. Iannis Xenakis (1922-2001), who was originally trained as an engineer and was working as an architect in the office of Le Corbusier and who later was to become an internationally known composer, designs in co-authorship with Le Corbusier the ‘vessel containing the poem’, the shell structure of the Philips pavilion.

A temporary structure, the pavilion was demolished shortly after the closing of the World Fair and the memory of this unique creative endeavour, of this collaboration of three artistic protagonists of the past century (Le Corbusier, Varèse and Xenakis) faded. Anyway, the architecture of the pavilion itself was not the focus of Le Corbusier’s attention; he considered the building mainly to be a support (a ‘vessel’) for the visual and acoustic projections on its interior. The architectural discourse had difficulty dealing...
with the media aspect, the visual and acoustic events of the *Electronic Poem*. For a long time architectural theorists also avoided researching the pavilion itself, as it was not easy to grasp nor to classify, its architectural language being a foreign body, an alien element in the context of Le Corbusier’s formal categories that shaped the canons of modernist architecture.

The recent rediscovery of the pavilion and its *Electronic Poem* is closely allied to the search for references and paradigms for the expanding fields of contemporary architecture. The dynamic expression of the pavilion’s architecture with its hyperbolic paraboloid and conoid shells is intriguing for contemporary architects, who are working on the expansion of the vocabulary of architectural forms into more complex, ‘fluid’ formations and shapes. This formal research, this integration of more complex forms, triggered by the recent developments of digital architectural design instruments (CAAD: Computer Aided Architectural Design) and construction tools (CAM: Computer Aided Manufacturing) that help control and realize three-dimensional complex structures, is still in search of its aesthetic correspondences.

As for the visual event, Le Corbusier’s *Electronic Poem*, even if its heroic atmosphere, its modernistic optimism about technology and the future seems outdated, it does exert a strong fascination today. This electronic
synthesis of arts, representing the Philips corporation, a pioneer in the development of media environments (from light and sound to today’s ‘intelligent’ networked devices and materials), is an early example of an architect’s work in media space. The *Electronic Poem* and the Philips pavilion can be seen as a prototype for the expansion of architecture into combined material and media space. It can be considered an early model of the emerging ‘hybrid’ spaces, where the ‘virtual’ is projected into our tactile world, generating combinations of digital and analogue environments, where media (visual and acoustic) space is fused with material place. The Philips pavilion is an early example of an architecture of ‘vessels’ (containers) within the complex multilayerings of the space of (media) flows.

This electronic synthesis of arts is based on Le Corbusier’s holistic approach, but is still a unique event within his architectural production. Xenakis, on the other hand, continued this research into complex architectural forms as well as into the complex ephemeral architectures of music and sound. He worked on the ‘poetics of the electronic age’, integrating in his creative artistic production the new electronic tools of the computer. Xenakis’s work can function as a very interesting reference for the contemporary architectural discourse.

**Transfers**

Referring to his personal architectural design contributions in the architectural office of Le Corbusier, Xenakis points out a very specific sort of architectural member: architectural elements that capture, guide and transform light. For example, for the Convent of La Tourette, Xenakis designed the rhythmically structured facade, the * pans de verre ondulatoires* (undulatory glazed panels), and the skylights, the *Light Canons*. These ‘architectures of light’ evolved later in Xenakis’s compositions of sound and light events: the *Polytopes*, the word (poly-topoi: multiplicity of places) describing the overlaying of music and light, creating various ever-changing asynchronous places, as well as in the *Diatope*, a combination of sound and light effects in a pavilion he designed himself especially for this purpose.

Xenakis’s (‘material’) architectural production was not prolific. Still, in his architectural design work, for example, in the urban proposal for the *Ville Cosmique* (1963), the *Diatope* (Paris/Bonn 1978-79) or in his competition entry for the *Cité de la Musique* (1984) there is consistent research into three-dimensional - in the sense of volumetric - complex architectural forms. Most of these designs are based on the geometries of the hyperbolic paraboloids and conoids he had also applied in the design of the Philips pavilion.

Xenakis was familiar with ruled surfaces, with hyperbolic paraboloid and conoid forms, through his work as an engineer. What is interesting is not only the hyperbolic paraboloid form itself in its continuity and complexity but also the way Xenakis implemented this same structure in music, in architecture and in his visual events. What is specific to Xenakis is the way he used these forms in different fields, transferred from one field to another, from the field of engineering to music, from music to architecture.
Before working on the Philips pavilion, Xenakis had introduced hyperbolic paraboloid structures in his musical composition *Metastaseis* (1953-54): graphs of straight lines mapping the rising or falling sounds of each instrument, the *glissandi*, generating curved, ruled, surfaces of sound. For his sound and light event *Polytope* in Montreal in 1967 too, Xenakis arranged the straight steel cables to which the lights were fixed so as to create hyperbolic paraboloid surfaces.

This dual sensibility for architecture and music enabled Xenakis to approach musical form in an architectural way and to compose architecture as a complex of (dynamic) relations. This experience of working simultaneously in architecture and music and applying the same (mental) structures in two different fields was of great importance for Xenakis, as it confirmed for him the role of these structures in artistic perception and creation. It opened the way for the practice of applying the same structures in music and visual events (*Polytopes*), transferring mathematical-scientific structures into artistic production.
Xenakis used a wide range of ‘transfers’ from the mathematical-scientific world, as for example, the Brownian motion resulting from the movement of gas molecules, the mathematical theory of probability (stochastic calculations), the theory of groups and chaos theory. These ‘transfers’ function as generators of creativity, as engines of innovation enhancing the expansion of the formal artistic vocabulary.

Xenakis’s transfer and use of scientific-mathematical methods is more than a practical solution to the problems of processing the dynamic formations of sound and light events, of organizing the mass phenomena of ‘clouds of sounds’ and ‘galaxies of light’, that he is confronted with when composing. It is an essential, integral part of his approach to art, of his view of the world. Xenakis writes:

Music is a matrix of ideas, of actions of energy, of mental processes, reflections in turn of the physical reality which created us and which sustains us [...]. Expression of visions of the universe, of its waves, of its branchings, of its human beings just as much as the fundamental theories of theoretical physics, of abstract logic, of modern algebra [...] Music is the harmony of the world, but homomorphicized by the domain of current thought.¹

One can profitably view another of Xenakis’s inventions in this context: a custom-made computer Xenakis started developing in the middle of the 1960s. Xenakis made use of the computer to control and (de)synchronize the overlappings of musical and visual events (Polytopes), as well as integrating the computer within his creative process to help generate and control his complex compositions. This digital instrument is a music computer with an architect’s drawing board as an interface that transforms graphical information into music and sound. This computer, linking visual form to acoustic form via the bridge of mathematical information, reflects Xenakis’s holistic approach and is an integral part of his research on complex forms (architectures) and their materializations in very different media and dimensions, in sound, in light, in time and in space.

**Morphologies**

The hyperbolic paraboloids of the shells of the Philips pavilion or of the *glissandi* of *Metastaseis* are three-dimensional curved surfaces created by the sliding of a straight line along curves. They are ruled surfaces; regulated and controlled double curved complex surfaces. Xenakis writes about these hyperbolic paraboloids: ‘the straight line permits one to imagine very complex forms with very simple controllable elements.’² For the engineer Xenakis, ‘free’ forms do not exist; curved surfaces are described mathematically/geometrically and their structural behaviour is defined.

The architectural tradition of the twentieth century, on the other hand, that is prevailing to this day and that was strongly influenced by the Corbusian canons, juxtaposes the ‘rational’ (rectangular) form and grid with the ‘free’ ‘irrational’ uncontrolled curve. Caught up in this polarity of

---

‘rational’, controlled, simple geometric form and uncontrolled complex ‘irrational’ volumetry, architectural terminology is very imprecise in describing curved, volumetric forms. Although this polarity has been long since surpassed, as sciences and mathematics have integrated in their rational approach the complexities and irregularities of our worlds, architecture is just now developing an understanding, a language to describe complex formations.

It is in this context that Xenakis pleads for the development of a general discipline of form, a ‘general morphology’: ‘Moreover it is time to create a new science of “morphologie générale” which will deal with the forms and the architectures of these diverse disciplines in their unvarying aspects as well as the laws which preside over their transformations.\textsuperscript{3}

This ‘general morphology’ would be research concerned with the understanding of form and its generation. It would be an investigation not only of fixed types and rigid geometries, but of irregularities and differentiations, an investigation of the ‘rationalities’ of dynamic process-forms. It would be an interdisciplinary effort, corresponding to Xenakis’s universal thinking and ‘transfer’ practice:

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.png}
\caption{Notations by Xenakis of the hyperbolic-paraboloid structures of the musical composition “Metastaseis” (1953-4): graphs of straight lines mapping the rising and falling sounds of each instrument, the “glissandi”, generating curved ruled surfaces of sound.}
\end{figure}

I have noticed figures, forms that belong either to the domain of abstract speculation like mathematics or logic or to more material speculations like those of physics with its phenomena that are either subatomic or atomic or like those of the geometrical expressions of genetics or reactions of its chemical molecules. These figures, these forms, which belong to so many disparate domains have fascinating similarities or differences and can explain other domains, like those of artistic activities.4

Thus the ‘material’ architectural work of Xenakis is an integral part of his artistic production and is to be seen in continuity with his architectures of sound (music) and light (Polytopes). His ‘material’ architectural experiments are very closely associated to his musical research, both being expressions of the same contemporary intelligence, the same all-round creativity, the bridge of abstraction (partly supported by the universal computer instrument) providing the connecting link.

Working on the ‘architecture of events’, Xenakis expresses a different approach concerning the dynamic perception of architecture to the one formulated by Sigfried Giedion in his book *Space, Time and Architecture*. Giedion, still in the tradition of the picture frames of the English garden, is pointing out to the relativity of spatial sequences (of material architecture). Xenakis, working within multi-layered (‘multimedia’) environments, is interested in the global view, the mental (re)construction of form and structure.

Today the avant-gardes of the 1950s-1960s, Xenakis’s contemporaries, function as sources of inspiration, as they first introduced the ‘media’ model and theme in architecture, inverting space. These other protagonists, for example, the Situationists or Archigram, represent a political, hedonistic-subversive approach with a strong interest in the social (communicational) aspect of the media, reflecting pop(ular) culture. Xenakis, on the other hand, stands in the idealistic-humanistic tradition with references ranging from ancient Greek philosophy to contemporary scientific thought - a last *homme universel*?