Survival or renewal? Structural imagination in recent electroacoustic and computer music

MARTA GRABOCZ

University of Strasbourg II
Home address: 173 Av. Jean-Jaures, 75019 Paris, France
E-mail: grabocz@ushs.u-strasb.fr

This article may be considered the outline of an ongoing study of different types of structural concepts, and their referential or non-referential content, in electroacoustic, computer and mixed music composed mostly in French electroacoustic music studios (GRM, IRCAM, UPIC, GMEM, etc.). This analytical study began in Hungary in 1988, in the course of a broadcast series on certain chapters of the history of electroacoustic music.[1] The study later investigated narrativity in electroacoustic music,[2] and then incorporated a more complex typology embracing formal, structural approaches in about thirty characteristic works composed since the 1970s. Work on these selected pieces offers a range of investigations into their structure, from the assumption of the oldest structural concepts through to very recent ideas.[3]

INTRODUCTION

The study began with the idea that, in spite of the apparent novelty of their material, works of electroacoustic, computer or mixed music often resort to earlier structural methods, such as the cyclic form, the enumerative form, the symmetric form or descriptive forms, or even programme music.

In most cases, the new material leads composers to apply structural principles known in the past, in order to attain equilibrium, the golden mean between unknown and traditional elements, all with the aim of facilitating the reception of the work by the public.

However, during the last ten years, the emergence of new structural types may be observed in electroacoustic music, in 'mixed' works, and also in computer-aided creation. The new structural principles often derive from extra-musical models chosen by the composer from processes having their origins in acoustic or electroacoustic techniques, or abstracted from other scientific fields.

In the following I shall present the three groups of structural ideas that are primarily used, and begin a typology of semantic elements adopted by the composers. This will reference the content one may detect in the works, starting from entirely new types, passing through intermediary constructions proposing a type of compromise, through to the most traditional ones.

1. INNOVATORY CONCEPTIONS OF STRUCTURE

Among the new structural ideas we will discover:

(1) a variety of extra-musical models,
(2) structures of static character, of stasis, and
(3) works whose articulation follows a diagram, a graphic pattern, where the vertical and horizontal axes of the drafted schema correspond to the evolution of ambitus and time.

1.1. Utilisation of extra-musical models

The extra-musical models are very varied: the composer can resort to the laws of natural phenomena, to catastrophe theory, to theory of prototypes in the field of cognitive psychology, or to the structural analysis of myths.

1.1.1. Natural phenomena

In Magnus Lindberg's work *Action–Situation–Signification* (composed in 1982 for four musicians and tape), the word *situation* in the title corresponds to the utilisation of the noises of nature (those of the sea, rain, fire and wind). The different sections of the composition start with a confused situation in which different sonorous objects, classified in accordance with the elements of nature, are mingled. When coming near to the end of a section, the texture becomes refined, concentrated to a point where finally it produces sounds referring only to the symbol in question. Once the action reaches this moment, it becomes

[1] This work has been supported in Hungary by the Soros Foundation.
[2] In the form of a paper presented at the 2nd International Symposium on Musical Signification (Helsinki, 1988), published in French, in the No. 51 issue of MUSICWORKS Magazine, and in the Acts of the Symposium published in English, in 1995: 'Narrativity and electroacoustic music', in *Musical signification*, E. Tarasti, ed., Mouton de Gruyter, Berlin and New York.
[3] Plan of a book, some chapters of which were drafted in France, from 1990 onwards, thanks to a grant awarded to CIREM by the Direction de la Musique du Ministere de la Culture, with a view to publishing works on electroacoustic music.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

a 'situation', and the concrete material comes to the foreground.[4]

The movements are: I: Earth/1; II: The Sea; III: Interlude: Wood; IV: Rain; V: Interlude: Metal; VI: Fire; VII: Wind; VIII: Earth/2.

> Two books constitute the basis of the work: Pierre Schaeffer's *Traite des objets musicaux* and Elias Canetti's *Mass und Macht*. The first shows a link with French concrete music which offered a model for the grouping of noises and other sonorous sources. Canetti's book was important from another point of view: Lindberg based the elaboration of his piece on Canetti's models concerning some analogies in behaviour between the phenomena of nature and those of human groups. For Lindberg, a composition resembles mathematics: it consists of the resolution of a given problem. In this case, the problem was to construct links between setting the musicians to motion (=action) and to make use of natural static concrete sounds (=situation). When this situation gets activated, the work gains its signification, while the union of the three words (action–situation–signification) provides the title of the work.[5]

In François-Bernard Mâche's work entitled *Marae* (Sea, rising tide) (1974), composed for six percussionists and tape, 'the rough sounds of nature (of the sea, the wind, the fire, a cave) are recorded and edited without manipulation. Yet, they are coloured with an instrumental writing which is essentially a *transcription* – in strict synchronism with its model.'[6]

The hidden message concerns the abolition of frontiers between nature and culture. The composer has devoted numerous essays, articles, as well as his book to exposing his ideas on the aesthetics 'of sonorous naturalism'. His statements are therefore in contrast with Lindberg's background idea: while utilising the same models, Lindberg wanted to emphasise the reciprocal interaction and transformation of the two worlds, that of the 'static' (=nature) and that of the 'dynamic' (=culture). The macrostructure, the internal evolution of *Marae*, corresponds to an initiatory travel *via* wind, the sea, a cave, then again the wind and, finally, fire.

Many other works created at the GRM (Groupe de Recherche Musicale de l'INA) and in other French studios in the course of the last twenty years, make use of all kinds of models of the 'sonorous landscape' (soundscape): see, for example, Bernard Parmegiani's *La creation du monde* (1984, GRM); Luc Ferrari's *Heterozygote* (1964, GRM); Georges Boeuf's *Abyssi symphonia* (1980, GMEM); F.-B. Mache's *Hyperion* (1981, UPIC); Jean-Claude Risset's *Sud* (1985, GRM); Michel Redolfi's *Pacific Tubular Waves* (1979) and *Immersion* (1980, GRM–GMEM); Pierre-Alain Jaffrennou's *Oceane . . . ou troisieme passage de la baleine* (1984, GRAME); Daniel Teruggi's *Sphaera* (1987/1990, GRM); Jacques Lejeune's *Opera d'eau* (1991, GRM), etc.

1.1.2. Scientific models

We find that other composers, thinking deeply on the sense of musical form, apply a variety of scientific theories.

Costin Miereanu resorts to catastrophe theory – following Rene Thom's and Jean Petitot's ideas[7] – as well as to the theory of narratives, of labyrinths known from the *nouveau roman*. In the work entitled *Labyrinthes d'Adrien* he creates 'characters of musical narrativity, who in fact are nothing other than the musical structures themselves: slack, pellicular structures, compressed by the steamroller, turbulent, abyssal structures, as well as numerous models originating from the morphology of catastrophe theory'.[8] (See, for example, 'the catastrophes of conflicts' or the 'associated catastrophes named cases of bifurcation', etc., which can correspond in music to the alternation of explosion and a static position – *statisme* – to abrupt changes and to conditions of internal stability, etc.)

The composer also uses certain ideas of the structural organisation of narratives, at the level of discourse as well as of its elements (e.g. the syntactic categories corresponding to such structural aspects as the 'zenithal', the 'arising', the 'twilight-like', the 'meteoric', the 'enveloping' – categories that seem to correspond to the syntactic types in the works by composers taking nature as their model).

Marco Stroppa, after having composed *Traiettoria* for piano and sounds synthesised by computer (in the 'Centro di Sonologia Computazionale' of Padua in 1982–4), realised that, in the third movement of his *Traiettoria* named 'Contrasti' (see: the cadence of the piano), he has 'semi-consciously' adopted the *theory of prototypes* applied in the field of cognitive psychology. These convergences allowed him to

[4] Cf. Risto Nieminen's study on the work, published as a text of presentation, accompanying the record FINLANDIA (FADC 372) 1990, devoted to M. Lindberg's works, pp. 11–12.
[5] Ibid., pp. 10–11.
[6] F.-B. Mache: Notes of Presentation, published for the creation of *Marae* 1974.
[7] Rene Thom: *Stabilite structurelle et morphogenese*, Amsterdam, Benjamins-Ediscience, 1972; Rene Thom: *Modeles mathematiques et morphogenese*, Christian Bourgois, 1980 (2nd edn); Jean Petitot: *Pour un schematisme de la structure: quelques implications semiotiques de la theorie des catastrophes*, Thesis, 4 vols., Ecole des Hautes Etudes en Sciences Sociales, 1982.
[8] The composer's text of presentation accompanying the record of the series 'Salabert Actuels', devoted to 'Espaces electroniques', 1988, SCD 8801, pp. 4–5.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

elaborate a theory on 'the organisms of musical information':[9]

> The search for an appropriate virtuosity has to be inspired by the work of ''instrumental synthesis'' commanding the compositional development of the piano material. Synthesis in a sense where the organisation of the 'morphemes' (=isolated sounds, resonances, gestural fragments, primitive figures, etc.) in groups generating complex sonorous events (named by the composer 'the organisms of musical information'), composes the structure of the temporal evolution of the pure sonorous material and founds the discourse of the piece. Therefore a functional and coherent virtuosity has to be 'conceived'. *These 'organisms of musical information', being kinds of compositional counterparts to the family of synthetic sounds, constitute the basis of musical language*. Their strong morphological identity endows them with a very differentiated character rendering them most distinct and recognisable. Each of them carries in itself its own evolution describing a trajectory with regard to the space of registers, the lifetime of each 'organism', the frequency and the development of its interventions, etc. The cadence for piano of 'Contrasti' is an example of the evolution of seven 'organisms', in conformity with the contrasting trajectories that influence each of them, up to the point of transforming their identity. Some passages of this cadence make dramatically explicit the interplay of tensions generated by the presence of centres of attraction inflecting the time curve of the trajectory of each 'organism'.[10] (Italicisation by the author)

1.1.3. Structural analysis of myths and narratives

In some of François-Bernard Mâche's works – such as *Aliunde*, *Danae*, *Iter memor* – the structural analysis of myths, revealing the magic and redemptive role of music played in a hero's life, serves as a structural–dramaturgical model. The first chapter of the composer's book (*Musique, mythe, nature. Ou les dauphins d'Arion*, Meridiens Klincksieck, 1991, published in English by Harwood Academic Publishers, London, 1992) presents the results of his thorough research on 'Music in myth':

> One can see that the comparison of these few Greek myths . . . brings back the same images all the time. To put it schematically: after an initial dive, the subject (not really a hero) goes through a dangerous odyssey. Perverted enemies try to lead him or her astray. Musical magic intervenes then, leading to the decisive dive. Divinities or their animal servants lend a helping hand to the diver who luckily accomplishes his odyssey. The wicked are punished – some of them by being petrified – and the good are rewarded, on earth or in heaven.[11,12]

1.2. Forms of stasis

The second group of the new processes is represented by the works of a static character: by stability and the slow transformation of sonorous material.

In 1981 Tristan Murail had already described the change in the thoughts of so-called 'spectral' composers – a change coming about thanks to the new means of sound analysis:

> Parallel to the appearance of new instruments, instrumental technique has been renewed and now offers the composer a whole category of sounds possessing unexpected characteristics – limit sounds, paradoxical sounds, unstable sounds, sonorous complexes defying all traditional description made by the means of harmony and timbre, since they are situated at the edge of the two concepts . . .
>
> The new means of analysis I have referred to allows us to cast a different glance at sounds, to travel in the interior of the sounds and observe their inner structure. We will immediately discover in this way that the sound is not a stable entity always identical with itself, as the abstract notes of a score could make us believe, . . . but that each sound is essentially variable, from one case to another of course, but also within its own duration. Rather than describing a sound with the help of ''parameters'' (pitch, timbre, dynamics, duration), it is more realistic, more in conformity with physical reality and that of perception, to consider it as a field of forces, where each force has its own evolution. *This study of sounds enables us to act on the sounds in a better way, to improve instrumental technique through the understanding of*

[9] See Marco Stroppa's article: 'Les organismes de l'information musicale: une approche de la composition' in S. McAdams and I. Deliege: *La musique et les sciences cognitives*, Pierre Mardaga, Brussels, 1989, pp. 203–34.

[10] French version of the composer's presentation text written for an explanatory leaflet accompanying the record CD WERGO 2030-2, 1992 (in the series 'Computer Music Currents', No. 10).

[11] F.-B. Mâche: *Musique, mythe, nature. Ou les dauphins d'Arion*. 2nd edn, Meridiens Klincksieck, 1991, p. 15. English translation: *Music, Myth and Nature, or the Dolphins of Arion*, Contemporary Music Studies No. 6, Harwood Academic Publishers, London, 1992.

[12] For a more detailed analysis see the author's article published in Nos. 22–3 of *Cahiers du CIREM*, 1992, entitled 'L'esquisse typologique des macrostructures dans les oeuvres de F.-B. Mache', pp. 128–30. (See the presentation of the analyses of *Aliunde*, of *Iter Memor* and of *Danae*, in the sense of this mythical schema mentioned above.) The full version of these analyses can be found in the article 'From the Natural Model to the Ideal Model' in the volume *Music, Society and Imagination in Contemporary France*, 'Contemporary Music Review' series, Harwood Academic Publishers, London, 1994.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

> *sound phenomena. It will also allow us to develop a musical trend based on the analysis of sounds, and to render the interior forces of sounds one of the starting points of the composer's work.*[13] (Italicisation by the author)

This compositional thought led to the birth of works like T. Murail's *Desintegrations*, Hugues Dufourt's *Saturne*, *Antiphysis*, John Chowning's *Stria*, and a whole series of pieces created in the studio of CRM in Rome (creations of the 'Centro di Richerche Musicali') at the end of the 1980s, and to the works of Laura Bianchini, Michelangelo Lupone, as well as those of Luigi Ceccarelli and his Electravox Ensemble in the 1990s.

In 1982, when creating *Saturne*, H. Dufourt formulated his ideas with regard to continuous transformation and concerning his materials created from fluid masses in the following way:

> In the field of composition, the convergence of these technologies appears by the inversion of the traditional relations of sounds and compositional process. *Instead of organising the sounds between themselves, an organisation will be drawn from the sonorous matter itself.*
>
> Consequently, the composing of music has been profoundly modified in the course of the last six years. The essentially evolutive character of the new material had to be taken into account. In this spirit, I have tried to transcribe and master the main features of a dynamic nature in continuous interaction: transitional traits, noises, resonances, complex sounds . . . *The main difficulty lies no doubt in the conversion of mentality imposed by this new discipline of composition. Namely instead of exerting an influence on stable configurations, we have to venture into the obscure fringes of the sound.*
>
> Formally, the task is a double one. *Its aim is to give an aesthetic dimension to new acoustic forms that are in a state of growth. It tends to providing these forms with a syntax that complies with continuous transformations. Saturne* is thus built around centres of forces, *manifesting a clear preference for fluid masses, states of tension, elongated forms, without a normal solution, and with an option for indeterminacy.* Instrumental timbres play a preponderant role. I tried to obtain pale tints and dim lights.[14] (Italicisation by the author)

This kind of approach to structural thought can be found in some works by Jean-Claude Eloy, such as *Shanti* (1973), *Gaku-No-Michi* (1978), *Anahata* (1984–6), in F.-B. Mache's microscopic procedures in the *Quatre phonographies de l'eau* (1980), in Jonathan Harvey's *Mortuos plango, vivos voco* (1980), and in Kaija Saariaho's *Verblendungen* (1978) and *Io* (1987), etc.

1.3. Graphical representation

The last type of new macrostructural conception is the form that would be engendered by a graphic representation, a diagram – following throughout a drawn sketch.

1.3.1. In addition to I. Xenakis' important works composed from 1950 onwards, this trend derives from the transcriptions of some pieces of concrete music, created mainly in the GRM in the 1970s, with a view to producing a hand-drawn score which helps in following the piece and allows the diffusion of the work even in the composer's absence; see for example, such scores as F. Bayle's *Jeıta* (1970), B. Parmegiani's *Pour en finir avec le pouvoir d'Orphee* (1972), Jean Schwarz's *Symphonie*, etc. To be sure, the first graphs of electroacoustical works were designed in the studios of Koln and Warsaw; see *Studie II* (1954), *Kontakte* (1959) by Karlheinz Stockhausen, the transcription by Rainer Wehinger of Gy. Ligeti's *Artikulation* (1958) published by Schott, then Boguslaw Schaffer's and V. Kotonski's scores realised in the form of diagrams in Poland, etc.

In these graphic representations subsequent to creation, each composer utilises his or her own symbols, bringing about in this fashion a system of hieroglyphs, sometimes calling to mind the utilisation of neumes. In the expressive and attractively pictographic transcriptions of *Jeıta* (1970), François Bayle created the recurrent symbols of the work: that of the electronic cluster consisting of 18 sounds, the murmur and splashes of water, the electronic or 'vocal' glissandi, the symbols of stalagmite or stalactite icicles.

If the musical material contains several complex layers, the notation becomes less pictorial, indicating mainly the change of the material and the superposition of the layers.

1.3.2. The indispensable and conscientious transcription of a magnetic tape first appeared in orchestral works accompanied by electroacoustic music (electronic or concrete):

> In *Volumes* (1960), F.-B. Mache set himself the aim of prolonging instrumental music with the

[13] Tristan Murail: 'Revolution des sons complexes' in: *Darmstadter Beitrage* XVIII, 30, Ferienkurse 1980, Schott, Mainz, 1980, p. 78.

[14] Presentation text by H. Dufourt on *Saturne*, published at the time of its first performance, Concert d'Itineraire, November 1982.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

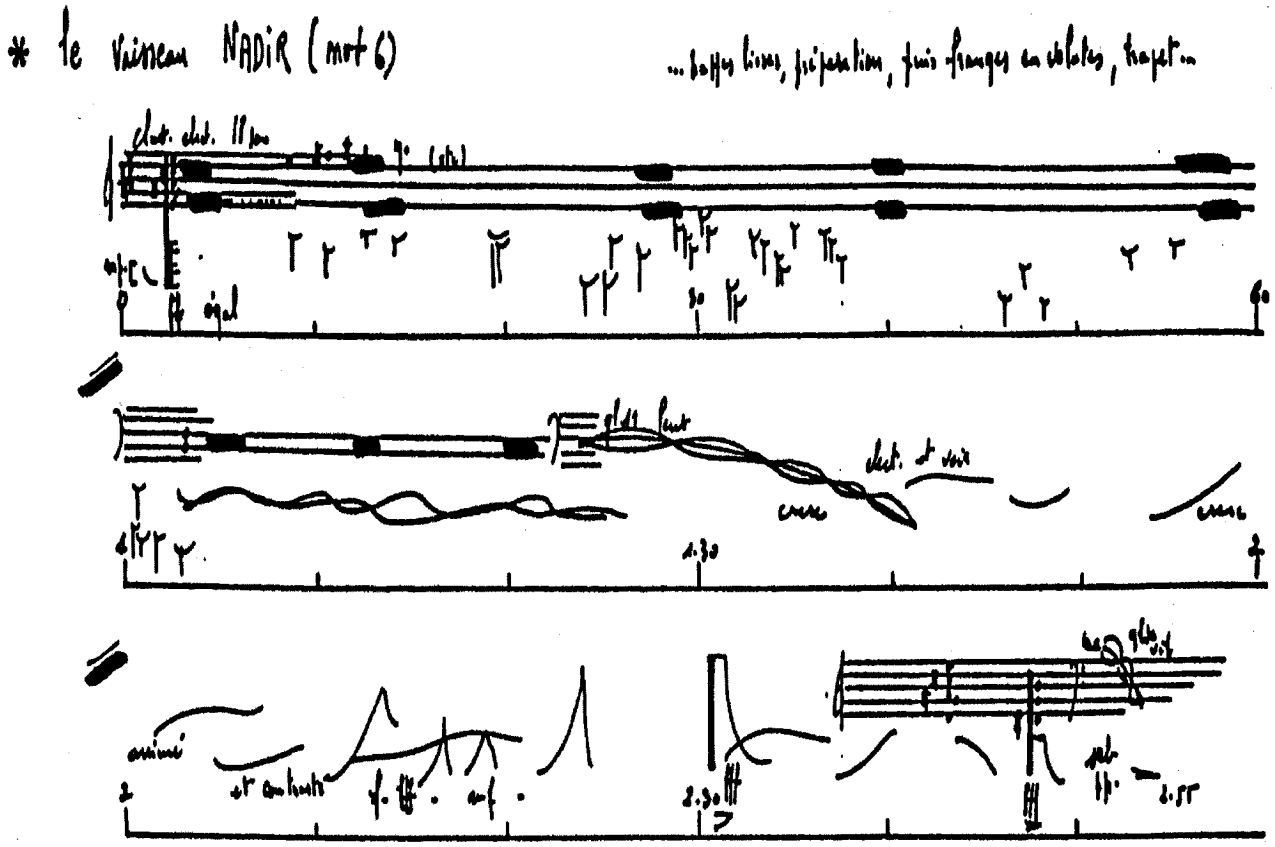


Figure 1. François Bayle: Movements 6 and 7 of *Jeita* (‘Le vaisseau Nadir’; ‘Oracle’).

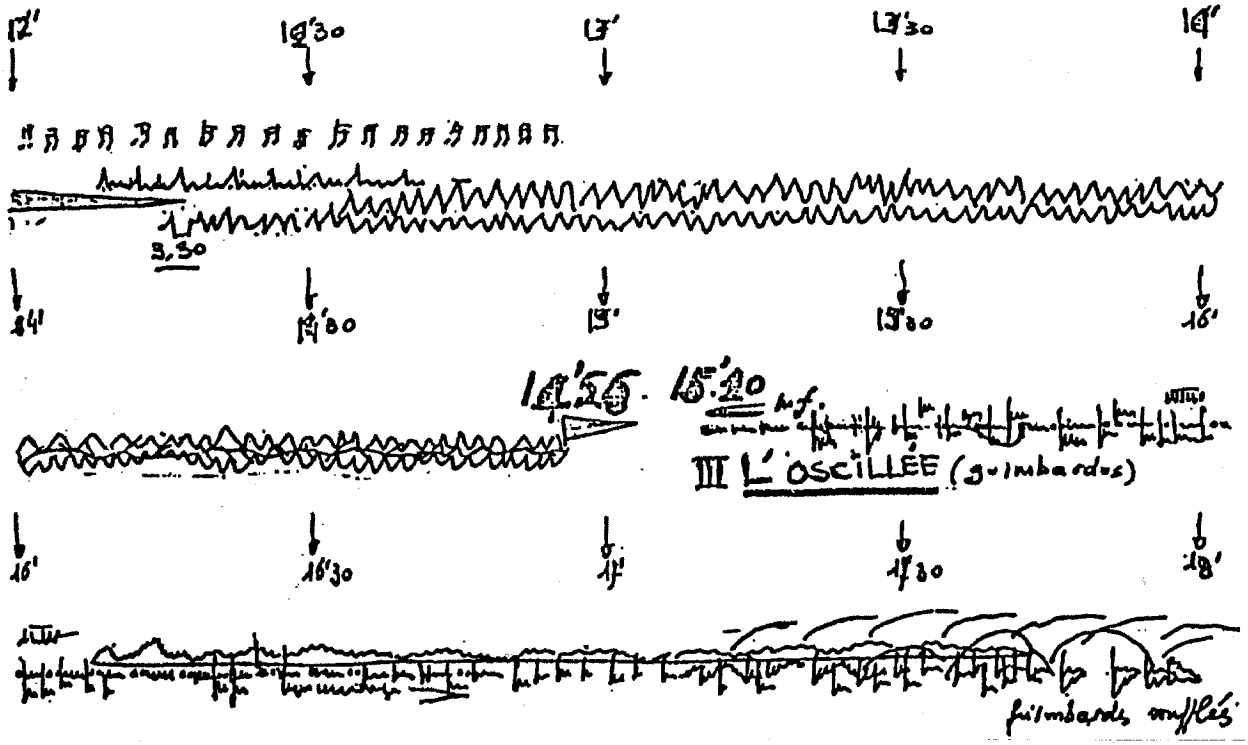


Figure 2. Bernard Parmegiani: *Pour en finir avec le pouvoir d’Orphée II* (1972), Movement III: ‘L’oscillee’.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

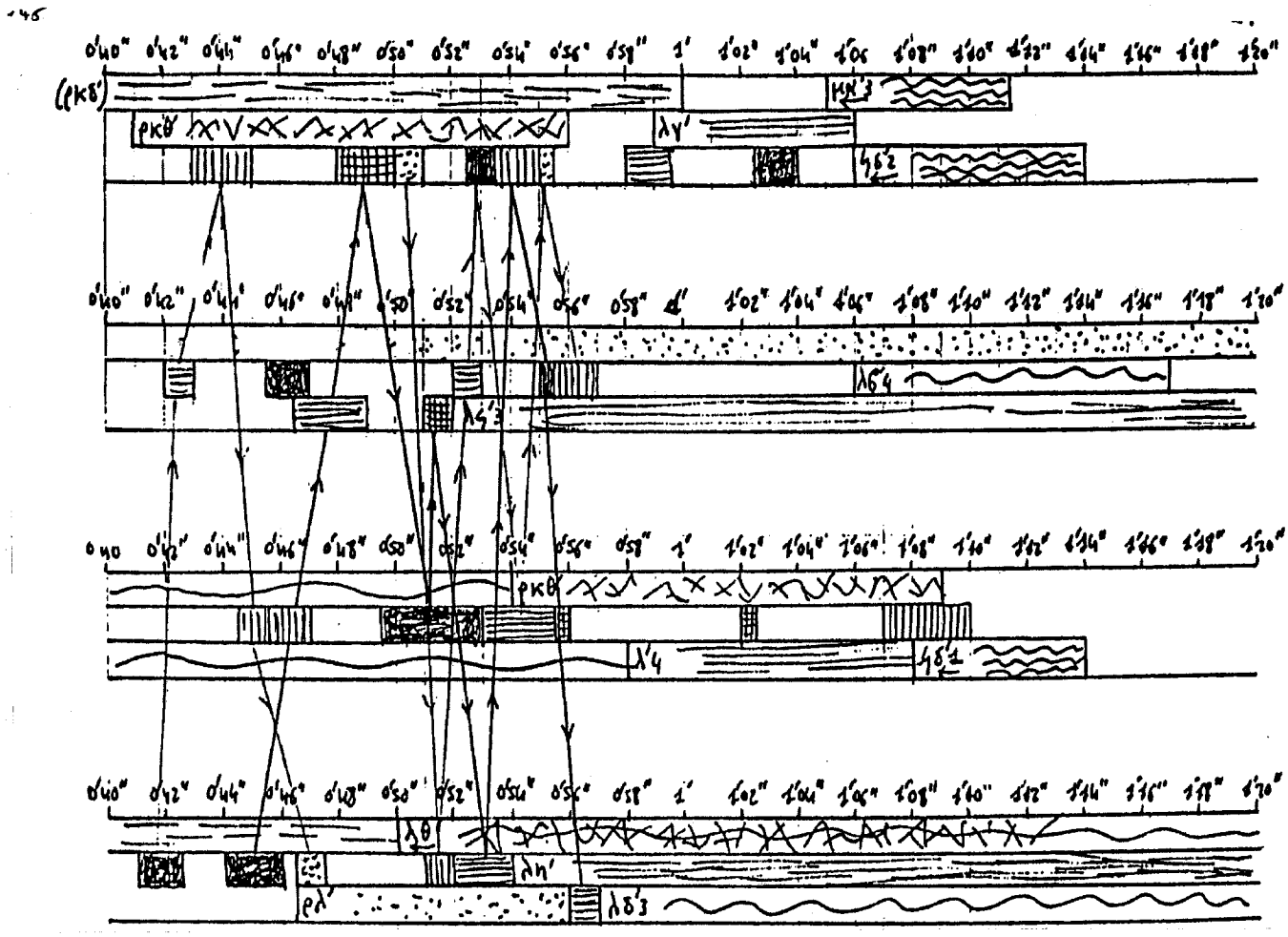


Figure 3. F.-B. Mache: page 14 of the graphic score of *Volumes* (3rd Movement: 'Spheres').

help of a tape with 12 synchronous tracks. ''The electroacoustic part itself is, for the most part, of instrumental origin, and it has the role of amplifying the orchestra – apart from any concertising spirit.

Reciprocally, the instrumental score is no doubt the first example of compositional style influenced by notions and sonorities familiar to 'concrete' music, to such a point that *the same symbols could serve for the notation of both*.

The author tried to use the lack of flexibility in the handling of tapes as a *spring-board for imagining new forms of masses*, that are sometimes near to Varese's conceptions (but not to his sonorities).''[15] (Italicisation by the author)

Fernand Vandenbogaerde's work entitled *Libration* (1983), written for tape at the CERM, demonstrates well, in the course of graphic transcription, the spatial–visual associations of points, grains, curves and textures carrying musical impulses and motives, clusters and glissandi (see figure 4).

[15] Extract of the presentation note written by the composer for *Volumes*.

1.3.3. A last conceptual stage in the utilisation of a geometric and visual schema came to life in some works by I. Xenakis, J.-C. Risset, M. Lindberg, K. Saariaho, T. Murail and M. Battier.

I have in mind the moment of historical evolution when *the graphic design precedes the composition of a work reflecting by it the articulations of its macrostructure*. We have already demonstrated the tripartite 'spatial' articulation of the form in Jean-Claude Risset's *Songes* (1979).[16] In the following I present – without going into details – two structures 'drawn' by Magnus Lindberg and Tristan Murail.

Since *Ur* (1986), Magnus Lindberg has made experiments with different 'spatial' dispositions of a chaconne (in his meaning, a series of chords): the rise and fall of these chords, their narrowing and growing progression with respect to the filling of the space or even the superposition of these processes.

[16] See the presentation of the graphic diagram on the spatial–temporal evolution of pitches in *Songes* in: Musicworks No. 52, p. 63, 1991, as supplement (erratum) added later to M. Grabocz's article entitled 'Narrativite et musique electro-acoustique', published in No. 51 of *Musicworks*, pp. 47–50. English translation: 'Narrativity and electroacoustic music', in *Musical signification*, E. Tarasti, ed., Mouton de Gruyter, Berlin and New York, 1995, pp. 535–40.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

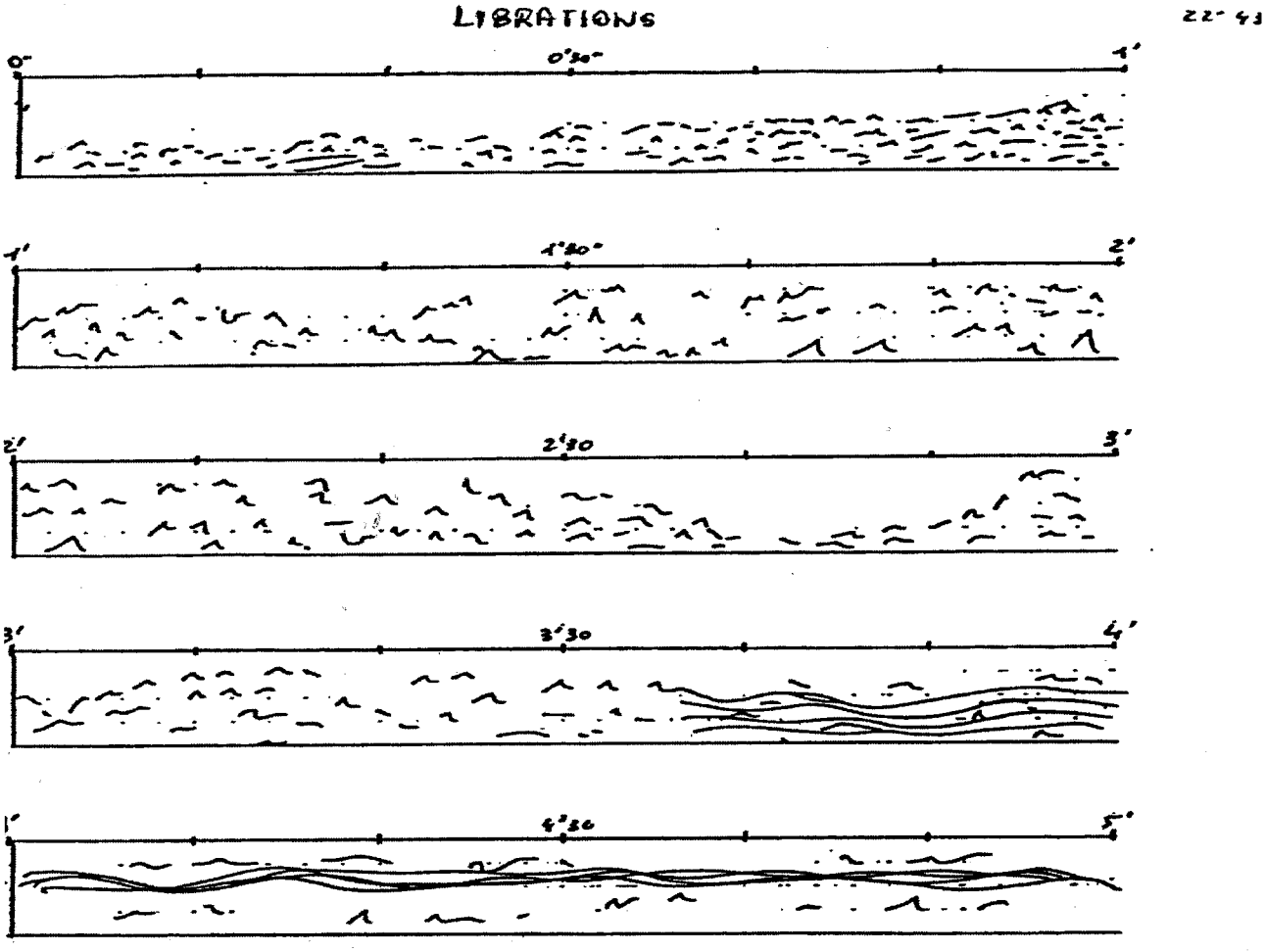


Figure 4. F. Vandenbogaerde: *Librations*, p. 1.

In *Joy* (1990), the catabasis/anabasis, the broadening and contraction of textures reach a higher level of structure: they can be found within each chaconne as well as in the big interludes (called by Lindberg 'processus'), articulating the great form, while connecting the variations of the chaconne, by the broad gestures of ascent – the filling in of the space (figure 5).

Tristan Murail's *Allegories* (1990) is a work constructed on the metamorphosis of an initial musical idea: on 'the process of process' as put by the composer. We acknowledge the transformations of a 'basic object', by way of different processes, thanks to a 'hypersyntax' applied beyond an elementary syntax.

The basic object is composed of an arpeggio followed by a resonance continued in a trill. It can be later transformed into a sonorous block or a 'cloud of sounds' (*nuage de sons*). Certain elements of this object will be developed, superposed, juxtaposed, or even inverted later on (figure 6). The instrumental ensemble of *Allegories* comprises flute (+piccolo), clarinet in B flat, horn, violin, cello, percussion (one instrumentalist) and digital clavier.

In this piece, T. Murail tries to mingle intimately computed sounds and instrumental music, so as to make it difficult to distinguish one from the other.

Most of the sounds are constructed by the technique of additive synthesis, with the help of Yamaha TX816 modules (two groups of four modules). The 'simulation' and/or the 'prolongation' of the instrumental spectra is given in real time by the performer playing on a MIDI clavier. This latter is connected with the synthesis modules by the intermediary of a Macintosh computer utilising the 'MAX' software, and the 'Allegories' program written in MAX.

This instrumental and electroacoustical device allows the composer to be able to calculate and realise the progressive distortions of a chosen spectrum. The utilisation of synthetic sounds allows also the 'prolongation' of instrumental sonorities in the registers inaccessible to traditional instruments. It also allows the amplification and the bringing into relief of the overtones (partials) of the spectra in those registers where, as a general rule, their audibility gets lost. In this way in *Allegories*, the composer can accomplish a form inspired by fractal geometry,

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

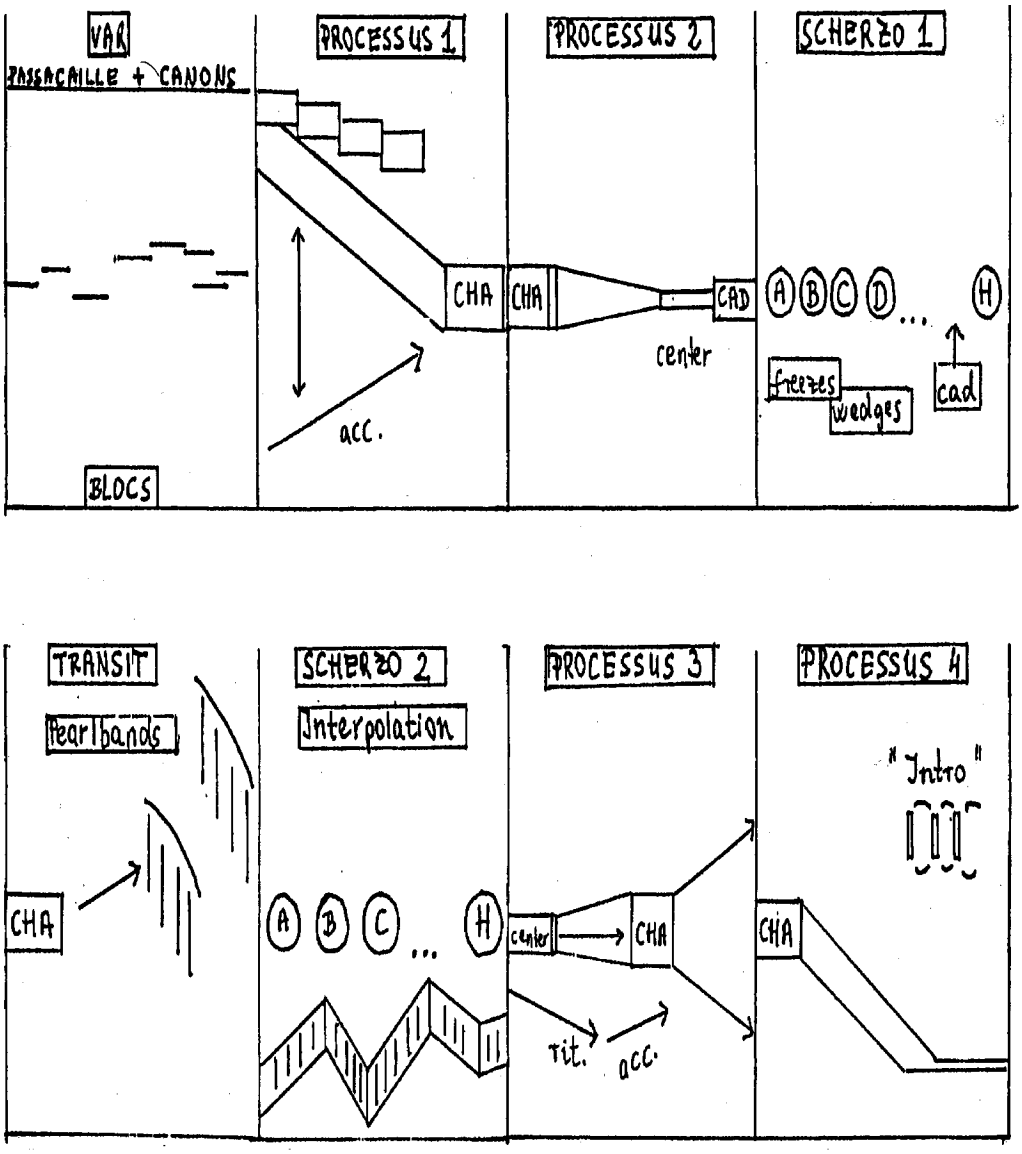


Figure 5. M. Lindberg: *Joy* (a sketch of the macrostructure, realised on the basis of the composer's sketch).

by self-similarity: we find the same contours of an object (and of its modifications) at the spectral level, of musical motives, at the level of the graphic schema of the sections and, finally, at the level of the macrostructure of the work (see figures 7 and 8).

A similar process can be observed when a global graphic schema, prior to the musical composition is used in some works by Kaija Saariaho (*Verblendungen*, *Lichtbogen*), and in other works by M. Lindberg and T. Murail.[17]

Marc Battier applies an altogether different procedure. In his work for marimba and tape, *Toca* (1993), the sound of a wooden bell is analysed, and the data obtained are used as materials for the marimba score. They are also displayed on the computer screen as a spectrum evolving in time.

The picture, resulting directly from the computer sound analysis, is transformed by the composer in various graphical ways. These new pictures are in turn used for additive resynthesis for the tape part of the piece. In so doing, the sonorities that are given birth maintain a somewhat familiar relationship with the original instrument. In this work, the use of such a graphical process ensures a continuum between the source sound object, the electroacoustic part and the score (figure 9).

2. BETWEEN THE KNOWN AND THE UNKNOWN: THE INTERMEDIARY MUSICAL STRUCTURE

When examining the nature of the development of a great number of mixed works, works written for tape

[17] See our first analysis of *Lichtbogen* by Saariaho and of *Ur* and *Joy* by Lindberg in: *Cahiers du CIREM*, Nos. 26–7, 'Musique et Geste', 1993, under the title: 'Conception gestuelle de la macrostructure dans la musique contemporaine finlandaise: K. Saariaho and M. Lindberg', review quoted: pp. 155–68.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

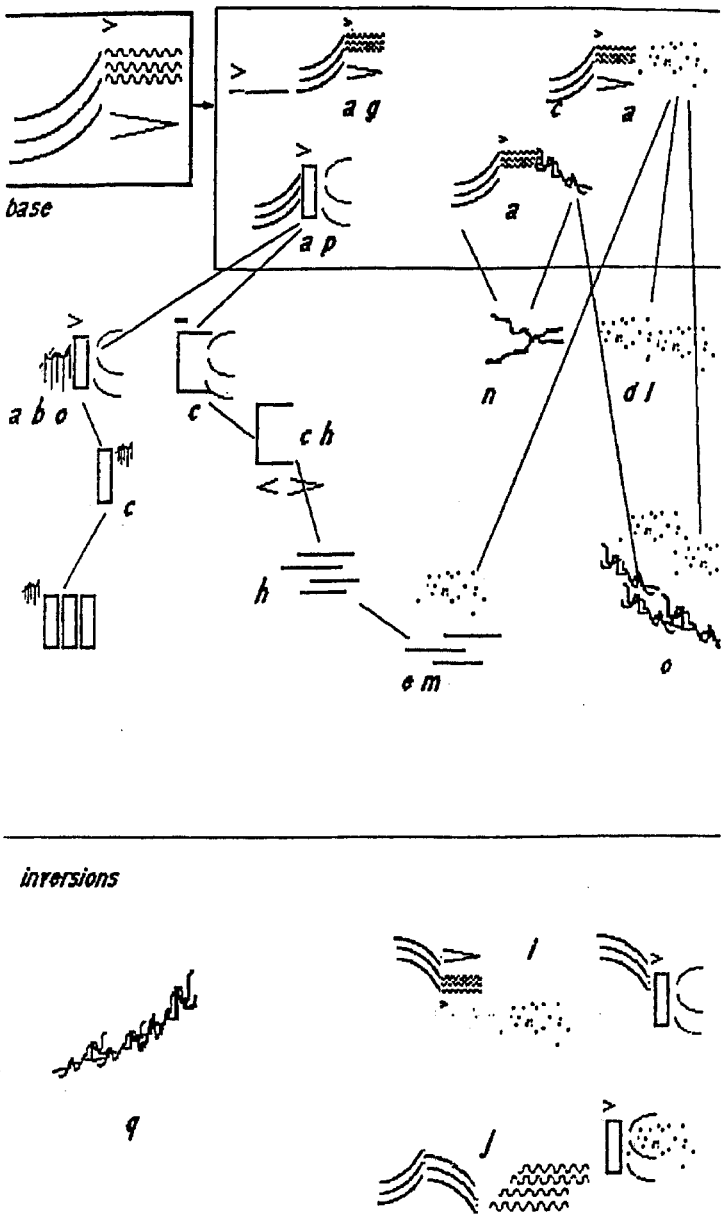


Figure 6. T. Murail: 'Objects' in *Allegories* (presentation by the composer).

or pieces making use of the computer in real time, we have to record that some very old principles of musical construction have reappeared, principles necessarily modified because of the new character of their sonorous material.

Without going too deeply into the details, let me present the three most frequent subgroups.

2.1. Variation forms in electroacoustic music

The eternal idea of variation is resorted to in our time with the help of synthetic sounds or the diverse sonorous techniques of concrete music, or even through treating sounds with the computer. Most frequently, these unprecedented sonorous sources are connected, in the form of a dialogue, with an acoustic instrument. Thanks to the control, to the treatment of the sound and to score following, the variational means have become considerably multiplied in the case of MIDI instruments.

Among pieces using tape – even if the creation of the sounds is computer aided – I would mention two works where the recourse to variations is not arbitrary: they allude to the traditions of a far-off past, namely to the oral tradition of folk songs in some countries in Eastern Europe.

In 1983, Tamas Ungvary realised variations on a theme of gypsy children's dance known in Hungary. At first, he used a PDP-15/XVM computer at the Stockholm EMS studio, employing his own software

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

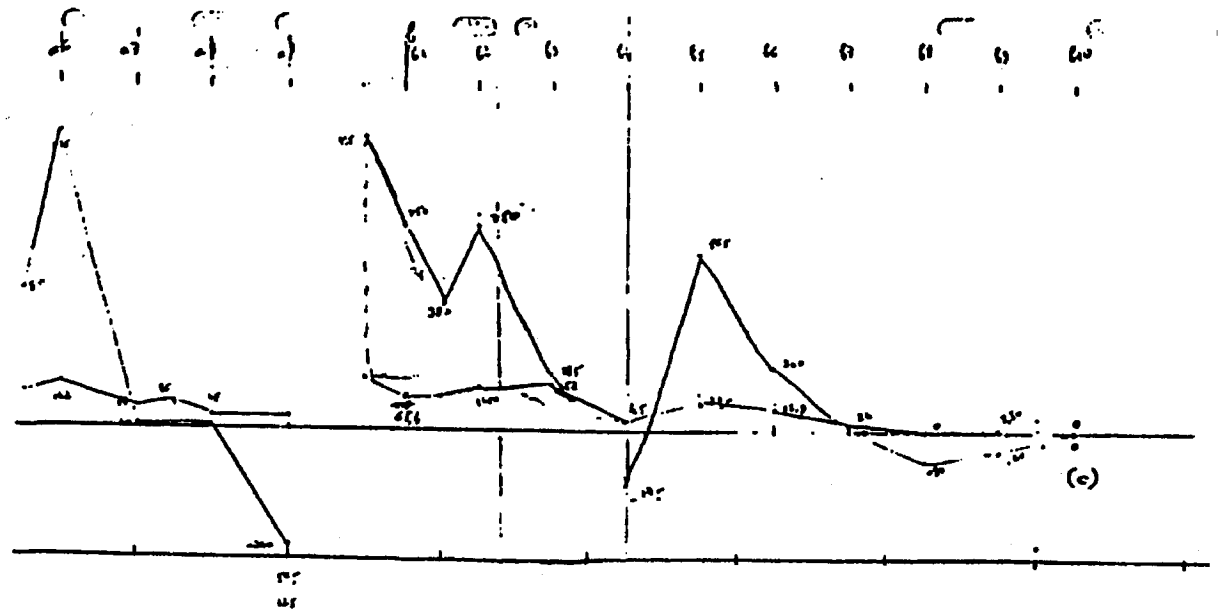


Figure 7. Diagram of the progression of distortions in the sections 1/a,b of *Allégories*.

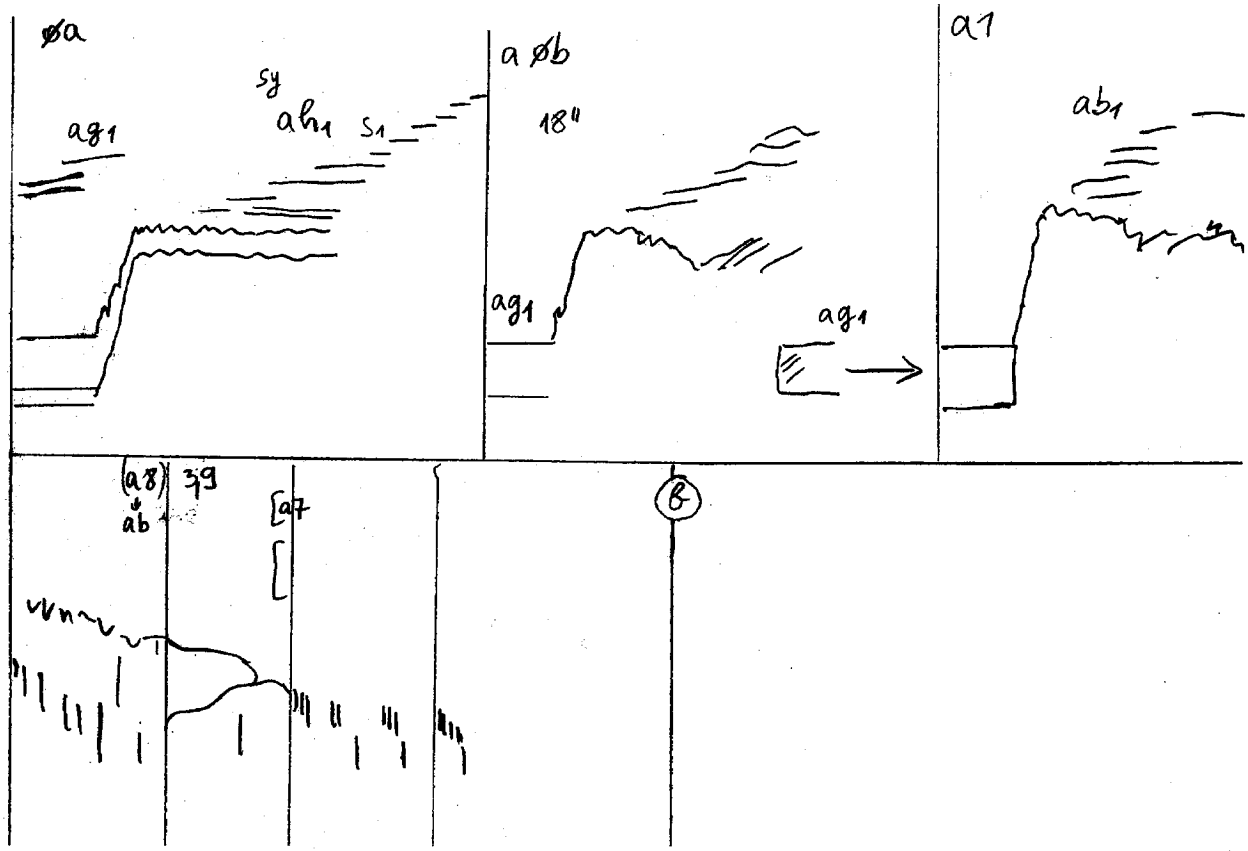


Figure 8. Diagram of the first section (1/a,b) of *Allégories*.

and a list of interactions named 'ILI' ('Interactive List Interpreter'). Later he turned – for sonorous transformations – to a program by Paul Pignon called 'Giant Fourier Transform Program' ('*Transformation Fourier a fenetre geante*'), developed on a VAX-11/750 computer.

From this derives the title of his work: *Gipsy Children's Giant Dance with ILI Fourier* (*Dance geante d'enfants tziganes avec ILI Fourier*). This new technique of the 1980s allowed Ungvary to create new material in a series of about ten variations (grouped in four sections) – always exploiting the same theme.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

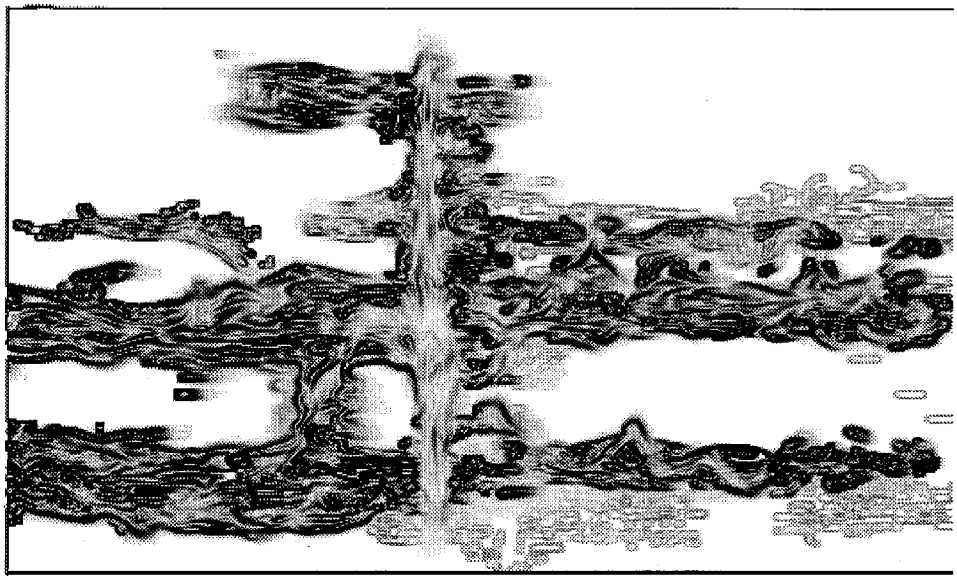


Figure 9. M. Battier: raw graphical analysis of the wooden bell using Phonogram, a program written by Vincent Lesbros.

The progressive transformation/deformation of spectra around another Hungarian folk song was developed by Laszlo Dubrovay on the Synclavier II of the Electronic Studio of the Technische Universitat of Berlin, in his *Symphonia* of 1981.

In the field of *musique concrete* variations, I should like to cite Alain Savouret's *L'arbre et caetera* (1972) (a form with refrains and development or variations), Guy Reibel's *Variations en etoile* (1976), Christian Zanesi's *Courir* (1989), some movements in B. Parmegiani's *Pour en finir avec le pouvoir d'Orphee II* (1972), and the movements of F. Bayle's *Fabulae* (1990–2).

In his work entitled *Red Bird. Or The Dream of a Political Prisoner* (1977), Trevor Wishart uses the transformation and variation of the traditional musical 'leitmotif', or those of 'concrete' origin (or even of electronic origin) in the manner these were used in R. Wagner's operas.

Philippe Manoury, in *Pluton* (1988, written for MIDI piano and computer, on the NeXT Station at IRCAM – *Station d'Informatique musicale de l'IRCAM*), varies certain basic ideas with the help of interactivity and the concept of 'virtual scores' which he devised. Thanks to the score follower, the software, and the prerecorded sequences, the pianist's interpretation creates multiple events, including sampled piano sounds, sounds of additive synthesis, infinite reverberations, Markov's matrices or chains set in movement on the basis of motives of a sampled piano, effects of phasing, etc. The possibilities of computer interaction (developed with Miller Puckette's MAX program) render it likely that the structure of this forty-five-minute work should often use the same element of the first section named 'toccata', and that the theme of the latter should be varied all through the five parts of *Pluton*:

I. First Toccata
II. Antiphone (second toccata)
III. Sequences
IV. Modulations (from the second part on)
V. Variations (from the first toccata on).

2.2. Evolutive, teleological forms in mixed genres

The second group of intermediary types is the form named 'evolutive' or 'teleological'. This is the case of many 'romantic' musical forms, born in the second half of the nineteenth century when the process of development and variation of one or two basic elements reaches a new stage, a real metamorphosis of the materials at the end of the structure.

Among contemporary works belonging to this category we find, for example, Peter Eotvos' *Intervalles interieurs* (1981) or Michael Levinas' *Prefixes* (1991), or Cort Lippe's *Music for Guitar and Tape* (based on sounds synthesised by computer), and F.-B. Mache's *Aulodie* (1983) for oboe (or saxophone) and tape. In P. Eotvos' work the hidden nature of a sonorous material becomes revealed little by little, moving forward through the development and variations of the same idea, so as to be found at the end of the piece in the form of clear references *to* traditional instrumental folk music familiar in Transylvania. In M. Levinas' *Prefixes* we witness the birth of 'stretto' *a la* Beethoven: a rising sequence varied and amplified with the help of rare sonorities (sampled and treated,

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

'hybridised') with the aim of expressing an acceleration and growth of tension.

In Kaija Saariaho's *Lichtbogen* (1986), the flute part – that of the protagonist of the work – is transformed by an electroacoustic device to such a point that it evokes the breathing of a surrealistic or supernatural being. The flautist, while playing, also pronounces phonemes. These are taken from Henry Vaughan's poem: *J'ai vu l'eternite l'autre nuit* (I saw Eternity the other night). In Kaija Saariaho's view one can find there a vision of infinite light and space: in 'endless light, all calm, Time [goes on] in hours, days, years'.[18] The end of *Lichtbogen* is meant to evoke this image while the rest of the piece is a progressive preparation for the amplification of the supernatural breathing (see note 17).

2.3. Renewed equilibrium forms

The last group of intermediary structures would be the old sonata form, or that of renewed 'equilibrium' forms (in German terminology, *Gleichgewichtsform*). In this latter sense we can state an internal symmetry of the structure (ABA') as well as an interior symmetry of its components: part A consists of an exposition, B is its contrast, while part A' brings the *denouement* by putting emphasis on one of the contrasting elements with the aim of resolving the conflict.

These 'cathartic' or 'dramatic' forms will fill the musical material with new qualities and with a new meaning of the conflict in such works as *Sud* (1985) by Jean-Claude Risset, in Philippe Manoury's *Jupiter* (1987), in F. Bayle's *Theatre d'ombres – Ombres blanches* (1988–9), in F.-B. Mache's *Rambaramb* (1973), etc.

In P. Manoury's *Jupiter* for flute and computer, the elements carrying form and conflict can be found in the timbre. This means that everything that was once expressed in the themes, motives and degrees of tonality as contrast (see the 'expositions' of sonata), as confrontation (see the 'development'), and then as *denouement* in classical-romantic music, is today embodied by or through the timbre.

Thanks to the score follower (IRCAM Computer Station MAX program) and to the treatment modules (harmonisers/transpositions, reverberation, the frequency shifter, effects of additive synthesis spectra filtered by the flute, etc.), and thanks to the sounds of the flute recorded and treated in this way, as well as to other synthetic sounds recorded and emitted by the flute, the work contains a scale of timbres going from noise effects, through different sonorities of the 'normal flute sound' type, and beyond to the sounds of the 'idealised flute', i.e. to ethereal, crystalline sounds derived from the flute.

With the help of these three categories, these three main classes of timbres, Manoury comes to create a discourse consisting of an exposition, of a conflicting part where the flute sounds 'get lost' – are submerged – in the loud clangour of grave and dissonant bells (see development), up to the point where, in the 're-exposition' section, ethereal, sparkling and silvery sonorities take over and dominate the sonorous world of gloomy bells.

Hence, this work too presents a 'problem', an intrigue, and the rest of the discourse is dedicated to the quest of a solution with the aim of resolving the conflict, finding an answer, and putting it in relief. This strategy of drama, of catharsis, has been known since Aristotle. In our day it appears again in a renewed manner, but the ways in which the alternations of tension and release and those of collision and *denouement* are handled lose none of their suggestive force.[19]

In his work *Sud*, Jean-Claude Risset too invents a hierarchy of elements. The three categories of timbres – designating three worlds – are the following:

(1) Sounds of the sea, the buoy, the birds, the waves, the surf, the storm.
(2) Sounds of the human world: the noises of steps, of instruments, etc.
(3) Sounds synthesised by the program MUSIC V, able to represent an imaginary, supernatural, surrealistic or ideal world, thanks to the 'ethereal' woof giving the impression of an organ, or a bell of a quasi-cosmic sonority, etc.

The conflicts arise between the elements belonging to these three different worlds, the mediation taking place with the help of a spectral hybridisation technique, through the aid of sounds synthesised by MUSIC V. At the end of the work we witness the birth of a new quality, the sonority of an imaginary organ evoking sublimation.[20]

3. TRADITIONAL FORMS

To this last group belong structures in which the new electroacoustic material does not call for a compromise when constructing music within the traditional frames.

[18] Text of presentation by Risto Niemien in the explanatory booklet accompanying the record FINLANDIA FACD 374, 1989, devoted to K. Saariaho's works, p. 15.

[19] See the detailed study on *Jupiter* made by the author of this article in the framework of the studies *Documentation Musicale* of IRCAM, 45 pp., 1991.

[20] See a somewhat more detailed presentation of this work in a critical review published in: *Cahiers du CIREM*, Nos. 14–15, December 1989, pp. 261–3 (under the title 'Creations de M. Battier, F.-B. Mache and J.-C. Risset in Hungary').

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press

3.1. Cyclical or enumerative works

These are created through the free juxtaposition of different movements forming a cycle or a suite; or the structure is conceived through the free enumeration of different small movements.

Works belonging to this class are: François Bayle's *Experience acoustique* (1970–2), *Jeita ou le murmure des eaux* (1970 – a work consisting of 17 movements), *Theatre d'ombres – derriere l'image* (1988–90); Bernard Parmegiani's *De natura sonorum* (10 movements, 1972), *La creation du monde* (1984); Michel Chion's *La ronde* (suite, 1982), *On n'arrete pas le regret* (children's scenes, 1975); Jonathan Harvey's *Bakhti* (1982 – a cycle of 12 movements for tape made at IRCAM and for an instrumental ensemble); D. Teruggi and J. Schwarz's *Mano a mano* (1989), Jean Schwarz's *Symphonie* (1974), *Erda* (1971), etc.

3.2. Descriptive works and programme music

Works relying on literary, biblical or mythical programmes for articulating their structure, or using texts that help to guide and inspire certain layers of the composition, have been known since the beginnings of western music history. Their reappearance seems quite natural and justified in the context of composition by electroacoustic means. This is perhaps the most widely used and developed genre in the fields of concrete music, or mixed music, and computer music.

Let me give some examples selected from among the great number of works illustrating this category: F. Bayle and B. Parmegiani's *La Divine Comedie* (GRM, 1972–4); Michel Chion's *La Tentation de Saint-Antoine* (GRM, 1984); K. Saariaho's *Stilleben* (YLE Experimental Studio, Helsinki, 1988); Morton Subotnik's *The Double Life of Amphibians – Ascent into Air* (IRCAM, 1981); Pierre Henry's *Le Livre des Morts egyptiens* (Egyptian Book of The Dead) (IRCAM, 1990); Gilbert Amy's *Une saison en enfer* (A Season in Hell) (GRM, 1979); Jean Schwarz's *Quatre saisons* (Four seasons) (GRM, 1983); Marco Stroppa's *Proemio* (Prologue) (IRCAM, 1990), *In cielo, in terra, in mare* (In Heaven, on Earth, in The Sea) – radiophonic opera (IRCAM, 1992); Pierre-Alain Jaffrennou's *Ocean ou troisieme passage de la baleine* (Ocean or The Third Passing of The Whale) (GRAME, 1984), etc.

* * *

The presentation of these three categories of concepts of musical structure within recent electroacoustic creations is based on my personal experience. This classification does not contain any value judgement. Obviously, it allows the existence of other, parallel comprehensive systems of view.

The classifications and discussions outlined here will achieve their final form through deep analyses and illustrations (with the help of sound and graphic examples, and scores), with reference to the aforementioned works. Some of these studies have already been prepared and published, while another part of the corpus is on its way to becoming realised.

https://doi.org/10.1017/S1355771897009035 Published online by Cambridge University Press