# SCHOOL OF MUSIC | UNIVERSITY OF ILLINOIS

| Thesis/Scholarly Essay Approval Form | Student UIN: 676069132 |
|---|---|

| | |
|---|---|
| Student's name: | Eun Joo Ju |
| Degree sought: | Doctor of Musical Arts |
| Program: | AMUSD: Music – UIUC- 10KS0265AMUS |

**APPROVAL OF THESIS/SCHOLARLY ESSAY BY FINAL EXAMINATION COMMITTEE**
We, the undersigned, recommend that the thesis/scholarly essay completed by the student listed above, be accepted by the School of Music for deposit.

Robinson, Dana (Chair)

Tipei, Sever (Director)

Bashford, Christina (Member)

Lund, Erik (Member)

**DEPARTMENTAL APPROVAL**

Head of department

3/14/16
Date

*The signature of the department head, or authorized signatory, is an assertion of the authenticity of the committee signatures and the acceptability of the thesis/scholarly essay to the department. Signatory must sign his or her own name.*

This form is required for completion of the thesis/scholarly essay deposit.

# IANNIS XENAKIS' *GMEEOORH* FOR ORGAN SOLO: THE USE OF ARBORESCENCES AND PERFORMANCE CHALLENGES

BY

EUN JOO JU

THESIS

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Musical Arts in Music
with a concentration in Performance and literature
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2016

Urbana, Illinois

Doctoral Committee:

Associate Professor Dana M. Robinson, Chair
Professor Sever Tipei, Director of Research
Associate Professor Christina Bashford
Professor Erik Lund

## ABSTRACT

IANNIS XENAKIS' GMEEOORH:
THE USE OF ARBORESCENCES AND PERFORMANCE CHALLENGES

A Thesis Submitted to the Faculty of the Graduate School and
the School of Music of the University of Illinois at Urbana-Champaign

by Eun Joo Ju

The purpose of this thesis is to explore Iannis Xenakis' work, *Gmeeoorh* for organ, based on the use of his compositional technique, *arborescence*, and also to offer new insights into the performance of avant-garde organ music by way of technical solutions to the extreme complexities and difficulties found in *Gmeeoorh*. It is also intended as a guideline to expand awareness of the organ repertoire of the late twentieth and twenty first centuries. The chapters are ordered as follows:

Chapter 1 begins with an overview of the trends and new developments in organ music during the late twentieth century, particularly the adaptation avant-garde methods by composers for the organ. Xenakis' *Gmeeoorh* is introduced, along with the composer's concepts of continuity of sound and the exploitation of the organ's capacities, which led to the use of *arborescence* in *Gmeeoorh*.

Chapter 2 deals with Xenakis' background, including his education and the influences on both his personal life and on him as a composer, and how his educational and career background, as a major in engineering and as an architect, led the composer to formulate his unique compositional aim (continuity) and the technique(s) to realize it (*arborescence*).

Chapter 3 considers Xenakian applications for continuity, the prototype of his arborescence, by way of Xenakis' application of mathematics in establishing the basis for his compositional philosophy (the association of music and architecture), examining Xenakis' development of arborescence through several examples from *Metastaseis B*, *Synaphaï*, *Noomena*, *Pithoprakta*, and other works.

Chapter 4 discusses possible technical solutions for the extreme complexities encountered in performing *Gmeeoorh* based on an analytical approach, by dividing *Gmeeoorh* into eight sections, and examining each section in detail from both compositional and performance aspects. In addition, the technical problems posed by each section will be addressed in the light of performance by one main organist-performer (OP), one organist-assistant (OA), and one registration-assistant (RA),

Chapter 5 concludes with a summary of the contents of each chapter, and reviews the practical methods outlined in Chapter 4 with regards to the preparation of *Gmeeoorh*, and offers guidelines for study, practice and performance, in order to reproduce Xenakis' score as accurately as possible.

An Appendix offers a brief description of my own project recital, given on November 13, 2015 on the organ of the Chapel of St. John the Divine (Episcopal), in Champaign, Illinois, and offers additional, practical suggestions for organists, not only for performing *Gmeeoorh*, but also, as has been one of the objectives of this paper, hopefully, will encourage the performance of avant-garde organ literature from the twentieth and twenty first centuries.

**Acknowledgements**

I would like to offer my gratitude to a number of individuals who have given me help and encouragement over the period in which this thesis was written.

Most of all, I especially wish to express my gratitude to my Director of Research, Dr. Sever Tipei, who, from the outset, encouraged me in my work, provided me with a critical perspective and many details and suggestions for all aspects of this study. I am also most grateful to Dr. Dana Robinson, for his faith in this study and his patient and kind encouragement over many years. I would also like to thank my other committee members, Professor Christina Bashford, and Professor Erik Lund, for their suggestions and encouragement. My special thanks also go to Dr. Michael Leonard, who has generously read and edited every page several times, offering invaluable comments and suggestions, while working on his own dissertation. There are other kinds of help that make this thesis possible: Sharon Kanach, Richard Coffey, Jennifer Philips, and Sandy Horn

Finally, I also want to take this opportunity to thank members of my family and friends — my husband, Min Ho, two daughters (Hyobin and Karen), Youth group Pastors (Tae Hwan, Tae Jung), and Mrs. Semmens, for providing all sorts of tangible and intangible support, prayer and love.

## TABLE OF CONTENTS

# CHAPTER 1.

## Introduction: Trends and New Developments in Organ Music During the Late 20th Century

> Imitation is an existential mistake. So, to escape from that trivial cycle of relationships in music, the musician, the artist, must be absolutely independent, which means absolutely alone. You must be convinced that you're doing what you must be doing, with the means at your disposal, at that particular time. If you had other means you'd be doing something different.[1]
>
> Bálint András Varga,
> *Conversations with Iannis Xenakis*

The purpose of this project is to expand the awareness of the repertory of avant-garde organ music from the late twentieth and twenty first centuries, much of which has not been extensively performed due to its complexity and technical difficulties. It is also intended to provide new insights into contemporary organ repertoire and to advance performance techniques for realizing non-idiomatic works. *Gmeeoorh* (1974) by Iannis Xenakis (1922-2001) is such a work.[2] Unlike many organ works which were written by composers who were organists themselves, Xenakis' only organ work was not written from an idiomatic standpoint but from his own compositional method based on *arborescences*. Xenakis' *arborescence* originates as a graph, resembling a tree-like structure, and can go through various transformations such as multi-dimensional rotation and expansion.[3]

After World War II, music took fundamentally different directions with the arrival of a younger generation of composers such as Pierre Boulez (b. 1925), John Cage (1912-1992), and Karlheinz Stockhausen (1928-2007). Breaking with the traditional tonal system, composers

---

[1] Bálint András Varga, *Conversations with Iannis Xenakis*, London: Faber and Farber, 1996, p. 212.
[2] The title of *Gmeeoorh* is of free anagram of organon (meaning the organ). Iannis Xenakis, Notes to the score of *Gmeeoorh*, (Version 61 notes) Paris: Salabert, 1974.
[3] According to Xenakis, *arborescence* resembles the shape of trees and is placed on pitch versus time space. Instead of having melodic patterns and polyphony, it can be transformed by rotations, zooms, and various alterations. Varga, pp. 86 – 89.

strived to find innovative ways to create new musical styles, such as new techniques for organizing pitch, and a stronger emphasis on timbre, and shifting textures. These compositional trends in mid-to-late twentieth century music were also adapted by composers for the organ.

Looking back on the trends of organ music since the early twentieth century, many were still based on traditional models, such as Marcel Dupré's (1886-1971) *Trois Préludes and Fugues, Op.7*; Maurice Duruflé's (1902-1986) *Prélude et Fugue sur le Nome d'Alain*; and Neo-Classic German organ works such as Paul Hindemith's (1895-1963) three *Organ Sonatas* and the *Kammerkonzert No.7* for organ and chamber orchestra, all of which utilize conventional forms such as fantasy, theme with variation, and fugue. With the new generation of composers, these compositional methods began to give way to more non-traditional models, emphasizing a new, systematic approach to pitch, texture and form. Olivier Messiaen (1908-1992) played a particularly significant role with his own *Technique de mon langage musical*, [4] and had a strong impact on the next generation of composers of the late twentieth century.

Among Messiaen's techniques, his block-like structure offers a framework from which to analyze works such as Xenakis' *Gmeeoorh*. Block-structure indicates a form divided into several different sections or units, sometimes contrasting various styles between each section, rather than having a gradual development of a theme.

The musical styles for organ underwent radical changes in the mid 1960s. Composers like Gyὸrgy Ligeti (1923-2006), an organist himself, constructed his own non-traditional and non-idiomatic models of composition, enlarging not only the possibilities for exacting new timbres from organ, but also introducing new graphic notations and performance techniques. In

[4] *The Technique of My Musical Language* is in two volumes. The first volume deals with Messaien's compositional methods, such as added values, nonretrogradable rhythms, and rhythmic pedal, and also includes his modes of limited transposition. The second volume contains musical examples and illustrations of the technique.

his first organ piece, *Ricercare* (1953), Ligeti took advantage of the full compass/range of the manuals and pedal. In *Volumina* (1961-62), Ligeti applied a then-new graphic notational system for sound mass textures, to produce various kinds of clusters. His graphic notation also delineates specific tone clusters, "either consisting of only white or black notes, or both resulting in chromatic tone clusters, and their function is either static or moving clusters."[5] In order to perform those clusters, the performer must often make use of the palms, forearms, or additional implements such as planks, in order to accurately interpret the notation and flow of the score into the topography of the keyboard.[6] With these experimental methods, Ligeti became the one of the first composers to create new sounds on the organ, emphasizing new timbres and performance techniques.

These innovative styles become more accentuated in Xenakis' *Gmeeoorh*. The work was composed for the 1974 Annual International Contemporary Organ Music Festival for Organists and Composers, in Harford, Connecticut and dedicated to concert organist Clyde Holloway. The composer made two versions of *Gemeeoorh*, for organs with a range of 56 notes, and 61 notes, respectively.

> In case the organ keyboard does not possess the 61 notes, it is possible, on one hand, to play the special versions which are part of this score and, on the other hand, to ignore the notes which are off the keyboard.[7]

This thesis will discuss the version *Gmeeoorh* for 61 notes.

---

[5] Sam Giles, *Investigating the Structure of Acoustic and Electronic Noise: An Analysis of 'Volumina' by György Ligeti and 'Canaanda' by Merzbow*. B.M. Edith Cowen University, Western Australia, April. 2012: p. 23.

[6] The use of keyboard clusters dates to the early twentieth-century with piano pieces such as *Three Irish Legends* (*The Tides of Manaunaun, The Hero Sun,* and *The Voice of Lir*, 1912) by Henry Cowell (1897-1965) which use white-key, black-key, and chromatic clusters played with both the palm and the forearm, and *The Piano Sonata No.2* (Known as the *Concord Sonata*, 1919) by Charles Ives (1874-1954) which requires the use of a $14\,^{3/4}$ inch long felt-padded board for right-hand clusters in the second movement.

[7] Iannis Xenakis. Notes to the score of *Gmeeoorh* (Version 61 notes) Paris: Salabert, 1974.

In this work, Xenakis' primary concerns are the continuity of sound and the exploitation of the organ's capacities. These main interests led to the use of *arborescence* in *Gmeeoorh*. *Arborescence* (referring to the shape of trees) is a method closely connected to his conception of form; where music is a kind of living organism that has its own life, rules of its own, and its own way of beginning and ending. The composer first outlined his musical ideas mathematically on graph paper, and then translated them into a musical score.[8] Xenakis uses multiple staves for each hand and pedal, necessitating an effective method of realization for its performance. Thanks to the efforts of Françoise Rieunier[9] (French organist, b.? – 2011) and Xavier Darasse[10](1934-1992), Xenakis made a feasible performance score. The use of *arborescence* brings about continuity through complex melodic patterns in each voice, creating a new kind of polyphony, combined with complex and multilayered textures throughout the piece. In addition, Xenakis delineates the form into eight block-like structures.

Another important feature of *Gmeeoorh* is that it exploits all the possibilities of the organ based on timbre. The piece was specifically written for the Gress-Miles organ at South Congregational Church in New Britain, Connecticut. The organ presently has 3 manuals and 60 ranks. The manuals are all based on the 16' series, giving a full range of sound, all the way to the Scharf 1', IV- VI ranks, and Zimbel 1/3', III-V ranks. This enabled Xenakis to produce all manner of tone colors ranging from the thunderous clusters of the last page to a wide range of complex effects such as employing frequent shifts of registration. Thus, the scope of this project is both to provide a basic analysis of the complete musical text, and to use this analysis to focus

[8] Varga, p. 90.
[9] Rieunier was a soloist of Radio France, and of the Orchestre de Paris, and was also a student and assistant to Olivier Messiaen. Her work with contemporary composers led to the creation of many new works for the organ.
[10] As a composer and organ virtuoso, Darasse was particularly dedicated to contemporary organ music. His principal organ work, a series titled *Organum* (1970-1988) is composed of eight pieces, which consists of solo works, as well as works for organ with other instruments

on dealing with technical difficulties by suggesting possible solutions, not only for realizing *Gmeeoorh,* but for facilitating and encouraging the performance of other avant-garde organ works as well. In order to further understand Xenakis' compositional style, his background and the development of his compositional methods will be discussed in Chapter 2; the occurrence and specific shapes of the arborescence, as found in *Gmeeoorh,* will be found in Chapter 3; and a performance-based analysis of its block-structure will be outlined in Chapter 4.

Scholars and performers have questioned the possibility of achieving accuracy in the performance of *Gmeeoorh* due to the difficulty and complexity of the piece. Among of the technical issues in *Gmeeoorh* are how to realize the extreme complexities of texture, handling the frequent changes of registration, and allowing performers to transcend to the limits of technique possible in both hands and pedal. Therefore, both the compositional structure of *Gmeeoorh* will be discussed vis-à-vis its technical challenges, to assist in making the work more accessible for those who wish to perform it, and also to broaden the performers' understanding, interest, and capacity for contemporary and avant-garde organ music as a whole. It is hoped that these suggestions and solutions will encourage and promote more performances of twentieth and twenty first century organ music.

## CHAPTER 2.

### Iannis Xenakis: Background and Formative Influences

> The name has cast the man. Iannis Xenakis means "gentle stranger. For him no territory, no ground is home."[11]
>
> Noutriza Matossian,
> *Xenakis*

Iannis Xenakis always searched for new territory, not only as a person but also as a composer. He was born to a Greek immigrant family on May 29, 1922, in Brăila, Romania. His mother, Phontini Pavloua, was accomplished as both a linguist and pianist.[12] Thanks to her, and also a radio station in Katowice,[13] Xenakis encountered music such as Romanian folk, gypsy music, and Catholic and Orthodox Church music.[14] When he was six years old, Xenakis received a small flute from his mother. He also later noted his own reactions to her piano playing; "When she started to play, I was almost paralyzed."[15] However his early musical experience ended in sad memory, due to his mother's death shortly thereafter. This incident influenced his belief that music should not be related to subjective feelings and experiences.[16]

At the age of ten, Xenakis was sent to a boarding school, Anarghyrios, on the island of Spetses in Greece, where he spent his childhood and adolescence. At first, he did not get along with other classmates due to his strange Greek accent, naïveté, and his lack of confidence. This led him to read numerous books in the library and later to become versed in Classical literature, science, philosophy and astronomy. This allowed Xenakis to begin to stand out among his

---

[11] Matossian, Nouritza. *Xenakis*. New York: Taplinger Publishing Company, Inc., 1986, p. 11.
[12] *Ibid,* p. 13.
[13] According to Xenakis, "we were living in Romania and we could pick up a Polish station in Katowice." Xenakis, Iannis, *Music and Architecture* Translated, compiled and presented by Sharon Kanach, Preface, xvi.
[14] Xenakis, *Ibid*, Also, Varga, *Conversation with Xenakis*, London: Faber and Farber, 1996, p. 10.
[15] Xenakis, *Ibid*.
[16] Varga, p. 10.

classmates. At this time he also discovered his natural ability for mathematics and science, which was to be a lifelong influence on his compositional process.

Xenakis' musical ability was fostered by an English headmaster, Esmeade Noël Paton. Paton perceived Xenakis' musical sensitivities and developed a long-term relationship with him.[17] Xenakis also had an opportunity to listen for the very first time to works such as J. S. Bach's Brandenburg Concertos, Beethoven's Fifth Symphony, and works by other European composers, through the radio in a meeting room at the boarding school.[18] He reminisced that the Fifth symphony "hit me like an apocalypse."[19] From then on, he gradually became involved in music by taking lessons in harmony, and also as a chorister, with works by Palestrina being a particular favorite.[20]

During his youth, Xenakis considered becoming an archeologist from his reading of the Classics, while "surrounded by the statues and temples"[21] of Greece. When he was sixteen years old, Xenakis prepared for the entrance examinations at the National Technical University of Athens (also known as Polytechnic School) after graduating from the boarding school.[22] At the same time, Xenakis began to pursue his interest in music by learning counterpoint and harmony with Aristotle Kondourov, a student of Alexander Scriabin in Russia. Kondourov made a particular impression on Xenakis, teaching him the Mozart *Requiem* by learning each of the

[17] Matossian, p. 16.
[18] Xenakis, *Music and Architecture,* Preface, p. xvi, and Varga, *Conversation with Xenakis*, p.12.
[19] Xenakis, *Music and Architecture,* Preface, p. xvi.
[20] Varga, p. 12.
[21] Xenakis, *Music and Architecture,* Preface, p. xvi.
[22] *Ibid.*

vocal parts.[23] In 1940, after two failures, he successfully passed the entrance examination at the Polytechnic.

However, Italy invaded Greece the same day the examination results were posted at the school, and the university was promptly closed.[24] Greece then was successively occupied by Italy,[25] and Germany,[26] with each aggression causing the school to repeatedly open and close. This led him to join the Resistance against the Germans in 1941 and later, becoming involved in Communist and Socialist organizations. Xenakis impassionedly took a lead in organizing demonstrations and giving speeches to move public opinion against the Nazis and in support of the Communists.[27] For these reasons, he was often sent into prison,[28] repeatedly interrupting his studies at the Polytechnic, and taking him several years to graduate. Even though Xenakis laid his musical studies aside during this period, he nevertheless had a chance to hear the music of Debussy, Ravel and Bartók for the first time, through an encounter with the nephew of the General Secretary of the Communist Party, while still constantly composing music and trying to find a piano to play even in the midst of war.[29]

After the war, with the withdrawal of the German/Nazi forces, the Greeks now faced extreme political polarization, which led to the Greek Civil War of 1946-1949, between the Greek army (supported by Great Britain and United States) and the Democratic army of the Communist Party. As an active member of the Communist organization known as the People's

[23] Matossian, pp. 17-18.
[24] Matossian, p. 18 and Varga, p. 16.
[25] Greco- Italian War (October 1940- April 1941)
[26] Battle of Greece (April 1941): It is name for the invasion of Greece by German. It led the occupation by German, Axis occupation of Greece.
[27] Mattosian, pp. 21-22.
[28] Xenakis, *Music and Architecture*, Preface, p. xvi.
[29] Matossian, p. 25.

Liberation Army (ELAS),[30] Xenakis later "fought against the British who had asked for the Liberation Army to drop their arms."[31] In January 1945, he was severely wounded by a shell from Sherman tanks during a fight with the British troops. The explosion not only killed two of his comrades, but also destroyed part of his face, leaving him partially blinded; the incident also devastated his hope and the beliefs he had fought for all the while.[32] The psychological effects of war resulting from shock profoundly affected Xenakis, as did the loss of sight in one eye. At the end of the war, Xenakis eventually decided to become a composer, because only music was able to bring true comfort to him, in the midst of the mental and emotional scars left on him by the battle.[33]

The year 1947 was a significant one in Xenakis's life. He returned to the Polytechnic and finally received his degree in civil engineering. However, because the Greek government was against the Communists and had sentenced him to death, he was compelled to flee to Italy and eventually succeeded in settling down in France, by virtue of his father's help, and with a false passport.[34] Even though he experienced severe difficulties in his new life in Paris, through his Greek friend and architect from the Athens Polytechnic, Georges Candilis, in 1948 Xenakis was fortunately employed by the noted Le Corbusier (1887-1965), in Le Corubsier's studio ATBAT (Atelier des Bâtisseurs, or "Builder's studio").[35] Employed as an engineer during his first years at Le Corbusier's studio, Xenakis calculated the reinforced concrete needed for the supporting

[30] Matossian, pp. 22-23.
[31] Xenakis, *Music and Architecture* (trans. Kanach), Preface, p. xvi.
[32] Matossian, pp. 26, 28.
[33] According to Matossian, a person suffering from shock is more strongly disturbed by sound than sight, through sirens, explosions, bombing and air raid during the war. Stockhausen, Berio and Xenakis are good examples. They had to adjust to a sound world which had never seemed possible before and each one had to adapt to in with their own way. This experience later affects their compositional method. Xenakis is no exception; *Xenakis*, p. 45.
[34] Varga, pp. 19-20.
[35] Xenakis, *Music and Architecture*, p. 10.

columns, floors, and platforms the Marseille Housing Projects.[36] Coincidently, his thesis at the Polytechnic was on the use of reinforced concrete in construction. At first, Xenakis was obliged to do the job although it was a tedious and mechanical one, but it was a steady living for him. According to his then-to-be wife, Françoise, during those days, Xenakis continued studying and composing music in every spare moment.[37] Notebooks from this time reveal Xenakis working intensively on counterpoint and harmony.[38] In Xenakis' search for his personal and musical identity, he wrote folk music arrangements, influenced by the folk music of Greece, Romania, and other nations,[39] and also some pieces which had no connection with traditional harmony and counterpoint.[40] His early affection for folklore initially led him to want to become a "Greek Bartók", a notion he later abandoned.[41] His Greek roots still are evident in later compositions,[42] and his early compositional style focused on Greek elements within a European style, but which was not yet avant-garde.

Working with Le Corbusier for twelve years was also a major influence which helped Xenakis to further formulate his own compositional method. He was inspired by Le Corbusier's ability to catch mathematical connections in buildings both ancient and modern. Also, Le Corbusier's system of proportions, derived from the human figure (called "Modulor"[43]) "became

[36] L'Unité d'Habitation de Marseille: the project , known as " La Cité radieuse, The Radiant City, was to build "a vast apartment block with 340 flats to house 1600 people with a whole floor of shops and offices inside the building and a roof garden across its length and breadth"; Matossian, p. 34, and, Xenakis, p. 10.
[37] Matossian, p. 37.
[38] *Ibid.*
[39] Varga, p. 26 and James Harley, *Xenakis*: *His Life and Music*, New York: Routledge, 2004, pp. 4-5.
[40] Varga, p. 26.
[41] Harley, p. 7.
[42] Harley cites the "Dionysian ritual in The Bacchae, Harley, p. 7.
[43] Le Corbusier rediscovered the Golden Section, the division of a line such that the smaller part is to the greater as the greater is to the whole, through the book of Matila Ghyka in 1920s. Le Corbusier applied the height of an average man, 6 foot, a basic unit, then worked with the golden proportions of that unit. It used basic unifier of scale and dimension in the Unite de Marseille.

the fundamental unifier of scale and dimension, and a daily tool among all of le Corbusier's staff, " [44] including Xenakis, since the Marseille Project.

Xenakis' early piece, *Tripli Zyia* (trio for flute, soprano and piano, 1952) showed the first example of mathematical procedure in music, applying the Fibonacci series into a rhythmic pattern of sixteenth notes (13 + 8 +5+3+2) of the opening piano part.[45] The best known of Xenakis' applications of the Modulor in his architectural designs are the "Undulating Glass Panes"[46] that decorate the frontage of the Monastery at la Tourettte (1954-1960). Through the influence of the tireless inquiry of Le Corbusier on him as an architect, along with his interest in science and mathematics for the current times, Xenakis' own passion for contemporary architecture grew, and later inspired him to compose music.

However, Xenakis always experienced bitterness because his works were rejected due to his lack of traditional musical training.[47] In order to fill up his deficiencies in traditional music, Xenakis pursued his musical studies with well-known composers of the day, such as Arthur Honegger and Nadia Boulanger.

Thanks to both Le Corbusier's influence, and at Nadia Boulanger's suggestion, Xenakis met Olivier Messiaen around 1950. From Messiaen he gained the courage to continue to compose music based on the primary influences of his education: mathematics, science, ancient Greek culture, and architecture. Xenakis followed Messiaen's advice to find his own, independent path as a composer, thereby regaining his self-confidence.[48] Xenkis attended

[44] Xenakis, *Music and Architecture*, p. 10.
[45] Harley, p. 5.
[46] Three levels of windows were varied the widths of the window panels according to the proportions of the Fibonacci series. Harley and Kanach, p. 10.
[47] Varga, pp. 26-27, also Matossian, pp. 36-37 and p. 48.
[48] Matossian, pp. 48-49.

Messiaen's analysis class from 1951 to 1953, where he obtained insights on a wide range of music and was influenced by Messiaen's new perspective on compositional style, such as his modes of limited transpositions, non-retrogradable rhythms, and block-like structures.

As Xenakis gradually became involved in actual design work around 1954, his work as principal designer of the Philips Pavilion (Brussels, 1958) was greatly important for him from the point of view both an architect and a composer. As he devised an entirely new approach to surface in architecture, which resulted in the hyperbolic paraboloid shapes in the Philips Pavilion, Xenakis also obtained the solution to continuity in his music, by use of glissando. He chose glissando in order to liberate the flow of the sound without breaking continuity. This freedom from constraint inspired the composition of *Metastaseis* (1954), the piece for an orchestra of 60 string players.[49]

Another important encounter was with the conductor Hermann Scherchen (1891-1966). As founder the periodical, *Melos* (1920),[50] Scherchen had worked with Schoenberg and performed many works of the Second Viennese School composed during Schoenberg's early years.[51] Scherchen had also encouraged Schoenberg, Berg, and Webern to produce many serial works, devoting himself to the advancement of the contemporary music of the time. Like Messiaen, Scherchen supported Xenakis' music, and also invited him to his studio in Gravesano, Switzerland, in order to give lectures and to write an article for his journal, the *Gravesaner Blätter*. Xenakis' first article in the journal was "The crisis of serial music (1955)." In the article, Xenakis rejected the principle of serial composition as being too restrictive and declared his position on composition, an 'independence' from serial structure which he had absorbed from

[49] Varga, p. 24.
[50] "*Melos*" still exists but as a publisher of music scores only; Kanach, p. xviii.
[51] Scherchen was a pioneer in defending Webern and the Second Viennese School. *Ibid,* p. xviii.

Messiaen.[52] " Music had to be composed in a manner which incorporates elements which change over time, not in geometrical, static ways, for music cannot be perceived as an entity that simultaneously represents the whole, but as pieces of a totality, in the flow of time."[53] After it was published, Xenakis was inundated by hostile responses from serial music composers, and found he had created "an impervious and lasting barrier among many circles of 'avant-garde' music."[54]

Owing to Scherchen's full support, Xenkais built his own career as a composer and lecturer for avant-garde music. Xenakis' articles in Scherchen's journal later became the sources for his book *Musique Formelles* (Paris: Editions Richard-Masse, 1963). The later English edition, *Formalized Music: Thought and Mathematics*, was published, with three additional chapters, by Indiana University Press, Bloomington in 1971. It was later republished in 1992 by Pendragon Press. A second English edition, revised with additional material, and translated by Sharon Kanach, was published again by Pendragon Press, in New York in 2001.

[52] Matossian, pp. 85-86.
[53] *Ibid*, p. 87.
[54] Xenakis, *Music and Architecture*, Preface, p. xviii.

## CHAPTER 3.

### "Xenakian Continuity"[55] and Arborescence as a Compositional Technique

> I was interested in the continuous change of chords. Let us take, for example, six of the twelve notes – we get one harmonic colour. Let us then take the complementary pairs of those six notes – once again, we get a particular harmonic colour. The change between the two occurs without any transition, abruptly. The question then came to me: how can one make that change a continuous one? So long as one remains in the same scale, the only solution is a glissando.[56]
>
> Iannis Xenakis, quoted in
> Bálint András Varga,
> *Conversations with Iannis Xenakis*

Dominated by Serialist composers in the 1950s, Xenakis strived to find his own and novel compositional path. In his work on the Philips Pavilion, Xenakis confronted the issue of continuity, both architecturally and sonically,[57] and his earlier conceptualizations as a composer impacted his architectural designs. In both music and in his design of the Philips Pavilion, he grappled with the problem of "how to get from one point to the other without breaking the continuity."[58] The solution was first achieved musically, by Xenakis' use of the *glissando*, using a Cartesian coordinate system to realize his sound structures mathematically, resulting in a graphic representation, and then "transferring them into the domain of sound by mapping the straight lines of the design onto glissando trajectories of individual string instruments in the orchestra." [59] The technique was first used in *Metastaseis* (1954) [see Figures 3.1 and 3.2]:

---

[55] The term "Xenakian "is taken from Wilfrido Terrazas, "Xenakis' *Wind Glissandi Writing*", in *Performing Xenakis*, translated, compiled and edited by Sharon Kanach. Hillsdale, New York: Pendragon Press, 2010, p. 26.
[56] Varga , p. 72.
[57] Like Edgard Varese'*Poème électronique* (Electronic Poem, 1958), an 8 minute- piece for the Philips Pavilion, Xenakis also composed *Concert PH* (1958), an electronic piece of 2 and ½ minutes, as the role of prelude or interlude. Actually, the piece was heard at the entrance and exit of the Pavilion. Both pieces were requested by Le Corbusier. *Ibid,* p. 58.
[58] Xenakis, *Music and Architecture,* p. 99.
[59] Quoted in James Harley, *Graphic conception of musical structure and sonority in Jonchaies by Iannis Xenakis*, compiled and edited by Kanach . New York, Pendragon Press, 2012, p. 206.

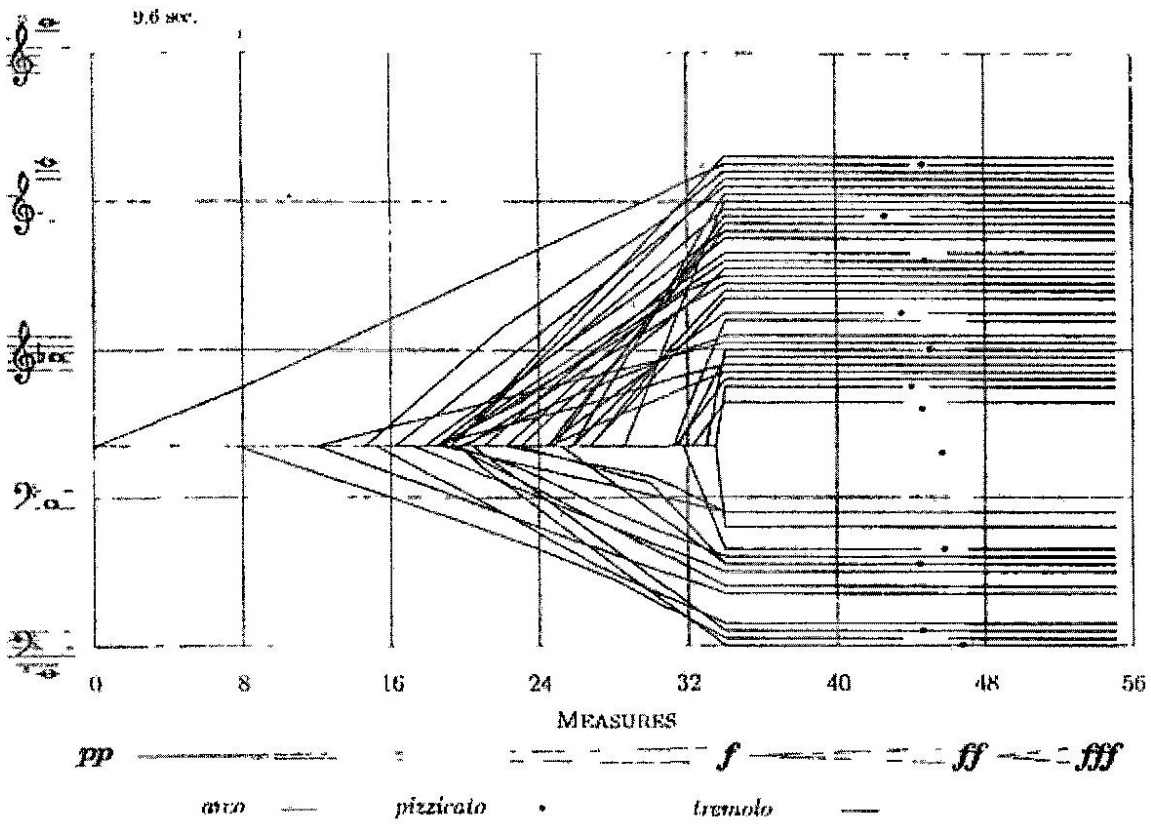



Figure 3.1— *Metastaseis,* Graphic representation of *Metastaseis,* mm. 0-34: Reproduced from Gibson, *The Instrumental Music of Iannis Xenakis,* p. 141 [Permission arranged].

[See next page]

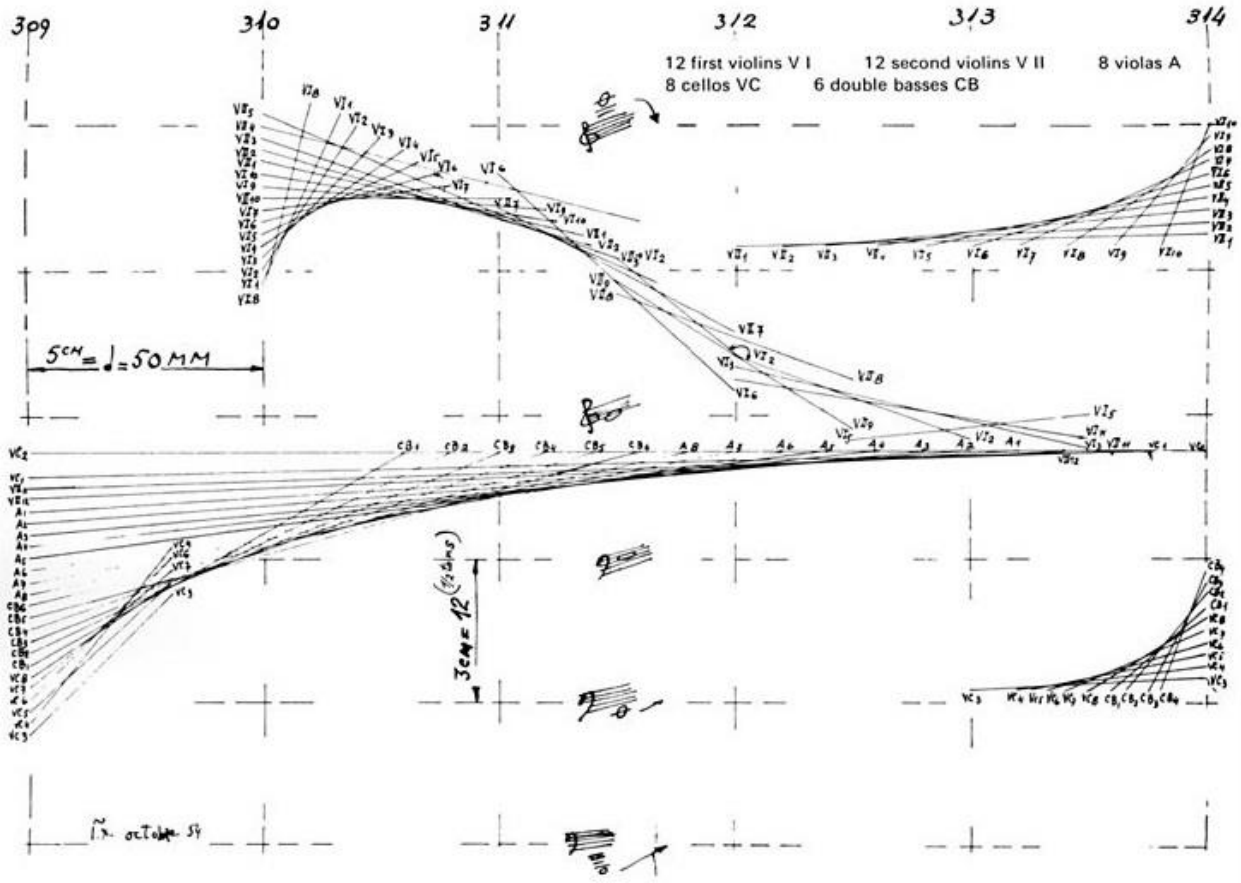



Figure 3.2 – *Metastaseis*, mm.309- 314: Graphic representation of *glissandi*, Reproduced form Xenakis, *Music and Architecture*, p. 99 [Permission arranged].

By applying the same principle to his architectural projects, Xenakis explained:

> I was able to create something in the field of architecture that hadn't existed before. In the Philips Pavilion I realized the basic ideas of *Metastasis*: 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. [60]

The result was the hyperbolic paraboloid, a structure where there is a continuous flow of surface from one point to another:

[see Figure on next page]

[60] Varga, p. 24.

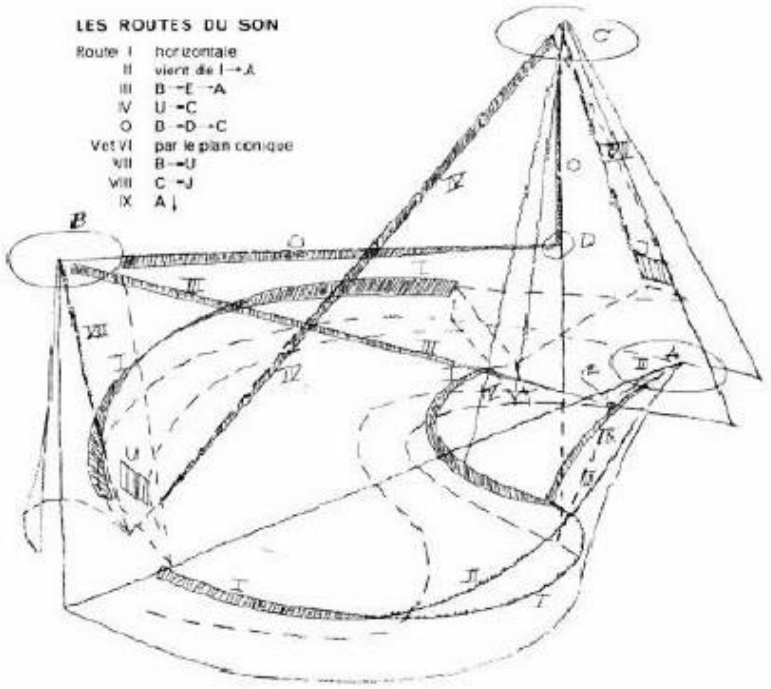



Figure 3.3 – The projection of sound across the hyperbolic paraboloids of the Philips Pavilion; Le Corbusier; Iannis Xenakis; Edgard Varèse, «Poème électronique» Philips Pavilion, 1958
Poème électronique (sketch) | © Le Corbusier; Iannis Xenakis; Edgard Varèse; [Permission arranged].

Even though the use of glissando was not a new technique, Xenakis sought to make the *glissando*, an "independent sonic entity."[61] That is, styles of *glissandi* which had not existed before. James Harley notes:

> Glissandi were nothing new, of course. The portamento had been commonly used to add certain sentimental expression, as in the work of Gustav Mahler,[62] one of the first to notate the effect explicitly. Béla Bartók abstracted the technique much further [see e.g., the fourth movement of his String Quartet No. 5, 1934] was no doubt an influence . . . [63]

Xenakis gives the following comment regarding *glissando* in his book *Music and Architecture*: "In music, the most remarkable straight line is that [which has] a constant and

[61] Harley, *Xenakis*: *His Life in Music*, pp. 10-11.
[62] Harley does not cite a specific example here.
[63] Harley, p. 10.

continuous pitch variation, the glissando."[64] Since then, glissando became Xenakis' most important composing device in the pursuit of continuity. He explains why he chose the glissando as an important tool in his compositions:

> Perhaps it's an influence from Euclidian geometry. Perhaps because the glissando is precisely a modification of something in time, but imperceptible, meaning that it is continuous but can't be grasped because man is a discontinuous being. It's a Zenonian[65] problematic or simply change in itself and it's a sort of perpetual fight to try to imagine a continuous movement in our perceptions and judgments.[66]

For Xenakis, continuity implies certain types of behavior, which Terrazas refers to as "movement."[67] Xenakis regarded *glissando* "the most usual behaviour of a sound." [68] "For Xenakis, then, a sound was alive when it contained movement",[69] patterning after the manner of Eastern Asian traditional music that uses various pitch domain with " sound always moving around it."[70]

On the other hand, Xenakis also tries to manifest the dialectical relationship between continuous and discontinuous change in sound.[71] Xenakis observed the duality in the "classical physics of waves",[72] and believed there was also a "duality in a sound and decided to make states of continuity and discontinuity a positive source of conceptual innovation in *Metastaseis* and later works." [73] For example, in *Metastaseis,* he employed glissandos as a means of continuity

---

[64] Terrazas, *"Xenakis' Wind Glissandi Writing."* In Kanach, *Performing Xenakis*, p. 26.
[65] Zenon of Ela (c.490 – c.493BC.) was a pre-Socratic Greek philosopher. Among Zenon's paradoxes, 'Achilles and the tortoise' illustrated "the contrast" between movements and immobility. This thought relates to Xenakis' continuity in *Metastaseis*. Varga, p. 72.
[66] Quoted in Terrazas, "*Xenakis'Wind Glissandi Writing."* In Kanach, *Performing Xenakis,* p. 28, quoted from Xenakis, *Art/Sciences: Alloys*, pp. 73-74.
[67] Kanach, *Performing Xenakis,* p. 28.
[68] Varga, p. 69.
[69] Terrazas/Kanach, p. 29.
[70] Varga, p. 69.
[71] "There's a dialectical contrast in it between *'meta'* [beyond, movement] and *'stasis'*[immobility]; Varga, p. 72.
[72] "waves in continuous medium behave sometimes as if they are a stream of particles while quantities which are discrete particles behave as if they are continuous waves"; Matossian, *Xenakis*, p. 88.
[73] *Ibid.*

and permutation of intervals as a way of discontinuity.[74] In addition, he used articulation "as a sort of quasi-continuum where maximum connectedness (legatissimo/glissando) dialogues with minimum connectedness (staccatissimo/discrete pitches) and where their intermediate steps are often relevant." [75] This type of movement, Xenakis has said, allows musicians to "enhance the phenomenon of sound."[76] Examples of Xenakis' use of continuous and discontinuous change can be illustrated by the score of *Metastaseis B;* [see Figures below and on next page]:

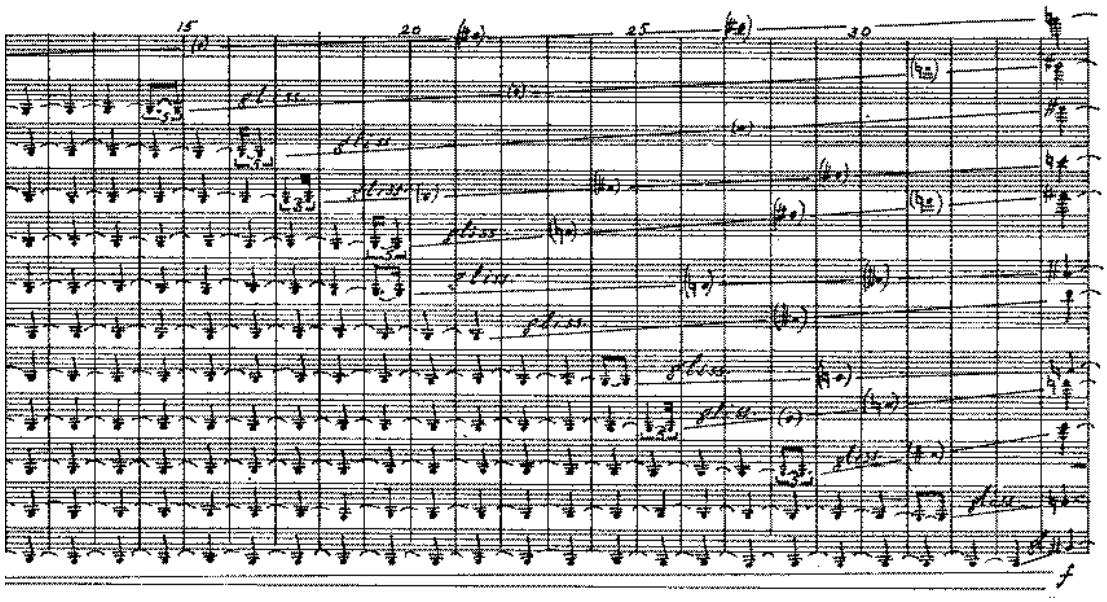


Figure 3.4 – *Metastaseis B,* [77] mm. 11-34, violin I, 1-12:
Showing *stasis* (all instruments on g) – changing to *meta* (continuous change) by use of glissando;
London: Boosey & Hawkes, 1967 [Permission arranged].

[74] *Ibid*, Varga, pp. 72-73.
[75] Quoted in Kanach, *Performing Xenakis*, p. 29.
[76] "Identifying pitch movement such as small glissandi as an important art of Asian musics would clearly give them a more continuous character. This is why Xenakis uses them as an example, not only for the pitch domain but also for the intensity and even timbral domains." *Ibid*, p. 29.
[77] "*Metastaseis B*, as the revised version of *Metastaseis A*, has slightly reduced string section in comparison with the original version, *Metastasis A*. *Metastaseis B* has been the standard version in performance and recording since its première in 1955. The première of *Metastaseis A* took place in 2008 in Torino, Italy with the orchestra RAI under Arturo Tamayo." Quoted in Ronald Squibs, "Varieties of transformation in Xenakis' Metastaseis", in *Xenakis Matters*, compiled and edited by Sharon Kanach, p. 157.

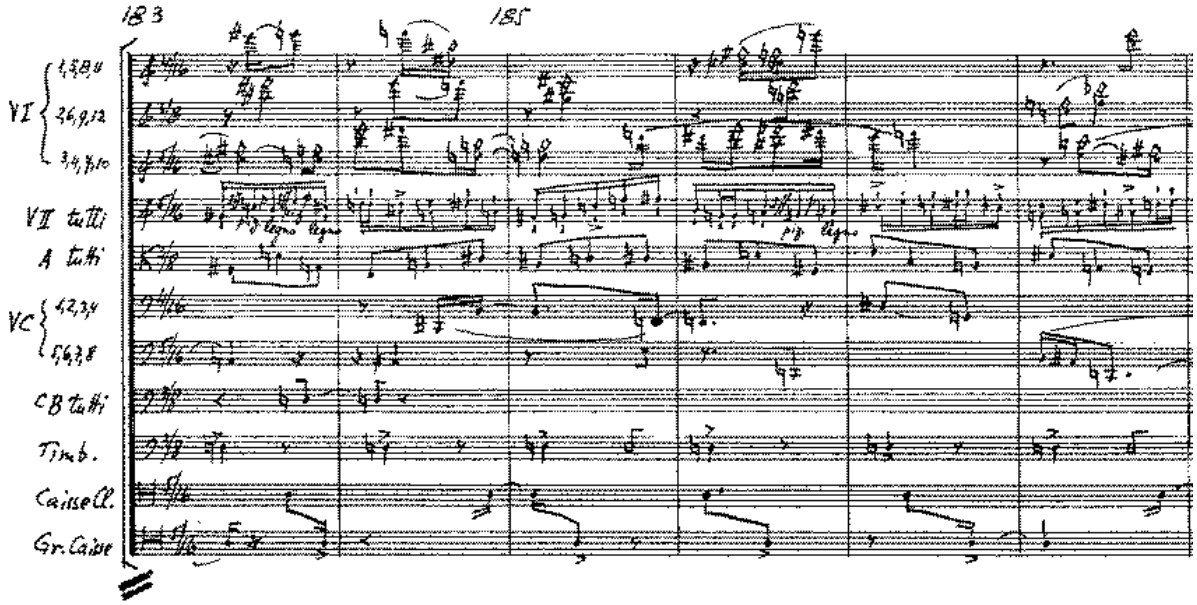



Figure 3.5 – *Metastaseis B*, mm. 183-188:
Illustrating discontinuous change through timbre and articulation
(normal/harmonics; legato and staccato),
London: Boosey & Hawkes, 1967 [Permission arranged].

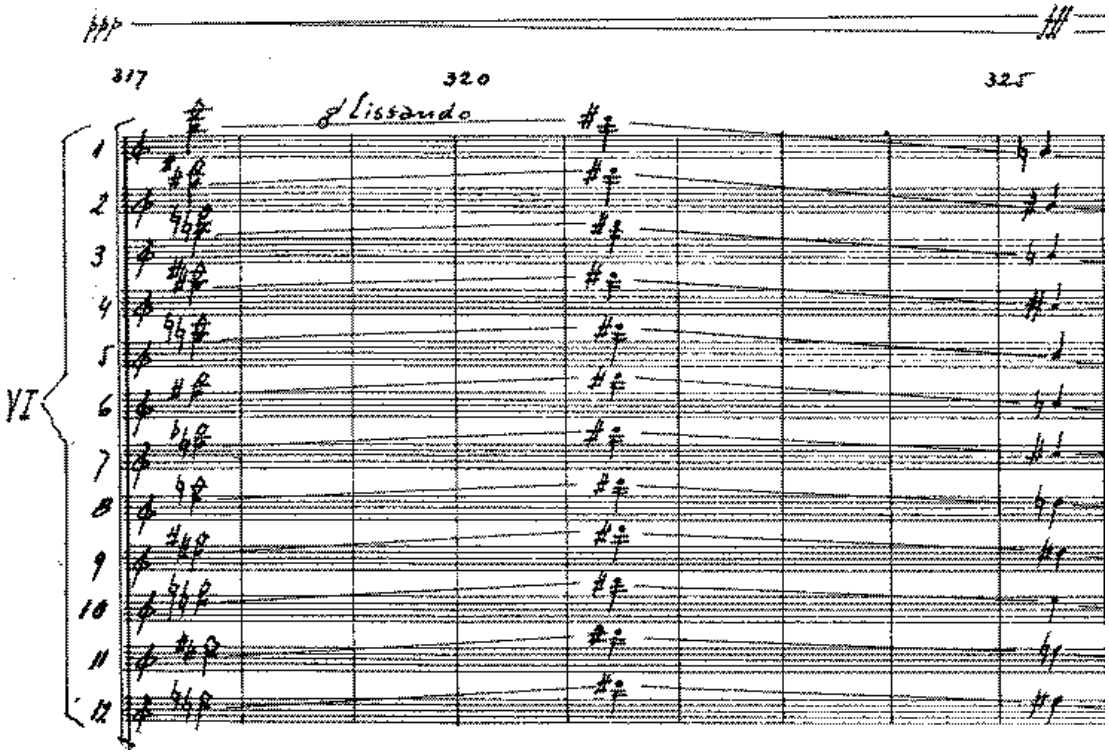



Figure 3.6— *Metastaseis B*, first violins, mm. 317-325:
Continuous change through glissando on all instruments.
London: Boosey & Hawkes, 1967 [Permission arranged].

The same techniques can also be observed in the score of *Gmeeoorh* (see Figures 3.7, 3.8):

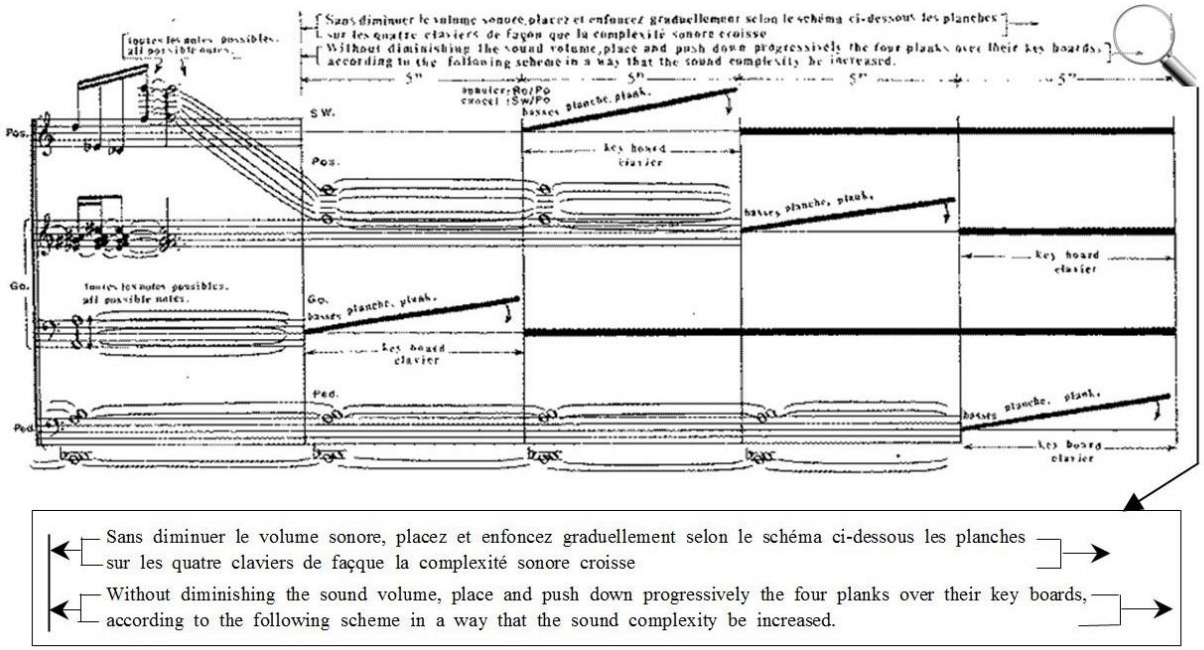



Figure 3.7— *Gmeeoorh*, mm. 292-296:
Shifting between layers of *stasis* and *meta* through use of *glissandi*;
Éditions Salabert, Version 61notes, 1974 [Permission arranged].

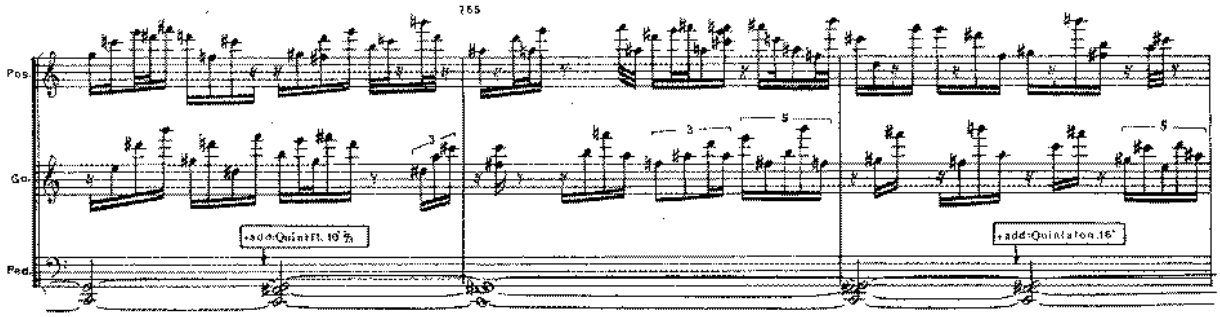



Figure 3.8— *Gmeeoorh*, mm. 264-266:
Discontinuous change through shifting of pitches over *stasis* in pedal;
Éditions Salabert, Version 61 notes, 1974 [Permission arranged].

Xenakis further developed his continuity-glissando technique and applied mathematical functions based on probability theory to his music, influenced by the book, *Calcul des*

*Probabilités* (published in 1925) by Paul Levy,[78] which Xenakis diligently read and studied by himself.[79] This theory enabled him to control and develop structures for arbitrary continuous sound-masses;

> We can control continuous transformations of large sets of granular and/or continuous sounds. In fact densities, durations, registers, speeds etc . . . can all be subjected to the law of large numbers with the necessary approximations. We can therefore with the aid of means and deviations shape these sets and make them evolve in different direction. The best known is that which moves from order to disorder, or vice versa, it is that which introduces the concept of entropy.[80]

In addition, the speed of his glissandi can be explained mathematically. For Xenakis, "the glissando can be assimilated sensorially and physically into the mathematical concept of speed."[81] In order to apply this to composition, Xenakis borrowed the "the two-dimensional plane, Cartesian coordinate system"; in which the vertical axis refers to pitches and the horizontal axis refers to time.[82] Therefore, a graph of a straight line based on the coordinates of these two elements (pitch/frequency and duration) would mathematically represent a glissando, where speed is "perceived . . .. as the by-product of sound in movement."[83] This enabled Xenakis to derive "a probability distribution of speeds." [84] With a glissando, it is speed that is perceived, rather than pitch.[85] The use of this technique (Xenakian *glissando*) resulted in his next composition, *Pithoprakta* (for orchestra of 49 musicians, 1956).[86] Here, perception of pitch is

[78] Paul Levy (1886-1971) was a French mathematician who specialized in probability theory.
[79] Matossian, p. 83.
[80] Mattosian, p. 94, the ellipsis points are Xenakis' own.
[81] Kanach, *Performing Xenakis,* p. 30.
[82] *Ibid*.
[83] Matossian, p. 94.
[84] *Ibid.*
[85] "The idea is that the glissando has no real pitch content (at least in the usual sense) because what is actually perceived is its speed, its direction and its outer pitch extremes. Speed is carefully suggested by musical notation." Kanach, *Performing Xenakis,* p. 30
[86] The title can be translated as "actions through probability" Harley, p. 13.

subordinated to the movement/effects of the *glissandi* between specific pitches, and then layered, producing a sound-mass of continuous movement:

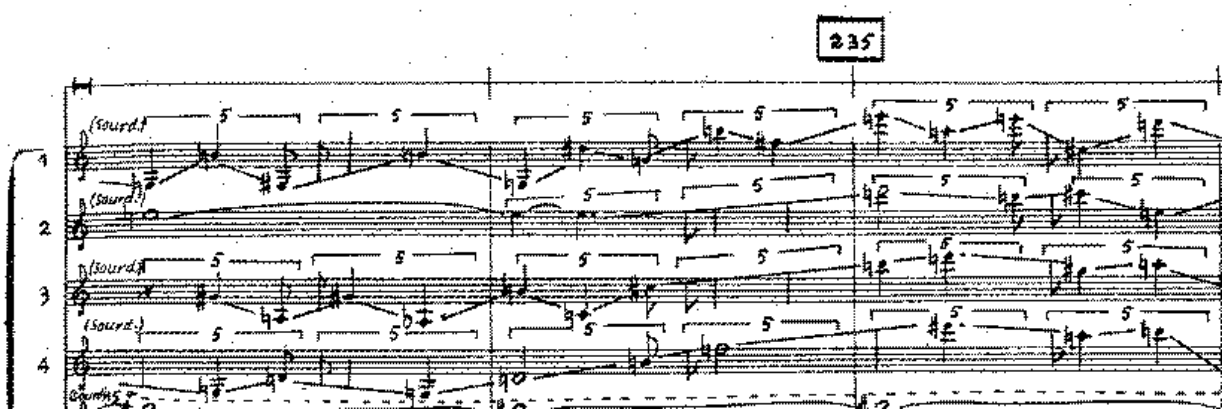



Figure 3.9— *Pithoprakta*, mm. 233-235: violins I
Boosey&Hawkes, 1967; [Permission arranged].

A similar effect can also be observed in *Gmeeoorh* (see Figure 3.10). Xenakis gradually builds clusters by way of *glissandi*, from the lowest keys to the highest ones, by applying a plank on the Swell, while at the same time adding more stops; at the same time, he creates a synthetic glissando in the pedal by reducing the pedal cluster from four notes to one, while reducing the stops (and consequently the harmonics) in between. Then, the whole compass of all three manuals and the pedal are simultaneously depressed, by planks, with stops of different harmonics of each manual and the pedal still being added in one by one, arbitrarily, resulting in a continuous–sound mass throughout [see Figure 3.10]:

[see Figure on next page]

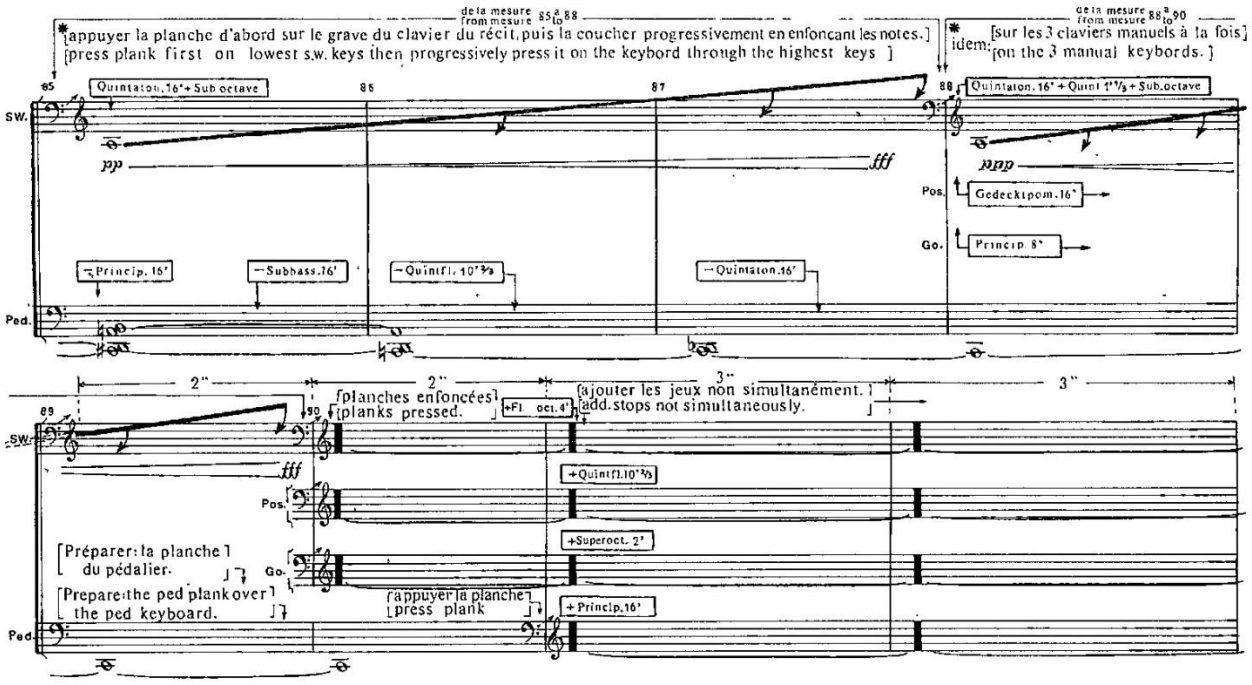



Figure 3.10— *Gmeeoorh*, mm. 85-92:
Ascending cluster-glissando on the Swell (mm. 85-89), while diminishing the pedal cluster (mm. 85-88); full-range clusters on all manuals and pedal beginning at mm. 90-91.
Éditions Salabert, Version 61 notes, 1974 [Permission arranged].

Later, Xenakis introduced curved glissandi in *Oresteïa* (1965-66).[87] Xenakis compared straight and curved ones as follows:

> From the point of view of continuity, it's impossible to imagine anything simpler than a straight line. Because once you have a curve, for example, you can imagine the forces which produced it, and there are all sorts of torsions and rich curves, while a straight line is one, without forces, identically repeating itself. [88]

[87] "Xenakis composed the core of the work as incidental music for a staging of that Aeschylus trilogy in Ypsilanti, Michigan in 1966 . . . . In truth, '*Oresteia'* [sic] is less an opera than a hybrid oratorio and ballet." Quoted from the article by Allan Kozinn, "An Opera of Epic, Composed in Stages." Music Review in the *The New York Times*; at: http://www.nytimes.com/2080/09/15/arts/music/15xena.html September, 14, 2008.
[88] Xenakis, *Arts/Scineces: Alloys*, p. 76: quoted in Kanach, *Performing Xenakis*, p. 31.

These new glissandi also have significant feature, *quilismata* (oscillations)[89], which means irregular and slow glissandi,[90] which should be played with "continuous but irregular pitch deviations around a specified written pitch."[91] It is notated with the following symbol: ~~~

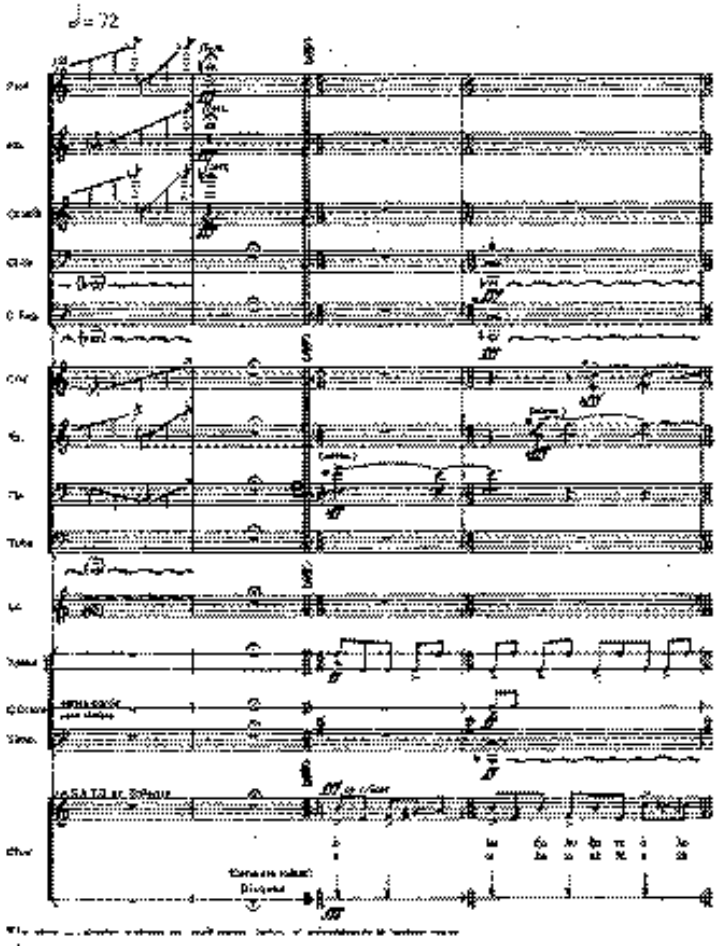


Figure 3.11— *Oresteïa,* mm. 355-358: The quilismata (oscillations) figurations can be seen in the bass clarinet, contrabassoon, horn, trumpet, trombone, and timpani parts; Xenakis footnote on the *quilismata* appears at the bottom of the score: "La signe signifié quilisma ou oscillations lentes et irregulières de la hauter notée."[92] Reproduced from Safir/Kanach, p. 293 [Permission arranged].

[89] "Xenakis speaks of 'quilismata' . . . [as] a vibrato-oscillations of pitches." Quoted from Joris De Henau, "*Gmeeoorh* (1974) for Organ by Iannis Xenakis: Towards a Critique of Arborescence." *Conference proceedings, International Symposium Iannis Xenakis,* 2005, p. 151.
[90] Kanach, *Performing Xenkis*, p, 41.
[91] *Ibid,* p. 1.
[92] Xenakis comment translates as "The sign: indicates a quilisma, or slow and irregular oscillations of notated pitch." My thanks to John Wagstaff for his assistance with this translation.

A similar technique is also can be found in the score of *Gmeeoorh*. Xenakis produced same effect not only by the execution of trills with the different speeds and irregularity but also, the addition of different harmonics (stops) between the Positiv and Pedal:

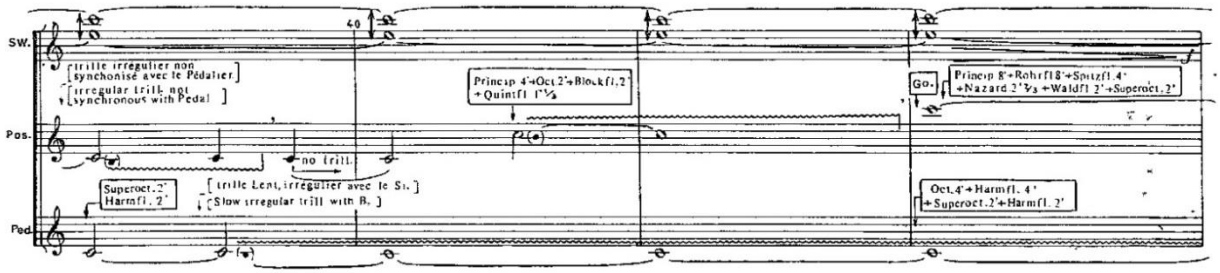



Figure 3.12— *Gmeeoorh*, mm. 39-42:
Trills between Positiv and Pedal, similar to the effect of *quilismata*.
Éditions Salabert, Version 61 notes, 1974 [Permission arranged].

**Arborescence as a Compositional Technique; Definition and Important Features**

The concept of Xenakis' *arborescence* can be understood through the meaning of the term itself. *Arborescence* originates from the Latin word, *arborescent*, meaning "treelike in size and form.[93]

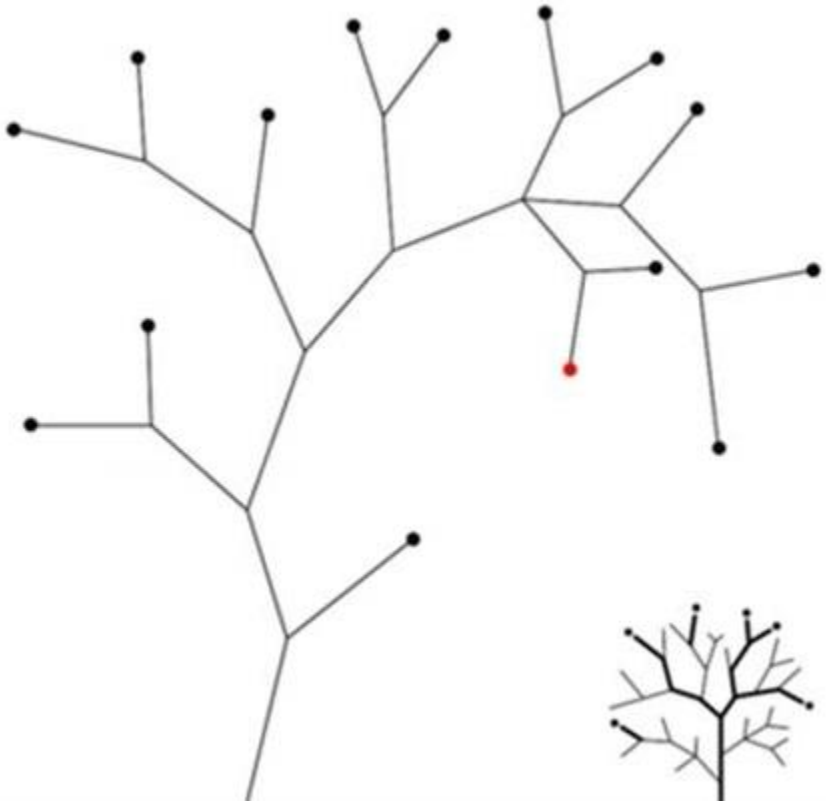


Figure 3.13 – From images for arborescence: www.google.com; accessed 03/09/2015.

*Arborescences* are also a part of graph theory:

> According to graph theory, an arborescence is a connected graph, without cycles, whose edges are directed away from a particular root in such way that any two vertices can be

[93] http:// www.dictionary.reference.com/browse/arborescent accessed 02/12/2015

> connected by a unique simple path. Because graph theory is concerned with the abstract properties of graphs, the relative positions of points and lines have no significance.[94]

Xenakis explained how the idea of arborescence appeared to him spontaneously in a conversation with a French journalist and columnist, Martine Cadieu (1924-2008):

> The idea of arborescence (clonings, I prefer to call them) cropped up in an instant, I don't know how. I just caught myself doing it . . . I wonder why I hadn't thought of it earlier.[95]

Xenakis never theorized his concept of arborescence,[96] yet discussed this approach and how it is manifested in his music in several interviews.[97]

If Xenakis' continuity represented his most important priority as a composer, then *arborescence* allowed him patterns of continuous change/development through manipulation of the basic melodic patterns. Xenakis contrasts this method with traditional development of in the form of variation. In variation (form), according to Xenakis, as the theme progresses, it starts being separated from the original one and arrives at the final stage with a totally different figure.[98] Xenakis' main objective was to create new, evolving melodic patterns which in turn result in patterns of continuous change and different kinds of transformation, "such as lengthening or contracting."[99] Xenakis explains the formation of these evolving melodic patterns in his conversations with Varga:

> The idea of arborescence is closely linked to causality, repetition and consequently variation. We start out of a point in space. This can be pitch versus time space or any other. In order for it to exist the point has continually to repeat itself. In this way a line is formed which can have any shape. Any point on the line can also reproduce itself and bring about an

[94] Benoît Gibson, *The Instrumental Music Iannis Xenakis; Theory, Practice, Self-Borrowing*, New York, Pendragon Press, 2011, p. 139.
[95] Gibson, p. 140. It is also mentioned in Varga, p. 61.
[96] De Henau, p. 151.
[97] Michael Zaplitny, Conversation with Iannis Xenakis, *Perspective of New Music*, 1975, Fall / Winter, Bálint András Barga, *Conversations with Iannis Xenakis*, James Harley, Iannis Xenakis in Conversation: 30 May 1993, *Contemporary Music Review*, 2002, Vol. 21.
[98] Varga, p. 77.
[99] *Ibid*, p. 89.

> arborescence. In this way, eventually, a bush comes about. Staring out of a point we have reached a bush or even a tree. This can occur freely but also according to the rules and can become as complicated as lightning or the veins in the body. Let us assume that we have such a tree in the pitch versus time domain. We can rotate [transform] it; the rotations can be treated as groups. But even it we leave groups out of account we have an object that we can transform. We can use traditional transformations of the melodic pattern: we can take the inverse of the basic melody, its retrograde and its retrograde inverse. There are of course many more possible transformations because we can rotate the object at any angle.[100]

This compositional method enabled him to embody new melodic patterns through all kinds of transformations while preserving the overall unity. The composer explains his concepts in the notes to the scores of *Gmeeoorh* and *Mists* (for piano, 1981):

> In continuation of ERIKHTHON for piano and orchestra, GMEEOORH (a free anagram of organon) pursues the research of a generalization of the melodic principle, by using linear arborescenses (clonings) undergoing various transformations such as homothetic, rotations, distortions, expansions, etc… [101]

> . . . arborescences, in other words of [are] bush-like clusters of melodic lines which undergo various rotations in the time space.[102]

The compositional technique of *arborescence* also led Xenakis to achieve a new mixture of melodic patterns by not only consolidating Xenakian continuity, but also by indirectly creating a new kind of polyphony in the music.[103] That is, a complex sound is conceived graphically by starting a line from a certain point, forming bushes from a root, and multiplying or transforming the evolving shapes. When transcribed into musical notation, it results in many independent lines (voices) of different rhythms and timbres, sometimes reaching over ten parts, simultaneously superimposed and multi-layered. The new polyphony resulting from *arborescence* confronts performers with the complexity and extreme difficulty of realizing the

[100] Varga, pp. 88-89.
[101] Iannis, Xenakis. Notes to the score of *Gmeeoorh*. Paris: Salabert, 1974.
[102] Iannis Xenakis, Notes to the score of *Mists*, Paris: Salabert. 1980.
[103] Matossian also gave a detail account on the concept of new polyphony in Xenakis' arborescence: "Arborescence or dendritic forms which start from a common source and ramify outwards like the branches of tree, the forking of lightning …. Translating such patterns into a time /pitch space he obtained a form of polyphony whose parts are co-related but not mechanically locked together as in counterpoint; a polyphony with the random element preserved and with individual voices remaining continuous." Matossian, p. 233.

score in performance [see Figure 3.14]:

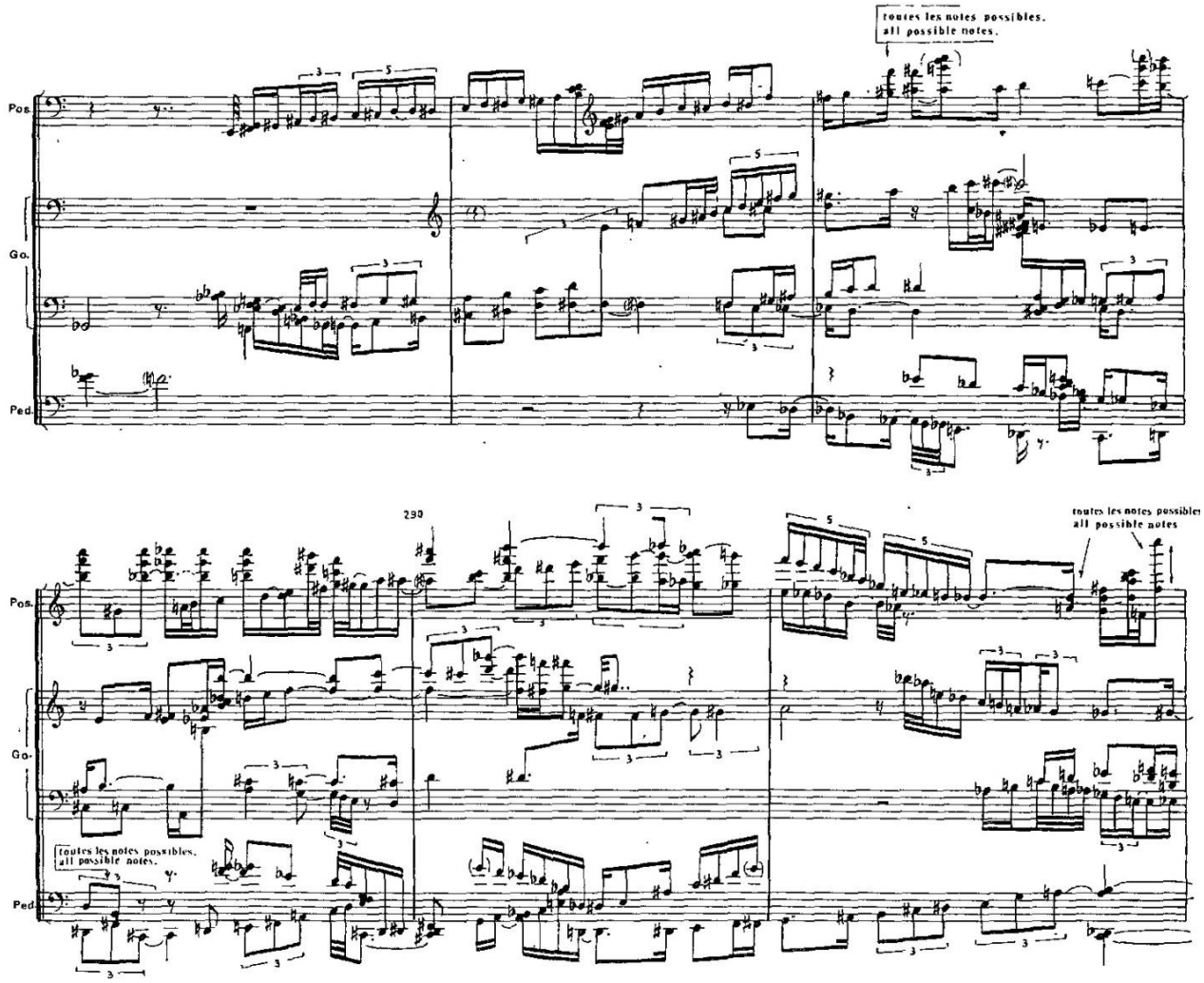



Figure 3.14— *Gmeeoorh*. mm.286 – 290:
Showing complexities and technical difficulties raised by arborescences.
Editions Salabert Version 61 notes, 1974 [Permission arranged]

There were representative works using *arborescence*: *Synaphï* (for piano and orchestra, 1969); *Evryali* (for piano, 1973); *Cendrées* (for mixed choir of 72 voices and orchestra, 1973); *Erikhthon* (for piano and orchestra, 1974); *Gmeeoorh* (for organ, 1974); *Noomena* (for an orchestra of 103 musicians, 1974); *Khoaï* (for harpsichord, 1976) [listed chronologically]. It is

interesting to note that Xenakis employed the idea of *arborescence* in works for instruments which do not have continuous, sustained sound, such as the piano and harpsichord.

## The Origin of Arborescence and its Development

Xenakis' early formulations for arborescence can be found in the piano part of *Synaphaï*. Here, Xenakis uses several staves for the piano part, with superimposed layers of over ten voices, each with a different dynamic [see Figure 3.15]:

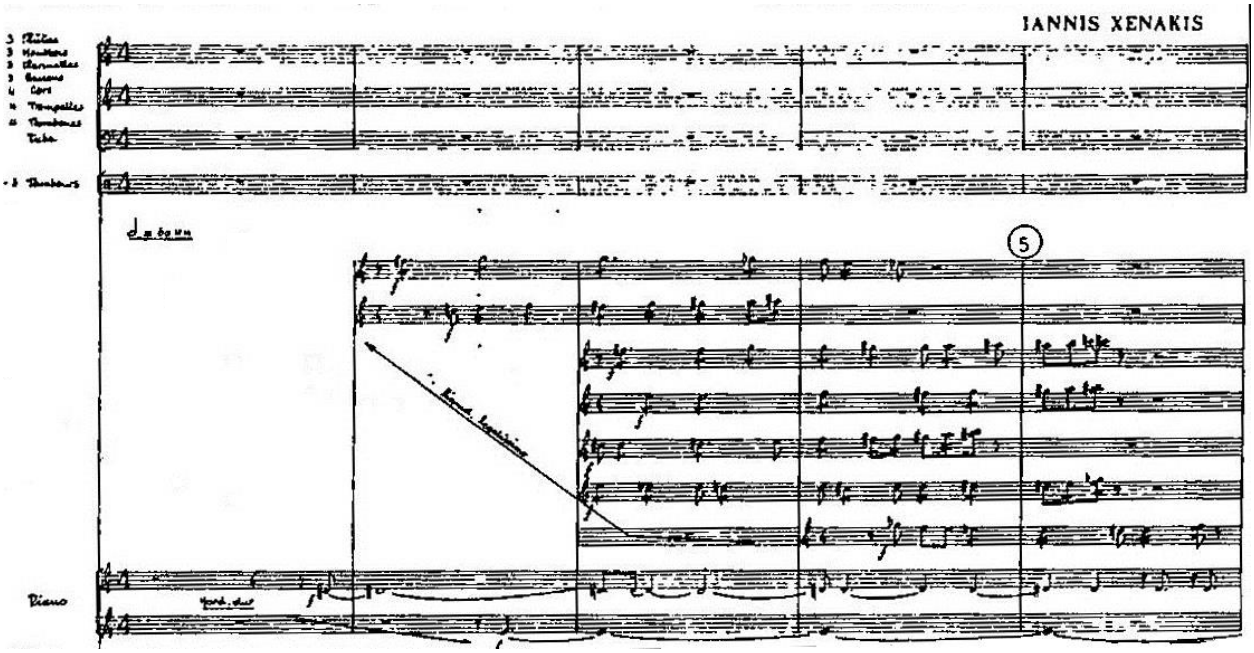



Figure 3.15 – *Synaphaï*, mm.1-5: Showing the prototypes of Xenakis' aborescence in the piano part.
Editions Salabert, 1969, [Permission arranged].

Evolving figures of arborescence can been seen in the opening section of *Metastaseis*, starting from the root (G), then branching out and multiplying from it, as seen earlier; however, we here can find only straight lines created with a ruler, without any transformations.

Xenakis does not separate the conceived sound-image written on a graph from "what will sound in reality."[104] Therefore he is fully aware of the difficulties presented to the performer of his works, even in such un-idiomatic passages as the following example from *Gmeeoorh*:

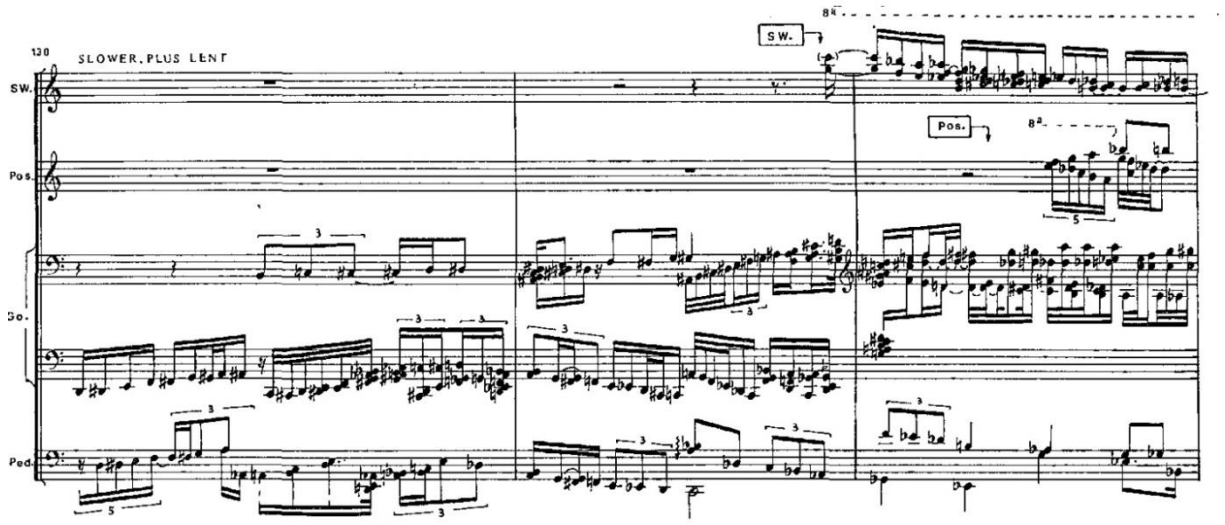



Figure 3.16— *Gmeeoorh*, the most complex development of arborescence, at mm. 130-133: The lines of aborescence cannot be distinguished by the ear.
Editions Salabert Version 61 notes, 1974 [Permission arranged].

[see Figure on next page]

[104] Varga, p. 90.

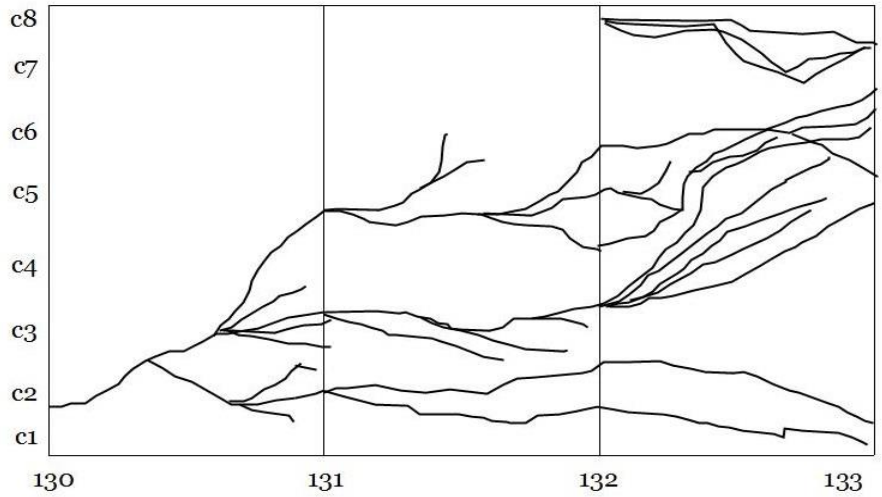



Figure 3.17 – *Gmeeoorh,* Graphic Representation of the score, mm 130-133:


Xenakis lamented the lack of an existing "theory about shapes", noting that the shape of trees (arborescences), ". . . is basic, both in nature and in logic, and potentially also in music."[105] Xenakian *arborescence* originates in the appearance of dendritic form and, furthermore gives way to various transformations such as rotation, contraction and augmentation.[106]

Xenakis' early *arborescence* resembled more-or-less linear tree-like shapes, which can be found in two of his first works with *arborescence*, *Evryali* (for piano), and *Cendrées.*[107] This type of arborescence contains "a continuous flow of lines moving in the same direction," [108] and consists of three important features: "root, connectivity, directed edges and the absence of cycles.[109]

[105] *Ibid,* p.127.
[106] "Another fantastic shape is that of trees. Arborescneces. Veins and nerves have that shape. Lightening has it. All software is based on a tree- like construction. This is another widespread form…. Therefore the idea of tree shape is basic, both in nature and in logic, and potentially also in music. I've used in music in the form of bushes, arborescences." Varga, p. 207.
[107] Zaplitny, p. 100.
[108] Gibson, p. 143.
[109] *Ibid.*

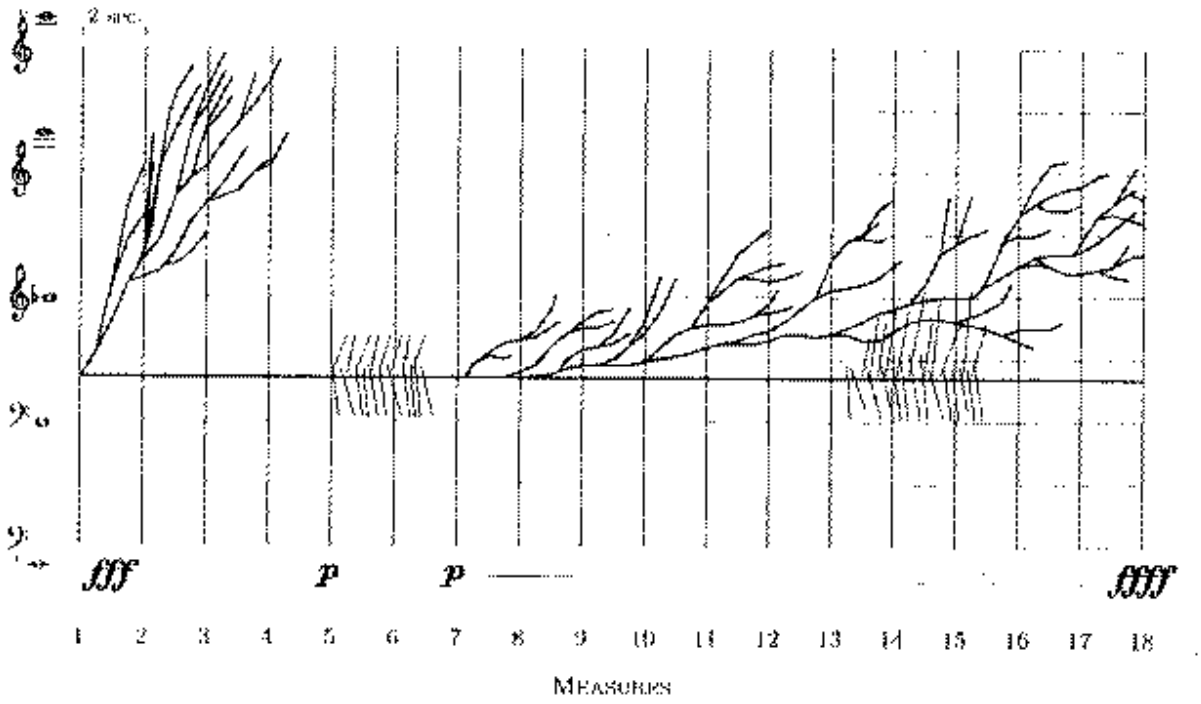



Figure 3.18— *Cendrées*, mm. 1-18: graphic representation.
Reproduced from Gibson, p. 142, [Permission arranged]

The first eight measures of *Gmeeoorh* starts the same kind of linear, tree-like *arborescence*.

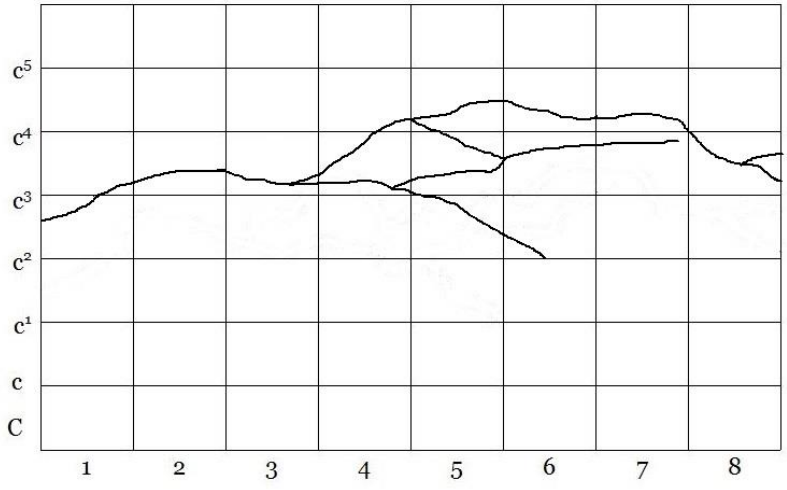



Figure 3.19— *Gmeeoorh*, mm. 1-8: graphic representation;

Later, this tree-like *arborescence* becomes much more complex, the continuous motion resulting in still more curves, which can be discovered in *Gmeeoorh*.

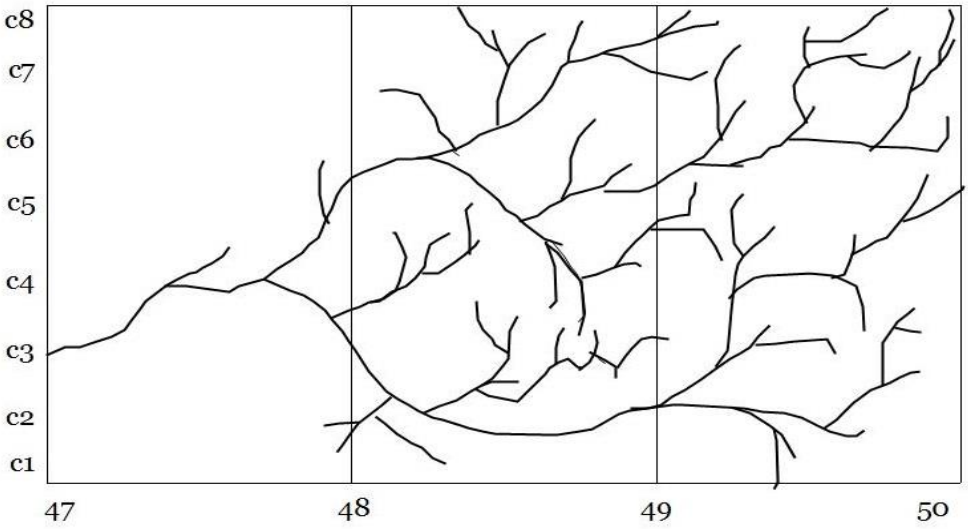



Figure 3.20— *Gmeeoorh*, mm. 47- 50: graphic representation.
Much more elaborated arborescence as an ongoing flow of continuous motions;


The second type of *arborescences* features various transformations entailing the continuous change of dynamics or timbres, resulting in a multi-channel sound effect. An example of can be found in *Erikhthon*. [see Figure 3.21]:

[see next page]

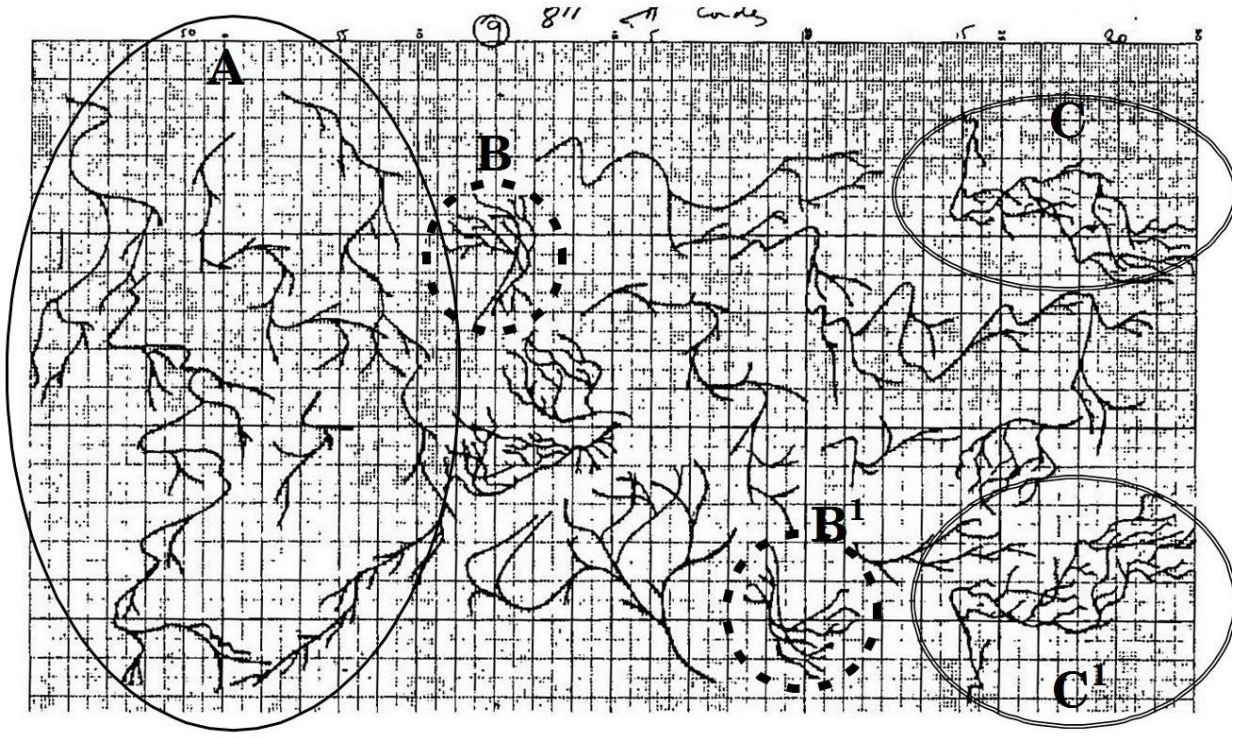



Figure 3.21 – Graphic representation of *Erikhthon* (concerto for a piano and orchestra, 1974), showing the tree-like shapes of the *arborescences*, multiplication (A) and rotation (B and $B^1$, C and $C^1$)
Graph reproduced from Matossian, *Xenakis*, p, 237, [Permission arranged];
outlines of arborescences (A, B, $B^1$, C, $C^1$) by Eun Joo Ju.

Xenakis also stressed the dynamic effect through his *arborescence*, which relates to his thoughts about new sound searching for his life.[110] In the first measure of *Noomena*, we can find an example how to be applied it, which contains the arborescence with ramifying motion and various dynamic changes of five voices. [see Figure 3.22]:

[see Figure on next page]

[110] "The aim is to make the sound itself live. There are different ways of doing that: we change the timbre, employ tremolos and accents, reappear the sound and change dynamics (I am only talking here of instrumental music, of course.) In this way the inner life of sound is not only in the general line of composition, of thought, but is also within the tiniest details." Varga, p. 64.

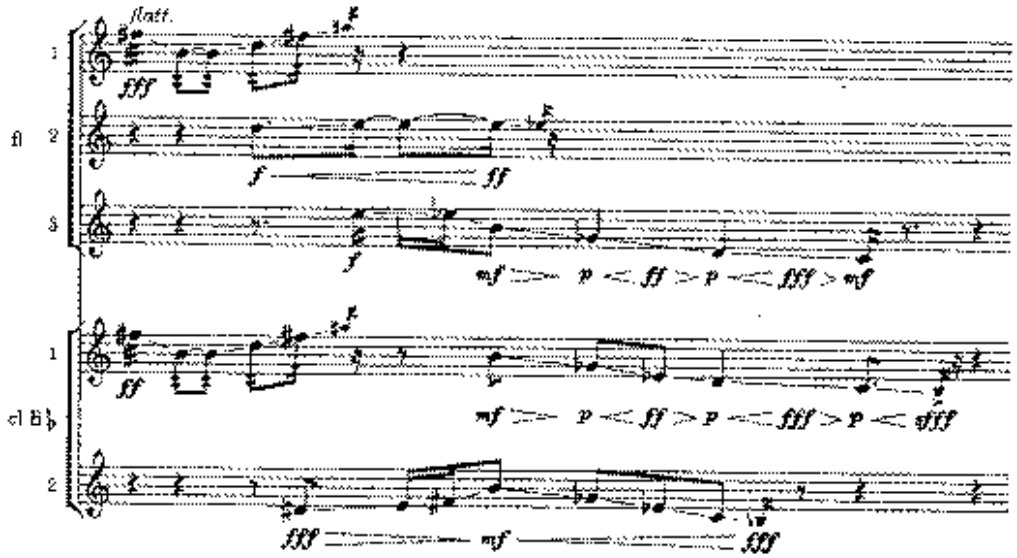


Figure 3.22 – *Noomena*, mm. 1-2:
Various change of dynamic level in five voices *arborescence*
Reproduced from Gibson, p. 144, [Permission arranged].

In *Gmeeoorh,* Xenakis not only employed different registrations (with different fundamentals) between the Swell, Positive and Pedal, but also used brief notated clusters on the Positiv. This compositional features led to create various dynamic layers, as in *Noomena* .

Swell: Fl.oct.4'+Viole oct.4'+Voix cel 4'+Princp.2'+Octave 2'+Tierce $1'^{2/3}$+Oct. 1'
Positiv: Holzged. 8'
Pedal: Dulzian 16'

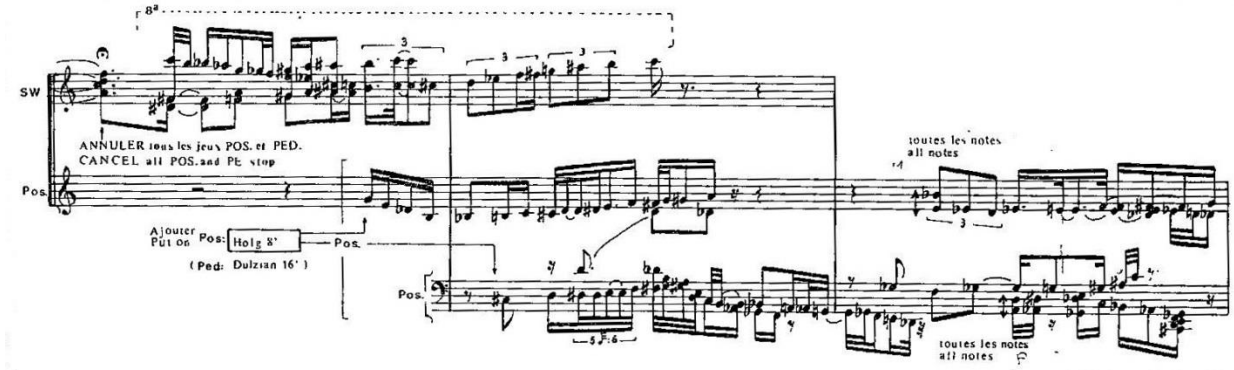



Figure 3.23— *Gmeeoorh*: mm. 136-138:
Showing different registrations and clusters on Positiv (m 138, at the sign ↕).
Editions Salabert Version 61 notes, 1974 [Permission arranged].

This innovative compositional technique of *arborescence* finally enabled Xenakis to achieve both a macroscopic and microscopic concept of his works. The first concept directly relates to the various shapes of arborescences which can be illustrated by graphic representation.[111] The latter one is accomplished by both Xenakis' detailed compositional techniques of arborescence (such as the multiplication of each voice, or branch, and its ramifications for continuity), and through manipulation of various dynamic levels.

[111] "A drawing may define the outlines of an object, its general contours its shape, but does not always reveal the details that make it interesting or 'alive.' *Ibid.*

## CHAPTER 4.

### Technical Solutions Based on an Analytical Approach to *Gmeeoorh*

> The title of the work composition [sic] *Gmeeoorh* – a free anagram of organon – refers to the ancient Greek origin of the organ as a secular instrument. The invention of the *Hydraulis*[112] is often attributed to Ktesibios, who lived in the 3rd century AD, better known for his practical inventions than for his theoretical knowledge. The name of the instrument refers to the hydraulic installation, which produces a stable wind. The work – which lasts about 30 minutes – constitutes a cosmos of piercing sonorities, hard and high pitched, but also soft and low, evoking the pre-christian, mythical roots of the organ.[113]
>
> De Henau
> *Conference proceedings*

Xenakis' only organ piece, *Gmeeoorh,* presents a myriad of complex sonorities, based on his use of *arborescences,* extensive use of register extremes created via unusual registrations (i.e., starting from a mutation or octave upwards),[114] and clusters (by fingers, feet, and different kinds of planks). In *Gmeeoorh*, the composer tests not only the limits of registers and colors available from the organ, but also pushes the technical capacities of the performer(s) to extremes. In performing *Gmeeoorh,* one should address two main issues in order to analyze, and then interpret, this piece. First the form: For the purposes of this thesis, *Gmeeoorh* will be delineated into eight parts, or sections, after De Henau's analysis.[115] Second, the technical problems which arise as a result of the musical difficulties (such as dense, complex counterpoint) found in each of the eight

[112] "A Greek named Ktesibios (an inventor and a mathematician), who lived in Alexandria, built an organ called a hydraulis about 250 B.C. Pressure was provided by water, which was pumped by hand. This instrument became popular in Rome where it was used for entertainment at feasts and gladiatorial combats." Quoted from Corliss Richard Arnold, *Organ Literature: A Comprehensive Survey*. Vol, 1. Maryland, Lanham, The Scarecrow Press, Inc. 2003. p. 1.
[113] De Henau, p. 154.
[114] In terms of registration in the *Gmeeoorh*, John Holtz(a professor and chairman of organ and liturgical music at Hartt College), the president of the International Festival of Contemporary Music, recorded all the stops and ranges of Gress-Miles organ at South Congregational Church, New Britain, Connecticut, individually for the composer; Françoise Rieunier, liner notes to *Xenakis/Chaynes/Chapelet: L'Orgue contemporain à Notre-Dame de Paris*. France, Disques du Solstice – SOCD 192, 2001, p. 11.
[115] According to Françoise Rieunier's liner notes, "It consists of eight clearly defined sections"; *Ibid*, p. 11.

sections will be addressed, along with suggestions on how to solve the technical problems in a way that supports developing an interpretation of *Gmeeoorh*.

**Sectional Overview**

Section 1: mm. 1-84: arborescences, creating dense counterpoint; clusters in both hands and feet and a sustained pedal trill.

Section 2: mm. 85-113: full-range clusters in both manuals ($C_3 – G_5$ or $C_3 – C_8$), and pedals ( $C_3 – F_5$ or $C_3 – G_5$ ),[116] necessitating the use of planks.

Section 3: mm. 114-129: "compact arborescences";[117] use of reeds (Trompette 16' and 8', Clarion 4') and chamades ("A-Pavillion").

Section 4: mm. 130-203: the most difficult and the longest section of the work; arborescences creating massive density (voices in 8+ parts) and sustained clusters, together with manipulation of registrations.

Section 5: mm. 204-262: the simplest section technically; sustained chords, where extremes of register are created/controlled through manipulation of registration.

Section 6: mm. 263-274: the least difficult contrapuntal section, two voices over a pedal-tone cluster; "clouds of sounds" [118] produced by extremely high registration (manuals beginning from 2, 2/3' and 1, 3/5', over a pedal 16').

Section 7: mm. 275-292: the shortest of the arborescence sections; dense counterpoint in both hands, with extremes of register, played at full organ, with all tremulants.

[116] For versions of 56 and 61 notes, respectively.
[117] De Henau, p. 155.
[118] *Ibid.*

Section 8: mm. 293- 298: clusters employing the full range of all three manuals and the pedals simultaneously; irregular, shaked-clusters employing planks on both manuals and pedal.

The technical problems posed by each section will now be addressed in the light of performance by one main organist-performer (OP), one organist-assistant (OA), and one registration-assistant (RA). Even though Xenakis suggested that "an assistant is advisable,"[119] I would again consider the aspect of live performance, and agree with the idea of having two assistants based on Françoise Rieunier's linear notes[120]. Performer-division (between the OP and OA) can be applied throughout the piece, as a means of retaining as many notes as possible in a performance of *Gmeeoorh*. The OP must also study Xenakis' registrations for each section beforehand, which will enable him/her to understand the arborescence's motion (divergence or development):

> As to the registration (the use of organ stops), the range consists of high to very high pitches, on the edge of the inaudible. Throughout the whole score, the registration originates from the graphical demands: arborescences that do not correspond to the range of the keyboard (for too high or too low), are reassigned to another keyboard or the pedal, with a corresponding registration. It is always the stop with the lowest fundamental on a certain keyboard that represents the drawn arborescence. In this way, the other stops (harmonics of the fundamental stop) which are added, do not carry a representational role, but furnish the desired timbre.[121]

[119] Iannis Xenakis. Notes to the score of *Gmeeoorh* (Version 61 notes) Paris: Salabert, 1974.
[120] ". . . the execution of such a piece requires the obligatory presence of one or two assistants." Rieunier, *Ibid*, p. 12.
[121] De Henau, p. 156.

This is to say that the registration is what realizes the graphic arborescences. Xenakis indicates a different harmonic/fundamental for each manual and pedal (rather than the standard 8' manual and 16' pedal), where, as De Henau notes, the lowest fundamental (for each manual or pedal), is the starting point of the arborescence. This can be clearly seen in Xenakis' registration for Section 1: Great – beginning from Rohrfloete 8'; Positive – beginning from Blockfloete 2'; Swell – beginning from Octave 1'; Pedal – beginning from Octave 4'. Xenakis describes how this registration supports the arborescent movement:

Also Xenakis wrote about the registration in his program note, Radio-France "Les mardis de la musique de chambre", in 1988.

> The stops are sometimes distributed according to their tone colour on the four keyboards. For this reason it was then necessary to play on three keyboards at once. The reeds in their lowest register, where they are the most characteristic, are often used for their pure colour and [are] confronted with one another, as well as with the flutes and the principals. Moreover, the harmonic layerings of the stops are frequently used in such a manner as to foil the classical colours of the major diatonic scale which are at the basis of the very conception of the organ stops.[122]

The rhythmic values in each voice become very complex as the arborescence develops. The different rhythmic values of each voice are superimposed upon each other, which create multilayered textures such as found in Sections 1, 3, 4 and 6. In Xenakis' conversations with Varga, the composer gave a description of the reasons why he chose these complex rhythmic values:

> Triplets combined with other rhythmic values make for a richer sound, based on very simple relationships – three to two, for instance . . . . in the rhythmical discourse, you need something to hold you on a given pattern so that you notice when it's 'spoilt' by another pattern. It's like walking and suddenly tripping over something, so that you have to regain your equilibrium.[123]

[122] *Ibid.*
[123] Varga, p. 142.

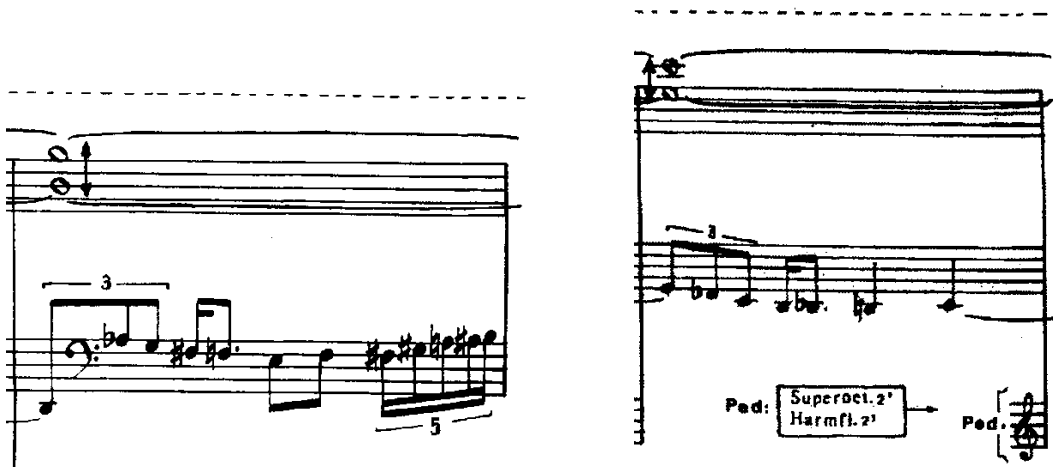
This musical feature presents the OP with the difficulty of executing all the notes by himself or herself. Did Xenakis consider these performing difficulties while composing his music? He gave his opinion about this problem, again in Varga's interview:

> I do take into account physical limitations of the performers, otherwise I would have written symphonic compositions for a single interpreter, for one piano. But I also take into account the fact that what is limitations today may not be so tomorrow. *Gmeeoorh,* for organ, which I wrote for Clyde Holloway, is also very difficult but not impossible.[124]

Xenakis provides his suggestion, "placing the fingers of one hand on the two manuals."[125] This solution is plausible only if the OP has large hands; if not, performer division would be the most practical solution for performing *Gmeeoorrh*.[126] Before proceeding to the analysis of *Gmeeorh*, the following differences must be noted between the 56-note version and the 61-note version. In the 56-note version, the first four pages of the score (mm. 1- 37) are written a perfect fourth below the notes appearing in the 61-note version. At m. 38, there is a change on the 3rd and 4th beats between the two versions [see Figure 4.1]:

Xenakis may have used the lower range on a Baroque-style organ (56 note) to accommodate the higher levels of arborescence needed by lowering the pitch, and making use of the available mutations and mixtures.

[124] *Ibid*, p. 65.
[125] *Ibid.*
[126] Xenakis himself notes that "For the passages which are too difficult, an assistant is advisable." Xenakis, notes to the score of *Gmeeoorh.*

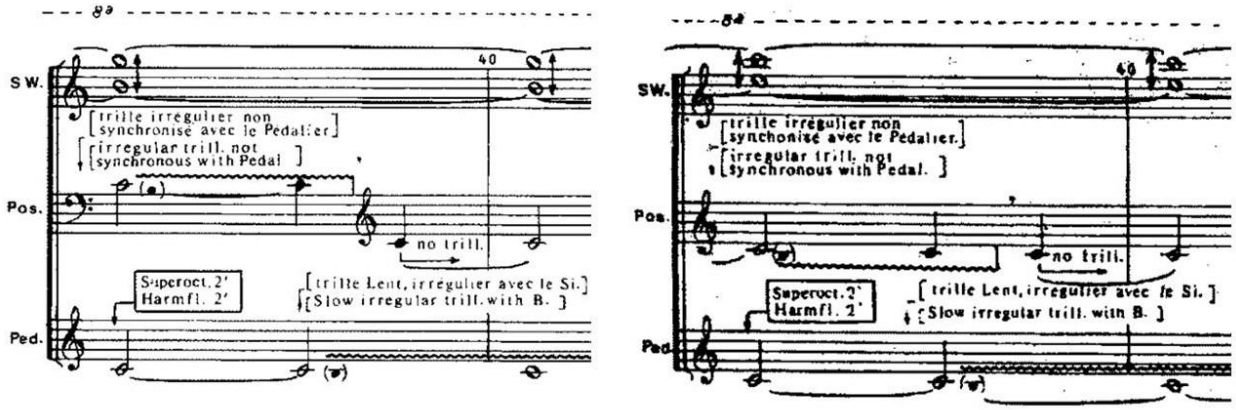



Version for 56 notes, m. 38 Version for 61 notes, m. 38
Note the changes on the 3rd and 4th beats between the two versions

Figure 4.1— *Gmeeoorh*, m. 38, 56 note and 61 note versions [Permission arranged].

Xenakis may have been satisfied with the remainder of the work for both versions; the cluster/transition in the 56-note version may have been intended to push the harmonic series upwards by maintaining the same trilled notes, except with a different cluster; in the 61-note version, again the trilled notes remain the same, but there is no need to push the harmonic series higher. This may also explain why Xenakis changed the notes on the 3rd and 4th beat of m. 38 of the 56-note version.

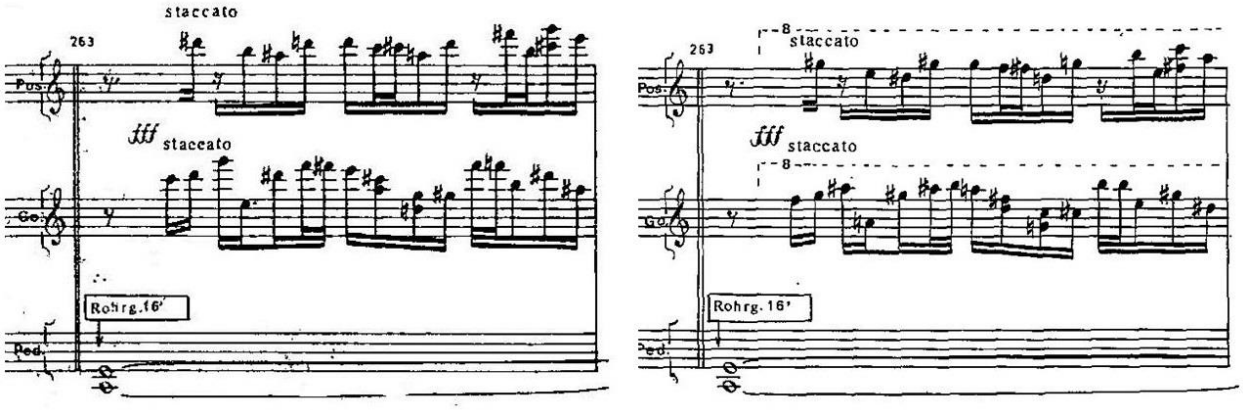
Then new material appears in the Positive and Pedal, with the same notes in each version, yet Xenakis retains the B-G cluster in the 56-note version, and the E-C cluster in the 61-note version [see Figure 4.2]:




Version for 56 notes m. 39 Version for 61 notes m. 39

Figure 4.2 – *Gmeeoorh*, m. 39, 56 note and 61 note versions [Permission arranged].

Another difference can be found in Section 7. In the 56-note version, the section 7 (m. 263-272) are written fourth below the notes appearing in the 61-note version. [see Figure 4.3]:




Version for 56 notes m. 263 Version for 61 notes m. 263

Figure 4.3 – *Gmeeoorh*, m. 263, note 56 note and 61 note versions [Permission arranged].

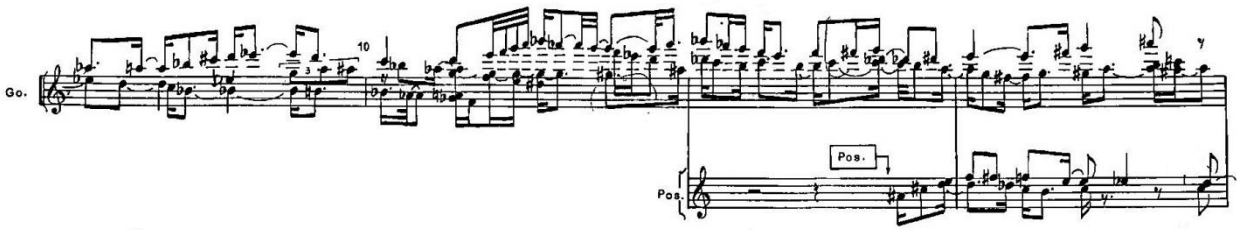
The remainder of the notes in both versions are the same, and the techniques for realization given below can be applied to both versions. However, a problem occurs in the 56-note version, where the notation is irrational, and exceeds the 56-note range of the keyboard (mm.

62, 132-137, 152-155, 278-280, 288). I suggest here that in this case the performer must use his/her discretion, and adapt the notes as best as possible within the given registration.

In addition, since the first performance of *Gmeeoorh* in 1975 by Clyde Holloway (on a three-manual organ), successive performances have also been presented on four-manual organs in Paris (2007, Françoise Rieunier with two assistants) and in New York (2007, Kevin Bowyer).

Section 1: mm. 1-84 As the branches of *arborescence* diverge into several voices, the OP faces difficulty in playing all of the voices. The opening passage, from mm. 1- 12, on the Great and pedal, can be played by the OP alone. Beginning at m. 11, the O-assistant can take over the Positive passages, allowing for performance of all the notes [see Figure 4.4]:

↓ OP on Great



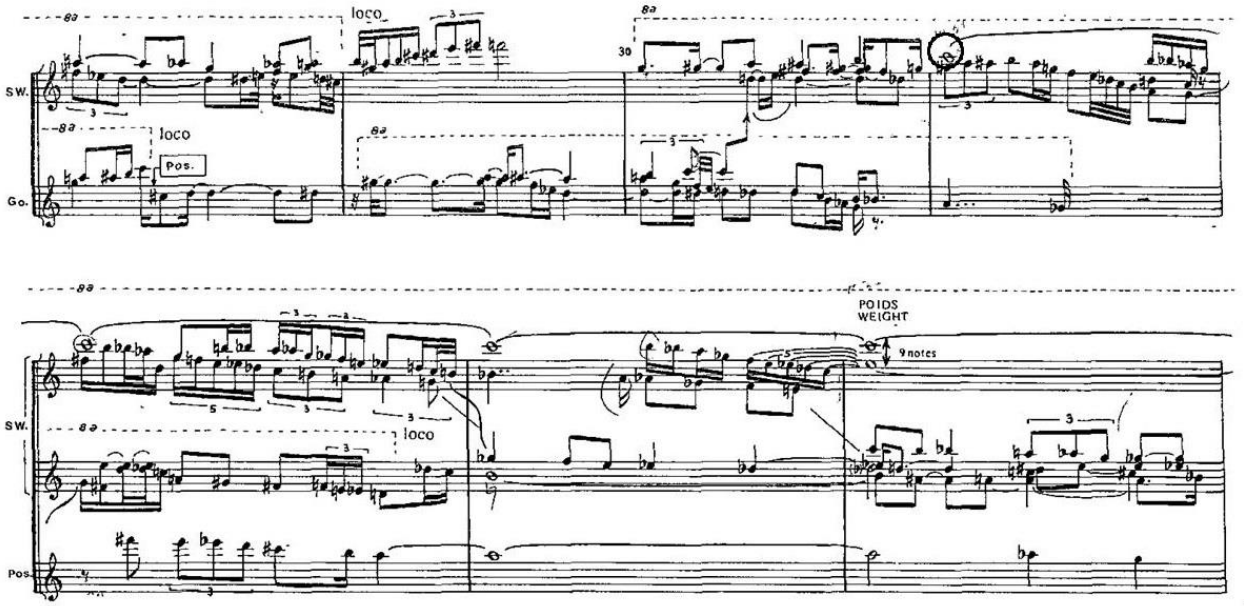

↑ OA on Positive

Figure 4.4 –Performer division between the Great (OP) and Positive (OA).
*Gmeeoorh*, mm. 10-12 [Permission arranged].

The passage beginning at the first whole note, the very highest pitch on the Swell (mm. 31), which is linked to the 9 note clusters pressed by the use of a weight (mm. 34-44), must be held by the RA [see Figure 4.2] Since the very opening, the whole range of each voice is

generally ascending until m.31. After this measure, the 5 voices of arborescence on the Swell and the Positive are starting to descend [127] until the first appearance of the trill between Positive and Pedal at m. 39; the division of parts allows for the sustained notes to be held, and to effectively accommodate all the remaining notes [see Figure 4.5]:

↓ OP on Swell ↓ $C_7$ Held by RA




↑OA on Positive ↑Palm-weight applied by RA

[↑ indicates where a performer begins on a given part]

Figure 4.5 – *Gmeeoorh*, mm. 29-39 [Permission arranged].

At m. 39, the OP should pay attention to Xenakis' instruction that the organist not play synchronously with the slow irregular trill between the Positive and Pedal, while adding different stops from the Great (coupled to the Positive), Positive, and Pedal. I suggest that the OP perform the rapid trill on the Positive and the slower trill with two feet [see Figure 4.6]:

[127] Xenakis calls them 'small rivers", *Ibid*.

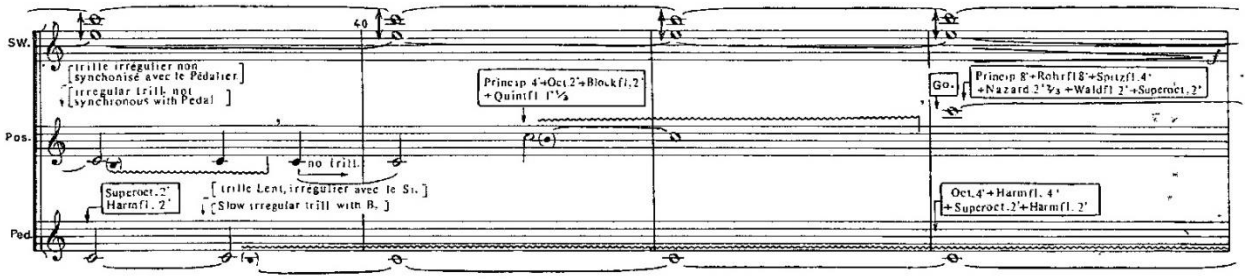



Figure 4.6 – *Gmeeoorh* mm.39-42 [Permission arranged].

In Varga's interview, Xenakis gives his interpretation of the irregular trill:

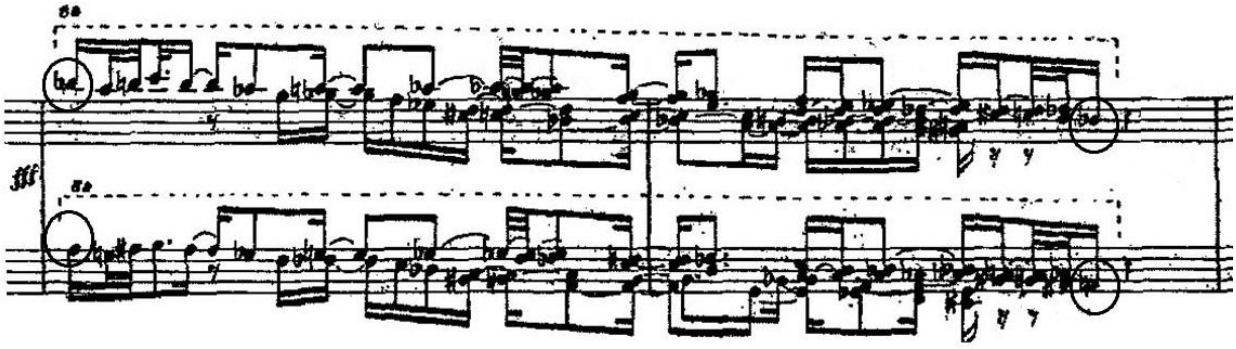
> They make the sound richer. Like the vibrato, the trill ought to be executed much more elaborately than is generally the case….So you see another aesthetic means to change the sound is to go from a smooth tone to a more or less rapid vibrato and then slow down again.[128]

At m. 47, the composer allows for a "shortest" possible fermata in order to change registration in the pedal. The arborescence then restarts on the Great, diverging into five voices between the Positive and Pedal. (mm.47-60). After a rest of one measure (m. 61), Xenakis for the first time employs the same rhythmic motion of arborescence in the same manual (Swell) from mm 62 to mm. 63. In order to accommodate all the pitches, the parts should be divided between the OP and OA. However, due to the overlapping parts between the two performers, it is recommended that the performer-parts be divided between the Great and the Swell, coupling the Swell to the Great [see Figure 4.5]. Another distinctive feature can also be found in these two short arborescences: the starting note of each arborescence-line is that the beginning and ending notes are the same, B-flat to B-flat, and F-natural to F-natural and one is the transposition of the other; [see Figure 4.7]:

[see Figure on next page]

[128] Varga, p. 154.

↓ B-flat (OA for Swell) ↓B-flat



↑ F-natural (OP on the Great) ↑F-natural

Figure 4.7 – *Gmeeoorh*, mm. 62-63 [Permission arranged].

After three measures of silence, the melody from the opening arborescence (Section 1) appears in the pedal, again with an ascending line, but with augmented rhythmic values (mm. 66-70). Later, each voice of the arborescence is briefly developed on the Great, while the "melody" continues in the pedal.[129] Here, Xenakis provides an extreme contrast in color and timbre between the Great and the Pedal. The melodic pedal part is played on all the Pedal 16's: Quintaton, Principal, Subbass, Rohrgedeckt, Posaune, Dulzian, and Basson. This is contrasted with the Great, coupled to the Swell and Positive, with each manual starting from the 2' principal and flute stops, with some additional mutations [see Figure 4.8]:

[see next page]

[129] *Ibid.*

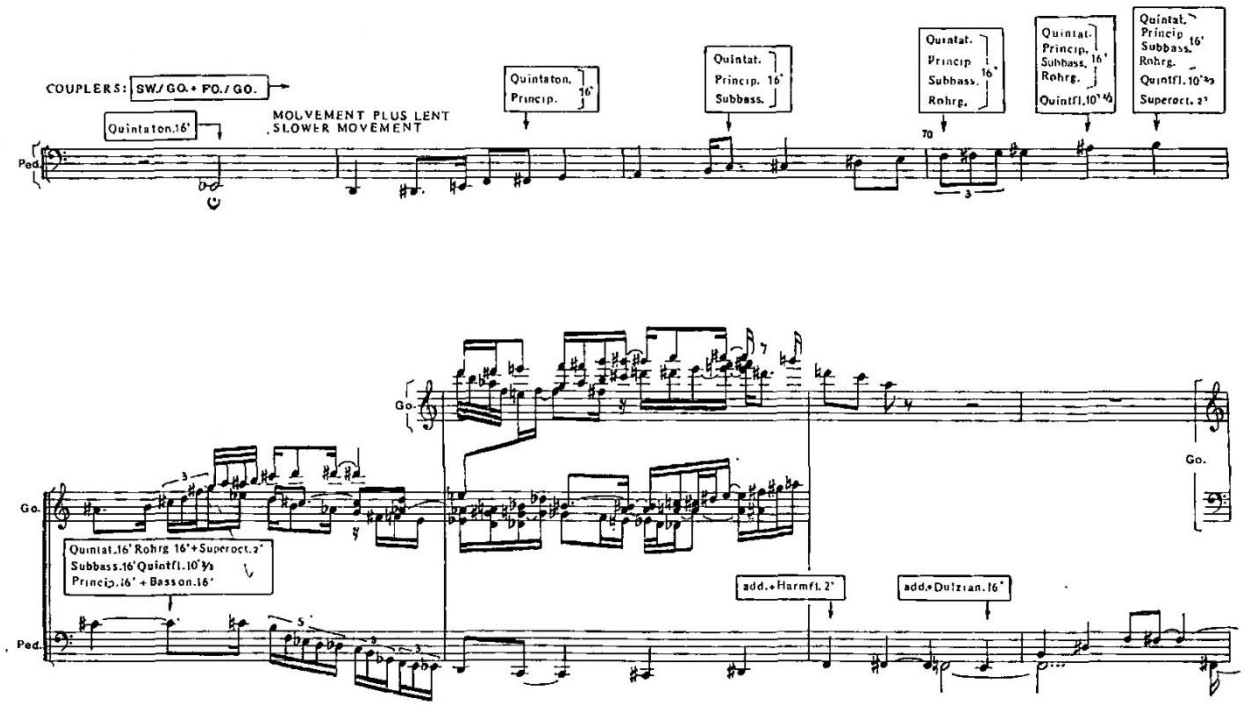



Figure 4.8 – *Gmeeoorh,* mm. 61-74 [Permission arranged].

The arboresence-shrub which opens Section 1 raises the question of what is to come, and what will be its outcome in terms of its sound effects by way of Xenakis' manipulation of the arborescence(s). What kind of new sounds will Xenakis generate from his new technique? As mentioned in Chapter 3, the sound-mass is the result of the complex textures of the arborescences, where the composite effect is that of layers of sound, flowing in the highest tessitura. These arborescences also lead to an array of unprecedented new organ sounds and colors. One of the problems faced by performers of *Gmeeoorh* is transcending the technical difficulties in such a way that allow these layers and new sounds to flow.

Section 2: mm.85-113

A short transition in the pedal appears at mm. 81-84; here the RA should prepare the four special planks for the clusters in all manuals and the pedal. After this transition, a different compositional section appears, and clusters for the full range of both manuals and pedal are introduced, using the four planks. Xenakis describes how to prepare the planks in detail:

> Without stop playing, prepare 4 special PLANKS and be ready to place them over the SW. GO. POS. and PED. Keyboards. These planks should not be heavy, but rigid enough so that a simple hand or foot pressure could hold down all the respective keys.[130]

The plank for the pedal should be specially curved to accommodate an AGO,[131] concave-radiating pedalboard.

There are two main compositional features in this section, the use of clusters by using the four planks, and the radical changes in the dynamic levels from ***ppp →fff→ppp***, adding different stops on each manual and pedal. Xenakis explained his important theoretical intentions about clusters and the extensive change of dynamics during the Varga's interview:

> The object is to obtain new sounds from traditional instruments of the orchestra . . . . You need many instruments to produce chords and clusters of that kind, and the woodwind, brass and the strings act like three personalities helping to make the novel colours move in masses.[132]

Just as the sounds of the orchestra are comprised of different colors coming from each instrument, the organ also retains various colors coming from each stop. Xenakis' registrations enable the performer to further build the textures/clusters, as seen in Figure 4.9:

[130] *Gmeeoorh*, Édition Salabert, Version 61 notes, 1974, p. 7.
[131] American Guild of Organists; the standard term for a concave-radiating pedalboard.
[132] Varga, p. 141.

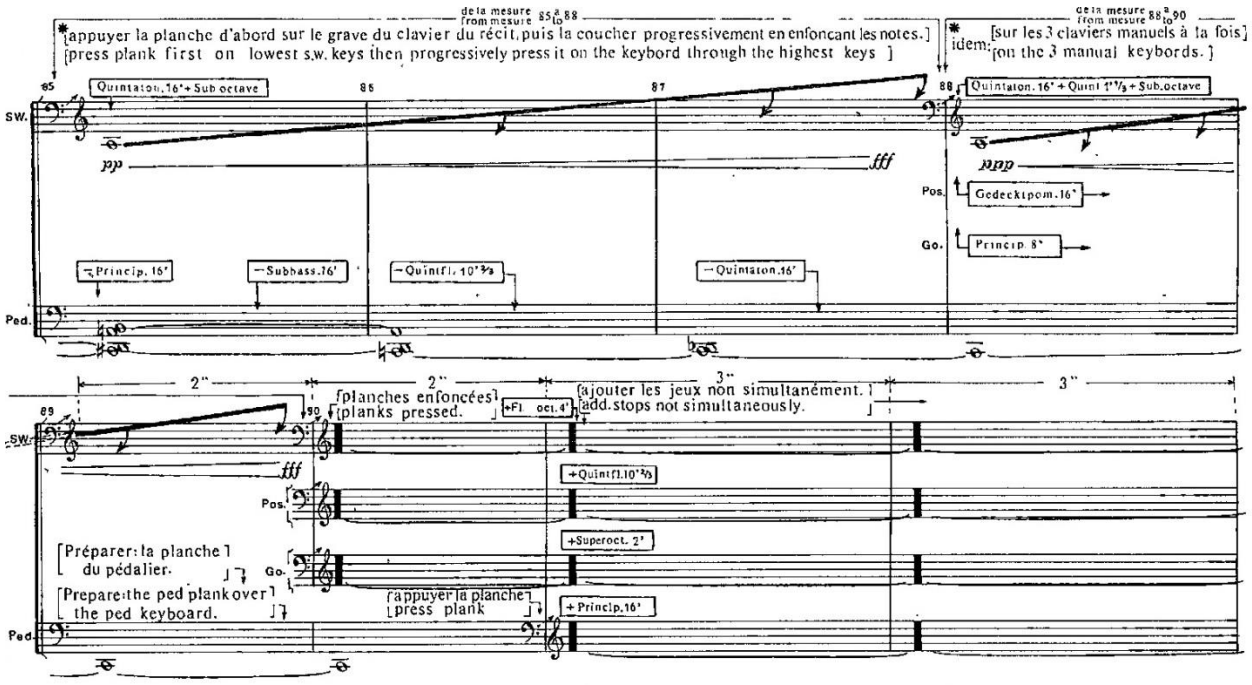



Figure 4.9 – *Gmeeoorh*: mm. 85- mm. 92: Showing durations and different stops continually added to all clusters. [Permission arranged].

In addition, Xenakis employs time-space notation (i.e., 2", 3", 4", or 5") starting at m. 82 until m. 110, while the stops change, and the clusters shift or disperse between the manuals and pedal. (See figure 4.9) This shifting is what I would interpret as Xenakis' technique for sustaining this vital or "live" force. I would suggest that Section 2 best shows Xenakis's conception of form:

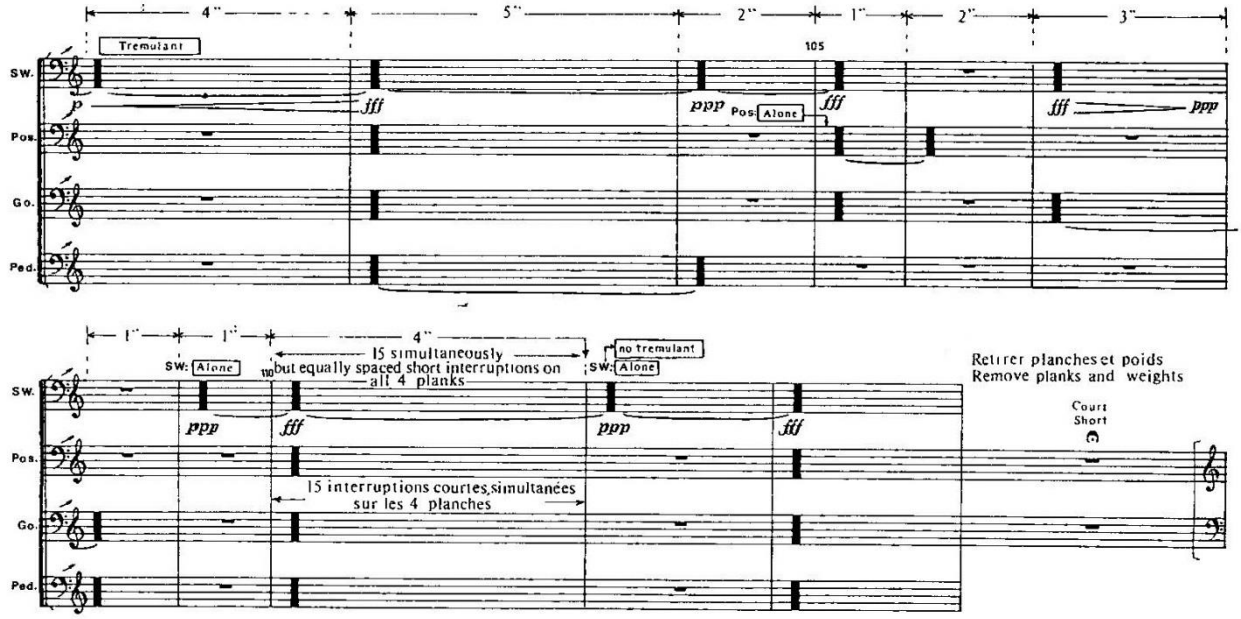
> The best solution is, I think, to live with form. That is, one builds it day by day, bit by bit. You may, of course, start out of a general idea, or a particular one, which you transform as the work progresses. Music is kind of organism, it's slow to take shape, like the gestation of babies. That is the best strategy, for it ensures that the music will be deep and alive and will conform to all your past experience, in that domain and in other domains as well.[133]

[133] *Ibid*, p. 203.

This view also directly relates to one aspect of Xenakis' arborescence; as an expression of an organic process.

Section 2 foreshows the final section of *Gmeeoorh*, which is also comprised of only clusters, again using the four planks with all stops and all tremulants, and again with specific durations (5", 30", 10"). I view section 2 as a living organism, an organic process intended to shatter all the windows of the concert hall [see Figure 4.10]: [134]

↓duration




↑ showing extensive change of dynamic level

Figure 4.10 – *Gmeeoorh* mm. 103- 112. [Permission arranged]

[134] An early example of this kind of effect can be found in the organ piece, "*The Thunderstorm*" by Thomas Ryder (1836-1887). Even though it was written in 19th century, his manipulation of the theme and material involving registration resembles Xenakis' organic process. It begins with a short theme played on soft string stops, then gradually develops into a brash "thunderstorm" by shifting of registration, culminating in manual chords over a pedal tremolo at full organ, then gradually returning to a quiet Vesper Hymn.

Section 3: mm. 114-129

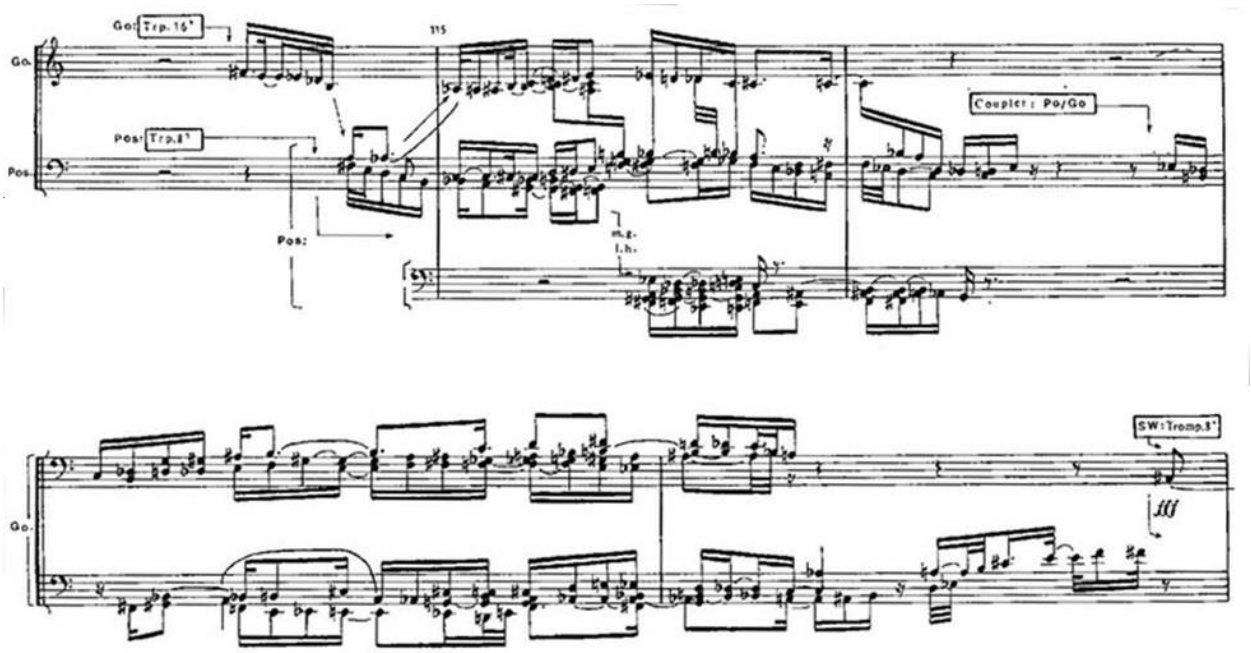
This section presents four short arborescent passages, demarcated by rests/pauses. The rests allow for registration changes that couple the trumpet stops from all three manuals: Trumpet 16' (GO), Trumpet 8' (POS), Trumpet-à-pavillon 8' (GO), Clarion-à-pavillon 4' (GO), Trumpet 8' (SW). The registration allows for both dense and powerful sound effects. Traditionally in organ music, the reed stops provide not only great color in organ registration, but also powerful and brilliant sonorities. I would suggest the registration of this section, a brassy reed chorus from 16' to 4', colors the arborescent lines in a way that makes the clusters even more pronounced. Particularly, the general range of this section is the lowest one among the sections, intensifying the effect by adding the Trompet 16' in the Great.

Even though the arborescenes are short, the complexities require the need for the OA[135] I would suggest part division would be best solution for OP: OP for from Great to Positiv and OA for the bottom part of Positive treble clef and OA for Bass Clef.

[see next page]

[135] Rieunier notes that "here one is obliged to resort to the help of an assistant." De Henau, p. 157.

↓OP for from Great to Positive




↑ OA for the bottom part of bass clef

Figure 4.11 — *Gmeeoorh*, mm. 114-121 [Permission arranged]

Section 4: mm. 130-203

This section features Xenakis' most advanced, complex arborescence spread over all manuals and pedal. In the registrations for Section 4, the range is also extensively expanded, from the 32' Posaune in the Pedal, to the 1' Octave (as fundamental) in the Swell, encompassing all additional octaves and mutations in between. In addition, the use of 8a [8va] in the Swell and Positiv [mm. 133-mm. 135] allows the listener to experience the full range of organ texture, from the very lowest to the very highest registers [see Figure 4.12 and Figure 4.13]:

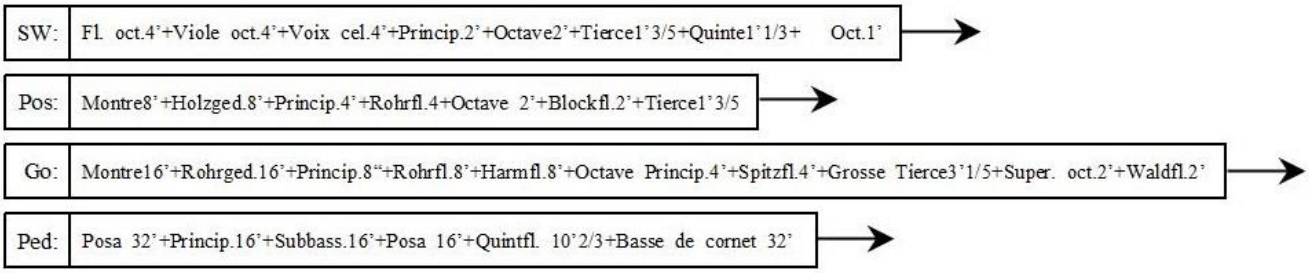



Figure 4.12 – *Gmeeoorh*, registration for section 4, p. 11, preceding m. 130; [Permission arranged].

↓ The use of 8a [8va] in the Swell, Positiv, and Great

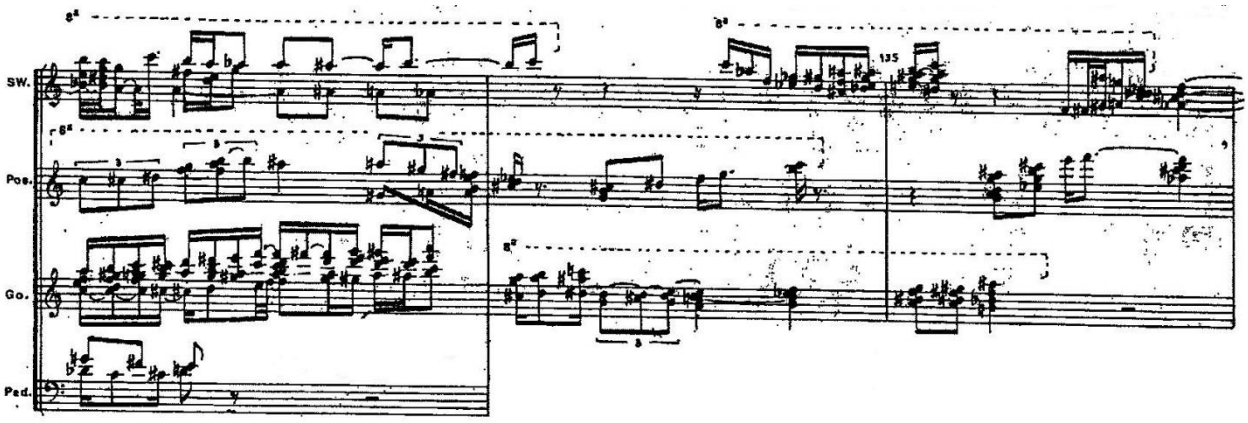



Figure 4.13 – *Gmeeoorh*, mm. 133-135; the Swell, Positiv, and Great are played in the very highest registers; [Permission arranged].

The most extensive arborescence appears on p.12, from mm. 130 to 135. The dense counterpoint definitely requires the OA. Here, the OP can divide the manuals: the Great can be played by the OP, and the OA can play the Swell and Positiv; the two voices of the pedal part are also distributed between the OP and OA.

After this extensive arborescence, Xenakis follows with a shorter arborescence section, cancelling all the stops on the Postiv and Pedal, and adding only the Positiv Holzgedeckt 8' and the Pedal Dulzian 16'at m. 136. From mm. 137 to m.148, the arborescence is played one or two

stops on the Positiv (Holzgedeckt 8' and Dulzian 16') and Pedal (Dulzian 16' and later adding the Subbass 16' and Quintfloete 10, 2/3'). Even though the registration is soft, the complex counterpoint remains, with intermittent clusters indicating "(↕), toutes les notes (all notes)."

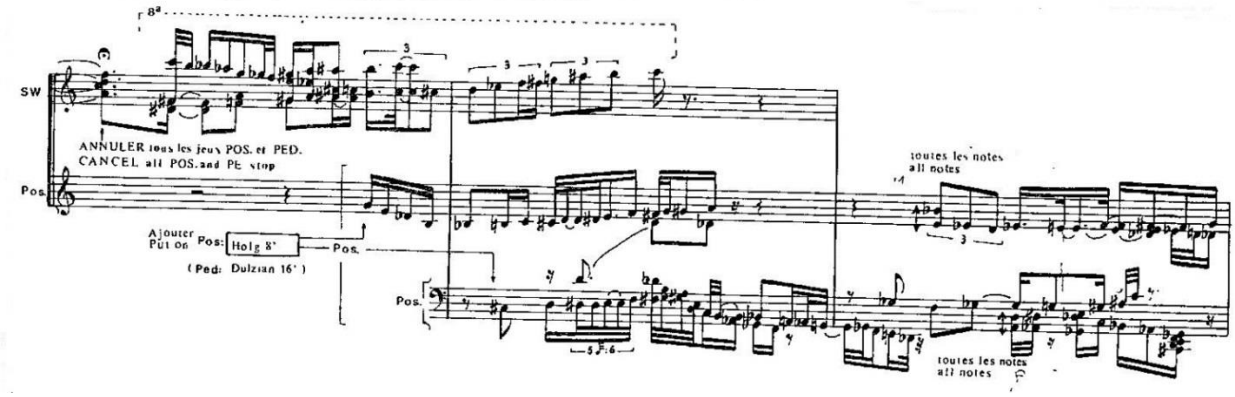



Figure 4. 14— *Gmeeoorh*, mm. 136-138; soft registration and cluster notation (↕) at mm. 138. [Permission arranged].

Even though Xenakis changes the tempo at the beginning of Section 4, "Slower, Plus Lent"[136], the OP still faces tonal and rhythmic complexities between the Great and Pedal, with a different rhythmic configuration for both hands and feet. These complexities prevail throughout Section 4. The organist(s) may feel daunted and intimidated by the level of difficulty at first.[137]

First, the OP must determine beforehand 1) the basic rhythmic (counting) unit – Section 4 may be divided into eighth notes; and then 2) develop a system for realizing areas of rhythmic counterpoint/complexity (i.e., triplet 8ths against 32nd notes against sixteenths) and mark these specific spots in the score. Then the OP assigns the manual and pedal distribution with the OA.

[136] Xenakis writes the English and French terms right next to each other.
[137] Solutions to similar complexities may be found in George Ritchie and George Stauffer, *Organ Technique, Modern & Early,* New Jersey, Prentice-Hall, Inc, 1992, p. 337; Ritchie and Stauffer specifically illustrate a movement from Ian Hamilton's *Threnos: In time of war* (1970).

Basically, the OP would play the Great and Pedal; the OA would take the Swell and Positiv, and the upper notes of the pedal part. After the performers have learned their respective parts individually, they may begin by practicing the pedal parts together for balance and coordination. Then they may practice in various combinations, each taking L.H, then R.H, individually, and then with the pedal part, and finally, with all parts together.

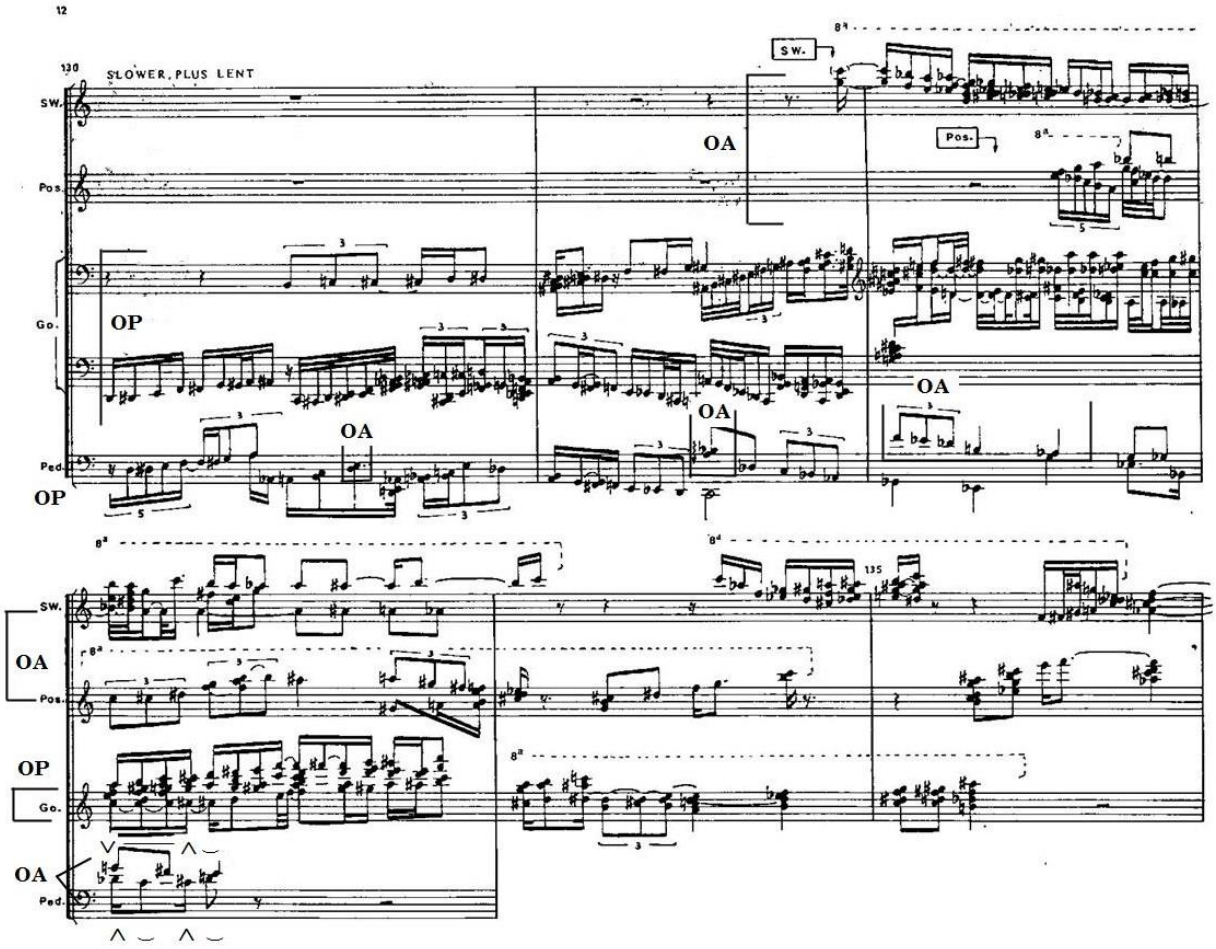



Figure 4.15 – *Gmeeoorh*, mm. 130-135, showing distribution of parts between OP and OA [Permission arranged].

This method can also be applied to Section 7, which also contains complex rhythmic patterns derived from arborescence. This method will also assist in the learning process of putting together the manual and pedal parts for both performers throughout the piece.

A short transition, beginning in the Pedal, appears at mm. 149-150, which returns to the same registration as in Section 4, gradually adding stops in the Pedal and Positiv. In addition, Xenakis employs a fifth/tritone cluster in the pedal (C, F#, G), which can be played by the OP alone (C and D-flat for the left foot, and F-sharp and G for the right foot).

Another extensive arborescence appears, from m.151, up to the second beat in m. 155. The same performer division again applies: the OP for Great, and the OA for Swell and Positiv, with the Pedal part divided as appropriate. Then, as short patches of arborescences present themselves from mm.156 to mm.194, these are made more pronounced by the continual addition of reeds and celeste stops in all manuals and Pedal: Cromorne 8'on the Positiv; Voix humaine 8', Basson 16', Voix celeste 8', and Octave celeste 4' on the Swell, and Posaune 32', 16', and Basson 16' in the Pedal. This also enables the OP to create a huge degree of crescendo. This development of the arborescence rapidly drops away and leads to the tritone pedal clusters which first appeared at mm. 149-150, now reappearing in the end of Section 4, with an added D-flat, acting as a bridge between Sections 4 and 5 [see Figure 4.16]:

[see Figure on next page]

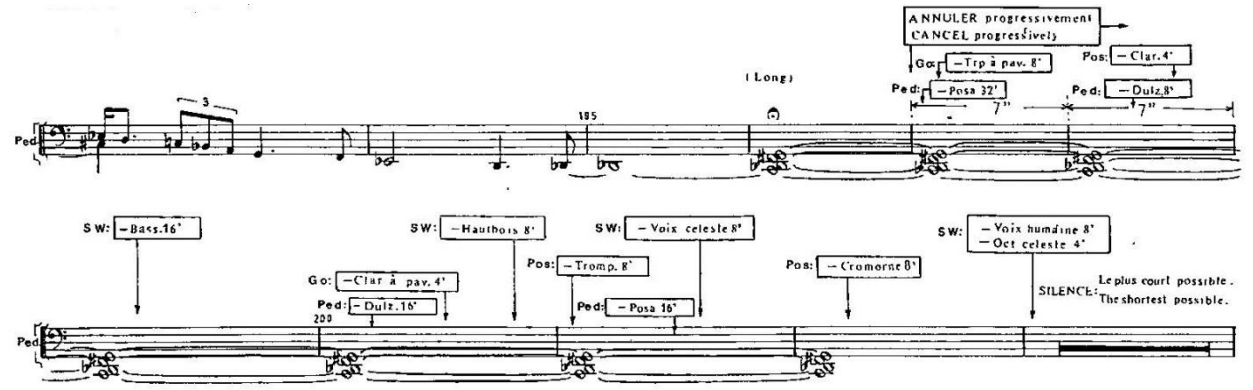



Figure 4.16 – *Gmeeoorh*, mm.193-203, pedal phrase; [Permission arranged].

Section 5: mm. 204-262

The compositional techniques used in Section 5 are completely different from the rest of the work. In contrast to the arborescent-figures in previous sections, here each voice is constructed of long sustained notes comprised of seconds, fifths, and octaves. The composer returns to the beginning tempo (of Section 1), which is faster than the previous section. Xenakis presents contrasts between the higher pitched stops on the Swell (a series beginning with Principal 2'), with the reed stops on the Positive (Dulzian 16', Trompette 8' and Cornet 8'), and on the Great (Trumpet and Clarion-à-pavillion), over the Pedal 16' and 10, 2/3'.

Here, the Swell and Positive would be assigned to OP, and OA would play the Great and several upper notes of Pedal part [see Figure 4.17]:

[see next page]

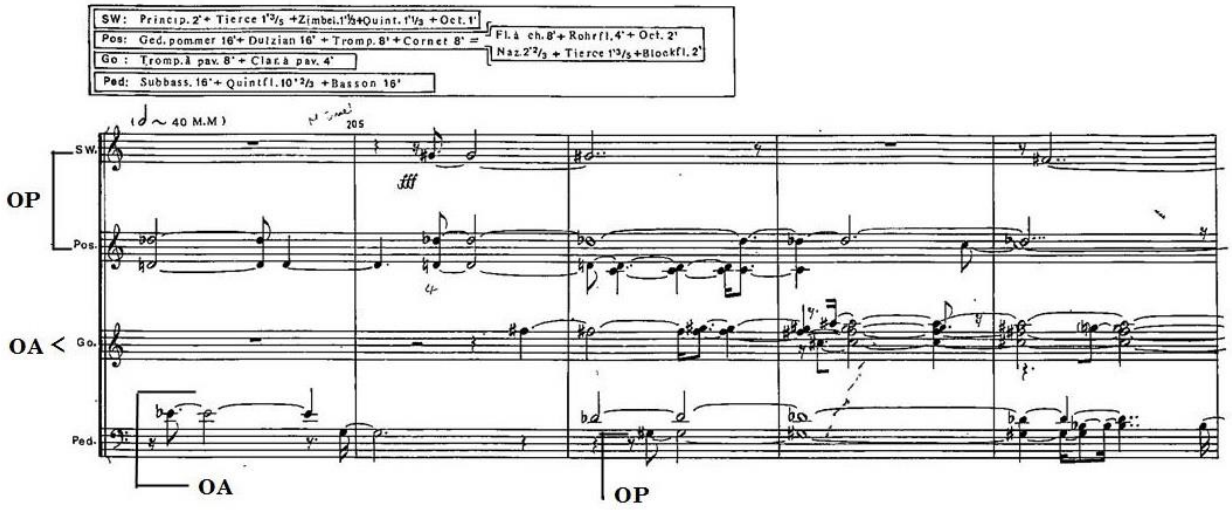



Figure 4.17 – *Gmeeoorh*, mm.204-208, showing part division between OP and OA [Permission arranged].

Rieunier illustrates this section as follows, "One could speak of a choral: A period of calmness after the vertiginous storm which precedes [it], but one with great variety of timbres."[138] She also describes Section 5 as "an atmosphere of improvisation."[139] I would suggest this section would be more closely regarded as a quartet due to the different colors coming from each manual and Pedal.

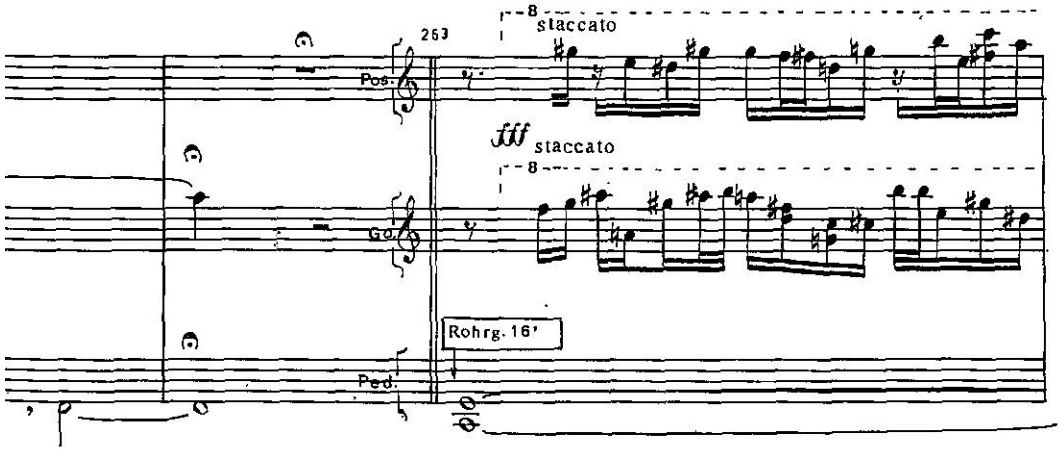
Section 6: mm. 263-274

At m.262, the manual parts briefly discontinue, whereas the Pedal part sustains one long note continues without pause or rest, connecting into Section 6. [see Figure 4.18]:

[see Figure on next page]

[138] Quoted in De Henau, p. 158.
[139] Rieunier, *Ibid*, p. 12.

↓ m. 262. manuals discontinue




↑ Pedal part continues

Figure 4.18 –*Gmeeoorh*, mm. 262-263, [Permission arranged].

Along with the pedal tone, (resultant bass), the composer requires fast staccato playing in the manuals. Even though it is the least difficult contrapuntal section, the rhythmic values of each voice are complex: all notes in the manuals (Great and Positiv) consist of sixteenth, thirty-seconds, triplets, and quintuplets, and different rhythmic ratios (4:3, 5:4 and 6:5) between Positiv and Great. In contrast to manuals, the Pedal cluster starts with long held notes, consisting of a fifth (c-g), then adding seconds, f-sharp and d-flat (as in the end of Section 4). Even though the continuity in the manuals breaks up due to the rapid staccato playing, the overall continuity is reinforced by the pedal clusters and continuous addition of stops. It is also strengthened by the contrast of registration between manuals and pedal. Whereas the pitch of all manuals begins at the 2' and contains mutation stops, 1⅓, or 2⅔, pedal part begins with a soft stop, the Rohrgedeckt 16', and adds strong reeds stops, Basson 16', Posaune 16', and then 32'. These compositional features lead to focus on creating a certain shape to the sound through the integration of the individual notes. De Henau refers to Section 6 as containing "clouds of

sounds" (Xenakis' own term).[140] By "clouds", Xenakis is referring to phenomenons of nature as a whole; not only clouds of vapor, but clusters of the human, animal, or insect worlds. As he contsructs these "clouds" in music, he "cites his turn to 'ideas amd techniques used in science – probabilities and the statistical approach'."[141] This same phenomenon that Xenakis refers to, musically, as "clouds" later manifests in the music of Ligeti and Penderecki as "sound-mass."

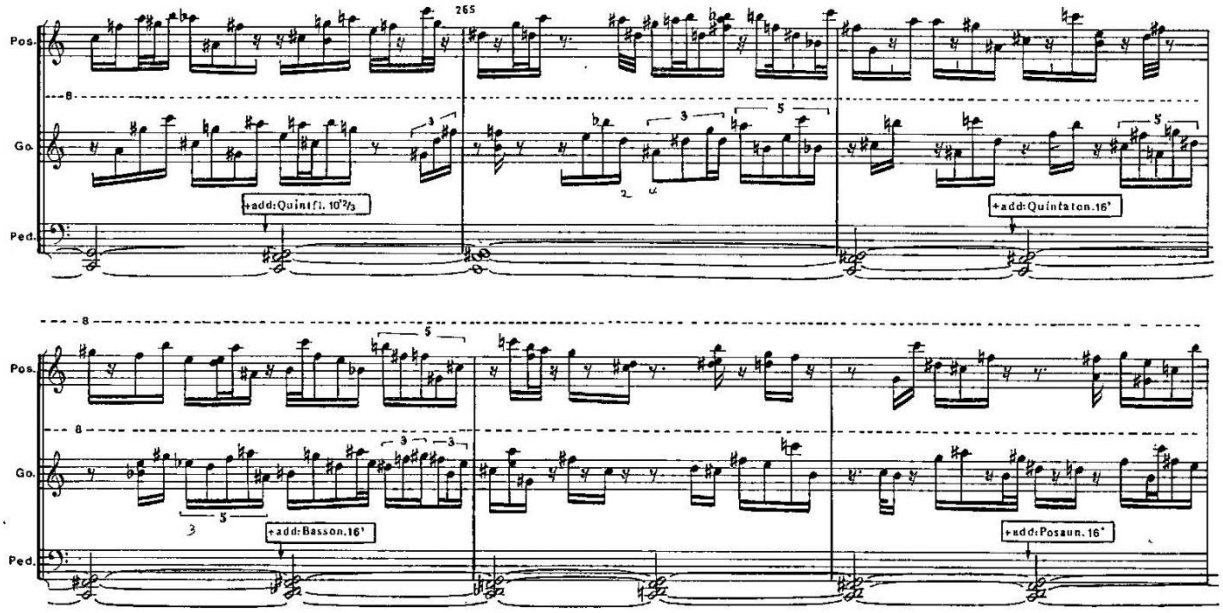
Section 6 can be described as a cadenza-like passage, containing improvisational-style passages on the manuals, and the tone clusters on the pedal part effected by continuous changing of the organ's colors/timbres.

This section would be one of the least difficult with regards to performance. However the OP may face a physical limitation depending on his/her height/stature. With regards to playing the manual parts at the extreme right side of the keyboards, and pressing the notes on the pedalboard on the extreme left side (the cluster of the lowest notes C, D-flat, F-sharp and G), if the OP cannot easily negotiate both hands and pedal, the OP can play the manual parts and the OA play the pedal part [see Figure 4.19]:

[see following page]

[140] De Henau, p. 159.
[141] Benjamine R. Levy, "Clouds and Arboresence in *Mycenae Alpha and the Polytope de Mycènes*," In Kanach, *Xenakis Matters*, pp. 173-174.

↓ Postiv and Great for OP




↑ Pedal part for OA

Figure 4.19 – *Gmeeoorh*, mm. 264-273, [Permission arranged].

Section 7: mm.275-292

Xenakis finally develops the arborescence to the fullest by using all the stops and tremulants from the organ, not writing any notes for the Swell, but retaining the Swell to Positiv coupler. Even though Xenakis omits a part for the Swell, this section still requires the OA, to play the Positiv due to the complexities distributed between the Positiv and Great parts. In Section 7, Xenakis also marks "toutes les notes possibles" (all possible notes) eight times throughout the section in the Positive and Great, somewhat like mini-clusters, Using "all possible" notes in a run, culminating in a *glissandi* effect [see Figure 4.20]:

↓ “all possible notes” (Positiv)

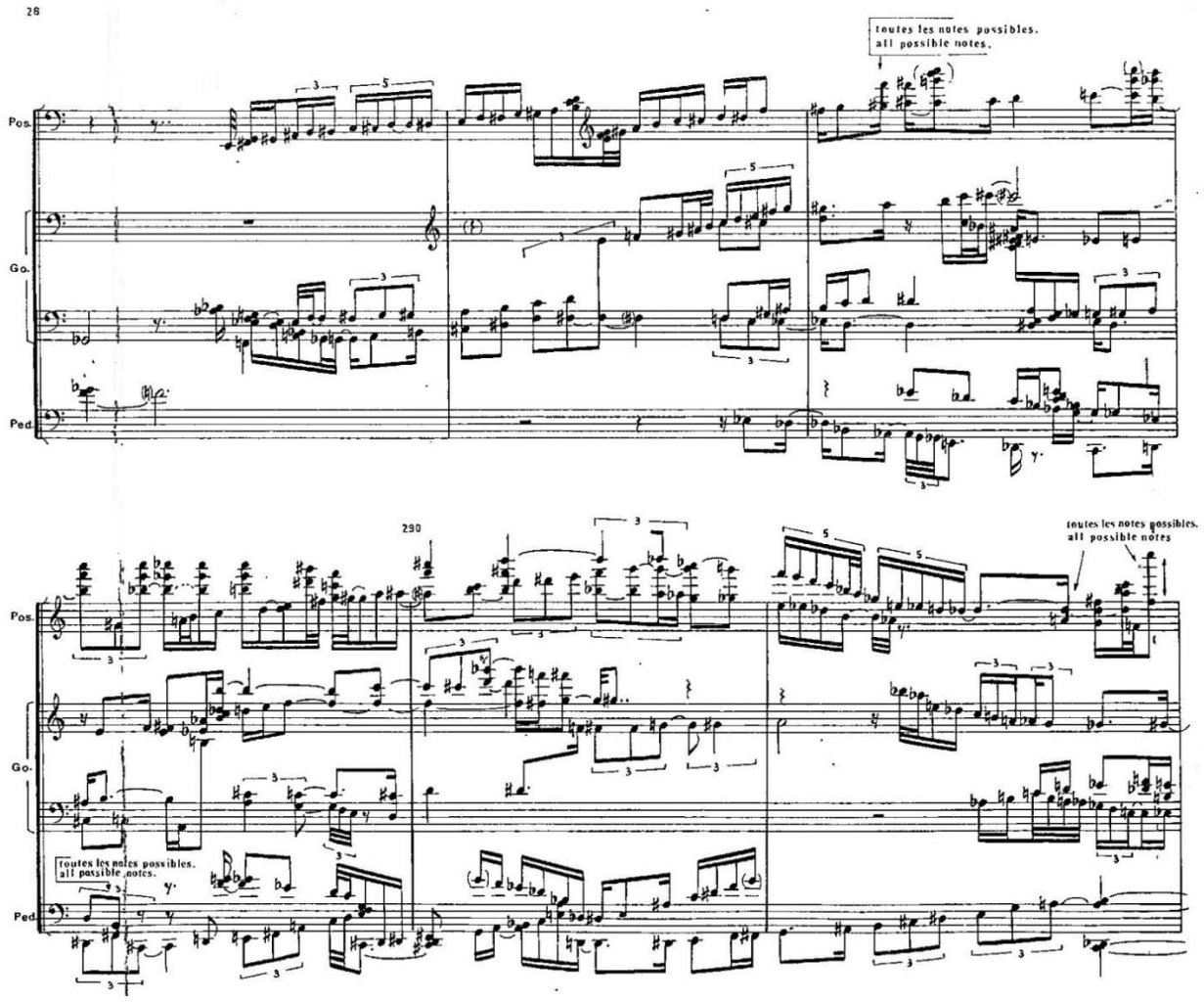
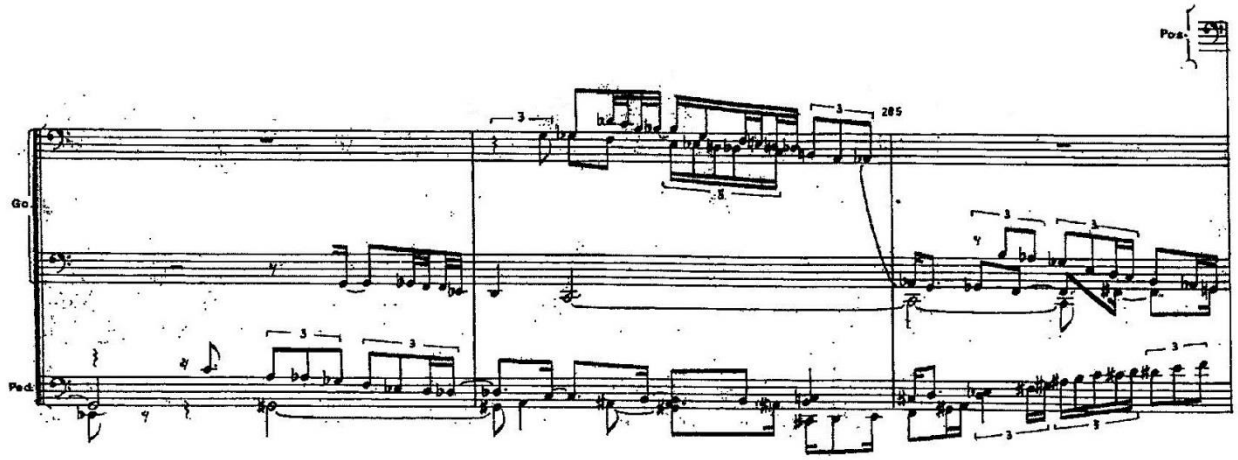



Figure 4.20 – *Gmeeoorh,* showing glissandi like effect, mm. 287-291 [Permission arranged].

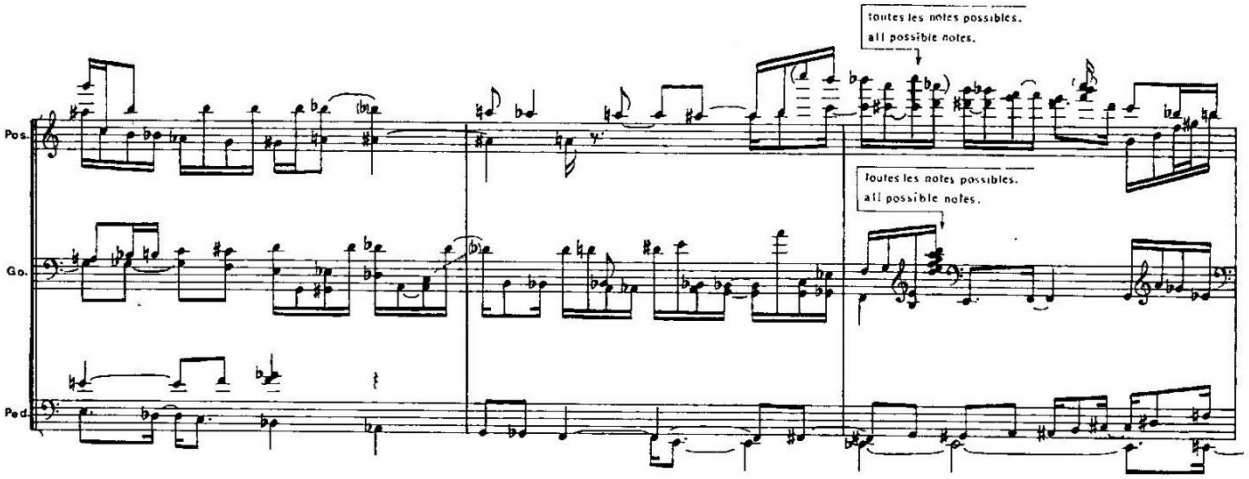
The pedal part of this section generally moves slower, rhythmically, than the manuals, yet still requires the OA, due to multiple voices. The pedal phrase contains the melody of the initial arborescence, both ascending and descending, and should be performed in a *sostenuto* style.

In this way, the section is very much like a modern chorale prelude, with complex manual figurations and containing the choral theme in the pedal [see Figures 4.21 and 4.22]: [142]




↑ dscending main phrase of arborescence in the Pedal

Figure 4.21 – *Gmeeoorh,* mm.283-285 [Permission arranged].




↑ ascending phrases of main melody
of arborescence in the Pedal

Figure 4.22 – *Gmeeoorh*, mm. 277-279 [Permission arranged].

[142] A complex example containing a double pedal part, with the melody in the pedal would be Karg-Elert, *Jesus, meine Zuversicht*, No. 27 from *Choral-Improvisationen*, op. 65.

Section 8: mm. 293-298

"According to Xenakis, this huge, extravagant mass of sound, in this intense, almost seismic activity, should shake the listener's body as if the instrument suddenly seemed to have to explode in order to let our soul, liberated at last, escape in the irrational domain." [143]

The final section has the effect of a sonorous explosion, coming from clusters played with full stops, using four planks in all manuals and the pedal part, a powerful, musical-volcanic eruption, as it were. Xenakis' description shows his detailed plan in regards to the all clusters, in order to simultaneously evoke all possible sounds, timbres and dynamic levels in the final page (p.29), in the space of just over one minute:

> Without diminishing the sound volume, place and push down progressively the four planks over their keyboards, according to the following scheme in a way that the sound complexity be increased.[144]

During the very last two measures, mm. 297-298, the OP and OA should shake for 30 seconds "in dense irregular bursts of fast tremolo and independently the four planks", and then "hold without shaking" for 10 seconds[145] requiring the OP and OA (and possibly the RA) to simultaneously depress the four planks on the Great, Swell, Positiv, and Pedal. In this conclusion to the work, I would suggest that Xenakis effectively exceeds all boundaries of sound and timbres possible from the organ through a culmination of all registers available on the instrument. [see Figure 4.23]:

---

[143] Françosie Rieunier, liner notes to *Xenakis/Chaynes/Chapelet: L'Orgue contemporain à Notre-Dame de Paris*. France, Disques du Solstice – SOCD 192, 2001, p. 12.

[144] *Gmeeoorh*, p. 29. Edition Salabert, 1974

[145] *Ibid.* Similar effects are found at the end of both György Ligeti's *Volumina*, for organ, and Penderecki's *Threnody to the Victims of Hiroschima* for 52 stringed instruments. In the Ligeti, the composer indicates that the motor/blower should be turned off while the organist holds both hands in a cluster on the same manual for 30 seconds, allowing the sound to dissipate (*Volumina*, No.s 40-41). At the end of the *Threnody* (m. 70), Penderecki gives a cluster from $C_2$ – C sharp $_6$ 52 quarter-tones, spread equally among the fifty-two strings, for 30 seconds, beginning at *fff*, with a gradual decrescendo to *pppp*.

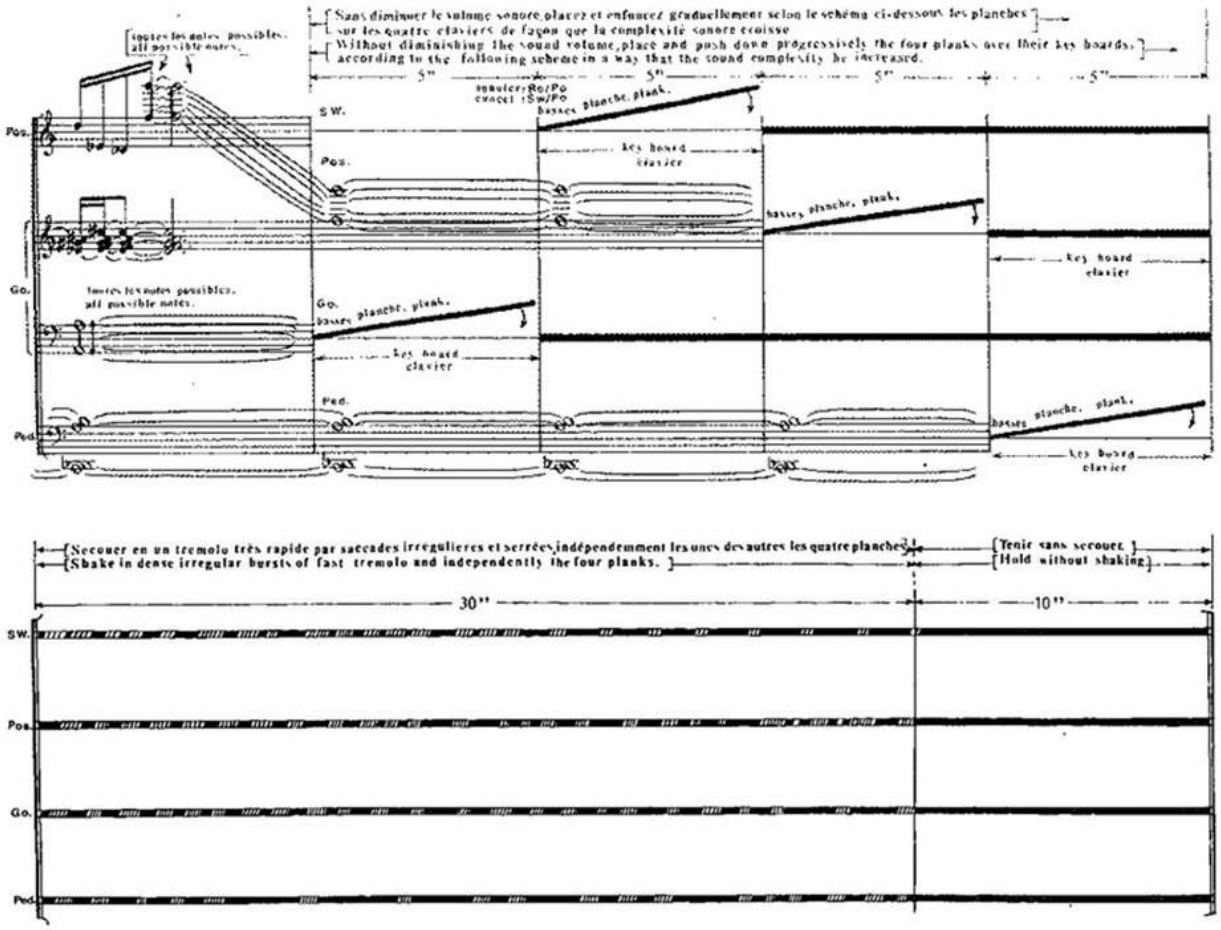



Figure 4.23 -*Gmeeoorh*, irregular and fast tremolo cluster, mm.292-298 [Permission arranged]

# CHAPTER 5.

## Conclusion

> I think that playing a musical instrument is like playing sports; there is a possibility of going beyond human limits. This is done throughout a lifetime, over generations; history offers us such examples. On the other hand, it is the challenge…. Because it is marvelous to see man doing with his body, very delicate and very violent tasks. It is a kind of modulation by sound of man's physical power and intelligence. Being forced to the extreme, it is as if he is transformed by the effort that he is producing….And it is for this reason, doing easy things has no interest; that's finished and belongs to the past. Going further, beyond the difficulties, that's the essence of our existence.[146]
>
> Sharon Kanach
> *Performing Xenakis*

Iannis Xenakis created works that challenge performers to go beyond their own technical capacities and the limitations of their instruments. Both his educational and career background, as a major in engineering and as an architect, led the composer to formulate his unique compositional aim (continuity) and the technique(s) to realize it (arborescence). Consequentially, Xenakis' application of mathematics plays an important role in his philosophy of composition (the association of music and architecture), with continuity as the representative goal of his compositional methods. Just as Xenakis tries to achieve continuity on orchestral instruments by the use of glissandi (as in *Metastaseis*, *Orestïa, and Hiketides*), the concept of arborescence also carries over into keyboard instruments: the piano (*Evryali*); the harpsichord (*Khoaï*); and the organ (*Gmeeoorh*). In *Gmeeoorh*, the composer not only creates continuous, evolving melodic patterns, but also produces various transformations of the organ's textures and timbres, while preserving the continuity through arborescence.

[146] Quoted in Kanach, *Performing* Xenakis, p. 12; Kanach notes, "Quote excerpted from Benny Sluchin, "*Linaia-Agon*, Towards an interpretation based on the theory," *Proceedings of the International Symposium Iannis Xenakis*, Athens, May 2005. Annexe, 307-11. [Original radio interview in 1973, in French.] (trans. B.S.); *ibid*, f.t. 2.

The objectives of realizing and performing *Gmeeoorh* has been a very complex task, as its purpose is to respect Xenakis' arborescence, indications, and musical intentions as much as possible. Another aspect of performing *Gmeeoorh* is that the organists need to consider the composers' specific intentions for the organ. Xenakis sought to extend the possibilities of the organ: unusual and frequent changes of registrations based on the divergence of arborescences, dense textures not fully playable by a single performer, and using full-range clusters on all manuals and pedal by use of four planks. These compositional features lead not only to exceeding the possibilities for the organ as a whole, but also expand the performer's capabilities in terms of new performance techniques, which can then be applied to performances of other avant-garde organ works.

To reproduce Xenakis' score in performance as accurately as possible, the following guidelines are suggested:

1. Have two organ assistants: the OA, who is assigned the part- divisions for performance, and the RA, who is in charge of registration and applying/removing the planks.
2. Divide *Gmeeoorh* into eight sections based on De Henau's analysis, in order to understand the form and main compositional features in each section.
3. Read each section of the score away from the organ bench at first, so as to fully understand the music as much as possible, and clarify the composers' intentions. Then work out each section carefully at the console, assigning parts for the OP and OA. As Roger Woodward suggests for the preparation of *Keqrops*, "Although this may seem

ridiculous, remember Mozart's advice about memorizing a piece of music by taking it to bed and placing it under the pillow."[147]

4. When encountering very complex textures due to the development of arborescences, try to find the basic rhythmic (counting) unit and develop a system for realizing areas of rhythmic counterpoint/complexity.
5. Apply your full attention to every step of practice, and learn to enjoy the process. Remember that "Xenakis often said that music is not realized by one's hands but by one's mind."[148]

*Gmeeoorh* is perhaps the most complex and challenging piece in the repertoire of late twentieth century – twenty first century organ music, rivaled only by Ferneyhough's *Sieben Sterne* (1970) in terms of sheer technical difficulty.[149] These and many other avant-garde organ works are rarely performed due to their technical complexities and difficulties, leaving a gap between the avant-garde works and mainstream organ literature. Composer-performers such as Martin Herchenröder of the University of Siegen, Germany, have done much to help bring avant-garde organ works into the mainstream repertory. Marilyn Mason, now Professor Emeritus of Organ at of the University of Michigan, has been exemplary in commissioning over seventy works during the course of her career, both traditional and avant-garde, for the organ. Performers and composers such as these help bridge the gap, not only between mainstream and modern repertory, but also the gap between the composer and audience in developing an affinity for new works. In addition, every year, the American Guild of Organists (AGO), supports its

[147] Roger Woodward, "Conquering Goliath: Preparing and Performing Xenakis' *Keqrops*: in Kanach, *Performing Xenakis*, p.138.
[148] *Ibid*, p. 121.
[149] A work such as Reger's *Variations and Fugue on an Original Theme*, Op. 73, from 1905, also challenges the performer in terms of technical difficulty and duration.

commitment to developing new music by sponsoring the New Music Competition & Commission, for new organ compositions. This competition encourages talented-composers to produce new avant-garde works for the organ.

The importance of this study is that it seeks to make a work like *Gmeeoorh* more accessible by giving a better understanding of Xenakis' compositional processes, and of the genesis and application of arborescences, evolving as it does from Xenakis' search for continuity, and providing a better framework for performers' understanding of complex and/or avant-garde works.

To further encourage the performance of *Gmeeoorh*, an Appendix detailing my project recital is given, with a description of the organ on which it was performed, highlighting the respective difficulties encountered in the execution of the piece, along with some additional suggestions for performance. *Gmeeoorh*, as well as many other representative compositions from the late $20^{th}/21^{st}$ centuries, serve to add to the long and distinguished evolution of the organ, and its repertoire

## Bibliography


Albright, William. "4th Festival of Contemporary Organ Music." *Music: the AGO & RCCO Magazine*, vol. 8. no. 9 (1974): 21-24.

Anderson, Christopher. *Twentieth-Century Organ Music*. (Routledge Studies in Musical Genres), New York: Routledge, 2011.

Antokolez, Elliot. *Twentieth Century Music*. New Jersey: Prentice Hall, 1992.

Arnold, Corliss Richard. *Organ Literature: A Comprehensive Survey*, 3rd ed. Maryland: The Scarecrow Press, Inc., 2003.

Audsley, George Ashdown. *Organ – Stops and Their Artistic Registration*. New York: H.W. Gray. Co., 1923.

Barnes, William Harrison. *The Contemporary American Organ: Its Evolution, Design, and Construction*, 8th ed. New Jersey: J. Fischer & Bro., 1964.

Boris, Mario. *Iannis Xenakis*: *The Man and His Music*. London: Boosey & Hawkes, 1967.

Butchers, Christopher. "The Random Arts: Xenakis, Mathematics and Music." *Tempo*, No. 85 (1968): 2-5.

Casonato, Ambra. *Mission Impossible*: *Orchestrating Gmeeoorh*. MM thesis; Conservatorium van Amsterdam, 2013.

Chung, Immin. *Mathematical and Architectural Concepts Manifested in Iannis Xenakis's Piano Music.* DMA dissertation; The University of Texas at Austin, 2003.

Cope, David. *New Directions in Music*, 7th ed. Illinois: Waverland Press, Inc., 2001.

Couroux, Marc. *Evryali* and the Exploding of the Interface: from Virtuosity to Anti-virtuosity and Beyond. *Contemporary Music Review*, vol. 21 (2002): 53-67.

De Henau, Joris. "*Gmeeoorh* (1974) for Organ by Iannis Xenakis: Towards a Critique of Arborescence." *Conference Proceedings, International Symposium, Iannis Xenakis*, vol. 2005-07715 (2005): 150-160.

Diemente, Edward. "Gmeeoorh" *Music: the AGO & RCCO Magazine*, vol. 9. no.6 (1975): 18.

Exarchos, Dimitrios. *Iannis Xenakis and Sieve Theory*: *An Analysis of the Late Music (1984-1993).* Ph.D. Dissertation: Goldsmiths College, University of London, 2007.

Flint, Ellen Rennie. "Metabolae, Arborescences and the Reconstruction of Time in Iannis Xenakis' *Psappha*." *Contemporary Music Review*, vol. 7 (1993): 221-248.

Gibson, Benoît. *The Instrumental Music of Iannis Xenakis: Theory, Practice, Self-Borrowing. The Iannis Xenakis Series No.3.* New York: Pendragon Press, 2010.

Gillock, Jon. *Performing Messiaen's Organ Music*. Indiana: Indiana University Press, 2010.

Goode, Jack. *Pipe Organ Registration*. Nashville: Abingdon Press, 1964.

Harley, James. "Iannis Xenakis in Conversation: 30 May 1993", *Contemporary Music Review*, vol. 21, no, 2/3 (2002): 11-20.

_____. *Xenakis*: *His Life and Music.* New York: Routledge, 2004.

Hill, Peter. "Xenakis and Performer." *Tempo*, No.142 (1975): 17-22.

Holloway, Clyde. "*Gmeeoorh*" *Music: the AGO & RCCO Magazine*, vol. 9. no.6 (1975): 18.

Kanach, Sharon. *Performing Xenakis.* The Iannis Xenakis Series No. 2. New York: Pendragon Press, 2010.

_____. *Xenakis Matters.* The Iannis Xenakis Series No, 4. New York: Pendragon Press, 2012.

Matossian, Nourtza. "Xenakis at 60." *Tempo*, no.142 (1982): 38-40.

_____. *Xenakis*. New York: Taplinger Publish Company, Inc., 1986.

Morgan, Robert. *Twentieth Century Music*: *A History of Musical Style in Modern Europe and America*. New York: W.W. Norton & Company, 1991.

Pace, Ian. "The Harpsichord Works of Iannis Xenakis." *Contemporary Music Review*, Vol. 20 (2000): 125- 140.

Solomos, Makis. "Xenakis' Early Works: From 'Bartókian Project' to Abstraction." *Contemporary Music Review*, Vol. 21, No. 2/3 (2002): 21-34

_____. *Présences de Iannis Xenakis* (*Presences of Iannis Xenakis*). Paris: Cdmc (Centre de documentation de la musique contemporaine), 2001.

_____. "Xenakis' Thought through his Writings." *Journal of New Music Research*, Vol.33, No.2 (2004): 125-136.

Soterious, Constantine. *Iannis Xenakis: The Analysis of Four Works for Piano Solo*. Charles University in Prague, Czech Republic, 2011.

Squibbs, Ronald. "Some Obeservations on Pitch, Texture, and Form in Xenakis' *Mists*", *Contemporary Music Review*, vol. 21, no. 2/3 (2002): 91-108.

_____. *An Analytical Approach to the Music of Iannis Xenakis: Studies of Recent Works*. Ph.D dissertation: Yale University, 1996.

_____. "Aspects of Compositional Realization in Xenakis: Pre-Stochastic and Early Stochastic Music." *Proceedings of the Xenakis International Symposium*, 2011. Department of Music, University Connecticut: 1-12.

Takahashi, Yuji. "Letter to the Editor." *Tempo*, no. 11 (1975): 53-54.

Thomopoulos, Stéphanos. "Evryali and the Arborescences: Graphic Representation as a Tool for Pianists in the Work of Iannis Xenakis." *Proceedings of the Xenakis International Symposium*, 2011: 1-8.

Watkins, Glenn. *Soundings: Music in the Twentieth Century*. New York: A Division of Macmillan, Inc., 1988.

Varga, Bálnt András. *Conversations with Iannis Xenakis*. London: Faber and Farber, 1996.

Xenakis, Iannis. *Arts/ Science: Alloys: The Thesis Defense of Iannis Xenakis*. Translated by Sharon Kanach. New York: Pendragon Press, 1985.

_____ . "The Crisis of Serial Music." *Gravesaner Blätter I* (1955): 2-4.

_____ . *Formalized Music*. Edited by Sharon Kanach. New York: Pendragon Press, 1992: originally published in French as *Musique Formeles* (Paris: Editions Richard-Masse, 1963): earlier English translation as *Formalized Music: Thought and Mathematics*. Bloomington: Indiana University Press, 1971.

_____ . *Music and Architecture*. Iannis Xenakis Series No. 1. Translated, compiled and presented by Sharon Kanach. New York: Pendragon Press, 2008.

_____ . *Gmeeoorh:* version for 56 notes (score). Paris: Editions Salabert, 1974.

_____ . *Gmeeoorh*: version for 61 notes (score). Paris: Editions Salabert, 1974.

_____ . *Metastaseis* (score). London: Boosey & Hawkes, 1967.

_____ . *Suppliantes D'eschyle* (*Hiketides*) (score). Paris: Editions Salabert, 1972.

_____ . *Synaphaï* (score). Paris: Editions Salabert, 1969.

Zaplitny, Michael. "Conversation with Iannis Xenakis", *Perspective of New Music,* vol. 14, no. 1 (1975): 86-103.

Discography and Videography

Françoise Rieunier, *Xenakis/Chaynes/Chapelet: L'Orgue contemporain à Notre-Dame de Paris*. France, Disques du Solstice – SOCD 192, 2001.

Iannis Xenakis *Gmeeoorh*, Part 1, at:
http://www. youtube.com/watch?v=WoRgo5_KzgA,Françoise Rieunier at Notre Dame.

Iannis Xenakis *Gmeeoorh*, Part 2, at:
http://www.youtube.com/watch?v=2hPHdruR7e8, Françoise Rieunier at Notre Dame.

## Appendix

This is a description of my project recital, the program, and the organ. It is hoped that this brief account offers additional practical assistance for organists, not only for attempting to perform *Gmeeoorh,* but, as has been one of the objectives of this paper, will also encourage the performance of organ literature from the twenty-first century.

The project recital was held at the Chapel of Saint John the Divine (Episcopal), Champaign, Illinois, on November, 13, 2015. Unlike Clyde Holloway's, predominantly French program,[150] I chose Johaan Sebastian Bach, *Fantasia and Fugue in G Minor, BWV 542*, and Olivier Messiaen, two movements from *L'Ascension*: *III. Transports de joie d'une âme devant la gloire du Christ qui est la sienne,* and *IV. Prière du Christ montant vers son Père,* and then Iannis Xenakis, *Gmeeoorh*. The two composers, Bach and Messiaen, had an important influence on Xenakis' compositional style and aesthetics.

First, Iannis Xenakis regarded J.S. Bah as a composer very highly. "Every work of his is stamped by his extraordinary personality and characterized by a unique intelligence, power and richness." [151] In addition, Bach's fugue style was greatly appreciated by Xenakis in terms of structure. It relates directly to Xenakis' opinion(s) on structures of (cellular) automaton, which is based on given rules.[152] He wanted to create music, "like living organisms that have a life of their own, rules of their own, their own way of beginning and ending, and what happens in between should have a logical life of its own." [153]

[150] Clyde Holloway performed all- French program during the first premier of *Gmeeoorh.* Edward Diemente, "Gmeeoorh" *Music: the AGO&RCCO Magazine*, vol. 9. No. 6 (1975), p. 18.
[151] Varga, p. 60.
[152] "the fugue is a forerunner of such an automaton." *Ibid,* p. 205.
[153] *Ibid,* p. 204.

Second, the third movement of *L'Ascension* not only features block-like structure, but also utilizes full organ and diverse colors coming from both manuals and the pedal, much like the second and the last movements of *Gmeeoorh.*

*Gmeeoorh* makes great demands upon the organ as well as the organist(s). Organists not only need to solve the musical complexities and technical difficulties, but also to deal with the capacities of the individual organ, such as wind pressure and key action.

First, according the article by Clyde Holloway, on the organ of South Congregational Church, New Britain (where *Gmeeoorh* was premiered[154]) the Great is on Manual I, the Positive on Manual II, and the Swell Manual III, reversed from the usual American order (Manual I: Positive, Manual II: Great, Manual III: Swell). This disposition (for which *Gmeeoorh* was written), allows for interchanges of fingering between the Great and Positive. In instruments with the normal American disposition (Positive II, and Great I), the organists will need to solve problems in readjusting the fingering in certain passages, such as in Section 5.

Second, the each manual division of the Gress-Miles organ contains several mutations, which allow for specific coloristic effects based on Xenakis'*arborescences.* [155] Holloway notes that modifications can be made (according to the specification of the instrument) but should be determined after organists have first heard Xenakis' intended effect. [156]

[154] "The Premiere of the complete version was February in 1975. A work in progress preview performance was in 1974. At that time the piece required two person playing and two person assisting, due to exceptional demands of the piece. Xenakis did not want the piece performed by two people and did whatever it took make possible performances by a single player. Dr. Holloway returned to South Church in February of 1975 to play the complete, one- organist version." Personal email correspondence with Richard Coffey. ( 12/12/2015) He was one of assistances both two performance of *Gmeeoorh* and the music director of South Church, since 1972.
[155] During the Fourth Festival of Contemporary Organ Muisc, June, 1974, Xenakis added or took out stops due to the relative volume . Clyde, Holloway, *"Gmeeoorh", Music: the AGO&RCCO Magazine*, vol. 9. No. 6 (1975), p. 18.
[156] *Ibid.*

Third, organists should consider the preparation of the four planks, for pressing all the notes from all manuals (61 notes each) and the pedal (32 notes), in Sections 2 and 8. If the organ possesses a concave-radiating AGO pedalboard, organists might wish to consult a carpenter, as Holloway did,[157] to make sufficient one, which can be transported easily, and designed not to cause any damage on the pedalboard. In addition, the type of action of the instrument is an important factor to determine if the notes from all manuals and pedals can be sounded at the same time. If not, Holloway suggested it is desirable to weight either the top or the bottom range of each manual according to the pitches of the stops used. [158]

Fourth, the wind supply of the organ will be another determinant on how many of the stops can be added or withdrawn based on the composer's directions. If the organ cannot accommodate all manual and pedal pitches played on all stops, again, a select registration, together with pressing either the top or bottom halves of the keyboards, may be used.

The organ used in my performance was built by John-Paul Buzard Pipe Organ Builders (Buzard Opus 7, II/36, built for the Chapel and dedicated in 1991). The organ is constructed of two manuals (Great and Swell) and pedal, yet has three enclosed manual divisions; Great, Swell A, and Swell B (or Choir), each under expression. Each of the three divisions is independently couple-able to either keyboard or the pedalboard. It is set on 4 electrically operated slider-chests, and 5 unit chests (for four pedal stops, and one Swell/Pedal stop). Swell A contains reeds such as Basson 16', Trompette 8', Clarion 4' and Major Tuba 8'; Swell B contains mutation stops, such as Nazard 2 2/3' and Tierce 1 3/5'. These feature aided in creating the special color effects required for *Gmeeoorh.* The three divisions also allowed the work to be

[157] "Holloway had to visit his local carpenter to have the pedalboard boar made to the AGO concave specs." Diemente, *Ibid*, p. 18.
[158] "This avoids the overly diatonic or pentatonic effect of depressing the white keys or the black keys." Holloway, *Ibid*, p. 18.

performed on two manuals, but also required some shifting of position of the OP/ OA on the organ bench.

With regards to the planks, instead, I chose the manner of depressing the very top range of Swell, the bottom part of Great with the forearms of OP and OA, as the organ's firing mechanism is not designed to accommodate all stops and pitches simultaneously; the low wind pressure of each manual and the pedal board was also a factor (Great / Pedal is 3, ½", and Swell is 4") which The Major Tuba 8', was not chosen for the registration in the cluster sections (2 and 8), since the higher wind pressure (8"-9") produces a disproportionately louder sound. (Including such a loud stop in the already-loud ensemble also risked possible damage to the stained glass windows of the sanctuary). This also led to not using a pedal plank; instead the OP and OA depressed the top and bottom part of the pedalboard.[159]

The stops plays on electro-pneumatic action, which is enable organists to depress the keys with very little pressure, regardless of the number of stops. This led OP / OA to not only easily press many notes, but also add different pitches based on the composer's request, without using planks, in order to create huge and extravagant mass of sound in the Section 2 and 8.

Finally, as I have pointed out, the performance of such a piece requires one or two assistants. Françoise Reunier had two assistants when recording *Gmeeoorh* in Paris. During my performance of the piece, I had one assistant (I as an OP); and the parts and change of registrations (such as adding or subtracting stops between the right and left side on the console, again based on the Xenakis' notes in the score) were divided between myself and the OA.

[159] I originally planned to use three different planks: two, built of thick Stylofoam, were acquired thanks to the custodian of my church. Another (plastic) plank was intended for the pedalboard.

Next, I will present the specification of the organ at South Congregational Church in New Britain, for which *Gmeeoorh* was composed, followed by the specification of the St. John's Chapel organ on which my performance was given. The specification of the Gress-Miles organ again reminds us that Iannis Xenakis tests not only pushed the technical capacities of the performer(s) to the extreme, but also limits of registers and colors available from the organ in *Gmeeoorh*.

## THE COOPER MEMORIAL CHANCEL ORGAN (1972)

**The Gress-Miles Organ Company**
Princeton, New Jersey

**South Congregational Church**
New Britain, Connecticut

### GREAT ORGAN (Manual I)

| | |
|---|---|
| Montre | 16' |
| Rohrgedeckt | 16' |
| Principal | 8' |
| Rohrfloete | 8' |
| Harmonic Flute | 8' |
| *Flute Celeste II (1974) | 8' |
| *Flute Celeste II (1974) | 4' |
| Octave | 4' |
| Spitzfloete | 4' |
| Grosse Tierce | 3-1/5' |
| Nasard | 2-2/3' |
| Superoctave | 2' |
| Waldfloete | 2' |
| Tierce | 1-3/5' |
| Mixture IV-VI | 1-1/3' |
| Scharf III-IV | 2/3' |
| Trumpet | 16' |
| Trumpet | 8' |
| Trompette-à-Pavillon | 8' |
| Clairon-à-Pavillon | 4' |
| Tremulant | |
| Zimbelstern (manual piston and toe stud) | |

(* under expression with Swell Organ)

### POSITIV ORGAN (Manual II)

| | |
|---|---|
| Gedecktpommer | 16' |
| Montre | 8' |
| Holzgedeckt | 8' |
| Flute-A-Cheminée | 8' |
| Viole da Gambe (Swell) | 8' |
| Principal | 4' |
| Rohrfloete | 4' |
| Nasat | 2-2/3' |
| Octave | 2' |
| Blockfloete | 2' |
| Tierce | 1-3/5' |
| Quintfloete | 1-1/3' |
| Siffloete | 1' |
| Scharf IV-VI | 1' |
| Dulzian | 16' |
| Trompette | 8' |
| Cromorne | 8' |
| Clairon | 4' |
| Chimes (tubular) | |
| Tremulant | |

### PEDAL ORGAN

| | |
|---|---|
| Contrebass (digital/32 notes) | 32' |
| Untersatz (digital/32 notes) | 32' |
| Acoustic Bass | 32' |
| Principal | 16' |
| Subbass | 16' |
| Rohrgedeckt (Great) | 16' |
| Quintaton (Swell) | 16' |
| Principal | 8' |
| Gedeckt | 8' |
| Bourdon (Swell) | 8' |
| Octave | 4' |
| Harmonic Flute (Great) | 4' |
| Superoctave | 2' |
| Mixture VI-VII | 2' |
| Basse de Cornet IV-V | 32' |
| Posaune | 32' |
| Posaune | 16' |
| Dulzian (Positiv) | 16' |
| Basson (Swell) | 16' |
| Trumpet | 8' |
| Dulzian (Positiv) | 8' |
| Basson (Swell) | 8' |
| Clairon | 4' |
| Cromorne (Positiv) | 4' |
| Cornett | 2' |

### SWELL ORGAN (Manual III)

| | |
|---|---|
| Quintaton | 16' |
| Bourdon | 8' |
| Quintadena | 8' |
| Viole da Gambe | 8' |
| Voix Celeste | 8' |
| Flute Octaviante | 4' |
| Octave Viole | 4' |
| Octave Celeste | 4' |
| Quint | 2-2/3' |
| Principal | 2' |
| Octavin | 2' |
| Terz | 1-3/5' |
| Quint | 1-1/3' |
| Octave | 1' |
| Zimbel III-V | 1/3' |
| Basson | 16' |
| Trompette | 8' |
| Hautbois | 8' |
| Voix Humaine | 8' |
| Clairon | 4' |
| Tremulant | |
| Sub Octave | |

**COUPLERS and MECHANICALS**

| | | | |
|---|---|---|---|
| Swell to Pedal | 8', 4' | Swell to Positiv | 16', 8' |
| Positiv to Pedal | 8' | Swell to Great | 16', 8' |
| Great to Pedal | 8' | Positiv to Great | 8' |

Zimbelstern (toe stud/manual piston)
Celesting Ranks Off (Flute Celeste) (manual piston)
Adjustable Tutti settings (toe stud/manual piston)
Multi-level combination action (254 levels)
Transposer (plus or minus six semi-tones)
MIDI preparation
Direct Memory Access
Registration sequencing system
Great/Positiv Manual transfer
Integrated digital displays
Classic Organ Works record/playback system

[April 29, 2006]

## THE JOHN-PAUL BUZARD OPUS 7 ORGAN (1991)

**John-Paul Buzard Pipe Organ Builders**
Champaign, Illinois

**The Episcopal Chapel of St. John Divine**
Champaign, Illinois

### GREAT ORGAN

| | |
|---|---|
| Gedeckt (wood) | 16' |
| Open Diapason (tin-façade) | 8' |
| Flute a Biberon | 8' |
| Viola da Gamba | 8' |
| Principal | 4' |
| Spire Flute | 4' |
| Fifteenth | 2' |
| Fourniture IV | 1-1/3' |
| Major Tuba (horiz. 10″ Wind) | 8' |
| Major Tuba Solo (C25-C61) | 8' |
| Cymbalstern | |

### SWELL ORGAN

| | |
|---|---|
| Salicional | 8' |
| Voix Celeste | 8' |
| Principal | 4' |
| Plein Jeu IV | 2' |
| Basson (1-12 1/2 length) | 16' |
| Trompette | 8' |
| Oboe | 8' |
| Clarion (from 16′) | 4' |
| Tremulant | |
| Major Tuba (Gt) | 8' |
| Major Tuba Solo (C25-C61) | |

### PEDAL ORGAN

| | |
|---|---|
| Subbass (1-12 elect.) | 32' |
| Lieblich Gedeckt (1-12 elect.) | 32' |
| Open Diapason (tin-façade) | 16' |
| Bourdon (wood) | 16' |
| Gedeckt (Gt) | 8' |
| Choral Bass | 4' |
| Mixture III | 2' |
| Trombone (wood) | 16' |
| Basson (Sw) | 16' |
| Major Tuba (Gt) | 8' |

### SWELL B ORGAN

| | |
|---|---|
| Stopped Diapason (wood) | 8' |
| Flute Celeste (wood) | 8' |
| Harmonic Flute | 4' |
| Nazard | 2-2/3' |
| Block Flute | 2' |
| Tierce | 1-3/5' |
| Clarinet | 8' |
| Tremulant | |