

Donau-Universität Krems, Department für Bildwissenschaften
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Music to be seen
The *Diatope* (1978) by Iannis Xenakis

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Musik zum Sehen. Die Diatope (1978) von Iannis Xenakis.

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Abstract

Theme:

This thesis revisits an automated sound and light installation, the *Diatope* by Iannis Xenakis (1922-2001), presented in Paris, France in 1978 and in Bonn, West Germany in 1979.

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Iannis Xenakis, one of the most influential composers of the second half of the 20th century, created a series of audiovisual installations known as the *Polytopes*, from 1968 to 1978. The *Diatope* was the last, and arguably the most ambitious realization in the series of the *Polytopes*. The title of the thesis, *Music to be seen*, is derived from a text by Xenakis (1982b), describing the visual spectacle and his approach to “composing with light”.

The *Diatope* was dismantled and ultimately destroyed shortly after its two presentations in 1978 and 1979. Today only the music component, the electroacoustic piece *La Légende d'Eer* survives intact. Our aim is to research the *Diatope* as an installation consisting equally of all media employed - music, light, and architecture -, in the context of Xenakis' quest for an art that develops in space and time. With the *Polytopes*, Xenakis articulated his coherent vision of a “synergy of art and technology”; however, these works have not yet been included in (media) art historical narratives. We therefore seek to critically examine and re-contextualize the *Diatope* from a (media) art historical perspective, examining the ways in which acoustic and visual spaces were negotiated within it.

Supervisor: Ass. Prof. Dimitris Charitos, University of Athens



Zusammenfassung

Thema:

Diese Arbeit behandelt die automatische Klang- und Lichtinstallation *Diatope* von Iannis Xenakis (1922-2001), die in Paris, Frankreich im Jahr 1978 und in Bonn, Westdeutschland im Jahr 1979 präsentiert wurde.

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Inhalt:

Iannis Xenakis, einer der einflussreichsten Komponisten der zweiten Hälfte des 20. Jahrhunderts, hat zwischen 1968 und 1978 eine als *Polytopes bekannte* Reihe audiovisueller Installationen erstellt. Die letzte und ohne Frage ehrgeizigste Realisierung der *Polytopes* Reihe war die *Diatope*. Der Titel dieser Arbeit, *Music to be seen*, ist von einem Text Xenakis' (1982b) abgeleitet, in dem er das visuelle Spektakel und seinen Ansatz zum "Komponieren mit Licht" beschreibt.

Die *Diatope* wurde nach ihrer Präsentation im Jahr 1978 und 1979 demontiert und komplett zerstört. Bis heute überlebte nur die musikalische Komponente, das elektroakustische Stück *La Légende d'Eer*, unversehrt. Unser Ziel ist es, die *Diatope* als eine zu gleichen Teilen aus allen eingesetzten Medien – Musik, Licht und Architektur – bestehende Installation im Kontext Xenakis' Suche nach einer sich in den Dimensionen Raum und Zeit entwickelnden Kunst zu sehen. Mit *Polytopes* artikuliert Xenakis seine umfassende Vision einer "Synergie von Kunst und Technologie"; Bisher wurden diese Werke jedoch noch nicht in (medien-) kunstgeschichtlichen Abhandlungen berücksichtigt. Deshalb versuchen wir, die *Diatope* in einen neuen Kontext zu stellen und aus der kunsthistorischen Perspektive kritisch zu betrachten, indem wir die Kommunikation akustischer und visueller Räume untersuchen.

Betreuer: Ass. Prof. Dimitris Charitos, Universität Athen

Through the MA program *MediaArtHistories* of the Danube University I was introduced to the emerging field of Media Art Histories. The course presented a unique opportunity to combine my “traditional” training in art history and archaeology with my profound interest in contemporary culture, art and music. The idea for the subject of the present thesis occurred in the course of my studies, through stimulating discussions with colleagues and lecturers, both in and out of the classroom - namely colleagues Jon Cates, Winnie Fu, Gabbi Kepplinger, Rachelle Knowles, Asia Walewska, Nina Wenhart, Rolf Wolfensberger, and lecturers Frieder Nake, Michael Century, Erkki Huhtamo, Katja Kwastek and Edward Shanken. The subject was chosen for a number of reasons, the main of which was my fascination with Iannis Xenakis’ electroacoustic oeuvre, and in particular the piece *La légende d’Eer* which was an integral part of the *Diatope*. Another reason was the accessibility of the bibliography and related material, located in Athens and Paris. Unfortunately I was not granted access to the Iannis Xenakis Archives at the time of writing, without which it was not possible to fully realize my initial thesis proposal. Nevertheless, I hope that the thesis provides an insight to an obsolete work; a work, which I believe, still raises pertinent questions in a contemporary context. By extension, I hope that the thesis contributes to a better understanding of Xenakis’ coherent artistic vision and practice, which is underrepresented in the relevant Anglophone discourses.

I would like to thank my supervisor Prof. Dimitris Charitos, for his support and valuable input, and Prof. Oliver Grau, for establishing the *MediaArtHistories* curriculum. In the frame of the program we were given the opportunity to attend lectures that would be practically impossible otherwise, parallel to employment. I would also like to thank my colleagues from the course, for the stimulating discussions and the nice time we spent together. For their ongoing love and support I owe a lot to my family, friends, roommates and soul mates – this too, among all things, would have never been possible without them.

I would also like to thank Monique Chardet and Jean-Philippe Bonilli at the Centre Pompidou Archives, who kindly provided their support and the best working conditions possible at the archives; Eugenia Alexaki, for generously providing me with a copy of her PhD thesis; Hans-Jürgen Nagel, coordinator of the *Diatope* in Bonn, who made time for an interview and provided material from his personal archive; Joel Chadabe, Nadia Diamantopoulou, Anastasia Georgaki, and Stathis Papastathopoulos for their feedback; the staff at the Centre de Documentation de la Musique Contemporaine (Paris), at the Music Library of Greece “Lilian Voudouri” and the library of the School of Fine Arts (Athens); and my friends in Paris for their hospitality. Last but not least, I would like to thank my colleagues at the Deste Foundation for Contemporary Art (Athens), for their understanding and support.

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Chapter I

Introduction

This thesis revisits an automated sound and light installation, the *Diatope* by Iannis Xenakis (1922-2001), presented in Paris, France in 1978 and in Bonn, West Germany in 1979. A pioneer composer of the second half of the 20th century, Xenakis created a series of audiovisual installations known as the *Polytopes*, from 1968 to 1978, of which the *Diatope* was the last, and arguably the most ambitious project. The title of the thesis, *Music to be seen*, is derived from a text by Xenakis, describing the visual spectacle, and densely summarizing his approach to “composing with light”¹.

Our aim is to research the *Diatope* as an installation consisting equally of all media used - music, light, and architecture -, in the context of Xenakis’ quest for an automated art that develops in space and time. Xenakis’ pioneering work as a composer and architect has been widely recognized and thoroughly researched; however, this is not the case for his contribution to “media art”. With the *Polytopes* Xenakis articulated his coherent vision of a “synergy of art and technology”; but even though these works have been studied in the fields of architecture and musicology, they are not included in art historical narratives. We therefore seek to critically re-contextualize the *Diatope* from a media art historical perspective, examining the ways in which acoustic and visual spaces were negotiated within it.

While artistic practices based on new technologies are often misconstrued as a comparatively recent phenomenon, they have in fact appeared much earlier, forming a surprisingly long and complex history. As Gere, 2002, suggests, any attempt to understand contemporary media art practice must first engage with media art’s long and complex history and, in particular, with the cultural context from which it emerged. We have chosen the *Diatope* as a paradigmatic example of earlier attempts to create an audiovisual, spatialized, immersive experience, based on cutting-edge technology. Offering many suggestive parallels with contemporary media art practice, this case study offers a theoretical and historical foundation for the “media art histories” discourse, and the art historical discourse in general.

As the *Polytopes* have been largely left outside the canonical histories of 20th century art, we will attempt a re-examination of their comparative significance, which is their canonical status (local, international) and their historic and reference values, focusing on the *Diatope*. Our primary aim is to enhance our understanding of a work that has become obsolete in a monographic study. Ultimately, from a “media art historical” perspective, we will attempt to examine the work in the context of early media art, and reassess the work’s non-canonical status in the context of art history.

When reviewing “media art” literature it becomes apparent that there is a problem of definition and classification of the field. A wide array of terms has been used to

¹ Xenakis, 1982b.

define technology-based art, and identify hybrid practices and tendencies: (new) media art, digital art, multimedia art, electronic art, art & technology, video art, software art, net art, generative art, information art, virtual (reality) art, interactive art, game art, telematic art, intermedia art, interactive installation. As Medosch, 2005, observes, most classification schemes are based on the technology used and only “few attempts have been made to categorize media art forms according to motives, topoi or other aesthetic categories and principles”². Even though we will return to this observation later on in this study, we will maintain the term “media art”, as an umbrella term, and not in a prescriptive manner. As a widely used convention to group artistic practices based on technology and (new) media, “media art” can be by and large synonymous with other intersecting terms such as “digital art”³, which we will be also using alternatively.

Media art history/-ies is an emerging field, which does not exist as an academic discipline and its role in art history curricula is marginal. Given the increasing significance of media and technology in contemporary culture and art, scholars from many different disciplines have contributed to this field during the past 20 years⁴. It is a field that is yet to be mapped, and in the frame of which different methodologies and approaches have been applied. As artistic practices that were based on new technologies and scientific ideas have been largely left outside the canonical histories of 20th century art, resources on their histories are limited. For example, in any standard art historical narrative of 20th century art, references to these tendencies are limited, if existing at all. For a long time, anyone wishing to access a media art historical overview between the late '60s and the early '90s, could basically only do so through the works of Frank Popper, Jack Burnham, and Gene Youngblood⁵. In this context, and before we attempt to propose new narratives and strategies, it is important to research individual artists and works that have been left in the margins of canonical art history.

In the case of Iannis Xenakis, it is striking that despite his pioneering work in music technology and innovation, his work in this field has been preserved only fragmentarily, from the *Polytopes* to his electroacoustic and electronic compositions (except the recordings)⁶. The *Diatope*, presented only two times and then sold as scrap metal, had an extremely short life span, and was treated with neglect until recently. Even though the work belongs to the recent past, one must follow an archaeological approach in order to access and study it.

Our research, based on archival and philological sources, is both synthetic and original. Original material has been recently uncovered in Xenakis' personal archives on deposit at the music department of the National Library of Paris (Bibliothèque

² Medosch, 2005, 24.

³ Paul, 2003, 7.

⁴ See <http://mediaarthistory.org> (13/6/10) and Grau, 2007.

⁵ Frank Popper's *Origins and Development of Kinetic Art* (1968), *Art, Action and Participation* (1975), *Art of the Electronic Age* (1993), and *From Technological to Virtual Art* (2007); Jack Burnham's *Beyond Modern Sculpture* (1968); and Gene Youngblood's reference work *Expanded Cinema* (1970). See Huhtamo, 2006, 358.

⁶ Hoffmann, 2009, 54.

Nationale de France BNF), in Paris⁷. Our initial aim was to transcribe the music and light “partitions”, study manuscripts and documents related to the *Diatope*, and if possible, decode the magnetic tapes containing the commands for the *spectacle*⁸. Unfortunately, we did not have access to this material at the time of writing, as the archives have only been inventoried partially and access to them is extremely limited. We therefore based our research on material published in Sterken, 2004; Solomos, 2006; Kanach, 2006 and Xenakis & Kanach, 2008, all of which include analyses, transcriptions or fac simile reproductions of a large number of these documents. Documentation of the *Diatope* is also preserved at the Centre Pompidou Archives, which is however limited to documents related to the coordination and the architectural construction of the work. Nevertheless, they were a very valuable resource.

Philological research served as a basis for both the reconstruction as well as the contextualization of the work. Xenakis wrote extensively and published many articles and interviews, which give us an insight into his working methods and artistic practice⁹. His writings do not belong to any specific intellectual tradition; however they have their own autonomy, as pure philosophical thought that is consistent in itself¹⁰. Especially his published thesis defense *Arts/Sciences: Alloys* provides an insight into some of the most fundamental philosophical motivations for his work in the domain of art and technology, and his persistence of vision. A recent publication of Xenakis’ architectural projects and texts, compiled, edited and translated by his former collaborator Sharon Kanach (Xenakis & Kanach, 2008), is also valuable resource, as it is the first compilation ever of all of Xenakis’ texts dealing with architecture and the relationships between music and architecture. This volume covers, at least partially, the problem that Xenakis’ writings and interviews have not yet been translated, compiled, and published critically¹¹.

Apart from his seminal 1958-text “Notes on an electronic gesture”, Xenakis did not further theorize his approach to the synthesis of the arts in a systematic and direct manner. However, he refers many times, directly or indirectly, in his writings to the *Polytopes* and his vision of a synthesis of the arts and of an art grounded in technology. The most prominent sources include the book on the *Polytopes* he co-edited with Olivier Revault d’Allones (Revault d’Allones, 1975) and two brief texts, “Lieu” (Xenakis, 1970) and “Les Polytopes” (Xenakis, 1982a), which he never published. His interviews also include enlightening mentions to the *Polytopes*, especially those taken by Varga (Varga, 1996) and Delalande (Delalande, 1997), as

⁷ Archives and material related to the *Diatope* that were kept at the CEMAMu and in Xenakis’ studio, have been transferred to the Iannis Xenakis Archives at the BNF (Kanach, 2002, 9; Sterken, 2004; Xenakis & Kanach, 2008, xii-xiii, 247).

⁸ The commands for the light show and audio spatialization were recorded on tape and could possibly be reproduced. These tapes have been kept at the CEMAMu until recently, when they were transferred to the Iannis Xenakis Archives at the BNF, Paris (Xenakis & Kanach, 2008, 247).

⁹ There are some 160 articles and more than 100 interviews. The two books Xenakis published, *Musique Architecture* (Xenakis, 1971) and *Musiques Formelles* (Xenakis, 1963; Xenakis, 1992) are edited collections of previously published, selected articles, while *Arts/Sciences: Alliages* (Xenakis, 1979) is a transcription of his PhD thesis defense in 1976 at the University of Paris-Sorbonne.

¹⁰ Solomos, 2004.

¹¹ A critical edition of all Xenakis’ texts is currently being prepared by Makis Solomos, Benoit Gibson and Sharon Kanach (Xenakis & Kanach, 2008, 126; Kanach quoted in Moss, 2010).

well as in his biography by Matossian (Matossian, 1981). As his approach to applications of technology in music composition and the visual domain was highly idiosyncratic, such texts and extracts can guide our interpretation of the works and artistic intentions.

Additionally to the aforementioned sources, the thesis is based on a literature review that includes relevant theoretical areas from different fields and histories of media art. The *Polytopes* have so far been researched in the disciplines of architecture and musicology¹². Recent research in the *Polytopes* includes articles by Harley, Maria Anna (1998), Solomos & Raczinski (1999), Oswalt (1991), Sterken (2004), and Solomos (2006)¹³. Xenakis' architectural oeuvre, from the period he worked with Le Corbusier to the architectural projects he realized as independent architect, has been thoroughly studied by Oswalt (1991), Sikiaridi (2001), Sterken (2004) and Xenakis' former student and collaborator Sharon Kanach (2006, 2008). Sven Sterken's PhD dissertation (Sterken, 2004) is a particularly valuable resource, as it is the first and so far only existing research of Xenakis' body of work in architecture. By effectuating a complete and critical analysis of his oeuvre, Sterken solved the principal problem of Xenakis' architectural oeuvre – that it was widely unknown.

As is the case with the relatively recent rediscovery of the Philips Pavilion and the *Poème électronique*¹⁴ (see Chapter I), the rediscovery of the *Polytopes* is closely tied to the search for references and paradigms for the expanding fields of contemporary architecture. The *Poème électronique* has been re-considered as an immersive multimedia technological environment, with many suggestive parallels with contemporary new media art practice¹⁵. However, the *Polytopes* are still excluded from (media) art historical narratives¹⁶, with the exception of Frank Popper's histories of art and technology (Popper, 1975; Popper, 1997), and Alexaki's PhD dissertation, which focuses on the *Polytope of Mycenae* (Alexaki, 1996). As audiovisual works, the *Polytopes* have been occasionally included in exhibitions and publications that engage in the *synaesthesia* and *visual music* discourses¹⁷.

However, it is only Harley (1998) and Solomos (1999, 2006, 2008) that have attempted a contextual reading of the *Polytopes* in their aesthetic and cultural context. Only Solomos (2005, 2006, 2008) has proposed an analysis of the

¹² Since the 1960s a large number of publications have appeared on Xenakis' work, including monographs, MA theses and PhD dissertations, and conference announcements. Xenakis' musical oeuvre has been thoroughly studied by scholars internationally, notably Makis Solomos, James Harley, and Peter Hoffmann, among others.

¹³ There are also two PhD dissertations on the *Polytopes*, which we haven't been able to access: Tric Olivier, *Le processus de conception en architecture. Point de vue monotopique un architecte regarde les Polytopes*, D.E.A., Université de Rennes, 1992; Iliescu Mihai, *Musical et extramusical. Eléments de pensée spatiale dans l'œuvre de Iannis Xenakis*, Doctoral Dissertation, Université de Paris I, 1996.

¹⁴ The architecture of the Philips Pavilion, designed by Xenakis and Le Corbusier, constitutes an early predecessor to the complex, "fluid" formations and shapes that are today triggered by the digitalization of architectural design methods (Sikiaridi, 2001, 201).

¹⁵ Mondloch, 2004; Shanken, 2009.

¹⁶ For ex. in the comprehensive Foster, Hal, Krauss, Rosalind, Bois, Yve-Alain, Buchloh, Benjamin HD (eds), *Art Since 1900*, London and New York: Thames & Hudson, 2004; as well as in Paul, 2003.

¹⁷ Brougher et al., 2005; Weibel & Jansen, 2006; Daniels et al., 2009.

components of the *Diatope*, suggesting possible ways to investigate the audiovisual relationships in the work and proposing a critical analysis. Based on his research, and the aforementioned sources, we will attempt to investigate the relationship of the audio and visual components in the *Diatope*, and its ontology as a technologically based artwork.

As Sterken's comparative chronology of Xenakis's architectural and musical œuvre indicates, there is much accordance between his writings and architectural projects, as well as between his architectural and compositional work¹⁸. Xenakis' work was multifaceted, interdisciplinary and experimental, but was formed according to an extremely coherent vision. Even though an in-depth study of the visual component has not been possible due to restricted access to the documentation, we will argue that the same applies to the *Diatope*, basing our hypothesis on archival research and close readings of Xenakis' writings and contemporary publications. The thesis hypothesizes that the structural relationship of the audiovisual components is central to the *Diatope*, and that it is in this relationship that resides the "digital aesthetic" of the work. In this manner, we hope to contribute to the study of the xenakian project, which demands to be studied on many levels.

A problem often encountered in the field of media art histories, ephemerality is here a central issue: can we thoroughly study a work that does no longer exist, and the ways in which space, sound and light were negotiated within it? Can we access a site-specific work that is lost forever? Even the music « soundtrack », *La légende d'Eer*, which survives today and follows an independent course, was composed for a specific space, and was mixed to be distributed kinetically in space. Technically speaking, the piece as organized sound was destroyed along with the construction, and the aural experience can never be re-created without the exact configuration of the space that supported it; the recording remains a trace of the aural production. The immersive physical experience of the *Diatope* has been compressed to photographic traces and stereo audio.

We therefore dispose but traces to support possible arguments on the relevance of the *Diatope* to contemporary media art practices and 20th century art history. However, we could consider the work's value by the pertinence of questions it raises in a context different than that of its creation. The danger here would be to take the value of the work as granted, as Xenakis' notoriety as a composer has always influenced to a great extent the critical appraisal of his architectural oeuvre, including the *Polytopes*¹⁹. It is certainly not easy to distinguish the composer from the architect, the theoretician or the artist. Nevertheless, these were all aspects of one coherent artistic vision and practice, which produced a multilayered output – be it compositional, architectural, theoretical or artistic.

¹⁸ Sterken, 2004, Appendix; Sterken, 2008a.

¹⁹ Sterken, 2004, 5.

The thesis begins with a brief overview of Xenakis' work in architecture and music. Basically an autodidact, Xenakis' idiosyncratic thinking and vision was shaped by his personal experiences as a resistance fighter, his interest in mathematics, physics and astrophysics, his profound knowledge of ancient Greek philosophy, and his work as an architect. Therefore, a brief historical account of his life and work was considered necessary. We will especially focus on his artistic thinking, and more specifically to the interrelations between his design for the Convent of *La Tourette* and the Philips Pavilion, his composition *Metastasis* – a classic example that illustrated how his innovative interdisciplinary methods were formed. With regards to the *Diatope* this example is specifically important, as in the program notes of the *Diatope* (and in many of his writings and interviews), Xenakis chose to include these three works as characteristic of his approach to art in general.

The second chapter refers to the *Polytopes*, and more specifically to the *Polytope of Montreal* and the *Polytope of Cluny*. These are of particular interest as they shared many common elements with the *Diatope*: they were also automated, site-specific, large-scale audiovisual installations.

The third chapter is dedicated to a detailed study of the *Diatope*. After a brief historical account of the conditions of commission and construction of the work, a thorough description of each component follows, in no hierarchical order: architecture, music/sound design, visual/light design. We will attempt a study of the installation as a whole, in relation with the texts Xenakis offered as “the argument” of the work.

The penultimate chapter proposes an analysis of the work's aesthetics, a contextualization of the *Diatope* in xenakian thought and early media art and a critical reappraisal of the project from our perspective today.

The final chapter offers an overview of the study's main points and conclusions. Not meant as an appraisal of Xenakis' “media art” practice, it suggests new directions for research.

Chapter II

Iannis Xenakis, architect, composer, theorist

II.i. Introduction

Iannis Xenakis (Braïla, Romania, May 29, 1922 – Paris, France, February 4, 2001) was the eldest son of a Greek family of the Diaspora¹. His father was a British company's shipping agent in Romania. In 1932, after the traumatic experience of his mother's early death (1927), Xenakis was sent in a private boarding school at the island of Spetsai, Greece. After graduating in 1938, he moved to Athens to prepare for entrance exams at the university; he parallel privately studied music, ancient Greek philosophy, mathematics and physics, which would be his life-long interests.

Xenakis was admitted in the School of Engineering of the Athens Polytechnic on October 28th, 1940, at the same day that fascist forces invaded Greece. Greece's occupation, which was particularly hard in Athens, would last until late 1944. Early during the occupation Xenakis joined the resistance forces, participating in mass protests and demonstrations, being imprisoned many times, and later taking active part in armed resistance as a leader of the communist party student movement². On December 1944, during fierce street fighting, Xenakis was gravely wounded by a shrapnel; he survived with his face severely disfigured and his left eye lost³. Despite the fact that the Athens Polytechnic worked intermittently during these years and his active involvement in resistance, Xenakis graduated in 1946 with a degree in civil engineering. But as in 1947 the new government began hunting down former resistance members, to be sent to concentration camps, Xenakis, fearing for his life, fled Greece on a fake passport. In the meantime, he gets trialed in absentia for political terrorism by a military tribunal, and is sentenced to death⁴.

Crossing into France through Italy, Xenakis arrived on 11 November 1947 in Paris, where he lived ever since; he became a French citizen in 1965. Recommended by architect George Candilis, Xenakis was employed by Le Corbusier on December 1947 as engineer⁵. He worked in Le Corbusier's studio until 1959, collaborating as engineer and architect on large-scale projects like the Monastery of La Tourette and the Philips Pavilion at the

¹ His first name is also written as Yannis, as it took some time to stabilize to Iannis (Greek: Ιωάννης Ιάκωβος Ξενάκης). Basic resources for Xenakis' biography are Barthel-Calvet, 2001; the chronicle by Matossian, 1981, and his interviews with Varga, 1996.

² ELAS, the National Popular Liberation Army (ΕΛΑΣ = Εθνικός Λαϊκός Απελευθερωτικός Στρατός), and its branch EAM, the National Liberation Front (EAM = Εθνικό Απελευθερωτικό Μέτωπο), were massive resistance groups of communist influence in Greece during WW II (Varon-Vassar, 2009, 269-314).

³ Soon after the German evacuation of Greece (October 1944), British forces stepped in to help restore the monarchy according to martial law imposed by Churchill. The communist forces that had taken part in the resistance opposed them and the country plunged into civil war. By December 1944, when fierce battles break out in Athens (known as *Dekemvriana*), Xenakis was leader of the communist students' company *Lord Byron*, a division of ELAS. For accounts on the events that took place see: Antoniou, 2006, 264-276. Xenakis himself would discuss this painful experience much later in life (Matossian, 1981; Varga, 1996).

⁴ The sentence was commuted to ten years' imprisonment in 1951, and only lifted some 23 years later, after the fall of "The Regime of the Colonels" in 1974. Xenakis was allowed to return to Greece only then.

⁵ Le Corbusier was one of the few employers in Paris who employed political refugees without papers, and there was a strong hellenic presence at his atelier at the time (Sterken, 2004, 20).

Brussels World's Fair (see below). At the same time, working long and hard, Xenakis developed his composition skills and produced his first mature works, such as *Metastasis* (1953-'54) and *Pithoprakta* (1956), which set him at the forefront of avant-garde music in the late '50s.

By 1959, when he left Le Corbusier's studio, Xenakis was able to support himself by composition and teaching; he was recognized as an important composer that introduced a number of innovations in music (see Chapter I.iii). He remained active both as an architect and a composer throughout his career, building a substantial record of research and production in both fields. He founded (1965) and directed the Center for Studies of Mathematical and Automated Music (CEMAMu) in Paris; the Center for Mathematical and Automated Music (CMAM), in Indiana University, Bloomington, USA (1967–72); founder of the Contemporary Music Research Center (KΣYME) in Athens (1979). He also taught composition as Associate Music Professor at the Indiana University, Bloomington, USA (1967–72); as Gresham Professor of Music, City University London (1975); Professor, Sorbonne I University, Paris (1973-89).

After several years of serious illness, Iannis Xenakis died in Paris on February 4, 2001. His wife, journalist and writer Françoise Xenakis, and his daughter, artist Mâkhi Xenakis, survive him.



Fig. 1. Iannis Xenakis in his studio, 1987.

II.ii. Iannis Xenakis, architect & engineer

Xenakis worked in Le Corbusier's atelier from 1947 to 1959, a period that signaled the apogee of the great architect's career⁶. He initially performed the tasks of an engineering assistant, calculating the resistance of building materials in large-scale projects⁷. Gradually, he became interested in the architectural aspects of projects. His first personal contribution to the architectural design of a project was the façades of a kindergarten on the rooftop of the *Unité d'Habitation* (1954), a housing project in Rezé-lès-Nantes in France⁸. His original solution of an aleatoric distribution of divides in a series of windows, whose dimensions were determined with the help of the Modulor, drew Le Corbusier's attention to his skills. Shortly afterwards Xenakis was appointed "project architect" for the project of the Convent of St. Marie de la Tourette, near Lyon, France (1953-60)⁹.

Apart from coordinating of the overall project, Xenakis designed elements of the interior spaces: the cloisters, the study hall, the library and the chapel. Together with Le Corbusier they designed the side chapel of the monastery's church, which was conceived as "a space formed of and by light"¹⁰: a dark room with small openings at the ceiling, "light guns" through which sunlight was projected on the floor. The sacristy included windows of colored light, the interiors of whose cylindrical shafts were painted in primary hues.



Left to right: Fig. 2. The sacristy at the chapel of the Convent of St. Marie de la Tourette.

Fig. 3. Detail of a light "canon" at the chapels' interior.

Fig. 4. Exterior view of two light "canons".

⁶ For a detailed historical account of Xenakis' work in Le Corbusier's atelier see Sterken, 2004, 14-50, 191-343; Sterken, 2008a, 294-308; Kanach, 2008, 2-124.

⁷ Initially Xenakis worked as a civil engineer in the ATBAT Atelier des Bâisseurs [Builders' Studio], a division of Le Corbusier's atelier that was responsible for the technical aspects of big projects, calculating the statics of the Unité de Marseille (1946-'50), Kanach, 2008, 14-17; he also developed, together with noted engineer Bernard Laffaille, a new structural principle for the Unité de Nantes (1950-'54). Responsible for issues relative to the construction, acoustics and acclimatization in almost all projects, Xenakis gradually became a sort of scientific consultant for Le Corbusier's atelier, intervening in various aspects of different projects (Sterken, 2004, 22).

⁸ The Unités d'Habitation [Housing Units] were based on a modernist residential housing design principle developed by Le Corbusier. The concept formed the basis of several housing developments designed by him throughout Europe with this name. The first and most famous of these buildings, also known as *Cité Radieuse* (Radiant City) is located in Marseille, France, built from 1947 to 1952. On Xenakis' contributions to these projects see Kanach, 2008, 18-20; Sterken, 2004, 23.

⁹ Potié, Philippe, *Le Corbusier: Le Couvent De La Tourette*, Basel : Birkhäuser Architecture, 1997; Sterken, 2004, 260-266; Kanach, 2008, 41-74.

¹⁰ Oswald, 2001, 211.

Xenakis' major contribution to *la Tourette* was his design of the building's west wing façade. He conceived the exterior walls of the lower floors of the building as a double frieze of large windows, extending to four floors, with concrete divides inserted across them. Applying Le Corbusier's Modulor, Xenakis arranged vertical and horizontal strips of concrete and strips of glass of different widths in a composition of musical glass walls¹¹. The concrete divides occur unevenly, widening out then closing together. When filtered through the strips of concrete, the constantly changing sunlight created patterns in variable rhythms of open and closed, which were projected onto the floor in "a detailed polyrhythmic study with light and shade as the dynamic range"¹². Architectural elements that capture, direct and transform natural light were a specific xenakian contribution to architectural designs realized in Le Corbusier's studio¹³.

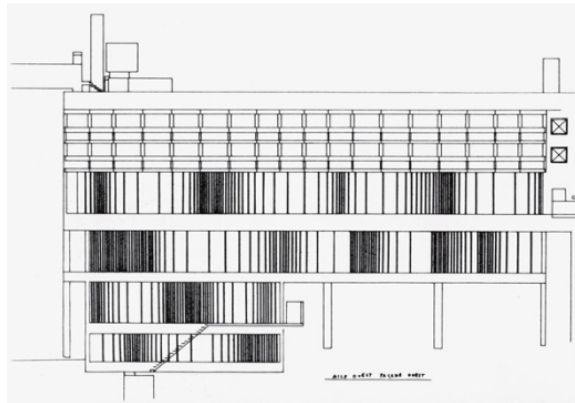


Fig. 5. Iannis Xenakis, design of the west elevation with undulating 'musical' screening of glass, Convent of St. Marie de la Tourette, c. 1955.



Fig. 6. Convent of St. Marie de la Tourette: exterior view of the west façade.

Fig. 7. Convent of St. Marie de la Tourette: interior view of the west façade.

¹¹ Evans, 2000, 295-296.

¹² Matossian, 1981, 66. Xenakis also transposed certain postulates of musical rhythms into architecture using undulating glass panes in the Housing project in Rezé-lès-Nantes (1950-54); in the Chandigarh project in India (1951-'59) (Kanach, 2008, 5-6, 21-40; Sterken, 2004, 23); in the Brazilian Student House at the University Campus in Paris; and in the Youth and Cultural Center in Firminy, France (1956-'59) (Kanach, 2008, 75-78).

¹³ Sikiaridi, 2001a, 202; Sikiaridi, 2010, 94.

The Philips Pavilion and the *Poème électronique* (1958)

In 1956 the Philips Company commissioned to Le Corbusier the design of their pavilion for the 1958 World Exhibition in Brussels, Belgium¹⁴. Rather than merely exhibiting the products in a “traditional” expo products display, the aim was to create an impressive multi-media display, using the company’s products of cutting-edge light and sound technology. Le Corbusier envisioned an “electronic poem”, where visual art and music would merge in a fully integrated site of technology¹⁵. The synthesis of image/light, sound, and architecture using Philips’ latest technologies would connect the levels of perception, marking the beginning of a new era – that fitted within the Brussel’s Worlds Fair’s theme of “Man and Progress”. The eight-minute spectacle *Poème électronique* [Electronic Poem] would consist of two independently created layers: a visual display created by Le Corbusier, and a music piece by composer Edgard Varèse (1883-1965), hosted in a pavilion especially designed for the occasion.

Le Corbusier’s initial architectural concept of the pavilion was a globular shaped shell with dark interior, where the *Poème électronique*, a collage of images and light effects would be projected on inverted projection screens. He conceived the plan of the pavilion as a “stomach”, where visitors would enter through a curved corridor, experience the eight-minute spectacle in its central area, and exit through another curved corridor. Le Corbusier entrusted the design of the pavilion and the coordination to Iannis Xenakis, who worked on the project from 1956 to 1958¹⁶. In order to solve the acoustic problems of Le Corbusier’s initially proposed design, Xenakis began considering more asymmetrical solutions based on hyperbolic surfaces. According to Xenakis, the concept of using curved surfaces composed of straight lines was directly inspired by his composition *Metastasis* (see below). He experimented with various configurations of conoids, to arrive to the solution of a shell comprising of as few ruled surfaces as possible: a cluster of nine hyperbolic paraboloids composed asymmetrically with three varying triangular peaks¹⁷.

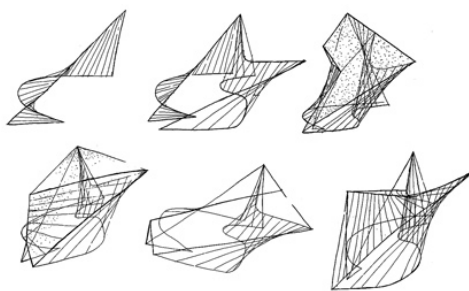


Fig. 8. Iannis Xenakis, studies on the design of the Philips Pavilion (1957).

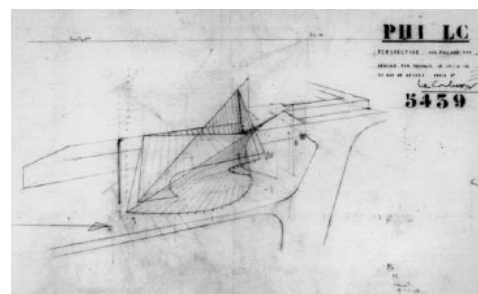


Fig. 9. Iannis Xenakis, design of the Philips Pavilion (1956).

¹⁴ Treib, 1996, gives a fascinating and comprehensive chronicle of the *Poème électronique* and the Philips Pavilion’s design and construction.

¹⁵ „I will not make a facade for Philips, but an electronic poem. Everything will happen inside: sound, light, color, rhythm. Perhaps, a scaffolding will be the pavilion’s only exterior aspect“, Le Corbusier in Petit (ed.), 1958, 23; quoted in Treib, 1996, 9. Le Corbusier’s interest in the integration of the arts occupied his thinking after WW II; on his concept of the *jeux électroniques*, electronic games that could be installed in architecture in an artistic synthesis of light, color, image, spoken word, and music, see Lootsma, 1986, 125-142; Treib, 1996, xiv-xvi, Lootsma, 2009.

¹⁶ Treib, 1996, 19-26; Sterken, 2004, 58-67 and 275-282; Kanach, 2008, 93-103.

¹⁷ The concept and development of the design is described in detail in Xenakis, 1958b.

The result was a self-supporting structure with curved surfaces, whose roof and walls seemed seamless. The interior walls, built of reinforced concrete covered with asbestos-coated tiles, formed a dark and sound-absorbing cavern. The Philips Pavilion was the world's first self-supporting hyperbolic paraboloid building, revolutionizing volumetric architecture¹⁸. Xenakis described the pavilion as "the dawn of a new architecture", which was based on the bending rather than on the shifting of surfaces¹⁹. He considered the Philips Pavilion as a pioneer in a movement towards a "volumetric architecture", in which the floor plan of a building implied little about the shape of the structure above it, exemplifying the transformation from classical Euclidean geometry to a more complex curvilinear and geodesic geometry in architecture.

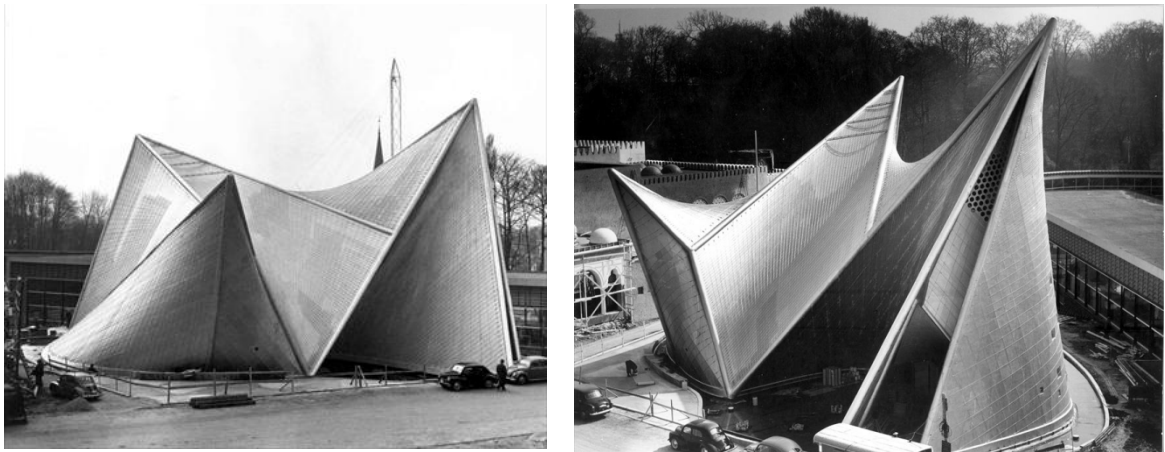


Fig. 10-11. The Philips Pavilion (1958).

The Philips Pavilion is important architecturally as it was the first freestanding structure to be constructed entirely from dissimilar hyperbolic paraboloids. Hyperbolic paraboloid forms were part of a general trend of modernist architecture that rose to prominence in the 1950s²⁰. The aesthetic qualities of hyperbolic paraboloid curves had also been explored earlier in sculpture, among others in the work of brothers Naum Gabo (1890-1972) and Antoine Pevsner (1886-1961)²¹. Gabo and Pevsner had been making "linear constructions" since 1941, by stretching threads or wires over a rigid formwork to imply continuously warping surfaces²². Curvilinear forms were also common in the aesthetics of early graphics experiments with photographic, mechanical, analogue and digital

¹⁸ Xenakis' design materialized through an innovative system of precast concrete panels, engineered by Hoyte C. Duyster, of the Belgian company Strabed, in close collaboration with Xenakis. As it was the first time a construction exclusively based on self-supporting hyperbolic paraboloids was realized, the design materialized after severe modeling and structural tests, carried out at the University of Delft (Treib, 40-82; Kanach, 2008, 95-98; Sterken, 2004, 23-27). The pavilion's construction was documented on film, see <http://www.edu.vrmmp.it/vep/debouw.html> (23/12/10).

¹⁹ Xenakis, 1971, 123-126. Xenakis wrote two articles on the architecture of the Philips Pavilion and the *Poème électronique*: Xenakis 1957 and Xenakis 1958b.

²⁰ Xenakis was familiar with ruled surfaces, hyperbolic paraboloid and conoid forms through his training and working experience in civil engineering, and especially through his collaboration with engineer Bernard Lafaille (Xenakis, 1957, 106; Xenakis, 1958b, 113). Hyperbolic paraboloid forms had been used for building self-supporting shells since the 1920's, and constituted the avant-garde paradigm of the post-war period (Sikiaridi, 2001, 206; Treib, 1996, 33-34, 238).

²¹ Xenakis refers to Pevsner as an influence (Bosseur, 1992, 49; Cabrera, 1994, 10; Sterken, 2004, 51-71). It is interesting to note that at the beginning of the project it was proposed that two sculptures, one by Pevsner, and one by mathematician Le Lionnais, would be placed near the entrance of the pavilion (Treib, 1996, 84).

²² Evans, 2000, 310.

computer techniques, for ex. in the work of Gyorgy Kepes (1906-2001), Ben F. Laposky (1914-2000), Herbert W. Franke (1927) and Peter Keetman (1916-2005), among others²³.

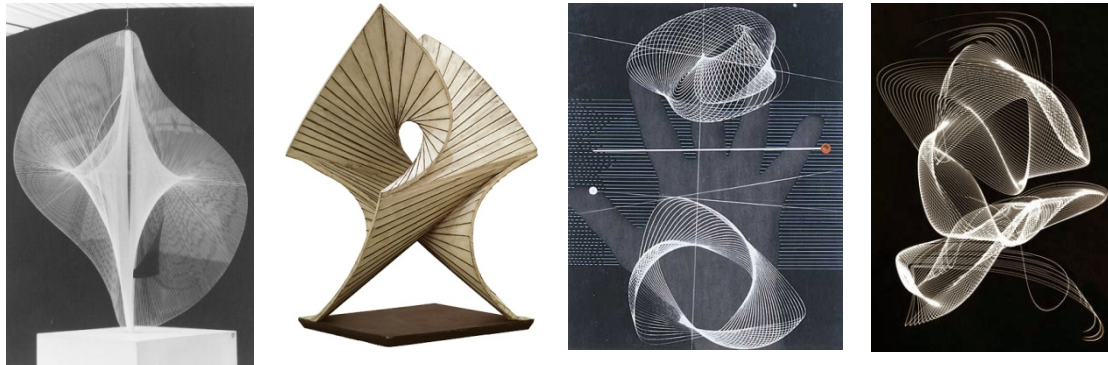


Fig. 12-15 (left to right): 12. Naum Gabo, *Lineal no 2*, 1949-'53. 13. Anton Pevsner, *Developable Surface* (*Surface développable*), 1938-'39, Bronze and copper. 14. Gyorgy Kepes, *Hand and Geometry*, 1939. 15. Peter Keetman, *Schwingungsfigur 995*, 1949.

An essentially mathematical solution, the aesthetic qualities of hyperbolic paraboloid forms stem from its fluidity, which renders two-dimensional shapes into three-dimensional volumes. It formally implies an unfolding movement over time, suggesting “a means to overcome the limitations imposed on flowing spaces by the orthogonality of the box.”²⁴ Xenakis’ solution of curvilinear forms for the architecture of the pavilion was aesthetically and functionally adequate for the purpose it was destined.

The music component, the piece *Poème électronique*, was composed by Edgar Varèse at the Philips laboratories in Eindhoven, with state of the art technical means of the time and the assistance of Philips Company’s experts. Varèse had been long before the *Poème électronique* in a search for a “spatial music”; his work had always sought the abstract and was, in part, visually inspired by concepts of form and spatial movement²⁵. Aiming at an intense fusion of space and sound experience, the *Poème électronique* was diffused in the interior space of the pavilion from an estimated 350 loudspeakers, spatialized in highly complex “sound routes” designed by Varèse and Xenakis²⁶.

²³ The compArt database at the University of Bremen is a valuable resource of early experiments in computer graphics <http://dada.compart-bremen.de/> (17/3/11).

²⁴ Treib, 1996, 33.

²⁵ The *Poème électronique* (1958) was his only fully electronic work, and the one that most literally realized the moving sound masses, which characterized his entire œuvre (“For the first time I heard my music literally projected into space”, Varèse quoted in: Treib, 1996, 211). It is today considered a pioneering work in 20th century music; a stereo mix was published under Varèse’s supervision (Columbia L.P. MS6146); other releases from Neuma (CD 450-74) and Attacca Babel (CD 9263-2). For an analysis of the work see: Cabrera, 1994, 75-93 and Feliciano, Richard, *An analysis of the Poème électronique*, in: Treib, 1996, 212-213. Varèse was an important influence on Xenakis (Mâche, 1985). Here we should also mention *Déserts* (1949-1954), a project on which Varèse had been working for years and which he had conceived as a multimedia piece, in the sense of the classical avant-garde film as a piece of music with a film. The project was never realized, but Varèse incorporated elements from the earlier *Déserts* in the *Poème électronique* (Mattis, 1992, 557-583).

²⁶ On the production and spatialization of the piece see Treib, 1996, 172-211; <http://www.edu.vrmmp.it/vep/music.html> (23/12/10). The original recording of *Poème électronique* was recorded on three audio tracks, distributed through a sophisticated switching process between hundreds of speakers (their number varies from 300 to 450, depending on the source), which were set into and all along the interior walls of the pavilion (Dobson et al., 2005).

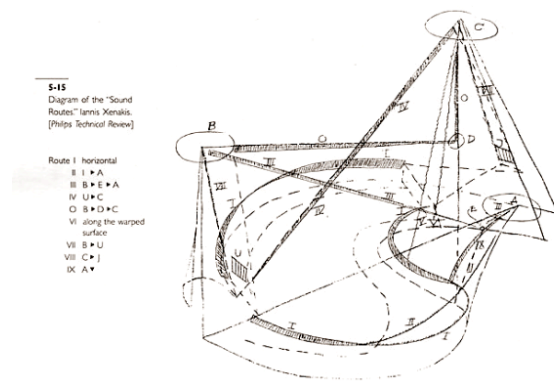


Fig. 16. Iannis Xenakis, diagram of the «sound routes», c. 1958.



Fig. 17. Interior view of the Philips Pavilion, 1958.

Xenakis was also invited to contribute a brief electroacoustic piece to the *Poème électronique, Concrète PH* (1958)²⁷. Its title referred to key elements of the Pavilion's architecture: the material of reinforced concrete and the basic shapes of hyperbolic paraboloids (*paraboloides hyperboliques*). The piece accompanied entering and exiting audiences as an interlude, and was also spatialized²⁸. As the structure that hosted it, the piece was formally based on parabolic and hyperbolic curves: in the spatialization of sound for the *Concrète PH* Xenakis clearly articulated his interpretation of mathematical principles as general truths, which could be expressed in different media and form a coherent aesthetic link between them²⁹. With the spatialization of the *Poème électronique* and *Concrète PH* Xenakis literally integrated musical and architectural form; "architecture was no longer restricted to playing the role of a reverberatory sounding board but became instead the source of sound: architecture and music were rendered coincident"³⁰.

The visual component of the *Poème Électronique* was an expression of Le Corbusier's "jeux électroniques" [electronic games], a new form of electronic art incorporating elements of "light, color, rhythm, motion and sound"³¹. Le Corbusier elaborated the visual part of the *Poème Électronique* with the assistance of graphic designer Jean Petit and filmmaker Philippe Agostini³². It comprised of five elements: a 480-second film, consisting of associative stills projected on two large screens; black and white still images

²⁷ *Concrète PH* (*Concret PH*) is available in a revised recording made in 1968 from: Nonesuch H-71246 (LP), Electronic Music Foundation Media EMF-003 (CD), the Institute of Sonology BVHAAST 9149-9150 (CD), Sub Rosa SR190 (CD), Caipirinha Prod CAI2027 (CD) and Ellipsis Arts ELLIP 3670 (CD). The piece consists of tape manipulations of recorded sound of burning charcoal.

²⁸ Recent research from the VEP project contributes to our existing knowledge of the spatialization of *Concrète PH* (Lombardo et al., 2010).

²⁹ Bridoux-Michel, 2005. Cabrera (Cabrera, 1994, 8-9) shows that Varèse's conception of spatial sound, f. ex. of the siren-like sounds in the *Poème électronique*, is also linked to hyperbolic and parabolic forms and movement in sound space.

³⁰ Treib, 1996, ix.

³¹ Le Corbusier, program of *Poème électronique*, 1958, quoted in Harley, M. A., 1998, 56. Le Corbusier's definition of the *jeux électroniques* remained somewhat abstract, as he did not specify any details.

³² For a detailed description and analysis of the visual component see Treib, 1996, 98-167; Mondloch, 2004, 59-61.

that were projected directly onto the curved interior walls of the pavilion³³; light effects such as colored lighting (*ambiances*) projected onto the walls, and narrow, brilliantly colored beams of light projected from perforated film (*tri-trous*)³⁴; and three-dimensional forms suspended in space (a female figure and an abstract sculpture made of metal tubes), that shined red and blue when irradiated with ultraviolet light; also, images of a red sun, a moon, and twinkling stars on the ceiling³⁵.

Conceived by Le Corbusier as a “story of humankind”, the film consisted of images that narrated the course of human civilization and the threats to its prolongation, which developed in seven thematic sections³⁶. On the projected film and on highlighted areas around the projection screens, simplified shapes of colored beams of light or black and white figures were projected and superimposed. The larger incandescent lights, projectors, and batteries of colored and white fluorescent tubes were hidden behind a concrete balustrade, so that only their effect on the walls was visible. On the audience’s side, the floor adjacent to the balustrade was lined with tiles, fluorescing bluish white³⁷.



Fig. 18-20. *Poème Electronique*, stills of the projections, 1958.

Le Corbusier's visual display was created independently of Varese's piece, and the relationship between music and visual spectacle was arbitrary. The sequences of the *Poème Electronique* was written on scores: the visual score (*minutage*), designed by Le Corbusier and Jean Petit, was split in two pages, one for the *ambiances* and one for the other visual effects³⁸, while the aural "control" score (of which only 30 seconds are still

³³ Additional still photos, some of which duplicated those used in the film, were projected on three 'windows', directly onto the interior walls. With the help of mirrors, moving pictures from film projectors were scattered throughout the room, increasing the illusionary effect. The curvature of the walls made parts of the pictures appear unfocused, creating a three dimensional illusionary space (Oswalt, 2001, 211).

³⁴ The ambient light design was very elaborate - there were 51 different lighting configurations (*ambiances*), covering a broad palette of colors in many combinations, f. ex. slide projectors casting changing spots of color onto the walls, or hundreds of colored fluorescent tubes and lamps simulating the course of a day (Treib, 1996, 154).

³⁵ Another visual element at the entrance of the pavilion was the “mathematical object”, a geometric sculpture designed by Xenakis on the request of Le Corbusier (Kanach, 2008, 100-101). The object is today in the collection of the Technical University of Eindhoven, Holland:

http://w3.tue.nl/en/services/daz/executive_committees/the_tue_art_committee/art_collection_tue/constructions_and_installations/le_corbusier/ (23/12/10).

³⁶ The seven thematic sections were: *Genesis* (0"-60"), *Matter and Spirit* (61"-120"), *From Darkness to Dawn* (121"-204"), *Manmade Gods* (205"-240"), *How Time Molds Civilization* (241"-300"), *Harmony* (301"-360"), *To All Mankind* (361"-480"). A Dutch production on the *Poème Electronique*, *Het electronisch gedicht* (1958), conveys a general idea of the imagery and montage: <http://www.youtube.com/watch?v=0YlBmx3VulY&feature=related> (22/10/10).

³⁷ Cabrera, 1994, 3-4.

³⁸ Stimson, 1991, 308-310.

preserved) indicated the routing of music tapes into loudspeakers. Xenakis coordinated the interior sound and light technology, together with technicians from the Philips Company. An important innovation was that all the commands for the audiovisual spectacle were automated, marking “the end of one epoch of exposition thought, the mechanical, and the beginning of another, the electronic”³⁹.

The Philips Pavilion attracted approximately 1.500.000 visitors from May 1958 until the World Fair’s conclusion on October 1959⁴⁰. Its prophetic language and technical novelties overwhelmed the audience; instead of the typical display of consumer products visitors encountered a total and immersive experience, where cutting-edge technology was put at the service of the arts. The pavilion’s architecture was an early and explicit manifestation of the deconstruction of Cartesian space: the sense of depth and perspective disappear, with floor, ceiling and walls all becoming part of a continuous fluid architecture. Inside a structure of subtle materiality⁴¹, the spectator's body was immersed in projected light and sound. This “fascinating moment of artistic synergy”⁴² was one of the first electronic installations to combine architecture, film, light and music in an immersive environment.

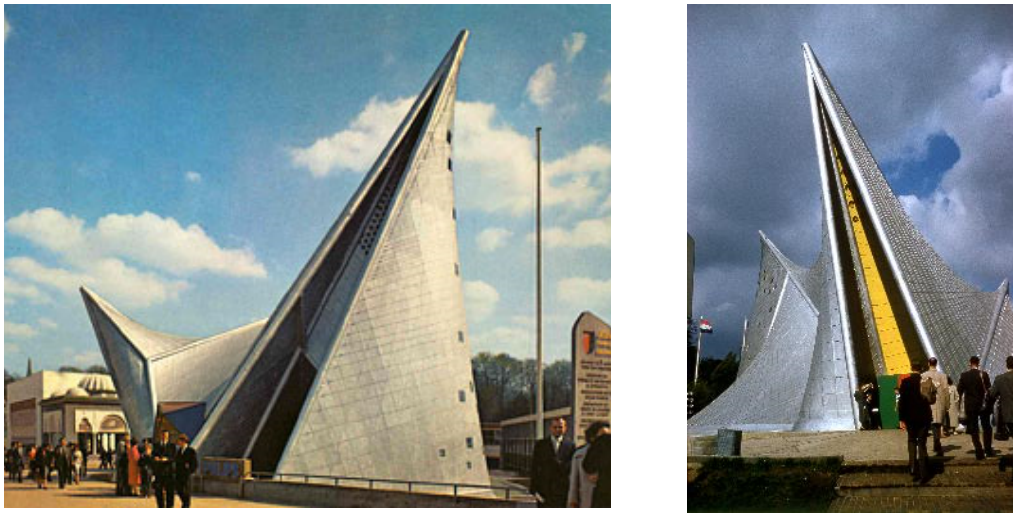


Fig. 21-22. The Philips Pavilion (1958).

The structure was demolished shortly after the closing of the World Exhibition, since it was not expected to last the winter⁴³. Today, the *Poème électronique* and the Philips Pavilion are considered a historic landmark, “a landmark in electronic media technology,

³⁹ Treib, 1996, x. All the commands for the *Poème électronique* were automated and stored on a 15-track magnetic tape (Xenakis& Kanach, 2008, 102-103).

⁴⁰ The *Poème Électronique*’s presentations took place from 20 May 1958 to the end of September 1958. The pavilion had a capacity of 500; 16 performances were given daily at half-hour intervals.

⁴¹ The structure was reduced to a 5 cm. thick concrete shell (Sterken, 2001b, 265-266).

⁴² Sikiaridi, 2001, 201.

⁴³ Treib, 1996, 226-228. Existing documentation today includes plans, preliminary sketches, documents, photographs, the film reels (at the Philips Company Archives, the Louis Kalfé Archives at the Getty Foundation, and the Fondation Le Corbusier), along with material published in the *Philips Technical Review* (v. 20 n. 1, 1958/1959) and a monograph on the *Poème Électronique* (Petit (ed.), 1958). Recently, a virtual reconstruction of the *Poème Électronique* was realized in the frame of the Virtual Electronic Poem (VEP) project (<http://www.edu.vrmmp.it/vep/>, <http://www.vrmmp.it/asalab/> (13/4/10); Lombardo et al., 2009).

that concomitantly tested the limits of architecture, both concrete and virtual”⁴⁴. One of the first entirely automated multimedia environments, the *Poème électronique* can be considered as a paradigmatic example of early attempts to create a spatialized, virtual experience for the spectator⁴⁵.

This early example of a “synthesis of the arts” was based on Le Corbusier’s holistic approach – however, from today’s perspective, the Philips Pavilion is a unique example in Le Corbusier’s otherwise consistent body of work, “a foreign body, an alien element in the context of the master’s architectural language that shaped the canons of modernist architecture”⁴⁶. The degree to which Xenakis’ contribution was decisive is shown in the various sketches and models of the pavilion, which document the radical transformation of Le Corbusier’s original idea. It was Xenakis’ highly acute mathematical understanding that enabled such a development. His innovations in design and representation were related to, but distinct from Le Corbusier’s earlier applications of virtual geometric structures to organize the distribution of forms in space⁴⁷. But even though the pavilion was a revolutionary construction, both container and expression of media, Le Corbusier considered the architecture of the pavilion primarily as a container for the *Poème électronique*⁴⁸.

Although Xenakis had been entirely responsible for the design of the Philips Pavilion, Le Corbusier and the commissioners felt that he should not be regarded as its creator, as he demanded upon its completion. Officially, Le Corbusier claimed to have authored both the architecture and the display. Le Corbusier acknowledged Xenakis’ co-authorship only after a violent dispute, which ultimately destroyed their working relationship⁴⁹. Xenakis was fired shortly afterwards, in 1959, while working on the design of the *Cité sportive* of Bagdad, whose stadium he also designs according to principles of the Philips Pavilion.⁵⁰

From 1959 onwards Xenakis would concentrate entirely on music composition, working on architectural projects only occasionally. His limited work as independent architect continues his research into the volumetric, complex architectural form, with most of his designs based on the geometries of the hyperbolic paraboloids and conoids: “SCHR 100”, a music studio for the conductor Hermann Scherchen in Gravesano, Switzerland (1961); the *Diatope* (1978); his proposal for the *Cité de la Musique* (1984, together with Jean-

⁴⁴ Treib, 1996, xix.

⁴⁵ Mondloch, 2004, 57.

⁴⁶ Sikiaridi, 2001, 201.

⁴⁷ Treib, 1996, xvi.

⁴⁸ In fact, apart from fulfilling certain commission prerequisites, “any other ideas concerning research of plasticity were to be discarded since they would take away from the light and sound spectacle”, Le Corbusier quoted in Xenakis, 1958b, 111. See also Lootsma, 2008; Lootsma, 2010.

⁴⁹ For Xenakis’ account on the Philips Pavilion see Matossian, 1981, 128-143; Treib, 1996, 15, 17, 85-89, 209, 234-235; Varga, 1996, 23-24; Sterken, 2004, 32; Kanach, 2008, 101-102, 104; Treib concludes that “although the pavilion was the brainchild of Le Corbusier, its realization and its electronic poem were truly a collaborative effort”, “an intriguing model of postmodern collaboration *avant la lettre*” (Treib, 1996, ix, xvi-xviii).

⁵⁰ The project was never realized. See Sterken, 2004, 34; Sterken, 2008a, 303; Kanach, 2008, 79-92.

Luis Vértet)⁵¹. Xenakis also applied his favorite paradigm of hyperbolic paraboloids on an urban scale, in his proposition for a *Cosmic City* of 5000 inhabitants (1963)⁵².

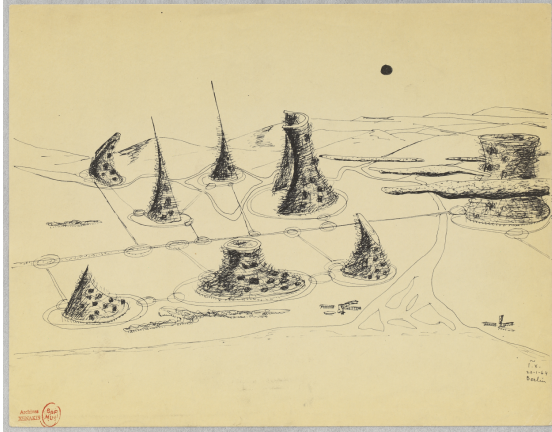


Fig. 23. Iannis Xenakis, *Cosmic City* (aerial perspective), 1963, ink on paper.

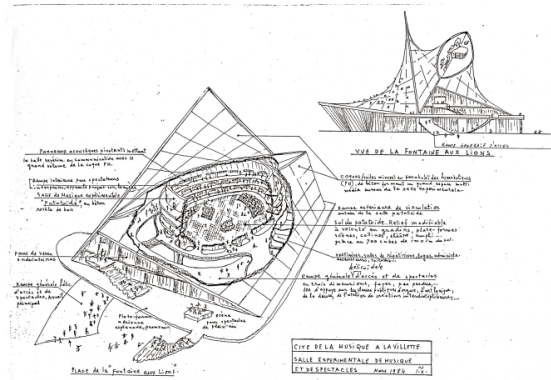


Fig. 24. Iannis Xenakis and Jean-Louis Veret, design proposal for the Cite de la Musique, 1984.

The apprenticeship by Le Corbusier, during which was exposed to issues of modern engineering and architectural forms and design, was crucial for his development of skills. His subsequent work as independent architect is full with references from knowledge he acquired at Le Corbusier's atelier⁵³. Moreover, Xenakis profited also as a composer, especially with regards to method. The large-scale effect of the architectural design demonstrated to Xenakis the ability to think architecturally with regard to temporal phenomena: "I found that problems in architecture were the same as in music. One thing I learned from architecture which is different from the way musicians work is to consider the overall shape of the composition, the way you see a building or a town. Instead of starting from a detail, like a theme, and building up the whole thing with rules, you have the whole in your mind and think about the details and the elements and, of course, the proportions. That was a useful mode of thinking."⁵⁴ Xenakis began with the overall shape of the composition, and then worked to detail its complexity of movement through time and space.

Another fundamental influence was the application of the Modulor, Le Corbusier's system of numerical proportions. Having applied the Modulor on different elements of architectural designs, Xenakis applied some of these concepts to early compositions such as *Metastasis*, *Pithoprakta* and *Syrmos* (1959), which are directly based on architectural concepts.

Through his working experience with Le Corbusier, Xenakis discovered common elements between music and architecture, and developed his "visual thinking"⁵⁵. The development of his design and drawing skills was a valuable benefit from his experiences

⁵¹ Sikiaridi, 2001a, 202; Sterken, 2004, 357-363; Kanach, 2008, 156-158, 178-189.

⁵² Xenakis, Iannis, *The Cosmic City* (1964), in: Kanach, 2008, 136-141; "La Ville Cosmique", in Choay, Françoise, *L'Urbanisme, Utopies et Réalités*, Paris: Le Seuil, 1965, 335-342; Jameson, Fredric, *The Ideologies of Theory: Essays 1971-1986*, Vol. 2, Syntax of History, London: Routledge, 1988, 91-92; Sterken, 2004, 365-368; Kanach, 2008, 127-129.

⁵³ Sterken, 2004, 74.

⁵⁴ Xenakis quoted in Matossian, 1981, 69.

⁵⁵ Xenakis quoted in Bosseur, 1992, 54.

in architecture: “Graphics are indispensable; there are things that can be more easily manipulated through drawing. I acquired this experience during the twelve years I dealt with architecture with Le Corbusier”⁵⁶. Many of his innovations in music were first materialized graphically on grid paper, which offered an alternative to traditional musical notation. Apart from indicating his thought processes and method of “thinking through the hand” Xenakis’ sketches and studies constitute in many cases authentic representations of a composition⁵⁷.

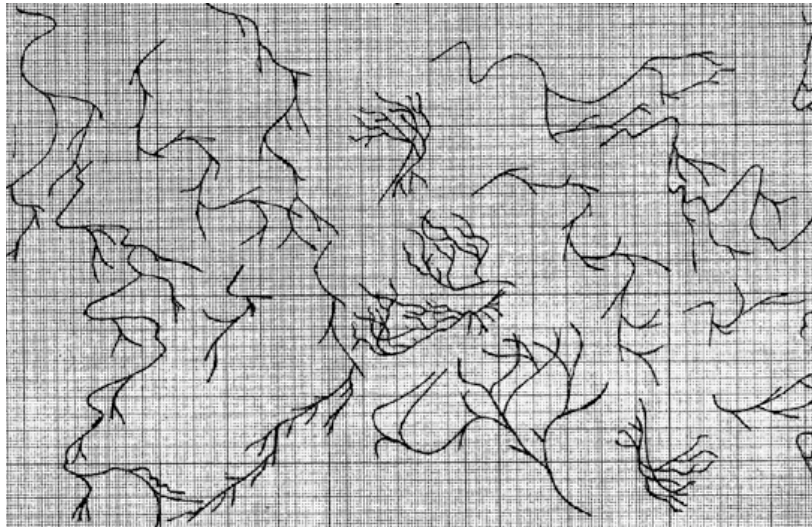


Fig. 25. Iannis Xenakis, graphic notation of arborescences for the piece *Erikhthon* (1974), detail.

⁵⁶ Xenakis quoted in Varga, 1996, 127.

⁵⁷ Kanach, 2002; Kanach, 2010.

II.iv. Iannis Xenakis, composer

Iannis Xenakis is considered today a seminal post-war avant-garde composer. He has composed prolifically, about 150 works, from the early 1950s until 1997⁵⁸. Xenakis introduced a number of innovative compositional techniques based on models and theories of mathematics and physics, such as probability theory, stochastic processes, statistics, statistical mechanics, group theory, game theory and set theory. He was also an important influence on the development of electroacoustic and electronic music. His electroacoustic works, although much smaller in number (14) compared to his orchestral works, introduced considerable innovations and were influential beyond their number. In addition to his orchestral and electroacoustic works, he has composed several choral, dramatic, and chamber works. His work continues to be performed at numerous festivals and concert halls worldwide, to stimulate scholarly research, and to influence subsequent practitioners⁵⁹.

Xenakis was introduced to music by his mother, and received his first formal training during his primary boarding school education. He started taking composition lessons at an early age, and studied music intermittently during his studies at the Athens Polytechnic. But although he had broad musical experience, Xenakis' formal training was limited. When in Paris, Xenakis tried to pursue further music studies and sought guidance from a number of renowned teachers, Arthur Honegger, Darius Milhaud, and Nadia Boulanger, but his desire to forge a path as a composer was met with discouragement. In 1951 he was referred to Olivier Messiaen, who understood his musical ideas and would guide them along; Messiaen recognized Xenakis' talent and encouraged his uncommon background in architecture and mathematics⁶⁰. Attending Messiaen's famous course "Esthétique et analyse musicale" as auditor at the Paris Conservatory in 1951–'54, Xenakis discovered serialism and gained a profound understanding of contemporary music. His first response to his teacher's encouragement to develop an individual style based on his scientific training, fusing together architecture, music, and mathematics in his compositional method, was his first "official" work, *Metastasis*.

To compose *Metastasis*⁶¹ (1953–'54) for orchestra, Xenakis combined his background in mathematics and physics with the ideas he had been developing in Corbusier's studio and the musical skills he had been honing with Messiaen. He introduced independent parts for every musician of the orchestra, using the *glissando* as a primary sonic element (see below). Impressed by the score of *Metastasis*, conductor Hermann Scherchen offered his support to the young composer⁶², and the work was premiered at the

⁵⁸ For a full list of works consult the catalogue of the Salabert Editions <http://www.durand-salabert-eschig.com/formcat/actuel/XENAKIS2006.pdf> and <http://www.iannis-xenakis.org/fxe/catalog/oeuvres.html> (23/8/10).

⁵⁹ In the frame of this thesis we cannot but refer briefly to Xenakis' work in music composition and theory. Apart from his own writings on music, especially his *Musiques Formelles* (1963/1981) and its translation in English *Formalized Music* (1971/1992), the works by Balint Andras Varga (1996), Makis Solomos (1996) and James Harley (2004) are the most comprehensive.

⁶⁰ Matossian 1981, 48; Dingle, 2007, 128-130. Conductor Hermann Scherchen, who would become a lifelong confidant and supporter of Xenakis', was also supportive of his uncommon background.

⁶¹ Also known as *Metastaseis* or *Metastaseis B*.

⁶² The relationship between Hermann Scherchen (1891-1966) and Xenakis would be very important to the latter (Matossian 1986, 77–79; Xenakis, Brown & Rahn, 1987, 20). Xenakis followed music composition studies with Scherchen at Gravesano, Switzerland. Scherchen also motivated Xenakis to write his first articles, which were

Donaueschingen Festival in Germany in 1955, under the direction of Hans Rosbaud. It was a breakthrough that set Xenakis at forefront of avant-garde music, but which also drew harsh criticism particularly from the serialists. Xenakis answered his critics in a bold article titled "The Crisis of Serial Music"⁶³, in which he articulated his formalized techniques. In the article Xenakis claimed that serialism's "linear" constraint on structural constructions imposed considerable restrictions. To overcome these limitations he counter-proposed a "Stochastic Music", which would "essentially incorporate the theory and calculation of probabilities, introducing an entire series of mathematical functions."⁶⁴

With this approach Xenakis pioneered the use of mathematical models in compositional practice. Throughout the '60s he continued to adapt principles and models of mathematics and physics to his instrumental music throughout the '60's, exploring new approaches to composition and complex rhythms and textures. Xenakis called "Stochastic Music" his approach to composition, which deals with large numbers of events structured according to probability-based formulas (Poisson's Law of Rare Events, Bernoulli's Law of Large Numbers, Maxwell-Boltzmann Kinetic Theory of Gasses). In his "stochastic" works, statistical methods were used at every level of the musical process, from score composition to sound synthesis. *Pithoprakta* (1955-6), meaning in Greek "action through probability", is based on statistical methods of generating orchestral textures: over the course of the work, "points" which are distributed according to probability calculations (using varying formulas for different sections such as Poisson's Law of Rare Events, Bernoulli's Law of Large Numbers, and Maxwell-Boltzmann's kinetic theory of gasses), move at various directions and speeds to form "clouds". Stochastic techniques were applied also on electroacoustic pieces, such as the statistical distribution of points on a plane in *Diamorphoses* (1957).

Xenakis implemented different mathematical paradigms such as set theory from Boolean algebra (*Herma*, 1962; *Eonta*, 1963-'64), game theory (*Duel*, 1959; *Stratégie*, 1962), group theory (*Nomos Alpha* (for Siegfried Palm), 1966⁶⁵). Later works try out different ideas: *Evryali* (1973) is based on Markov chains; *ST/10* (1962) and *Atrées* (1958-'62) on the normal distribution; *N'Shima* (1975) on Brownian motion. Later on, Xenakis also employed the mathematical theories of games ("Strategic Music"), and sets and logic

published between 1955 and 1966 in Scherchen's review *Gravesaner Blätter* (Kanach, 2008, 126): "La crise de la musique sérielle", *Gravesaner Blätter* n°1, 1955, 2-4; "Wahrscheinlichkeitstheorie und Musik", *Gravesaner Blätter* n°6, 1956, 28-34; "Der Modulor / The Modulor", *Gravesaner Blätter* n°9, 1957, 2-3/3-5; "Le Corbusiers Elektronisches Gedicht / Le Corbusier's Electronic Poem —the Philips Pavilion", *Gravesaner Blätter* n°9, 1957, 43-50/51-54; "Auf der Suche einer Stochastischen Musik / In search of a Stochastic Music", *Gravesaner Blätter* n°11-12, 1958, 98-111/112-122; "Grundlagen einer stochastischen Musik / Elements of Stochastic Music", *Gravesaner Blätter* in four parts: 1) n°18, 1960, 61-83/84-105; 2) n°19-20, 1960, 128-139/140-150; 3) n°21, 1961, 102-111/113-121; 4) n°22, 1961, 131-143/144-145; "Stochastische Musik / Stochastic Music", *Gravesaner Blätter* n°23-24, 1962, 156-168/169-184; "Freie stochastische Musik durch den Elektronenrechner / Free Stochastic Music from the Computer", *Gravesaner Blätter* n°26, 1965, 54-78/79-92; "Zu einer Philosophie der Musik / Toward a philosophy of Music", *Gravesaner Blätter* n°29, 1966, 23-38/39-52.

⁶³ Xenakis, 1955.

⁶⁴ Xenakis, 1958a, 133.

⁶⁵ Xenakis often mapped these approaches out in articles and essays, some of which formed the basis of his 1963 *Musiques Formelles* (*Formalized Music*, 1971). For concrete examples on how Xenakis' compositional methods borrowed from fundamental ideas that belong to models central to the natural sciences of the 20th century, such as relativity theory, quanta theory, "chaos" theory, see Hoffmann, 1994.

(“Symbolic Music”) to music composition⁶⁶. The application of mathematical models and theories allowed Xenakis, to some degree, to discover new musical ideas out of a totally unrestricted vocabulary. Science as a model is central to his thinking, though his concept of science is linked to metaphysics and vision. But although patterns and formalistic ideas form an important component of his style, they do not overwhelm it. He often intervened by “artistic freedom” to these processes, and gradually, especially from the 1970s onwards, his music takes on a more instinctive approach.

Xenakis’ enthusiasm for space and the architectural is articulated in musical composition throughout his work. Elements of spatial dynamics can be traced in early works such as *Pithoprakta* (1956), and spatiality as a compositional parameter is a core element in some of his compositions from the ‘60s on, f. ex. in pieces such as *Eonta* (1964), *Terretektorh* (1965-‘66) and *Nomos Gamma* (1967-‘68)⁶⁷. *Terretektorh* (1965-‘66) was his first composition that entailed the spatialization of the orchestra, with 88 musicians dispersed throughout the performance space and the audience, arranged in a circular formation around the conductor⁶⁸.

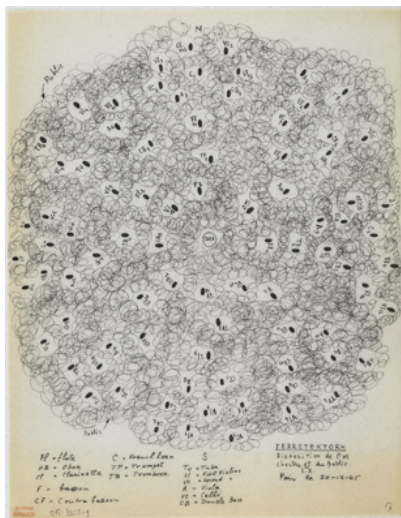


Fig. 26. Iannis Xenakis, Study for the distribution of musicians in *Terretektorh* (1965-66), December 20, 1965.

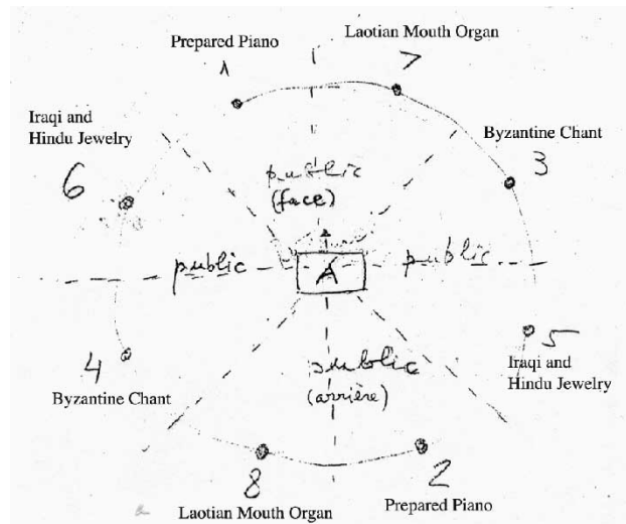


Fig. 27. Iannis Xenakis, diagram of the distribution in *Bohor* (1962).

Space as a compositional parameter played a major role also in electroacoustic pieces such as *Bohor* (1962), where speakers distributed around the audience projected dynamic shifts of sound between them, at ear-splitting volume.

Xenakis was introduced to electroacoustic music and composition techniques at the *Groupe de Recherche de Musicale* (GRM) [Music Research Group], Pierre Schaeffer’s studio at Radio France⁶⁹. At the GRM Xenakis was able to undertake research into

⁶⁶ Xenakis, 1992, 122-126; 155-177.

⁶⁷ Harley, M. A., 1994.

⁶⁸ Xenakis quoted in Bosseur, 1992, 56-58. See also Santana, 2000.

⁶⁹ Established by Pierre Schaeffer (1910-1995) and Pierre Henry (1927) in 1958, the “Groupe de Recherche Musicale” was an organization dedicated to studying and producing concrete music (Gayou, 2007). The studio grew through the ‘50s and attracted many composers, among them Pierre Boulez, Karlheinz Stockhausen, Luc Ferrari and Olivier

electronic sound synthesis, and he composed his first electronic pieces there between 1957 and 1962⁷⁰. His electroacoustic pieces dating from this period show a texture concept that Xenakis had also been exploring in his instrumental works, what he calls "cloud" or "galaxy" technique, manifested by slowly evolving, granular sound masses in which the internal details are constantly moving. Xenakis departed from the purer, more transparent appropriations of concrete music that prevailed at the GRM studio, and explored instead the deeper structures of sound materials, preferring extremely rich or extremely faint sounds, highly amplified⁷¹. Xenakis emphasized the spatial properties of sound and experimented with new distribution techniques. Taking further Pierre Schaeffer's idea of the movement of sound along sonic trajectories, Xenakis reformulated Schaeffer's concepts as *static stereophony* (sound emanating from numerous points dispersed in space) and *cinematic stereophony* (sound whose sources were both multiple and mobile)⁷². *Bohor* (1962), one of the first 8-channel works using sounds recorded in stereophony, marked a new level of sonic exploration. The extreme level of amplification at the premiere, intensified by the distribution of loudspeakers surrounding the audience, was one of the first manifestations of Xenakis' noise aesthetic⁷³.

Shortly afterwards Xenakis withdrew from GRM. Among other reasons for his withdrawal was his interest in computer-aided composition, as Schaeffer had rejected all of Xenakis' proposals and initiatives to take interest in the nascent information technologies⁷⁴. Xenakis' use of stochastic functions in musical composition necessitated swarms of calculations, which would be clearly best performed by computer⁷⁵. To accelerate the numerous calculations required by his stochastic approach, he began using computers as a tool in 1962, integrating his creative practice and experimental approach with computer technology. Once he developed a workable compositional algorithm in 1962, Xenakis wrote the first of a series of pieces composed with the aid of an IBM mainframe⁷⁶. The numeric data generated by the "stochastic music program" ST

Messiaen, who introduced Xenakis; on Xenakis's involvement with the GRM, see Gayou, 2007, 116-119, and Delalande & Gayou, 2001, 32-33.

⁷⁰ Xenakis produced five works with recorded sounds from natural sources, manipulating them by varying tape speed or playing sounds backward: *Diamorphoses* (1957), *Concret P.H.* (1958), *Analogique B* (1959) and *Bohor* (1962). At the GRM Xenakis also composed electroacoustic soundtracks for films: *Orient-Occident* (1960) for "Orient-Occident: images d' une Exposition" (1960) by Enrico Fulchignoni (1960), and *NEG-ALE* for Peter Kassovitz's Vasarely (1960), an abstract film on the artwork of Op-Art painter Victor Vasarely documenting an exhibition of his work; he later withdrew this work from his catalogue.

⁷¹ For overviews of Xenakis' electroacoustic work see: Harley, J., 2002; Harley, 2004; Hoffmann 2001; Hoffmann 2002; Hoffmann 2009; Luque, 2006; Solomos 1993; Valsamakis, 2000.

⁷² Xenakis, 1958a; Harley, M. A, 1998, 64.

⁷³ Harley, 2002, 41.

⁷⁴ Xenakis was a close friend of Pierre Barbaud (1911-1990), pioneer in computer-aided composition. Together with Roger Blanchard, Jeannine Charbonnier, Jean Germain, and Brian de Martinoir they formed the *Groupe de Musique Algorithmique de Paris* (GMAP) [Paris Group of Algorithmic Music]. In 1963 Xenakis tried to form (within GRM) a group that would work on the application of theories of informatics and cybernetics in music, the "MYAM", but without success (Gayou, 2007, 120-121).

⁷⁵ Xenakis' stochastic music could as well be composed by hand. In reverse, as Harley, J., 2002, observes, some of the procedures Xenakis developed prior to 1962, when he developed a workable algorithm for composition, could also have been programmed.

⁷⁶ Xenakis wrote the "Stochastic Music Program" in FORTRAN in 1962, running on an IBM-7090 at the headquarters of IBM France. The program used an algorithm elaborated on the thesis of minimal constraints and rules, as applied in *Achorripsis* (1956-'57). It employed interlinked probability functions to simultaneously determine the macrostructure and the note parameters of a composition. Xenakis considered the algorithm itself as a musical form, from which a

in the FORTRAN language, were afterwards transcribed into traditional music notation scores, to be played by musical instruments. Xenakis wrote six pieces with the stochastic music program: *ST/48* (1962), *ST/10* (1962), *Amorsima-Morsima*, *ST/4* (1956-62), *Atrées* (1960) and *Morsima-Amorsima* (1962)⁷⁷; these first musical applications of computer-aided composition were essentially combinatorial and formal. After these pieces Xenakis stopped composing with stochastic processes for several years, as he considered the method to present considerable limitations⁷⁸.

Xenakis continued his research in computer-aided composition techniques in the frame of the CEMAMu - *Centre d'Etudes de Mathématique et Automatique Musicales* [School of Mathematical and Automated Music], which he founded in 1966 near Paris⁷⁹. During his tenure at Indiana University (1967–'72), he conceived a method of sound synthesis using probability functions and used computers to synthesize sounds using probability functions for the first time⁸⁰. He continued his research back in Paris, in CEMAMu, from 1972 to 1977, developing the “dynamic stochastic synthesis”, an extension of the stochastic synthesis. Together with the CEMAMu team, Xenakis developed two different computer-based compositional environments for electroacoustic music: the UPIC system (1978) and the GENDYN program (1991).

With the GENDYN sound synthesis software, an extension of the dynamic stochastic synthesis method, Xenakis realized in the 1990s the application of probability theory to sound synthesis⁸¹. His works *Gendy3* (1991) and *S709* (1994) are composed with this method, while *La Légende d'Eer* (1977 - 1978), the music component of the *Diatope*, uses elements synthesized with an earlier implementation of the concept. The theory behind the new proposed models for the micro-time sound synthesis is based on the direct manipulation of the atmospheric pressure curve, the waveform that represents sound. This approach was fundamentally different to the Fourier concept of sound⁸².

Another approach Xenakis introduced to music composition was the graphical waveform synthesis. The computer system called UPIC (*Unité Polygogique Informatique de CEMAMu*) [Polyagogic Informatics Unit of CEMAMu] was a sort of interactive drawing board for music composition, which translated graphical information into musical

large number of different compositions could be created (Luque, 2006, 9). At the same time, Xenakis theorized about the possibility of using stochastic techniques to synthesize sounds (Xenakis, 1992, 144).

⁷⁷ Xenakis, 1992, 131-144. The program was also used to write some sections of *Eonta* (1963-'64) (Varga 1996, 101-102).

⁷⁸ Xenakis quoted in Varga, 1996, 80.

⁷⁹ Originally named EMAMU *Équipe de Mathématiques Musicales* [Group of Musical Mathematics], Xenakis founded this computer music research institute together with Théodore Guilbaut and Marc Barbut. Titled CEMAMu since 1972, the CEMAMu studios were housed in the CNET (National Centre for Telecommunication Research) at Issy-les-Moulineaux, near Paris (Kanach, 2008, 280). The *Ateliers UPIC* (a division of CEMAMu established by Xenakis in 1985) and the *Centre for Composition Iannis Xenakis CCMIX* (www.ccmix.com) were recently integrated in the newly established Centre Iannis Xenakis, based at the Université de Rouen and the Centre Culturel de Rencontre du Couvent de La Tourette (Kanach, 280-281).

⁸⁰ Solomos, 2006, 4.

⁸¹ Xenakis, 1992, 289-293. See also: Roads, 1996; Valsamakis, 2000, 40-52; Hoffman, 2001, 174; Harley, 2002, 54-56; Solomos, 2006, 4; Luque, 2006, 21-24, 90.

⁸² Fourier synthesis is a method of electronically constructing a signal with a specific, desired periodic waveform. It works by combining a sine wave signal and sine-wave or cosine-wave harmonics (signals at multiples of the lowest, or fundamental, frequency) in certain proportions. The scheme gets its name from a French mathematician and physicist named Jean Baptiste Joseph, Baron de Fourier. See Xenakis, 1992.

results. Curves and lines drawn with an electromagnetic pen could be interpreted in real time by the UPIC as instructions for the sound synthesis process⁸³.

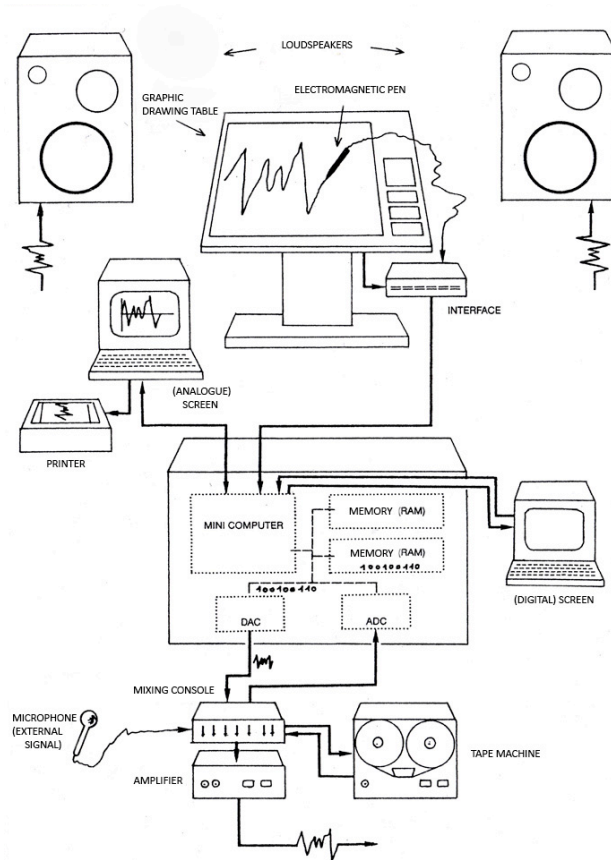


Fig. 28. The structure of the UPIC.

One of the most advanced graphic-based systems for sound synthesis up to today, the UPIC was further developed from the first prototype to several subsequent hardware versions, to a software version in 2000⁸⁴. Linking visual form to audio output through mathematics and computing, the UPIC enabled Xenakis' proposed model for graphic synthesis of sound, based on the intuitiveness of drawing by hand. The UPIC reflects the composer's ongoing preoccupation with form and structure, and his essentially architectural method. Graphical synthesis was only one of Xenakis' proposed sound synthesis models; the other two, granular and stochastic waveform synthesis, continue to be explored by contemporary practitioners⁸⁵.

⁸³ Xenakis composed four pieces with the UPIC system: *Mycènes Alpha* (1978), *Pour la paix* (1981), *Taurhiphanie* (1987) and *Voyage absolu des Unari vers Andromède* (1989). For a description of the UPIC's function, see Xenakis, 1992, 329-333, Kanach, 2008, 281-283.

⁸⁴ (1977 and 1983-87), a PC hardware version (1991-95), and a PC software version (2000-01).

⁸⁵ As Valsamakis, 2000, 52, notes, those models opened new paths in research and composition but their musical possibilities remain largely unmapped.

II.v. Towards a General Morphology

In Le Corbusier's words, Xenakis combined «three favorable vocations [engineer, composer, architect] united in one man»⁸⁶. Xenakis was active throughout his career as architect and composer, building a substantial record of research and production in both fields. While the media he employed were very different, his architectural and musical work is characterized by great consistency. As Sterken argues, Xenakis' "diverse skills advanced his creative work at the intersections of sound and space, through an approach that combines the arts with the sciences without losing the identities of either"⁸⁷.

The integration of art and science was fundamental in his practice, influencing, directly or indirectly, his entire work. He was involved in science and technology at a formative level, and saw things as almost an engineer would in terms of their structural relationship to one another. It was by going back to these foundations of artistic phenomena that he discovered new ideas that informed his artistic practice; most of his pieces for orchestra or solo organs were composed based on scientific models, especially statistical theories. Xenakis also introduced concepts from mathematics and physics to the composition of sound, in his granular and stochastic waveform synthesis⁸⁸.

A common misconception is that he simply applied scientific principles to artistic practice, but in fact he often deviated from the very rules he imposed on his creative and compositional process, by reason of aesthetic freedom and choice⁸⁹. Xenakis based the arguments for his method on his Pythagorean credo:

*It should be borne in mind that computer technology is only a tool. If I use mathematical functions or even sometimes physical theories in music, it is because there is a profound connection between music and numbers. All of Pythagorean theory, of course, is based on this thesis. But it is a truth which derives from our own mental structure, nothing more. Once you have grasped this principle, it is easy to make use of whole chunks of mathematical thought, which is already present in music and even, in some cases, at a much more advanced stage than in mathematics.*⁹⁰

Although Xenakis was attracted to universal structures that permeate and govern nature and the universe, he was never interested in simply replicating such structures as literal translations. Instead, he tested these "laws" on different levels and in different fields, ultimately formulating them as metaphysical statements, a "metamusic"⁹¹. Statistical and group-theoretical musical constructs are at the foundations of his search for a unitary theory of thought and perception, of which his musical and architectural creations are a necessary subset. Drawing his inspiration and method from abstract

⁸⁶ Le Corbusier, *Modulor 2*, London: Faber and Faber, 1958, 326; quoted in Treib, 1996, 15.

⁸⁷ Sterken, 2007, 21-51. Sterken's comparative chronology of Xenakis's architectural and musical œuvre (Sterken, 2004, 513-523; Kanach, 2008, 286-293) indicates many interrelationships between his compositional work and architectural projects, as well as with his writings.

⁸⁸ Valsamakis, 2000, 52-53.

⁸⁹ Varga, 1996, 201-202.

⁹⁰ Xenakis, 1986, 5.

⁹¹ Xenakis, 1992, 180-200.

structures *outside* the musical realm, Xenakis' main contribution to the development of music was the engagement of new areas of thought. His intention was to investigate what he called "global morphology", a search for deep forms that motivate human thought processes and concrete manifestations (art, science, technology, architecture) and even the evolution and perception of biological forms.

«I believe that is what is lacking today: a theory about shapes. Perhaps in twenty, thirty, forty years' time, fundamental shapes will be classified, along with their applications and expressions in different fields of observations and production.»⁹²

According to this concept, these fundamental, archetypal shapes can be found everywhere and at various scales and levels, as "forms corresponding to some inner necessity". These basic shapes (f. ex. spiral, clouds and arborescence), have both concrete and abstract connotations. In his writings he mentions veins and lighting as examples of arborescence, and describes clouds consisting of gasses, insects, or crowds of people. More abstractly, however, Xenakis maintains that the branch-like structures are «closely linked to causality, repetition, and consequently variation» as individual points replicate themselves. Conversely, cloudlike shapes are connected to stochastic probability and outside-time structures.

Xenakis's holistic approach to form is also expressed in his writings, where he pleads for interdisciplinary research into form. He insisted repeatedly on the development of a discipline of "general Morphology", focusing on formal research in different fields. For Xenakis form is not to be dealt with in connection with and in relation to general formal research; his research into musical and visual form has been an expression of this ongoing concern. By extension, Xenakis advocated for the emergence of a new type of artist, the artist-conceptor, another constant theme in Xenakis' writings and works from the very beginning⁹³:

It seems that a new type of musician is necessary, an "artist-conceptor" of new, abstract, and free forms, tending towards complexities, and then towards generalizations on several levels of sound organization. [...] The artist-conceptor will have to be knowledgeable in such varied domains as mathematics, logic, physics, chemistry, biology, genetics, paleontology (for the evolution of forms), the humanities and history; in short, a sort of universality, but one based upon, guided by and oriented towards forms and architectures.⁹⁴

Xenakis' vision was shaped by his cultural origins, his wartime traumas, his passion for nature, science and philosophy, and his mystical bent for cosmology. His thinking is

⁹² Varga, 1996, 78.

⁹³ The notion of the "artist-conceptor" was first published by Xenakis in his *Musique. Architecture*, 183, and later developed in his "Preliminary statement" to his Doctoral Defense (Xenakis, 1979, 1-10). Le Corbusier was also profoundly interested in structures and forms found in nature, see Treib, 1996, 37.

⁹⁴ Xenakis, 1985, 173-4, 187; also Xenakis, 1981, 16-17.

deeply rooted in ancient Greece⁹⁵; it can be argued that his holistic approach to art, architecture and music, is directly linked to ancient Greek thought, reflecting a purely Pythagorean approach. The idea that music is foremost a mathematical discipline and that all arts are fundamentally one can be traced repeatedly in ancient Greek thought, even though it remains abstract:

“It is vaguely implicit in their [the ancient Greeks’] philosophical Diktum that the All is One; in the Platonic view that the whole universe is a manifestation of divine mind, and in the Neoplatonic theory of beauty as an emanation from that mind”⁹⁶.

Xenakis loved to be outdoors in nature and was profoundly influenced by natural phenomena and their observation⁹⁷. His individual and family vacation was usually spent in wild nature, surrounded by the sea, gazing at the night sky, immersed in natural sounds⁹⁸. His approach was deeply rooted in human experience as well. Like his contemporaries Karlheinz Stockhausen (1928-2007)⁹⁹ and Luciano Berio (1925-2003), Xenakis was deeply marked by his wartime experiences:

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, death¹⁰⁰. These traumatic experiences surfaced later on in his work: During the cold December nights, when we were fighting against the English, I heard another music. It wasn’t an organized battle, but a series of ambushes during which shots were fired from house to house, with long, silent intervals, and each shot infinitely echoed throughout the city, accompanied by tracer bullets that added a visual spectacle to the sounds of shooting. All those memories surfaced several years later in my first composition, Metastasis, and in other works that followed.¹⁰¹

Xenakis wrote extensively and published many books and articles, which provide insight into his artistic practice. His writings do not belong to any specific intellectual tradition; however they have their own autonomy, as pure philosophical thought that is consistent in itself¹⁰². Especially his published thesis defense *Arts/Sciences: Alloys* provides an insight into some of the most fundamental philosophical motivations for his work and his persistence of vision. However, he hardly conceptualized or theorized the relationship

⁹⁵ He explicitly referred to ancient Greek sources in his interviews and writings, and he would often chose titles for his works with reference to ancient Greek literature and philosophy.

⁹⁶ Murno, Thomas, *The arts and their interrelations*, New York: The Liberal Arts Press, 1949, 423; quoted in Alexaki, 1996, 54.

⁹⁷ Xenakis, 1980a, xvi; Alexaki, 1996, 137.

⁹⁸ Matossian, 1981, 230.

⁹⁹ “Fantastic, the music and light show of the bombers, sometimes one thousand or more flying in formation over the Ruhrgebiet. A roar such as you never heard in your life when they approached from afar, wave after wave. Amazing light beams crossed the sky hitting a little silverfish here, the puff of an explosion there, and then music with sirens and detonations of all sorts, the flak flak of cannons shooting, phosphor bombs with their strange light, and I, completely entranced, despite the destruction before my eyes.” Karlheinz Stockhausen cited in Matossian, 1981, 213.

¹⁰⁰ Xenakis, 1992, 9.

¹⁰¹ Xenakis, 1980a, xviii. See also Xenakis quoted in Matossian, 1981, 58.

¹⁰² Solomos, 2004.

between architecture, music and visual art, nor did he specify a common method in his dealing with both musical and architectural form. However, the idea that there is an underlying unity between music, architecture, and mathematics and physics, is constantly implied in his work. Xenakis conceived sonic forms as shapes analogous to visual/geometrical forms. A comparative analysis of his solution for the west-wing façade of La Tourette, his composition *Metastasis*, and the architecture of the Philips Pavilion, is illuminating.

At the time Xenakis composed his breakthrough orchestral work *Metastasis* (1953-‘54), he was working on the project of the Convent of St. Marie de la Tourette, specifically on the design of the west wing façade, which is structured around a series of undulating glass panes that filter sunlight in variable rhythms. The solution Xenakis applied to the structure was an essentially musical solution to an architectural problem: he applied the “harmonic” proportions of the golden section, a central theme in the *Modulor*, in the undulating glass panes of the façade (see Chapter I.ii). To compose *Metastasis*, Xenakis again applied the geometric progressions of the *Modulor*, this time to the organization of intervallic rhythmic structures and the duration of musical parameters, such as dynamics and timbres¹⁰³. Many elements of the piece’s micro- and macrostructure are based on the “harmonic” proportions of the golden ratio and the Fibonacci series. Scored for an orchestra of sixty-one instruments, the piece is based on glissandi, with each string part individually notated; the strings glide off one by one, transforming constantly to form a dense mass with extreme alternations of dynamics and timbre. Using geometry as a formative module, Xenakis sketched the string glissandos as an architectural graph on grid paper, with pitch and time on the two axes:

*The glissando is a straight line planted in space...it is pitch and time rolled into one. The points marking time and pitch are ordered, which means they can be transcribed onto an oblique straight line.*¹⁰⁴

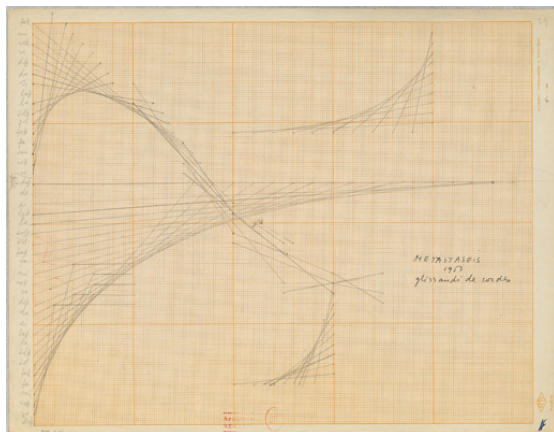


Fig. 29. Iannis Xenakis, Study for *Metastasis*, 1953.

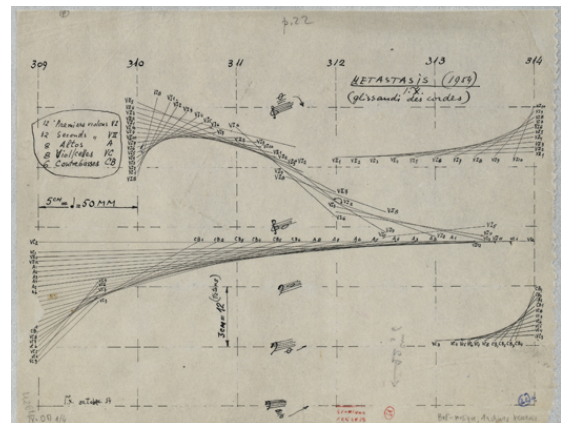


Fig. 30. Iannis Xenakis, Study for *Metastasis*, 1954.

¹⁰³ Xenakis quoted in Bosseur, 1992, 54; See also Treib, 1996, 15; Sikiaridi, 2010, 100. Frisius, Rudolph, *Xenakis und der Rhythmus, Neue Zeitschrift für Musik*, vol. 144, n. 4, April 1983, p. 13-17, quoted in Sikiaridi, 2001, 206.

¹⁰⁴ Xenakis quoted in Bosseur, 50. See also Hoffman, 1998, 143-144.

More than preparatory studies, these sketches are authentic representations of the composition, offering a synthetic picture of the sonic events. Xenakis' sketches, drawings, and notation systems reveal the particularities of his method, where the visual aspect played an important role¹⁰⁵. In preparatory sketches Xenakis used an architect's skills and approach to meticulously work out contingencies and levels of his musical compositions; furthermore, they bear witness to his constant preoccupation with the overall form, as structures of relations or abstract concepts. Architectural method provided an essentially visual solution to music notation, which could "grasp" the fluctuating transformations of musical structures and parameters with highly rarefied precision:

*Why (...) do I choose to go through the graphics stage before transforming this into music? I have now understood that there are certain structures contained in visual and auditory experience that are comparable, - mental structures, to be precise. For example, time, so fundamental in music, is marked by a succession of ordered instants, as it were, in that they occur one after the other. The points along a straight line are organized in the same way. It is quite easy, therefore, to transfer from one to the other.*¹⁰⁶

As Illiescu observes, "the glissandi, like the sound mass and the arborescence, embody the Xenakian idea of an underlying unity between music, architecture and mathematics"¹⁰⁷. This experience of working simultaneously in architecture and music, applying the same structural elements in different fields was determinative for Xenakis' thinking, as he interrelated the problems he encountered in architecture with that of music composition. Following a different path from that of the traditional approach to composition, he worked first with the overall form and the general structure of the composition. This approach informed his methods in creating both the micro- and macrostructure of a work, electroacoustic or orchestral, and opened the way for the practice of applying the same structures in music and visual events in the *Polytopes*, transferring mathematical structures into artistic production¹⁰⁸.

The ruled surfaces that formed the string glissandi of *Metastasis* influenced Xenakis' design of the Philips Pavilion a few years later. He transposed the glissandi of *Metastasis* to formulate the pavilion's volumetric architecture in a continuity of line through curves:

*"In the Philips Pavilion I realized the basic idea of Metastaseis: as in the music, here too I was interested in the question of whether it is possible to get from one point to another without breaking the continuity. In Metastaseis this problem led to glissandos, while in the pavilion is resulted in the hyperbolic parabola shapes."*¹⁰⁹

¹⁰⁵ Alexaki, 1996, 123; Kanach, 2002, 190-197; Kanach, 2010. These include preliminary drawings, algebraic and geometric calculations, brief notes, projections of various contingencies, and schematics at a high level of definition.

¹⁰⁶ Xenakis quoted in Bosseur, 1992, 50.

¹⁰⁷ Illiescu, 2005, 1.

¹⁰⁸ Sikiaridi, 2001, 206.

¹⁰⁹ Xenakis quoted in Varga, 1996, 24; see also: Delalande, 1997, 113; Xenakis, 1992, 10.

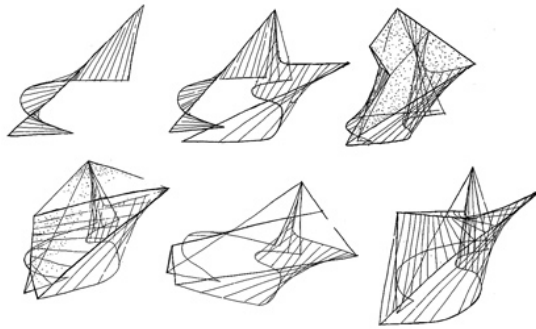


Fig. 8. Iannis Xenakis, studies on the design of the Philips Pavilion (1957).

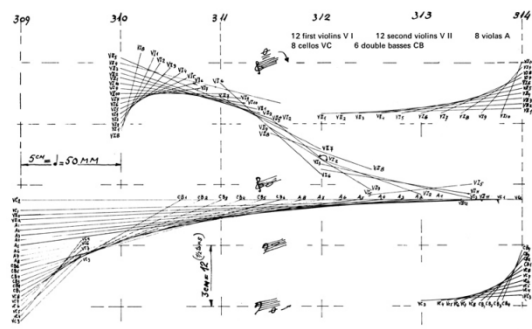


Fig. 31. Iannis Xenakis, graphical representation of the glissandi pitches in Metastasis.

As Sikiaridi, 2001, observes, apart from some kind of Xenakis' stylistic signature, the different applications of surfaces of variable curvature are interesting not only in their aesthetic qualities, but also in the way this form is used in different fields. Transferring a certain structure from one field to another, from engineering to music, and from music to architecture is specific to Xenakis¹¹⁰. This concept of transposing forms and structures to different fields was also articulated as the hypothesis of the "structures d'ordre" [order structures], Xenakis' hypothesis that the structure of different musical characteristics (tone, rhythm, etc.) could be treated in a similar manner, with the same techniques. The same can be applied to the sound and light: "The structure of a total order is the same, whether it comes from sound or light"¹¹¹. In fact, "there's no question of "translating" a sonic gesture into a visual one, since both of them result from an abstract archetypical gesture. Xenakis' double work of a composer and of an architect actually shows that, by passing from the domain of the visible to that of the audible (or inversely), the gesture doesn't need to disguise itself, for both visible and audible shapes are inherent to it"¹¹². In this manner, Xenakis attempted to overcome the cognitive division whereby material and structure are considered to be two different aspects of a composition. In his holistic approach, all different levels of a composition could be unified by applying the same structural models. Furthermore, all three sound synthesis models he proposed (granular, graphical, and stochastic waveform synthesis) supply also ideas on musical form; with this approach the same model can be applied to the structure of a composition, both on the micro- and the macro level¹¹³.

With his rigid engineer's logic Xenakis reduced composition – both architecture and music – to an abstract process, by basing musical and spatial design on mathematical models. What he is concerned with is not just the interdisciplinary (in the sense of an exchange between different disciplines), but rather a *transdisciplinarity* – that is, the transposition of the same abstract paradigm in different disciplines. The *Polytopes*, his series of multimedia, site-specific installations, are a clear instance of this. They represent the synthesis of the three fields from which Xenakis's creative practice draws – architecture, music and technology¹¹⁴.

¹¹⁰ Sikiaridi, 2001, 206 ; Sikiaridi, 2010, 96, 100.

¹¹¹ Xenakis, Iannis, « La voie de la recherche et de la question », *Preuves*, n°177, 1965, 33-36 ; quoted in Solomos, 2006, 28.

¹¹² Illiescu, 2005, 4.

¹¹³ Valsamakis, 2000, 53-54.

¹¹⁴ Sterken, 2001d, 81.

Chapter III

The Polytopes

III.i. The formation of the idea of a synthesis of the arts

In his interviews Xenakis accounts that his idea for creating a unified visual and auditory space and experience dates back to two earlier events in his life. The first was his directing, at a young age, of a play of an ancient Greek tragedy in Athens. He conceived the stage design as solemnly based on lighting and light changes, and in retrospect considered this the first time he realized “the importance of visual phenomena as visual music”¹. Xenakis would work on scores for ancient Greek tragedies throughout his career as composer, sharing with other dramatists a common recognition of ancient Greek drama as an integrated spectacle, that only later came to be regarded as art².

Another, more indirect yet profound influence came from Xenakis’ wartime experiences, especially during the battles that took place in Athens in 1946-1947:

*Whether you like it or not, simultaneous visual and auditory events that are both specific and extraordinary, without any apparent connections, enter one’s brain when experienced as fighting in the street. For example, speeding bullets of various colors plus their trajectories – all of that was visually striking. They can be compared to the movements of celestial bodies, comets... falling stars [...] I witnessed bombing – those were extraordinary [...] Not to mention the army’s searchlights (since there wasn’t radar then), which created a stunning ballet in the sky. Plus the explosions, plus... All of that created a fantastic spectacle, one that can never be seen in times of peace.*³



Fig. 32. Photograph of aerial bombing in Athens, May 1941.

¹ Xenakis quoted in Delalande, 1997, 111; also in Bosseur, 1992, 54.

² Turner, 2009, 188-190.

³ Xenakis quoted in Delalande, 1997, 111-113 (translation by S. Kanach in: Kanach, 2008, 198). See also Matossian, 1981, 212-213.

These images of explosions and light beams, accompanied by the noise of raging war, were deeply inscribed in his memory and aesthetics. Elsewhere, Xenakis states a different direct influence for the *Polytopes*, the observation and experience of natural phenomena:

*In the case of the polytopes I was attracted to the idea of repeating on a lower level what Nature carries out on a grand scale. The notion of Nature covers not only the earth but also the universe.*⁴

In this sense, the strong impression of natural phenomena formed the origin of the xenakian concept for a holistic approach to art. Xenakis' use of space as a central element in composition was also inspired by natural phenomena; according to Matossian, *Terretektorh* (1965-'66), was partly inspired by one of the composer's many intense experiences with nature and its sounds⁵. In *Terretektorh*, Xenakis' first composition that entailed the spatialization of the orchestra, applying the idea of the spiral: listeners were seated among the 88 performers, whose placement was partly determined by probability distributions. At the premiere, the audience was encouraged to move about and change points of listening, in an active engagement with the process of perceiving the work. Space as a compositional parameter also played an important role in the electroacoustic piece *Bohor* (1962), which is characterized by microstructures and spatialization – also common traits of the “soundtracks” of the *Polytopes*. Drawing from his experience with spatialized orchestral works, Xenakis used multiple loudspeakers distributed around the audience, projecting dynamic shifts of sound between them. In a diagram depicting the relationships between his architectural and musical works⁶, Xenakis directly connects the *Polytopes* with *Bohor*.

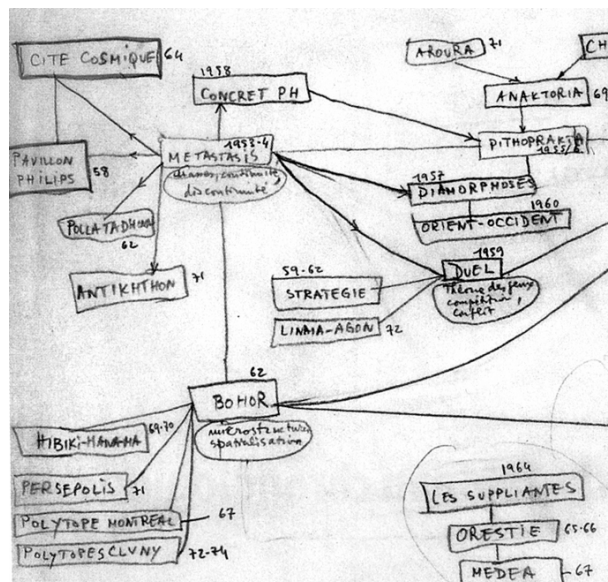


Fig. 33. Iannis Xenakis, diagram of relationships of works, detail. from Kanach, 2008

⁴ Xenakis quoted in Varga, 1996, 112-113. See also Xenakis, 1982a, 202; Xenakis quoted in Bosseur, 1992, 53-54.

⁵ Matossian, 1981, 230.

⁶ Kanach, 2006, 418-419; Kanach, 2008, 284-285. It is not clear but he probably refers to the audio components only (the respected pieces *Hibiki Hana Ma*, *Persepolis*, *Polytope* and *Polytope de Cluny*).

Xenakis further elaborated the sonic dimensionality and spatialization of his music in the electroacoustic piece *Hibiki Hana Ma* (for 12-track tape, 18')⁷, a commission for the "Space Theatre" of the Tekko Kan [Iron and Steel] Pavilion of the Japanese Federation of Steel and Iron at the Osaka World Exhibition of 1970⁸. The theatre disposed an impressive audio setup of 800 speakers integrated in the shell of the pavilion (both in the space and beneath the floor), enabling the determination of localization of sound and its dynamic distribution during performances. The piece was spatialized through the 800 loudspeakers in 250 groupings, immersing the audience in sound⁹.



Fig. 34. The "Steel Pavilion" at the Osaka Expo '70.



Fig. 35. View of the "Space Theater" inside the "Steel Pavilion".

A powerful laser dispositive by Japanese visual artist Keiji Usami accompanied the piece: a net of laser beams, starting from the center and the walls of the hall, according to a program running parallel and synchronized to the music¹⁰. The visual and the musical part of the spectacle were closely related, following in parallel the output of a stochastic program¹¹. There were also other kinetic, film and dynamic laser works by Usami on display at the pavilion, as well as an impressive large-scale display of moving laser beams accompanying the electroacoustic music of Toru Takemitsu. Keiji Usami (Osaka, 1940) was one of the first artists to build installations employing interlocking patterns of different-colored laser beams¹². In his work *Laser Beam Join* Usami used low frequency

⁷ *Hibiki-Hana-Ma* (could be translated from the Japanese as "reverberation-flower-interval") was originally conceived for 12 channels, was later mixed down to eight for concert diffusion and then to two for the recording, Harley, 2002, 44. It is available by EMF CD 003 and Mode records: Xenakis, electronic works 2: Polytope de Cluny, *Hibiki Hana Ma*, Mode 203 (CD or Surround DVD).

⁸ The Steel Pavilion is still conserved today, as an exhibition hall for the Expo 70 history <http://www.expo70.or.jp/e/index.html> (15/10/10)

⁹ Xenakis, 1970, 142-143, 145. Burt mentions 1000 loudspeakers, many of which could be moved either by hand or by electrical power (Burt, 2001, 132). The tape piece was distributed kinetically, by means of an automation process based on perforated film, similar to that of the *Polytope of Montreal*. The final work was based on two scores: the musical score and a "kinetic" score for the sound distribution.

¹⁰ Fleuret, 1988, 177; Fleuret, 1970, 51.

¹¹ Valsamakis, 2000, 27. The performances were running from April through October 1970 (Kanach, 2008, 143).

¹² We could not find any sources or documentation on Usami's work, apart from an unsigned article on «Laser Beam Joint», published in the *Nature/Science Annual*, Time Life Books, 1970; reprinted in *Facsimile Magazine*, Vol. 2, n. 1, Haoyan of America, 2008; <http://www.facsimilemagazine.com/2008/01/index.html> (4/1/11). There is also documentation on "Laser Beam Joint" at the EAT (Experiments in Art and Technology) archives (www.oac.cdlib.org/data/13030/rt/tf4j49n6rt/files/tf4j49n6rt.pdf) – "Laser Beam Joint" was going to be included in EAT's exhibition "Some More Beginnings" (1968), at the Brooklyn Museum, New York, one of the first exhibitions of art and technology. Apparently the work was denied permission in the USA by the authorities, as did not comply with public safety standards. See "Experiments in Art and Technology, A Brief History and Summary of Major Projects 1966 – 1998", 4-5, accessible at: www.vasulka.org/archive/Writings/EAT.pdf (11/12/10).

laser beams reflected by mirrors, which penetrated five green plastic panels sculpted with two overlapping figures of running men. The mirrors, set into the panels where the figures intersected, bounced the laser beams back and forth among the outlined men, creating what Usami described as “a network of symbolic relationships”. Usami’s laser displays made a strong impression on Xenakis, especially the technology used to create laser configurations with mirrors. He decided to apply this technology to his *Polytopes* - in the *Polytope of Persepolis* (1971) he used two laser beam projectors, while the full application of this technique was realized in the *Polytope de Cluny* (see below, Chapter III.iv)¹³.

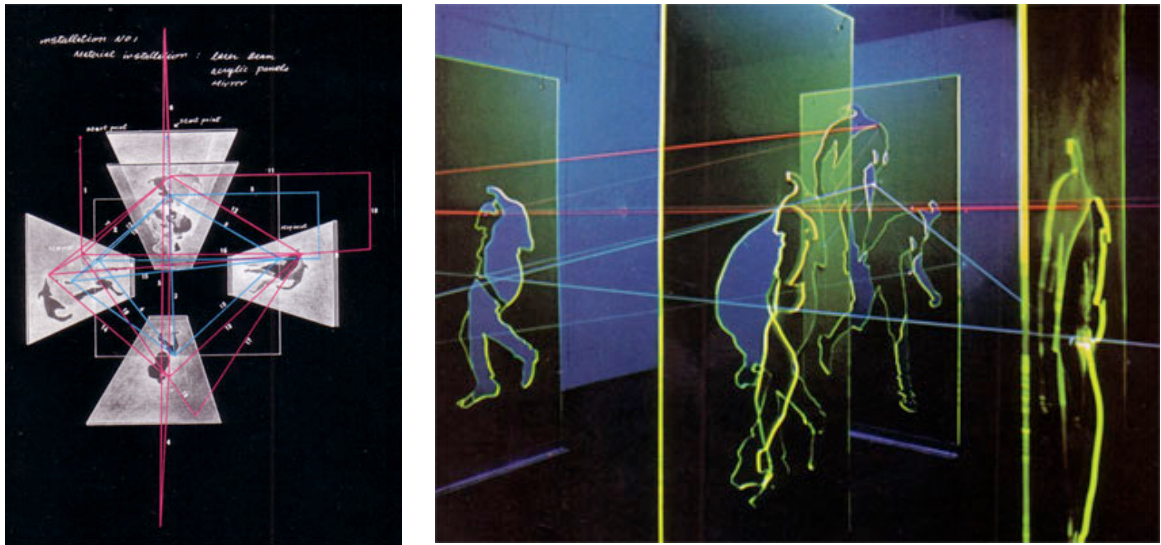


Fig. 36-37. Keiji Usami, *Laser Beam Joint*, date unknown – before 1969. Sketch plan and installation view.

When Xenakis was invited to present *Hibiki Hana Ma* back in Paris, at the Théâtre de la Ville on November 29, 1971, he chose to accompany the piece with an abstract scenic «performance». He experimented with the movement of fifty automatic technical elements that were part of the theater’s stage¹⁴. This idea followed up an unrealized proposal for an abstract, mobile stage set for a choreography by Georges Balanchine in 1969¹⁵. There are also a few traces of an idea for an automated performance project, mentioned in Sterken, 2004¹⁶. Of particular interest is an unrealized project for a «ballet of emancipated robots». The performance of the robots would be accompanied by music composed at the CEMAMu and distributed spatially; during the performance, sounds composed in real-time by the robots on UPIC systems onstage would be integrated in the music.

Xenakis also participated at the International Osaka Expo ’70 with a lumino-kinetic sound sculpture titled “Idole Amesha Spenta”, especially commissioned by Iran for its participation at the pavilion of “Regional Corporation for Development”¹⁷. Light flashes

¹³ According to Kanach, 2008, Xenakis brought back to Paris abundant documentation on this new technology. See also Fleuret, 1970, 51.

¹⁴ Xenakis quoted in Szendy, 1994, 111; See also Fleuret, 1988, 177; Sterken, 2004, 475-476.

¹⁵ Sterken, 2004, 468-469.

¹⁶ Sterken, 2004, 480-482.

¹⁷ Xenakis, 1970, 146-147; Sterken, 2004, 470-472; Sterken 2008a, 315-316.

designed as prismatic transparent tears were distributed over a steel sphere of about 1 m. diameter, which was divided by a black band at its equator, rotating slowly and pierced by laser beams. The sculpture was complemented by excerpts of *Diamorphoses* (1957) on four tracks, distributed by four speakers suspended from the ceiling¹⁸.

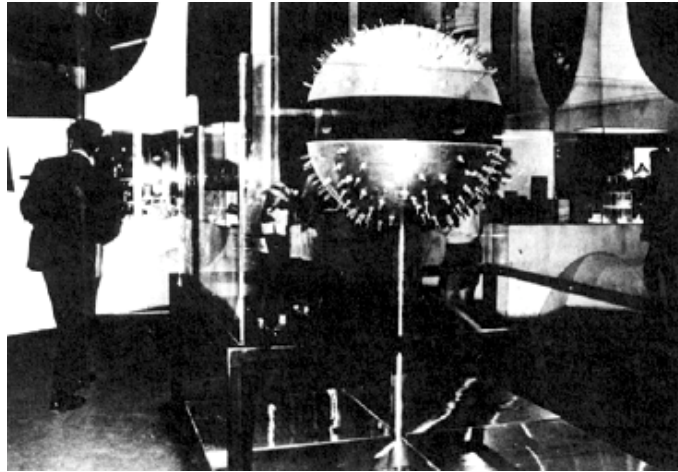


Fig. 38. Installation view, Iannis Xenakis, *Idole Amesha Spenta*, 1970.

¹⁸ Xenakis, 1970, 146-147.

III.ii. The “total electronic gesture”

Apart from the aforementioned early or later influences, it was arguably the Philips Pavilion of 1958 that proved a true model and stimulation for Xenakis’ immersive multimedia works¹⁹. The Philips Pavilion and the *Poème électronique* was his first opportunity to experiment with sound spatialization and architecture, on a large scale and with state of the art technology at his disposal. Still, Xenakis was rather critical of the *Poème électronique*’s final result; he considered the lack of a single, coherent artistic vision – due to the double authorship and the absence of cooperation between Le Corbusier and Varese – to be the work’s essential weakness. He was particularly critical of Le Corbusier’s visual component, as too much narrative and figurative:

*One day, he (Le Corbusier) asked me: “But what do you think of the spectacle?” And then I said: “Very honestly, listen, I did not expect a figurative spectacle (because it was figurative); I thought that you were going to do something more abstract” – like he also tried to do in his painting, movements of forms, colors, marks, things like that. He didn’t say anything, he didn’t do otherwise, it stayed like that. But my mind was very much occupied by this; the possibility of doing a spectacle, not with figurative things, like in cinema, in the bottom line, but something abstract, something that would approach much more to music.*²⁰

Xenakis’ aesthetic was much closer to abstract expression and for a more holistic approach. He outlines this aesthetic and his vision of a “synthesis of the arts in the electronic age” already in 1958, in his seminal text “Notes towards an electronic gesture”²¹. The essay was first published in a book about the *Poème électronique*; even though it does not directly refer to the work, there is one explicit reference at the end of the essay:

*In this respect, the Philips Pavilion at the Brussels World’s Fair represents a first experiment in this artistic synthesis of sound, light, and architecture, an initial step towards an “Electronic Gesture”.*²²

Thus the essay can be read as both Xenakis’ subtle criticism of the *Poème électronique*, as well as his manifesto for a new form of electronic/technological art, the “geste électronique total”. Xenakis will not return later on to this kind of programmatic writing, especially with regards to the visual arts, but he will choose to include and republish this

¹⁹ Xenakis quoted in Bosseur, 1992, 53-54.

²⁰ Xenakis quoted in Delalande, 1997, 113-114 (translation by the author).

²¹ Xenakis, 1958a. Xenakis, Iannis, *Notes sur un “geste électronique”*, in: Petit, Jean, (ed.), *Le Poème électronique de Le Corbusier*, Paris: Éditions de Minuit, 1958, 226-231. Actually, it was first published a few months earlier in Swedish translation: Xenakis, Iannis, “Reflektioner över Geste Électronique,” *Nutida Musik*, Stockholm, March 1958. Xenakis, Iannis, *Notes on an electronic gesture*, in Kanach, 2008, 131-134. Originally published as: Xenakis, Iannis, “Reflektioner över Geste Électronique,” *Nutida Musik*, Stockholm, March 1958 (in Swedish translation). Published in French: Xenakis, Iannis, *Notes sur un “geste électronique”*, in: Petit, Jean, (ed.), *Le Poème électronique de Le Corbusier*, Paris: Éditions de Minuit, 1958, 226-231; Xenakis, Iannis, « Notes “sur un geste électronique” », *La Revue musicale*, n° 244, Paris: Richard Masse, 1959, 25-30 ; Xenakis, 1971, 142-150; Xenakis, 1996, 17-28; Kanach, 2006, 197-202.

²² Xenakis, 1958a, 134.

text many times in editions of collected writings²³. It is thus important to refer to the essays' basic points, as it constitutes the theoretical basis of the *Polytopes*.

The essay's beginning clearly indicates the programmatic manner of what is to follow. It also highlights the fundamental role abstraction plays in the synthesis of the arts:

I will attempt to highlight some of the current tendencies within artistic creation that are converging towards an integration of the visual and audible arts.

The intentions behind painting and sculpture have already adopted the most recent stages of physical, mathematical and philosophical thought. These are steps towards Abstraction. Abstraction, here, is meant in the sense of conscious manipulation of laws and pure ideas, and not of concrete objects.

In fact, the play of forms and colors, once separated from their physical context, implies conceptual networks of a higher level. This play represents comparisons and valuations of pure ideas that exist within events and anecdotal objects, but that become detached from them in order to form concepts that are necessary for perceiving and controlling in a wider, faster and easier way, all the relationships between volume and light. Through Abstraction, these two arts lean towards a philosophy of essences, which subtly and gradually develops into mathematics and logic.²⁴

This definition of abstraction is crucial, as abstraction is a constant reference in most of Xenakis' sporadic writings on the *Polytopes*, as well as a central concept in his music, both in his theoretical writing and compositional practice:

Music has also followed the path towards abstraction, as defined at the beginning of this paper and, surprisingly enough, over approximately the same time span as painting. [...] The abstract current is so powerful and so important that any of its detractors within the realm of the arts appear to be inflicted by mental deficiency.²⁵

According to Xenakis, the process of musical "abstraction" consists of a shift towards atonality; it also relies on electroacoustic techniques: the appropriation and manipulation of concrete sounds (*Musique Concrète* techniques of the GRM studio) and the creation of electronic sonorities (Cologne Studio techniques). Electro acoustic techniques, and in particular sound distribution equipment, allow for the transposition of Euclidean space into acoustic space, and therefore for the organization of projected sound, "static" or "cinematic", into "veritable Sonic Gestures"²⁶.

²³ Xenakis, Iannis, « Notes "sur un geste électronique" », *La Revue musicale*, n° 244, Paris: Richard Masse, 1959, 25-30 ; Xenakis, 1971, 142-150; Xenakis, 1996, 17-28.

²⁴ Xenakis, 1958a, 131.

²⁵ Xenakis, 1958a, 132.

²⁶ Xenakis, 1958a, 132-134.

Xenakis argues that sound's "conquest of geometric space" can, if desirable, be combined with parallel developments in the visual domain. The fine arts "have remained contained within their secular immobility" in suspended time; however, they are now challenged by cinema, which endows "images within an actual third dimension, time"²⁷. Still, film projection remains constrained on a single, flat screen and the hall's absolute obscurity. The ultimate prerogative for Xenakis is for the visual arts to "actually leap into space"; this can be achieved for example by several warped screens instead of one, superimposed projections on the curved surfaces of a hall's walls, "colored environments, stemming from rhythmic and colored streams" produced with the help of an advanced, automatically controlled electronic infrastructure²⁸.

According to Xenakis, a new architecture emerges "together with this new technological art form, an architecture that is truly three dimensional"²⁹. In this "vast audiovisual synthesis" spatial locations as well as sound parameters (pitches, durations, timbres and dynamic levels) are inherent to the structure, thanks to new technological developments. Indeed, Xenakis would continue his research into complex architectural forms, expanding it and combining it with his musical and visual work, integrating the computer as a tool in his artistic practice.

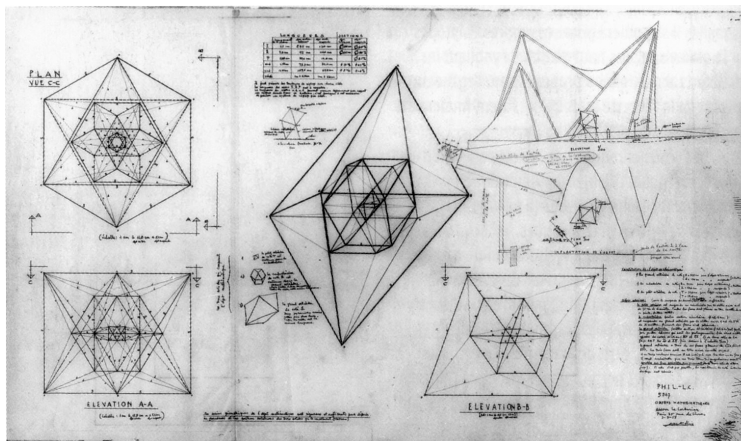


Fig. 39. Iannis Xenakis, design for the *objet mathématique*, 1957.

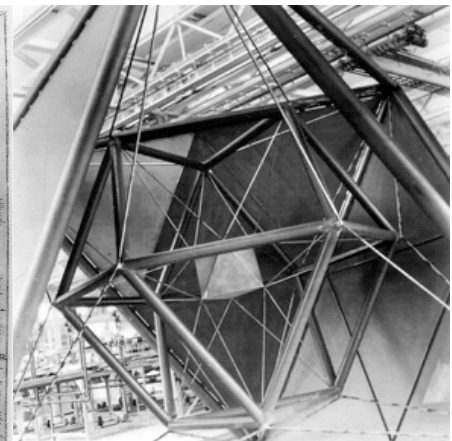


Fig. 40. The *objet mathématique*, 1958.

²⁷ Xenakis, 1958a, 131-132. Xenakis specifically refers to «cinematic painting», with Louis Bunnuel's "Un Chien Andalou" (1928) and Ferdinand Leger's "Le Ballet Mécanique" (1924) in mind. Such works were not structurally based on narrative continuity, but on graphic and rhythmic associations.

²⁸ Xenakis articulates these thoughts at a very early stage of the development of "expanded cinema" practices (Youngblood, 1970).

²⁹ Xenakis, 1958a, 132. Here Xenakis refers to the Philips Pavilion's volumetric architecture, as described in Xenakis, 1957 and Xenakis, 1958b.

III.iii. The Polytopes

Between 1966 and 1978, Xenakis created a series of site-specific light and sound installations, employing cutting-edge technology of the time - in "an attempt to develop a new form of art with light and sound"³⁰. He called these works *Polytopes*, a term he coined himself, that consists of the Greek words *πολυ-* [many, numerous] and *τόπος* [place, site, location], in an effort to describe their complexity and particularity³¹. Indeed, the term *polytope* captures the complexity of these unusual light-and-sound works that still defy categorization today³². Furthermore, every Polytope bears the name of the site or the city where it was installed, underlining the site-specific character of the works.

The *polytope* is based on the idea of an extensive, unified space, consisting of many smaller elements, whose spatial complexity is articulated by sound and light in flux. According to Xenakis, the polytope "experiments with novel ways of using sound and light. It's an attempt to develop a new form of art with light and sound"³³. A virtual three-dimensional grid forms the basis for all consisting elements, which become fully integrated in space. The large scale of these multimedia works aimed at the public's participation, which situated at the intersection of all these layers is immersed in the work. The work becomes so deeply integrated in the site, that "the *topos*, the place itself, is rendered the medium"³⁴.

Five *Polytopes* were realized in total: the *Polytope of Montreal* (1967), the *Polytope of Persepolis* in Iran (1971), the *Polytope of Cluny* (1972-1974) and the *Diatope* (1978) in Paris, and the *Polytope of Mycenae* in Greece (1978)³⁵. They were all ambitious commissions by institutions and festivals. Depending on the particularities each commission and site presented, each project had distinct characteristics; however the main concept remained the same, according to Xenakis' coherent artistic vision, as

³⁰ Varga, 1996, 112.

³¹ Xenakis claimed a certain paternity of the term "polytopes", as a neologism to describe his audiovisual installations. However, there are suggestions that he was familiar with the mathematical term (Kanach, 2008, 198) – this is also suggested by the "mathematical object" that was suspended at the interior of the Philips Pavilion, which recalls the 24-cell polytope. (Treib, 1996, 89; Sterken, 2004, 405; Kanach, 2008, 100-101). The mathematical term "polytope" was introduced by Alicia Boole Stott (http://en.wikipedia.org/wiki/Alicia_Boole_Stott (6/10/2010); Phillips, T., *The Princess of Polytopia: Alicia Boole Stott and the 120-cell*, <http://www.ams.org/samplings/feature-column/fcarc-boole> (12/10/10). It designates a number of mathematical objects born of the sequence point, line, polygon, and polyhedron and it is commonly used in mathematics, as a number of related, but slightly different mathematical objects. In the context of Xenakis' works, there are various interpretations of this generic term: "The "Polytope" may be described as the articulation of space and time by sound and light in movement" (Matossian, 1979, 39); "The word "polytope" (...) refers to a superposition of different spaces: sound, light, architecture, color" (Sterken, 2001a, 191); "The title is to be understood as a name for space installations, in which numerous places – spaces of light, color, sound and architecture – are superimposed upon one another" (Oswalt, 2001, 212); "The word *Polytopes* described the overlaying of musical and light events, creating various ever-changing asynchronous places" (Sikiaridi, 2001, 202-203).

³² It is characteristic that many different generic or descriptive terms have been applied in various contexts to describe the *Polytopes*: *multimedia installations*, *spectacle*, *Ton-und-Licht-Bewegung*, *sono-vidéo-cinétique*, *video-cinétique*, *musical land art*, *geographical art*, *actions de lumière et de son*, *geste de lumière et de son*, a.o.

³³ Varga, 1996, 112.

³⁴ Sterken, 2001d, 82.

³⁵ For some time it was misconceived that Xenakis had also realized an "Osaka Polytope" for the Osaka World Expo in 1970; however, this was not the case. Xenakis contributed with a spatialized music piece to a pavilion in the Osaka Expo (see above), but did not realize a *Polytope* (Sterken, 2004, 470-476). Xenakis referred to the *Diatope* as a *Polytope* – even though he chose to differentiate its name, for specific reasons (see Chapter IV).

expressed in his seminal 1958 essay³⁶. The *Polytopes* consisted of abstract forms and virtual volumes of sound and light, which developed independently, not synchronically, but parallel. Xenakis insisted that the ultimate synthesis and attribution of meaning are assigned to the spectator, who is the interpreter of the work³⁷.

The *Polytopes* can be divided in three groups, according to their particular parameters and attributes. The first one comprises of the *Polytope de Montréal* (1967) and the *Polytope de Cluny* (1972-'74), two installations that were developed for a specific, closed space (the French Pavilion of the 1967 World Expo in Montreal, and the Roman Baths of Cluny in Paris). In each case, Xenakis handled the architectural space as Cartesian systems composed of sonorous (speakers) or luminous points (flashes attached to cable grids), constructing from these axiomatic entities, forms and virtual volumes of sound or light in movement. We will refer extensively to these two works below, as they are closely related to the *Diatope*.

A second group of polytopes, the *Polytope of Persepolis* (1971) in Iran, and the *Polytope of Mycenae* (1978), in Greece, were large-scale works that extended to entire archaeological sites and landscapes of historical significance³⁸. These *polytopes* were presented live in front of large audiences, and were more «mass celebrations» that took place in specific sociopolitical contexts. Xenakis manipulated all spatial parameters (light, sound, color, movements, etc.) in an artistic interpretation and celebration of the historical site, in spectacles with dramaturgical, theatrical, symbolic and ritual aspects. Spatialized electroacoustic and live orchestral music, campfires, children's choirs bearing torches, animals bearing bells, lasers and anti-aircraft light projectors, where all orchestrated in an amalgamation of cutting-edge technology and archaism, according to precise "scenarios".

The *Polytope of Persepolis* was commissioned for the Shiraz Arts Festival, as a site-specific work for the historic site of Persepolis, located amidst the desert³⁹. The work was staged in the dark, on the opening night of the festival (August 26, 1971), and it premiered electroacoustic piece *Persepolis* (8-track tape, 56')⁴⁰. The piece was projected from 59 loudspeakers (divided into sets of 8 and 16), dispersed among the ancient ruins and surrounding the spectators. The music was accompanied by a spectacle that took place on the nearby hills: two large bonfires burning on the hilltops, while groups of children carrying torches created moving light trajectories, following geometrical and irregular patterns. The environmental conditions of the location did not allow Xenakis to

³⁶ Xenakis, 1958a. Xenakis did not further theorize his "synthesis of the arts" regarding the *Polytopes*; there are only some program notes for each work, the book he co-edited with Olivier Revault d'Allones (Revault d'Allones, 1975) and two brief texts: "Lieu" (Xenakis, 1970) and "Les Polytopes" (Xenakis, 1982a).

³⁷ Sterken, 2001a, 191.

³⁸ In the frame of this group we should also mention two minor *spectacles* by Xenakis: an unrealized *Light and sound spectacle* (1979), in Arc-et-Senans, France (Sterken, 2004, 479), and *Tauriphonie* (1987), an extravagant sound-and-light spectacle, referring to the traditions of the archaic culture of Crete, which premiered on 13 July 1987 at the ancient Roman amphitheater in Arles, France (*Tauriphonie* (1987) in: "Iannis Xenakis", Neuma 45086, 1994) (Sterken, 2004, 477).

³⁹ The performance took place at the ancient ruins of the palace of Darius, as the opening act of the 1971 Shiraz Arts Festival, which celebrated the 2500th anniversary of the Persian Empire. For more details see Alexaki, 1996, 132-133; Harley, M. A., 57-58; Gluck, 2007; Kanach, 2008, 199-198, 217-224.

⁴⁰ Valsamakis, 2000, 28; Harley, 2002, 45-46.

present a spectacle based on high technology; however this was the first occasion he employed laser beams (two), which together with diffuse light and spotlights brightened the night sky.

The *Polytope of Mycenae* was the last in the series of *Polytopes*, realized in 1978⁴¹. A “feast of light, movement and music”, it was presented on five successive evenings (1-5 September 1978) at the historical site of the ruins of the ancient Acropolis of Mycenae, in the Peloponnese, Greece, and attracted an estimated of 40,000 spectators⁴². The spectacle was characterized by an idiosyncratic coexistence of the archaic with the modern: the music component consisted of live performances of Xenakis’ musical works inspired by ancient Greek tragedies, linked with seven electronic interludes⁴³. The visual component included beams of twelve anti-aircraft searchlights, three anti-aircraft searchlights⁴⁴, as well as distant patterns of light, formed by processions of children carrying torches and herds of goats bearing lights and bells – it concluded with a colorful fireworks display. There were also bonfires on the hilltops and projections of images abundant with allusions to ancient Greek culture, such as the funeral masks of the Achaean kings onto the ancient ruins of the acropolis⁴⁵.

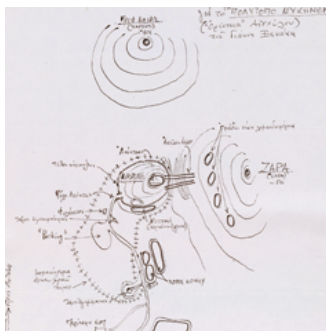


Fig. 41. Iannis Xenakis, sketch for the *Polytope of Mycenae*, 1978.



Fig. 42. View of the *Polytope of Persepolis* performance, 1971.

A third group of *Polytopes* would comprise Xenakis’ utopian projects of urban or even cosmic scale, which all developed only as proposals and remained unrealized: a *Polytope*

⁴¹ Το Πολύτοπο των Μυκηνών, Γενικό Πρόγραμμα Πολύτοπο Μυκηνών [The Polytope of Mycenae, General Program], Hellenic Association for Contemporary Music, Athens, 1978. For a detailed description and analysis see: Alexaki, 1996, 139-156; Kanach, 2008, 232-246.

⁴² The *Polytope of Mycenae* had a festive character. The work should be considered in its sociopolitical context: a political refugee, Xenakis was able to return to his native Greece only after 30 years, after the fall of the junta (1967-1974). The commission was a tribute to the now worldwide famous composer, who in turn wanted to pay tribute to his cultural heritage.

⁴³ These consisted of repetitions of a brief centerpiece, *Mykenes Alpha* (*Mycenae Alpha* (1978), Xenakis’ first full-scale composition using the UPIC (“Electro Acoustic Music: Classics” Neuma 45074, 1993). The sound component also included recitations from Homer and from recently discovered Mycenaean funeral inscriptions.

⁴⁴ Located at a distance of 10 kilometers from Mycenae, positioned so that their bright beams formed a pyramid above the ancient ruins.

⁴⁵ A film documentation of the performance is available at the ERT archives: <http://www.ert-archives.gr/V3/public/pop-info.aspx?tid=7117&tsz=0&act=mlInfo> (27/12/10). See also the documentaries by Ferris, Costas, “Xenakis Polytopon” (1978) and Psychramis, Fotis, “Polytope de Mycene. Iannis Xenakis” (1978). For press accounts of the time see the bibliographies of Alexaki, 1996 and Sterken, 2004.

of Paris (1974)⁴⁶, an unrealized proposal for a spectacle integrating laser lights that would be emitted by satellites for the celebration of the American bicentenary (1975)⁴⁷; a *Polytope of Mexico* (1980-1981)⁴⁸, and a *Polytope of Athens* (1984-85)⁴⁹. Xenakis also envisioned projects involving interaction and intercontinental communication, which would extend to entire continents⁵⁰. The enormous financial and technical demands of his proposals were impossible to meet; however, even if they were never materialized, these projects document Xenakis' utopian vision for a cybernetic interactive art on a cosmic scale: from gigantic sound-and-light displays connecting continents, to Northern Lights spectacles illuminating the Earth's atmosphere⁵¹.

⁴⁶ The first proposal for the Centre Pompidou commission (see below, Chapter IV.i).

⁴⁷ Xenakis, 1971, 186; Xenakis, 1979, 17; Sterken, 2004, 467.

⁴⁸ The *Polytope* would take place in the ancient site of pyramids in Teotihuacan. Like in the *Polytope of Mycenae*, the *Polytope of Mexico* would include new compositions on the UPIC and existing orchestral works, laser and anti-aircraft projectors, with crowds of people also taking part in the project. It was cancelled because of political circumstances (Varga, 1996, 116; Sterken, 2004, 460-462; Sterken, 2008, 320; Kanach, 2008, 201).

⁴⁹ The *Polytope of Athens* was probably the most utopian and ambitious project Xenakis tried to materialize; it would consist on music and light events extending to the entire city, involving helicopters, army searchlights, laser beams, boats' foghorns, hot-air balloons, sirens, as well as thousands of pigeons. The *spectacle* would focus on the ancient Acropolis, which was the reason why the archaeological board denied permission for the project, fearing potential harm of the site. See: Sterken, 2004, 464-466; Sterken, 2008, 321; Kanach, 2008, 201. For press accounts on the controversy at the time, see: Chrysostalis, A., "Ιάnnης Ξενάκης: Δυστυχώς τα λόγια δεν αρκούν" [Iannis Xenakis: Unfortunately words are not sufficient], *ENA*, date unknown; Romanou, K., "Το "Πολύτοπο των Αθηνών θέαμα για ελεύθερους ανθρώπους" [Το Polytopo ton Athenon theama gia eleftherous anthropous], *I Kathimerini*, 27-28.1.1985; Galani, E., "Το "Πολύτοπο" αναμένει την κρίση των αρχαιολόγων" [Το Polytopo anamenei tin krisi ton archaeologon], *I Kathimerini*, 22.1.1985.

⁵⁰ Xenakis mentions, for ex., "... projects, sound and light events with communication between continents – Japan, United States, Europe, Russia, Africa – either with radio beams reflecting so that in many places on earth you could have sound and light events produced simultaneously like a game. Then I wanted to create Northern Lights in the temperate regions with electromagnetic beams but it was feared that this would harm the ozone layer of the earth." Xenakis quoted in Matossian, 1981, 222; Xenakis, 1985, 5; Xenakis quoted in Szendy, Peter, „Ici et là. Entretien avec Iannis Xenakis“, in *Espaces - Les cahiers de l'Ircam. Recherche et Musique*, 1994, 112; Kanach, 2008, 247.

⁵¹ Harley, M. A., 1998, 63-64.

III.iii.a. The *Polytope of Montreal* (1967)

When in 1966 Xenakis received a commission for a music piece to accompany a visual show of crystallography for the French Pavilion at the World's Expo 1967 in Montreal, he proposed to create an "electronic sculpture combining light, music, and structures"⁵² instead, located within the pavilion's central void space⁵³. Almost a decade after the *Poème électronique*, he was given the chance to materialize his ideas for a new form of electronic art⁵⁴.

The *Polytope de Montréal* continued Xenakis' expression of ruled surface geometry. The *Polytope* was conceived as a large sculpture, a 'transparent architecture', evolving within the huge void space in the center of the Pavilion. Over 200 steel cables of varying length (from 20 to 31 m.) were suspended throughout the 7 floors, supporting 1200 light flashes. Their intersecting dynamic shifts formed a virtual architecture of five hyperbolic volumes. Xenakis described the final result as:

*(...) a transparent architecture composed of steel cables that shall articulate this huge empty space and will serve as the support of the luminous points. These are ruled forms, (...) changing, evolving forms, in every sense of the word, and they faithfully follow laws of mathematical progression. In addition, they "respond" to one another, from one side to the other.*⁵⁵

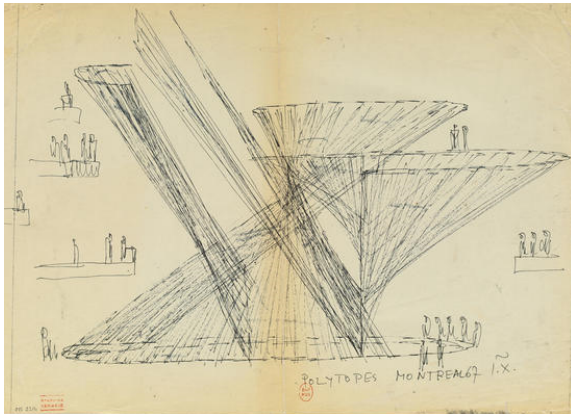


Fig. 43. Iannis Xenakis, Study for the *Polytope de Montréal*, c. 1967.

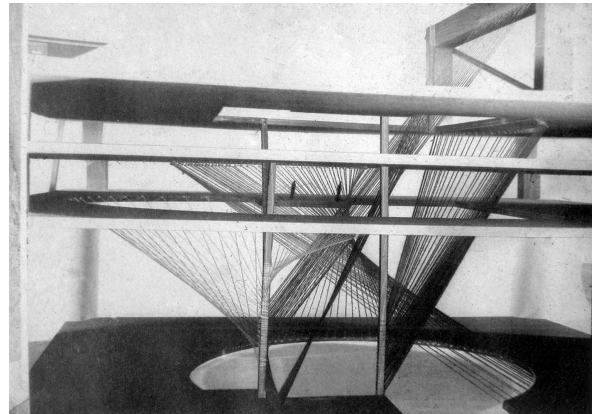


Fig. 44. Scale model of the *Polytope de Montréal*, c. 1967.

⁵² Kanach, 2008, 99 (trans. S. Kanach).

⁵³ The Montreal Expo lasted from 28 April until 27 October 1967. The French Pavilion, designed by Jean Faugeron, included several floors of display rooms, all opening onto a central void space. Between the performances (from April 26 to October 2, 1967), the cables formed an abstract sculpture in the center of the Pavilion. After the end of Expo Montreal, the French Pavilion was used as an exhibition space, and the *Polytope*'s structure remained in place as a transparent sculpture until 1992 (Kanach, 2008, 206; Sterken, 2008a, 315).

⁵⁴ Revault d'Allones, 1975, 46-69; Alexaki, 1996, 131-132; Sterken, 2001a, 191; Sterken, 2001b, 267-271; Sterken, 2004; Kanach, 2006, 294-307; Kanach, 2008, 199, 203-216.

⁵⁵ Xenakis, Iannis, "The *Polytope de Montréal*: Commentary", 1967, in : Kanach, 2008, 213-214.

The light flashes, arranged in five grids, were divided in five groups of colors: 800 white and 400 colored - 100 each of red, blue, green and yellow⁵⁶. Color played an important role in the structure of the visual events; the light-show scenario⁵⁷ shows that the color of the light flashes was also a defining compositional parameter in the *polytope's* «visual music»⁵⁸.

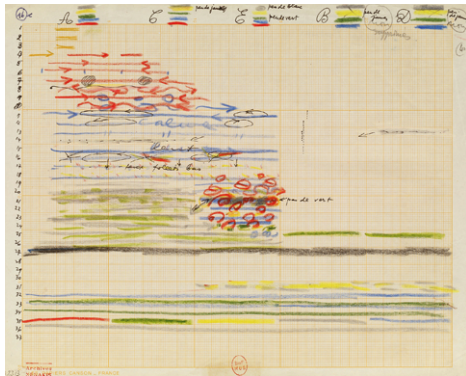


Fig. 45. Iannis Xenakis, Study for the *Polytope de Montréal* (light score), c. 1966.

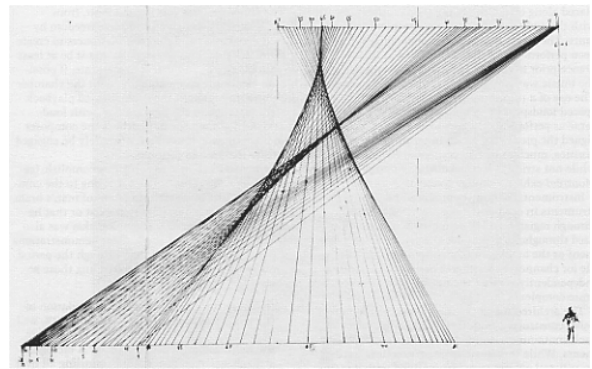


Fig. 46. Iannis Xenakis, design for the *Polytope de Montréal*, c. 1966.

The flashing lights were programmed to create fixed fields or clouds, creating and moving along the trajectories of spirals, circles or complicated curves in three dimensions. These movements and their parameters were constructed according to logical operations, much like in Xenakis' musical compositions. As he explained in the program, he applied musical composition techniques to the design of the light component: probability calculations, logical structure, group structures:

*The light composition is based on the Theory of Groups. For example, vertical and horizontal cross sections, differentiation in layered levels. I distinguish the various floors by varying different rhythms, characterize each horizontal cross-section, but there is a relationship between everything thanks to extremely precise moduli. At certain times, rhythms begin to create patterns, and to permeate into each other. Sub-groups appear as well as rhythmic invasions by groups, all to create a first general rhythmic pattern.*⁵⁹

In the «sequence of events» described in the *polytope's* scenario⁶⁰, some light events are organized according to stochastic distributions («a continuous stochastic river», «stochastically distributed rivers that intersect», «effervescent stochastic swirling», etc.), while others follow certain natural forms or mathematical shapes and patterns (curves, spirals, «the 24 transformations of the tetrahedron», Klein group, Wilson's chamber). The result was virtual volumes of light, in arabesque, spiral, galactic, streaming, or

⁵⁶ The flashes were especially developed for the project by the company Orthotron (Sterken, 2008a, 315).

⁵⁷ «Scénario approximatif des événements lumineux et visuels du vide du pavillon de la France à l'exposition 1979 de Montréal», November 12, 1967 (BNF), published in Sterken, 2004, 485-486 and Kanach, 2008, 210-211 (in English).

⁵⁸ Xenakis, 1970, 145.

⁵⁹ Iannis Xenakis, «The *Polytope de Montréal*: Commentary», 1967, in Kanach, 2008, 213-214.

⁶⁰ «Scénario approximatif des événements lumineux et visuels du vide du pavillon de la France à l'exposition 1979 de Montréal», November 12, 1967 (BNF), published in Sterken, 2004, 485-486 and Kanach, 2008, 210-211 (in English).

exploding configurations in flux. White light was dominating, but colored lights distributed over the five surfaces, also emerged gradually from the white light patterns⁶¹. The flashes produced “white light, similar to the sun, in a continuous spectrum with increasingly intense blue and green beams, creating a relatively cold and penetrating light.”⁶² The flashes created various constellations in motion that changed every 25th of the second, so that the human eye perceived their variations as shifting, continuous movement.

The changes of patterns and the rhythm of the light composition were also governed by probability calculations, logical operations and group structures:

*There are many compositional operations going on in these groups, by that I mean logical operations. If, for example, a flash lights up following a given rhythm, it may change rhythm when another dynamic invasion occurs, or, maintain its original rhythm, or, only maintain what the two rhythms share in common. It is a logical operation of conjunction or disjunction, or of complimentary actions. There is also a complete definition of the surface by the individual circuits. Paths of light flashes through successive lighting define new perspectives depending on where they are observed.*⁶³

At the time the automation of the work posed many technical problems, as it was not possible to control by computer the commands for the light component⁶⁴. Automation was ultimately attained by a “primitive” command film-perforation system laboriously executed by hand, with the technical assistance of Jean Colmant. The process was as follows: each state of change was first drawn on millimeter paper and then photographed onto a film frame with 1200 spots representing the number of flashes. The thousands of photographs of perforated charts, containing the coordinates of each of the light circuits, were put together successively on one film reel according to the “light score”. During the performance, projected rays of a continuous light were filtered through the holes of the perforated film, activating a light-sensory panel, which in turn activated each specific circuit/flash light⁶⁵. For the 6-minute spectacle, 19,000 successive

⁶¹ Revault d'Allonnes, 1975, 65-69; Xenakis, 1971, 171-173; Matossian, 1981, 214-216; Varga, 1996, 114. The visual effect is documented in a documentary of the Montreal Expo, an excerpt of which is available online at: <http://www.youtube.com/watch?v=BcFyLajL230> (26/9/10).

⁶² Xenakis quoted in Delalande, 114; quoted in Kanach, 2008, 205-206

⁶³ Iannis Xenakis, “The Polytope de Montréal: Commentary”, 1967, in Kanach, 2008, 213-214.

⁶⁴ Initially Xenakis wanted the entire light and sound interplay to be computer automated, proposing a potential collaboration with companies; see: “Proposition for the French Pavilion at the Montreal’s World’s Fair” (n.d. - approx. 1966); in: Kanach, 2008, 208-209. In this document it is implied that Xenakis initially wanted to give an interactive character to (a part of) the polytope’s sessions: “some events of the performance may be conceived so that the public may intervene interactively in the process of creation (...) Some of these interactive events may provide the opportunity for some artistic competitions among spectators, a possibility that would create a landmark in the history of the arts.”

⁶⁵ In Xenakis’ account: *In Montreal the frames of the film followed one another (every) 25th of a second. Each black frame had a white spot on it and the light passing through it activated a special photoelectric cell. Altogether I had 1200 of them. I had to prepare the score and the set-up of the lights. The Polytope lasted six minutes; the lights flashed 25 times per second, that is 1500 times per minute, 9000 times during the six minutes of the show. I needed that many frames. The man the organizers commissioned to prepare them nearly went crazy completing the job. When we met, he said, “I give up! I’m on the verge of a nervous breakdown!” his frames, however, were more or less flawless.*

light events were calculated, in order to "create a luminous flow analogous to that of music issuing from a sonic source"⁶⁶.



Fig. 47. The *Polytope de Montréal*, 1967.

The accompanying music, *Polytope* (1967), for four identical ensembles of eleven musicians each, was composed of continuous, slowly shifting glissandi⁶⁷. The piece was pre-recorded on tape and was spatialized at the Pavilion, in four groups of loudspeakers placed below the suspended nets of cables and lights. There were no programmatic links between the design of the supporting sculpture, the succession of flash bulbs, and the music; this was «an encounter between two different musics, one to be seen and one to

Xenakis quoted in Varga, 1996, 116; quoted in Kanach, 2008, 204 (trans. S. Kanach); Xenakis quoted in Delalande, 1997, 117-119.

⁶⁶ Xenakis quoted in Fleuret, (ed.), *Regards sur Iannis Xenakis*, 159-187.

⁶⁷ The recording of this composition used in the numerous Montreal performances was prepared in Paris by the Ars Nova ensemble under the direction of Marius Constant. This composition remains in Xenakis's catalogue under the title of "Polytope de Montréal", but apparently it has never been performed live.

be heard»⁶⁸. Xenakis deliberately set the music and visual component in contrast: the uniformity in timbre and the continuity of the composition's glissandi were deliberately in contrast with the pointillist light component⁶⁹. However, the different components share much in common, but on a deeper, structural level. When Xenakis claims that «the link is not between them but beyond or behind them»⁷⁰, a principle that will be repeated in the subsequent *polytopes*, he implies that the different components all share a common core. As the visual configurations and their successions were composed much as he would compose a musical score, so was the virtual architecture designed to «faithfully follow laws of mathematical progression»⁷¹.

Performances took place once every hour, and lasted six minutes, during which the public could move freely within and through this “cloud of luminous and acoustic events of varying intensities”⁷², changing perspective during the spectacle. Xenakis had managed to dissolve the projection screen into countless picture points of what he called «real light», creating an architectural space as a pure field of densities⁷³. With the «vertical and horizontal segmentation and the differentiation of superimposed layers»⁷⁴, sound and light are used as material to create space. As he described the *Polytope of Montreal*, this was «a first step for music in space, with visuals and with real light»⁷⁵.

⁶⁸ Xenakis quoted in Bosseur, 1992; quoted in Kanach, 2008, 206.

⁶⁹ «The music is independent from the light spectacle. I wanted to create a contrast. The lights in my spectacle create a multitude of points that stop and go. The music creates a continuity, thanks to the glissandi. The sound changes, but never stops.» Iannis Xenakis, “The *Polytope de Montréal*: Commentary”, 1967, in Kanach, 2008, 213-214.

⁷⁰ Xenakis quoted in Varga, 1996, 114.

⁷¹ We haven't been able to find more information on the composition techniques employed at the “Polytope de Montreal” (1967) piece. James Harley's observation is enlightening: “Xenakis designed the piece very much in terms of layers of sonorities, much as he had composed *Bohor*. Thus, while not strictly electroacoustic, *Polytope de Montreal* exhibits similar concerns” (Harley, 2002, 41-42).

⁷² Oswald, 2001, 212.

⁷³ Oswald, 2001, 212.

⁷⁴ Xenakis, Iannis, linear notes of *Iannis Xenakis*, Berlin: Edition RZ, 2003, (CD), 9-10 ; quoted in LaBelle, 2006, 190.

⁷⁵ Xenakis quoted in Delalande, 1997, 114; quoted in Kanach, 2008, 205-206.

III.iii.b. The *Polytope of Cluny*

The *Polytope de Cluny*⁷⁶ was staged at the Roman Baths of the Cluny Museum in Paris, in 1972⁷⁷. The work was presented in two versions, slightly different from each other, the first one from November 1972 to October 1973 and the second from December 1973 to January 1974, with an estimate of 100.000 visitors total⁷⁸. Within the T-shaped, barrel-vaulted ancient site, an interior scaffolding was installed as a double of the architectural space folded alongside the vaults of the *thermae*. Much like a Cartesian grid, this structure of steel tubes supported 600 lights along with 400 small mirrors, and 12 loudspeakers. The steel structure transformed the informal location without imposing itself, transforming the historic site only temporarily. The audience (500 spectators per session) could sit or lie on the floor freely to experience «actions in light and sound»⁷⁹ extending to a 24 min. duration.



Fig. 48. *Polytope de Cluny* (1972), installation view.



Fig. 49. *Polytope de Cluny* (1972), installation view.

The musical part, the electroacoustic piece *Polytope de Cluny* (tape, 7-channel) was relatively simple, characterized mainly by modulating timbres and rhythmic pulses⁸⁰. The musical material used consists of both instrumental and concrete sounds transformed through tape manipulation and sound-processing techniques. Complementary to these standard electroacoustic synthesis techniques, Xenakis also integrated computer-generated synthesized sounds in the piece. These sounds were the first results of his experiments in stochastic synthesis, calculated using stochastic algorithms at the CEMAMu⁸¹. The sound was distributed at the site by 12 loudspeakers scattered around

⁷⁶ Revault d'Allones, 1975, 72-113; Matossian, 1981, 270-272; Fleuret, 1988, 178-179; Alexaki, 1996, 133.

⁷⁷ The project was commissioned by the French Ministry of Cultural Affairs, in the frame of the first edition of the *Festival d'Automne* (directed by Michel Guy) and *Les Journées de musique contemporaine de Paris* (Semaines Internationales musicales de Paris, under the direction of Maurice Fleuret).

⁷⁸ Sterken, 2008a, 317. Sources vary as to the total number of visitors to the *Polytope de Cluny* I & II, from 100.000 to 200.000 registered entries. The project had immense success, with four daily performances during the week and six on Saturdays.

⁷⁹ As described in the program of the *Polytope of Cluny*; quoted in Kanach, 2008, 200.

⁸⁰ Matossian, 1981, 221.

⁸¹ See Chapter II. iii.

and throughout the audience. The sound distribution, controlled by 7 channels of the 8-channel control tape, followed predetermined variations of T and square patterns.

For the visual component of the installation Xenakis used a powerful display, based on technology that for its most part was developed especially for the project⁸². 600 white xenon flashes and 400 fixed and pivotal mirrors were attached to the scaffolding, over the sides and the top. There were also three strong laser projectors, a krypton laser producing red beams and two argon lasers producing green and blue beams each.

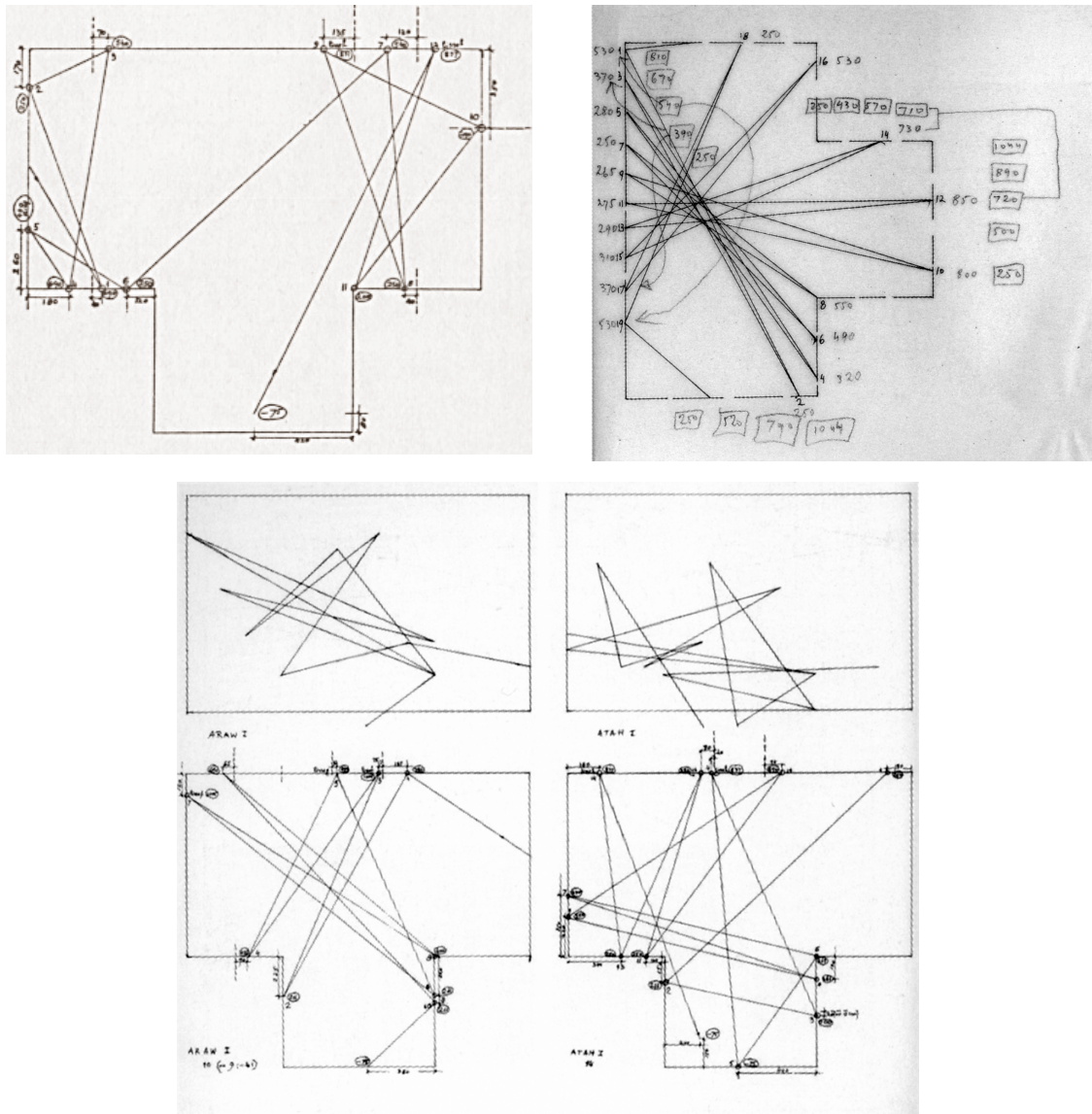


Fig. 50-52. Iannis Xenakis, Study sketches for the configurations of the flash lights, c. 1971.

⁸² Kanach, 2008, 200.

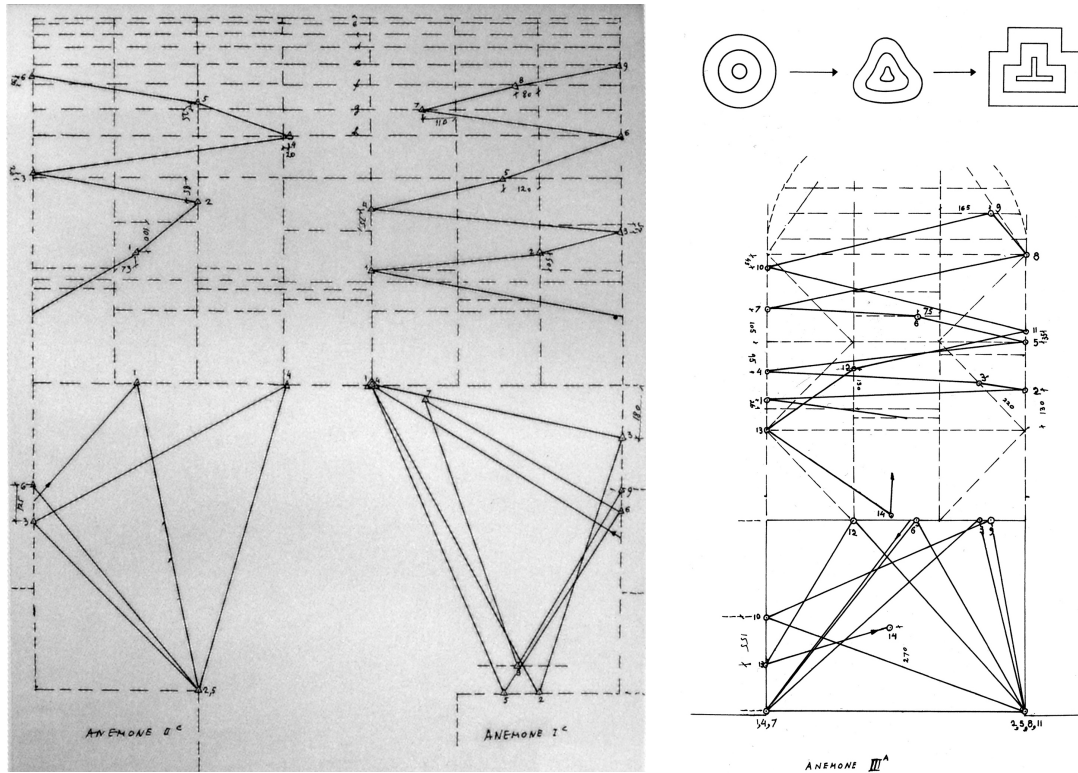


Fig. 53-54. Iannis Xenakis, sketches for the laser configuration *Anemone*, c. 1971.

The direction of the lasers and the angles of the mirrors were precisely calculated so that the laser beams were accurately reflected by the mirrors; additionally, the pivotal mirrors could be individually triggered by means of a motor mechanism, changing their reflecting orientation to different planes, thus forming different sets of light configurations. The resulting sets of various geometric configurations of light in space, appeared like holograms, virtual drawings unfolding in space above the spectators.

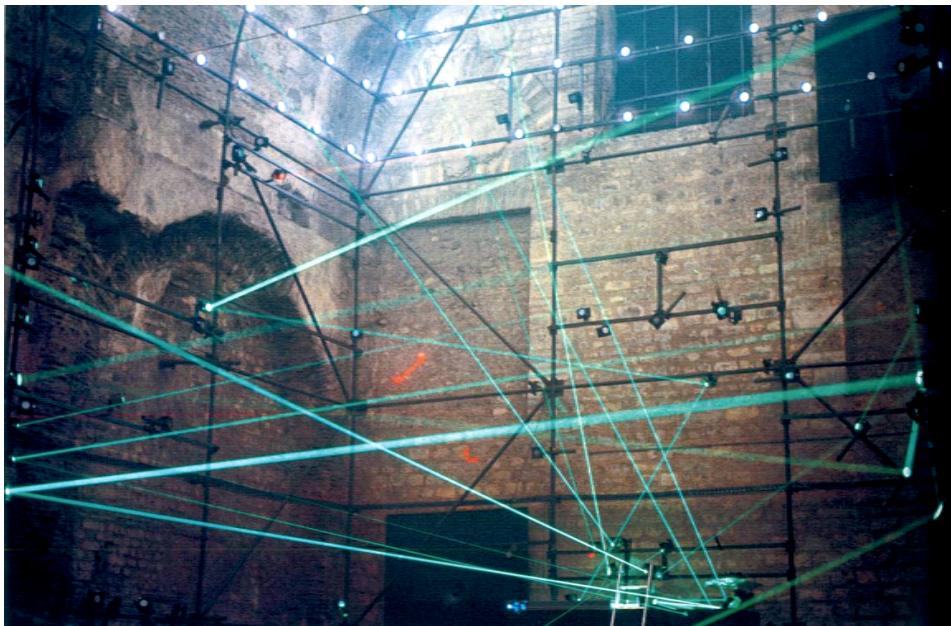


Fig. 55. The *Polytope de Cluny*, 1972.

The 600 flash lights were also programmed to form different patterns, which could be grouped as: a) various geometric shapes such as circles, spirals, or crossing lines, b) the emulation of various natural phenomena such as galaxies, northern lights, rivers, ponds, etc., c) patterns produced by stochastic functions. As in the Polytope de Montreal the points moved in variable rhythms creating different formations and shapes in flux.

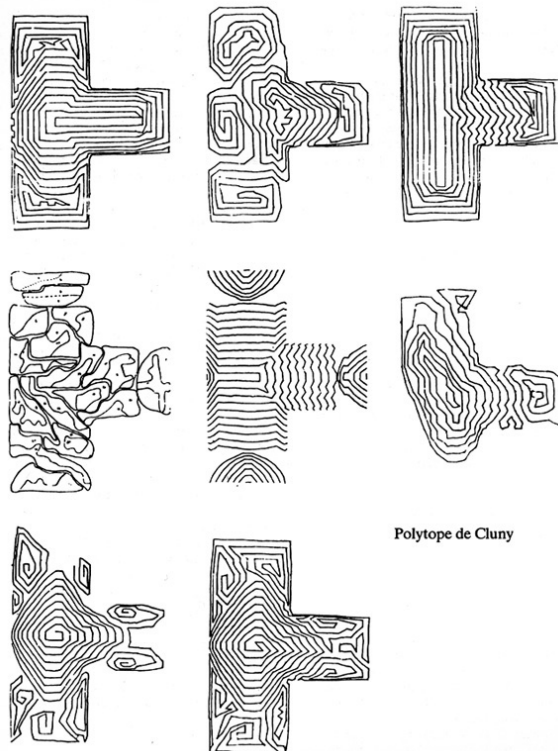


Fig. 56. Iannis Xenakis, sketch with the configurations of the light flashes for *Cluny*, c. 1971.

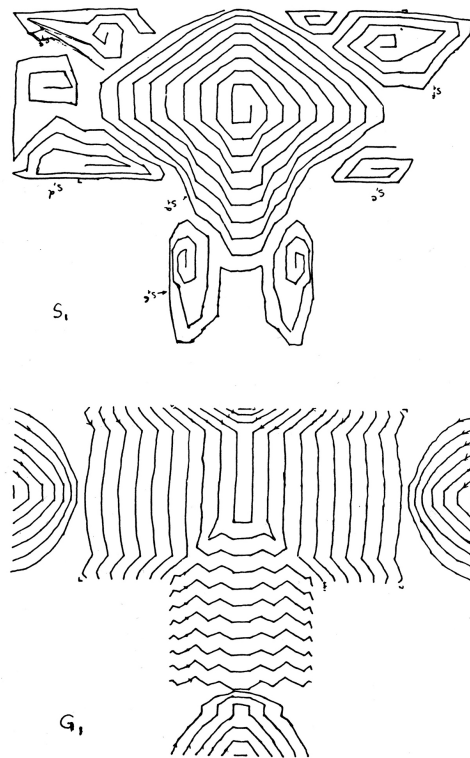


Fig. 57. Iannis Xenakis, sketches of concentric patterns of the flash lights, c. 1971.

Some shapes and formations purposely resembled various natural phenomena and forms, such as the “lotus” or the “anemones”; the configurations of the flash lights evoked twinkling stars and moving galaxies. As Harley, M. A., interestingly notes, the initial title of the whole project, *La Riviere* [The River], testifies Xenakis’ inspiration from natural phenomena, filtered through the language of mathematics⁸³. The result was formed as a dynamic net of color laser lines contra-pointed with the light masses of the flash lights.

⁸³ Harley, M. A., 57. Excerpts of the performance appeared in a documentary by Mark Kidel (1991): <http://www.youtube.com/watch?v=ikIDWi1-HLA>; http://www.ubu.com/film/xenakis_polytope.html.

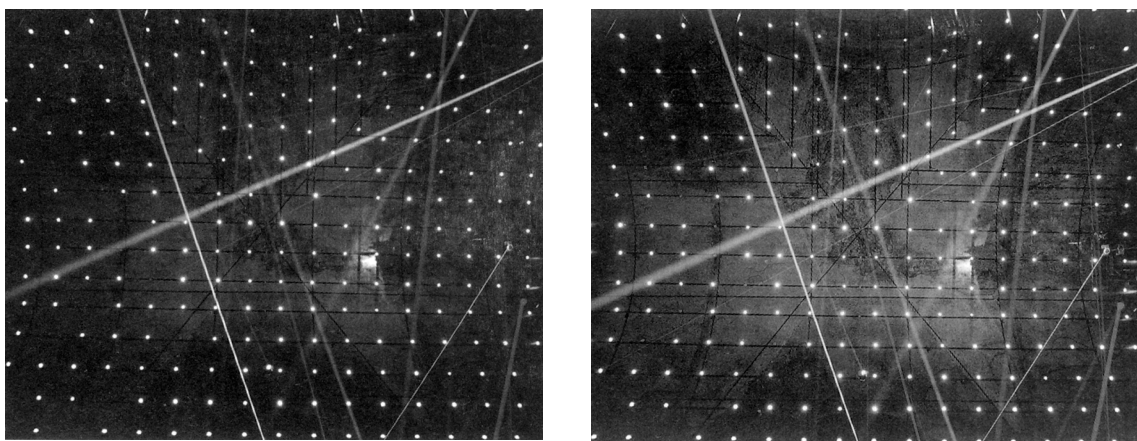


Fig. 58-59. The *Polytope of Cluny*, photograph, 1972.

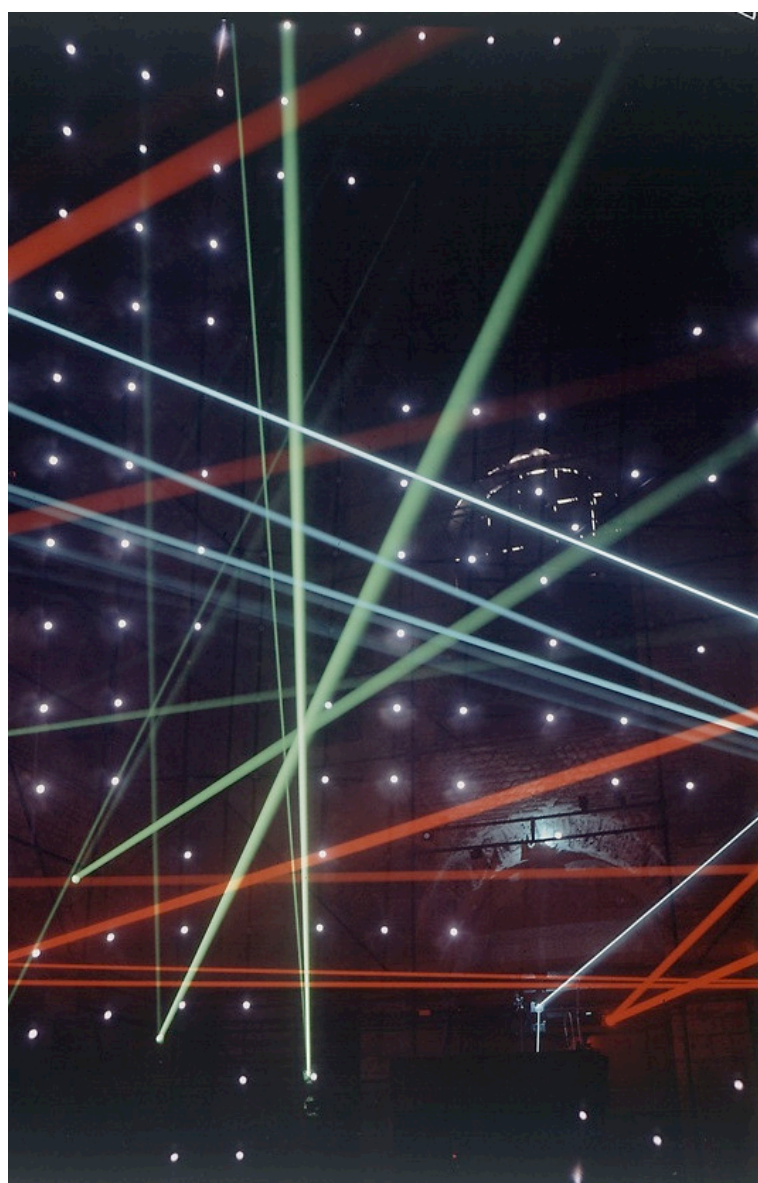


Fig. 60. The *Polytope de Cluny*, view of the *spectacle*, c. 1972.



Fig. 61. The *Polytope de Cluny*, photograph of laser configurations, c. 1972.

The entire visual spectacle was designed according to principles of mathematics such as possibility and group theory, and was programmed in FORTRAN 4, by adapting the program ST that Xenakis developed and used as tool for his compositional practice in the early '60s⁸⁴. All the light patterns were automated and computer controlled: the state of the lights, the lengths of the laser beams and the positions of the mirrors, were all translated in binary commands encoded on the eighth track of the magnetic command tape. The music distribution commands were assigned to the other seven tracks. Thus, the movements of light could be coordinated with the flow of sound, allowing for precisely controlled timing between the different elements. The automation of the control and distribution of both audio and visual components was feasible thanks to state-of-the-art computer technology of the time⁸⁵.

The desired effect, however, was not synchronization. In contrast to the complexity of the visual part of the Polytope, the musical part was much simpler; it's varying pulses and modulating timbres providing a counterpoint to the density of the lights⁸⁶. Like in the Polytope of Montreal, Xenakis sought parallels rather than unions: "I wanted to establish a contrast: the lights are a multitude of points, with stops, starts, etc., and the music is continuous, for although the sound changes it does not stop"⁸⁷. Much like in the *Polytope of Montreal*, Xenakis' installation creates a modulation of the existing space.

⁸⁴ Fleuret, 1988, 179; Sterken, 2008a, 317.

⁸⁵ The computer (IBM and Ampex equipment) generated some 43,200,000 binary commands for each performance in total (Sterken, 2008a, 317).

⁸⁶ Matossian, 1981, 221.

⁸⁷ Xenakis quoted in Fleuret, 1972; quoted in Harley, J., 2002, 45.

However, there are several important differences between the projects of Montreal and Cluny. For Xenakis, «the most important difference is that in Montreal I achieved the visual effect through film, while in Cluny I used digital magnetic tape»⁸⁸. Apart from the technical specifications, this had also aesthetic implications: the contrast between the aural and visual layers in the *Polytope of Montreal* was based on the juxtaposition of the linear continuity of the music with the pointillistic visual *spectacle*, while at Cluny, both the visual and the audio component included both continuous and discrete events. The refined technology allowed for the projection in space of variable combinations of complex configurations. Furthermore, in Cluny the audience is submerged in the spectacle, witnessing «the temporary transformation of this historical site into a violent cataclysm»⁸⁹.

⁸⁸ Harley, M. A., 1998, 63.

⁸⁹ Sterken, 2001b, 267-271.

Chapter IV

The *Diatope*

IV. i. Introduction

The *Diatope* was a hybrid construction, as the term itself that Xenakis coined to name it, from the Greek words *δια-* (across, through) and *τόπος* (place, location)¹. Essentially a *Polytope*, the *Diatope*'s specific difference is that the work was hosted in an architectural shell especially conceived and designed by Xenakis. The change of the prefix to *dia-* (across, through) emphasized "the homogeneous, enveloping spatiality of three media permeating each other: static architecture, spatialized music and mobile light"².

The work was based on the electroacoustic piece *La Légende d'Eer* (1977-78), which was spatialized and combined with a light component. As in the *Polytope de Cluny*, the audiovisual *spectacle* was computer controlled and entirely automated – the sound distribution to 11 speakers, as well as the commands for the electronic flashes and the lasers. In terms of wealth of media the *Diatope* has been Xenakis' most ambitious realization, combining architecture, music and light, along with five texts chosen by him as the work's "argument". The production of the work demanded an enormous investment at the time, and the joined efforts of several collaborators. Technical means already employed in other xenakian projects were included, but new software and technological means were developed especially for the work.

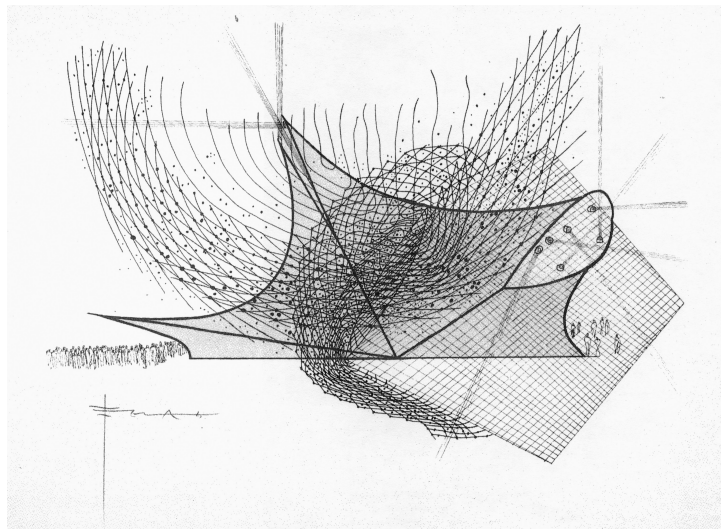


Fig. 61. The *Diatope*, lithography by Xenakis (1978), reproduced on the invitation for the inauguration of the work.

¹ Before deciding on the title *Diatope*, Xenakis referred to this project as "Polytope" (Xenakis, 1975), or the "Beaubourg Polytope" or "Beaubourgtope", an allusion to where it was located (Kanach, 2008, 256). The term *diatope* has also been used recently in the context of linguistics as a description of a language database by Evensen; it designates a space of dialogues "that encompasses intra-textual relationships, linking utterances within a single dialogue, as well as intertextual relationships, linking utterances in two or more different dialogues" (Evensen, 2002, 382-383).

² Harley, M. A., 1998, 64.

The architecture of the *Diatope* was conceived so that it could travel in a number of other locations; however, due to its high costs of maintenance it was only presented two times, in 1978 at the Square Beaubourg, next to the Centre Georges Pompidou in Paris, France, and in 1979 at the Hauptbahnhof Square in Bonn, West Germany. It was afterwards dismantled and stored, until it was sold as scrap metal in 1984. Today only the original music and magnetic control tapes are preserved³. Documentation of the work is located at the Iannis Xenakis Archives at the National Library of France, as well as in the Centre Pompidou Archives⁴. The only known existing visual documentation of the *spectacle* is a set of slides by Xenakis' assistant Bruno Rastoin⁵. A 24-page catalogue⁶ was published at the time, including photographs, preliminary sketches, and texts by Xenakis, Maurice Fleuret, Jean Millier, and earlier texts by Le Corbusier on Xenakis' design of the west façade of the Convent of La Tourette and the Philips Pavilion, as well as five philosophical and scientific texts were included in the catalogue, chosen by Xenakis in a programmatic manner. Apart from these program notes, Xenakis also refers extensively to *La Légende d'Eer* and the *Diatope* in two texts (Xenakis, 1981/Xenakis 1985; Xenakis, 1982b), and briefly in subsequent writings and interviews (Matossian, 1981; Delalande, 1997; Varga, 1996; Szendy, 1996).



Fig. 63. View of the *Diatope*, 1978, Paris.

³ The magnetic tapes containing the commands for the lights were stored until recently at the CEMAMu, now transferred to the Iannis Xenakis Archives at the National Library of France (BNF), Kanach, 2008, 247.

⁴ The Iannis Xenakis archives at the Bibliothèque Nationale de France (BNF) are in the process of being inventoried. For the *Diatope* see: Iannis Xenakis Archives, Bibliothèque Nationale de France: X(A), 11-12. As we didn't have access to these archives at the time of writing, we only took in consideration those that are transcribed in: Solomos, 2006, 22-25, or reproduced fac simile in: Kanach, 2006, 352, 356-357; Kanach, 2008, 263-265; even though there exist more (Sterken, 2004, 452). Relevant documentation is also preserved at the Archives Centre Georges Pompidou, which have not yet been inventoried.

⁵ These slides are included in: Iannis Xenakis, *La Légende d'Eer*, Electroacoustic Music (1), Xenakis Edition vol. 5, Mode 148 (DVD 5.1 surround sound), US, 2006. The DVD includes an audiovisual montage of some 350 slides taken by Bruno Rastoin at the time.

⁶ *Centre Georges Pompidou: geste de lumière et son. Le Diatope – Xenakis*, Paris, Centre Georges Pompidou, no date (ca 1978), 24 p.

IV. ii. Historical overview: conditions of commission and construction

In 1974, shortly after the completion of the successful *Polytope de Cluny* (1972-'74), Robert Bordaz, president of the newly established *Centre National d'Art et de Culture Georges Pompidou*, invited Xenakis to create a new work, involving light and sound to animate the building and the square in front for the inauguration of the center⁷. Xenakis's initial idea was a utopian project: a "World Polytope", where cities all over the globe would engage in a "complex artistic game", combining "the most advanced scientific research with the most prophetic artistic forms", in "a fantastic network of optimistic and pacifistic art throughout the world."⁸ Like the rest of the proposed *Polytopes* of cosmic scale, it was never realized.

Less, but similarly ambitious proposals followed. These are outlined by Xenakis in a "Preliminary Studies" document⁹, together with his final proposal: a) a large-scale light show which would encompass the Centre Pompidou on the inside and outside, extending also over the entire city by means of "an outdoor aerial network of laser beams linking the highest points of Paris", accompanied by a special score that would integrate, among others, sirens of aerial alert¹⁰. b) Enveloping "the Center's four facades with a luminous net covered with electronic flashes", setting the building "ablaze in a white, moving and dazzling light according to a predetermined light score and automatically controlled by a computer"¹¹; c) "A double, three dimensional webbing made from cables and metal frameworks, scattered with electronic flashes that would follow a predetermined score/program", suspended about 50 m. high and over the Beaubourg square, in front of the center¹².

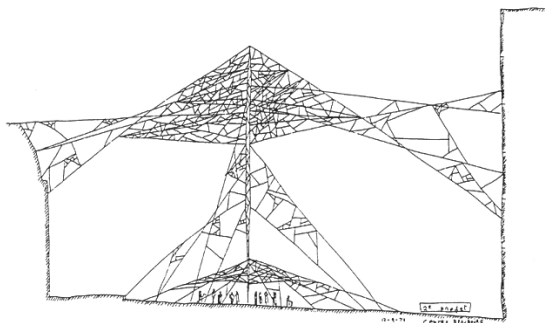


Fig. 64. Iannis Xenakis, "Beaubourg Polytope", sketch of unrealized proposal, c. 1974 (Xenakis, 1974).

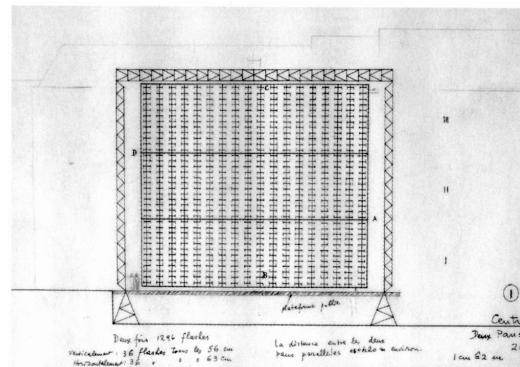


Fig. 65. Iannis Xenakis, "Beaubourg Polytope", sketch of unrealized proposal, c. 1974.

⁷ See: Letter from Robert Bordaz to Iannis Xenakis, May 10th 1974 (Archives Centre Pompidou). Bordaz was also the commissioner of the *Polytope of Montreal* for the French Pavilion at the 1967 World Expo in Montreal.

⁸ Kanach, 2008, 247, 254-255. The proposal is described in a report by Xenakis, titled "World Polytope (Global interactions of light and sound)", dated March 1974 (Iannis Xenakis Archives, BNF). It is also mentioned in Fleuret, 1988, 181.

⁹ Xenakis, 1974; Kanach, 2008, 256-259.

¹⁰ "First proposal" in Xenakis, 1974, 1; Kanach, 2008, 256. See also: Xenakis, 1976, 186; Xenakis, 1979, 17; Sterken, 2004, 445.

¹¹ "Second proposal", in Xenakis, 1974, 1; Kanach, 2008, 256.

¹² "Third proposal", in Xenakis, 1974, 1; Kanach, 2008, 256.

All three different proposals were rejected due to financial constraints¹³. In his “definitive project proposal”¹⁴, Xenakis had to adjust his project to more modest proportions: two *Polytopes*, an “open” and a “closed” one, installed in front of the center. The *Open Polytope* would comprise of two identical vertical matrixes of cable net (of 19.60 m. height and 22 m. width), each one integrating 1296 electronic flashes; these “curtains” would be placed parallel to each other, with enough space for the public to circulate in between, experiencing “a sort of wind of light oscillating between the two veils”¹⁵. The *Closed Polytope* was conceived as an “enclosed and autonomous surface/shell” where “actions de lumière et de son”, light and sound events of approximately 30 minutes would be hosted.

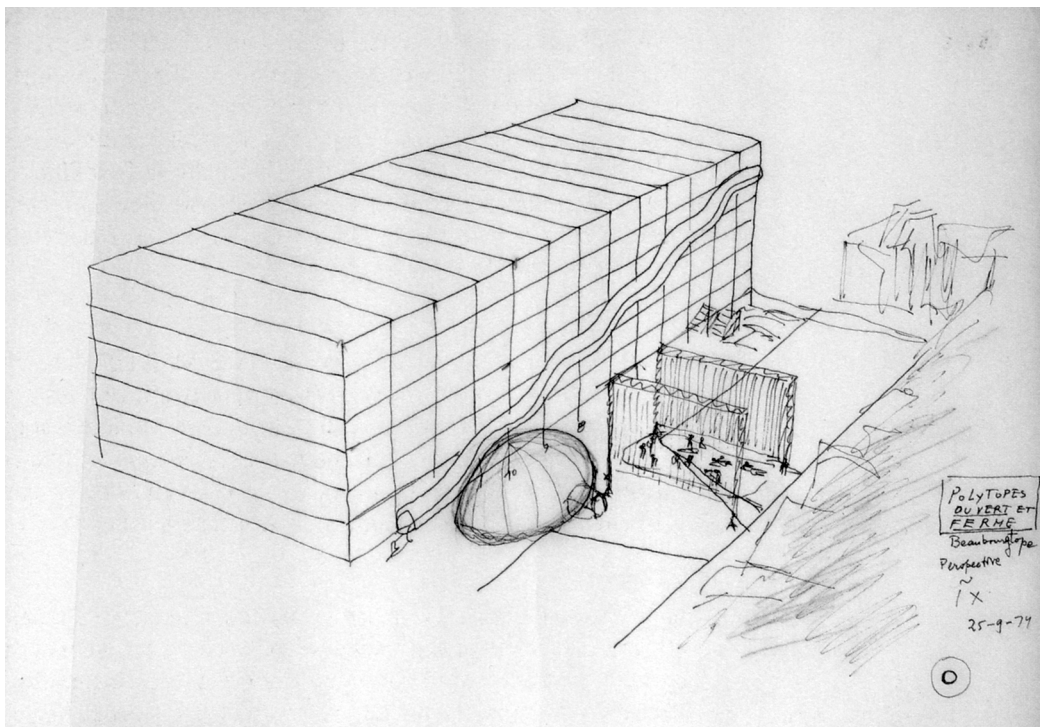


Fig. 66. Iannis Xenakis, *Beaubourg Polytope*, proposition for a closed *Polytope* and an open *Polytope*, c. 1974.

With this twofold solution Xenakis explicitly tried to balance the high costs of his ideas: a new event would be combined with a more “safe” solution, close to the successful *Polytope de Cluny*¹⁶. Nevertheless, the idea of an “open” component was also dismissed due to financial constraints - only the “closed” *Polytope* was finally materialized.

¹³ Also due to the disapproval of the architects of the Centre Pompidou, Richard Rogers and Renzo Piano (document “Compte rendu de reunion”, dated 5/11/1974, and letter from R. Piano and R. Rogers to R. Bordaz, dated 22/10/1974, both at the Archives Centre Pompidou).

¹⁴ “Fourth proposal – final project”, in Xenakis, 1974, 2-6; Kanach, 2008, 257-259.

¹⁵ Xenakis, 1974, 4.

¹⁶ “The fundamental ideas behind this project are the following: 1) concentrate the events and the equipment needed in order to reduce costs...use materials from the *Polytope de Cluny*...and organize it in an enclosed and autonomous surface/shell where paying entries will be possible... 2) in order to justify the investment and to make the spectacle available to a maximum number of spectators, the POLYTOPE must become itinerant...”, Xenakis, 1974, 2; Kanach, 2008, 257.

After trying out different solutions on the basis of spheres (a hemispheric dome with conventional internal frame and a geodesic sphere)¹⁷, Xenakis oriented his design for the architecture of the *closed Polytope*, the *Diatope*, to double-curve forms, based on the principles applied to the *Philips Pavilion* of 1958. This solution was also in this case dictated by practical reasons of acoustics and maximum free space for the visual component. The structure was designed as light and transportable¹⁸.

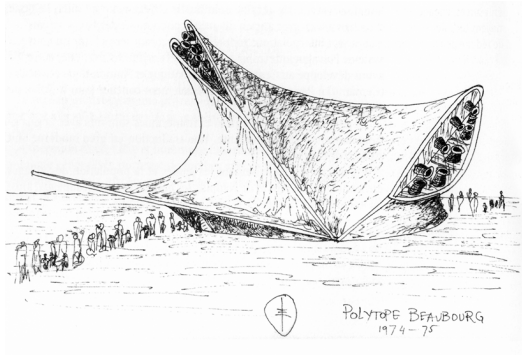


Fig. 67. Iannis Xenakis, drawing of the *Diatope*, 1975.

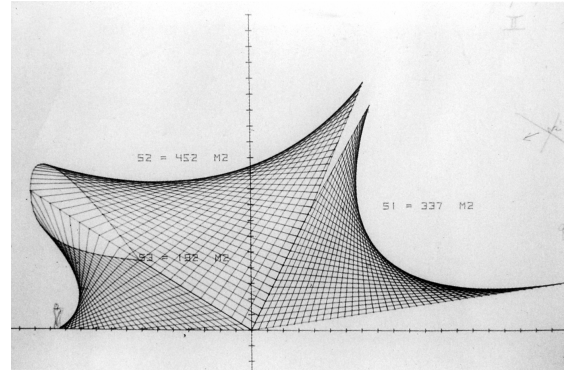


Fig. 68. Study of the *Diatope*'s shell by T.A.A.A., c. 1976.

A call for offers was launched on September 1975¹⁹: T.A.A.A. (Technique avancée de l'architecture et de l'aménagement), an office specialized in light structures, was assigned the construction of the tent, and the Société Esmerly Caron/Groupe Arcora the construction of the supporting skeleton. The structure was installed at the Beaubourg Square, next to the Pompidou Center.

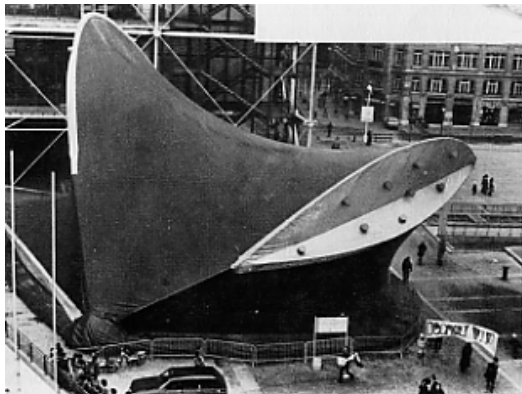


Fig. 69. The *Diatope*, 1978.

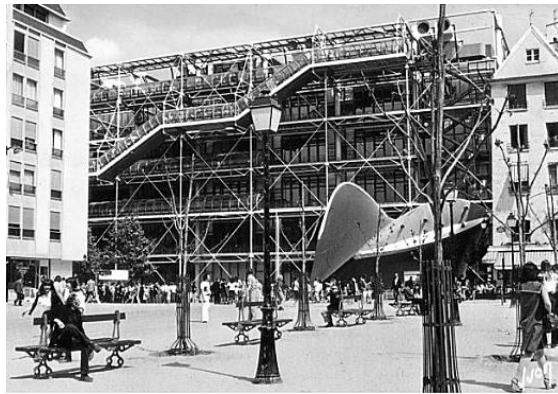


Fig. 70. View of the *Diatope*, 1978.

Xenakis' principal collaborators for the project were Blaise Gautier, Claude Mollard, Michel Prinzie, Jean-Marc Prodhomme, Bernard Bacri, Bernard Tomasi, Marcel Bonnaud, Jean Seyrig, Marc Malinowski, Wolfgang Becker, Volker Müller, and James Whitman. The computer programming was realized at CEMAMu. The equipment and

¹⁷ Note "Avant-projet de couverture de la structure inaugurale. Examen de différentes solutions possibles", April 9, 1975, Iannis Xenakis Archives, Bibliothèque Nationale de France), quoted in Sterken, 2004.

¹⁸ According to Fleuret, 1988, 178, Xenakis had also considered a light, tent-like structure to host his *Polytope* for the Festival d'Automne in 1972 – a balloon shaped structure, placed at the four bases of the Eiffel Tower. Tent-like structures were very common in World Expositions.

¹⁹ See related documents at the Archives of the Centre Pompidou, f. ex. « Appel d'offres pour la coque du pavillon », dated September 1975.

programming required for the automation of the entire *spectacle* was realized by Cornelia Colyer, Xenakis' collaborator at the CEMAMu; the programming of the visual part, as well as for the synchronization of the audio and visual components. Some equipment from the *Polytope of Cluny* was recuperated, including lights and flashes, as well as some control apparatuses²⁰.

The premiere of the *Diatope* was initially programmed to coincide with the opening of the Centre Pompidou, but due to technical problems it was continuously delayed. The work was presented to the press on June 14, 1978, but was closed down immediately for two weeks due to technical problems²¹. It finally opened for the public in June 28th 1978, through the 31st December 1987²², receiving a total of 9.055 visitors (tickets) – a very small number compared to the success of the *Polytope de Cluny*, and insufficient to cover the investment²³.



Fig. 71-72. The *Diatope*, Paris, 1978.

The *Diatope* was afterwards transferred to Bonn, Germany, where it was reassembled in three months at the central Bahnhofplatz. Under the subtitle “Klang – Laser/Licht – Bewegungen” [Sound-Laser/Light-Movements], the work was presented from May 2 - October 31, 1979, as part of the popular *Floralies - Bundesgartenschau* Festival²⁴. The original structure, equipment and tent were dismantled, transported to, and reassembled in Bonn. At the re-installation Xenakis “improved” the design of the sound and light components so that they would be “clearer, stronger, and would assure the extra-terrestrial aspect he pursued.”²⁵

²⁰ Sterken, 2004, 446. All technical specifications of the *Diatope* are described in detail in technical reports at the Centre Pompidou Archives (M. Prinzie, “Rapport technique sur le Diatope de Y. Xenakis”, dated 4.4.1977, typed manuscript, 8 p.; B. Bacri, “Diatope de Iannis Xenakis. Etat du materiel au retour de l’exploitation à Bonn”, dated 15/12/1979, typed manuscript, 3p.; B. Bacri, “Diatope de I. Xenakis. Liste de matériels”, dated 15/4/1981, typed manuscript, 4 p., attachment to a letter from B. Bacri to J. L. Choplin, dated 24/4/1981).

²¹ Matossian, 1981, 277-278, gives a fascinating account of the final stages of the realization of the *Diatope*. See also Sterken, 2004, 447-450.

²² There were 3 sessions daily on weekdays and 5 during the weekend.

²³ The total cost of the *Diatope* mounted to 4.034.000 FF. According to the estimation in 1976 the total tickets for a year were estimated to 2.900.000 FF (note “Spectacle Xenakis. Nouvelle estimation des charges et recettes”, 4 novembre 1976, Archives Centre Pompidou), but that attendance was never reached.

²⁴ Xenakis had been awarded in 1977 the Beethoven prize of the city of Bonn.

²⁵ This is mentioned in a note titled: “Rapport de mission de MM. Ajac et Gauthier” (May 15, 1979, Archives Centre Pompidou): [According to the evolving concept Xenakis always wanted to give to the *Diatope*, he reworked the visual and sound partitures so that they would be clearer and stronger, assuring above all the

Again, technical problems appeared that delayed the inauguration. From May 1st, 1979 to November 1st, 1979, a total of 25000 visitors attended the presentations of the *Diatope* (three presentations daily).

Upon its return from Bonn, the installation's architectural components and equipment were stored at the Parc de La Villette in Paris. The Centre Pompidou and Xenakis himself made considerable efforts to install the work in other cities or cultural centers; however, as the costs were simply too high they all failed²⁶. At the end, the *Diatope* was donated in 1982 to the Regional Office for Culture of Marseille²⁷. All the equipment and structural elements were transferred to Marseille, so that the *Diatope* could be presented in the frame of a festival; however, the technical equipment did not function any more and the vinyl membrane had deteriorated. As the costs to repair the work were simply too high, the elements of the work were ultimately discarded or sold as scrap metal in 1984²⁸. The *Diatope* was to be the last in the series of *Polytopes*: "the delusions of the "Diatope" contributed without doubt to Xenakis' dissatisfaction and discouragement to undertake a new undertaking of the kind."²⁹



Fig. 73. The *Diatope*, Bonn, 1979.

desired extraterrestrial aspect][« Xenakis, selon la conception évolutive qu'il a toujours voulu donner au *Diatope*, a retravaillé les partitions visuelles et sonores qui sont plus claires, plus fortes et assurent davantage l'aspect extra-terrestre souhaité.»)

²⁶ A contract for the exploitation of the *Diatope* was signed with B. Bacri in 1979; after it expired in 1979, Xenakis himself tried to promote the *Diatope* by writing to mayors of European cities and to contacts in cultural institutions, but without success (Letters by Xenakis at the Iannis Xenakis Archives, BNF; Sterken, 2004, p. 447). In 1980 the Centre Pompidou offered the *Diatope* to the City of Athens for a symbolic price, but it was finally not accepted (Correspondance between M. Groshens and M. Daskalakis (National Office of Hellenic Tourism) during April – May 1980, mentioned in Sterken, 2004, 449; document titled "Diatope. Point de la situation au 15 avril 1980" by M. Godefroy, typed manuscript, 3 p., Archives Centre Pompidou).

²⁷ The work was sold to the city for a symbolic price. See the note titled "Diatope. Point de la situation au 15 novembre 1982" (typed manuscript, 2p., Archives Centre Pompidou).

²⁸ The estimated price for its reconstruction then was 2.000.000 FF - even the simple renewal of the flashes (every six months) amounted to 90.000 FF. For every presentation 80 Kwh of electricity and 1.500 litres of water for cooling were consumed (Sterken, 2004, 451-452; Sterken, 2008a, 319).

²⁹ Fleuret, 1988, 181 (translation by the author).

IV.iii. Description and analysis: architecture, music, light

IV.iii.a. Architecture

The basic element that differentiates the *Diatope* from the other *Polytopes* is the architectural construction, which was especially designed to host the spectacle, constituting an integral part of the work³⁰. The architecture was conceived as a shell formed by three hyperbolic paraboloids, a concept is very close to the curvilinear form of the Philips Pavilion of 1958³¹. As Matossian explains, the *Diatope* "did not have a constant radius of curvature like the sphere but a different radius of curvature at each spot giving a variable form of smooth surfaces recalling the Philips Pavilion"³².

Xenakis was familiar with the geometry of ruled surfaces, and particularly hyperbolic paraboloid and conoid forms; most of his architectural designs are characterized by his consistent research into the volumetric architectural form³³. Hyperbolic paraboloids constitute a theme in Xenakis's oeuvre; as we mentioned above, Sikiaridi has shown that the way this same structure is implemented in music and in architecture is *specific* to Xenakis³⁴.

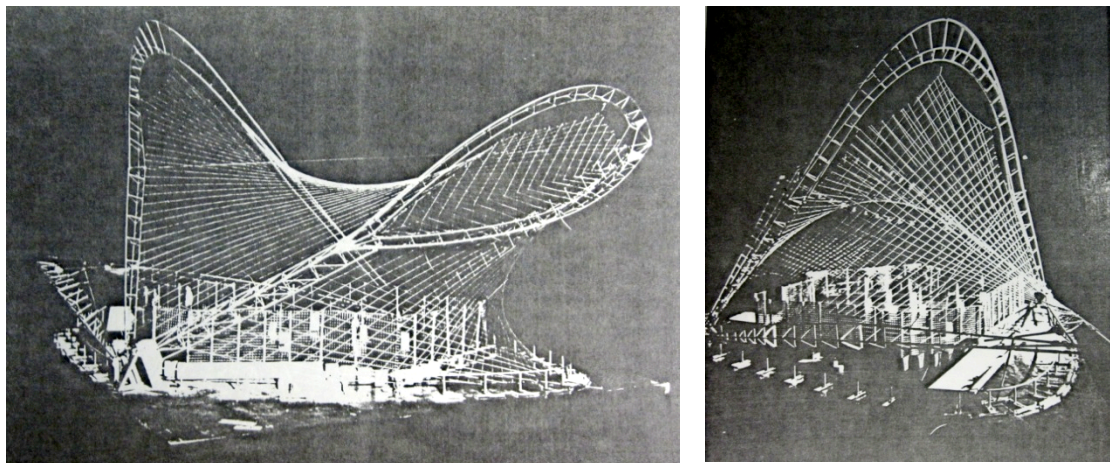


Fig. 74-75. The *Diatope*'s model, c. 1975.

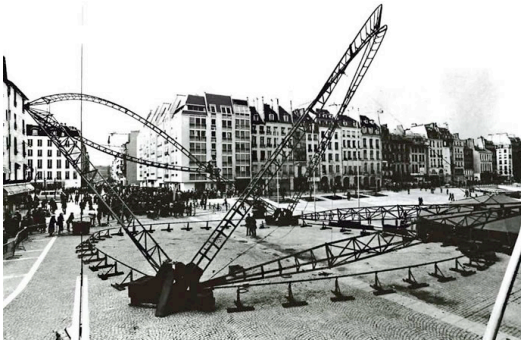
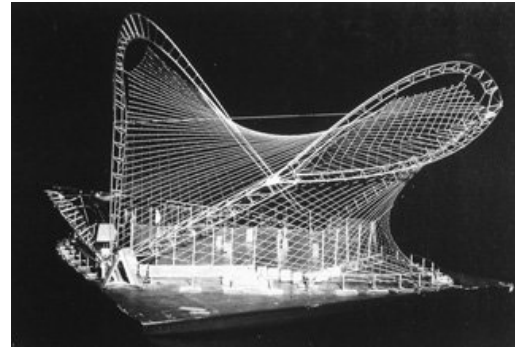
³⁰ Sterken, 2001a, 192.

³¹ Xenakis, 1978, 10. For a comparison of the architecture of the *Philips Pavilion* and the *Diatope*, see Sterken, 2004, 60, 71-82.

³² Matossian, 1981, 223.

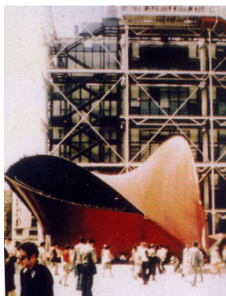
³³ For example in the case of the Bagdad stadium (1958), a music studio in Gravesano, Switzerland (1961), and in his proposal for the *Cité de la Musique* (1984) together with J. L. Véret, all unrealized projects (Sterken, 2004, 71-82; Kanach, 2008, 89-92). Sterken, 2004, 51, traces an important transposition of the metaphorical value of the regulated surfaces in Xenakis's architectural oeuvre: while during the '50s they express the hopes of the avant-garde architects, at the end of his career, the very same geometric solution becomes an expression of nostalgia.

³⁴ Sikiaridi, 2001, 206.

Fig. 76. The steel skeleton of the *Diatope*, c. 1978Fig. 77. Scale model of the *Diatope*, c. 1976.

The combination of several intersecting concave and convex surfaces to maximize the available free space and minimize the covering surface served also another purpose:

The Diatope's form, because of the laser trajectories, also had to conform to the following principle: a maximum of free volume for a minimum of enclosing surface. The classical answer is the sphere³⁵. But the sphere, beautiful in itself, is poor for acoustics and less rich tactilely than some other, double-curvature forms. Whence the current configuration, which is a sphere in its principles, yet open to the world by the convergence of its geometrical construction, using hyperbolic paraboloids.³⁶

Fig. 78-80. The *Diatope*, Paris, 1978.

Apart from its aesthetic qualities³⁷, the solution of a shell formed by three hyperbolic paraboloids replied to “a forever present and unresolved question - that of which architectural form to give to musical and visual events”, a question that occupied Xenakis for more than 20 years. Xenakis was deeply concerned about how architecture would better “serve” audiovisual practices:

What architectural form is to be given to musical or visual performances? I say that there is no unique answer. But I also say that the effect of the chosen architectural form has a quasi-tactile influence on the quality of the music or spectacle performed in it. This is aside from all considerations of

³⁵ When referring to spherical form solutions Xenakis probably had in mind architect Fritz Borneman's design of Stockhausen's *Sphere* auditorium (the German Pavilion at the Osaka Expo of 1970), where a maximum of 550 listeners were situated on a central sound-permeable platform, surrounded by loudspeakers.

³⁶ Xenakis, 1978, 9-10. (Engl. trans. by S. Kanach, in: Solomos, 2005; Kanach, 2008, 261-262).

³⁷ See Chapter II.iii.

acoustics or of optimal proportions for visualizing or listening.³⁸ A similar architectonic solution was proposed in 1980 for the *Cité de la Musique* of Paris, by Xenakis in collaboration with architect Jean Louis Veret.

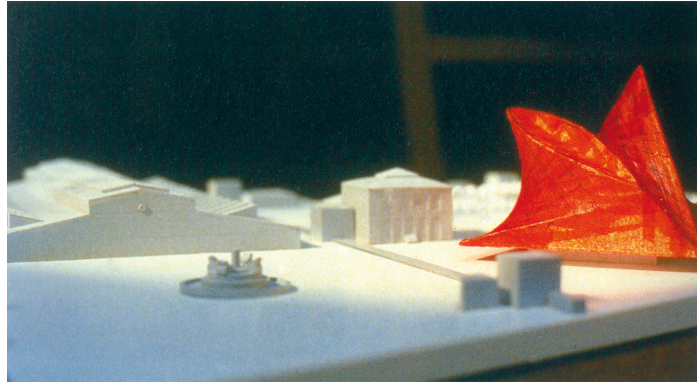


Fig. 81. Iannis Xenakis & Jean-Luis Veret, scale model of the proposed *Cité de la Musique*, 1980.

The supporting shell of the *Diatope* consisted of a steel frame structure over which a 960 m² semi-transparent, red vinyl membrane was stretched, leaving two openings. The structure was self-supporting, without foundations or stretched cables at the outside (to ensure stability 160 bags of sand weighing about 5 tons were installed under the subfloor, and the structure was “anchored” to the ground). The two steel arcs of the skeleton extended to a height of approximately 20 m., supporting three hyperbolic paraboloids. The parallelepiped floor plan (21x21 m.) consisted of two steel porticos, covering 400 m².

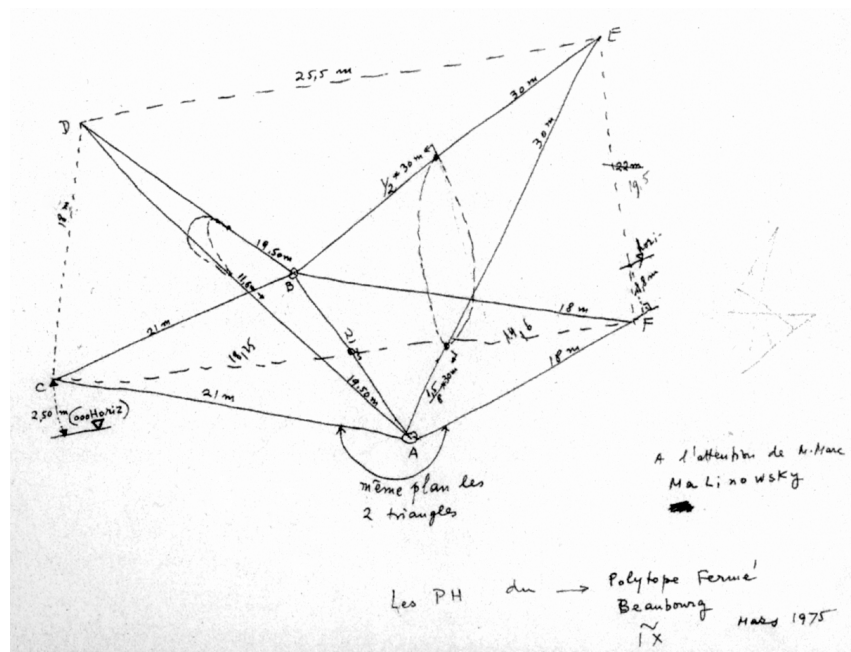


Fig. 82. Iannis Xenakis, The *Diatope*, study design of the geometric definition, 1976.

³⁸ Xenakis, 1978, 9-10. (Engl. trans. by S. Kanach, in: Kanach, 2008, 261-262). See also Xenakis, 1980a, xx; Xenakis quoted in Matossian, 1981, 182; Xenakis, 1980b; Xenakis, 1983; Sterken, 2004, 71-82.

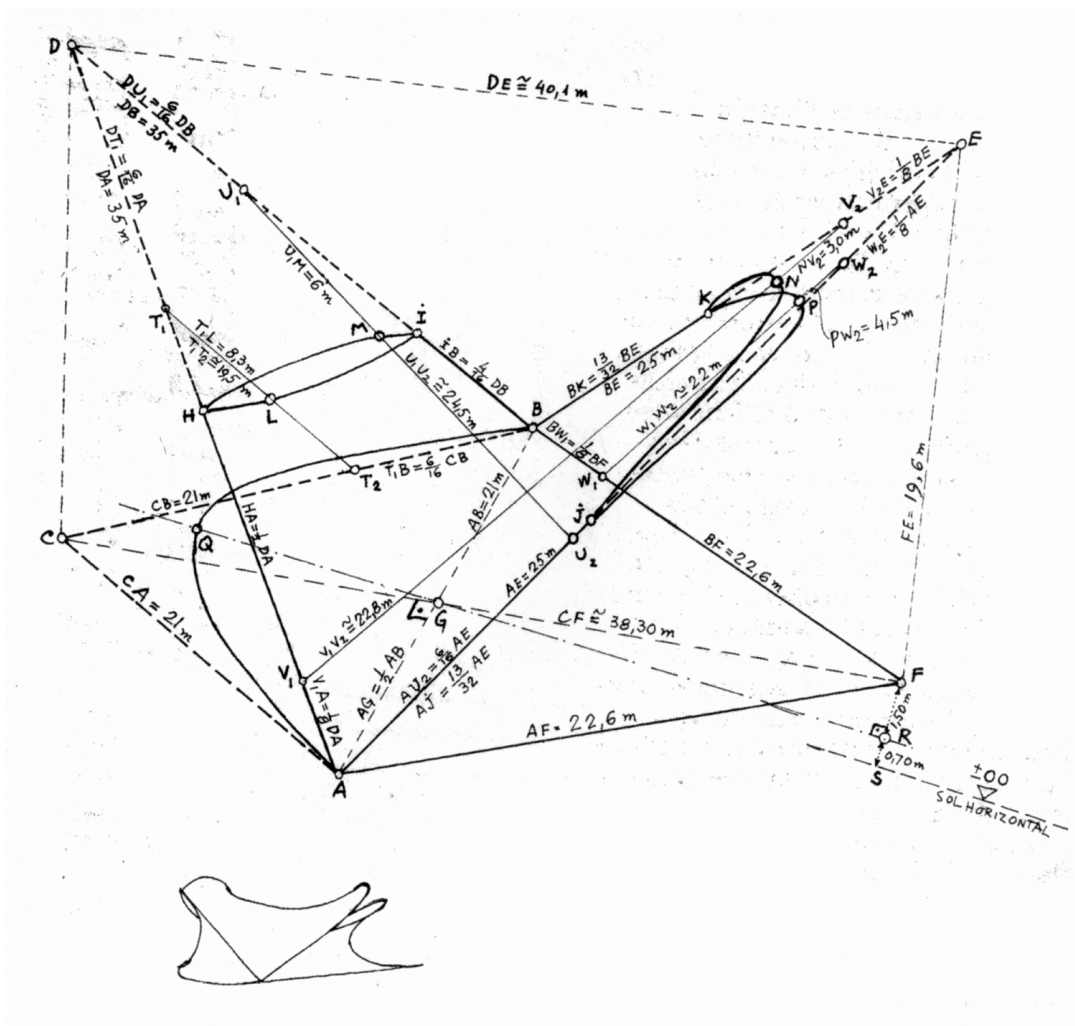


Fig. 83. Iannis Xenakis, *The Diatope*, study design of the geometric definition, 1976.

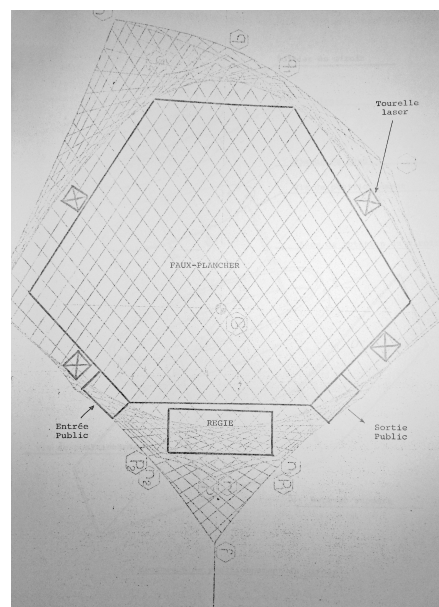


Fig. 84. *The Diatope*, floor plan, 1976.

Visitors (200 maximum) entered through a tunnel of stretched fabric shaped like an arc (2 m. wide and 2,7 m. high). The subfloor (165 m²) where visitors could wonder was positioned 70 cm underground, at ground level parallel to the plan, and was composed of 1718 translucent reinforced glass tiles.³⁹ A metal cable net (of 2.500 m. of steel cable of Ø 6 mm.) was suspended at a 50-cm. distance from the vinyl cover, where the electronic flashes were attached. Six “light wells” (“puits de lumière”), columns made of reinforced glass, were erected in the interior of the shell, based on the subfloor, around which a peripheral *garde-fou en treillis soude de 2 m. de haut* was protecting the public from the laser projectors. The reinforced glass elements, tiles and columns, were employed in order to filter and reflect the laser light beams they received.

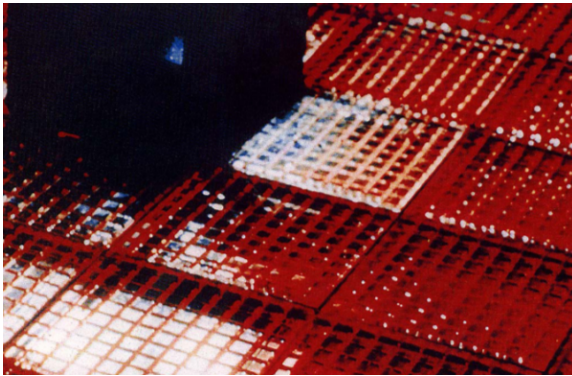


Fig. 85. The *Diatope*, photograph of the translucent glass tiles floor.



Fig. 86. The *Diatope*, Paris, 1978.



Fig. 87. The *Diatope*, Paris, 1978.



Fig. 88. The *Diatope*, Bonn, 1979.

The choice of semi-transparent vinyl, both light and permeable, accurately corresponds to, and translates architectonically, the second meaning of Xenakis's chosen prefix, “dia”: pervious. Light and sound permeated the *Diatope* from within to the outside, and vice-versa: external noise from the surrounds would drift in, filtered by the vinyl, and the music would “leak” to the outside. This direct relationship with the surrounding environment was apparently a feature that

³⁹ Kanach, 2008, 249. Xenakis wanted light to be reflected from underneath the floor – initially he wanted the elevated subfloor to be metallic, with voids permitting rays to be projected from underneath (note by Xenakis titled “Polytope Beaubourg. Equipement souhaite”, dated 21/2/1975, Archives Centre Pompidou).

Xenakis not simply accepted, but also intended to achieve⁴⁰; it was a different sort of immersion, which pursued an interaction with the urban environment. In the *Diatope*'s architecture the space boundaries of the walls and ceilings disappear - like in the Philips Pavilion, only now also the floor disappears, since it is made of glass tiles. The visitor would get the feeling of floating in the middle of the room.

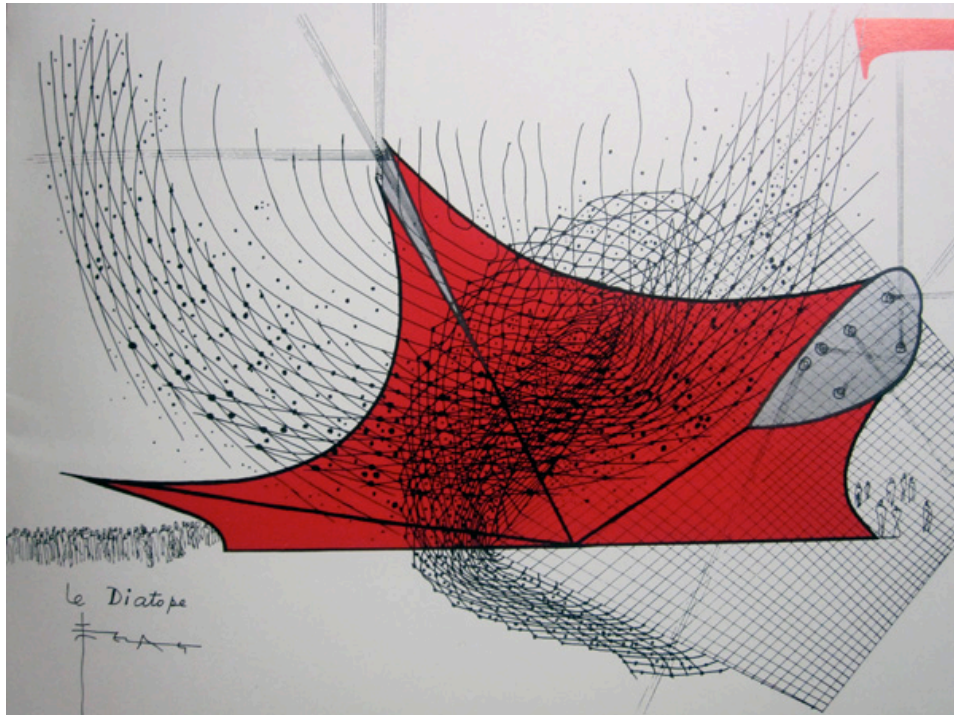


Fig. 89. Iannis Xenakis, The *Diatope*, lithography reproduced on the catalogue cover, 1978.

⁴⁰ This is a point that all researchers insist on (Oswalt, 2002a; Sterken, 2001a, 192; Kanach, 2008, 249). With regards to the volume of the audio component and the lightness of the architectural shell's material, this effect would have been deliberate; however, the visual component's effect would have been reduced by daylight. There are some indications that Xenakis aimed for an interaction-with-the-external-environment-effect (« la membrane textile doit se trouver entièrement à l'extérieur ou à l'intérieur de l'ossature métallique, et non pas panachée intérieur-extérieur comme l'exigerait l'Architecte », Letter from M. Malinowski of the TAAA to M. Prodhomme, August 26, 1975); and there is also his « programmatic » aim to « abolish the obscurity of a hall » (Xenakis, 1958a, 132). However, apart from the fact that the inside of the shell was blackened for opacity, there are also indications that the *spectacle* took place in complete obscurity (« Comme dans les salles de cinéma, le spectacle se déroule dans l'obscurité, seules sont visible les indications relatives aux issues de secours », Technical report by M. Prinzie, dated 4.4.1977, Archives Centre Pompidou). Our hypothesis: as some neighborhood residents who complained to the police for the noise coming from the performances, the work was permitted to operate only until 19:00 (Sterken, 2001a, 192), even though originally this was not the case. Sonic transparency might have been pursued, but not visual, at least not to the same degree.

IV.iii.b. Music: *La légende d'Eer*

The aural component of the *Diatope* was the electroacoustic piece for tape *La légende d'Eer* [The Legend of Er] (7 channels, 46'), composed by Xenakis in 1977 (in a first version)⁴¹. The title refers to the homonym myth from Plato's *Republic* that narrates the return of the soldier Er from the world of the departed (see below Chapter IV.v). Originally commissioned by the West German Radio (Westdeutscher Rundfunk - WDR) in Cologne, the piece was first presented on February 11, 1978 at the planetarium of Bochum, Germany, as part of the *Musik der Zeit IV Festival*⁴². The piece continues to be performed in different mixes⁴³.



Fig. 90. Iannis Xenakis during the *Polytope of Persepolis* performance, 1971.

⁴¹ Xenakis produced multiple versions of all his tape pieces, mixing for different numbers of channels, accounting for different playback situations, and so forth (Harley, J., 2002, 37). The final version survives today on a four-track tape for performances (1977), a stereo version on CD ("Iannis Xenakis 2", Auvidis Montaigne, MO 782058 (CD), 1995; reissued by Montaigne/Naïve AD 061 MO 782144 (CD), 2001) and a remastered edition for surround sound (Mode Records, Mode 148, CD and DVD 5.1).

⁴² According to Hand-Jürgen Nagel, coordinator for the *Diatope*'s transfer to Bonn and later director of the Goethe Institut in Calcutta, India, Xenakis was invited to perform *La Légende d'Eer* in Calcutta (Interview with the author, July 2009). The performance took place on February 25th 1982 at the Birla Planetarium in Calcutta; Xenakis mixed the piece live. Also James Harley mentions that the piece was presented in Delphi, Greece "beneath a meteor-streaked August sky" (Harley, J., "Record Review, Xenakis: *La légende d'Eer* (*Diatope*)", *Tempo*, 1996, 64). Also performed by Xenakis live (Klangregie) in the frame of Ars Electronica '90, Digitale Träume - Virtuelle Welten, 8-14 Sept. 1990 (Leopoldseeder, Hannes, Schöpf, Christine, Stocker, Gerfried, "1974-2004" *Ars Electronica. The Network for Art, Technology and society: The First 25 Years*", Ostfildern-Ruit: Hatje Cantz, 2004, 257).

⁴³ F.ex. in the frame of the *Xenakis Festival*, Royal Festival Hall, London, October 7-9, 2005; also in site-specific mixes by sound artist Daniel Teige, see <http://web.me.com/danielteige/dafoot/xenakis.html> (4/1/11).

Like the “soundtracks” of the *Polytopes* of Persepolis (1971) and Cluny (1972), *La Légende d'Eer* was also an electroacoustic piece. The music material consists on existing sounds (manipulated instrumental sounds, various manipulated natural sounds) and computer generated sounds, recorded on a 7-track 1” tape⁴⁴. Most of the sound materials used in the piece are very similar to the ones used in the *Polytope de Cluny*, although a greater prominence is given to synthetic sounds, both analogue and digital (stochastic). These were realized by mathematical functions on a computer and subsequently converted from digital to analog at the Centre d’Etudes de Mathématique et d’Automatique Musicales (CEMAMu)”. In *La Légende d'Eer* Xenakis applied for the first time some of the results of his new sound synthesis technique, the *Dynamic Stochastic Synthesis*: synthetic sounds composed by probability functions, by acting directly on the pressure-time curve⁴⁵. The synthetic sounds were composed at the CEMAMu, while the final composition, as well as the processing of the concrete elements (filtering, reverberation, transpositions of speed, etc.) was realized at the WDR electronic studio in Cologne in 1977⁴⁶.

The piece is a huge crescendo and decrescendo stretching over 45’ with a climax that is apocalyptic. The form obeys an arch-structure – music appears very slowly, with high-pitch sounds, followed by waves of sound that culminate gradually in an apocalyptic cosmogony, to disappear progressively afterwards⁴⁷. The music pieces for the *Polytope of Persepolis* and the *Polytope of Cluny* are similar with regards to impact – a dense mix of disparate sounds with a hypnotizing effect; however, *La légende d'Eer*’s long duration and simplicity of its dramatic arche form, distinguishes the piece from Xenakis’ musical œuvre⁴⁸. In this case, the tie to *Bohor* (1962) is stronger than the other *polytopes*, as both pieces are based on huge volumes and masses of sound in gradual transformations⁴⁹.

Though the original spatialization program has been lost, we know that the music was diffused in space by 11 loudspeakers (60 W). In the program notes Xenakis briefly mentions that: “each track is distributed over the eleven high quality

⁴⁴ Xenakis, 1978, 10-11; Valsamakis, 2000, 29; Hoffman, 2001, 174; Luque, 2006, 21-24. For an analysis of the piece see Harley, J., 2002; Solomos, 2005; Solomos, 2006, 4.

⁴⁵ See Chapter II.iv. *La Légende d'Eer* uses elements synthesized with an earlier implementation of the basic concept of *dynamic stochastic synthesis*. Xenakis used mathematically controlled disorder as his point of departure for calculating stochastic variations of sound pressure directly on the time-pressure curve (Xenakis, 1982b, 268-269). These sounds were actually the earlier implementation of the application of probability theory to sound synthesis, an application Xenakis realized in the 1990s with the *GENDYN* sound synthesis software. See Xenakis, 1978, 12; Xenakis 1992, 289-293; Valsamakis, 2000, 40-52; Hoffman, 2001, 174; Harley, 2002, 54-56; Solomos, 2006, 4; Luque, 2006, 21-24, 90.

⁴⁶ The studio for electronic music of the WDR (Studio für Elektronische Musik des Westdeutschen Rundfunks Köln) in Cologne, Germany, was one of the most important laboratories for electronic and electroacoustic music in Europe at the time.

⁴⁷ For an analysis of the piece see: Solomos & Raszinski, 1999, 66-67; Barrett, 2002, 72-78; Harley, 2002b, 49-50; Solomos 2008a, 199-201 (also Solomos, 2005; Solomos, 2006; Solomos 2008b). Solomos bases his analysis on the work’s “score”, a schema on graph paper where Xenakis outlines the sounds used.

⁴⁸ Solomos, 2005.

⁴⁹ Although the *Diatope* is not mentioned in the diagram (see Chapter III.i). The 8-channel electroacoustic work *Bohor* (1962) is one of the first pieces where Xenakis’ “noise” aesthetic is manifested. At its Radio-France premiere, the amplification was pushed to an extreme level, and the loudspeakers were distributed to surround the audience. *La légende d'Eer* takes this approach much further; see Harley, J., 2002, 41.

loudspeakers scattered throughout the shell of the *Diatope*. The static or kinetic distribution is realized by means of a special computer program”⁵⁰. According to a manuscript concerning the spatialization of sound (fig. 91), the distribution of the tracks I, IV, V and VII were doubled, through a symmetric emplacement of the speakers: North and South (II), North-east and South-west (V), North-west and South-west (VII)⁵¹.

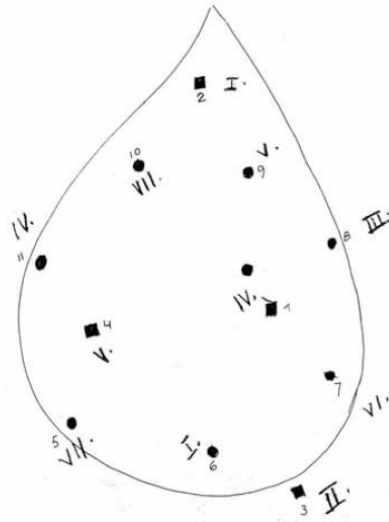


Fig. 91. Iannis Xenakis, diagram of the distribution of the channels (I to VII) to the speakers (1 to 11).

⁵⁰ Xenakis, 1978, 11; quoted in Solomos, 2005 (transl. S. Kanach). See also Xenakis, 1985, 184. “Static or kinetic distribution” refers to Xenakis’ definition of “Static Stereophonics” and “Cinematic Stereophonics”, as described in Xenakis, 1958a, 134.

⁵¹ Solomos, 2008a, 199-201; See also Solomos, 2004; Solomos, 2005; Solomos, 2008b.

IV.iii.c. The light component

Unfortunately very little remains of the light component⁵²: apart from a set of slides by Xenakis' assistant Bruno Rastoin⁵³, that statically convey the visual effect, there are some sketches and studies by Xenakis and printouts of the commands⁵⁴. However, according to Kanach⁵⁵, the magnetic tapes containing the commands for the flashes and the lasers have also been preserved and could be possibly reproduced.

The light component was hosted inside the architectural shell, whose upper internal surfaces were hung with a network of steel cables at a distance of roughly 50 cm. from the tent. Following the shell's form, the steel cable net also formed hyperbolic paraboloids, on which some of the optical and electrical equipment was attached, while another part was installed at the sides of the structure. The commands for flashes and the lasers were automatically controlled from an independent control room, located in a van within the tent. The technical optical equipment included⁵⁶:

- 1680 electronic white xenon flashes (produced by the company *Orthotron*), most of them attached to the cable net lining the ceiling and walls of the shell in regular grid, and some underneath the glass-tile floor⁵⁷.
- 4 laser projectors (manufactured by the company *Spectraphysics*), 4 W each, of which 3 green, and 1 red. The laser projectors were installed below the level of the glass-tile subfloor, in the service area surrounding the audience. The beam's direction was adjustable, controlled by a motor.
- Approximately 400, round or hexagon, fixed or pivotal mirrors, of 75 mm diameter each⁵⁸. Mounted on the 6 translucent glass columns within the audience area, and

⁵² Solomos & Racinski, 1999, 65-66; Solomos, 2006, 21-25; Solomos, 2008a, 202-204; Kanach, 2008, 250.

⁵³ These became recently commercially available in: Iannis Xenakis - electronic works 1: *La Légende d'Eer*, Electroacoustic Work for 7-channel tape Mode Records, Xenakis Edition Vol. 5, MO 148 (DVD), USA, 2005. The "film" accompanying the piece in this edition actually comprises of the 350 slides taken during the original presentation of the work in Paris. For a sample see:

http://www.youtube.com/watch?v=gdmWJPMKm_Y&feature=player_embedded (23/6/10). Unfortunately the work was never filmed (Kanach, 2008, 247), even though Xenakis wanted to have the work documented on film ("*Synthèse de Réunion du 2/11/76, Polytope Xenakis*", dated 3.11.1976, Archives Centre Pompidou).

⁵⁴ These are preserved at the Iannis Xenakis archives at the BNF; we only took in consideration those that are transcribed in: Solomos, 2006, 22-25, or reproduced *fac simile* in: Kanach, 2006, 352, 356-357; Kanach, 2008, 263-265, and Sterken, 2004, even though there exist more at the BNF (Sterken, 2004, 452).

⁵⁵ Kanach, 2008, 247.

⁵⁶ Numbers vary according to sources – the above-mentioned numbers are those stated in the *Diatope* program (Xenakis, 1978). Initially Xenakis had asked for more light equipment (2 red and 3 green lasers in addition to the 2 lasers from Cluny; 1000-1500 new flashes, in addition to 600 flashes from Cluny; 300 new mirrors in addition to the 300 from Cluny), so as to achieve a richer light component (note by Xenakis titled "*Polytope Beabourg – Equipement souhaité*", dated 21.2.1975, Archives Centre Pompidou). They were apparently limited due to their high price at the time. For more details on the technical specifications and effects see the "Technical report by Michel Prinzie", dated 4.4.1977, Archives Centre Pompidou.

⁵⁷ The flashes were 1680 according to Xenakis, 1978; 1600 according to Xenakis, 1981, 30. Their technical specifications are described in the document "*Orthotron*" (Solomos & Racinski, 1999, 65; Solomos, 2006, 21-22; related documents at the Pompidou Archives).

also on poles in the service area, the mirrors received the beams and reflected them to other mirrors, forming complex configurations from the reflected laser beams. Some of the mirrors were attached to micrometric metal fasteners with a spiral-grooved shaft, in order to change angle and form different configurations.

- Optical devices for rapid beam displacement, as well as other special laser effects, such as enormous prisms that split the laser beams before they were reflected to the mirrors. Some mirrors were also equipped with optic filters and prisms. The glass columns and floor also functioned as filters of light.

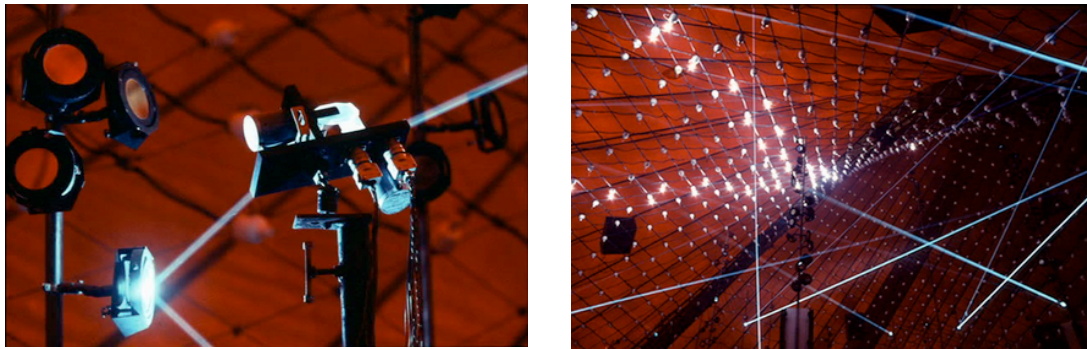


Fig. 92-93. The laser reflection mechanism

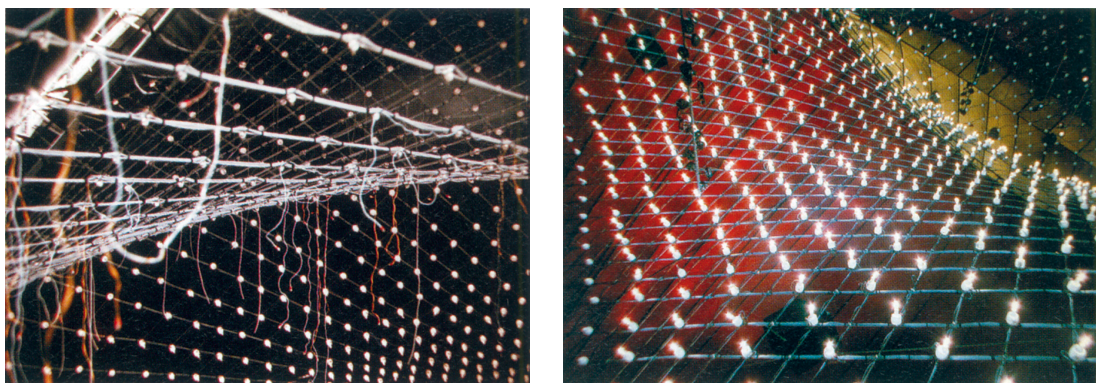


Fig. 94-95. Close view of the cable net supporting the flash lights.

Initially, Xenakis intended to have a “richer” light component⁵⁹. Like the soundbank used for the music piece, many of the visual configurations had been already used in the *Polytope de Cluny*⁶⁰. The light component in the *Diatope* was similar to that of the *Polytope de Cluny*: the basic aesthetic of geometric configurations consisting of points and lines remained the same. But the light configurations had greater

⁵⁸ The mirrors were 365 according to the “Tableau récapitulatif”, 496 according to the “Liste des matériels”, and 400 according to Iannis Xenakis, “Les chemins de la composition musicale”, 12. Regarding their technical characteristics, see the technical notice “Quick Elec”, Archives Pompidou.

⁵⁹ Note by Xenakis titled “Polytope Beabourg – Equipement souhaité”, dated 21.2.1975, Archives Centre Pompidou.

⁶⁰ Revault d’Allonnes, 1975; Fleuret, 1988, 180. Xenakis had to recuperate some of the technical equipment of the *Polytope de Cluny*; even though this was proposed for economy, it proved a very problematic and time-consuming process, as the equipment had not been stored properly (Sterken, 2004, 448).

complexity and refinement of movement than in the previous *polytopes*, as a more advanced control system was used, with more patterns and designs, moving, also projected on and filtered through the floor. As we know from descriptions, photos and sketches, the two distinct elements, laser rays and white light flashes formed successions of both abstract and figurative configurations in flux.

Apart from straight lines, the laser beams transformed by optical devices and reflected by the mirrors were multiplied, creating probabilistic or deterministic patterns, "multiplicities of luminous spider webs in movement"⁶¹. Xenakis' sketches for the light show mention shapes such as "lotuses", galaxies" and "wheels." In preliminary sketches the laser configurations are given poetic names, such as: "lotus", "anémones", "galaxies", "spiders", "araignées", "nappes", "roués", "wheels"; also abstract names: "G2", "Ω3", "Ω2", "W2", etc. Three basic laser figures appeared in variations throughout the *spectacle*, constituting the morphological basis of visual events: "Lotus" (5 variations), "Anemone" (4 variations), "Araignée" (6 variations). These were combined with three "roues" [wheels], rotating geometric figures of 6 variations each⁶².

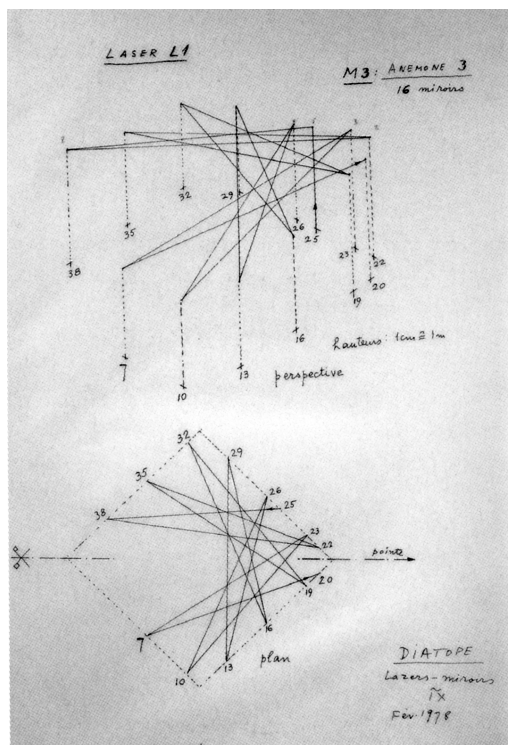


Fig. 96. Iannis Xenakis, design of a variation of the "anémones" lasers configuration, Feb. 1978.

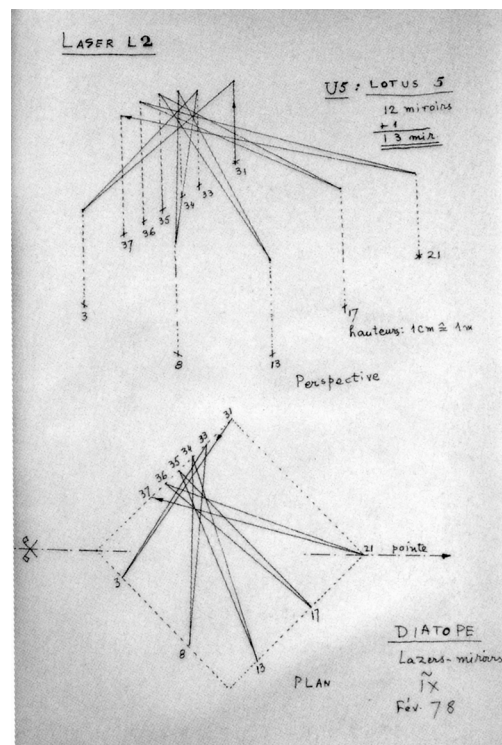


Fig. 97. Iannis Xenakis, design of a variation of the "lotus" lasers configuration, Feb. 1978.

⁶¹ Xenakis, 1974, 257; Xenakis, 1985, 184.

⁶² Note "Tableau récapitulatif des laser et des 400 miroirs", May 7, 1978, Iannis Xenakis Archives, BNF. See Sterken, 2008a, 204.

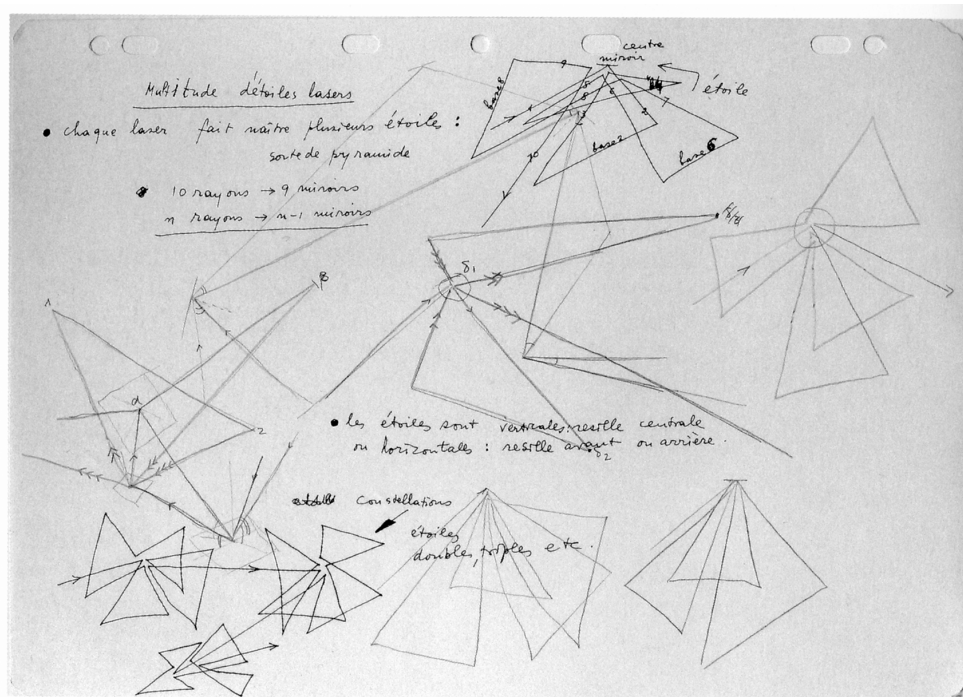


Fig. 98: Iannis Xenakis, design of a variation of the “stars” lasers configurations, 1978.

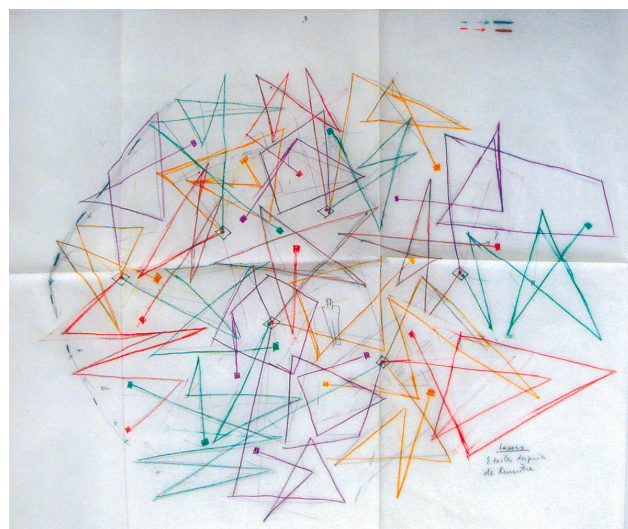
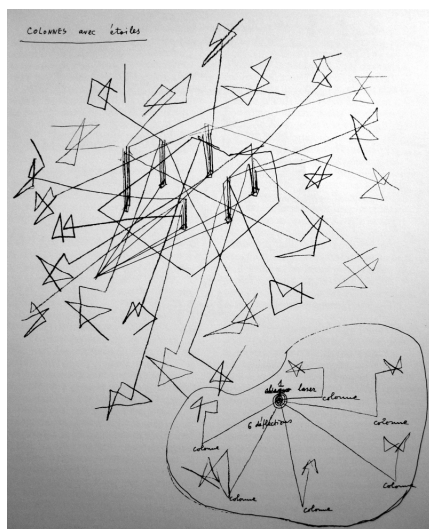


Fig. 99-100. Iannis Xenakis, design of a variation of “stars” , laser configurations, c. 1978.

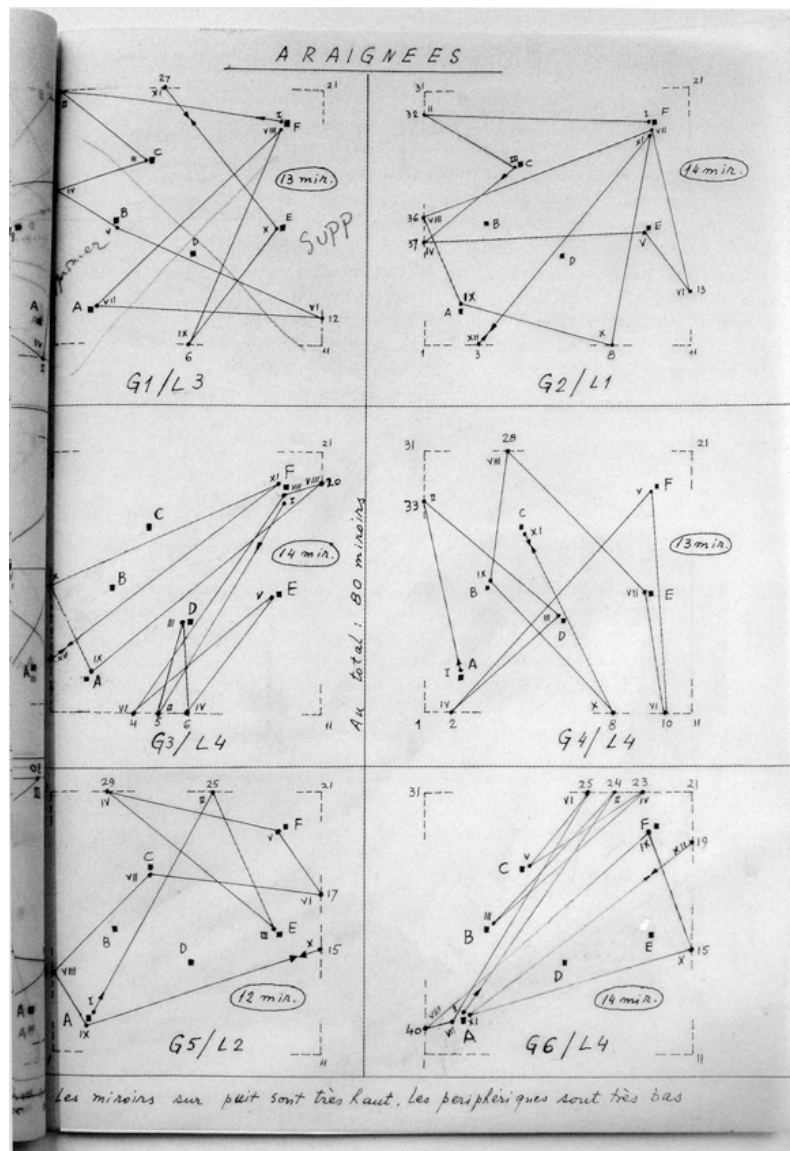


Fig. 101. Iannis Xenakis, design of a variation of the “araignees” lasers configurations, c. 1978.

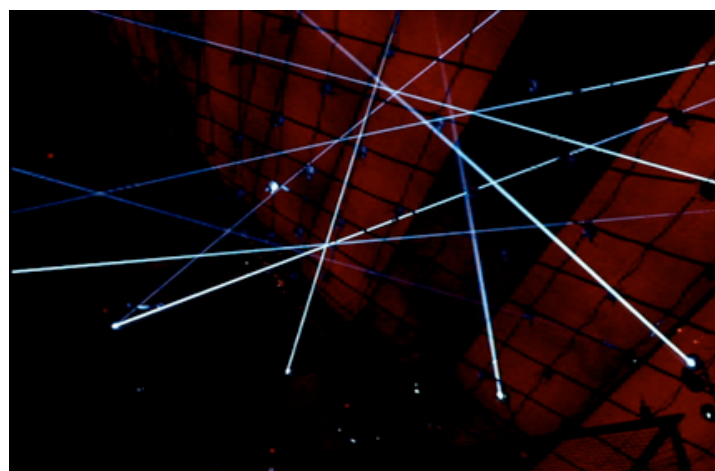


Fig. 102. Photograph of a laser configuration.

Xenakis also used poetical names to describe the configurations of the flashes: “lotus”, “anémones”, “galaxies”, “araignés”, or “nappes”. The lighting of the flashes generated “all kinds of interpenetrating, disappearing, rebounding, transforming figures”⁶³, for ex. “galaxies in movement”, “rotating spirals that appeared and dissappeared in total obscurity”, “oscillating circles”.

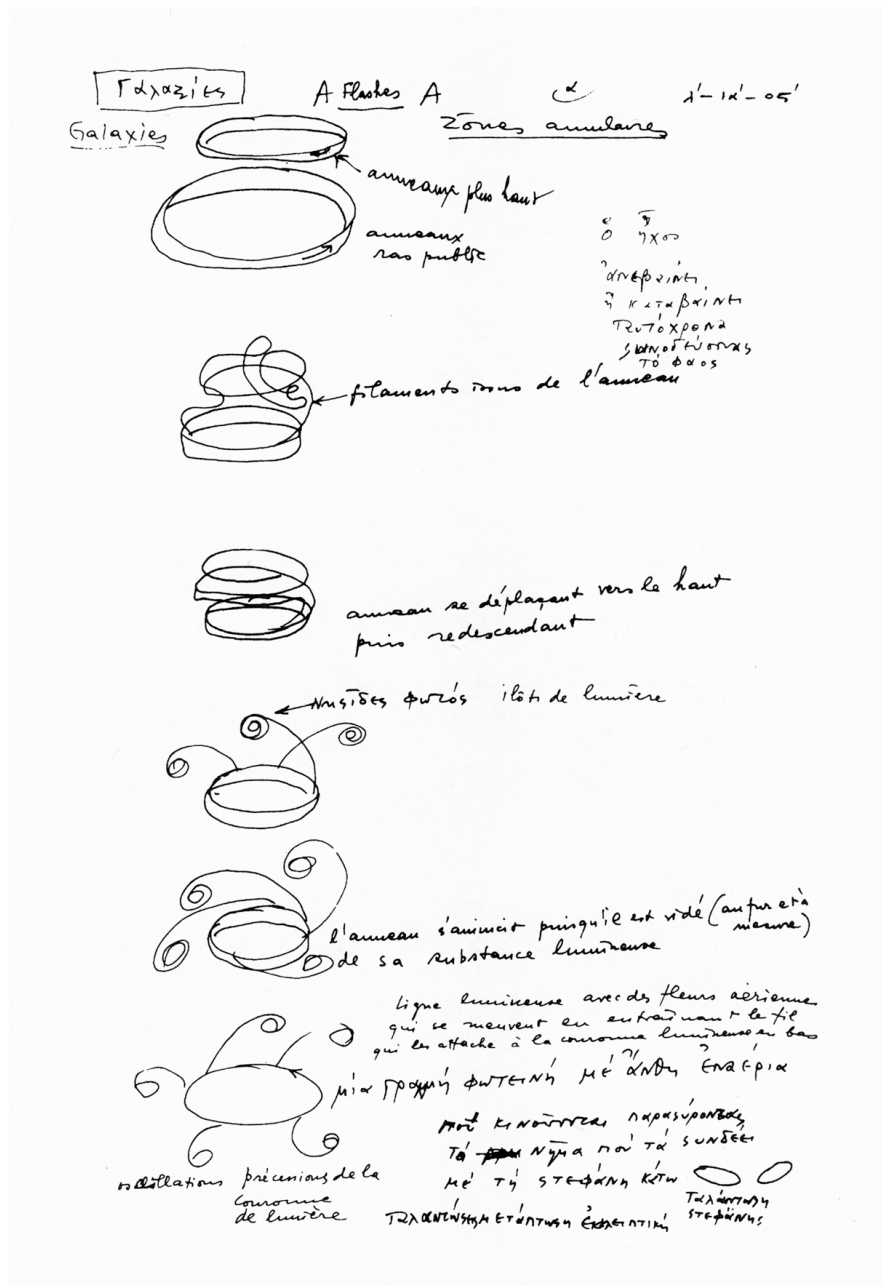


Fig. 103. Iannis Xenakis, manuscript, study of the configurations “galaxies” of the flashes, November 30, 1976.

The light patterns were produced by mathematical functions, ranging from imaginary numbers to probability distributions (logistic, hyperbolic, archimedian). Complex-number transformations and probability distributions created the Brownian movements of mass events, both in the case of the light flashes and the

⁶³ Xenakis, 1978, 6; Kanach, 2008, 263.

laser beams. The light patterns and events were programmed by Cornelia Colyer in FORTRAN IV, in an adaptation of the program ST (conceived by Xenakis at the beginning of the 1960s) to the light events⁶⁴. In addition to these patterns, other events in light were designed freely, by hand, and were then translated in code.

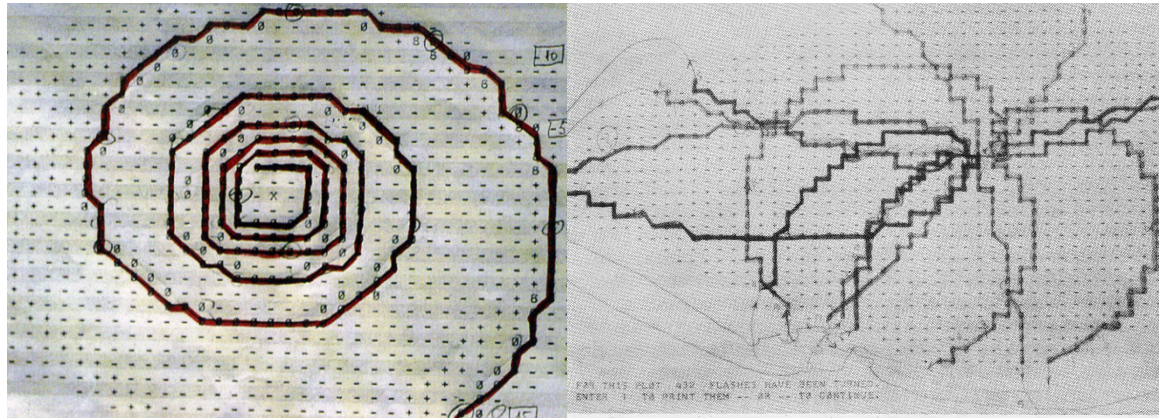


Fig. 104-105. Printouts of computer-simulated trajectories of the electronic flashes patterns of the *Diatope*, c. 1978. Left : spiral / right : complex conformal transformations (detail).

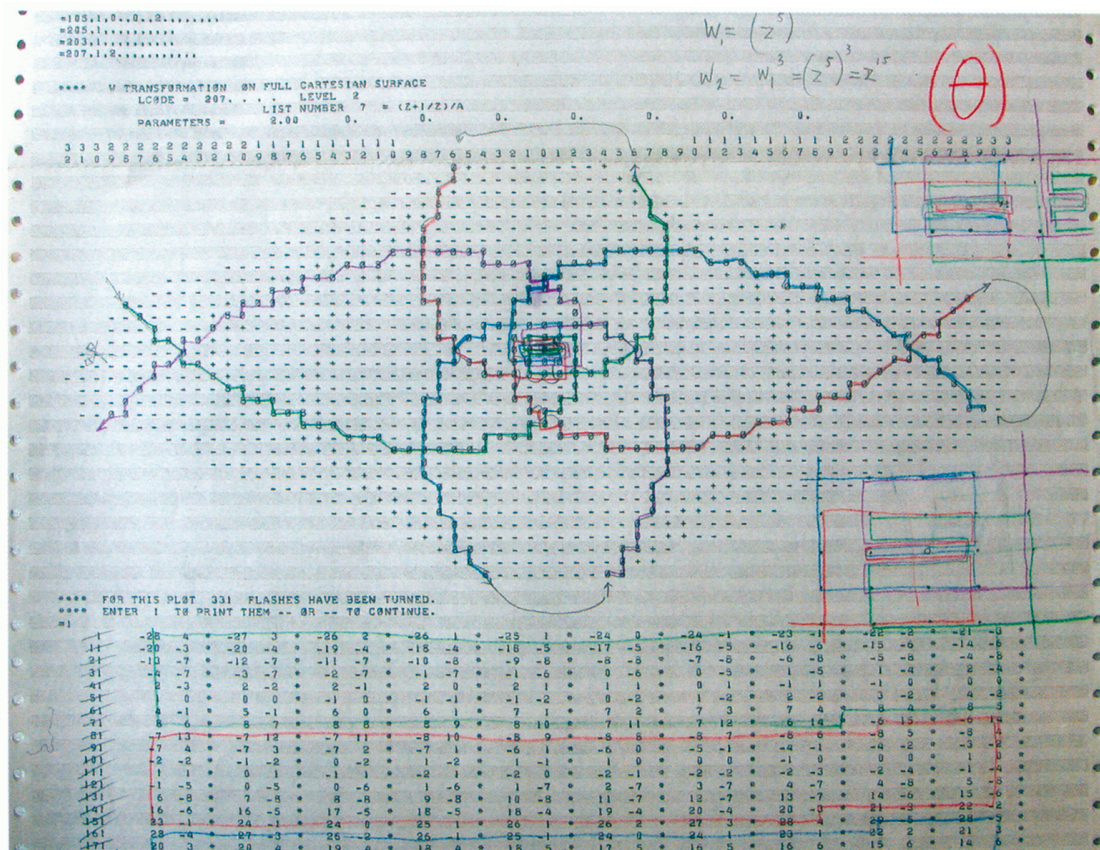


Fig. 106. Printout of computer-simulated trajectories of the electronic flashes patterns of the *Diatope*, c. 1978.

⁶⁴ Xenakis, 1985, 184; Xenakis quoted in *The Courier*, 1986, 6; Sterken, 2008a, 317. Xenakis quoted in D'Alonnes, 63 (Engl. trans. by Harley, M. A., 1998, 64).

The whole visual component was organized in two “scores”, where the light composition was arranged in time, in relation with the musical “partition”⁶⁵. In the first one the light events are synoptically outlined in relation to the music “partition”⁶⁶. The light events are named briefly in English, French and Greek: “12 red lights”, “golden zigzag”, “silver comets”, “waterfall + domes”, “violet candles”, “fireflies”, “Cauchy”, “falling star”, “shining stars”, etc. The other document is the definitive “partition”, on which Xenakis worked on for the final version⁶⁷.

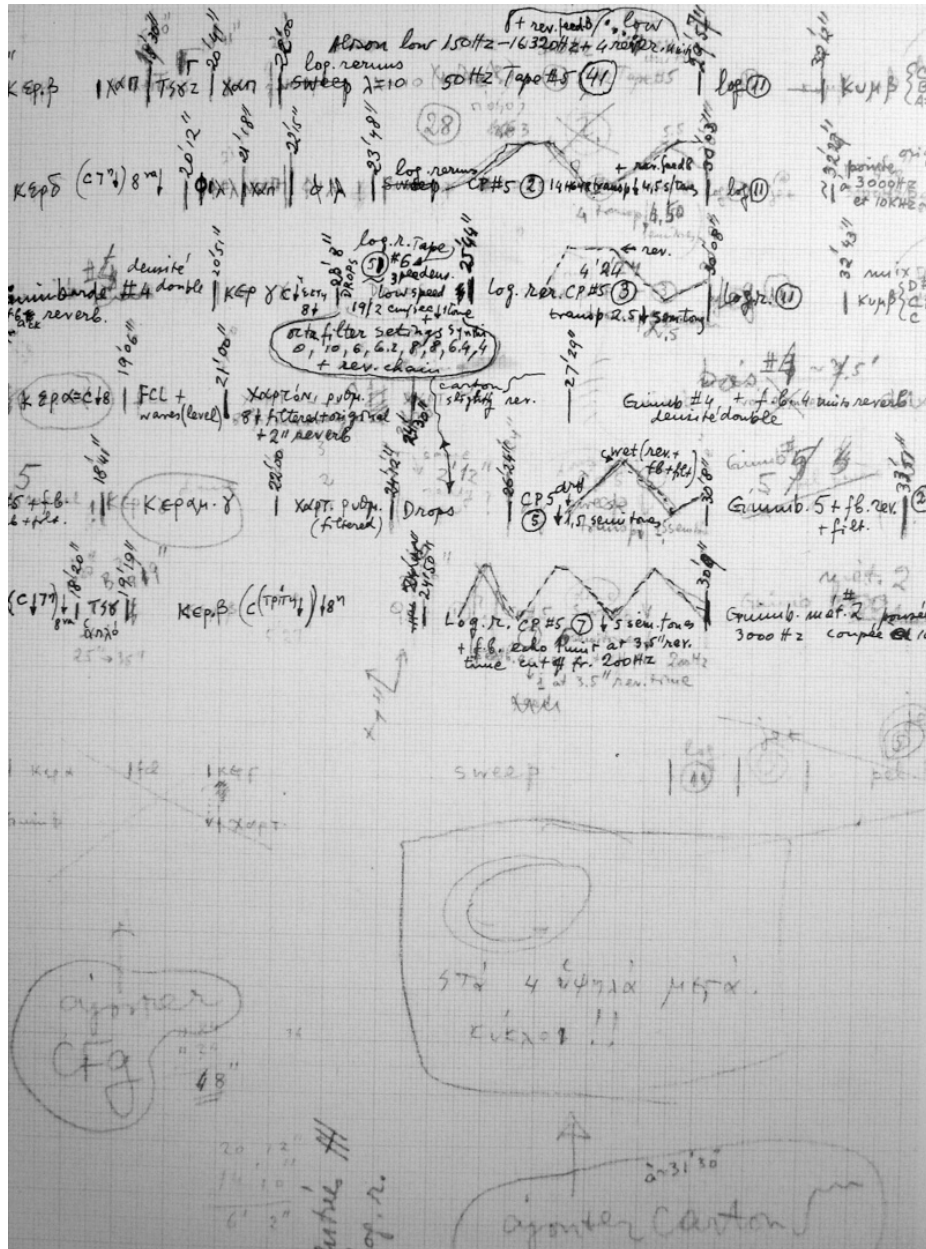


Fig. 107. Iannis Xenakis, detail of the “scenario” of the *Diatope*, c. 1978.

⁶⁵ Both documents are preserved in the Iannis Xenakis Archives at the BNF. For both light “partitions” Xenakis used photocopies of the music “partition”, see Solomos, 2006, 17-18 (reproduced fac simile in Solomos, 2006, 33-36).

⁶⁶ Parts of the document are transcribed by Solomos, 2006, 24-25, after the original document.

⁶⁷ Solomos, 2006, 24-25.

The sequence the later document was apparently later programmed as input data, defining at each $1/25^{\text{th}}$ of a second the exact state of each flash and laser. The flashes changed their state every 40 msec, producing the illusion of continuous movement⁶⁸. The flash lights outlined complex surfaces, created fixed fields or clouds and moved along the trajectories of spirals, circles or complicated curves in three dimensions. The rhythms of these movements were constructed with the help of simple logical operations (sums, differences). In Xenakis' 1974 proposal there is a thorough description of the flash lights composition:

*Group theory will, in certain cases, be employed systematically, for the flash-elements. Vertical and horizontal cross-sections differentiated by specific lighting rhythms (but related to each other thanks to extremely precise moduli) are born of the "Sieve" theory. At certain times, rhythms begin to create patterns, and then are disrupted. Sub-groups appear, as well as rhythmic invasions by groups of flashes, all to create a first general rhythmic pattern. (...) These are logical operations of conjunction, disjunction, or of complimentary actions.*⁶⁹

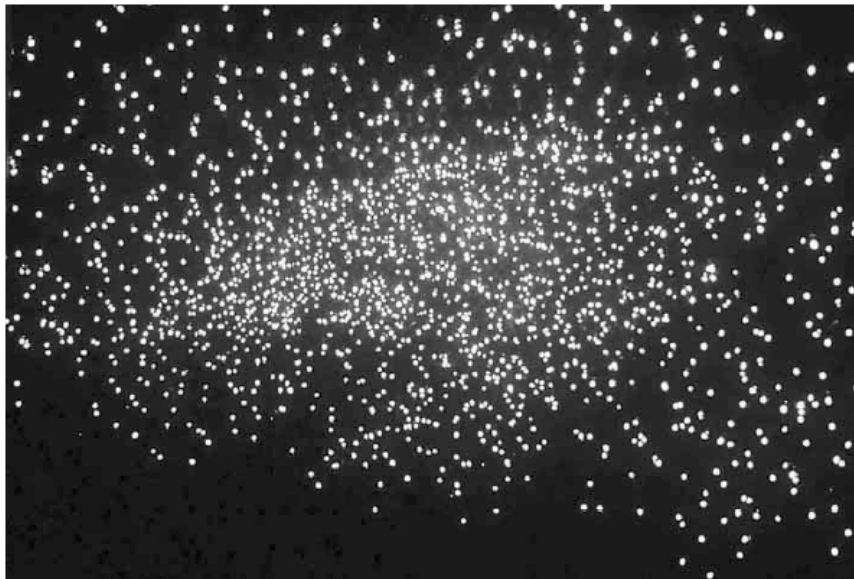


Fig. 108. The *Diatope*, formation of lash lights.

⁶⁸ "The digital tape on which the information is stored operates a complete renewal of state 25 times a second, a sampling rate which allows the eye to perceive a sensation of movement as in film", Xenakis quoted in Matossian, 1979, 39-40.

⁶⁹ Xenakis, 1974, 258.

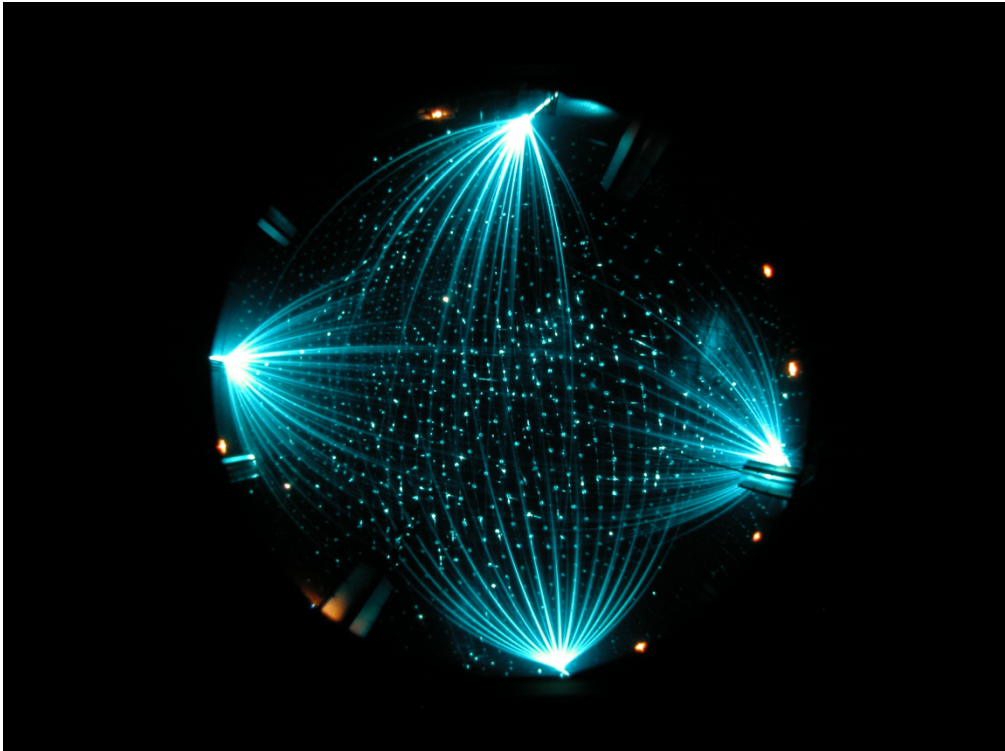


Fig. 109. Photograph (fish-eye lens) of the *Diatope* visual *spectacle*.

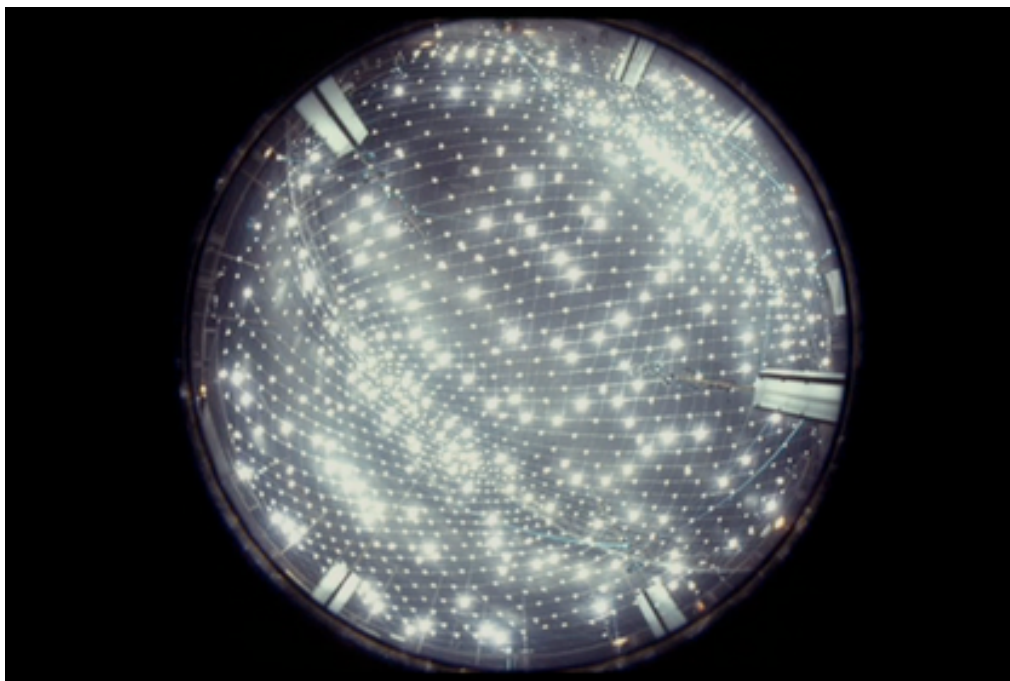


Fig. 110. Photograph (fish-eye lens) of the *Diatope* visual *spectacle*.

IV.iii.d. *Music to be seen - and heard*

Apart from the computer-aided composition of the light events, the commands that controlled the flashes, the laser beams, and the mirror positions, as well as the commands for the volume and the dynamic distribution of the seven audio tracks were also computer-controlled. Xenakis insisted on the automation of the Polytopes since the *Polytope de Montreal*, as a means to achieve more control over the final result; in fact he considered the digital automation of the *Polytope de Cluny* and the *Diatope* to be their most specific different, in comparison to the film-based procedure he had to follow in the case of Montreal⁷⁰. Each 46' performance of the *Diatope* entailed some 140,5 million binary commands total⁷¹, stored on nine-track digital tape⁷². One technician coordinated the synchronized reading and execution of the tape. The total duration of each presentation could vary, and it was possible to change the synchronization of the overlappings of musical and visual events, so that performances would not be exactly the same.

It is difficult to define the exact visual and audio relationship, due to lack of evidence in documentation⁷³. Even though Xenakis worked on photocopies of the music "partition" to develop the visual events in time, apparently there was no common "partition" for both components⁷⁴. In addition, the music was commissioned separately, and was clearly conceived to stand as an independent piece. Xenakis clearly stated he did not seek an absolute analogy or (in)correspondence, but a certain independence between the two components:

*The light spectacle in itself should be as strong as the music, and should be able to be seen alone, without the music and stand on its own. The same is true for the music; it should be able to stand alone, without the visuals. Only this way can we be sure to surpass ourselves, to go beyond our own capabilities. An accumulation of mediocre elements will never turn this aggregate into something valid, with the power to transform. It comes down to being a problem of the meaning we can give to music, or to art in general.*⁷⁵

For Xenakis, as the visual and the aural address different senses and different fields of perception, there is no need for music and visuals to correspond⁷⁶. He considered synaesthetic expressions in the work of Kandinsky or Messiaen as "subjective, metaphorical expressions"⁷⁷. The synthesis was a direct result of the superposition of the different media, where each art maintains its own specificity and the final

⁷⁰ Harley, A. M., 1998, FN 48.

⁷¹ Over 2000 elements (flashes, mirrors, lasers, sound parameters) x 1/25th of a second x approx. 46 min. (Kanach, 2008, 248).

⁷² Xenakis, 1985, 184. Solomos & Raszczinski, 1999, fn 25. Cornelia Colyer developed the programming at CEMAMu, with Xenakis's collaboration (The Canadian Commission for UNESCO, *Computer music: a directory to current work*, 1976, 50-52).

⁷³ Solomos, 2008a, 206.

⁷⁴ Solomos, 2006, 16.

⁷⁵ Xenakis, 1970, 145.

⁷⁶ Xenakis quoted in Revault d'Allonnes, 1975, 115; Xenakis quoted in Bosseur, 1992, 52-53.

⁷⁷ Alexaki, 1996, 127.

aesthetic result is created wholly from ever-changing relationships: light, plasticity, design, music⁷⁸. Abstraction calls the spectator's intelligence, as she is invited to mentally participate in the synthesis⁷⁹.

Matossian's account⁸⁰, one of the few and probably the most insightful, gives an impression of how it was to experience the *Diatope* live:

The programme is highly structured: a soft sparse beginning with a few flashes from the strobes and very high steely pitches becoming louder and more compelling; gradually different elements are displayed alone, then alternate; static configurations of green lasers meet and cross precise straight lines and sharp angles; figures described by a quick succession of strobes bound across the surface overhead in prescribed paths; more pointillistic textures in the music are driven by a powerful whirring pulse, spinning around with the lights while the laser beams begin to draw on the black surface like luminous coloured crayons – spirals, arcs, like a giant doodling across the sky. Lights and music coincide in a climax as the strobes increase in density and also in speed, until the space is illuminated and vision sliced sharply at each repeated onslaught of light and darkness. Laser beams shine and intersect in ever-increasing complexes while the glass floor and columns assume a translucent green, leaving the spectators seemingly suspended in mid-air. Percussive particles are washed by resonances of concrete sounds, there is a minor climax of lights with an accelerando and the piece recedes quietly, as it began.

It is evident in the above description of the *spectacle*, that there were some points of coincidence. As Solomos, 2006, observes, there are indications that certain associations were direct, based on the principle of tautology; for example there are notes in Xenakis' light "partition" that "the sound rises and diminishes simultaneously with the light" (fig. 103, upper right). In his detailed analysis of *La Légende d'Eer* Solomos distinguishes 6 parts to the piece, of different duration each⁸¹; even though any segmentation of the piece can only be relative - its transitions being subtle and continuous - each part functions differently in the composition⁸². Maybe a similar structure of the light component, or certain relationships between the unfolding of the two components in time, with regards to function, rhythm, intensity etc., could be suggested, after a juxtaposing study of the light "partition" with the analysis and "score" of the music piece⁸³.

⁷⁸ "In reality, an artist is a theoretician, a manipulator and creator of forms in movement. Seen from the point of view of art, all our knowledge and our actions are but aesthetic expressions of forms and their transformations." Xenakis, 1982b, 266-271.

⁷⁹ Sterken, 2001a, 191.

⁸⁰ Matossian, 1979, 39-40.

⁸¹ Part 1: 0'00-6'33, part 2: 6'34-19'18, part 3: 19'19-25', part 4: 25'-32'54, part five: 32'55-40'16, part 6: 40'17-45'48 (Solomos, 2006, 6-16). A slightly different analysis is proposed by Harley, J., 2002b, 50.

⁸² Solomos, 2006, 5.

⁸³ It was our initial purpose to realize such a comparative study. Unfortunately this was not possible as we didn't have access to these documents at the time of writing, even after repeated efforts.

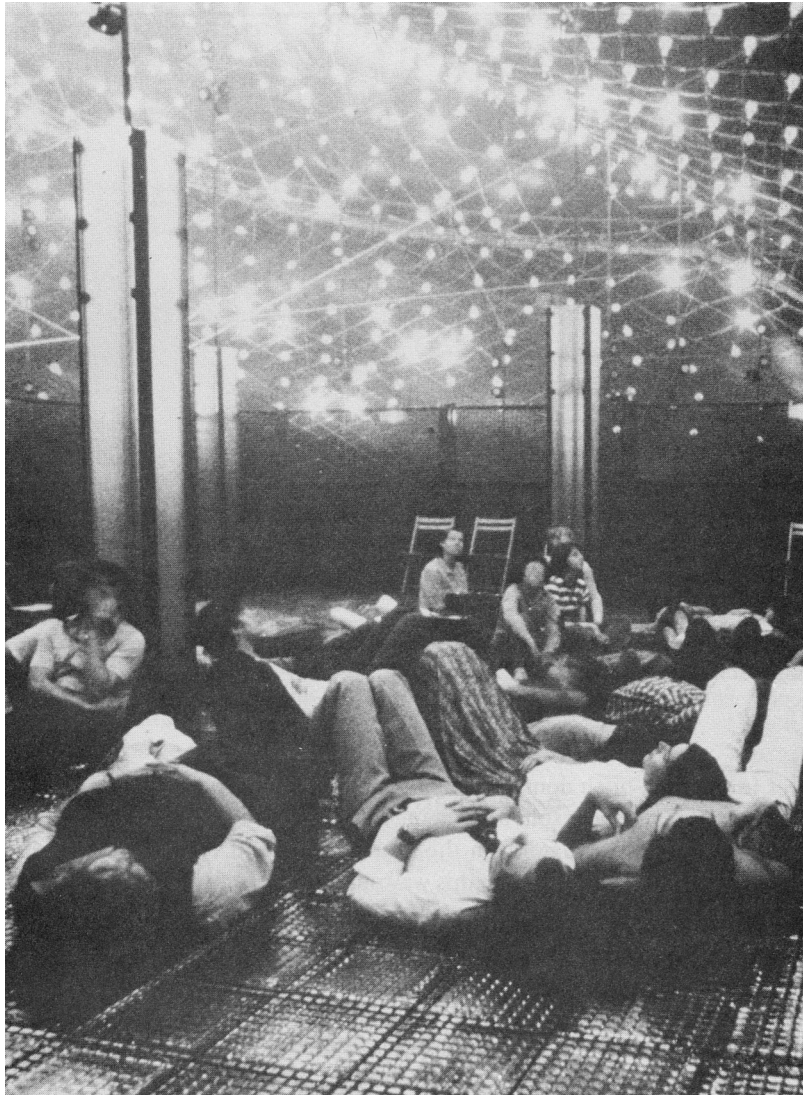


Fig. 111. The *Diatope*, view during presentation, 1978.

Moreover, in the light “partitions” similar expressions to those of light events are used to describe sounds, for example “sonic falling stars”, “brownian movements”, “logistical function”, “waves”, “eel”⁸⁴. These analogies point to a different level where the aural and the visual coincide, in their structural principles: mathematics and geometry. Xenakis explicitly says that he handles his media as points – flashes, or straight lines - laser beams⁸⁵. Treating the luminous points as sonic quanta, Xenakis transposed his musical composition methods to the visual domain⁸⁶. For example, masses of sound events or masses of visual events were treated similarly from the point of view of their structure:

Occasionally, there are some compositions, or structures, which coincide, as for example in the Diatope presented at the Pompidou Center. For the inaugural performance, there were one thousand six hundred electronic flashes which I was free to trigger off as I wished. This provided a sort of

⁸⁴ Solomos, 2006, 17-18.

⁸⁵ Xenakis, 1978, 11.

⁸⁶ Xenakis, 1985, 182.

*mass of luminous points, like sound points. When working with space, I have at my disposal two dimensions, or three, plus time. In music I can have more than one dimension by changing, for example, timbres in relation to pitch. With timbres this provides two dimensions and, with time, three, including intensity. This gives me a total of three dimensions, plus time. However, it is important to take care not to assimilate these dimensions in a simplistic manner, because the way in which our eyes and ears intercept visual or sound phenomena is quite different.*⁸⁷

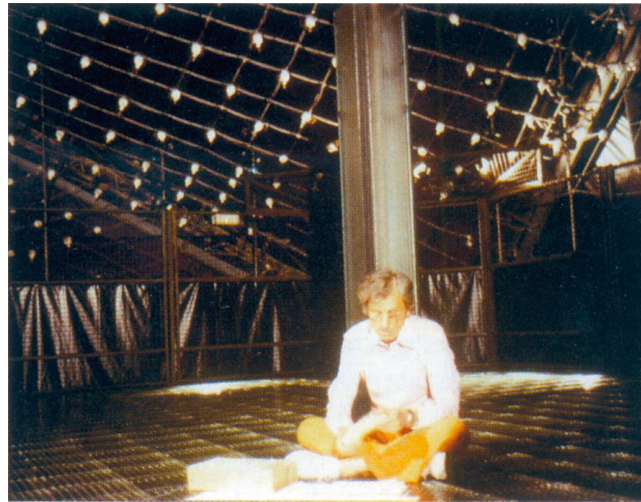


Fig. 112. Iannis Xenakis inside the *Diatope*, 1978.

A characteristic example of this approach is the application of the distributional function to the musical form, the rhythmic transformations, the complex timbres and the variable streams of pitch-and-intensity patterns of *La Légende d'Eer*, as well as to the light patterns⁸⁸. In a similar manner, the calculus of probability, like in stochastic music synthesis that Xenakis advocated and applied since the mid 1950s, was applied to the appearance and dissolving of light clouds⁸⁹. In fact the same functions and compositional principles that were applied on a microlevel on sounds used in the piece, also structured some light events. Brownian movement, applied in the dynamic stochastic synthesis of sounds used in *La Légende d'Eer*, was also applied to organize the flashes' configurations structure⁹⁰. Another example is the use of the Cauchy distribution, also applied to both synthetic sounds and light configurations⁹¹. These examples are only indicative of such affinities, simply implied by Xenakis in many of his writings and interviews; for the mapping of these relationships a thorough study of the traces of the visual *spectacle* would be required.

⁸⁷ Xenakis quoted in Bosseur, 1992, 52-53.

⁸⁸ Harley, M. A., 1998, fn. 66.

⁸⁹ Xenakis quoted in The Courier, 1986, 6.

⁹⁰ Xenakis, 1978, 10; Kanach, 2008, 262-263.

⁹¹ "Cauchy functions" were applied to sound synthesis as an alternative to the Fourier analysis in elements of the piece (Xenakis, 1978, 10; Kanach, 2008, 262). The indication "Cauchy" is also in light partitions for some flash light configurations (Solomos, 2006, 25).

*Consequently, it seems that a new kind of musician is necessary, that of the artist-conceiver of free and abstract new forms, tending toward complications and generalizations at several levels of sound organization. For example, a form, a construction, an organization built on Markovian chains or on a complex of interlocked probability functions may be carried over simultaneously onto several levels of musical micro-, meso-, and macrocompositions. One can also extend this remark to the visual domain - for example, in a spectacle made out of laser beams and electronic flashes of the Polytope of Cluny and the Diatope of the Centre Georges Pompidou.*⁹²

Xenakis insists on this deeper structural relationship between the aural and the visual. He articulates this structuralist approach in a highly poetic manner: “(...) just as our universe is created from grains (of matter) and straight lines (photon radiation), this spectacle offers a miniaturized yet symbolic and abstract reflection of it. In this way, music and light are united together. In some sense, this is a kind of cosmic “harmony of the spheres” of the cosmos, which, by means of art, becomes one with that of thought.”⁹³ Xenakis’ thinking was deeply rooted in ancient Greek philosophy; not simply out of nostalgia or out of a sense of heritage, but because it brought him closer to the unmediated heart of things. The idea of the unity of the visual and the aural is implied in many areas of ancient Greek thought, together with the conception of the universe as one unity⁹⁴. The Pythagorean idea of the “Harmony of the Spheres” and the ‘Musica Universalis’ was arguably the most prominent and clearly articulated example of this underlying theme of ancient Greek thought. The ‘Musica Universalis’ is the harmonic music created by the movements of celestial bodies, a music that is not literally audible but rather a mathematical concept to grasp the harmony of the cosmos. This harmony is founded in mathematics, which should therefore constitute the foundation of aesthetics.



Fig. 113. The *Diatope*, 1978.

⁹² Xenakis, 1985, 173.

⁹³ Xenakis, 1978, 12; Kanach, 2008, 263.

⁹⁴ Alexaki, 1996, 49.

IV.iii.e. The texts

Xenakis included an array of five excerpts from literary texts in the *Diatope*'s catalogue⁹⁵ to illustrate his philosophical and metaphysical views that informed the work. The authors and sources were among his favorite references⁹⁶. These included: *The Legend of Er*, an extract from Plato's *Republic*; *Poimandres*, a fragment from *The Divine Pymander*⁹⁷ attributed to the alchemist Hermes Trismegistus; "L'infini", a meditation on the infinite from Blaise Pascal's *Pensées*⁹⁸; *Siebenkäs*, an extract by Jean-Paul (Johan) Friedrich Richter⁹⁹; and an extract from the *Scientific American*, from an article describing a supernova by astrophysicist Robert Kirschner¹⁰⁰. Dating from different periods, the texts formed "multiple resonances" with each other and extended thematic threads from ancient Greek thought to modern astronomy and philosophy. They all dealt with themes of eternal dualities and with the relation of man with the cosmos and his destiny.

Excerpts from the final chapter of Plato's *Republic*¹⁰¹ narrate the legend of the soldier Er's return from the underworld - the same source of the musical component's title. The story concerns a soldier named Er who returns from the dead and gives his account of his experience. Er's narration culminates with an apocalyptic vision of the "Spindle of Necessity," a great shaft encircled with eight rings representing the eight celestial spheres known to ancient astronomy: on each ring a siren sings one pitch continuously, corresponding to the circumference of its orbit of rotation. Together they sung the whole eight-note scale, forming in ensemble a cosmic harmony, the "music of the spheres". The three Fates are seated on thrones amidst the sirens, accompanying their song: Lachesis singing of the past, Clotho of the present, and Atropos of the future. Their song accompanies souls ascending a shining luminous pillar, the "axis of the universe" that binds together the "wheels of the cosmos"¹⁰².

An apocalyptic vision is also the subject of the excerpt from *The Divine Pymander*, with light serving as a metaphor of the "divine mind" and the idea of human insignificance and solitude a central theme. This theme reappears in the excerpt by Pascal: "For indeed, what is man within nature? A void in the face of infinity, a whole before the void, a center between nothingness and wholeness...unable to perceive the void from whence he came, nor the infinity in which he is submerged."

⁹⁵ The *Diatope*, 1978, 12-18. For versions of these excerpts in English see Kanach, 2008, 272-277.

⁹⁶ Xenakis, 1980a, xvi-xvii; Xenakis quoted in Toop, 1995, 17; Barthel-Calvet, 2001, 26. *Siebenkäs* is also cited as a reference in Xenakis' pieces *Nekuia* (1981) and *Pour la Paix* (1981). Xenakis was a long-time subscriber to the *Scientific American* (Solomos, 2006, 30).

⁹⁷ Hermes Trismegistus, *Corpus Hermeticum* (2 c. B.C.), Vol. I.

⁹⁸ <http://oregonstate.edu/instruct/phl302/texts/pascal/pensees-contents.html>

⁹⁹ http://gutenberg.spiegel.de/?id=5&xid=1332&kapitel=1#gb_found (4/1/11)

¹⁰⁰ Kirschner, Robert, "Supernovas in other galaxies", *Scientific American*, December 1976.

¹⁰¹ Plato, *The Republic*, book X, paragraphs 613c-621d. Engl. transl. by Benjamin Jowett available at: <http://classics.mit.edu/Plato/republic.html> (4/1/11).

¹⁰² Harley, A. M., 1998, connects the gradual transformation of superimposed layers of sound, the rotation of sound masses in audible circles and spirals, the continuous modulation of unusual timbres, of Xenakis' homonym music piece, with the description of the famous music of the spheres given by Plato in the myth.

The chosen excerpt from *Siebenkäs* evokes similar ideas and agony: “Christ went on: “I traversed the worlds, I ascended into the suns, and soared with the Milky Ways through the wastes of heaven; but there is no God. I descended to the last reaches of the shadows of Being, and I looked into the chasm and cried: ‘Father, where art thou?’ But I heard only the eternal storm ruled by none, and the shimmering rainbow of essence stood without sun to create it, trickling above the abyss.”

The final excerpt comes from an article that evokes a “type II supernova” whose explosion was observed at the end of 1970: the expanding star would engulf the whole solar system, destroying humankind in the process. Even though Kirchner’s scientific language is very different from the poetic language of the previous texts, still the description maintains a quasi-metaphysical quality. The choice of the text implies Xenakis’ absolute faith in science as the way to understand the universe and existence, as an articulation of science’s dominant position in 20th century thought.

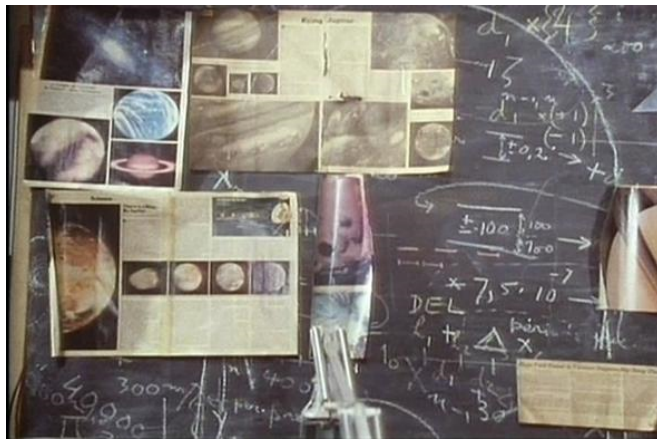


Fig. 114. View of Xenakis' studio, movie still from *Something Rich and Strange: The Life and Music of Iannis Xenakis*, Mark Kidell/BBC, 1991.



Fig. 115. Xenakis in his studio, date unknown.

The connecting thread is the cosmic imagery of astounding light formations and the apocalyptic visions that are experienced through light.

Xenakis explicitly denied that he included these texts in any programmatic or narrative manner – the texts were meant to illustrate, rather than explain. The texts “form the argument for the spectacle”¹⁰³. Invoking Pythagorean ideas, they reflect Xenakis’ views on human existence, destiny and death. “This spectacle and its music form multiple resonances with the chosen texts and form a sort of sonorous string pulled tight by mankind through cosmic space and eternity; a string of ideas, of science, of revelations coiled around it. The spectacle is created from the harmonics of this cosmic string”¹⁰⁴. Harley, 1998, interprets the “program” of *Le Diatope* as a testimony to Xenakis’ atheism and his vision of human solitude in the universe:

¹⁰³ Xenakis quoted in Toop, 1995, 18.

¹⁰⁴ Xenakis, 1978, 8-9.

*The texts lead the reader from ancient beliefs in after-death punishment and reward through the revelation of an androcentric, rationalistic universe to the rejection of faith and abandonment of all hope in salvation. The final description of the supernova would then imply that the infinity and destiny of the universe may be, in the end, understood and predicted only by science-the ultimate source of human knowledge. This scenario replaces religion with scientism and faith in the revelatory function of art.*¹⁰⁵

¹⁰⁵ Harley, M. A., 1998, 64.

Chapter V

The *Diatope*: aesthetics and contextualization

V. i. The aesthetics of the “total electronic gesture”

With its cosmic imagery of trajectories of galaxies, violent storms, volcanic eruptions, shooting stars and rotating or dispersing spirals, the *Diatope* clearly evokes an extra-terrestrial effect. Similar evocations of cosmic phenomena are commonly found in Xenakis’ writings, whose interest in astrophysics and astronomy had been strong very early on:

Composing with sounds for the ear leads us to compose with light for the eyes. (...) To make them gleam in space is to create music for the eyes – visually abstract music that would put galaxies, stars, and their transformation within the reach of humanity, on a terrestrial scale, of course. (...) The result is a new art of vision and hearing that is (...) really an abstract spectacle in the sense of music, of the astral or terrestrial type. Movements of galaxies, (sped up) storms, and aurora borealis are examples of what this new art not just recreates—this would be without interest—but truly creates with the means put at its disposal by the present technology. Presently a new type of artist can master events of the size of a large city if given the means. And soon the artist will be able to go out into the cosmos. This is realized with and in the DIATOPÉ.¹

Thus the light configurations suggest a poetry of natural and cosmic elements that develops in the darkened interior of the installation, in an analogy with the black void of the universe.

But Xenakis wanted to create both a representation of cosmogony and a poetry of elements²: apart from the cosmic evocations, the notion of abstraction is also central. As much as, according to Xenakis, the points and lines of light invite comparison with the basic elements of the universe, grains of matter and lines of photon rays, they nevertheless remain abstract mathematical entities³. It is through abstraction that the formal relationship between the aural and the visual, and the resulting representational analogy is defined. Therefore the *spectacle* is at the same time abstract and concrete; there is no contradiction between figuration and abstraction, but a constant oscillation between the two. For example, the light “galaxies” can be perceived as actual representations of galaxies, but also as an abstract configuration of points⁴. The same can be suggested for the music⁵. In fact,

¹ Xenakis, 1985, 182.

² Xenakis quoted in Delalande, 1997, 117.

³ This is what Xenakis means when he refers to laser and flash light as “real light”, in contrast to “light reflected off a screen”, Xenakis quoted in Delalande, 1997, 114; quoted in Kanach, 2008, 205-206 (Engl. trans. by S. Kanach). Xenakis clearly identified his choice of laser and flash light for their proximity to music due to their abstract qualities and their capacity to render natural phenomena visual by applying models from physics to their organization. (Xenakis, 1982a).

⁴ Solomos, 2008a, 206-207.

according to Xenakis' Weltanschauung, there's no question of "translation", since both abstraction and representation, both natural phenomena and artistic expression, are in this case described and informed by the same universal laws of physics and astrophysics.

This almost metaphysical relationship is imprinted on the structure of the constituent parts of the work; through their quantification and digitization, it becomes inherent in the work's ontology. Enabled through computer technology, this new amalgamation of sound and light resides in the digital domain. The transposition of a "plural gesture"⁶ in different fields, as is for example the case in the glissandi of *Metastasis* and their corresponding graphical and architectural shapes⁷, is no longer conflicting in the digital aesthetic. Xenakis grasped this relationship, expressing it in his characteristic articulation as a "fluid, rational and intuitive aesthetic":

Today as never before, man has access to events made of real light thanks to – for the time being – lasers, electronic flashes, light projectors and computers. Suddenly, we understand that a new art of light is at our doorstep, one that is not painting, nor frescos, nor theatre, nor ballet, nor opera. By definition, an art which is outside of man [...] An art like music itself, without any anthropomorphic or realistic references. This is the meaning of my polytopian adventures [...] It is the search for a pan-musical expression.

In addition, these experiences have proven to what extent it was natural and efficacious to use the same procedures for the construction and architecture of these light projections as for their architectures of sound.

In the end, a sort of fluid, rational and intuitive aesthetic of the imagination seems to flow between light, sound, technology, and theories, nearly without any break in continuity.⁸

Xenakis had expressed a craving for the complete, computer-controlled automation of the work ever since the *Polytope of Montreal*, striving for greater control over the final result; in this sense, the *Diatope* represents the summum genus of his previous efforts. This is a direction he also pursued in his music practice, in his pioneering contribution to computer-aided composition. His interest in computer technology was not simply to facilitate the swarms of calculations required by his stochastic synthesis techniques, but also to investigate the possibilities of a computable, automated music:

An additional advantage of using a computer as compared to manual exploration is that the composer may become bold and investigate developments or audacities stemming from [the composer's] basic systems.⁹

⁵ Solomos, 2006, 26.

⁶ Illiescu, 2005, 4.

⁷ For an analysis of the xenakian transposition of a "plural gesture" in different fields see Illiescu, 2005.

⁸ Xenakis, 1982a, 202.

⁹ Xenakis, 1971, 268.

Xenakis had showed early on interest in systems that generate a whole of music within a closed design¹⁰. His interest in the idea of an “Automated Art”¹¹ is also manifested in his persistence in creating a composing automaton, the UPIC. The *Diatope* incorporates Xenakis’ “updated” theory and vision for a new art and a new type of artist, capable of creating form using the same compositional techniques in both in the musical and visual realm¹².

A tendency to glorify technology is evident in the composer's descriptions of the *Diatope*¹³, as is in his use of language in general. Xenakis was convinced that the future of the arts lies in technology, which influences both the creative process and our perception, and he considered the *Polytopes* as manifestations of this conviction¹⁴. His focus on technoscience in an affirmative way situates his practice in the field of “high media art” (Medosch, 2005), which has always embraced technoscience as an aesthetic strategy to negotiate its position in the art system:

*All speculation about any reality of media understood as ontological is just a continuation of strategies of legitimization of classical modernity - for instance when the essence or substance of a digital art work should be defined out of the structure of the underlying program.*¹⁵

The ontological criterion of “being digital”¹⁶ has been broadly applied in digital art to define media art works. In extension, especially in the case of virtual art, it has been a basic argument for its relevance: since the same laws that govern “the world itself” are the same that constitute the digital, “digital art is becoming a more and more adequate expression of our world”¹⁷. In the discourse on “high media art”, the digital ontology statement has allowed differentiating media art from the “traditional” fine arts.

It is characteristic how Flusser’s articulation of his theory of the “digital apparition” (Flusser, 1996) evokes the xenakian arguments for mathematics as the normative aesthetic paradigm¹⁸:

*What remains is that everything is digital, i.e. that everything has to be looked at as a more or less dense distribution of point elements, of bits.*¹⁹

¹⁰ Kollias, 2008; Hoffmann, 2009.

¹¹ Hoffmann, 2009, 55.

¹² Xenakis, 1982b.

¹³ Harley, M. A., 1998, fn. 65.

¹⁴ Xenakis, 1980a, xx.

¹⁵ Schmitz, Norbert M., „Medialität als ästhetische Strategie der Moderne. Zur Diskursgeschichte der Moderne“, in Gendolla, Peter, Schmitz, Norbert M., Schneider, Irmela, Spangenberg, Peter M. (eds.), *Formen interaktiver Medienkunst*, Frankfurt am Main: Suhrkamp, 2001, 123; quoted in Medosch, 2005, 45 (translation A. Medosch).

¹⁶ Negroponte, Nicolas, *Being digital*, New York: Knopf, 1995; quoted in Medosch, 2005, 47.

¹⁷ Weibel, 1984, quoted in Medosch, 2005, 47.

¹⁸ See pp. 84-85, Xenakis quoted in Bosseur, 1992, 52-53.

¹⁹ Flusser, Vilem, „Digital Apparition“, in: Druckrey, Timothy (ed.), *Electronic Culture: Technology and Visual Representation*, New York: Aperture Foundation, 1996, 244; quoted in Medosch, 2005, 47.

Xenakis' approach embodied early on the idealization of mathematics as the normative aesthetic and theoretical paradigm, falling in line with one of technoscience's strongest ontological statements. At the same time, he repeatedly reminded that "computer technology is just a tool"²⁰, and that it should only be used in artistic practice when the work demands it. In the case of xenakian practice, the ontological criterion of "being digital" defines both the artwork and the argument behind the artistic practice; thus the classic distinction between media art that uses technology as a *tool* and media art that employs technology as a *medium*²¹ cannot be applied in this case. The *Diatope* derives from a coherent vision and a holistic approach to the digital aesthetic, of an artist who was involved with technology at a fundamental, formative level.

Furthermore, the phenomenological relation between (architectural) space and music/visuals seems to be equally, if not more, important than the digital aesthetic. The installation was defined by both the structural elements of the architectonic space and the media employed. As with the steel cables of the *Montreal Polytope* and the scaffolding of the *Cluny Polytope*, the media supporting structures are treated as a Cartesian grid, to create a "three-dimensional screen with the flashing lights as its pixels, enveloping the audience"²². However, as Sterken argues, in these two *Polytopes* and the *Diatope* there is no distinct line dividing the real and the virtual, but rather a "superimposition of spaces"²³; space is ultimately conceived as "a collection of dilated pixels, each with its own series of coordinates of intensity, place, sound, color and time"²⁴. It is in the resolution of layers of light and sound that superimposed, immaterial spaces are created, as temporary modulations of the physical space. These are formed parallel, based on the same abstract and geometrical vocabulary - whether it is transposed in architecture, light or sound²⁵. Xenakis replaces the vanishing points of architectural space with curving surfaces, modulations and intensities, in an "architecture of densities"²⁶.

It is in this "architecture of densities" that the spectator is immersed, recalling Paul Valéry in that "Music and architecture differ from the other arts in their capacity to surround man entirely"²⁷. The immersive experience created is integrated to the physical space, instead of substituting it – this is already evident in Xenakis' rejection of the sphere as an architectural shell for the work²⁸. Placing the spectator "under constant attack"²⁹, Xenakis clearly did not aim for an illusory effect:

²⁰ Xenakis, 1986, 6.

²¹ Paul, 2003, 8.

²² Sterken, 2001b, 267-271. According to Sterken's argument, these three *Polytopes* can be considered as early manifestations of media architecture (Sterken, 2001d, 84).

²³ Sterken, 2001b, 267-271.

²⁴ Sterken, 2001d, 84.

²⁵ Sterken, 2001b, 268.

²⁶ LaBelle, 2006, 190.

²⁷ Valéry, Paul, *Eupalinos ou l'architecte*, Paris: Gallimard, 1924, 131; quoted in Sterken, 2007, 43.

²⁸ Solomos & Raczinski, 1999, 65; Sterken, 2004, 72.

²⁹ Matossian, 1981, 226.

*When I composed La Légende d'Eer I was thinking of someone in the middle of the Ocean. The elements surround him, sometimes raging, sometimes calm.*³⁰

The *Diatope* was an electronic “Maelström”, where one was “constantly exposed to sound and light”³¹; therefore much closer to contemporary audiovisual performance, particularly of a noise aesthetic, than to virtual art (Popper, 2007). Moreover, it has been argued that the immersive experience was not isolated from the outside world; the transparent vinyl cover allowed sound, air and light to penetrate the interior, rendering the spectator aware of both environments simultaneously³². We cannot know this for a fact, as the work is destroyed – but if this were the case, the *Diatope* would not have merely been a closed system, a system isolated from its environment where the initial conditions determined a particular final state, but a hybrid, “halfway between reality and virtuality”³³.

Independently of how successful – or not – the final realized result actually was, it can be argued that the vision behind the *Diatope* is extremely coherent, that of a “total gesture of light and sound” as outlined already in Xenakis’ 1958 “Notes sur un geste électronique” (see Chapter III.ii). There are evident affinities between the Philips Pavilion and the *Poème Electronique*, and the *Diatope*: the volumetric architecture of regulated surfaces, the light and transparent character of an architecture as both container and expression of media, the not predetermined conditions of viewing, the spatialization of sound, the superimposing layers of visual projections from different sources, the immersive experience. With the *Diatope*, Xenakis closes a circle: if the essential weakness of the *Poème Electronique* was that it was basically a multimedia show, where architectural qualities were not fully exploited but instead substituted with illusionary cinematographic spaces³⁴, the *Diatope* carries further the idea of the total work of art, offering a reinterpretation of the *Poème Electronique* “within the technological paradigm of the digital age”³⁵.

³⁰ Xenakis quoted by Dominique Druhen from an interview with Xenakis in April 1995 in: “à propos de *La Légende d'Eer*”, Linear notes, Montaigne/Naïve AD 061 (CD); quoted in Solomos, 2005.

³¹ Fleuret, 1988, 180.

³² Sterken, 2001d, 84. The change in prefix in the *Diatope*'s name also signifies this, “δια-” meaning “through” (Sterken, 2001b, 270).

³³ Sterken, 2001b, 271.

³⁴ Oswalt, 2001, 212. As Treib notes: “The sound routes and dispersed loudspeakers that disposed Varèse’s organized sound/music in space were inherently related to three or even four dimensions, and to the architecture of the pavilion itself. The cinematic presentation (...), on the other hand, was created flat – indeed, from flat originals. Its flatness was distorted by the curving surfaces of the pavilion, but it remained a basically bisymmetrical planar display on the walls” (Treib, 1996, 248).

³⁵ Sterken, 2008b, 96-97.

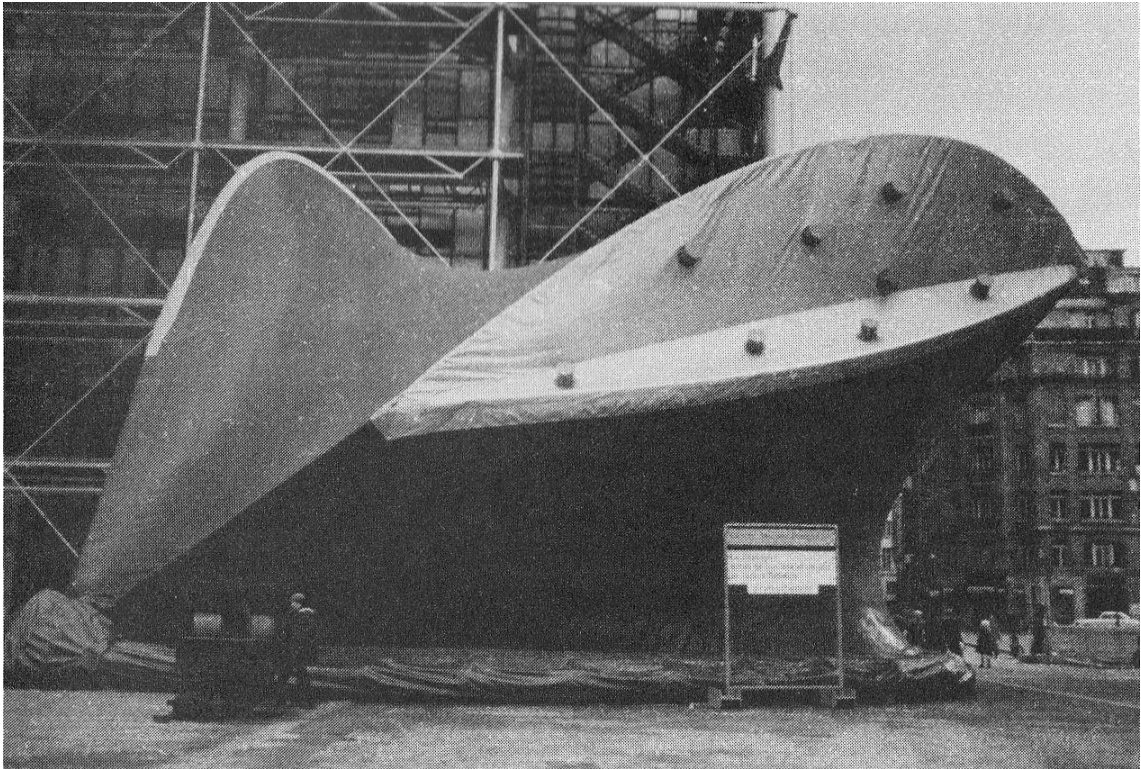


Fig. 116. The *Diatope* in Paris, 1978.

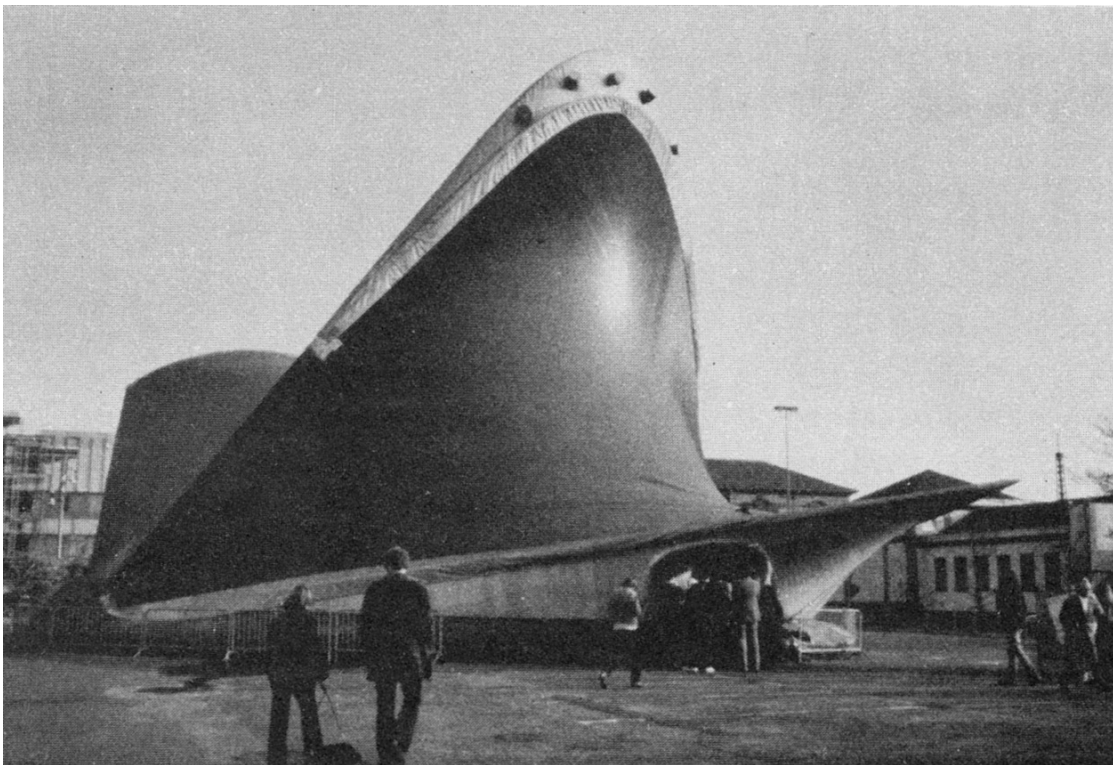


Fig. 117. The *Diatope* in Bonn, 1979.

V. ii. The *Diatope* in the context of Art History

As is the case with the *Poème Électronique*, one can liken the *Diatope* “to a Catholic requiem mass, to a Wagnerian operatic *Gesamtkunstwerk*, more mundanely to a *son et lumière*, even to a 1960s psychedelic light show – or more drastically think of it as a prototype of virtual reality”³⁶. An essentially hybrid work, the *Diatope* participates in many different, yet intersecting art historical narratives, each of which we will examine briefly.

The *Diatope*, and the *Polytopes* in general, can be considered as characteristic *Gesamtkunstwerke*³⁷; as staged light and sound performances they take part in the long tradition of Wagner's conception of the total artwork. Another evident connection can be drawn with music and light spectacles, *sons et lumières*, the purpose of which is usually to bring some famous building to life and to recount its history. The *Polytopes* also participate in the long history of vast audiovisual spectacles, which ranges from ancient and medieval theater, to Handel's royal fireworks and Aleksandr Scriabin's presentation of his symphony *Prometheus*, accompanied by projected rays of colored light. Also, as *spectacles* designed for large audiences, the *Polytopes* certainly incorporated Xenakis' experiences from the World Exhibitions he participated in (Brussels, 1958; Montreal 1968; Osaka, 1970).

Connected with the notion of the *Gesamtkunstwerk*, audiovisual relationships have been explored by 19th and 20th century composers such as Wagner, Scriabin and Messiaen, including numerous experiments towards a “color organ”. Synaesthesia was the topic of intensive scientific investigation in the late 19th and early 20th centuries, as a neurologically-based condition in which sensory or cognitive stimulation automatically leads to secondary sensory or cognitive experiences. This condition is inherent in certain people, synaesthetes. The term has also been used in the context of cross-sensory, mainly audiovisual, artistic practices³⁸. Since the 1950s, when technological means offered new possibilities for artistic experimentation, “synaesthesia” has been a major theme of artistic research³⁹. Xenakis was aware of these experiments, as well as of such work by Mondrian, Kandinsky, and his teacher, Messiaen, but never showed interest in such an approach.

Such connections can be drawn through the audiovisual analogy, which applies on a phenomenological level. However, Xenakis' practice developed from his specific formal language and structuralist approach to composition. The *Polytopes* participate in the tradition of the *Gesamtkunstwerk* and visual music, but they don't

³⁶ Treib, 1996, x.

³⁷ Frisius, 1987, 91-94. The term *Gesamtkunstwerk* refers to the utopian aspirations beginning in the early nineteenth century toward the union of all the arts into a single work of art. Its insufficient treatment in terms of art history is one of the main reasons for the arbitrary use of the word. See John, Barbara, “The Idea of the *Gesamtkunstwerk* in Historical Development”, in Daniels et al., 2009, 140-149.

³⁸ See Campen, Crétien, *Synesthesia in art and science*, Cambridge, Massachusetts: The MIT Press, 2007. For a bibliography see van Campen, Crétien (ed.), *Bibliography: Synesthesia in art and science*, <http://www.leonardo.info/isast/spec.projects/synesthesiabib.html> (3/3/11).

³⁹ Popper, 2007, 161; *Sons & Lumières*, 2004; Brougher et al., 2005; <http://www.centerforvisualmusic.org/> (2/2/10).

entirely belong there. Sharing the same theoretical basis with the romantic tradition of the *Gesamtkunstwerk* – ancient Greek thought, and in particular Pythagorism – Xenakis arrives at *visual music* and the *synthesis of the arts*, but through a different, individual path, “bypassing” the affiliated romantic and modernist traditions⁴⁰. Moreover, his practice differs from that of his predecessors and contemporaries by placing an emphasis on the use of the most advanced technology, which situates it in the media art discourse.

On a phenomenological level, one can argue for connections between the *Polytopes* and sound art, and lumino-kinetic or “light art”. The staging of the artwork and the abolition of the concert hall was common practice in 20th c. avant-garde music; composers such as John Cage and Karlheinz Stockhausen, and many of their contemporaries, practiced the “staging” of music performance in the ‘60s and ‘70s.



Fig. 118. The German Pavilion – “Spherical Concert Hall”, Osaka World Expo, 1970.



Fig. 119. The German Pavilion – “Spherical Concert Hall”, 1970, during a performance by Karlheinz Stockhausen.

Sound was explored in direct relation to architecture and environmental geographies. This tradition, which today resides in the practice of sound installation and the discourse of “sound art”, brought to the fore the parameters of space, acoustics, psychodynamics of listening, and corporeal experience⁴¹. Xenakis’ 1958 spatialization of the *Poème Électronique* and *Concret PH* anticipated many aspects of electroacoustic and fixed media practice, which only later on became central; the *Polytopes* congeal his ongoing concern for architectural space and the spatialization for sound. While they remain outside the cultural and aesthetic category of sound art and sound installation, the *Polytopes* nonetheless run parallel to the developments of the genre⁴².

Lumino-kinetic art, rooted in the Bauhaus tradition, presents another contextual frame for the *Polytopes*. “Modern Light Art” includes early lumino-kinetic practices, for ex. in the work of Francis Picabia, Marcel Duchamp, Man Ray, Vladimir Tatlin and Naum Gabo, which were based on mechanical movement, using light solely to

⁴⁰ Specifically for the influence of Plato to Xenakis see Lewis, 2010.

⁴¹ LaBelle, 2006, 192.

⁴² LaBelle, 2006, 192.

illuminate and emphasize the functioning of the mechanism⁴³. A second tendency appeared in the early '60s, represented for instance in the work of members of the *New Tendencies* exhibitions and group in Zagreb from 1961 onwards⁴⁴, or by Victor Vasarely and the GRAV (Groupe de Recherche d'Art Visuel) group in Paris. It is characterized by works based on the movement of the spectator's eyes, either by the manner of looking at the work (guiding the eye) or by changing position before the work, stimulating the eye to move. The trend was short-lived; in the late '60s lumino-kinetic art lost its cybernetic edge by being rebranded as 'Op Art' by commercial galleries⁴⁵. However, certain practitioners developed an early digital aesthetic, by applying computers for controlling light and sound environments. Especially in the audiovisual, dynamic programmed works of Vladimir Bonacic, created in the context of the *New Tendencies*, the digital aesthetic is very strong. In his work *GF.E 16/4* Bonacic applied random programming to the audio and the visual "sculpture", treating colored light bulbs as pixels⁴⁶.

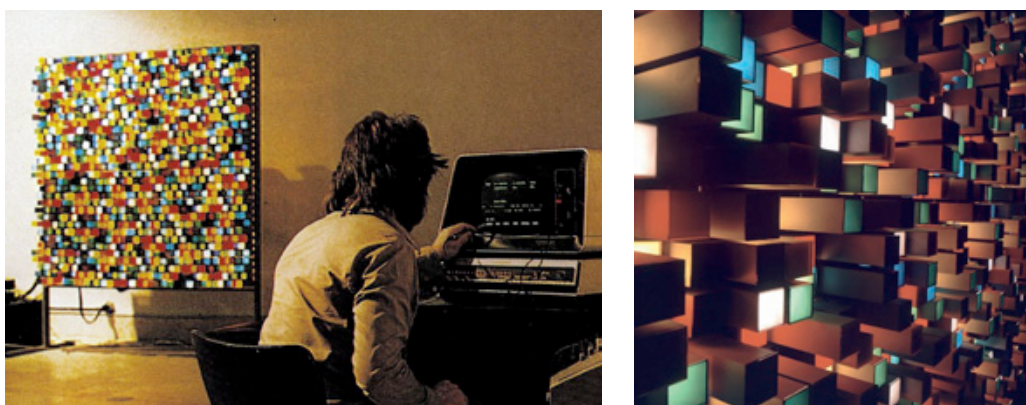


Fig. 120-121. Vladimir Bonacic, *GF.E 16/4*, 1969 – 1970.

After the invention of the laser⁴⁷ and the first artistic experiments with it, the part of lumino-kinetic art using laser technology was rebranded as "laser art"⁴⁸. Artistic applications of the laser technology made appeared in three main areas: in combined visual and aural productions, in long-distance environmental plastic displays and in holography⁴⁹. Initially advertised as "a new visual art" that "pushes out the frontiers of art and enlarges the possibilities of creation", laser art was a prominent feature in a variety of exhibitions throughout the late 1960s and early

⁴³ Popper, 2007, 13-18.

⁴⁴ On the *New Tendencies* movement see: Fritz, Darko, "New Tendencies", *Oris*, no. 54, 2008, Arhitekt, Zagreb, 176 – 191, available at http://darkofritz.net/text/Fritz.NT_oris%2054.pdf (11/3/11); Rosen, Margit (ed.), *A Little-Known Story about a Movement, a Magazine, and the Computer's Arrival in Art. New Tendencies and Bit International, 1961–1973*, Cambridge, Massachusetts: The MIT Press, 2011.

⁴⁵ Medosch, 2005, 33.

⁴⁶ Popper & Nechvatal, 2003, 7. For Bonacic's work see Fritz, 2008.

⁴⁷ Even though Albert Einstein had already established the theoretical basis for laser technology in 1917, the laser (named from the initials of Light Amplification by Stimulated Emission of Radiation) was invented in 1960 by Theodore Maiman of the Hughes Aircraft Company in California. As the name implies, the laser generates a beam of light that is totally coherent since it is all one wavelength.

⁴⁸ For more on laser art see Popper, 2007, 49-51; also Mächtel, Alexandra, *Technische, wirtschaftliche und ästhetische Aspekte von Lasershow, Bachelor diss.*, Heinrich-Heine-Universität Düsseldorf, 07/2005; online version at: <http://www.maechtel.com/laser/index.html> (23/8/10).

⁴⁹ Popper, 2007, 52-56; Youngblood, 1970, 399-413.

'70s – the first one being “Laser Light – A New Visual Art”, organized by Leon Goldman at the Cincinnati Art Museum, in 1969⁵⁰.

Shortly after simple early applications of the technology in art contexts⁵¹, artists used mirrors in combination with laser beams to create room-sized installations and light environments. Joël Stein, Mike Campbell, Baron Kody, Horst H. Baumann, Rockne Krebs, Robert Whitman, Lowell Cross, and the above-mentioned Keiji Usami⁵², were among the early practitioners.

Laser art had a particularly strong presence in the Osaka World Exhibition of 1970, from visual shows synchronized to music, as in the case of Xenakis' and Usami's above mentioned collaboration, to nocturnal large-scale laser displays. It was also preeminently featured in individual pavilions. Krebs created one of the first large-scale laser installations for the US Pavilion, consisting of a variety of singular beams in different colors that were projected onto mirrors⁵³.

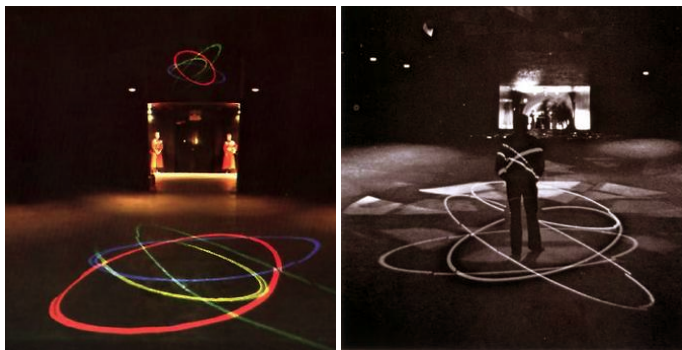


Fig. 122-123. Pepsi Pavilion, 1970, the “Clam Room”.



Fig. 124. External view of the Pepsi Pavilion by night, with Frosty Myers' *Light Frame* sculpture (1970).

The Pepsi Cola Pavilion also featured an audiovisual laser-light work by pioneer artist Lowell Cross. The Pepsi Pavilion was conceived and programmed by the EAT group (Experiments in Art and Technology)⁵⁴. At night Frosty Myers' *Light Frame* sculpture created a tilted rectangle of xenon laser light around the Pavilion, transpiercing the “cloud” on the dome⁵⁵. Its main space, the “Mirror Dome”⁵⁶, hosted a dense

⁵⁰ Boyle, Richard J., *Laser Light: A New Visual Art*, Cincinnati: Cincinnati Art Museum, 1969, 12.

⁵¹ Early applications of laser technology in an art context include Leo Beiser's experiments in the sixties with what he called Co-Op-Art (Coherent-Optical-Art), and the integration of laser technology in some performances of the *9 Evenings* in 1967 (Youngblood, 1970, 401).

⁵² By the late '60s lasers were also used for stage design, for example Swedish artist Carl Frederick Reuterswärd used lasers in a performance of “Faust” in Stockholm in 1968; around the same time French artist Joël Stein experimented with fixed and moving mirrors reflecting laser beams on the stage.

⁵³ Blake, Peter, “Raising the roof at Osaka”, *New York Magazine*, Issue 13, April 1970, 53. See also Hewlett-Packard's *Measure magazine*, February 1970, 2-4; available online from: www.hparchive.com/measure_magazine/HP-Measure-1970-02.pdf (23/8/10).

⁵⁴ <http://www.fondation-langlois.org/html/e/page.php?NumPage=401> (23/8/10).

⁵⁵ <http://www.medienkunstnetz.de/works/pepsi-pavillon/images/8/?desc=full> (11/12/10).

⁵⁶ <http://www.medienkunstnetz.de/works/pepsi-pavillon/images/1/> (11/12/10).

program of artist-engineer collaborations throughout the Expo's duration⁵⁷. To enter the main space of the pavilion, visitors entered through a tunnel and descended into a dark clam-shaped room lit by moving patterns of laser light. The "Clam room" was dark, with some light coming from the glass ceiling that was the center part of the floor of the Mirror Dome. A sound activated laser deflection system, *Video/Laser II*, designed by Lowell Cross, projected moving laser patterns by means of vibrating mirrors⁵⁸. The fervor over laser light art rapidly died down, however, perhaps due to the suspect popularity of its increasing presence in rock concerts and light shows from the '70s onwards. The immersive nature of the light show – with its emphasis on sound, color and technology – assumed even more expansive forms such as the discotheque, which reformulated the loose painterly vocabulary of psychedelia into controlled and gridded dance floors and fashionable interiors.

At the same time new installations of immense proportions by both artists and composers appeared⁵⁹. A tendency towards combined visual and aural productions was soon established: artists and composers such as Otto Piene, Carl Fredrik Reuterswärd, Iannis Xenakis and Paul Earls staged multimedia spectacles⁶⁰. Paul Earls started in the early 1970s to introduce laser systems into his displays before specializing in projections of graphic designs (*Laser Chamber*, 1979) in collaboration with Otto Piene. Earls also used laser projections in collaborative works with Piene and other members of the Center for Advanced Visual Studies of the MIT, with the most preeminent being *Centrebeam* (Kassel, 1977; Washington, DC, 1978)⁶¹. These works commonly share an immersive quality, blurring the distinction between the space of the spectator and that of the artwork. They participate in the general tendency towards the dematerialization of the art object, a process typical of 20th c. art.

⁵⁷ See Youngblood, 1970, 416; Klüver, Billy, Martin, Julie, Rose, Barbara (eds.), *"Pavilion" by Experiments in Art and Technology*, New York: E.P. Dutton & Co., 1972; Packer, Randall «The Pepsi Pavilion: Laboratory for Social Experimentation», in: Shaw, Jeffrey, Weibel, Peter (eds), *Future Cinema. The cinematic Imaginary after Film*, Exh. cat., Cambridge, Mass./London, England: The MIT Press, 2003, 145; <http://www.fondation-langlois.org/html/e/page.php?NumPage=306> (4/1/11).

⁵⁸ The laser beam was split from a krypton laser into four colors, and each color beam was sent to sets of mirrors mounted at right angles and vibrating up to 500 cycles per second to create the patterns. The work was an extension of the multi-color laser performance with electronic music that Cross developed in collaboration with David Tudor and Carson Jeffries in 1969. See Cross, Lowell, «Laser deflection system», in: Klüver, Billy, Martin, Julie and Rose, Barbara (eds.), *Pavilion*, New York: E. P. Dutton, 1972, 235-237.

⁵⁹ Brougher et al., 2005, 170.

⁶⁰ Popper, 1993, 65; Popper, 2007, 24.

⁶¹ Piene, Otto, Goldring, Elizabeth (eds), *Centerbeam*, Massachusetts Institute of Technology. Center for Advanced Visual Studies, 1980, available online at: <http://museum.mit.edu/150/89>



Fig. 125. The *Diatope*, interior view during spectacle, Bonn, 1979.



Fig. 126. The *Diatope*, interior view during spectacle, Bonn, 1979.



Fig. 127. The *Polytope de Cluny*, Paris, 1972.

Integrating space as a fundamental parameter, the *Polytopes* participate in the tradition of new art forms that emerged after the Second World War, such as happenings, performances, installations and environments⁶². Frank Popper, one of the few art historians who have included the *Polytopes* in their narratives, classifies them as multisensory environments⁶³, media art works that emerge in the late '60s – early '70s in the USA, Japan and Europe. The site-specific character and the

⁶² Weibel, 1991; Paul, 2003; Manovich, 2001.

⁶³ Popper, Frank, *Die kinetische Kunst. Licht und Bewegung. Umwelt und Action*, Köln, 1975, 135, 142; quoted in Alexaki, 1996, 135.

spectatorship conditions rendered the *Polytopes* characteristic examples of a general tendency towards the dematerialization of the art object and the wish to blur the boundaries between the space of the artwork and that of the spectator/audience; what Xenakis called «the musicalization of space»⁶⁴. Indeed, together with the audiovisual character, the two elements all the *Polytopes* commonly share are the not strictly determined conditions of spectatorship – the visitor could choose where to sit, stand or move within the work -, and their ephemeral nature.

Much like similar works that explored the aesthetic potential of new technologies, the *Polytopes* proved to be ephemeral and transient in essence. Founded on the cutting-edge technology of the time, the *Diatope* participates at the technological ephemeral, appearing as a simple demonstration of potential. In this context, the copious efforts to describe the work, both at the time of its presentation and in retrospective, are enlightening: “Geste de lumière et de son”, “Kunst und licht bewegung”. Revault d’Allonnes, who together with Xenakis co-edited the only monograph on the *Polytopes* that was published at the time used the term “spectacle visuel et sonore”⁶⁵. The term *spectacle* has many connotations, which are different in a French and English or German context⁶⁶; however, a negative connotation has been attributed to the term, as drawn from Guy Debord’s book “The Society of the Spectacle”⁶⁷. In Debord’s critique of postwar capitalism, which has influenced both cyberculture and postmodernist thought, the spectacle is not so much a set of particular cultural or media events and practices, as much as an illusion, a separation from, or masking of, real life, permeating the entire specter of social life in the “society of the spectacle”⁶⁸. By the 1980s the term ‘spectacle’ takes on an almost entirely pejorative connotation, which surfaces often in the context of contemporary art⁶⁹. In this context, in the official catalogue of Xenakis’ works of the (German) editions Salabert, the *Diatope* is described as a “Licht und Tonwerk”⁷⁰.

The “failure” of the *Diatope* to engage in art discourses and endure, as an artwork, can be associated with the historical concurrence of its creation. As Gere argues, “the late 1960s were both the zenith and the beginning of the end for both the widespread application of cybernetics in contemporary art, and for attempts to use the computer as an artistic medium.”⁷¹ In the early ‘80s interest in media art slacked, as neo-expressionist painting and neo-conceptual art dominated the art system⁷²; in the field of media art, the main trend was “multimedia”, with installation works and

⁶⁴ Revault D’Allonnes, 1975, 128.

⁶⁵ Revault D’Allonnes, 1975, 128.

⁶⁶ In French, the term refers to any sort of exhibition or performance that is presented in a visible way to an audience. In English a *spectacle* is anything that is the object of the gaze, especially something intended for public display; it can mean an exhibition or performance, but is usually used with a negative connotation: “spectacle” is generally construed as “a piece of stage-display or pageantry, as contrasted with real drama” Davis, Patrice, Shantz, Christine, *Dictionary of the theatre: terms, concepts, and analysis*, Toronto: University of Toronto Press, 1998, 346.

⁶⁷ Debord, Guy, *The Society of the Spectacle*, 1967; English translation: Black & Red, 1977, available online from http://library.nothingness.org/articles/SI/en/pub_contents/4 (4/1/11).

⁶⁸ Lister, M., Dovey, J., et al., *New media: a critical introduction*, Routledge, 2009, 142.

⁶⁹ <http://www.tate.org.uk/modern/eventseducation/symposia/7682.htm> (3/3/11).

⁷⁰ Alexaki, 1996, 136.

⁷¹ Gere, 2004, 62.

⁷² Medosch, 2005, 27.

performances dominating the scene⁷³. At the same time, the “high media art” scene was just beginning to form – f. ex. the Ars Electronica Festival in Austria. “High media art” (Medosch, 2005), the media art discourse that started in the ‘80s and became dominant by the mid ‘90s, flourished in this newly established institutional context⁷⁴. Medosch identifies the “high media art” discourse with the institutionalization of technologically-based art⁷⁵, which was just forming when Xenakis, discouraged from the *Diatope*’s reception, would gradually stop making further plans in this domain⁷⁶.

The *Diatope* was rendered obsolete shortly after its expensive production, suffering from inherent contradictions: an idiosyncratic anti-aesthetic based on the grandiloquence of a state institution⁷⁷. In 1978, the peak of interest in cybernetic art was already past; the *Diatope* was not that new and not that old, created at a time when “high media art” and its supporting institutions were just in the process of being established. The work did not continue its ambitious itinerary, whereas it was not broadly promoted, nor documented, and any published documentation did not circulate widely. With a few exceptions, the French press saw in the *Diatope* a banal repetition of the success of the precedent *Polytope de Cluny*, which had been enthusiastically received by the more or less same journalists and public⁷⁸. This also stems from the attendance numbers of both works: while the *Polytope de Cluny* was one of the most successful productions of the *Festival d’Automne*, both in terms of attendance and investment, the production of the *Diatope* never reached its goals.

Ernst Gombrich’s criticism of 19th c. art and its historiography is still relevant in the 20th century, and especially on media art. As in modernity the historic sequence of styles became a dogma, new styles are becoming obsolete “before the paint has dried”. But, according to Gombrich, the historic view on one style succeeding and replacing the next has obscured the view on major paradigm shifts in art. He concludes that the principle of progress has been inflicted on art, and argues that instead of blindly following this external principle, art should exercise its right to formulate its own goals and to question the legitimacy of scientific projects, because otherwise it subsumes to an irresistible development⁷⁹:

What has come to be termed variously "digital art", "computer art" or "electronic art" stands at the intersections of vectors of three historic forces: engineering (in particular computer science), transnational commodity capitalism and the traditional "fine arts". [...] Digital media artists are attempting to deal aesthetically with a technology which is the

⁷³ Paul, 2003, 133.

⁷⁴ Medosch, 2005, 5. According to Medosch, the discourse on high media art uncritically relies on many elements of the techno-imaginary, justifying its claims through the material basis of its practice, the use of new media technologies and in particular the computer.

⁷⁵ Medosch, 2005, 5.

⁷⁶ His proposals for a *Polytope of Mexico* and a *Polytope of Athens* remained unrealized (see Chapter III. Iii).

⁷⁷ Solomos & Raczinski, 1999, 67.

⁷⁸ See for ex. Lonchamp, 1978.

⁷⁹ Gombrich, Ernst, *The Ideas of Progress and their Impact on Art*, New York: The Cooper Union School of Art and Architecture, 1971/1987, 107.

*technology of power in our culture, both paradigmatically and economically.*⁸⁰

Xenakis' gigantic projects required the mobilization of vast financial, human and material resources. Such reserves are readily available in few places-among them, huge corporations, rich governmental agencies and totalitarian military institutions. At the same time, Xenakis had faith in the "peace dividend," dreaming about the artistic benefits of converting military equipment to peaceful purposes. The vast scale of the polytopes called for substantial sociopolitical support: they required funds and resources from various organizations and needed the public to visit them and care about them so that the governments or other institutions felt that their expenditures were justified. This way the *Diatope* was lost, somewhere between utopia and technocracy.

Together with the actual installation, the proposed aesthetic experience is forever lost – another reason that the work possesses an obscure fame. It can only be suggested through the traces illustrated above, and possibly reconstructed or reenacted. But even then we can only speculate about it, even though oral histories indicate that the totality of the experience was where the essence of the work resided⁸¹. The same can be suggested for the whole series of *Polytopes*, as site-specific, ephemeral works.

It can be argued that the *Diatope* is the most complete realization among the *Polytopes*, as it was the only one for which Xenakis also conceived an architecture. As a solution to the problem of "which architectural form to give to musical or visual manifestations", the design of the *Diatope* documents Xenakis' research on the acoustic qualities of space and on the spatialized projection of sound and light. Furthermore, with the *Diatope* Xenakis ultimately materialized his vision for an "automated art". As we argued, the work holds a prominent position in xenakian thought and practice as a condensed crystallization of Xenakis' process, which was truly hybridized and interdisciplinary. His quest for an automated art followed a solitary, idiosyncratic approach; that of a postmodern Pythagorean, who delved into ancient Greek thought and contemporary science, and affirmatively embraced any and all technological advancement, transferring vague hopes in technological and scientific progress⁸².

⁸⁰ Penny, Simmon, "Realities of the Virtual", 127, in Schwarz, Hans Peter, Shaw, Jeffrey (eds.), *Media Art Perspectives*, Karlsruhe: Edition ZKM, 1996, 127-134; quoted in Medosch, 2005, 25.

⁸¹ "I experienced the *Diatope* – its montage, démontage and many, many performances in-between, and have to confess that nothing compares to the total experience of lying on the floor, feeling the earth move under you to the beat of Xenakis's music, with his light and laser compositions blinding your sight, within his specifically designed environment. (...) You just had to be there to understand, but I also understand that if you weren't, you may not be able to see my point." Sharon Kanach, Linear Notes in: Iannis Xenakis, *Electronic Works 2: Polytope de Cluny, Hibiki Hana Ma*, Mode records Mode 203 (CD or Surround DVD).

⁸² "(...) the most advanced scientific research can be combined with the most prophetic artistic forms. Yet both can remain powerful abstractions closely related to cosmic phenomena with immediate effect on the imagination of the most humble man and child of all races and religions. These means are now available and one can create a fantastic network of optimistic and pacifistic art throughout the world." Xenakis, I., "World Polytope (Global interactions of light and sound)", in: Xenakis/Kanach, 2008, 255.

The product of a coherent artistic vision and practice, the *Polytopes* form an integral part of the history of 20th century art. As audiovisual *spectacles* they belong to the genre's long formative history, which can be historically traced back to any number of beginnings - from ancient Greek tragedy and medieval court masques, to Scriabin's Prometheus or Wagner's concept of the *Gesamtkunstwerk*. At the same time, integrating space as a fundamental parameter, the *Polytopes* take part in the process of the dematerialization of the art object and the integration of the space of the spectator and that of the artwork. In this regard, they also belong to the tradition of happenings, performances, installations and environments, typical art forms that emerged in the postwar period⁸³. However, unlike these artistic events that were for the most part conceived as non-hierarchical and collaborative, Xenakis insisted on single authorship and emphasized the absolute control over the final result by means of automation⁸⁴. While the application of mechanical apparatuses and technological tools in multimedia works is hardly a novelty, the *Diatope* differs from similar preexisting and contemporary works by being entirely based on the most advanced technology to create an audiovisual experience in the spectator.

As automated audiovisual environments, the *Polytope of Cluny* and the *Diatope* have also many suggestive parallels with contemporary practices of computer-based audiovisual performance. In (electronic) music sets the visual component has been established as standard practice, whether it is based on moving image and/or disorienting light shows. With the development and wide availability of computer technology in the '90s, computer-generated visuals, usually synchronized to the audio, have been commonly integrated in electronic music performances. In some artistic practices the aesthetic of abstraction is central, whereas the audio and the visual output can be generated by the same algorithms⁸⁵. Xenakis' description of the *Diatope* as "a new form of visual and audio art, that is neither ballet nor opera, but a truly abstract spectacle in the sense that it is a terrestrial or abstract music"⁸⁶, fits surprisingly well with contemporary generative audiovisual practices.

The relevance of Xenakis' artistic practice today is also suggested by the revived interest in his electroacoustic work from the late '90s onwards: the revived interest in the UPIC (at a time where all sorts of sound synthesis software and applications are being developed), the performances and tributes that have been taking place in concert halls, festivals, and museums, and the numerous new releases of his

⁸³ For example the Independent Group's series of multimedia exhibitions (1956-1957), Allan Kaprow's Happenings (1958-1962), Robert Rauschenberg's series of responsive environments (late 1960s) and the experimentations of Fluxus artists in performance, film and an array of mixed media (early 1960s).

⁸⁴ As Mondloch, 2004, suggests, much like in the case of the "highly controlled 1958 Poème électronique masterminded by Le Corbusier", which "seems a more fitting prototype for current immersive technological artistic environments than the more frequently suggested precedents of the 1960s experimental, largely non-hierarchical art and media practices." (Mondloch, 2004, 62).

⁸⁵ For ex. Ryoji Ikeda's *datamatics* performances (2006)

<http://www.ryojiikeda.com/project/datamatics/> (13/3/11); the *rhythm_screen* multiscreen audio-visual performances by artists of the raster-noton label, premiered at club transmediale 2009

<http://www.clubtransmediale.de/festival-09/night-program/schedule/28/raster-notonrhythm-screen.html>

(13/3/11); the work of media artist Klaus Obermaier <http://www.exile.at/ko/> (13/3/11); or the UPIC sessions by Russel Haswell and Florian Hecker.

⁸⁶ Iannis Xenakis, *Les chemins de la composition musicale*, 29-30.

electroacoustic music⁸⁷. Xenakis' "war aesthetic", early manifested in his electroacoustic works, belongs to the aesthetic landscape that grew from the ruins of postwar Europe; this aesthetic has had a long lasting influence in experimental genres of popular music, especially in the noise music scene. As James Harley, 2002, observes, there are many parallels between Xenakis' "war aesthetic" and contemporary experimental electronic music, particularly in the embracing of technology and the high density and amplitude sound aesthetic⁸⁸. Although we are missing significant information to assert the totality of the aesthetic experience in the *Diatope*, we can speculate, based on the above analysis, that the conditions of spectatorship were highly disciplined, requiring the observer's rapt attention and placing them "under constant attack"⁸⁹. Apparently, the music's "war aesthetic" was dominant in the visual spectacle as well.

Regarding the above, Xenakis' *Diatope* belongs to the tradition of technology based art that emerged in the postwar period, to which we refer to as media art or digital art. It remains relevant as an integral part of the "media art histories" that redefined the entire area of aesthetic awareness in the 20th century.

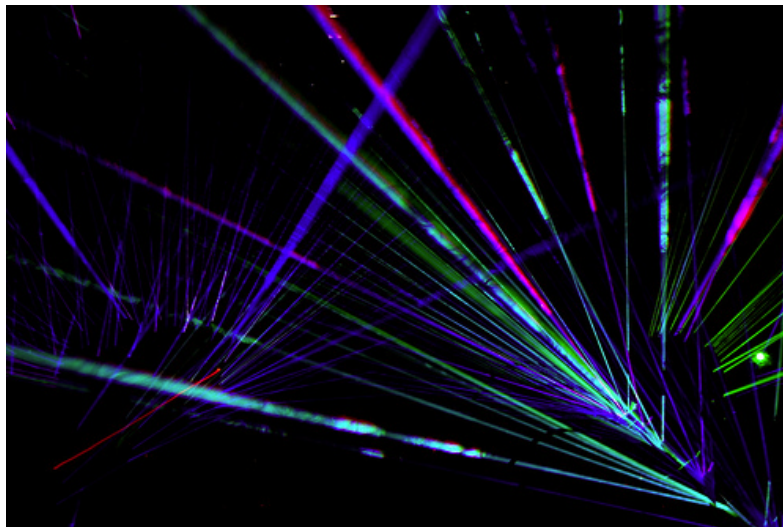


Fig. 128. Russel Haswell and Florian Hecker, *UPIC* diffusion session at sonic acts xiii festival, 25 February 2010, Amsterdam.

⁸⁷ Harley, J., 2002, 33.

⁸⁸ Harley, J., 2002, 41.

⁸⁹ Matossian, 1979, 40.

Chapter VI

Conclusions

In the present thesis, our aim has been to research the *Diatope* as an installation consisting equally of all media used - music, light, and architecture -, in the context of Xenakis' quest for an automated art that develops in space and time. Ultimately, from a media art historical perspective, we attempted to examine the work in the context of early media art, and reassess the work's non-canonical status in the context of art history. In this manner, we hope to contribute to the study of Xenakis' oeuvre, which demands to be studied on many different levels.

Active throughout his career as architect and composer, Xenakis built a substantial record of research and production in both fields¹. Involved in science and technology at a formative level, Xenakis saw things as almost an engineer would in terms of their structural relationship to one another. This approach is inherent in his method, which is based on transferring a certain structure from one field to another, from engineering to music, and from music to architecture². It was by going back to the foundations of artistic phenomena that Xenakis discovered new ideas that informed his artistic practice, attempting to overcome the cognitive division whereby material and structure are considered to be two different aspects of a composition³. His holistic approach to form is also expressed in his writings, where he pleads for interdisciplinary research into form, proposing the development of a new discipline of "general Morphology": form should not to be dealt with in isolation in each discipline, but in connection with and in relation to general formal research.

With his rigid engineer's logic Xenakis reduced composition – both architecture and music – to an abstract process, by basing musical and spatial design on mathematical models. What he is concerned with is not just the interdisciplinary (in the sense of an exchange between different disciplines), but rather a *transdisciplinarity* – that is, the transposition of the same abstract paradigm in different disciplines. The *Polytopes*, and in particular the *Polytope de Montreal*, the *Polytope de Cluny*, and the *Diatope*, they are clearly articulations of this *transdisciplinarity*. They are the synthesis of the three poles round which Xenakis's creative universe is composed – architecture, music and technology⁴.

Founded on the cutting-edge technology of the time, the *Diatope* participates at the technological ephemeral, appearing as a simple demonstration of potential. This thesis hypothesizes that the structural relationship of the audiovisual components is central to the *Diatope*, and that it is in this relationship that resides the "digital aesthetic" of the work, rendering it extremely relevant in the light of contemporary art and culture.

¹ Sterken, 2007, 21-51. Sterken's comparative chronology of Xenakis's architectural and musical oeuvre (Sterken, 2004, 513-523; Xenakis & Kanach, 2008, 286-293) indicates many interrelationships between his compositional work and architectural projects, as well as with his writings.

² Sikiaridi, 2001, 206 ; Sikiaridi, 2010, 96, 100.

³ Valsamakis, 2000, 53.

⁴ Sterken, 2001d, 81.

As we mentioned above, Xenakis' oeuvre and method demand to be studied on many different levels. His *transdisciplinary* thinking presents a demanding challenge to the researcher, as it was extremely complex and multileveled. We cannot but recognize that most the points we touched upon in the context of this thesis are merely consequences of the present work and, to a large degree, speculations. Their elaboration from mere hypotheses to theses sustained with strong arguments requires a much more in-depth, multi-layered study, extending to different disciplines. The process of researching and writing on the *Diatope* and Xenakis' practice gradually resulted in an ascertainment of how demanding the study of media art histories, and of any interdisciplinary subject, can be.

With regards to Xenakis' oeuvre, the available bibliography is truly vast. While in the context of this thesis we have confined our sources to those more or less directly related to the *Polytopes*, there are many indications, as we argued before, that a close study of Xenakis' musical oeuvre and practice is indispensable for anyone wishing to investigate Xenakis' audiovisual syntheses. Recent research, to which we didn't manage to get access, extends to many different levels, yielding interesting results⁵. As Xenakis' writings are very dispersed, we have largely relied on Kanach, 2008, as an English-language source. Hopefully a future critical edition of Xenakis' writings will include all the material that is indispensable for the study of his work⁶.

Such texts could support an investigation and/or an interpretation of the *Polytopes*. However, as the works do not exist anymore, a close study of the unpublished material preserved at the Iannis Xenakis Archives, located at the National Library of France in Paris, is ultimately indispensable for the researcher⁷. Unfortunately, even though we made repeated efforts, we did not have access to them at the time of writing. This was a basic obstacle that affected largely the strength of our arguments, and changed the initial planning of the research.

As Sterken's comparative chronology of Xenakis' architectural and musical oeuvre indicates, there is much accordance between his writings and architectural projects, as well as between his architectural and compositional work⁸; the same has been argued for Xenakis' instrumental and electroacoustic music⁹. Based on these observations, future research could extend to comparatively studying the audio and

⁵ See for ex. Iliescu, Miha, *Musical et extramusical. Éléments de pensée spatiale dans l'œuvre de Iannis Xenakis*, PhD Diss., Université de Paris I, 1996; Gibson, Benoît, *Théorie et pratique dans la musique de Iannis Xenakis : à propos du montage*, PhD Diss., Paris, Ecole des Hautes Etudes en Sciences Sociales, 2003.

⁶ A corpus of Xenakis' writings and interviews is currently being edited by Benoît Gibson, Sharon Kanach and Makis Solomos (Kanach, 2008, xiii).

⁷ The same goes for the digital command tapes of the *Diatope*, which have been recently discovered, yet their condition is not yet known (Kanach, 2008, 247).

⁸ Sterken, 2004.

⁹ See for ex., Solomos, Makis, "The unity of Xenakis' instrumental and electroacoustic music. The case of "brownian movements", *Perspectives of New Music*, vol. 39, n°1, 2001, 244-254; Pires, Isabel, "Quelques réflexions sur les rapports entre l' électroacoustique et la musique instrumentale de Xenakis: le cas de la *Légende d'Eer* et *Jonchaies*", Proceedings of the Electroacoustic Music Studies Network International Conference, 3-7 June 2008, Paris, available online at: <http://www.ems-network.org> (11/12/10).

visual components of the Polytopes comparatively. In the case of the *Diatope*, a comparative analysis of the light “partition” and the music “partition” would certainly provide more enlightening with regards to the audiovisual relationship and the structure of the *spectacle*. Furthermore, a comparative analysis of the visual components of the *Polytope of Montreal*, the *Polytope of Cluny* and the *Diatope*, with their “soundtracks” and with Xenakis’ musical oeuvre and compositional techniques in general, could reveal new aspects of his truly interdisciplinary and hybrid practice. Ultimately, a critical investigation of whether the *Diatope*’s intrinsic architectural qualities justify a physical reconstruction or not, could be realized¹⁰.

We hope to have shown that narratives of media art histories extend to different fields and disciplines, and that relevant works have not yet been studied in this context. Unlike cinema and film, which have been studied comparatively to media art¹¹, comparative histories with other fields such as music are still missing. Computers began to be used in the late 1950s for both the creation of music and images/graphics; these parallel developments, intertwined in the first place¹², suggest many parallels between these practices and their respected histories. Contemporary media art, and digital culture in extension, is essentially audiovisual and interdisciplinary; it is on this basis that the histories of computer music and art should be comparatively studied. The challenge for a history of media/digital art is to encompass all these diverse but intersecting practices and narratives.

The dissolving of the audiovisual *Gesamtkunstwerk* into mass culture has a complex history, closely tied with World Exhibitions and institutional patronage. Requiring immense resources, these large-scale, technology-based spectacles became entangled with the culture industry, and subsequently were integrated in it. Indeed, “high media art” (Medosch, 2005) has very deep roots that extend beyond the institutionalization of media art, to the role of the avant-garde in the early and mid-20th century. Taking a more pragmatic approach, we can look beyond ontological and/or phenomenological classification schemes, which are based on the technology used and the strategies/media formats of presentation. We can attempt to analyze and categorize media art forms “according to motives, topoi or other aesthetic categories and principles”¹³. Such an approach could support a critical investigation of both the recent art history and contemporary artistic practice. This requirement is apparent in the entire case of contemporary art, whether it is made with new media technologies or traditional means. While much experimentation in new media is so costly that subsidizing from institutions and the industry is indispensable, star contemporary artists working with “traditional” means increasingly rely on software, new technologies, and anonymous labor to meet the demands of the art market¹⁴. Such modes of production directly reflect the interests of the art market and the culture industry; even when artistic vision and authorship are set off to advantage

¹⁰ Sterken, 2008b.

¹¹ Manovich, Lev, *The Language of New Media*, Massachusetts, Mass.: The MIT Press, 2002.

¹² See for example Gere, 2004, 51-52.

¹³ Medosch, 2005, 24.

¹⁴ For ex. the large scale studios of Jeff Koons, Takashi Murakami and Damien Hirst.

and deemed undisputed. A critical analysis of modes of production in contemporary (media) art could engage in the theoretical support of artistic practices which wish to take a critical stance towards the inherent contradictions of contemporary (media) art, and move beyond the dominant techno-imaginary.

As in terms of the Anglophone discourse Xenakis seems underrepresented, we hope that the present thesis will serve as a contribution to the study of his work, providing new ground for future research. We hope to have shown that the *Diatope* can be regarded as a paradigmatic early attempt to create an immersive audiovisual experience in the spectator, based on computer technology. We have argued that its immersive, audiovisual aesthetic that resides in the digital has many suggestive parallels with that of contemporary artistic production in new media and digital culture, thus offering a theoretical and historical foundation for the art-historical discourse regarding the proliferation of immersive, audiovisual art practices in contemporary culture.

We should also highlight that a genuinely critical response to Xenakis' work and practice is still missing from the field. We believe that it is worth further investigating Xenakis' practice and thought – to quote Olivier Messiaen “a thought not radically new, but radically different”¹⁵.



Fig. 129. Iannis Xenakis.

¹⁵ “Une pensée, non pas radicalement nouvelle mais radicalement autre”, Olivier Messiaen quoted in: Fleuret, Maurice (ed.), *Regards sur Iannis Xenakis*, Paris: Stock, 1981, 19.

VII. Bibliography and sources

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¹ Solomos, 2001a, 231-265, available and regularly updated online at: <http://www.iannis-xenakis.org/fxe/biblio/biblio.html> (4/1/11). See also Harley, James, "Iannis Xenakis Bibliography and Discography", *LEONARDO online*, <http://mitpress2.edu/e-journals/Leonardo/isast/spec.projects/Xenakisbib.html> (4/1/11); Sterken, 2004; Xenakis/Kanach, 2008.

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3 In an abbreviated version and a different English translation, the text was also in the program notes (5 p., typed) for the live performance of the *Légende d'Eer* in the Birla Planetarium in Calcutta on February 25, 1982. (HJNagel personal archiv).

4 The text has an additional English subtitle: “Thoughts on the correlations between public and sources (theatrical and auditional) from the point of view of: a) size b) location c) nature of sources d) shelter e) technology. Examples of spectacles-auditions from the «polytopon» of Persepolis, Mycenae, Cluny, Montreal, Beaubourg, Philips.”

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⁵ In Xenakis, 1985, there is a postscript mentioning to the first edition of a different version of this text, published in the book "The Art of Music: Tradition and Change by William B. Christ and Richard P. Delone of the School of Music, Indiana University, Bloomington". In the Centre Georges Pompidou/IRCAM 1981 edition there is a postscript mention that the article was first published in English in an MIT Press publication. We haven't been able to trace neither publications.

Online Resources

<http://www.iannis-xenakis.org> (4/1/11)

Website of the organization “The Friends of Xenakis” with rich material and bibliographic sources.

<http://brahms.ircam.fr/composers/composer/3397/> (4/1/11)

Ircam webpage for Iannis Xenakis.

<http://www.olats.org/pionniers/pp/xenakis/xenakis.php> (4/1/11)

Leonardo webpage for Iannis Xenakis.

<http://www.edu.vrmmp.it/vep/>; http://www.edu.vrmmp.it/vep/vep_old/ (23/11/10)

The website of the VEP project, rich in archival material concerning the Philips Pavilion and the *Poème électronique*.

<http://bxmc.poly.edu/projects/xenakis> (7/1/11)

Video recordings of the lectures presented in the frame of the conference “Xenakis. Past, Present, and Future” at the Brooklyn Experimental Media Center, New York January 28-30, 2010.

<http://xenakis.musicportal.gr/main/?lang=en> (7/1/11)

IEMA portal for Iannis Xenakis.

<http://www.ubu.com/film/xenakis.html> (7/1/11)

Xenakis audio and audiovisual material.

http://www.drawingcenter.org/exh_past.cfm?exh=662 (7/1/11)

<http://www.cca.qc.ca/en/education-events/970-sharon-kanach-and-carey-lovelace-iannis-xenakis> (7/1/11)

Webpages of the “Iannis Xenakis. Architect, composer, visionary” exhibition.

<http://www.music.columbia.edu/masterpieces/notes/xenakis/notes.html> (8/1/11)

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Material on Xenakis at the webpage of specialist James Harley.

Discography⁶

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Interview of Iannis Xenakis with Hans Ulrich Obrist, Paris 1995, Hans Ulrich Obrist personal archive (presented in the frame of the "marathon marathon" project at the Acropolis Museum, Athens, 19/10/2010).

"Iannis Xenakis dans le métro », Actualités régionales Ile de France, 27/07/1981 (03min16s), accessible online at:
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⁶ For a complete catalogue of musical works <http://www.iannis-xenakis.org/xen/works/works1.html> (1/10/2010); <http://www.iannis-xenakis.org/fxe/biblio/discogene.html> (1/10/2010) and www.durand-salabert-eschig.com/formcat/catalogues/xenakis_iannis.pdf (1/10/2010).

Abbreviations

BNF	Iannis Xenakis Archives, Bibliothèque Nationale de France, Paris
ACP	Archives Centre Pompidou, Paris
AHJN	Personal archive of Hans-Jürgen Nagel

List of image sources

Fig. 1. Kanach, 2006.

Fig. 2. Andy Matthews, 1998.

http://www.flickr.com/photos/ginja_andy/4252645778/

Fig. 3. <http://www.flickr.com/photos/8808719@N06/1434746891/>

Fig. 4. Hans Jan Dürr <http://www.flickr.com/photos/durr-architect/3736628824/>

Fig. 5. <http://www.iannis-xenakis.org/xen/archi/real.html>

Fig. 6. Matossian, 1986.

Fig. 7. <http://www.flickr.com/photos/aitiri/2855905533/>

Fig. 8. <http://www.inderscience.com/jdr/backfiles/articles/issue2004.02/Art2.html>

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Fig. 13. Peggy Guggenheim Collection, Venice © Antoine Pevsner, by SIAE 2008

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