Orchestrating Noise
Traces of *Mycènes alpha* in *Anémoessa*

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Background

From the earliest stages of his career, Iannis Xenakis was interested in two different approaches to composition: the definition of low-level material, or micro-composition, and the construction of high-level form, or macro-composition. Having an engineering education and working experience, Xenakis turned to graphic design as a means of achieving his goals. He would often sketch out the music on graph paper, on which he would create various geometric shapes. Reading them as a simple two-dimensional diagram – in which the horizontal axis represents time and the vertical one pitch – he could use those sketches as guidelines for creating a traditionally notated musical score. In contrast to composers of the past, who used notes as basic elements of their music material, Xenakis was able to define and control the movements of large sound structures and then elaborate their scoring details *a posteriori*. Two early orchestra examples, *Metastaseis* (1953–54) and *Pithoprakta* (1955–56) establish this method and are among Xenakis's most celebrated works (Bello 2001; Harley 2004).

UPIC

The idea of being able to *draw* music continued to intrigue Xenakis in the years to come. In 1966, he founded EMAMu (Equipe de Mathématique et Automatique Musicales), an institute aimed at designing equipment for computer-aided sound synthesis and music production. In 1972, EMAMu became CEMAMu (Centre d'Études de Mathématique et Automatique Musicales), a non-profit organisation supported by the French Ministry of Culture. By 1977, Xenakis developed the so-called UPIC (Unité Polyagogique Informatique du CEMAMu), his

musical composition and sound-production system. It was conceived as a computer-based system with which the user could graphically describe different levels of composition and synthesise sound from it (Valsamakis 2010).

Figure 7.1: *Iannis Xenakis and the UPIC board. Centre Iannis Xenakis.*

The UPIC consists of a digitising tablet with a vector display. As is the case with Xenakis's early sketches for *Metastaseis* and *Pithoprakta*, the tablet represents a two-dimensional pitch versus time diagram. The user can draw waveforms and store them in the internal memory. One then proceeds to trace a graphic score and the computer uses the pre-assigned waveforms to render the sound. Equally so, the dynamics and articulations can be defined by drawing envelopes. The speed at which the score is rendered can also be predefined by the user. As the idea behind the UPIC system was to manipulate various aspects of sound with a single intuitive drawing gesture, traditional musical parameters – pitch, timbre, dynamics, articulation and tempo – find their analogies in the new electronic context (Figure 7.1). The resulting score shows no details of timbre and dynamics but provides only information regarding the pitch and relative duration of the sounds. After more than two decades since the first graphic experimentation, the UPIC finally allowed Xenakis to visualise and synthesise sound directly from his freehand drawings without the need for further time-

consuming transcription (Harley 2004; Nelson 2010; Valsamakis 2000; Squibbs 1996).

Polytope de Mycènes

By the time the UPIC was finalised, Xenakis was preparing the largest multimedia spectacle in his œuvre: *Polytope de Mycènes* (1978). The first music to be created exclusively on the new system was a series of 'sound interpolations'[1] which would premiere at the ancient site of Mycenae. For this spectacle, Xenakis created several pages of graphic scores, which he placed between live music performances and narrations. The polytope included seven such interpolations in total, initially titled *UPIC I–VII*. The duration of the individual interpolations ranged from 30 seconds to two minutes.[2]

The early version of the UPIC had limitations which lingered in the compositional process. As there was no real-time synthesis, the composer needed to wait for the computer to render the drawing before he/she could hear the sound result, and this could take quite some time. There were also no mixing functions, so the pages needed to be prepared in such a way that they could be linked together. Such limitations could have prevented Xenakis from approaching the composition in any other way than as an exercise. Nevertheless, he was ultimately satisfied with the outcome and recognized the experiment not only as a suitable implementation in his polytope but as a new official composition as well: *Mycènes alpha* (1978) (Squibbs 1996; Valsamakis 2010). As a separate entry in Xenakis's catalogue of works, there was no need for the individual segments to be arranged in the same order as they occurred in *Polytope de Mycènes*. Indeed, Xenakis permutated the order of graphic scores to form a new structure consisting of the same blocks of sound.[3] In this way, the composer may have considered this work an electronic suite: a collection of shorter, interrelated movements, without any strict order.[4]

1 The term 'sound interpolation' was used in the programme catalogue of the polytope. The catalogue is available at the KSYME Archives.

2 For a detailed analysis of the concept and the formal structure of the *Polytope de Mycènes*, see Slavíček (2022).

3 The audio recordings of the *Polytope de Mycènes* performance are available at the KSYME Archives.

4 A percussion piece Xenakis completed earlier that year, *Pléïades* (1978), also consists of movements which can be performed in any desired order.

Mycènes alpha

The *Mycènes alpha* drawings exploited archetypal shapes which can be found in different arts and sciences. Xenakis determined two such shapes: 'clouds' and branching systems, which he called 'arborescences'.[5] He defined a 'cloud' as a form that occurs in many places, naming crowds and flocks as examples (Varga 1996: 206f.). He used stochastic functions to construct cloud-like musical events. The arborescent shape, on the other hand, resembles the growth of a tree and can be found in lightning or in the cardiovascular system. Arboricity is linked to causality, repetition and variation. Unlike clouds, it is deductive and includes temporal progression. To manipulate such shapes in music, Xenakis reached out for Markov chains and random walks. While the musical equivalent of clouds can be understood as a pointillistic multitude, he expressed arborescences using glissando tones. In *Mycènes alpha*, he explored the dichotomy and the possible connections between these archetypical shapes (Levy 2012; see Figure 7.2).

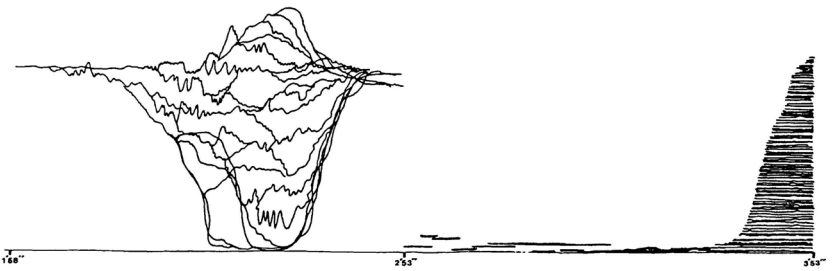

Figure 7.2: *Iannis Xenakis*, Mycènes alpha, *Segment 5 (1'58"–2'53") 'arborescences' and segment 6 (2'53"–3'53") 'clouds', Collection Famille Xenakis DR, score.*

The score consists of 13 segments, each having a characteristic graphic outline (Table 7.1).[6] Most of them are approximately one minute long. The shor-

5 Xenakis borrows the term 'arborescence' from mathematics, namely graph theory, in which it describes a directed graph form of a rooted tree.

6 Although not officially indicated in the score, Squibbs and Di Scipio agree on the numeration of the segments. The same division of the piece into 13 segments is used in this paper. The arguments for this are timestamps in the score and Xenakis's own sketches for the piece created on tracing paper. The scans of sketches are available on the official website of Centre Iannis Xenakis: http://www.centre-iannis-xenakis.org/upic_mycenae?lang=en (accessed September 22, 2022).

test segment (segment 4, timestamp 1′53″–1′58″) is only five seconds in duration. The score contains timestamps to mark where one segment ends and the new one begins.[7] Segments 7 and 13 are graphically identical but reproduced at different speeds (the former lasting around 20 seconds and the latter a full minute). Segment 3 and the beginning of segment 6 also resemble each other visually and audibly. Segments 11 and 12 differ in duration, lasting one minute and 20 seconds, respectively, but are visually similar as if the latter were a diminution or a simplification of the former. The transition from segment 9 to 10 is uninterrupted and can be understood as a single block of sound (Squibbs 1996; Di Scipio 1998).[8]

Mycènes alpha		
Segment number	**Timestamps**	**Approximate duration**
1	0′00″–0′17″	20″
2	0′17″–0′55″	40″
3	0′55″–1′53″	60″
4	1′53″–1′58″	5″
5	1′58″–2′53″	60″
6	2′53″–3′53″	60″
7	3′53″–4′17″	20″
8	4′17″–5′16″	60″
9	5′16″–6′16″	60″
10	6′16″–7′16″	60″
11	7′16″–8′15″	60″
12	8′15″–8′35″	20″
13	8′35″–9′36″	60″

Table 7.1: *Sections of* Mycènes alpha. *Formal division by the author.*

7 The beginning of the published score contains an error: at the 0′17″ mark the timestamp wrongly reads 0′55″. The next timestamp, which should read 0′55″, was left blank.

8 These two segments also appeared one after another at the polytope performance, meaning Xenakis most probably imagined them as a unified whole.

Anémoessa

After a long period of high productivity, Xenakis created only one score for a large ensemble in the following year: *Anémoessa* (1979) for mixed choir (82 or 42 voices) and an orchestra of 90 musicians. The piece was commissioned for the Holland Festival and was performed in Amsterdam on 21 June 1979, by the Dutch Radio Choir and Orchestra under the baton of Richard Dufallo. The title stands for 'exposed to the wind' in Greek, and the choir sings exclusively vowel sounds throughout the piece (Harley 2004: 113f.). The difference between the material performed by the choir and the orchestra is minimal, as both singers and players mostly engage in creating typical Xenakian sonorities: clusters and glissandi. The score manuscript is written entirely in common time (4/4) with five measures on each page (225 measures in total). The tempo indication is 64 bpm or faster, so five measures per page add up to a duration of slightly less than 20 seconds, meaning that one measure is less than four seconds. The performance lasts between ten and 15 minutes.

In the Xenakis Archives there are 17 pages of sketches for *Anémoessa*, consisting of drawings, diagrams, calculations, and texts.[9] The composer assigned Ancient Greek numerals[10] with subscripts to various drawings and created three different versions of macro-structure:

1. $\alpha_{\alpha\beta\gamma} - \beta_{\alpha\beta\gamma} - \gamma_{\alpha\beta\gamma} - \chi_{\alpha} - \varepsilon_{\alpha\beta\gamma} - \chi_{\alpha\beta} - \varsigma_{\alpha} - \chi_{\beta} - \zeta_{\alpha} - \chi_{\gamma} - \eta_{\alpha} - \chi_{\delta} - \theta_{\alpha\beta\gamma} - \iota - \iota\alpha - \chi_{\varepsilon} - \delta_{\alpha\beta\gamma} - \iota\beta$;
2. $\gamma_{\alpha\beta\gamma} - \chi_{\alpha} - \varepsilon_{\alpha\beta\gamma} - \chi_{\alpha\beta} - \varsigma_{\alpha} - \chi_{\beta} - \alpha_{\alpha\beta\gamma} - \beta_{\alpha\beta\gamma} - \zeta_{\alpha} - \chi_{\gamma} - \eta_{\alpha} - \chi_{\delta} - \theta_{\alpha\beta\gamma} - \chi_{\varepsilon} - \iota_{\alpha\beta} - \delta_{\alpha\beta\gamma} - \iota\alpha_{\alpha\beta\gamma} - \iota\beta_{\alpha\beta}$;
3. $\gamma_{\alpha\beta\gamma} - \chi_{\alpha} - \varepsilon_{\alpha\beta\gamma} - \chi_{\alpha\beta} - \varsigma_{\alpha} - \chi_{\beta} - \zeta_{\alpha} - \chi_{\gamma} - \eta_{\alpha} - \chi_{\delta} - \theta_{\alpha\beta\gamma} - \iota_{\alpha\beta} - \iota\alpha_{\alpha\beta\gamma} - \chi_{\varepsilon} - \alpha_{\alpha\beta\gamma} - \beta_{\alpha\beta\gamma} - \delta_{\alpha\beta\gamma} - \iota\beta_{\alpha\beta}$.[11]

While he crossed out the first two versions, he underlined the third one and wrote 'bon' (good) underneath. In the score, Xenakis also marked the same numerals for each segment that corresponds to the ones in the sketches, only this time serving as rehearsal marks for the conductor. The 'bon' order of numerals from the sketches corresponds to the one written in the score.

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9 Collection Famille Xenakis DR, folder OM 26–2.

10 α (alpha) = 1; β (beta) = 2; γ (gamma) = 3; δ (delta) = 4; ε (epsilon) = 5; ς (digamma) = 6; ζ (zeta) = 7; η (eta) = 8; θ (theta) = 9; ι (iota) = 10. The combinations result in higher numbers, for example: iota (ι = 10) and alpha (α = 1) equal 11 (ια). Transliterated to Latin, these values are traditionally converted to Roman numerals.

11 Found on the first and last page of the sketches, Collection Famille Xenakis DR, OM 26–2, pp. 1, 17.

All three versions consist of 18 segments. Apart from the δ (delta) segment, which occurs before the last one, the original version follows the alphabetical order of 12 numerals (α, β, γ, … ιβ), intersected six times by the numeral χ (khi). Although χ denotes the number 600 in the ancient numeral system, it is unlikely that Xenakis meant anything numerical in this case. Instead, χ stands for chorus (χορός; khorós), as each of the six such segments are scored for voices a cappella.[12] The second and third versions maintained the intersecting χ between the segments but further rearranged the original alphabetical order. Unlike the last two versions, the original one also has a single ι (iota) which likely corresponded to ιαβ in the other two versions. The second and third versions are almost identical, only with different positions of segments $α_{αβγ}$, $β_{αβγ}$ and $ια_{αβγ}$. The sections of the third and final version are ordered according to the following proportions:

$γ_{αβγ}$ [3(1+1+1)] – $χ_α$ [5] – $ε_{αβγ}$ [3(1+1+1)] – $χ_{αβ}$ [2(1+1)] – $ς_α$ [1] – $χ_β$ [3+2/5] – $ζ_α$ [1/5] – $χ_γ$ [2/5] – $η_α$ [1] – $χ_δ$ [1] – $θ_{αβγ}$ [3(1+1+1)] – $ι_{αβ}$ [2(1+1)] – $ια_{αβγ}$ [3(1+1+1)] – $χ_ε$ [6] – $α_{αβγ}$ [3(1+1+1)] – $β_{αβγ}$ [3(1+1+1)] – $δ_{αβγ}$ [3(1+1+1)] – $ιβ_{αβ}$ [2(1+1)].[13]

The majority of subscripts of the segments represent exactly five measures in the score. The exceptions are $χ_α$ (25 measures), $χ_β$ (17 measures), $ζ_α$ (one measure), $χ_γ$ (two measures), and $χ_ε$ (30 measures) with no subdivisions. While there is nothing unusual about Xenakis's shaping of the macro-form using the blocks of material, his drawings in the sketches must be taken seriously. Out of 17 pages, 12 of them – the ones which correspond to 12 segments annotated by the Greek numerals – are copied directly from the graphic score of *Mycènes alpha* (see Figures 7.3 and 7.4; Gibson 2011: 208).

This is not an isolated example of self-borrowing in Xenakis's œuvre, and Xenakis is far from being the only composer to reuse his own material. His early electronic music and polytopes have many common passages drawn from acoustic sources. In other works, he would select certain fragments for their sonic qualities and transfer them to create new ones. Once these fragments were removed from their original context, they became independent entities, which he would further manipulate as desired. Such manipulations include everything from literal repetition, transpositions, inversions, arrangements for different instrumentation and other transformations (Di Scipio 2004; Gibson 2005).

12 Xenakis also wrote the Greek word χορός on the ninth page of the sketches, where he drew the vocal lines for the $χ_α$ segment.

13 Author's analysis: One unit in the representation stands for five measures in the score.

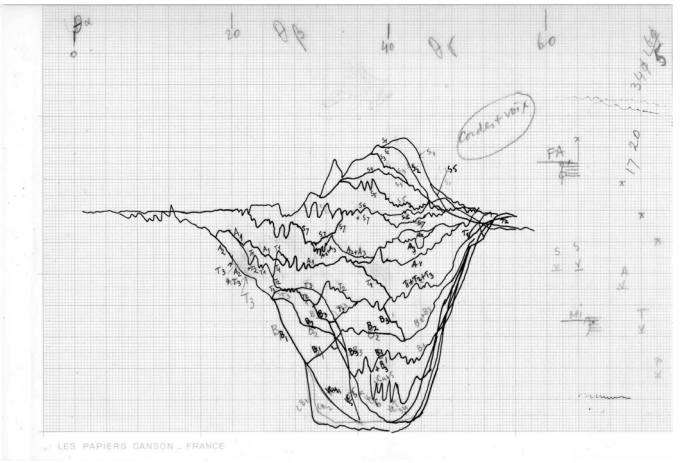

Figure 7.3: *Iannis Xenakis, sketches for* Anémoessa, *Collection Famille Xenakis DR, OM 26–2, p. 15.*

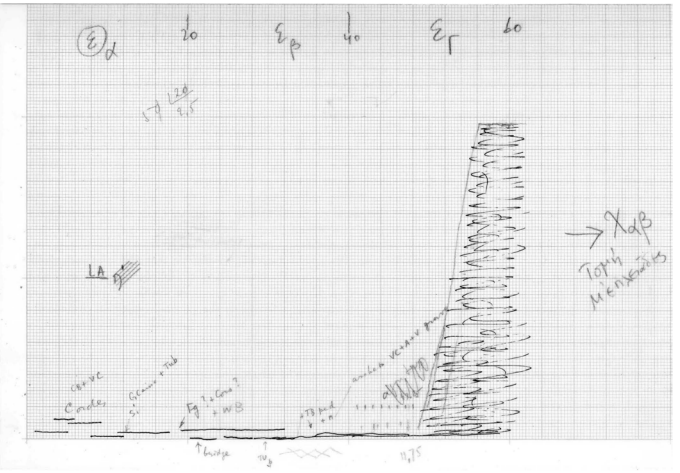

Figure 7.4: *Iannis Xenakis, sketches for* Anémoessa, *Collection Famille Xenakis DR, OM 26–2, p. 11.*

Even *Polytope de Mycènes* – within which *Mycènes alpha* material was first performed – contained five existing pieces from the composer's catalogue. But unlike his early *musique concrète* works, in which the recordings of various in-

struments and ensembles became building blocks for further electronic manipulation, the situation here is reversed: An electronic piece is transformed into an acoustic one.

A particularly interesting page among the *Anémoessa* sketches is the very last one, which is also the only one created on blank paper without a millimetre grid (Figure 7.5).

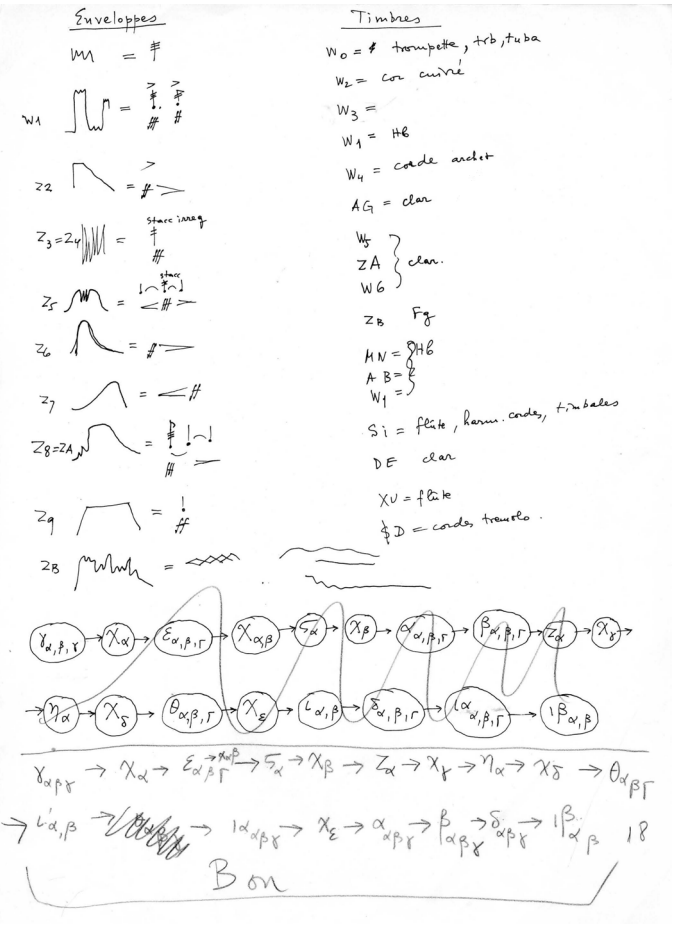

Figure 7.5: *Iannis Xenakis, sketches for* Anémoessa, *Collection Famille Xenakis DR, OM 26–2, p. 17.*

Above the previously explained three versions of a macro-structure, Xenakis wrote down a list of various envelopes and timbres and their musical analogies. For example, he compared a square wave in electronics to a tremolo technique in instrumental performance and a sharp random walk envelope to an irregular staccato. The list of timbres includes the list of instruments, groups of instruments or instrumental techniques such as 'strings tremolo'. All envelopes and timbres are assigned a code name which Xenakis used as a memo for the creation of UPIC scores. This list equally served as a memo for the transcription of UPIC material to the orchestra. By consistently assigning ancient numerals in both the sketches and the final score of *Anémoessa*, Xenakis made it possible to detect each of the corresponding segments transcribed from *Mycènes alpha* (Table 7.2). At times, one is even able to visually track analogous sections in the scores, for example, segment 3 of *Anémoessa* and segment 6 of *Mycènes alpha* (Figure 7.6).

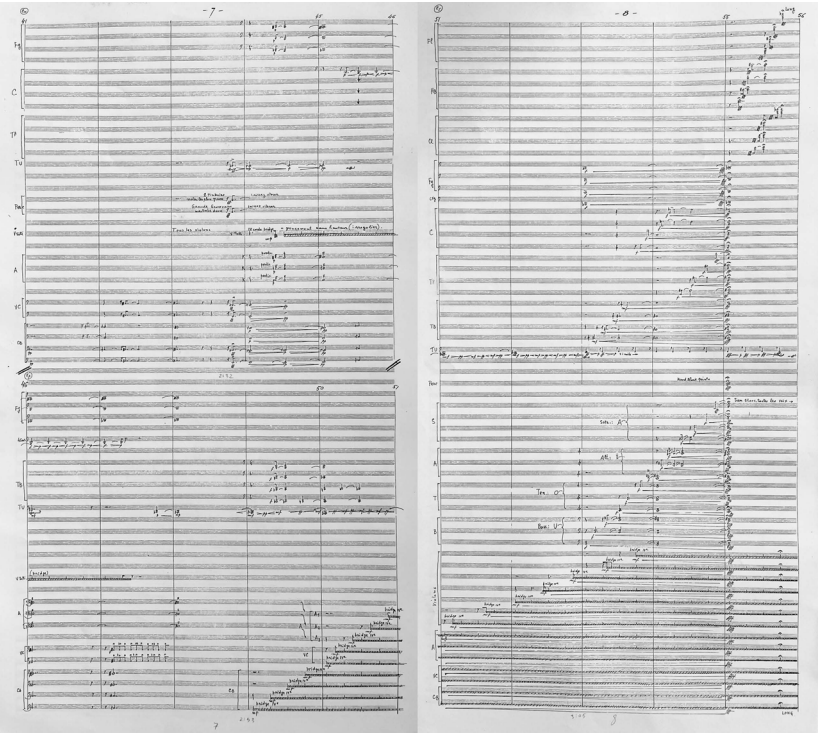

Figure 7.6: *Iannis Xenakis*, Anémoessa, *pp. 7f., (bars 44–55) as analogous to segment 6 of* Mycènes alpha (*Fig. 7.2, 1'58"–2'53"*), *Durand Salabert Eschig, Paris.*

Anémoessa				*Mycènes alpha*	
Segment number	Rehearsal mark(s)	Bar(s)	Maximal duration	Segment number	Times-tamps
1	$\gamma_{\alpha,\beta,\gamma}$	1–15	60″	11	7′16″–8′15″
2	χ_{α}	16	90″	–	–
3	$\varepsilon_{\alpha,\beta,\gamma}$	41–55	60″	6	2′53″–3′53″
4	$\chi_{\alpha,\beta}$	56–65	40″	–	–
5	ς_{α}	66–70	20″	4	1′53″–1′58″
6	χ_{β}	71–87	68″	–	–
7	ζ_{α}	88	4″	4	1′53″–1′58″
8	χ_{γ}	89–90	8″	–	–
9	η_{α}	91–95	20″	1	0′00″–0′17″
10	χ_{δ}	96–100	20″	–	–
11	$\theta_{\alpha,\beta,\gamma}$	101–115	60″	5	1′58″–2′53″
12	$\iota_{\alpha,\beta}$	116–125	40″	2	0′17″–0′55″
13	$\iota\alpha_{\alpha,\beta,\gamma}$	126–140	60″	8	4′17″–5′16″
14	χ_{ε}	141–170	120″	–	–
15	$\alpha_{\alpha,\beta,\gamma}$	171–185	60″	9	5′16″–6′16″
16	$\beta_{\alpha,\beta,\gamma}$	186–200	60″	10	6′16″–7′16″
17	$\delta_{\alpha,\beta,\gamma}$	201–215	60″	13	8′35″–9′36″
18	$\iota\beta_{\alpha,\beta}$	216–225	40″	12	8′15″–8′35″

Table 7.2: *Corresponding segments of* Anémoessa *and* Mycènes alpha. *List by the author.*[14]

The Self-borrowing Method

Xenakis's intention to transfer the electronic material to orchestra and choir is revealed in an interview with Enzo Restagno (Restagno 1988: 56, 58). Another hint can be found on page 3 of the *Anémoessa* sketches, where Xenakis wrote a memo in Greek mentioning *Mycènes alpha* (Collection Famille Xenakis DR, OM 26-2) . But one can find other quotations in *Anémoessa* as well, namely

14 Segments 9 and 10 of *Mycènes alpha* follow one another in *Anémoessa*, just as they did in the *Polytope de Mycènes*.

that of a percussion piece *Pléïades* (1978). An adaptation from the *Claviers* (keyboards) movement is identified in sopranos and altos in bars 161–170 (Harley 2004: 113; Gibson 2011: 208). Another possible source is a composition similar to *Anémoessa* in instrumentation, *Cendrées* (1973), scored for choir and orchestra. On page 13 of the *Anémoessa* sketches, above the indication for *Pléïades* implementation, Xenakis simply wrote *Cendrées* (Collection Famille Xenakis DR, OM 26–2). Indeed, some choral passages of *Anémoessa* seem to resemble the vocalising style of its precursor.[15] All six a cappella segments of *Anémoessa* – those assigned the numeral χ (khi) – are composed of random walks, which is also evident in the curvy lines in the sketches.[16]

Gibson compared various instances of self-borrowing in Xenakis's instrumental works and pointed out the similarities between the pieces *N'Shima* (1975) and *Nyuyo* (1985). Xenakis transferred 69 bars from *N'Shima*, which occupies almost a third of the *Nyuyo* score. As an extreme example of such an approach, Gibson stated that it is probably the longest excerpt that Xenakis transcribed (Gibson 2005: 270f.). In the case of *Mycènes alpha* and *Anémoessa* one could argue the contrary: Out of 225 bars, 136 of them have been taken from *Mycènes alpha*, thus comprising approximately two thirds of the piece. What makes this example unique is the fact that the entire *Mycènes alpha* material is present in *Anémoessa* instead of selected sections only.[17] One must acknowledge, however, that Gibson (2005) focused exclusively on Xenakis's instrumental music in his paper. The instances of self-borrowing in electronic pieces (for example, those in the polytopes) could cover more, but that was never the point. In addition, the case of *Mycènes alpha* and *Anémoessa* is specific because Xenakis did not (and could not) simply copy the notes from one piece to the other. Until the creation of *Anémoessa*, *Mycènes alpha* was not composed with notes but with lines on a UPIC board. That means Xenakis had

15 As the focus of this paper is the transfer of the electronic material into an acoustic context, an in-depth analysis of possible connections between *Anémoessa* and *Cendrées* is omitted. If there should be any correlation, the transfer is likely not direct and without manipulation of the material. It is also possible that there is no instance of self-borrowing in this case, but Xenakis wrote a memo to describe the vocalising style he wished to achieve. Whatever the reason for the appearance of *Cendrées* in the sketches, there is still plenty of room for further research on the *Anémoessa* sources.

16 See Collection Famille Xenakis DR, OM 26–2, pp. 1, 2, 9, 12, 13 and 14.

17 The only exception is segment 3 of *Mycènes alpha*. However, this segment's material (at least partially) appears in segment 6, so one could argue that no material has been omitted.

to interpret the drawings first before he could take any further steps, which is assuredly a creative process in its own right.

Conclusion

All three instances of the same music – the sound interpolations of *Polytope de Mycènes*, the electronic piece *Mycènes alpha*, and *Anémoessa* – were created in the span of approximately one year. Although they share the same material, the order of individual segments differs in each instance. Xenakis's reasons for reaching out for existing material and applying it in other works could be explained by the shortage of time to produce a score. However, in the aforementioned interview with Restagno, Xenakis stated that to him transcription is not merely a mechanical operation. Whether or not such a method was a time-saver is a matter of debate, but in the case of *Anémoessa*, Xenakis intentionally tested his techniques and experimented with a single sonic material in diverse contexts.

It is crucial to understand that in his early years, Xenakis used drawing as a compositional tool, not to produce scores with graphic notation. Once the graphics were finished, he would transcribe them into conventional music notation. With the development of the UPIC, this process was eliminated. One did not need to transcribe anything because the drawings *were* the score. There was no need for live performers because the computer did all the work. After decades of experimentation, Xenakis's architectural dream to draw music by hand came true. And yet, he repeated the same transcription process with *Anémoessa*, despite the fact that he had already finalised the recording of an electronic piece. Such a procedural enantiodromia indicates that there is no difference of value between electronic and acoustic music in Xenakis's reasoning. They are genres of equal worth, sharing aesthetics and compositional techniques.

* * *

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Audio-visual Presentation

The audio-visual presentation of all corresponding segments of the *Anémoessa* and *Mycènes alpha* scores is available under the following link: https://vimeo.com/751070889 (accessed March 27, 2024).

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