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Analysing the First Electroacoustic Music of Iannis Xenakis

5th European Music Analysis Conference, Bristol, April 2002

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XENAKIS' ELECTROACOUSTIC MUSIC AND ANALYSIS

The number of electroacoustic works produced by Iannis Xenakis represents only a slight percentage of his overall output: about one-tenth, including the few mixed-media pieces coupling instruments with tape. Nevertheless, their importance is enormous at least for two reasons. First, like Stockhausen or Berio, Xenakis was one of the firsts to compose electroacoustic music in the historical sense of the word, filling the gap between the two antagonistic trends of the early fifties: the *concrète* and the *electronic* approach. Second, unlike Berio, who after some early works stopped composing for tape, Xenakis continued to do so; and unlike Stockhausen who did follow the dramatic evolution of this relatively new musical genre, Xenakis also significantly contributed to its technology.

We can classify the 16 electroacoustic works Xenakis composed into three categories according to the techniques they imply. This classification also corresponds to three periods in his production:

- 1) The most important reaches from 1957 to 1977. These works use *concrète* and synthesised sound, and thus belong to the electroacoustic genre in the historical sense of the word mentioned above. This category can be further subdivided into:
 - a) works composed in the studios of GRM (Groupe de Recherches Musicales) between 1957 and 1962: *Diamorphoses* (1957), *Concret PH* (1958), the tape part of *Analogique* (*Analogique B*, 1959), *Orient-Occident* (1960) and *Bohor* (1962)¹.
 - b) after the break with Schaeffer (see below): works composed in various studios between 1969 and 1977 and intended for multimedia productions, namely the famous *polytopes*: *Hibiki Hana Ma* (1969-70), *Persepolis* (1971), *Polytope de Chuny* (1972), *La légende d'Eer* (1977)—in this category we can add the tape of *Kraanerg* (1968-69).
- 2) The four works composed for/with the UPIC, the musical “drawing board” developed by Xenakis and his team at CEMAMu², beginning in 1975: *Mycènes alpha* (1978), the tape of *Pour la Paix* (1981), *Taurhiphanie* (1987) and *Voyage absolu des Unari vers Andromède* (1989).

¹ Two other works have been withdrawn by Xenakis: *Vasarely* (1960) and *Formes rouges* (1961).

² Cf. Gérard Marino, Marie-Hélène Serra, Jean-Michel Racizinski, “The UPIC System: Origins and Innovations”, *Perspectives of New Music* vol.31 n°1, 1991, p. 258-269.

3) The two works composed with the program GENDYN which Xenakis completed in 1991 at CEMAMu with the help of Marie-Hélène Serra³: *Gendy3* (1991) and *S709* (1994).

We see in this classification a clear evolution where Xenakis always finds himself in the centre of the musico-technological discourse concerning electroacoustic, electronic, tape music, etc.⁴. His first pieces contributed, as stated, to the birth of electroacoustic music in its historical sense. With the UPIC, Xenakis was looking for a new way to ease the access to music-making with the computer — of course his method (the drawing board) has its advantages and disadvantages. Finally, through the music of the third period, Xenakis explored the limits of algorithmic techniques applied to music.

Until today, Xenakis' electroacoustic production has not aroused the interest of many analysts. For the first category, we have studies of Agostino Di Scipio, Makis Solomos and Stefania de Stefano⁵. For the second one, there is only one analysis, of Ronald J. Squibbs⁶. And for the third, we have the analysis of Agostino Di Scipio and Peter Hoffmann⁷. The reasons of this luck of interest are not to be found in the particularity of Xenakis' electroacoustic music, but in the difficulty of analysing electroacoustic music in general. With the first category of works, the difficulty is the absence not only of scores, but also of any documents on their composition. With the UPIC pieces, there is a “score”, but which is not helpful as are instrumental scores. Finally, with the GENDYN compositions, we can work with the program, but that doesn't mean that we can answer easier to analytical questions.

XENAKIS' FIRST ELECTROACOUSTIC COMPOSITIONS

To introduce the analysis of *Diamorphoses* and *Orient-Occident* — in fact rather a graphical representation as an attempt for their analysis —, I shall briefly recall the famous quarrel between Xenakis and Pierre Schaeffer. Xenakis was probably present at the first concert of *musique concrète* in 1950, at a time when he was studying with Olivier Messiaen

³ Cf. Marie-Hélène Serra, “Stochastic Composition and Stochastic Timbre: GENDY 3 by Iannis Xenakis”, *Perspectives of New Music* vol. 31 n°1, 1993, p. 236-257.

⁴ Note the relative disinterest of Xenakis in mixed (tape and instrumental) music: only 3 out of the 16 compositions are of that kind: *Analogique*, *Kraanerg* and *Pour la Paix*.

⁵ Cf. Agostino Di Scipio, “Compositional Models in Xenakis's Electroacoustic Music”, *Perspectives of New Music* 36 n°2, 1998, p. 201-243; Agostino Di Scipio, “The problem of 2nd-order sonorities in Xenakis' electroacoustic music”, *Organised Sound* 2 n°3, 1997, p. 165-178 (extended as “Clarification on Xenakis: the Cybernetics of Stochastic Music”, in Makis Solomos (ed.), *Présences de Iannis Xenakis / Presences of Iannis Xenakis*, Paris, CDMC, 2001, p. 71-84); Makis Solomos, *A propos des premières œuvres (1953-1969) de I. Xenakis*, Ph.D. dissertation, Université Paris 4, 1993, p. 263-272 (the graphic transcription of *Diamorphoses* and *Orient-Occident* presented in the present paper are issued from this study); Stefania de Stefano, “Spettromorfologie e articolazione strutturale in *Diamorphoses* (1957) di Iannis Xenakis”, in M.C. De Amicis (ed.), *Atti del Congresso di Dittatica della musica elettronica*, L'Aquila, Istituto Gramma, 1998, p. 131-133.

⁶ Cf. Ronald J. Squibbs, “Images of Sound in Xenakis' *Mycenae-Alpha*”, in Gérard Assayag, Marc Chemillier, Christian Eloy (ed.), *Troisièmes journées d'informatique musicale JIM 96 = Les cahiers du GREYC* 4, 1996, p. 208-219.

⁷ Cf. Agostino Di Scipio, *op. cit.* (the two articles); Peter Hoffmann, “Analysis through Resynthesis. *Gendy3* by Iannis Xenakis”, in *Présences de Iannis Xenakis, op. cit.*, p. 185-194; Peter Hoffman, Makis Solomos, “The Electroacoustic Music of Xenakis”, in *Proceedings of the First Symposium on Computer and Music*, Corfu, Ionian University, 1998, p. 86-94. For the program GENDYN, cf. also Peter Hoffmann, “Implementing the Dynamic Stochastic Synthesis”, in Gérard Assayag, Marc Chemillier, Christian Eloy (ed.), *op. cit.*, p. 341-347.

and composing music in the spirit of Bartók. In 1953, he tried to get access to Schaeffer's studio. Thanks to a recommendation by Messiaen, he met Schaeffer in 1954. During four years he was more and more involved in the projects of this group. In 1958, when the “inventor of *musique concrète*” attempted to align his colleagues, the quarrel started. In 1959, Schaeffer spoke very roughly about *Analogique B*. The latest clash took place in 1963, when Xenakis proposed the use of mathematics and the computer in the studio. On the refusal of Schaeffer, Xenakis left the group.

We still do not know exactly what happened in this historical dispute. I invited Françoise Delalande to speak about that in the symposium *Présences de Iannis Xenakis* (Paris, Radio France-CDMC, January 1998). But his paper⁸ is very general, either because he didn't search for documents (and there are documents in the INA/GRM's archives!), either because he didn't want to speak about that. It would be very interesting, though, to know what were the arguments of Schaeffer against the use of computers because it is well known that, some years later, he changed his mind. Maybe we will know one day, when somebody will be assigned the task to transcribe the kilometres of tapes with the recordings of the GRM discussions of that time... Nevertheless, it is clear that Xenakis and Schaeffer could not find common grounds: Xenakis spoke much about abstraction but was very pragmatic in the end, whereas Schaeffer spoke much about “concreteness” while his theoretical thought tended to be very abstract (his *Traité des objets musicaux* is actually an ambitious project to found a phenomenology of music⁹).

It has often been said that the composers of the fifties were much influenced by their electroacoustic experience, transferring their results in this domain to their writing for instruments. David Ewen e.g., wrote that Xenakis “explored the possibilities of simulating electronically produced sounds and sonorities with conventional instruments”¹⁰. Hugues Dufourt, probably thinking of his own music, repeated the same statement¹¹. However, this is not true. It may be that electroacoustic practice made composers like Ligeti, Stockhausen or Berio discover radical new ways of conceiving music in general — and, consequently, they applied these concepts in their instrumental music. But Xenakis' case is similar to Varèse's, who wrote a radically new music *before* the introduction of the new technology, a music which was no more composition *with* sounds but composition *of* sound. Xenakis developed this concept already in his orchestral works *Metastaseis* (1953-54) and *Pithoprakta* (1955-56), i.e. before his electroacoustic experience. Even more so, his first electroacoustic pieces¹² continue the musical thinking introduced by the two orchestral works mentioned above, while the major part of his instrumental production of that time (1956-62)¹³ opens a kind of parenthesis. Trying to systematise and to implement the stochastic techniques introduced in bars 52-59 of *Pithoprakta*, the compositions *Achorripsis* (1956-57), *Analogique A* (1958) and

⁸ Cf. François Delalande, Evelyne Gayou, “Xenakis et le GRM”, in *Présences de Iannis Xenakis*, *op. cit.*, p. 29-36.

⁹ Cf. Makis Solomos, “Schaeffer phénoménologue”, in *Ouïr, entendre, écouter, comprendre après Schaeffer*, Paris, Buchet/Chastel-INA/GRM, 1999, p. 53-67.

¹⁰ David Ewen, *Composers of Tomorrow's Music*, New York, Dodd Mead and Co, 1971, p. 125.

¹¹ Cf. Hugues Dufourt, “Hauteur et timbre”, *Inharmoniques* n°3, 1988, p. 69.

¹² With the exception of *Analogique B*.

¹³ With the exception of *Syrmos* (1959) and *Herma* (1961).

the 5 *ST* pieces (*ST/48*, *ST/10*, *ST/4*, *Morsima-Amorsima* and *Atrées*: 1956-62) abandon for a while the concept of composing-the-sound in favour of a much more austere sound world. In contrast, the electroacoustic pieces of this epoch (*Diamorphoses*, *Concret PH*, *Orient-Occident* and *Bohor*) pursue and develop the sound concept even further.

DIAMORPHOSES AND ORIENT-OCCIDENT

Let us now focus on *Diamorphoses* and *Orient-Occident*. *Diamorphoses* provided an opportunity for Olivier Messiaen to pay tribute to his former student by stating that “ce sont de gigantesques toiles d'araignées dont les calculs préalables se muent en délices sonores de la plus intense poésie”¹⁴, alluding probably to the passage of glissandi between 6:00 and 6:16. But we don't know if Xenakis made calculations. My hypothesis is that he didn't, and that everything in *Diamorphoses* was worked out empirically.

The aims of Xenakis in *Diamorphoses* are numerous and interrelated. We can mention it as a study on:

1. noises
2. the duality continuity-discontinuity and especially of how continuity can be produced by discontinuity
3. glissandi
4. variations of density and their logarithmic perception
5. stochastic processes
6. emergence of complex sonorities (sounds and forms) through 2, 4 and 5
7. dramatic form.

Here are Xenakis' own words about *Diamorphoses*, for those analysts who would like to search the ways it was composed:

- in *Formalized Music*, on the beginning of chapter 2, Xenakis writes: “Now we can rapidly generalize the study of musical composition with the aid of stochastics. The first thesis is that stochastics is valuable not only in instrumental music, but also in electromagnetic music. We have demonstrated this with several works: *Diamorphoses* [...], *Concret PH* [...]; and *Orient-Occident* [...]”¹⁵.
- the sound material is made of “décollages de jets, tremblements de terre, accidents de chemins de fer, ainsi que des instruments de musique tels que cloches, percussion et vents”¹⁶.
- before beginning the composition, the aims were: “Mélanger des timbres en vue d'arriver à un corps sonore pareil à un *bruit blanc*; étudier l'évolution des timbres, de la dynamique et du registre; faire des unissons avec attaques seules, avec ou sans transposition; faire des chromosomes d'attaques”¹⁷.
- to the question of Varga: “*Diamorphoses* was the first among your electroacoustic compositions. What did you learn in the course of its realization?”, Xenakis answers: “I drew several conclusions. For instance, that by dense mixing one can obtain continuous sounds out of discontinuous ones. It also became clear that there is a logarithmic relationship between the increase in density and its perception. I made the following experiment: I recorded sounds on tape without regular rhythm, of irregular density. Then I copied the recording and mixed it with itself. However, I edited the second tape in such a way that I avoided any repetition and echo: the sequence of sounds didn't correspond to that on the first tape. When I listened to the new recording I asked myself: Can I hear the difference? And I found that I had arrived at the border of a change. I then

¹⁴ Olivier Messiaen, “Préface”, *Revue Musicale* n°244, 1959 p. 5.

¹⁵ Iannis Xenakis, *Formalized Music*, Stuyvesant (New York), Pendragon Press, 1992, p. 43.

¹⁶ This quotation is of Nouritza Matossian (*Iannis Xenakis*, Paris, Fayard, 1981, p. 148), but the words are probably those of Xenakis.

¹⁷ Xenakis in *idem*.

carried out these operations with three tapes. The result was that the density undoubtedly increased by one step. In order to perceive an increase of the same magnitude I had to mix the three tapes once again, with the help of three tape-recorders. The density was now nine times greater but, as I said, my senses perceived it as an increase of only one step. Here is the proof of the logarithmic connection”¹⁸.

-in his interview by Delalande, Xenakis says: “Il y a des parties qui sont très construites, avec des petits glissandi de cloches. J’avais des cloches merveilleuses qui produisaient des sons très intéressants ; je les avais enregistrés et je les faisais glisser ; et puis ensuite je les mixais de manière conforme à des distributions de probabilité pour obtenir des formes de son nouvelles, et intéressantes, bien sûr. Ca, c’est surtout la deuxième partie de *Diamorphoses*. Donc ces préoccupations étaient à la fois abstraites, autant que possibles, et globales, et aussi terre à terre, travaillant avec le matériau existant ; par exemple, j’étais très content de pouvoir utiliser, de nouveau dans *Diamorphoses*, des bruits qui n’étaient pas considérés comme musicaux et que, je crois, personne n’avait utilisés de cette façon-là avant moi. Je prenais des chocs de bennes, des choses comme ça, des tremblements de terre enregistrés vite, et puis je les mettais ensemble pour essayer de comprendre aussi bien leur nature interne, par opposition ou par similitude, et de les faire évoluer, et faire passer de l’un à l’autre. Et ça, ça ne pouvait se faire qu’en travaillant sur le tas avec le matériau même. En mettant ses mains dedans, dans ses intestins, et pas d’une manière abstraite. Mais d’autres parties, d’autres passages de *Diamorphoses* étaient faits de manière plus abstraite comme dans d’autres pièces, comme *Analogique B*”¹⁹.

As for *Orient-Occident*, one of the first histories of electronic music ever written refers to it as a major masterpiece for tape²⁰. And it is worth pointing out that it happens to be one of Xenakis' “easier” works, probably due to the narrative project behind its composition. *Orient-Occident* was conceived as music for a short film by Enrico Fulchignoni, commissioned by UNESCO. The music traces the film's development which relates the passage from one civilisation to another, from prehistoric times to Alexander the Great. Although it is certain that Xenakis did not compose an “illustrative” music, some of his chosen sonorities are quite suggestive. For example, the highly reverberated atmosphere toward the end (beginning at 8:00) seems to evoke the later civilisations of Antiquity, marked by a special sensuality, as has been written by the author of the film²¹.

ANALYSIS OF *DIAMORPHOSES* AND *ORIENT-OCCIDENT*

For the graphical transcription (see **figures 1 and 2**) of these compositions in an attempt for their analysis, I rely on perception rather than on a physical sound analysis (e.g. a spectrogram). My interest was not so much the physical aspect of these pieces (neither was it the physical sound sources) nor the technology used by Xenakis, but mainly two things:

1. the types of sounds used by Xenakis and their relationship with the “sonorities” of his instrumental music. By “sonorities” I refer to my hypothesis that all Xenakis’ instrumental music is in fact, regardless of what theories or technologies are used,

¹⁸ Xenakis in Bálint A. Varga, *Conversations with Iannis Xenakis*, London, Faber and Faber, 1996, p. 111. A footnote adds: “It is a matter here, therefore, of a logarithm of base 3” (*ibid.*, p. 218).

¹⁹ Xenakis in François Delalande, “*Il faut être constamment un immigré*”. *Entretiens avec Xenakis*, Paris, Buchet-Chastel/INA-GRM, 1997, p. 39.

²⁰ Cf. Herbert Ruscol, *The Liberation of Sound. An introduction to Electronic Music*, Prentice-Hall International, 1972, p. 235.

²¹ Cf. Enrico Fulchignoni “*Sur Orient-Occident*, in *Regards sur Iannis Xenakis*, Paris, Stock, 1981, p. 260.

composition-of-sound, and that it is always determined by three types of sonorities: sliding sounds, static sounds and masses of punctual ones²².

2. the relationship between these sounds, i.e. the form of the pieces.

Thus, in the present transcriptions, which respect the two traditional dimensions of time and pitch — of course the latter is, in the case of a music which uses almost exclusively noise sounds, not precise at all — and which represent loudness by thickness, the most important aspect lies in the types of sounds used: it is not the shape of the graphics which is important, but their distinction and numbering (with the letters subdividing numbers).

I apply the first of the two above-mentioned goals to the transcription of *Diamorphoses*. In this composition, the sounds are not very much differentiated because, as has been said, here Xenakis is interested in the shades of noise. Only 15 sounds are clearly differentiated and we can classify them into only five categories according to: a) their spectral composition: graduation from white noise to quasi-sinusoidal sounds; b) their duration; c) the evolution of their pitches: static or glissando; d) their density: from isolated sounds to sound masses. These categories are:

-continuous noise: sounds *a.1* to *a.4*

-percussive sounds: *b.1*, *b.2*

-more “pure” sounds: with sliding (sound *c*) or static with continuity (*d.1*) or interrupted by silence (*d.2*)

-quasi-sinusoidal sounds organised in static small fields or small sliding (sounds *e* and *f*) or in masses of high-pitched glissandi (sound *g*)

-punctual sounds isolated or in small masses: *h.1*, *h.2* and *i*.

Concerning the relationships with the three above-mentioned sonorities of the instrumental production, only sounds *a*, *b* and some *e* do not correspond to one of the three types. The others correspond in the following manner:

-sliding sounds: sounds *c*, *f* and *g*

-static sounds: *d.1*, *d.2* and some sounds *e*

-punctual sounds: *h* and *i*.

In contrast to *Diamorphoses*, *Orient-Occident* has many more different sounds: the piece is much nearer to the *concrète* tradition than *Diamorphoses* —remember also the narrative background of this composition. For this reason, here the interest of the analysis rather lies in the second goal mentioned above: the relationship between the sounds. Their typology is less important than the affinities that exist between sounds which seem very different at first glance. The affinities can be established by:

-direct acoustic affinities: all the sounds that have the same number (*1a-1b*, *2a* to *2g*, etc.)

-indirect acoustic affinities: the pairs *2b-16*, *2d-20*, *4c-12a*, *7-12a*, *7-19*, *8-10*, *9-14*, *17-22*

-the possibility to derive one sound from another: this is only the case for sounds *17* and *18* which produce sound *21*

-the association to the same well-known instrumental sounds: sounds *3*, *4a*, *5*, *6*, *7*, *9*, *17*, *19*, *22* and *23* are very near to percussion sounds

²² Cf. Makis Solomos, *A propos...*, *op. cit.*, chapter 3 and 9 to 11; Makis Solomos, *Iannis Xenakis*, Mercuès, P.O. Editions, chapter 5.

-formal associations: sounds *3, 4a, 5, 6, 7, 8* and *9* enter simultaneously and contrast with what precedes; sounds *11* and *13* succeed one another and have the same function; sounds *14* and *15* are always heard together

-associations full of imagery: of course here the affinities are very numerous: I mention only the “oceanic” atmosphere which is established progressively toward the end of the composition with sounds *17, 21, 22, 23, 24* and *25*.

Diamorphoses

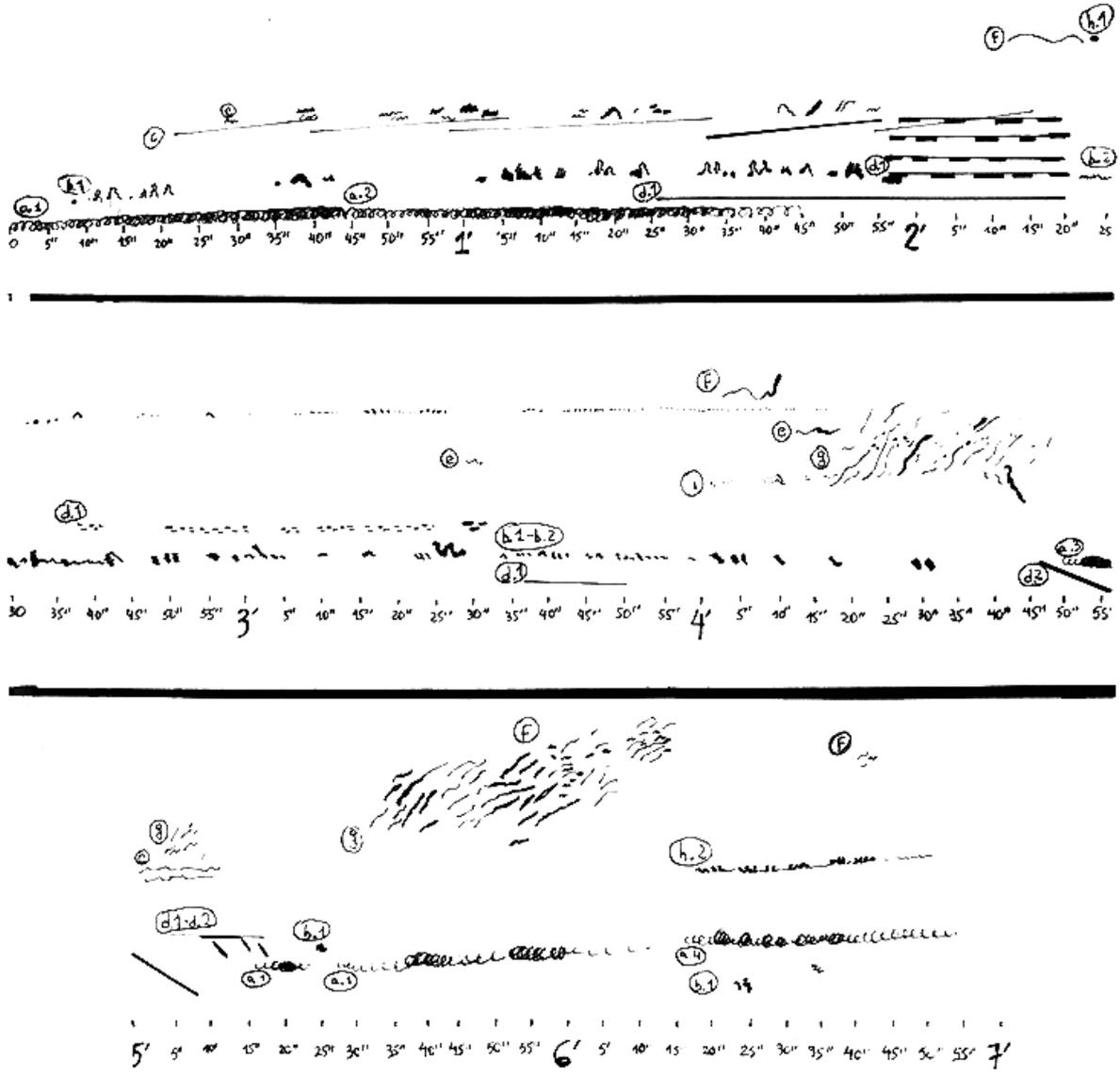


Figure 1: Graphical transcription of *Diamorphoses*

Figure 2: Graphical transcription of *Orient-Occident*