Compositional Strategies in Electroacoustic Music

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Note: The sound examples are recorded separately for reference only.
Their level was optimised and fades were used for a better audition.

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Abstract

This thesis accompanies the five electroacoustic pieces of the portfolio and aims to discuss compositional strategies. The pieces were designed with the intention of exploring ways of creating relationships between musical materials of differing natures. Structuring methods are outlined using examples from two acousmatic and three mixed works (for solo instrument and electroacoustic sounds). Analyses from a macro- and micro-perspective aid in describing the principal elements of musical discourse and the personal methods of achieving musical coherence.

Three stages of the compositional process are defined and discussed, forming a framework within which the computer sound transformations and instrumental sources are described. The first stage consists of the generation of material and the qualifying of the sounds as the basis for initial musical relationships. Then the structuring of the musical discourse is discussed, highlighting links at macro and microstructural levels. Finally, issues of performance are discussed. Feedback from the performer and the design of a common synchronisation method for the three pieces drives the structural design of the works. Musical material and the visual information during performance are investigated, and consideration is given to their implications throughout the compositional process.

Introduction

Throughout the compositional process of this folio I have identified different perspectives from which to consider the problems and characteristics of organising sound materials and generating musical ideas. Relationships and strategies are not confined to a single piece, and related compositional methods can be implemented in various works. Thus, general compositional patterns can be defined and compared alongside methods particular to one piece.

Two acousmatic pieces and three works for solo instrument and electroacoustic sounds constitute the framework within which to explore three main stages of the compositional process. The generation of sound material, the design of structure and 'performance concerns' are the basic divisions that provide the basis for approaching both the compositional procedures within one piece and within the broader perspective of the development of methods across pieces.

In order to help articulate the relationships and organisation of material, the problems of relating musical elements and structuring ideas are addressed from two perspectives. The long-term perspective describes methods of controlling the density of activity, the rate at which events occur (control of time flow) and the design of a coherent macrostructure. The local, short-term perspective considers detailed sound design (microstructural design, spatial decisions and spectromorphological design).

In order to establish the ground for further discussion, Chapter 1 addresses the concept of language. This section is concerned with the problems of language design and the processes of generating and selecting musical material. Using examples from the five pieces, problems of selecting different source sounds are examined. It also considers the influence of the methods used to generate sound material from an instrumental source are also considered, taking into account the role of recognisable sources and their influence upon the organisation of musical ideas.

Chapter 2 outlines the process of creating musical discourse by defining the musical function of elements and events. The design of relationships between materials is crucial to the compositional process and is discussed using examples

in mixed and acousmatic pieces together with an analysis of the spectral operations which aid the development of musical discourse.

Chapter 3 is concerned with concrete strategies used to control the flow of musical ideas and with methods used to unify the materials. The chapter describes the organisational procedures in the five pieces by discussing the strategies utilised to design musical syntax. Concepts like time, pitch, sound behaviour and micro- and macrostructuring processes are discussed in order to identify approaches which are decisive factors of the structural design.

The influential role of performance considerations is addressed in Chapter 4. Dealing with a live performer, the problems of accurate graphical representation, recording issues, and the strategies needed for successful synchronisation are discussed.

Finally, Chapter 5 is a summary of the more relevant approaches utilised in various works and a detailed description of methods which apply to individual pieces. This section underlines common and individual compositional approaches throughout the five pieces, considering their implications as elements of structural design.

1. Material

"The artist who has something to communicate through the medium of his chosen language -be it speech or music- must be the master of that language and not its servant"

D.Cook

1.1 Language and material in electroacoustic music

This chapter discusses the idea of language and its implications for musical material, concentrating on the process of judging musical material in the light of the five pieces in the portfolio. Through concrete examples and description of the characteristics and differences between instrumental and electroacoustic material, and the influence of technology and recognisable sources, the chapter addresses the problems of generating material and its context together with how structure and performance are influenced.

1.1.1 Language

The act of composition requires a constant development of strategies that establish principles of order. These strategies, which combine technical competence with aesthetic resolve, interact with each other at many levels to guide the creative process and define hierarchies of musical elements. The need for unity within musical discourse is the basis for a set of regulations that are expected to aid the generation of coherent musical expression.[1] The creative areas of sound exploration and the personal interests of the composer will influence the rules that determine how musical materials relate to each other and how specific relationships will be favoured in a piece.

It is possible to consider the idea of language as a tool for modelling the conception and perception of ideas where musical discourse is controlled by the interaction between sounds and patterns of repetition. The composer offers a musical statement based on the characteristics of the sound, the transformation of materials and the continuous development and control of musical rules. A coherent approach to musical language will help create a "musical path" guiding

[1] Language can be defined as the laws of musical construction which are supposed to generate coherent expression (Cook, 1974, p.212).

the listener through the piece, determining focal possibilities and levels of complexity at a given moment.

> "Discovering oneself in the midst of a large forest with no idea of the way out, one is hardly likely to find the flowers beautiful or the bird calls fascinating. However with the introduction of only a marginal trail or signpost, one can move around with a completely different sensation. Because electroacoustic resources offer the potential to create particularly exotic forests of sound there is a compelling need for references. It's important to understand that a point of reference need not be familiar timbres or rhythms, but a process that is comprehended by the listener. A person in the forest finds security in the function of the paths and sign posts, not in the paths or posts themselves" (Keane, 1986, p.110).

Musical language can be regarded as the relationship between processes rather than the relationship between individual elements. Therefore it cannot be defined by isolated sound transformations, musical events, rhythmic interaction or any other individual aspect of composition. It is the processes of transformation, strategically chosen sound references, and internal relationships that control the content of sound material, which define the language.

Throughout the compositional process stereotypes, pre-conceptions and the personal interpretation of the variables that intervene in the creation of a work undergo constant change. Thus, language is dynamic due to the permanent evolution and redefinition of the rules defining musical syntax. However, this evolution of language does not necessarily mean that its complexity increases as it evolves. Information accumulates, taking into account an increased number of variables and relationships, thereby generating a more effective set of rules for musical exploration. A constant transformation and restructuring of hierarchical principles, and the permanent recontextualisation of relationships, structural strategies and materials, can either broaden or reduce the framework within

which the coherence of musical actions is judged. Language is therefore not a compositional tool or a group of techniques but a conjunction of strategies for correlating musical elements that can be identified as set of musical laws or a method for achieving unity.

1.1.2 Material and language design

The composer's need to structure a coherent musical discourse arises from critical interaction with, and the analysis of, initial ideas and musical material. The process of creating a new piece is one of designing a palette of diverse materials, inventing a sound world whose elements influence the network[2] of musical connections, and a sound world which complies with the set of rules designed to generate a coherent language within a self-contained sound environment.

Language can be viewed from a macro-perspective, when general trends can be identified beyond the limits of an individual work. On the other hand, from a micro-perspective, the compositional approaches utilised to create ideas may only be expected to comply with the rules governing a particular piece. The accumulation of short-term, local ideas may eventually establish longer streams of musical activity without necessarily being present in other works.

Language design is driven by the specific needs of the user. The process commences with the choice of material and a personal analysis of its potential. The language itself emerges from this initial selection process. Conversely, one could say that the selection of material is influenced by language design.

Preconceived ways of working, and decision-making at every stage of the pre-compositional process (planning, selecting and recording sources) is already a filter for the piece's creative output. Therefore, the "composed" status of the musical material is informed by functional and operational approaches, together with other aesthetic concerns. Thus, the relationship between language and material becomes responsible for the design and development of musical ideas in order to maintain the stylistic integrity required by the composer.

The act of composing can be considered as a way to define principles of order involving the abstraction of multiple musical ideas. Taking into account the

[2]A network can be defined as a group of relationships. A sound can be part of a network when it has multiple links at different levels.

system of relationships planned in advance, and those that emerge throughout the process, the placement or layering of ideas within a musical discourse is but one of the stages of the compositional process. It is important for the composer to be able to qualify the musical results of his ideas and react to them. A musical thread will be established by a sequence of relationships that acts as a structural backbone for the piece. Order is created through measurable parameters and nonmeasurable elements that aid in the process of relating and creating a hierarchy of materials.

In music that incorporates electroacoustic means, a single note or sound is no longer necessarily the smallest, indivisible unit of musical content. Therefore, the constant development of musical language and the permanent recontextualisation and analysis of the musical material must address simultaneously, characteristics at micro- and macro-levels. Thus, the composer deals at the same time with multiple time scales and different structural levels.

1.2 Sound material

Before working on the pieces discussed here I had been more interested in using environmental sounds than sound sources recorded under studio conditions. My instrumental composition background and interest in soundscape composition had been the main influences. The challenge was to transfer and re-use my instrumental knowledge as well as discover new acousmatic possibilities.

The process of generating the initial palette of sounds for an acousmatic piece initiates the exploration of sound materials as elements from which musical content and structure can emerge. After selecting and recording sound sources, exploring their characteristics is the main issue. This is a stage of experimentation, as well as a time for learning the available tools and transformation possibilities. Three principal ways of considering the characteristics of sound material can be identified:

a) Spectral: selecting those characteristics which seem suitable to fulfil the preliminary idea of the piece. An example could be the search for textures with clearly defined pitch and spectral characteristics.
b) Morphological: the spectral shaping of a sound over a period of time.

Sounds can be combined and linked on the basis of their morphological features thereby generating a set of sound materials.

c) Gestural: an idiomatic musical event with particular intervallic, dynamic, rhythmic and other characteristics. Sounds may be combined in a number of ways to create musical gestures.

Transformations and combining sound materials are by no means independent stages in composition. Decisions are constantly being taken, and at the same time an awareness of musical language and structure grows, and constant improvement of the material's suitability for particular musical purposes opens new possibilities of discourse. For example, in the acousmatic piece 'Cycles' this was especially true due to the fact that there was no pre-planned structure. Musical elements were selected during the process of sound transformation and therefore important compositional decisions like the general structure resulted from transforming and combining the sound sources.

1.2.1 Sound sources in 'Cycles'

An important initial concern was to develop a piece where a growth in the awareness of human-related activity was present. Dividing the source selection process into two recording stages and the use of sounds originating from human-related actions helped to create a sound palette with a substantial variety of sound material for this purpose.

The initial sources were recorded in a controlled studio environment in order to obtain a wide range of timbres and different morphologies. In a second stage, sounds of a different nature were added. Recognisable sources, like short vocal sounds and traditional instruments, were recorded outside the studio with a portable DAT machine, and then selected if they seemed to offer transformation possibilities.

Original sources:

- Kitchen wok with coins with a clear physical action and energy. Metallic sounds with bright sound and internal activity.
- The orchestral bass drum is easily recognised and is the source of all

transformations that defined the "floor" of the wide pitch framework from the beginning of the piece.

- Vitamin C tablet dissolving in water: a long texturally oriented and granular-like sound, suitable for an evolution process.

Sources added during the composition:

- Ethnic wind instrument: a flute-like, noisy sound with unstable pitch.
- Choir sounding through a church's street speaker: a choral sound, easily identifiable and very suitable for filtering because of the noisy source.
- Voice saying "stop": studio-recorded voice. The actual meaning of the word was more important than its spectral characteristics.
- Radio-like waves: used as a source sound although it was the result of previous transformations. This sound has long trajectories of limited harmonic content which change pitch constantly.

The initial group of sounds helped to define the general colour and sound world for the piece, while the second group was introduced in response to the need for more gesture-based material and sounds of an identifiable source. Nevertheless, both are used to control the amount of activity in certain areas of the spectrum which emerged as an important structural parameter. Thus, the original group of sounds defined the characteristics needed for the second group. The non-recognisable sources are mainly long, evolving sounds that set a spectral framework, and are intended to create the overall sound world for the piece, while the sources added later are mainly short sound events in the middle area of the spectrum and without any long-term transformation.

Sections of accumulating energy with sudden short, high-energy events were designed to create contrasting amounts of activity within specific areas of the spectrum. To develop these intended contrasting spectrums the first group of sources proved to be insufficient. There was a need for a new group of sounds that could be linked to their source and that could be used to increase the amount of middle frequencies in the spectrum. In this way, a sound world with clear high- and low-spectral borders could have, at the same time, different amounts of human-related activity.

An example of this approach can be identified when the density of activity within the sound boundaries set at the beginning of the work (1'34"), is defined by sounds that are clearly related to their source in such a way that they can be easily recognisable. They also have an important amount of energy between 700Hz and 7Khz and are mainly human-like voices or percussive sounds. Figure 1 (Sound example CD1-1) shows the spectral analysis of the opening section, where the short high-intensity event at 1'34" is a vocal-related sound that fills most of the spectrum.

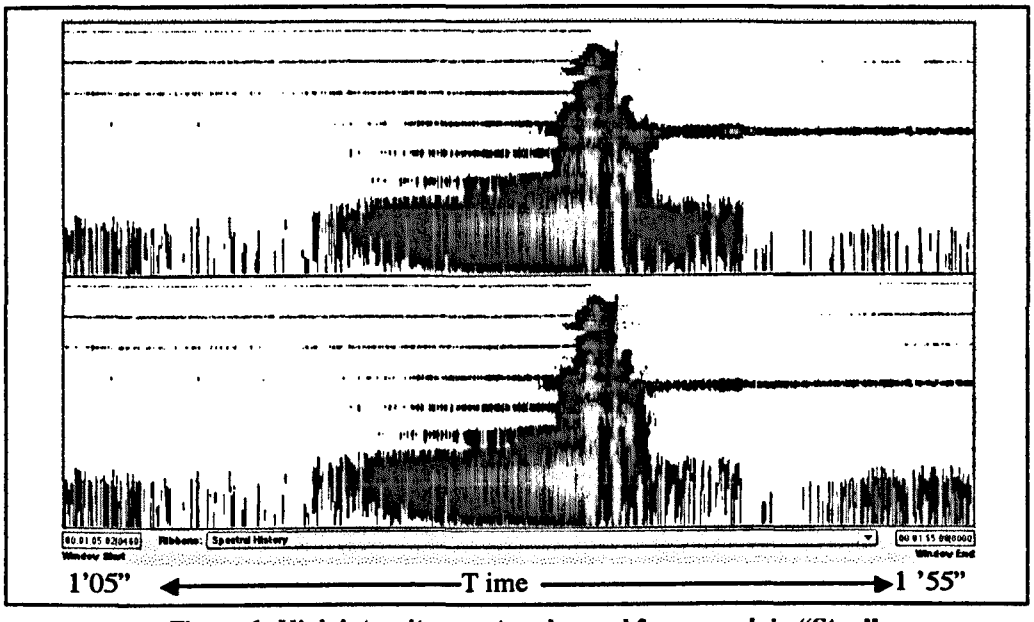


Figure 1. High intensity event and sound framework in "Stop".

The contrast in the amount of energy in this section is an example of what influenced the process of selecting material for the final structure of the piece. Therefore, what could be regarded as a simple process of selecting sources was also a process of designing the general structure of the piece.

1.2.2 Hierarchy of sound material in 'Friction of things in other places'

The strategy for developing sounds used in 'Friction of things in other places' ('Fotiop') highlights the way in which the process of selecting material is guided by an aesthetic intention.

A hierarchy was established based on the number of sounds coinciding in one category of a pre-designed table used as a method to catalogue sound material and therefore control its placement. The table was also useful to identify certain contexts of the work where a particular sound world was intended or emphasis was placed on the source of the sound or its spectral or morphological characteristics. This made it possible to identify and isolate suitable sounds as part of specific sound contexts and at the same time to weight their suitability to be related to others in terms of their spectromorphological or source characteristics. Table 1 illustrates how some of the sound materials for 'Fotiop' can be analysed and placed within the pre-defined grid. The table was a tool to identify sounds in order to link them with others rather than a thorough categorisation of the sound material. That is why some sounds that can be placed in two different cells depending on which of their features were considered more important. Therefore the table not only grouped the sounds, but also helped to identify them as useful within a different sound context.

			Sound attributes					
			Spectral		Morphological		Source	
			Noise-based	High harmonic content	Inactive	Active	Recognisable	Non-recognisable
Sound types	Rhythmic	Repetitive	C (1'00")				D (5'07")	(1'49")
		Non-repetitive				E (3'59")	A (3'25")	
	Long sounds			(6'56")	(0'18")	(2'18")	B (5'12")	
	Short sounds		(0'00")				(6'53")	(1'21")

Table 1. Sound hierachy in "Fotiop".

For example, Sound A (Sound example CD1-2) occurring at 3'25" in the piece, although it went through certain transformations in order to filter some of its low frequencies, can be easily related to a source (drops of water). Sound B (Sound example CD1-3) at 5'12" clearly originated from a pipe-like instrument and has a slow attack with a long sustain period where some transformations were applied without interfering with the recognisability of its timbre. Sound C (Sound example CD1-4) at 1'00" has an internal repeated loop with an unclear source. On the other hand, sound D (Sound example CD1-5) is a low-level drum

loop of identifiable source (percussive origin). Finally, Sound E (Sound example CD1-6) can be described as active and rhythmic but without any obvious pattern of repetition. This sound also illustrates how the table was used only to identify certain characteristic of the sounds required for possible relationships. In sound E there is an obvious link to the vocal source of the sound that is not evident in the Table. However, the results of using the table defined the sound world for each section of the piece.

1.2.3 Sound material in mixed pieces

Although material can be considered the result of pre-compositional creative processes, in the case of mixed pieces one of the main variables is the degree to which the relationships between recorded and live parts is explored. The use of a live instrument highlights an initial concern for designing relationships and linking media where the role of each medium and its degree of relatedness are intended to work for a common musical purpose. Instrument and recorded material interact at multiple levels. During the act of composition they become part of a micro world that deals with relating them within the boundaries of a single musical event, but from a broader temporal perspective they are part of macro networks from which structure is designed.

In the three mixed pieces discussed in this thesis the exploration of, and experimentation with, instrumental performance techniques, together with analytical strategies, guided the creative output. Two main areas of compositional activity had a direct aesthetic influence upon the musical result:

a) Physical

The timbral characteristics of the sound created by an instrument is defined by numerous elements (mechanical features, different sound generating processes or its multiphonic possibilities) and offer a vast array of sound design options to the composer.

b) Conceptual

Although preconceived ideas regarding the design of the musical language are linked to physical aspects of the instrument, external compositional ideas were used to organise, relate and structure musical content.

Ideas for the mixed pieces were initially organised and developed with the physical and conceptual areas in mind, and mainly related to the process of applying structural ideas to pre-selected sound material. For example, in 'Twilight' for bassoon and electroacoustic sounds, there was a conscious decision to conserve first and foremost the sound attributes of the instrument. As discussed below, aspects of the bassoon's physical characteristics were used as timbral guidelines.

1.2.4 Sound material for 'Twilight'

The use of a bassoon as the principal source of material for the electroacoustic part required addressing certain concerns regarding aspects of its sound and mechanics. The timbre and spectral characteristics of the bassoon's double reed and conical-bore determine its distinctive sound colour. The lower register can be defined as brittle and dry in tone quality, the middle range is more "horn like" and the upper register is "nasal" (Blatter, 1997 p.118). It is a low-register instrument with a focused sound and defined harmonic contours. Because of this the dynamic properties are directly related to a particular register. The lower end is powerful and can be carefully controlled whereas in a higher register contrasting dynamics can be difficult to obtain.

On the other hand, the metallic mechanism is an intrinsic part of the instrument's sound and is available as compositional material. Also the size and mechanics of the instrument result in a complex array of areas from where the sound is projected and therefore makes its amplification and recording problematic. However, this characteristic of sound production can be helpful, within a controlled environment, in obtaining isolated sounds suitable for studio transformations.

Although the recording of source material was influenced by the pre-compositional structural ideas explained later, it was initially necessary to gather a wide range of sound types and morphologies. The process of gathering material was divided into the following stages:

1) Access to three different contemporary bassoon performers was useful in obtaining both different perspectives of the instrument's capabilities and

varied personal conceptions of what a successful bassoon piece would be like from the performer's point of view. The most fruitful aspect of the interaction with the performers was the recording of sufficient material to facilitate the exploration of transformational potential, therefore enabling the redefinition of the instrumental material being recorded .

This process was sub-divided into three stages defined by the type of material recorded:

a) The recording of pre-composed ideas with the intention of obtaining a general spectrum of the instrument's sound. (Individual notes, short scales, articulations like *flatterzunge* and double tongue and low register sounds with different attacks and duration).
b) Feedback from the performer, recording his personal ideas and performance techniques (the performer's articulation of different short gestures).
c) Non-conventional sounds (multiphonics, *glissandi*, key sounds, sounds without the reed and non-pitched eolic sounds).

2) The process of combining and transforming timbres generated the initial material for the recorded part. At this stage sounds were explored individually, and subsequent transformations were intended to emphasise particular characteristics of a sound in the following ways:

a) Prolongation: sounds that require a large amount of air are generally shorter in duration and so their continuant phases were extended.
b) Combination: pitches that are impossible to combine in real time by the performer.
c) Filtering: exploring, altering, and the resynthesis of the harmonic spectrum of some sounds to obtain slightly modified timbres. These are pitched and clearly recognisable as originating from the bassoon.
d) Emphasis: increasing the presence of harmonics in certain low-register sounds.

The other two mixed pieces in the portfolio went through a similar initial categorisation in order to obtain a broad spectrum of sounds. However, in the case of 'Rimbarimba' sounds were intentionally kept less transformed in order to aid the initial intention of creating rhythmic sections of high intensity. On the other hand, 'Tolerance' required an extensive palette of sounds that included multiple transformations in order to obtain sounds with spectral characteristics or with behaviours that could be linked with ideas originating from cello material.

1.2.5 Generating the material for the electroacoustic part in 'Tolerance'

The process of generating musical material described below resulted in a palette of musical ideas for the instrument and a catalogue of electroacoustic sounds and gestures closely related to some of the initial ideas for the instrumental part. This relationship was aimed at creating a gestural link between media and defined the spectral framework for the piece. The process was divided in three separated main stages:

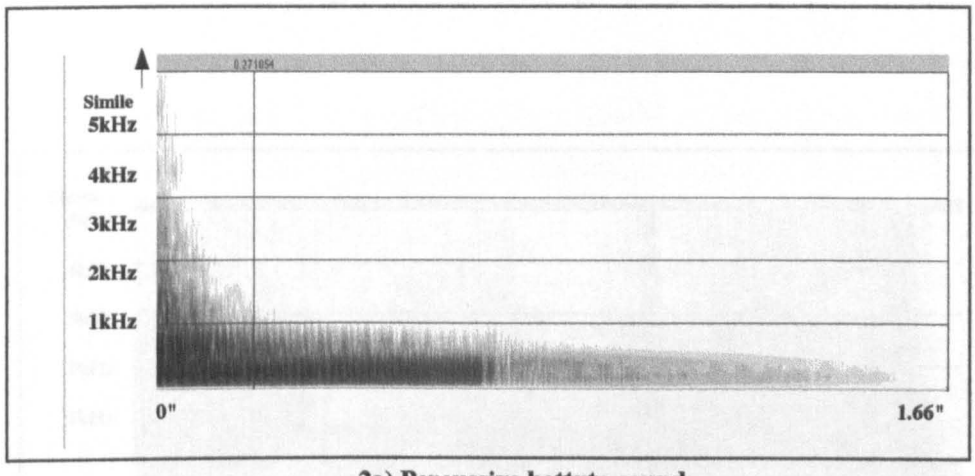
1) An initial three-stage process of obtaining the material:
    a) Exploring performance techniques.
    b) Analysing the recorded sounds from an instrumental point of view (their harmonic content, rhythmic possibilities, etc) or with software (their spectral characteristics, etc).
    c) Ideas obtained from the performer and from analyses of other pieces.
2) Through studio transformations the aim was to create a series of gestures and phrases for the electroacoustic part. These also directly influenced the instrumental writing.
3) A second recording session, divided into two stages:
    a) Recording and editing sound sources other than the cello (mainly voices).
    b) Recording of longer musical ideas or phrases written for the instrument, for subsequent studio transformation.

In 'Tolerance' the grouping of sound sources based on certain performance techniques was intentional in order to emphasise the cello's electroacoustic possibilities. In this way, a broad output of musical material was obtained which

form the basis for the relations between the electroacoustic sounds and the instrument.

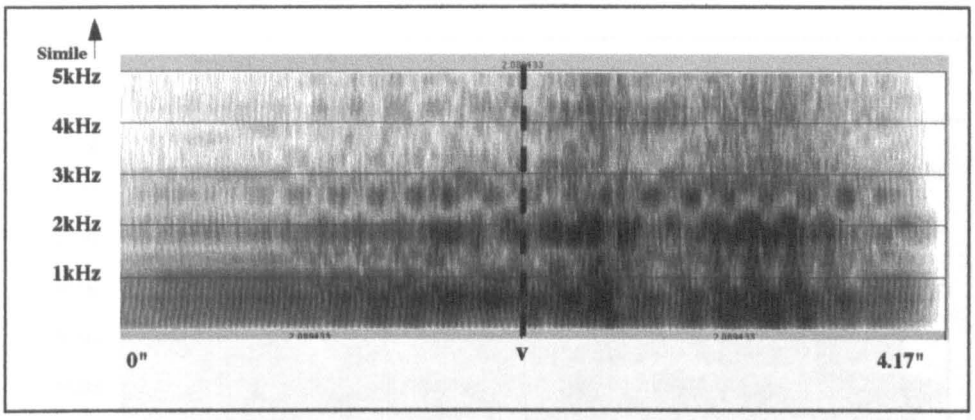
The following categories of performance techniques were used:

1) Percussive sounds are those with a fast and sharp attack together with short sustain and resonance. These can be produced with or without the bow and can be pitched (e.g. notes, chords, etc.) or non-pitched (e.g. wood sounds, etc.). The sounds selected for electroacoustic transformations were mainly *pizzicato*, *Bartok pizzicato* and low-pitched *battuto* sounds (Fig. 2a) (Sound example CD1-7).



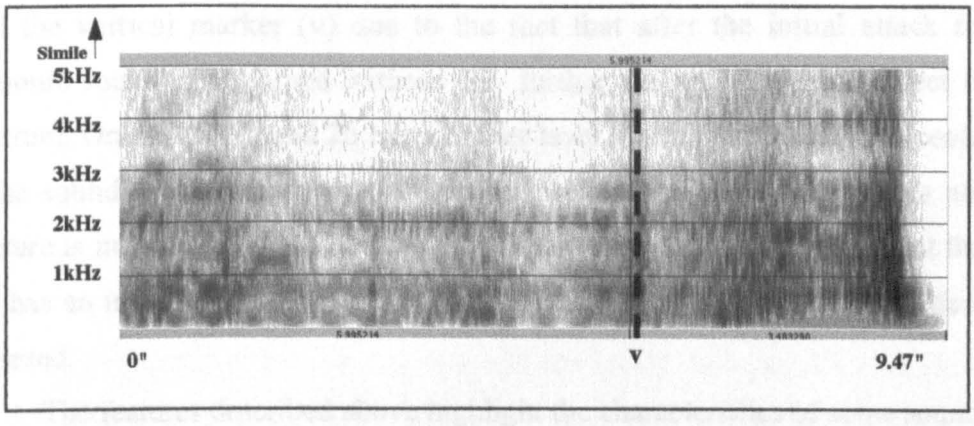
2a) Percussive battuto sound.

2) Sustained sounds were useful for their changing spectral qualities. For example, sustained harmonic sounds can be elements in creating spectral convergence with other spectrally related sounds. Two techniques were used in 'Tolerance'. The first was to use sustained sounds with a change in bow direction, perceived as an accentuation within the continuum but without a new attack (Fig. 2b)(Sound example CD1-8).



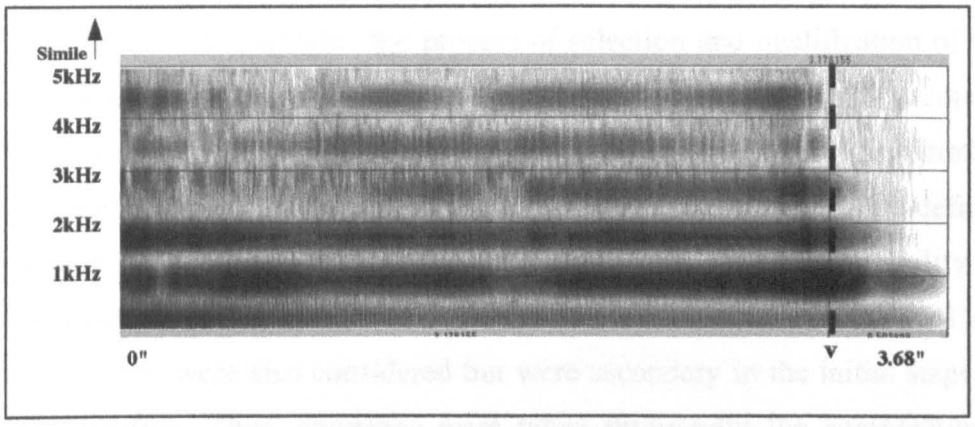
2b) Change in bow direction.

Multiple *glissandi* (constant movement of the performer's hand and sometimes two fingers moving in opposite directions) was the second technique. It can be included in this category due to spectral similarity to the other sustained sounds (Fig. 2c)(Sound example CD1-9).



2c) Multiple *glissandi*.

3) As a result of the cello's multiphonic capabilities it is possible to combine the previously mentioned sounds. Combinations of a single pitch with two different attacks can be obtained, for example a *pizzicato* note together with a bowed note (Fig. 2d)(Sound example CD1-10).



2d) Pizzicato with harmonic.

In the previous examples sound 2a demonstrates a clear percussive behaviour with a relatively long release. Examples 2b and 2d have an evident stability in certain areas of the spectrum, but besides their timbral difference there is a contrast in their level of activity. Example 2d maintains a constant level until the vertical marker (v) due to the fact that after the initial attack the harmonic sound is sustained without any further change that could affect its spectrum. On the other hand 2b has a higher level of activity towards the centre of the sound (vertical marker) where the direction of the bow changes and pressure is increased. Finally, 2c shows a somewhat erratic spectral content that also has an increase in activity after the vertical marker when the amplitude is increased.

The features described above highlight the characteristics of some sounds that were selected and emphasized during the transformation process. These characteristics were then available as links between the instrument and its electroacoustic counterpart. In a way, this was simultaneously a process of creating and analysing the musical material based on a spectral analysis[3], which helped in defining aspects of timbre and pitch later in the compositional process after most of the studio transformations had been carried out.

These source sounds were not the only ones used for the electroacoustic part. Traditional cello sounds and sounds from sources other than the cello (vocal sounds) also play an important part in the piece and will be discussed below.

[3]The spectral analysis was an aural process.

1.2.6 Percussion and electroacoustic sounds

In 'Tolerance' and 'Twilight' the process of selection and qualification of the material was carried out according to a pre-defined sound world and structural plan. On the contrary, the process of dealing with the material for 'Rimbarimba' for marimba and electroacoustic sounds, was different in terms of the pre-defined requirements. Materials were weighted based more on their suitability as rhythmic objects and their usefulness for forming rhythmic patterns. Spectral and timbral interest were also considered but were secondary in the initial stage of the composition. Thus, decisions were taken throughout the compositional process about the inclusion of materials in sections whose boundaries were defined by rhythmic elements.

The intrinsic rhythmic suitability of the vast majority of percussive sources is a compositional constraint which can influence the creation of an electroacoustic counterpart. Therefore, other characteristics of some percussion instruments such as pitch range, multiple timbral possibilities or specific performance techniques, are available for the electroacoustic composer to emphasise non-rhythmic aspects of the selected instrument.

The timbre of the marimba can be described as "dark and mellow and sometimes has been compared to that of the cello or the lower-register saxophone" (Blatter, 1997 p.204). Together with the change in timbre achieved by using different mallets, it is possible to extend the duration of a pitch by performing *tremolandi*. Due to its sharp and fast attack the marimba is agile for fast melodic lines and chords sections using more than two mallets, but at the same time within an electroacoustic environment, the marimba can be used not only in sections requiring tight synchronisation but also in texture-based sections where synchronisation is less of a concern.

In order to explore the marimba as the most prominent source for the piece, certain features of the instrument's sound were fundamental in the process of gathering sound material. As Figure 3 (Sound example CD1-11) illustrates the marimba's fast attack and decay are prominent features. The length of the decay varies depending on the register used. However, because the attack is directly related to the physical action of the performer, it does not change drastically depending on the register. Therefore, the attack time remains constant and the

duration of the decay time is higher when the register is lower.[4] Nevertheless, the fact that there is practically no sustain was of particular importance in planning possibilities for electroacoustic transformation. As explained later, exploration of electroacoustic transformations was intentional in order to create two contrasting approaches to relationships between the media (cross-media rhythmic objects and texture-based sections).

The way in which the characteristics of the marimba sound were explored is directly linked to their use as generators of musical material:

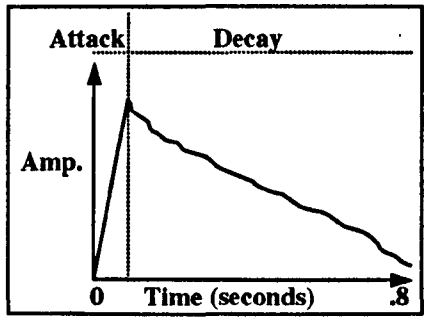


Figure 3. Low-register marimba sound.

1) Fast attack: the sharp attack was used to generate gestures with multiple attacks suitable for transformations in order to obtain sounds with a high amount of internal activity. Through computer means multiple attacks can be compressed into a short period of time so as to be perceived as morphological elements of internal activity, part of a longer fragment and not as individual sounds. In certain sections, closeness of multiple attacks works as a useful linking method. Figure 4 (Sound example CD1-12) shows a series of multiple attacks in the electroacoustic part followed by the instrumental gesture that begins just after 2'46". The *tremolos*[5] are followed by an accented (fast attack) low note that is mixed with the newly introduced attacks in the

[4] Room reverberation can affect the perception of this characteristic. However, it does not affect it significantly when the sources are recorded in an isolated environment like a recording studio.

[5] Although a fast attack is a characteristic of most percussion instruments they all have different decays. It is also worth mentioning that in the case of the marimba the decay and generation of harmonics increases when the frequency of the sound decreases. *Tremolos* can be an instrumental way of emphasising the repetition of attacks over a change in pitch or rhythm. Therefore, they are generally used in the piece as a way to mimic instrumentally multiple attacks in the electroacoustic part.

electroacoustic part. This section was intended as a short, fast-attack passage with a high number of events.

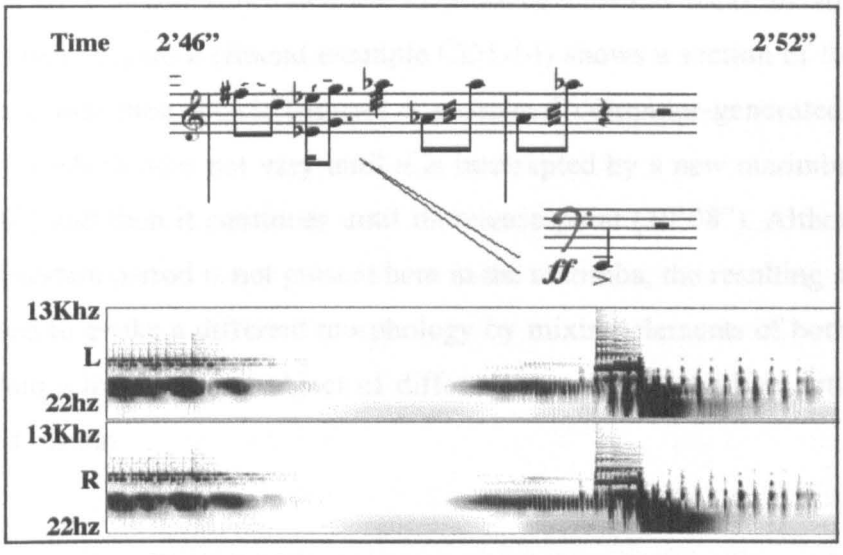


Figure 4. Multiple fast attacks in both media.

2) Decay: the use of computer-designed resonances in order to manipulate the decay of the marimba sound resulted in multiple hybrid short sounds. Resonances were mainly created from close transformations of the instrumental material. Therefore, they can be more easily identified as occurring within the same acoustic space, and function as coherent sounds.

In Figure 5 (Sound example CD1-13) the fragment consists of repeated attacks in the marimba part followed by a louder accentuated two note chord (G & E). An artificial resonance is applied which masks the marimba timbre and fades into a short silence.

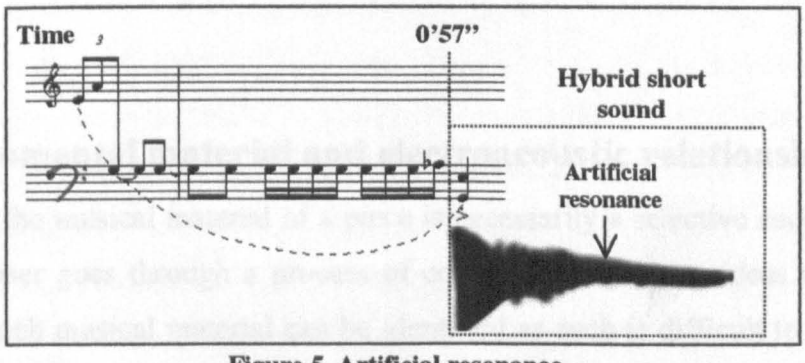


Figure 5. Artificial resonance.

3) Sustain: When manipulating materials in the studio the sustain section of a sound is especially suitable for extension (internal loops with cross-fades to obtain imperceptible boundaries). In 'Rimbarimba' the absence of a sustained section of a sound was intended to produce musical ideas of structural importance. Figure 6 (Sound example CD1-14) shows a section of the piece where a marimba attack triggers a sustained computer-generated sound (10'04") which does not vary until it is interrupted by a new marimba attack (10'06") and then it continues until its release point (10'08"). Although the actual sustain period is not present here in the marimba, the resulting sound is intended to evoke a different morphology by mixing elements of both media to obtain a longer sound object of different morphology with an artificially created sustain.

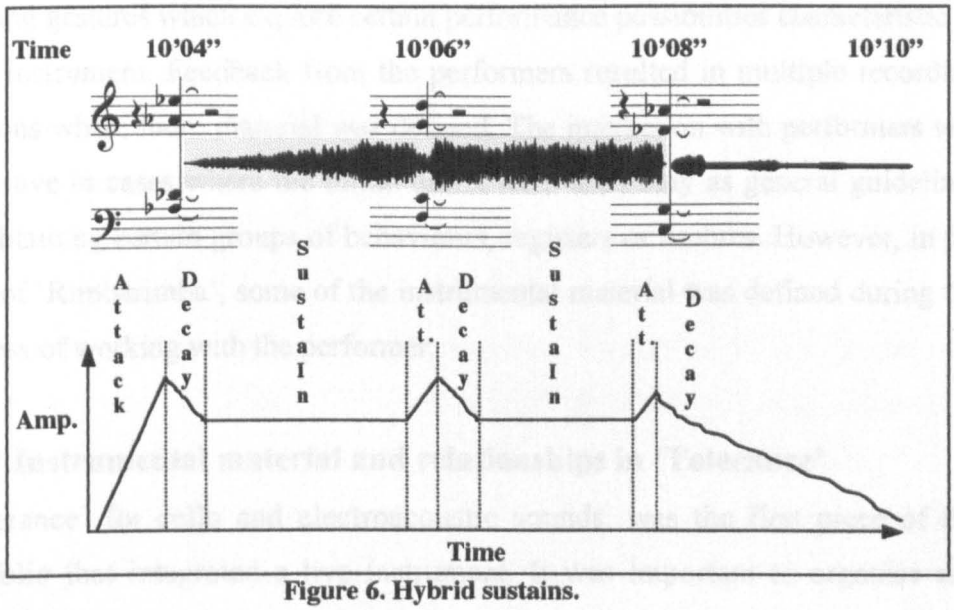


Figure 6. Hybrid sustains.

1.3 Instrumental material and electroacoustic relationships

Describing the musical material of a piece is necessarily a selective endeavour. The composer goes through a process of constantly evaluating ideas and the stage at which musical material can be identified as such is difficult to define. The material itself is an evolving entity that deals with sounds which will be the

source of musical content prior to the determining of any specific musical outcome.

The process of generating instrumental material in the context of mixed pieces is no different from the equivalent stage for the electroacoustic counterpart. Even more, it is created simultaneously and is often closely related to the electroacoustic part in terms of procedures and strategies of selection and control. Nevertheless, it involves the fact that in order for the composer to corroborate and react, the material must go through the performer (interpretation) and therefore it includes external information not completely controlled by the composer. Another issue is that, as opposed to the purely electroacoustic material and sound transformations, instrumental ideas are not heard immediately after being composed. Therefore, they will acquire a different status because their potential and characteristics as material are usually identified at a later stage.

In the three mixed pieces the initial instrumental ideas emerged from drafting gestures which explore certain performance possibilities characteristic of each instrument. Feedback from the performers resulted in multiple recording sessions where more material was defined. The interaction with performers was definitive in cases where the initial drafts were used only as general guidelines for obtaining certain groups of behaviours, registers or timbres. However, in the case of 'Rimbarimba', some of the instrumental material was defined during the process of working with the performer.

1.3.1 Instrumental material and relationships in 'Tolerance'

'Tolerance' for cello and electroacoustic sounds, was the first piece of the portfolio that integrated a live instrument. It was important to organise and identify suitable musical materials and to consider their influence upon the piece's language and dramatic discourse. Thereafter a careful revision of the sound materials and structural relationships developed was a fundamental part of understanding the strategies and processes within the piece.

The cello is an excellent melodic instrument which also possesses a wide range of harmonic possibilities. New techniques developed during the last half of the 20th century offer an extended palette of sound materials that can be of particular interest to the electroacoustic composer. The cello's dynamic and

spectral characteristics further widen this choice of available sounds, thus providing it with advantages in the electroacoustic medium. Furthermore the performer may have extremely detailed control over the shaping and colour of sounds and can acquire a high degree of intimacy with the cello that is not feasible with instruments built using an attached mechanism (bassoon, saxophone, etc).[6]

The core group of musical ideas was composed, following which certain were selected, their "compatibility" with the musical draft for the piece being the main criterion. It is therefore possible to say that the process of selection was influenced by an abstract pre-conceived idea. This initial group of musical ideas was subsequently used as the origin of the sound sources in the electroacoustic part. They can be described as follows:

1) Traditional bowed sounds are the broadest category. As with many instruments the spectral richness of the cello decreases as the frequency of the sound increases. That is why, although sounds were recorded throughout the whole range of the instrument, the majority of the recorded sounds used are within the first octave. Different bowing techniques offer many subtle variations in colour and tone. In other words the pitch, spectral envelope, jitter and amplitude envelope correlate to various bowing actions.
2) Other sounds were generated by combining special fingerings, uncommon bowing attacks or the use of objects to attack the strings or body of the cello. They have variable spectral richness and particular colour depending mainly on the pitch range within which they occur. These sounds are particularly dependent on the performer's knowledge of the instrument's sound possibilities and therefore include sounds that can be considered "personal". For example, the sounds created by knocking with the fist and open hand on different parts of the body of the cello originated from an improvisatory approach and rely directly on the performer's own technique.

[6] Although they may have comparable features, instruments with an attached mechanism offer less control over features like, for example, a continuous uninterrupted sound or change of pitch without a new attack.

The generation of material conceived specifically for the instrument was guided by the following three considerations:

1) Cello gestures were intended to offer contrasting levels of activity, use most of the instrument's range, and were also designed to achieve events of clear "action-reaction" between media. The gesture-based material provided a general grid for the structure of the piece where gestures are used as events to emphasise the link between the instrumental and electroacoustic part. An example occurs in the gesture just before 5'15". Here, the electroacoustic part increases in amplitude and contains a noise-based sound that gradually accumulates energy in parallel with the cello gesture (Fig.7) (Sound example CD1-15).

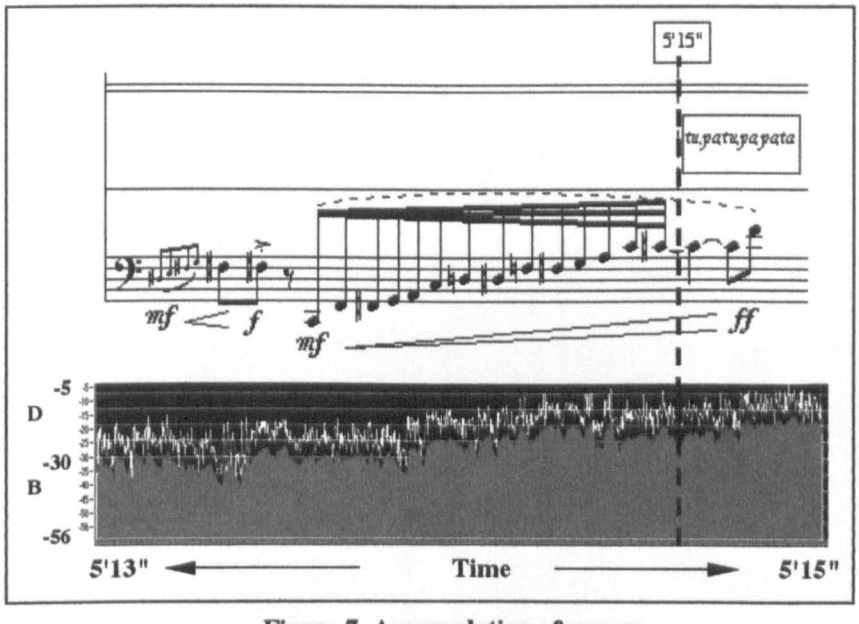


Figure 7. Accumulation of energy.

Selecting musical material with similar behaviours in terms of accumulation of energy, as in the previous example, not only influenced the piece's structural characteristics but also helped to design events with a strong link both at a visual (performance) and aural (sound activity) level.

An example of a gesture used in a different context occurs 1'27" (Fig.8a)(Sound example CD1-16). In this case the gesture triggers a new

section in the electroacoustic part created mainly from low-pitched *glissando*-like sounds. The opposite occurs in the gesture shown in Figure 8b (Sound example CD1-17), where the electroacoustic part ends abruptly at 0'24" triggering this short and fast gesture as a link between a section of intense activity and one which is slower and which emphasises recognisable cello sounds. Their common characteristic is that in these two cases the gestures were used as links between two sections with a contrasting number of sound layers.

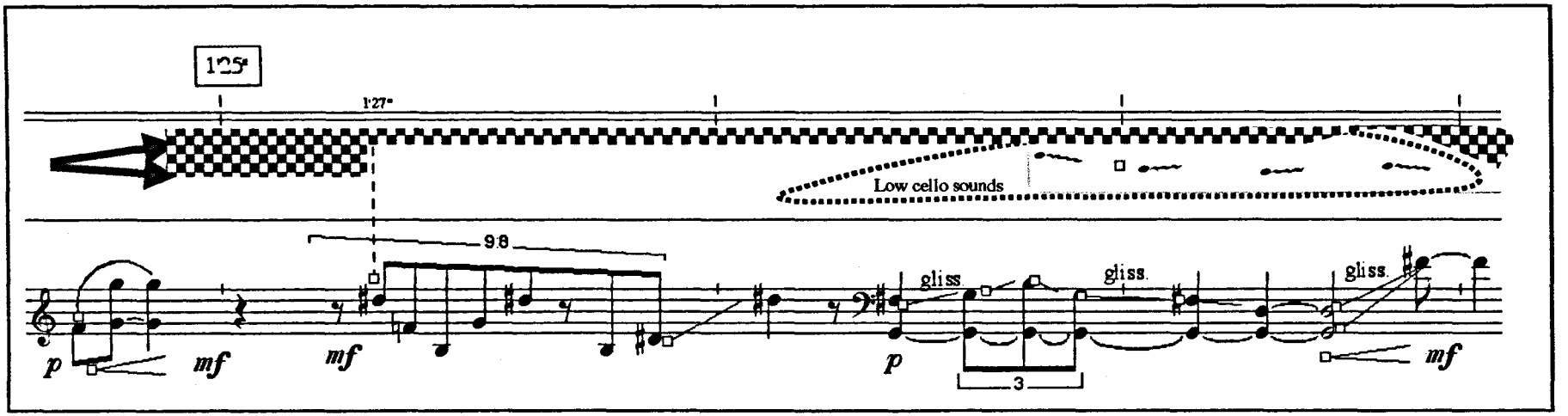


Figure 8a. Cello gesture at 1'27".

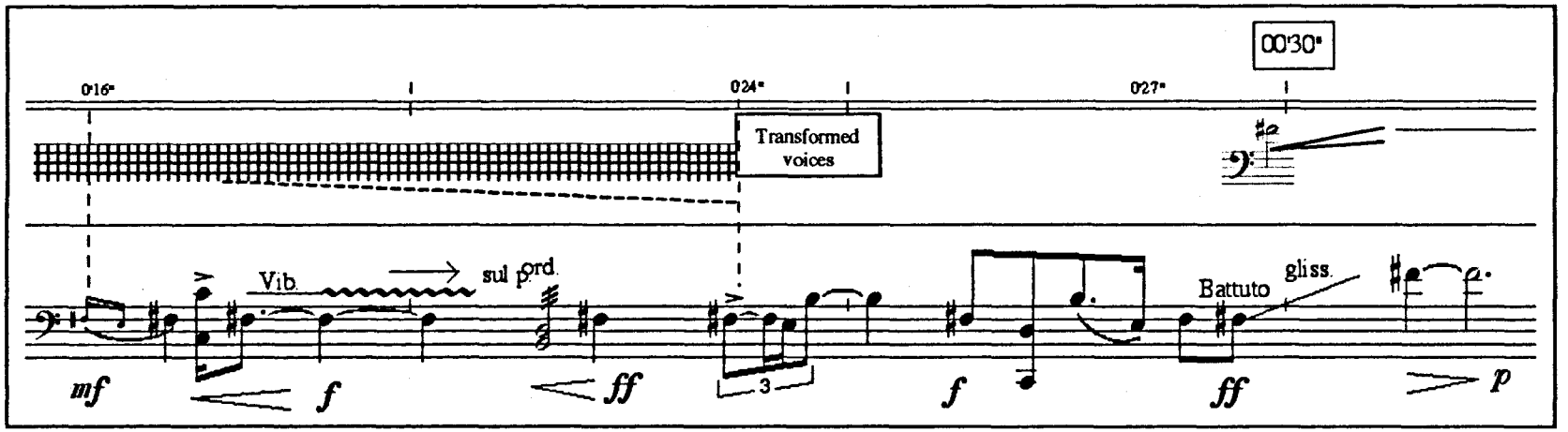


Figure 8b. Cello gesture at 0'24".

2) Harmonies and harmonic relationships derive from the recorded sound sources. In the context of the piece the cello plays chords that are transformed and which appear simultaneously in the electroacoustic part, establishing a link not only between the media but also between the original source sound material and its transformation.

The examples in Figure 9 illustrate two of the intervallic relationships that define the harmonic properties of certain sections of the piece. Figure 9a (Sound example CD1-18) is the first instrumental event and defines the harmonic contour of the opening section (0'00"-0'26"), where the majority of the instrumental activity occurs within the pitches set by the initial chord (B & F#). Although there are some pitches outside that range, their harmonic importance is secondary.

On the other hand, figure 9b (Sound example CD1-19) is a self contained idea that alters constantly the harmonic limits of the interval. The permanent redefinition of the harmonic contour can be used as a powerful link between media if the same behaviour is explored in the electroacoustic part.

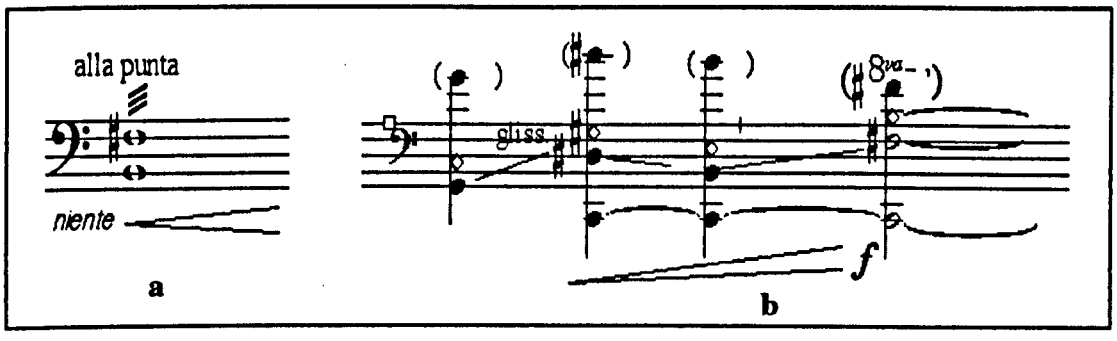


Figure 9. Harmonic intervals.

This approach can be demonstrated by showing spectral analyses of two sounds that appear simultaneously in the piece and that have this particular pitch link (Fig.10)(Sound example CD1-20). After the pitch link occurs, each sound changes and becomes harmonically separated again. In the case of the electroacoustic part the F# (187Hz) is maintained for about 6" until the *glissando*-like chords appear, which is the beginning of the next section. On

the other hand, the instrumental part changes pitch and uses one of the cells described below (marked "z" in Fig.12). In this way both media are momentarily separated again until the new section.

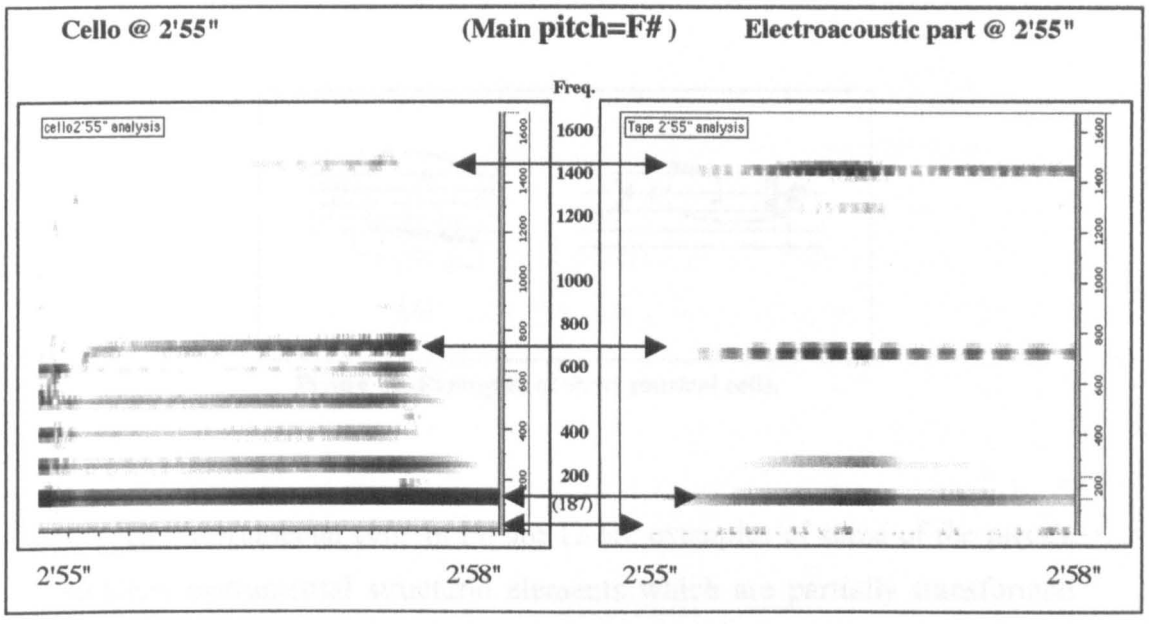


Figure 10. Analyses at 2'55".

Figure 10 shows analyses of the cello and electroacoustic parts at 2'55". The corresponding cello notation is illustrated in Figure 11, where arrows show how the principal frequencies of both media match for almost 3 seconds.

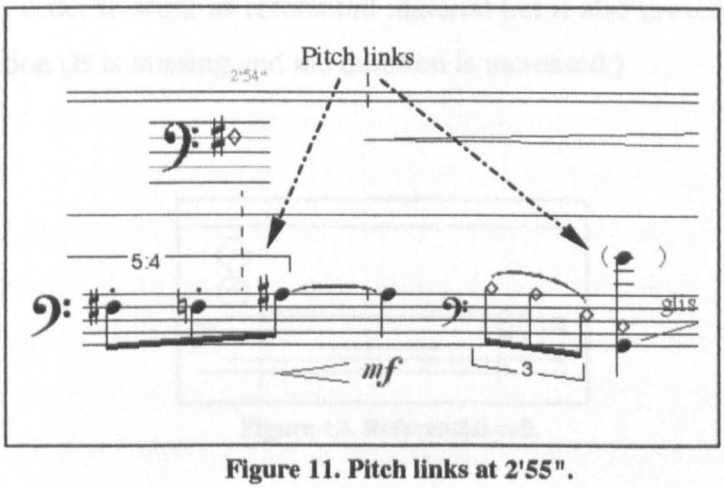


Figure 11. Pitch links at 2'55".

3) Short intervallic and rhythmic cells are used as units for harmonic or rhythmic development. In the case of the instrumental writing, these cells offered a set of musical ideas which contain the potential for combination and transformation, but can also be placed in different contexts in order to work as reminders of previous events.

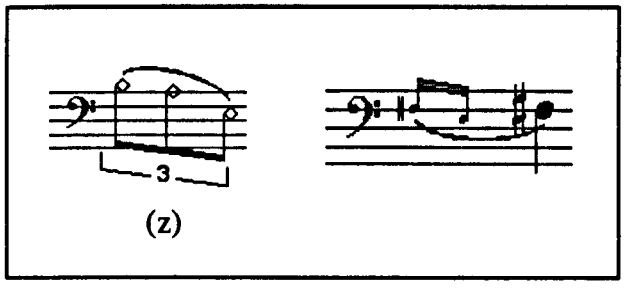


Figure 12. Examples of short musical cells.

The instrumental cells in Figure 12 are examples of some of the piece's smallest instrumental structural elements which are partially transformed without losing their identity. This influences musical structure within the piece by defining patterns of repetition. In a similar way, electroacoustic sound units can be transformed while retaining some of their identity. An example is the cell marked "z" in Figure 12, which can be found without transformation in different places like at 2'34" (Sound example CD1-21) and at 3'51" (Sound example CD1-22). It also appears at 10'28" where two pitches are placed simultaneously but are still written as harmonics (Fig.13)(Sound example CD1-23). This transformation retains a certain identity in order to work as referential material but it also presents a different configuration (B is missing and the duration is increased.)

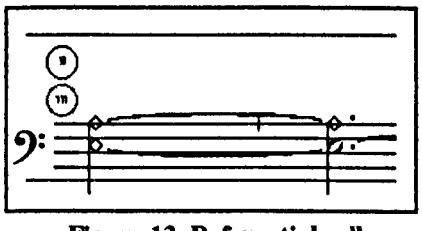


Figure 13. Referential cell.

Throughout the compositional process of the three mixed pieces the idea of using referential material gathered in importance as a structuring tool. However, in terms of dealing with the instrumental material it was indispensable in 'Rimbarimba'.

1.3.2 Material in 'Rimbarimba'

'Rimbarimba' deals with referential material as a strategy to structure ideas and relate media. References occur at multiple levels simultaneously within the electroacoustic or instrumental part or as specific links between media. The piece deals with musical material exposed in a self-defined temporal framework, where all of the events that are to be evoked later are presented within the initial eight-and-a-half minutes of the piece. Sound elements and gestural components are layered, relying on possibilities for connectivity, which depends on the successful control of the characteristics of their identity in order to contribute to the musical discourse. Particular characteristics of the selected elements can be developed or applied to other elements thus generating relationships and structural meaning.

The piece's auto-referential approach can be better described if divided into the following:

1) Harmonic references: the instrumental part leads most of the pitch and harmonic developments in the piece. At the beginning, the marimba introduces pitches that define the main harmonic framework for the rest of the piece. By developing fragments obtained from the initial pitch material and by transferring some of the harmonic explorations onto the recorded part, the marimba constantly utilises references to the initial pitch material to achieve coherence and a congruent harmonic development.

   Figure 14 shows various instrumental events where references to the initial harmonic content of the piece are present. In all these instances the sound context and relationships with the recorded part vary, and their identity and potential for achieving coherence lie in recognisable links within the harmonic content. The initial pitches (A & G) shown in "a" (Sound example CD1-24) are established in the first gesture of the piece and later repeated and

developed into different harmonic sections. References to this particular interval (a major second) are used throughout the piece where, although they can appear transposed, the intervallic relationship is maintained. In Figure 14 "b" (Sound example CD1-25) is an example of the repeated intervallic relationship with a different range. The same pitches (marked with an ellipse) are among those heard. On the other hand, "c" at bar 330 (Sound example CD1-26) is a section where the intervallic material is repeated and extended using a different performance technique (*tremolo*) to create an harmonic floor. Finally event "d" (Sound example CD1-27) is an identical reference that occurs later in the piece at bar 371 and acts structurally as a border between sections.

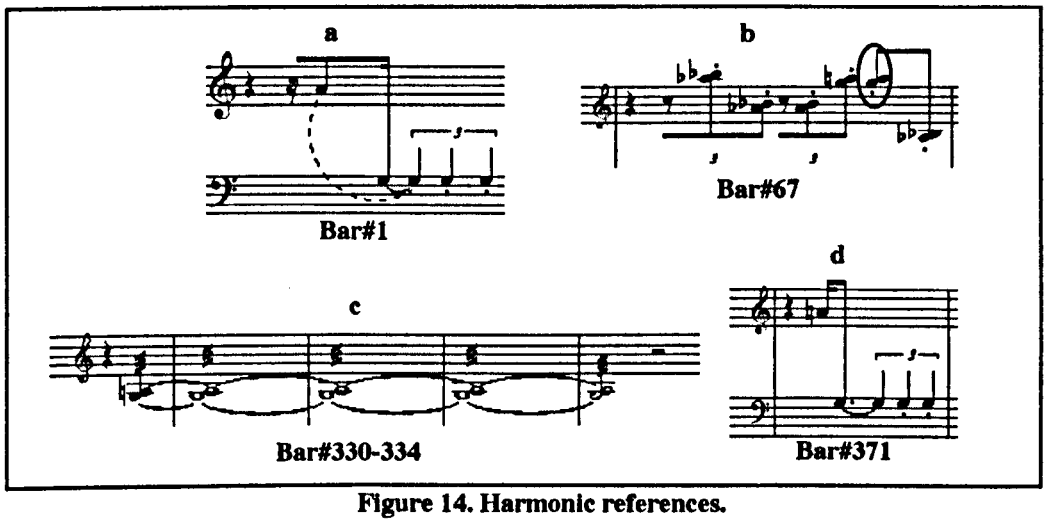


Figure 14. Harmonic references.

In summary, the instances (b, c & d) emerged from the harmonic content of the first gesture of the piece (a). They reappear in different sections maintaining their harmonic identity while the surrounding context and rhythmic relationships vary.

2) Gestural references: gestural identity was of primary importance in the generation of the musical discourse. The rhythm-based contexts discussed later in the text (section 3.4.3) were explored as suitable ground for the development of material whilst retaining gestural identity. Throughout the piece, there are examples of recontextualised gestural ideas, where events are repeated, incorporating morphological variations using performance

techniques such as *tremolos*. In this way, the role of identity carrier was attached to the gestural content of specific material, where rhythmic content was emphasized, while other aspects of the musical idea were modified on repetition.

An example is shown below (Fig.15) where gesture "a" (Sound example CD1-28) which occurs relatively early in the piece (bars 36-37), is later used to broaden the pitch range of particular sections (b)(Sound example CD1-29), and ultimately evolves into the ascending gestures of the piece's final section (c) (Sound example CD1-30). The two resulting gestures (b and c) are related to the original one (a) in terms of their shape and contour and not in their pitch content.

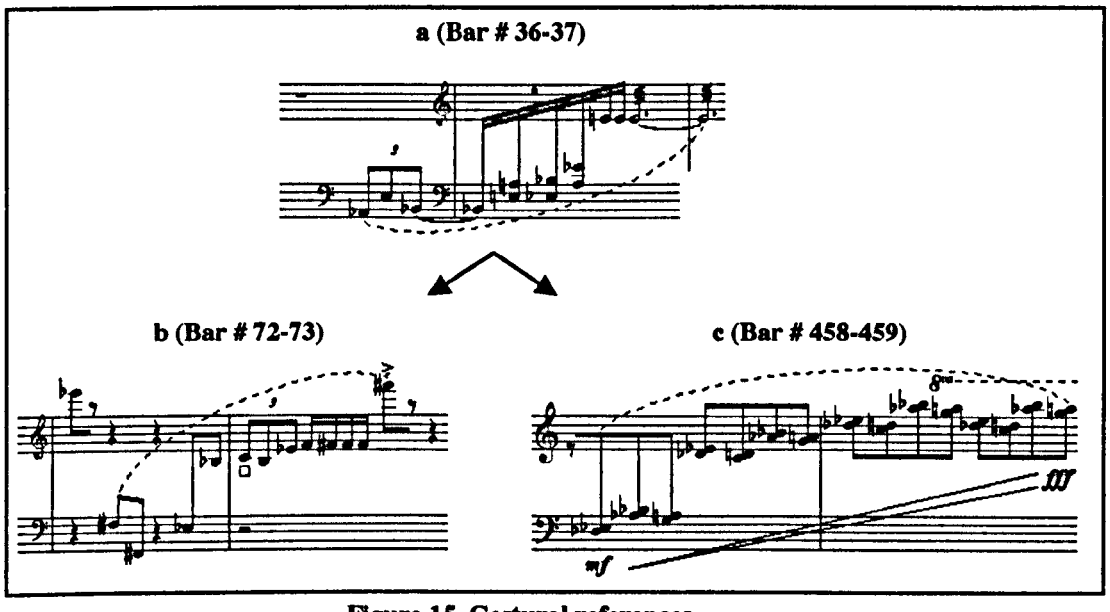


Figure 15. Gestural references.

3) Spectral references: the idea of using spectral material in order to structure and develop the piece was limited to the generation of sections of similar spectral relationships. As opposed to a purely spectral-repetition strategy, the method used does not necessarily imply or aim for recognition of these references by the listener. Therefore, it was a way of controlling the placement of material with structural implications

In the two sections from 4'45" to 5'30" (Sound example CD1-31) and from 11'18" to 11'54" (Sound example CD1-32) the context is based on a

spectrally homogenous sound with few or no relevant attacks. Although certain spectral similarities that also act as referential elements, exist in the electroacoustic part, these two sections were layered to balance structurally the discourse against the otherwise rhythmically-based high-energy sections. This was possible due to the similarity in the spectral relationship of the marimba and the recorded sounds.

1.4 Identifiable sources

Known source sounds are helpful for creating boundaries. Their recognisable character makes them easier to identify as independent elements even when they have been subject to transformation, assuming that the transformation is not too destructive. However, from the perspective of their importance as material prior to making definitive structural decisions, they possess qualities that make them influential at a compositional stage.

Sounds where a source, physical action or material can be inferred require a defined strategy as to their functionality, due to their inherent possibility of being differentiated in an environment where they do not form the majority of the sounds. In these cases, the use of such materials can be the result of different strategies or a combination of methods that emphasise their role as pitch or gestural elements. In other cases, as with speech sounds, they can also be utilised as carriers of meaning, which also has a direct structural impact. Various strategies were explored in order to place sounds with a clear link to their source (vocal and non-vocal) within the general sound world of each piece.

1.4.1 Recognisable sources in 'Cycles'

The use of sounds of recognisable origin was of particular interest in 'Cycles' not only because they are central to the way the piece is structured, but because they determine the process of selecting and transforming non-recognisable sounds.

The most relevant sounds are:

a) The vocal-like sounds that work as triggers for the release of energy (Sound example CD1- 33).

b) The bass drum (Sound example CD1-34) that is repeated throughout the first movement.
c) The choir used at 2'33" (Sound example CD1-35) and 4'24" (Sound example CD1-36) is an important structural element of the second movement linking sections "g" and "j" (See section 3.1.2).
d) Radio-like waves (Sound example CD1-37) are easily identifiable when repeated due to their characteristic pitch trajectories, which create contrast within the overall sound framework in "potS".

The idea that recognisable elements should return to the sound world a number of times almost untransformed, came from the plan for a cyclic structure. I intended to create sound worlds where energy builds gradually and is suddenly released, triggered by external human-related causes (recognisable sounds).

The idea of referential material is also relevant in the light of recognisable sources. For example, in 'Cycles', the idea of a two-movement piece seemed suitable for exploring different ways of using similar source sounds within contrasting contexts. Although the general structure of both movements is the same, the idea of dealing with the same material in the second movement gave me the opportunity to reuse sounds as reminders of the first movement and transform their surroundings. In this way, sounds and their structural function are linked across movements, even when the sound world in the second movement has a faster internal development of ideas and a higher density of events.

A recognisable sound on its own cannot be considered to have a structural function. Its interest resides in the fact that it works as an element in creating repeated cycles or musical phrases. Thus, structural functions for some of the recognisable sounds can be defined as follows:

a) Recognisable sounds are in the foreground when there is a considerable change in the spectral quality or sense of motion (cycles of sound). For example the sound at 0'47" (Sound example CD1-38) is repeated at 3'18" (Sound example CD1-39) in the first movement. The density of elements in both cases is low. Its structural function can be described as an "anchor" sound that defines the starting point of a segment of increased tension.
b) Known source sounds are used as identifiable events when transformations

take place in other areas of the sound context. An example is the sound at 2'34" in the first movement (Sound example CD1-40). It is a vocal sound with a clear interval which is repeated identically every time that the same sound is present, for example at 4'34" (Sound example CD1-41) in the second movement. While their function can be explained as one of dividing or marking the borders between sections, the lack of transformation makes the sound identifiable and recognisable when the sound world is changing.

c) Sounds with obvious links to their origin are placed as events to define long and short cycles. For example, the bass drum sound (Sound example CD1-42) is repeated together with an almost identical sound context, and works as a "sound icon" that helps emphasising the intention of a repeated idea. These sounds also define the limits of longer musical cycles within the first movement. This strategy and the above example, are discussed further in the section that deals with structure in 'Cycles' (section 4.1.2).

1.4.2 Vocal sources in 'Tolerance'

A group of vocal sounds was introduced as part of the sound catalogue for the electroacoustic part in 'Tolerance'. Created at a later stage of the compositional process (described as stage 3a in section 1.2.5) they were intended as an element of contrast that inevitably raised the following concerns:

1) Sounds of recognisable human origin have a direct implication for the listener's perception of the piece. However, there are also sounds in the second half of the piece (from 7'03") that are less identifiable but which are human-related.
2) Their relatively restricted spectral content limited their use as elements on a long-term temporal basis rather than as sound units with their own structural meaning. These sounds are used as rhythmical cells which retain a clear link to their vocal origin.
3) Being short and with fast attack they offer possibilities for rhythmic development and were always utilised in combination with other sounds of the same type to create short vocal-like utterances.

4) Identifiable words were intentionally avoided in order to create sounds that do not imply any specific semantic content.

In terms of their functionality within the piece, the vocal sounds were considered in relation to their restricted spectral timbre and revealed origin together with their short duration. This made them useful as rhythmic patterns but without necessarily repeating such patterns in exactly same way. Their timbre links them as an independent set of rhythmically based sounds throughout sections of the piece. On the other hand, from a structural point of view, their placement as "aural markers" for the instrumental part serves two main purposes. First, they help define the musical phrases of the instrumental part and also the "quietness" of the beginning of the second half. Secondly, they are also intended to create a third layer within the discourse, one that is never in the foreground but nevertheless influences the internal activity of the musical discourse.

1.4.3 Identifiable material in 'Friction of things in other places'

The initial idea was to explore the possibility of generating multiple streams of sound material that can be placed simultaneously in time but with clear differences in timbre and spatial placement. In 'Fotiop' this was done by using many sounds whose source can be related to their origin. Minor transformations were used, but only those that can be controlled so as not to affect deeply the spectral characteristics of the sources (e.g. filtering of the extreme frequencies, short stretching or transportation).

The following figures show one sound and its transformation that can be used as referential material. The original sound was a short female choir voice with little pitch variation, which was initially planned as part of a short, high-activity event forming a boundary between two sections.

Figure 16a (Sound example CD1-43) shows a frequency analysis of the original sound between 500Hz and 16KHz. On the other hand, Figure 16b (Sound example CD1-44) shows the frequency analysis of the filtered sound. The dotted square (Fig. 16b) shows the section of the sound that was filtered in order to alter slightly its spectrum without affecting its link with its source.

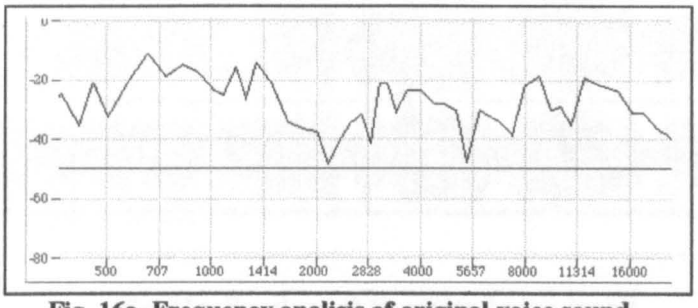


Fig. 16a. Frequency analisis of original voice sound.

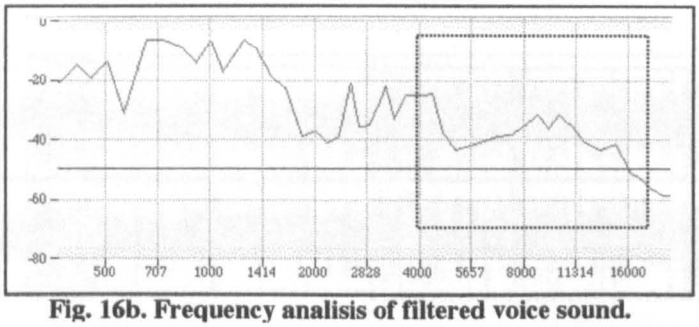


Fig. 16b. Frequency analisis of filtered voice sound.

Another example of transformations intended not to alter the spectral qualities of a sound beyond recognition was the use of granulation after the initial attack of the original sound. This helped to create an obvious transformation, but allowed the sound to be recognised because the spectral characteristics of the initial attack are unmodified.

Figure 17a illustrates the envelope of the same choir voice from Figure 16a (Sound example CD1-43). The sound has five steady sections which correspond to the internal morphology of the sound (the voice sound is continuous but has different pitches). However the transformation was applied only to the very first section of the sound (x). This means that the representation of the sound illustrated in Figure 17b is that of the modified sound enclosed in "x" in Figure 17a. Through the use of granulation, the initial fragment of the sound was repeated (y) and then in the last half, the granulation of the same material (z) generated the last 500 milliseconds of the sound. Although the amplitude is different, the initial attack is untransformed in 17b.

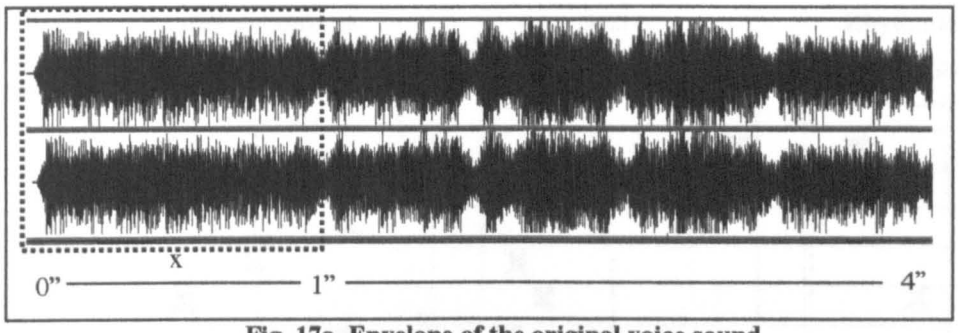


Fig. 17a. Envelope of the original voice sound.

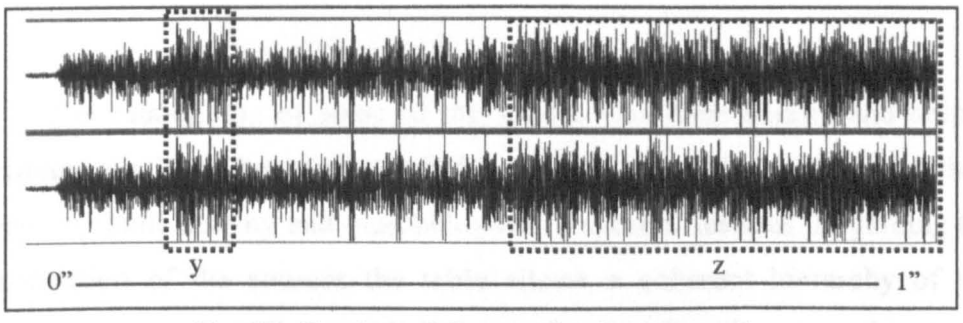


Fig. 17b. Envelope of the granulated voice sound.

The vocal sounds are part of the same fast event in the piece from 4'08" to 4'22" (Sound example CD1-45). However, the voices appear to occur in different spatial positions due to the modifications described above but they maintain a direct source link. In this way, the intention of placing related sounds in different spatial layers helps to broaden the virtual physical limits of the piece thereby creating a more complex and detailed sound image.

Sounds were grouped using the table described earlier in the text (Table 1) and were catalogued according to their placement on Table 2 which served as a method to identify the types of sounds required for certain sections of the piece.

Sound	Sound example	Principal interest (Morphological/Spectral)		Source (Recognisable/Unrecognisable)		Rhythmic activity (Low/Intense)	
0'14"	CD1-46	X			X	X	
0'57"	CD1-47		X		X	X	
1'50"	CD1-48		X		X		X
2'50"	CD1-49	X		X			X
3'22"	CD1-50	X		X		X	
4'13"	CD1-51		X	X			X
5'29"	CD1-52	X			X		X
6'07"	CD1-53	X			X	X	
6'39"	CD1-54		X	X		X	

Table 2. Cataloguing of sounds in "Fotiop".

The cataloguing of some of the sounds was done aurally and helped identifying similitude between sounds for possible links taking into account their source, rhythmic activity and morphological or spectral features. Regarding the identification of the sources the table allows a coherent hierarchy of the recognisable sources to be established in order to utilise it as sound material throughout the piece. However, the table was not used to organise the totality of sounds for the piece and the links were not intended to be immediately identifiable by the listener. For example sounds at 2'50" (Sound example CD1-49) and 4'13" (Sound example CD1-51) have an intense rhythmic activity as one of their main characteristics. Although their source, spectral and morphological features are different both are used to generate an increased amount of activity for certain events of the piece. Thus, because of their similitude in rhythmic activity their structural functionality is similar.

2. Compositional Strategies

"Music was intended to reflect the mysterious accord that exists between nature and imagination"
C.Debussy

2.1 Discourse and meaning

The transmitting of musical ideas operates at multiple levels. For the composer working with acousmatic sound, a formal development of ideas will serve as the generator of a successful discourse. Organisation and coordination of musical material will emerge as an internal "conversation" between the composer's principles of order and the resulting musical information revealed from the concrete functionality of the material. As Vaggione states "constructability can emerge from a plurality of interactive factors" (Vaggione, 2001 p.56).

Musical discourse can be regarded as the way in which musical elements flow and work as evidence of their relationships and roles within the particular network or hierarchy of a piece. It is the way in which the substance of ideas is transformed into functionality. However, it is not possible to achieve functionality within musical ideas without recognisable residues of their essence as elements of discourse. The effectiveness of a verbal discourse resides not only in a successful choice of words, it also depends on the layering of meanings in time and the chosen strategy to create links between ideas. Therefore, in music, the ability to create an elaborated discourse in order to transmit an idea requires the ability to control the layering of musical events with particular meanings.

The concept of musical meaning gathers particular importance when one considers that the individual events of a piece have an internal function as part of the musical discourse. Hence, meaning would be defined by an element of structural content because of its specific placement, and the relationships that emerge due to the context in which it is placed. A sound lacks musical meaning until a relationship is present, and it acquires meaning as an element of discourse through the presence of other elements with which it can be compared. Thus, meaning emerges from the combination of elements to which a sound can be related, and compared to which it can be identified as different. The meaning of a musical element is continually changing and is not discrete. Internal characteristics of the material are constantly emphasized, reduced, prolonged,

shortened and mixed with others. This manipulation is not evident without the possibility of comparing and identifying the changing variables.

Unlike the layering of words in a text as basic structuring units for written discourse, the placement of musical "words" or ideas involves complex units that are not limited to a one-dimensional representation. Their boundaries are never definitive, and they are constantly being redefined by the composer. That is why, although there could be a pre-conceived intention to design a particular relationship or emphasise links between elements, the process of combining timbres or parameters such as pitch and duration, does not include any musical meaning in itself.

In a mixed piece musical ideas emerge from the significance attached to individual sounds and to the relationship between musical elements and media behaviour. Although their possible identification may vary, the differences between the elements compared are what creates a sense of development. A controlled process of transformation in any field will generate a targeted evolution of the musical material. Thus, ideas can be linked and a musical discourse established.

The process of comparing elements does not necessarily refer to the perception and reception of a piece. It also occurs as the composer develops the piece's particular musical language in the studio. Listener and composer alike therefore compare elements in order to gather musical meaning.

2.1.1 Designing discourse in 'Friction of things in other places'

In acousmatic pieces elements of discourse go beyond their possibilities as simple carriers of structural content. Recorded sounds are the unique element whose internal characteristics are available in order to establish musical networks where principles of order are at the core of the organisation of musical ideas and of the critical interaction of ideas with the materials.

Discourse contains a plurality of layers of musical operations of multiple types. It is possible to say that although musical ideas are independent of their application within a piece of music, it is a result of their formalisation within a piece's hierarchy of musical elements that they become influential in the flow of ideas.

In the acousmatic piece 'Friction of things in other places' ('Fotiop') the flow of ideas was explored through a method of linking materials to create contrasting sections of rhythmic or textural interest. In this way, the musical ideas were linked mainly by referring to the internal characteristics of the individual sounds used. The formalisation of the ideas into musical discourse derived from a strategy of linking sections based on considering the characteristics of the group of sounds used for that section.

Sections where sounds were utilised to generate textures rather than rhythmic complexity were intended initially as sections of contrasting internal activity. Here, most of the interest resides within the harmonic content of the sounds and their spatial placement in order to create different sound images. An example would be the initial section from 0'00" until 1'00" (Sound example CD2-1) shown in "a" in Figure 18. At the opening there is a low density of sound material and attacks, and therefore the flow of material focuses on spectral content. As the sonogram shows, this section basically comprises sounds within the lower end of the spectrum and creates a continuum without new loud attacks.

A second approach is shown in sections where although there is no emphasis on rhythmic repetition, an intense internal activity is present in most of the sounds. In these cases, for example from 2'16" until 2'50" ("b" in Fig.18) (Sound example CD2-2), the sound morphologies generate a section of cumulative energy without necessarily being perceived as rhythmic objects. This approach is useful to link texturally based sections with ones where rhythmic content is in the foreground like that one between 6'06"-6'16", explained below. In the sonogram, two short events which cover a wider range of the spectrum are present but there are no fast attack events like those represented in sonogram "c".

Finally, as exemplified in "c" (Fig.18), the definition of boundaries was obtained by sections of rhythmic activity with noise-based sounds and a low harmonic content. Such strategies are useful tools to achieve a successful musical discourse by switching focus between various layers or streams of activity. It is possible momentarily to change the focus of the musical material from a context with a wide stereo image and a low rate of internal activity into a context where short non-harmonic percussion-like sounds create gestures where rhythmic interest is emphasized. An example of this can be found from 6'05" until 6'16" ("c" in Fig.18) (Sound example CD2-3), where loud sounds with a percussive

origin are placed in the centre of the spatial image which contains an intense amount of rhythmic activity. They slowly reduce their dynamic level and integrate with the texture at 6'16", where the long-evolving sections in the background become more prominent features of the general sound world

These examples are intended to illustrate a method of controlling the placement of ideas obtained from the individual groups of sounds. The intention was to create sections emphasising the internal spectral or morphological qualities of each group of sounds, creating a discourse by placing them throughout a grid where contrast between texture-based and rhythm-based content was a priority.

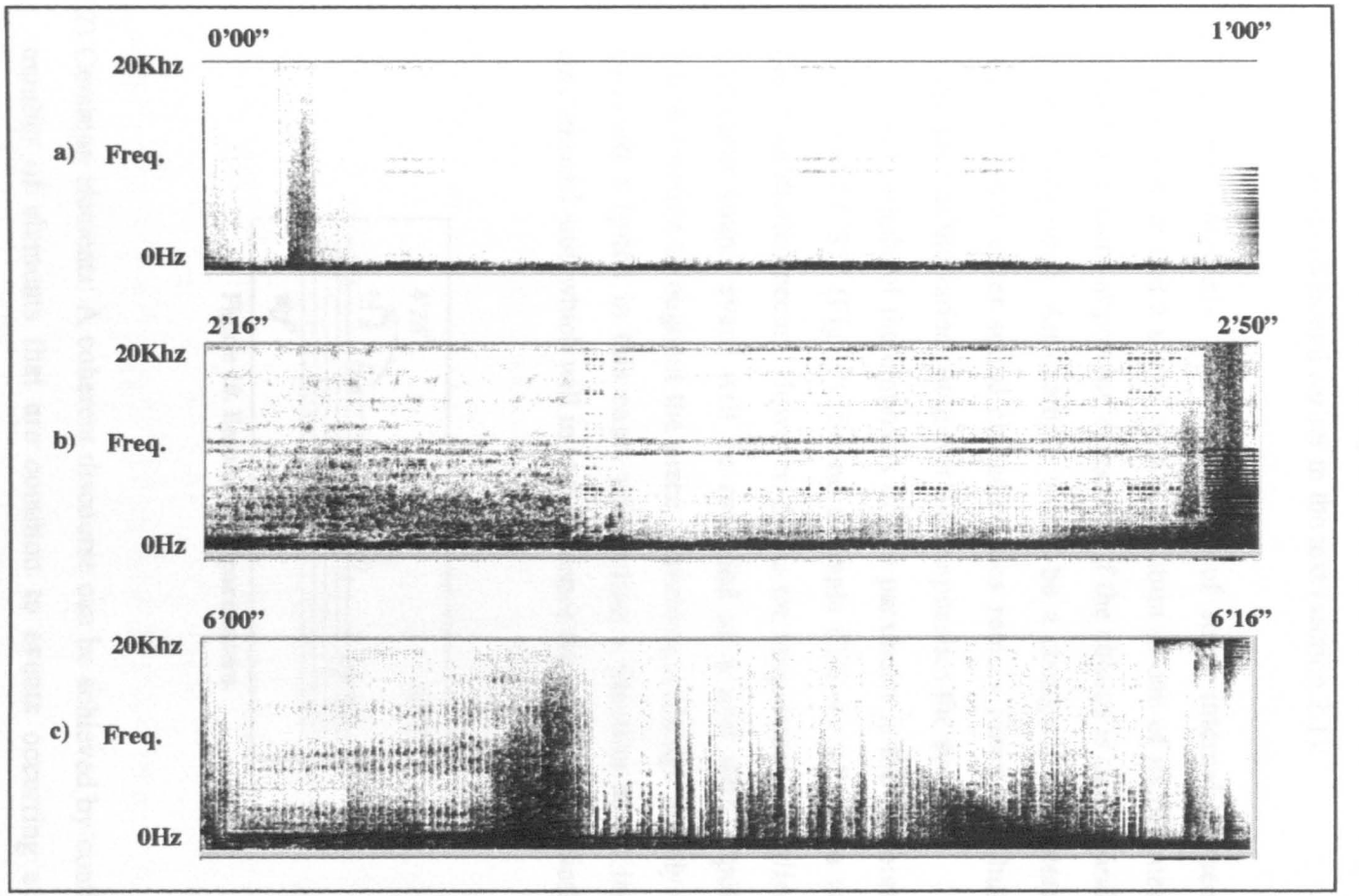


Figure 18. Contrast of internal activity in 'Fotiop'.

2.1.2 Elements of discourse in 'Twilight'

Composing 'Twilight' was a process of setting limits to the amount of musical information being layered simultaneously. There was an intentional strategy of organising musical material taking into account some of the concepts regarding musical meaning mentioned earlier in the text (section 2.1):

1) Parameter emphasis: The uniqueness of some internal elements can be emphasized so that a sound with a variation in one of its parameters can be regarded as more important, especially if the change is drastic and presented in the foreground. An example would be a change in the internal rate of activity when other sound characteristics remain identical. Thus, it is the singularity of the varied parameter that emphasises the event.

   An example of the emphasis of one parameter is the bassoon part from 4'24" until 4'37" (Fig.19) (Sound example CD2-4), where no variation in timbre or rhythm occurs. However, due to the long descending *glissando,* that particular sound event will be regarded as a unit with a potential for transformation throughout the piece. Moreover, a change in only one of the parameters (pitch in this case) will define a function as an independent instrumental unit, which will in turn influence the rest of the musical stream.

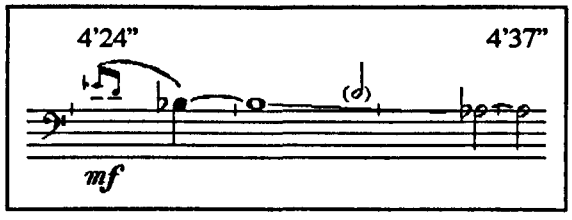


Figure 19. Emphasising parameters.

2) Common elements: A coherent discourse can be achieved by controlling the number of elements that are common to events occurring at different moments. These can be divided in three categories, the first one being when two sounds have similar spectral content and behaviour (similar behaviour and spectral content). Examples are the first sound of the piece (0'00") (Sound example CD2-5) and the sound at the beginning of the fourth movement

(11'00") (Sound example CD2-6). This noise-based sound is repeated (with a shorter envelope) in order to evoke the context of the beginning of the piece at the start of the fourth movement.

The second category is when two independent sounds can be recognised as originating mainly from the same source (common source). Throughout the piece different sounds of vocal origin are used mainly to create short gestures that are mixed with other sounds with similar morphologies in the recorded part. An example of common source sounds are those at 1'52" (Sound example CD2-7), 6'42" (Sound example CD2-8) and 11'16" (Sound example CD2-9). They clearly originate from a vocal source although their function within the particular sound event is different and their internal morphologies are not identical.

Finally, the third category would be sounds produced by a similar action (common action). This can occur through a similar performance technique on the live instrument or by applying the same transformation to different sounds, for example, the different sounds obtained from the bassoon by attacks with no defined pitch, produced by hitting different key combinations. Although their timbre and duration may vary and they may appear in different rhythmic combinations, they maintain their common source characteristics. Some of these sounds occur in at 6'11" (Sound example CD2-10), 7'09" (Sound example CD2-11) and 7'38" (Sound example CD2-12).

The idea of source-cause (Smalley, 1993) is relevant when not only the body of the source is important but also the action required in generating the sound: how memorable a sound is and how drastic the transformation applied to that sound will interfere with the recognisability of the source.

3) Morphological similitude: Similar morphologies can be identified as such even when they belong to sounds with radically different spectral content. It is therefore possible to identify morphological correspondence or equivalence in sounds that are spectrally different.

Figure 20 illustrates how the bassoon's trill at 2'00" is immediately followed by a vocal sound in the recorded part, which itself is morphologically similar (2'05") (Sound example CD2-13). There is also a recorded bassoon trill in the electroacoustic part to emphasise this overall

sound relationship. The vocal sound prolongs this morphological type even when the bassoon *tremolo* finishes.

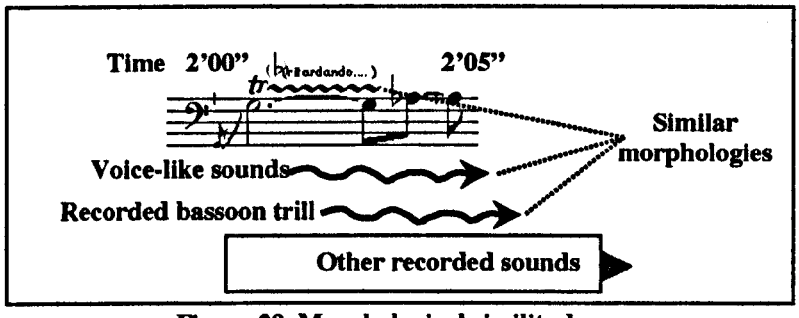


Figure 20. Morphological similitude.

4) Contrast: As musical discourse emerges from the relationship of the events within a particular sound context, a sudden and simultaneous change in multiple parameters will attach certain importance to that particular event. The contrast obtained through a change in pitch, timbre, dynamic, level of internal activity and other parameters will be perceived as a prominent feature within the evolving sound continuum. A contrasting element such as this will possess particular structural meaning in a piece where the musical stream would not otherwise be interfered with by a contrasting event.

In 'Twilight' this strategy helped define the rate at which musical information was delivered, considering these events as boundaries between musical phrases. The sonogram in Figure 21 (Sound example CD2-14) shows the contrasting amount of activity in sections "a" and "b". At 11'14" (marked "v") the section abruptly interrupts the ongoing tension-building process with a different timbre (a bell-like sound is introduced in the foreground). All the other parameters are rapidly changed due to the fact that the overall sound world includes only reverberations of the previously heard sounds which are fading out for two seconds. Therefore, there is an absence of rhythmic information, pitch remains undefined and the spectrum becomes empty.

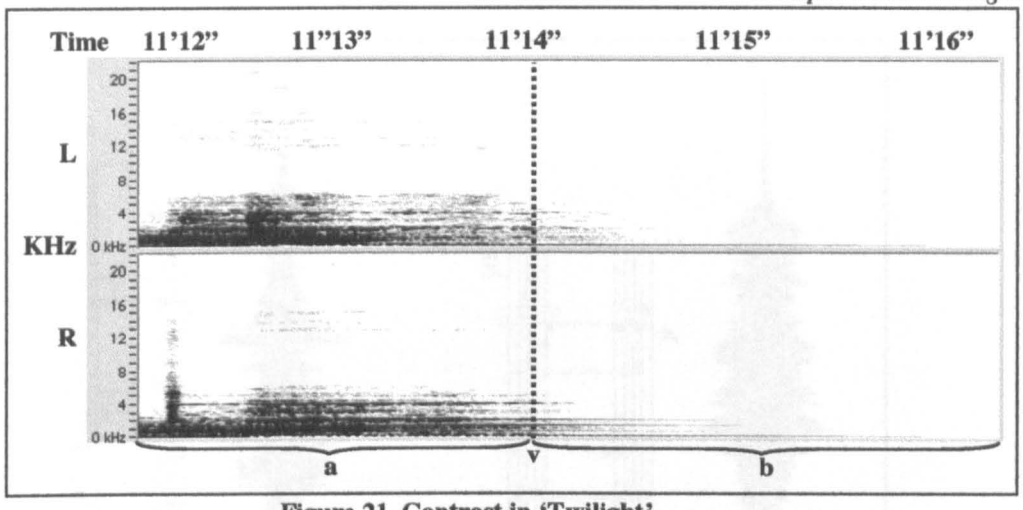


Figure 21. Contrast in 'Twilight'.

2.1.3 Implementation of musical roles in 'Rimbarimba'

As discussed in the previous chapter, the role of the musical material is defined and constantly reoriented in order to generate a suitable context for the composer's reaction to the creative output. The interactive process of transforming sound and generating an instrumental part is also a process of judging the state of the overall musical context. The composer is responsible for qualifying the relationships and their implications, and for responding in accordance with the defined constraints in order to achieve coherence.

An example in 'Rimbarimba' is the section between 9'27" and 10'11" (Sound example CD2-15) where a series of chords is mixed with recorded extended resonances (Fig.22). These were placed with the following two main roles in mind. The first is a structural role due to the fact that these chords occur roughly in the middle section of the piece, and can be explained as a section where the piece's key pitches are presented in a vertical manner. This is enhanced by the fact that they follow a section the main characteristic of which is a horizontal layering of material (from 7'47"). They also aid in generating a section that is spectrally limited and has a slow rate of activity. Therefore, the structural importance of these chords is definitive in preparing for a subsequent cumulative process which itself prepares the highly active final section of the piece. They also act as a structural divider between the last two thirds of the piece.

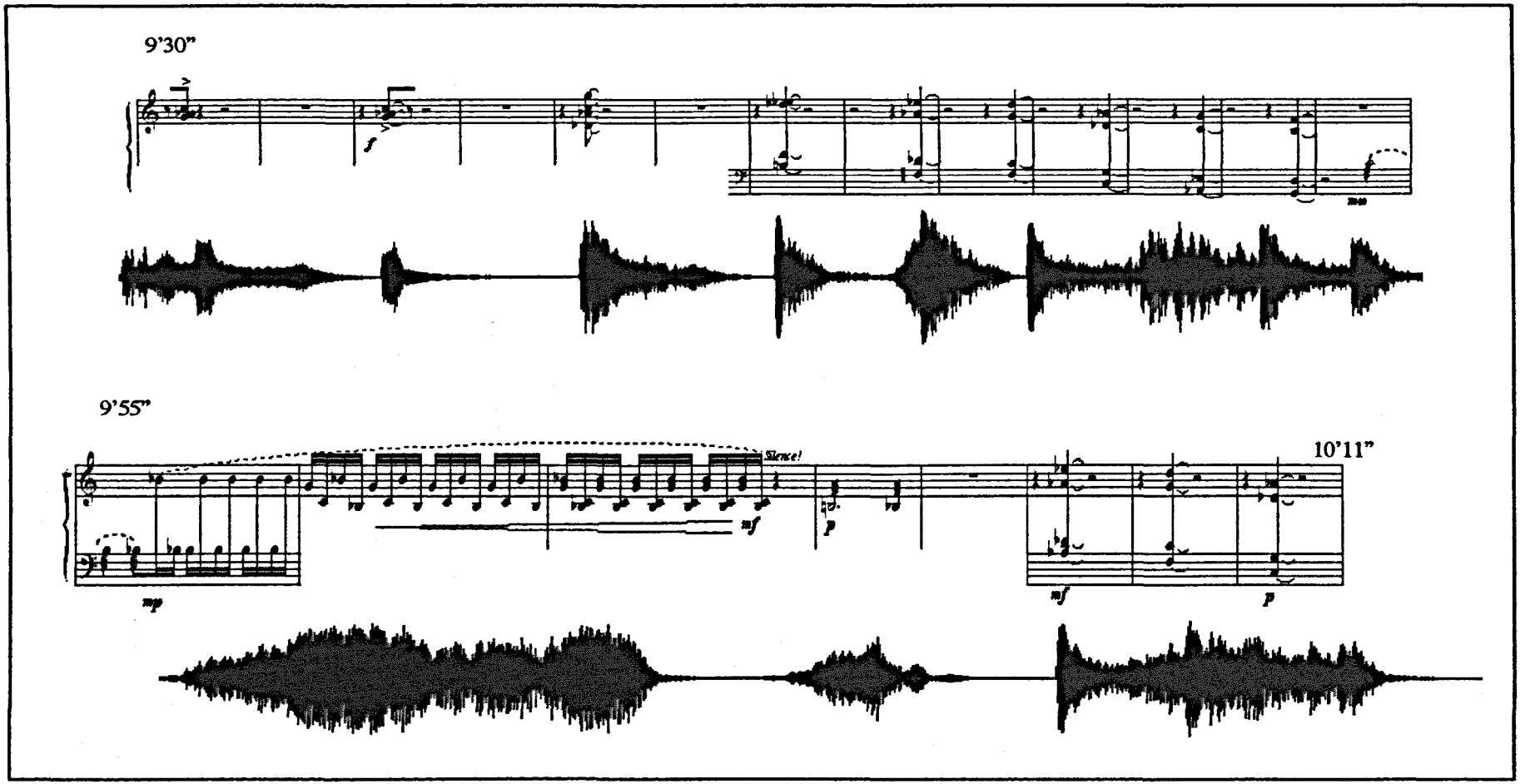


Figure 22. Resonances in 'Rimbarimba'.

The second role is as contrasting events, as exemplified after the high-intensity section found between 7'47"-9'27" (Sound example CD2-16) where the series of chords acts as fading out impulses. Their spectral constraint and slow harmonic evolution, together with a sound context without any other elements, were intended to create a contrasting sound world in which the amount of perceived activity reduces.

2.2 Designing relationships

The multiple operational levels in the compositional process require the composer to define the set of links between sounds and musical options that interest him in order to unify the otherwise fragmented sound world. Clarke refers to this idea when he says that "the ability to make connections between sounds and transform one type of sound event into another is central feature of many compositions" (Clarke, 1999 p.239).

If we consider acousmatic music as a process of linking many different acoustic individuals into one coherent sound environment, the composer's principal duty is one of designing an inclusive environment without destroying their individual sonic identity.

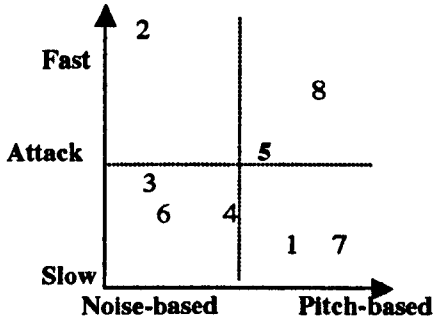
2.2.1 Sound links in 'Cycles'

In the acousmatic piece 'Cycles' the issue of designing links between musical events was a constant concern. Sounds and their transformations are almost a "living" element that changes constantly and reveals itself as a multidimensional palette of parameters. The process of designing sound relations was mainly based on three musical characteristics: spectral features, transformations, and morphology. Parameters like frequency and duration were considered secondary for developing the musical ideas and linking sound material.

1) Timbres with similar characteristics are grouped and used with this idea in mind. Therefore their possible combinations can be used as unifying elements. An example of this is the sound context occurring at 1'00" (Sound example CD2-17) and at 2'00" (Sound example CD2-18) in the first section of 'Stop',

which have common timbres within a different sound framework.

2) Equivalent transformations or similar processes of manipulation can be applied to materials with different characteristics, or similar transformations can be applied to the same sounds. The sounds at 4'08" (Sound example CD2-19) in 'Stop' are an example. They are clearly a result of transformations of the same source as those sounds in the first seconds (0'02") of 'potS' (Sound example CD2-20). These heavily processed granular–like sounds are a link between two different transformations (in two different movements) applied to the same sound.
3) Articulation of musical ideas is a powerful tool for linking musical material, and the morphology of the sounds helps to group and combine them. In 'Cycles', musical phrases were basically defined by the sound's particular elements and their transformations regarding attack, spectral features and their possible combinations according to their common characteristics. For example, as Figure 23 shows, sounds "1" and "3" share a slow attack. Therefore, they were combined in the first movement between 0'30" and 0'47" (Sound example CD2-21). On the other hand, sounds "2" and "5" are mainly noise-based with fast attack. Therefore they also sound simultaneously at the opening section of the second movement (0'00"-0'32") (Sound example CD2-22).



Sound #	Time	Movement	Description of sounds
1.	0'35"	'Stop'.	Unprocessed bass drum.
2.	0'28"	'potS'.	Noise-based fast sounds originated from filtered voice sources.
3.	0'30"	'Stop'.	Active noise sound originated from the vitamin C tablet recordings.
4.	1'05"	'Stop'.	Slow pitched continuous sound.
5.	0'06"	'potS'.	Slowly evolving low sound that defines the lower end of the sound framework in the initial section of the second movement.
6.	5'09"	'Stop'.	Slow attack noise sound originated from transformations of the vitamin C tablet recordings.
7.	1'58"	'Stop'.	Pitched sound of constrained spectrum.
8.	2'38"	'Stop'.	Transformed vocal sound.

Figure 23. Spectral characteristics to create articulations.

The process of establishing links between sound material becomes more complicated when multiple variables are to be modified at the same time. In 'Cycles' there is a particular concern with this and it was an intentional decision to avoid simultaneous changes in more than one field.

Between 1'43" and 2'38" in 'Stop' (Sound example CD2-23) the spectrum covered is reduced and various sounds are slowly integrated without any change in flow of time (For example sound "6"). It changes considerably towards the end of the movement. This is a slow evolving texture without any change in the overall sense of tempo and rhythm. Another case would be rhythm, which can evolve without any timbral change. The sounds occurring between 4'08" and 4'34" in 'Stop' (Sound example CD2-24) are a good example of the sense of *accelerando* within a sound without any change in its timbral characteristics.

Phrases and gestures can be identified while the timbral or rhythmic relations remain the same. For example, in 'potS" the initial gesture at 0'00" (Sound example CD2-25) has a clear sense of motion. A different sound (sound

'2' in Figure 23) is suddenly introduced in the foreground at 0'28" but does not change the general sense of rhythmic activity, tempo or timbral framework.

2.2.2 Relating material in mixed pieces

As discussed earlier (section 2.2), a piece for solo instrument and an electroacoustic part will inevitably uncover the problems of developing a successful set of relationships while maintaining and exploiting the uniqueness of the piece's available combinations.

A mixed piece with solo instrument has an unavoidable parallel with Western music concepts and musical forms, and strategies identified as part of a Western-music tradition are still present at the core of the process of developing musical material. The need for a dialectic discourse, dissension and rivalry between parts, generation of the solo material and its sublimation to the electroacoustic part or vice versa, are among the expected basic relational ideas. The composer must address these concerns and define a set of musical rules for a successful discourse to take place.

In the light of the three mixed pieces there are some concepts that acquire importance as methods of relating elements. Although, some strategies to create links at multiple levels are the result of explorations that are impossible to describe in all stages, it is possible to find common techniques and approaches to generating relationships.

By superimposing musical material in a controlled way it is possible to emphasise prominent characteristics. Relationships can be achieved by controlling dynamic, spectral and morphological qualities and singularities can be selected as suitable for development by prioritising spectral or morphological characteristics.

On the other hand, imitation is available as a tool for relating the recorded and live instrumental parts in order to obtain spectrally and gesturally interesting sound worlds. However, this is different from plain repetitive techniques in the way that boundaries between different sound objects can be masked.

A third concept would be the possibility to combine methods to relate elements and generate "hybrids" that contain emphasized characteristics from various materials. The intention behind hybridisation is to generate new

morphological material by pairing sound elements not originally related. The spectral content of the combined material was therefore seldom manipulated in order to highlight the closeness of the hybrid material.

2.2.3 Developing links in 'Twilight'

'Twilight' contains useful examples of the development of links in a mixed piece. Relationships were developed using the following basic ideas:

1) Superimposing.

Similarities in the material can be highlighted and used as unifying tools through the simultaneous layering of different musical ideas. Although superimposing has direct structural implications, it is helpful in controlling the complexity of the resulting sound and spectral content at any particular moment in the piece.

The superimposing of material can be done taking into account its morphological progress, its spectral content or a combination of both. The combined musical materials will have particular spectral and morphological characteristics that define them as relevant elements within the musical discourse. Such elements can be placed and used as events of structural significance. In other words, the simultaneous controlled placement of independent materials belonging to different media will generate a new set of links, influencing the rate at which the events in the piece unfold.

Figure 24 shows how superimposing is used in 'Twilight' as a mean of emphasising certain attributes of the musical material and therefore of controlling the rate at which the musical information is delivered. The event was created by superimposing short bassoon and non-bassoon source sounds and can be considered an independent event in the piece. There is a continuous evolution of the sounds in this section where all the overlapped elements are confined to the event's duration (2'27"-2'46") (Sound example CD2-26). The bassoon's material is based on Ab, F, Eb and A. This particular sequence of pitches is augmented by different performance techniques in order to obtain a diverse instrumental colour (fast-notes, *frullato*, repeated attacks and *tremolo*). At the same time, the recorded part introduces four

independent elements (a, b, c & d) that gradually help define the overall sound world for this particular fragment of the piece.

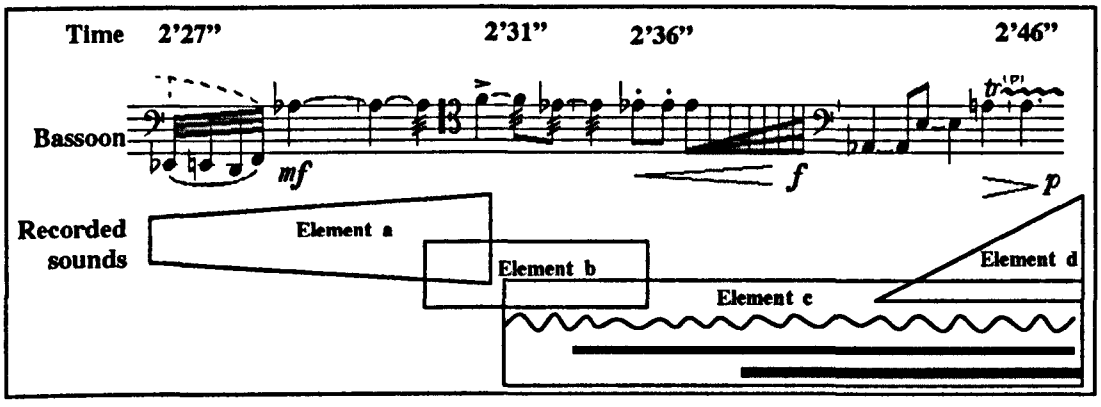


Figure 24. Superimposing in 'Twilight'.

Examples of the new set of links created in this section are the fast accelerating attacks in the bassoon part (2'36") which overlap with the initial trill in the recorded part (in element "c"), and the initial voice-like recorded sound which occurs at the same time as the bassoon's *frullato* (2'31").

Superimposing occurs not only between the instrumental and the recorded parts, but also within the recorded part itself. In the example the superimposition of elements in the electroacoustic part can be divided in to those without a recognisable bassoon origin (elements a, b & d explained below) and element "c" which comprises three pitched bassoon sounds, one playing a trill and two other sustained notes. "a" is an harmonically constrained sound that works as a "bridge" linking the previous event. "b" is a transformed vocal-like sound which emulates the morphological behaviour of the bassoon sound by imitating a tremolo. "d" occurs towards the end of the section at 2'40" and it is a noise-based sound that rapidly increases in dynamics and in internal activity. Finally, element "c" works as an intermediary between the instrumental sounds and the computer transformations. Its nature as an intermediary is significant due to the fact that it includes morphologies and timbres directly related to the live instrumental part. The untransformed bassoon sounds included in element "c" from 2'32"

are extended beyond the end of the event at 2'46" which also defines its role as an intermediary event.

Superimposing can also be considered as a strategy to establish relationships not only between instrument and recorded part, but between the available sound materials in general, regardless of their origin, considering, for example, their spectral, rhythmic or harmonic attributes. The superimposing of sounds creates a palette of musical variables from which combinations emerge as independent events. It is therefore necessary to control characteristics such as positioning (space), mixing of material (dynamic level) and length of the overlapped elements (duration).

Summing up, a vertical array of previously non-related sounds with particular structural functions will be perceived as a new event with an internal sound hierarchy and relationships. Thus through superimposition, independent sounds can be a method to control sound density.

2) Imitation.

Resemblance between diverse musical materials acts as an effective method of establishing links between the recorded sound and live instrument. An element whose characteristics (spectral or morphological) are also identifiable in sounds present in its surroundings will establish itself as "belonging" to that particular sound context. A sound is able to appropriate features obtained from its role in any particular context, such attached features that are suitable for development as compositional elements.

Successful timbral imitation depends on the sound sources available. However, the possibilities for timbral control in the instrument and emphasis of certain spectral characteristics through the use of technology, combined with other dynamic and rhythmic relationships, offer the potential for masking timbral boundaries within sound material. Two different methods of imitation were used in 'Twilight':

a) Sound concealment: developing objects with similar timbral characteristics is a method useful to disguise sound identity. Transformations can be used to imitate live instrument performance techniques in order to create spectral similarity and create ambiguity of timbre.

In Figure 25 the transformed sounds in the recorded part are recognisable bassoon sounds that have defined pitches (A & Bb/D). They are masked by the multiphonic in the live bassoon part. In this way, the whole segment between 4'10" and 4'20" (Sound example CD2-27) appears to be timbrally uniform and, although the source is clearly bassoon-related, it is difficult to identify the medium where the sound occurs. There are also two non-bassoon related sounds in the recorded part in the background, which help link this section to the subsequent section.

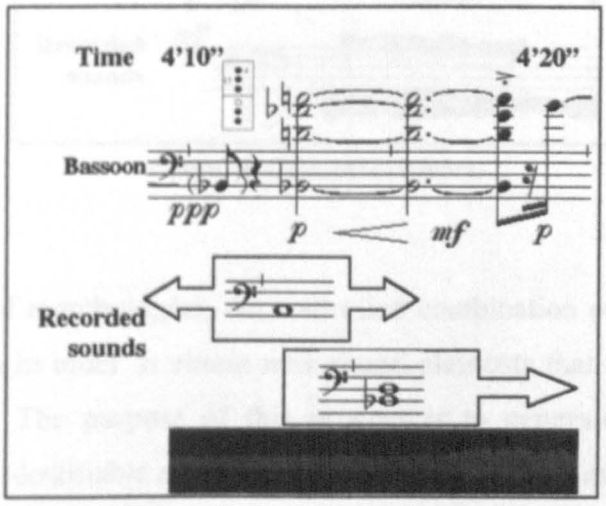


Figure. 25. Sound concealment.

b) Gestural imitation: although gestures can be identified as originating from a specific source, they can also be a useful unifying tool when gestural information from both sources is combined. Gestures in 'Twilight' were conceived as musical elements regardless of their source and it was the combination of their intervallic, dynamic and rhythmic characteristics that guided the process of creating these cross-media gestures.

Figure 26 (Sound example CD2-28) is an example of such a gesture occurring early in the piece (0'45") which, although it is clearly triggered by the live bassoon, cannot be described as purely instrumental nor recorded. The process of creating it involved the initial *appogiaturas* followed by a sustained note occurring simultaneously with a vibrato-like transformation of the same pitch. The original intervallic and rhythmic information of the *appogiatura* were used to create gestural material in the

recorded part. The sustained note is slowly transformed and combined with a new pitch in order to prepare the following colour trill (0'55"). These elements occur simultaneously and can be perceived as one short gesture which, although it is clearly suggestive of its source (bassoon), does not have any dominant gestural feature that identifies it as belonging to either the recorded or instrumental part.

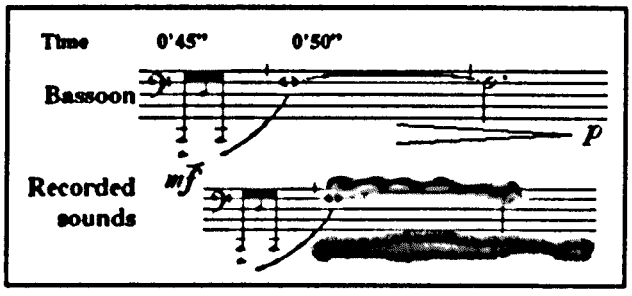


Figure 26. Gestural imitation.

3) Hybridisation of morphologies: the controlled combination of material from different media in order to obtain new sound elements that retain essential characteristics. The purpose of this process is to generate new musical material that is identifiable as relating to its origin, but also as a variable that contributes to the development of musical discourse. However, in order to be identifiable as variables, the newly obtained sound elements must retain certain characteristics of their source identity. In 'Twilight' these were both spectral and morphological characteristics.

The continuous input of energy required to obtain a bassoon sound imposes a morphology, which was central to the studio transformations of the recorded material in 'Twilight'. The mixture of material was guided by the need to generate new sound morphologies for the recorded part, maintaining the spectral characteristics of the bassoon.

Figure 27 illustrates a bassoon sound and its recorded counterpart created mainly from bassoon transformations of the sustained note in the instrumental part at 6'35" (Sound example CD2-30). The morphology of the recorded part at 6'35" (Sound example CD2-29) is different from the bassoon sound which has a slower than normal attack with a longer sustain. The recorded part also presents an artificially applied vibrato different from a bassoon's natural

vibrato in that it does not alter as dynamics vary. The sound world of the recorded part in this event is also influenced by short, fast attack sounds, also of bassoon origin, which occur throughout the piece with little variation. Although their external morphologies are different, the recorded sounds are identifiable as originating from the bassoon as a result of their spectral relatedness.[7]

Thus the resulting sound is spectrally similar to both original elements (Sound example CD2-31). However, the resulting morphologies are more complex and possess internal attributes that are the result of mixing both elements. The identity of an applied morphology is still present but new internal activity is also audible.

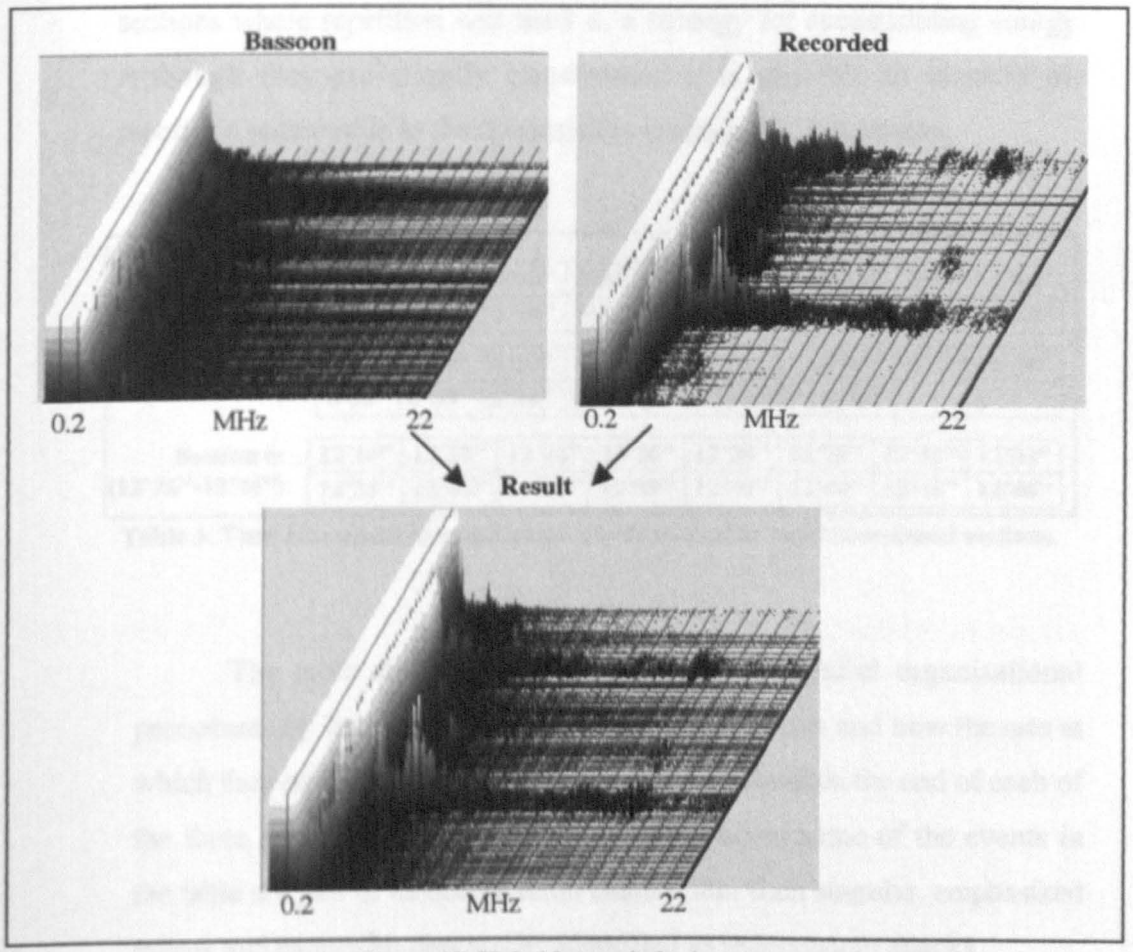


Figure 27. Hybrid morphologies.

[7] In this case only a small amount of filtering was applied to the sound.

2.2.4 Particularities of relationships in 'Rimbarimba'

The processes of organising sound events address the problems that arise from the particular relationship between instrument and recorded part. In 'Rimbarimba' this was addressed in the following ways:

1) Pre-defined limits: These were subdivided into consideration of the marimba's particularities and of the sources available for transformation in the studio:

a) Repetition could be considered a straightforward strategy for defining musical rules. However, in this piece the repetition of certain sound elements was planned previous to the layering of sounds and defined the way in which other objects were subsequently placed.

Table 3 shows an example of repeated sounds in the opening section of the piece (0"-1'48") (Sound example CD2-32). They determined other sections where repetition was used as a strategy for accumulating energy. Although they are slightly transformed it is possible to identify the repetition pattern due to the dynamically emphasized fast attacks.

Section a:	0'01"	0'05"	0'16"	0'24"	0'30"	0'36"	0'55"	0'57"	1'04"
(0"-1'48")	1'09"	1'23"	1'38"	1'40"	1'43"	1'45"	1'46"	1'47"	1'48"
Section b:	5'58"	6'08"	6'10"	6'14"	6'18"	6'21"	6'24"	6'28"	6'30"
(5'58"6'38")	6'31"	6'33"	6'34"	6'35"	6'36"	6'37"	6'38"		
Section c:	12'16"	12'22"	12'24"	12'26"	12'28"	12'29"	12'31"	12'33"	
(12'16"-12'46")	12'35"	12'36"	12'37"	12'39"	12'41"	12'44"	12'45"	12'46"	

Table 3. Time placement of emphasized events in similar repetition-based sections.

The table shows similar situations and parallel organisational procedures by listing the times of the principal events and how the rate at which they occur increases in a similar manner towards the end of each of the three sections. However, as the piece evolves some of the events in the table are part of an acceleration chain rather than singular, emphasized events and cannot be necessarily identified as independent attacks.

In order to define one of the methods for linking media, the approach to the placement of events in each of the three sections is the

same. The duration of sections "b" (Sound example CD2-33) and "c" (Sound example CD2-34) is also similar in order to define them as balanced structural elements of similar importance.

b) In order to maintain a high amount of activity in the instrumental part over long durations, it was necessary to limit the amount of new pitch information introduced by the recorded part. The marimba acts as the principal pitch content provider in these gesture-based short fragments, and its dynamic level places it in the sonic foreground.

Figure 28 (Sound example CD2-35) is an example of an instrumental gesture towards the end of the piece. Here, an ascending pitch trajectory occurs in the acoustic foreground and contains the majority of the rhythmic and pitch interest. The recorded part is used to resemble the gestural shape of the instrumental part in order to increase tension leading to the last event in the piece.

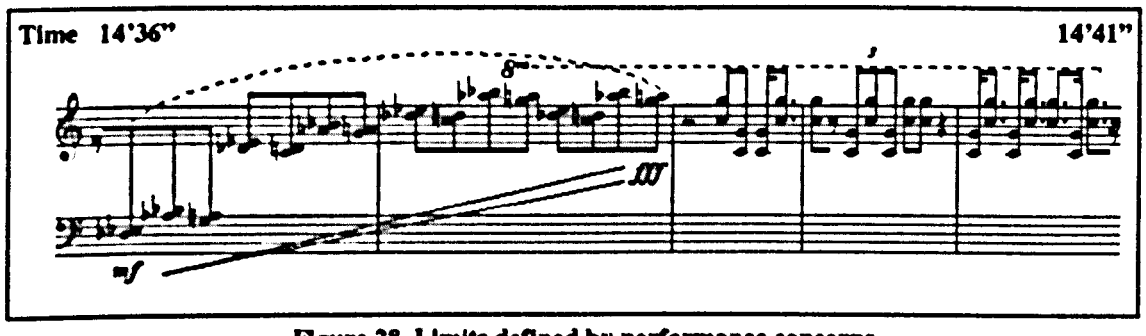


Figure 28. Limits defined by performance concerns.

2) Limits defined during composition: placement of particular high-amplitude recorded sounds was limited to events where the instrumental part acts as a triggering device. This rule emerged throughout the compositional process as a way of maintaining a coherent link in the pattern of action-reaction between the marimba and electroacoustic parts. The marimba was defined as responsible for putting into motion certain loud elements in the recorded part.

The following example (Fig.29) contains three instances where this method of relating media was used (Sound examples CD2-36 (a), CD2-37 (b)

& CD2-38 (c)). All these instrumental gestures work as short events that trigger sections of contrasting sound activity in the recorded part.

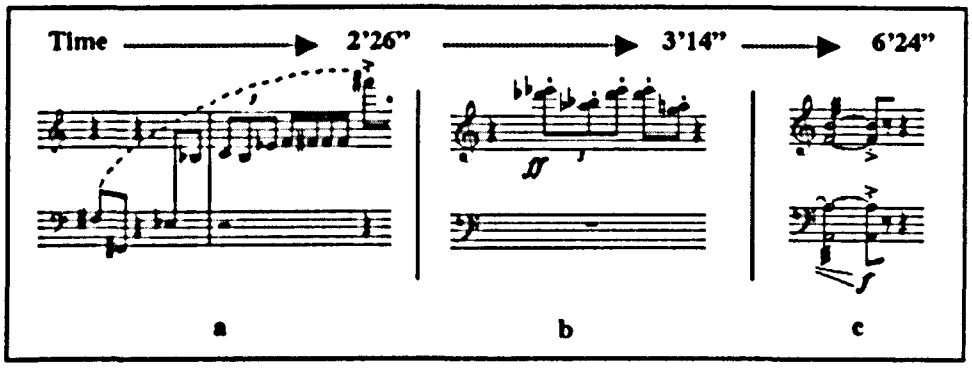


Figure 29. Instrumental gestures that trigger high amplitude events.

2.3 Spectral operations

Takemitsu considers that the composer's task begins with the recognition and experience of the initial basic sounds without any consideration for their future musical functions (Takemitsu, 1995). This approach has particular implications regarding music that includes electroacoustic sounds. The contemplation of the recorded sounds by the composer occurs during the compositional process in the studio in a physical and concrete manner. The composer is able to experience the sounds as opposed to the material for the instrumental part which will be explored in an abstract way. Electroacoustic tools offer the ability to manipulate sounds at the first stage of the creative process.

Nevertheless, Takemitsu's concept refers to something more basic, to the need for careful exploration of the sound's intrinsic possibilities. In a way, we could consider this as the need to explore the material inside the material. Each sound, be it instrumental or electroacoustic, has inherent qualities and the composer's task would be to exploit these as units for development and create "bridges" within the musical stream, linking them in a dramatic discourse. Takemitsu's idea of an initial consideration of the material prior to defining its functionality can be applied to the process of dealing with spectral issues of sound.

Exploring aspects of the sound's spectrum without considering its musical function was one of the initial compositional stages in 'Tolerance', which led to a musical result that had a decisive influence on the piece's structure. In 'Rimbarimba' the spectral content of the sound material helped in creating links between media.

2.3.1 Spectral activity in 'Tolerance'

In terms of large-scale structure the piece was defined by the coverage of spectral space. A piece comprising two distinct parts with regard to the overall spectral framework was the result of the initial exploration. From a spectral point of view and as shown in Figure 30, the piece is structured as follows: section "A" comprising sub-sections a,b,c,d & e and Section "B" comprising two spectrally similar sections.

The dividing moment between sections occurs at 7'00". Section "A" is mainly a "building section", where the piece's material is presented and the general flow of time is established. In this part there are internal independent sections with particular spectral characteristics (marked a,b,c,d & e). The aim was to create a "spectral climax" in the middle of the piece (marked "X"). The strategies used to create the sub-sections contained in "A" were mainly those described earlier in the text. The spectral richness of the sub-divisions is less than that of the climax at the end of "A" (marked "X").

Section "B" is characterised by a marked reduction of the spectrum covered and could be considered spectrally more uniform than section "A". Except for the event marked "Y" this section is limited to a fixed spectral framework. Section "B" of the piece is related more to sounds of less harmonic complexity and fewer sound layers are used simultaneously. The cello part relies more on the use of harmonics whereas the electroacoustic sounds were designed to mix with the less spectrally rich and also less complex material of the second half.

The structural decisions based on spectral characteristics are not intended to be perceived by the listener as phrases or independent sections of the piece. There are other processes of structural design that rely more on aural recognition. The idea of identifying sections by their spectral content was a personal approach

undertaken in order to fulfil a pre-conceived plan of a two-section piece of contrasting levels of sound complexity. It helped to achieve an "A-B" form which in itself was a useful way of controlling the placement of the materials available.

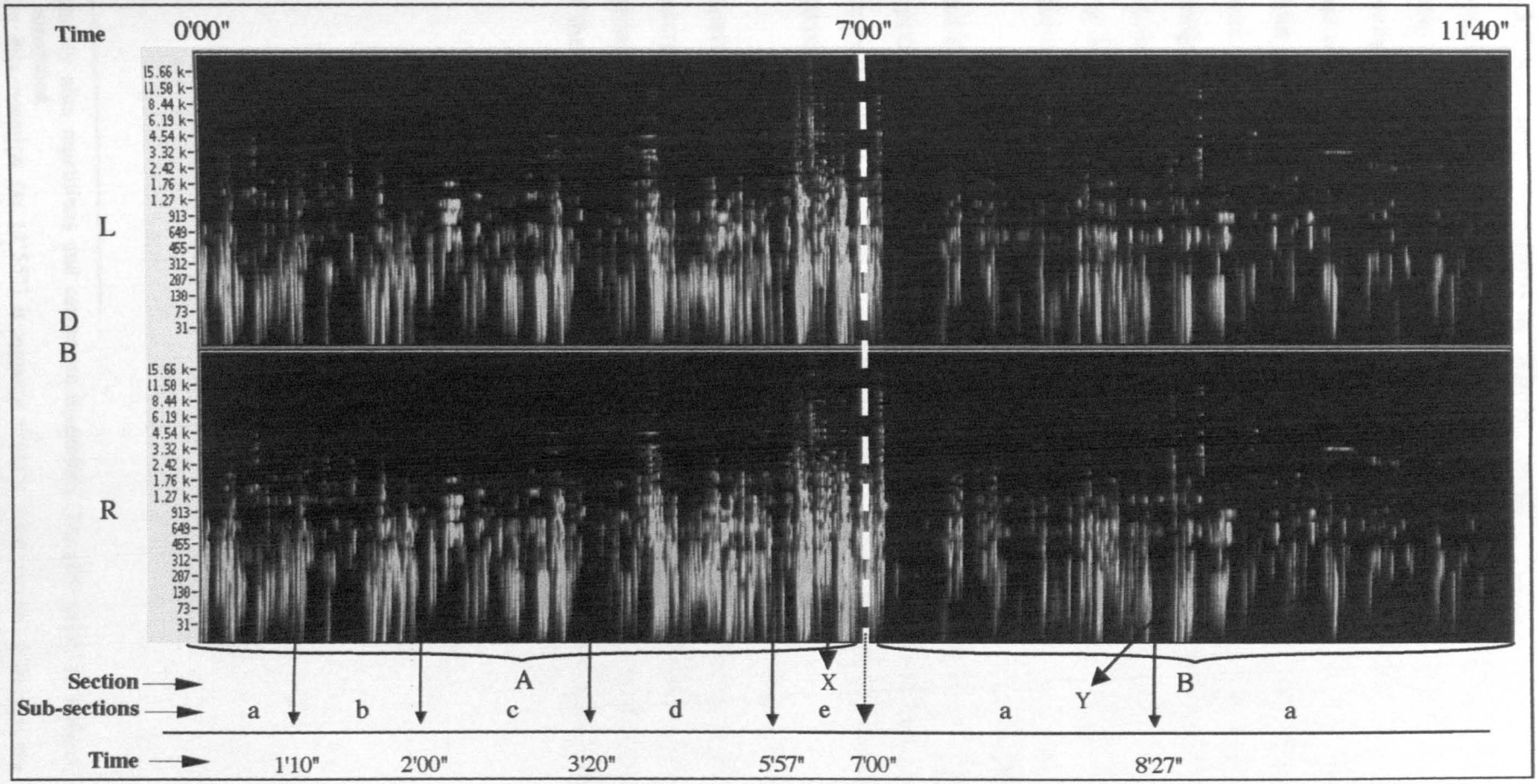


Figure 30. Complete spectrogram of 'Tolerance'.

2.3.2 Spectral operations in 'Rimbarimba'

Spectral operations are another concept that gathered importance when designing links for 'Rimbarimba'. In order to offset the influence of the marimba's rhythmic predominance, spectrally paired cross-media sounds were generated and repeated many times. Their recognisable identity as sound elements comes from an absence of transformations and dynamic emphasis when repeated. They were obtained from defining a fixed pair of sounds in each medium and were designed as short gestures that influence the rate at which the material is being layered in the piece (particularly at the beginning, as explained below for Fig.31). Therefore, they also affect the temporal pacing of the piece at a microstructural level due to this ability to set the pulse rate.

Figure 31 shows one of the paired sounds which is used multiple times, and the spectral analyses of both media (independently and superimposed). The repetitions are present in a context where, due to minor variations[8], they create the sensation of a slowly accelerating pattern of impulses. Hence, the repetitions are recognisable and dynamically emphasized.

At the initial section of the piece (0"-1'48") (Sound example CD2-39) the repetition of the element in Figure 31 has a direct structural implication. It emerges as the only generator of pitch and rhythmical material and defines the initial tempo and rate at which elements are introduced. Some of the repetitions of these paired sounds occur at: 6", 15", 24", 30", 1'04", 1'09" and 12'55".[9]

[8]Mainly note repetitions and resonance extensions. No new pitch or timbral material is introduced.

[9]On this occasion (at 12'55") it appears slightly transformed. Although the intervallic characteristics remain, the recorded counterpart's timbre is modified but retains similar behavioural characteristics.

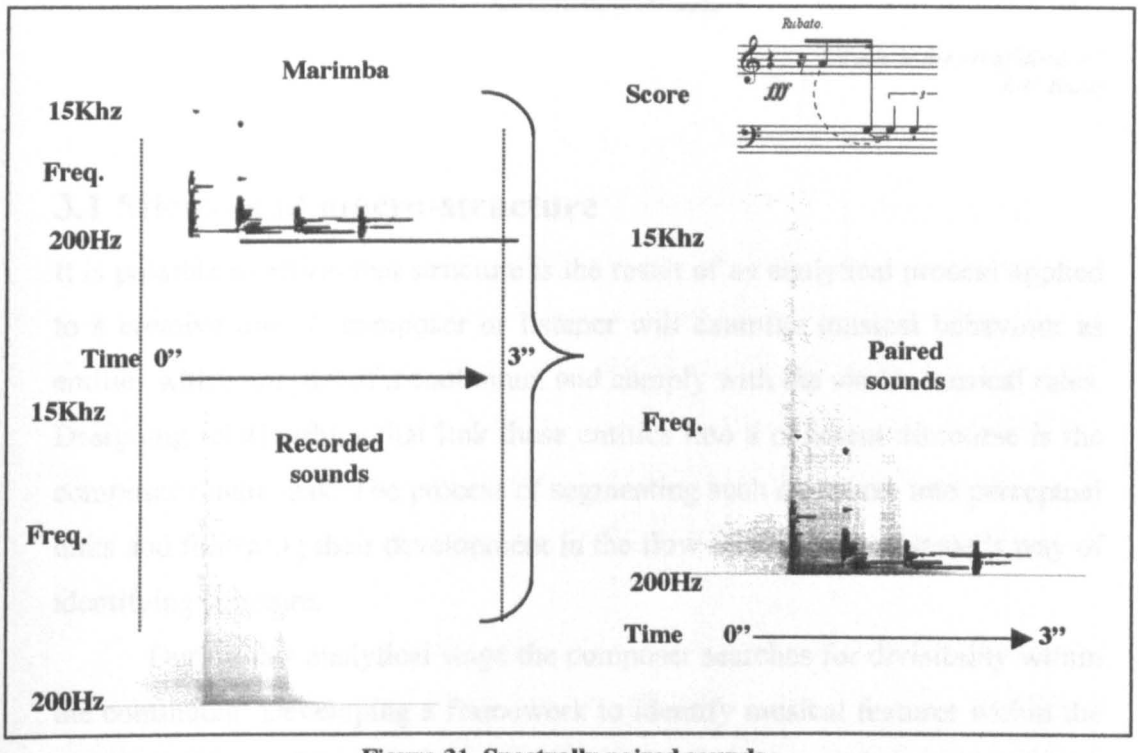


Figure 31. Spectrally paired sounds.

3. Structure

"Music is the art of illusion"
J.-C.Risset

3.1 Micro- and macro-structure

It is possible to affirm that structure is the result of an analytical process applied to a creative one. A composer or listener will examine musical behaviour as entities which are part of a continuum and comply with the work's musical rules. Designing relationships that link these entities into a coherent discourse is the composer's main task. The process of segmenting such discourse into perceptual units and following their development in the flow of time is the listener's way of identifying structure.

During this analytical stage the composer searches for divisibility within the continuum. Developing a framework to identify musical features within the sound stream would necessarily take into account the issue of time. Identifying individual elements can be described within two time-frames:

1) Macrostructure: Phrases and sections of a piece have a structural meaning that can be identified as part of a longer time span. Nevertheless, they can only be identified as such when they are complete, and they possess significance within context. Macrostructure may be defined as a continuum of musical events that is disturbed or interrupted by elements which are different in nature.

2) Microstructure: Events and sounds recognised as more important have a structural function that can be identified as part of a shorter time span. This creates a pre-defined hierarchy that could be applied to musical decision-making. Therefore, priorities are set in order to guide the compositional process. The composer chooses certain musical elements and gives them a structural function by creating a discourse that highlights the importance of

phrases, sounds, events or cells. At this level units can be combined, transformed and developed.[10]

3.1.1 Time scales, memory and expectation

What can be done by the composer is very much related to his ability to design a grid that can work on two different time scales. The first would be a micro-time scale where every detail of the sound is decided upon and carefully designed. In this case, it is usually possible to lose the overall significance of a particular short musical event because of the repeated listening situation in the composition studio. The second one would be a macro-perspective where the temporal placement of musical material dictates how blocks of sound information relate to each other from a structural point of view.

In both cases the listening process relies on memory in order to grasp the functionality of the received sound information since music is capable of creating and fulfilling expectations. Memory and expectation both depend on the idea of repetitions and variations of musical material, which are clearly concepts related to time.

When working with detailed elements of sound (micro-time scale), it would be difficult to interpret any particular decision from the point of view of its influence in the piece as a whole. Nevertheless, it is the high level of sound control available that gives the composer the option of dealing with memory and expectation. Sounds include much information in many different domains that can be controlled in order to create structure at a micro-level. For example, the slow transformation of a parameter within a long sound to generate expectation (e.g. internal rate of activity or dynamics) influences how time is perceived in the piece.

Some of the micro-level details that might be evident to the composer within the environment of the composition studio may be difficult for the listener to identify, and relationships might hardly be evident during a first listening. Therefore, memory's importance in defining structural coherence should improve as a result of repeated listening.

[10]It is worth mentioning that the process of creating musical material is different from work at a microstructural level in the sense that the former is purely an aesthetic process to generate ideas. When creating musical material the composer may not have a definitive idea of the piece, nor of how this material could be incorporated into the discourse.

At a macro-scale level memory is critical. Time flow is based on the fact that the listener is able to identify repetitions, variations and make connections. The composer's task is to use referential elements as a tool to create expectation, but also to generate surprise and a unified dramatic discourse.

The limits of memory are difficult to define: how much information can be remembered and which relationships are more important is complicated to control. The composer will need to create an environment that offers the listener an active role, but will also need to be cautious about the amount of information that is present at any particular moment.

3.1.2 Links beyond movements in 'Cycles'

The word 'Cycles' indicates the idea of musical events coming back in different circumstances and of elements that are identifiable within different sound contexts. The initial plan for the piece's structure was a musical grid which focused on main events which release energy and on the high-energy vocal-like sounds as objects that define the main sections of the first movement ('Stop' 0'00"-7'30"). The opening movement is the exposition of basic gestures and sounds, with contrast between long textural sections of expectation, and fast and short high-energy events.

The next stage was to create an independently identifiable second movement[11] where structural decisions were made based on a re-interpretation of the first movement's structure. Thus, the second movement ('potS' 7'30"-12'30") can be considered a recapitulation of the initial musical grid where the recognisable sound sources have a structural function beyond the movement's duration. The piece's idea was to create a cross-movement functionality that establishes equivalent structural roles for the recognisable sources.

The following diagram (Fig.32) illustrates the structure of both movements and the fact that the second movement is represented as contained within the structure of the first. The circular representation of the movements provides a better way of comparing sections than the linear graphic representation of the piece's score.

The example in box "AA" shows how section "e", "f" and "g" were the

[11] There is a short silence between movements in order to separate them.

result of re-organising the material of sections "a" and "b" from the first movement. We can describe section "a" as a rather slow moving texture that sets the overall spectral framework for the entire movement, whereas section "b" introduces the first clear sense of motion and cumulates energy towards the energy releasing event at 4'34". In the second movement their related sections ("e", "f" and "g") set the sense of motion immediately and lead the sound world towards the main energy release events at 0'50" and 1'51" (end of section "f").

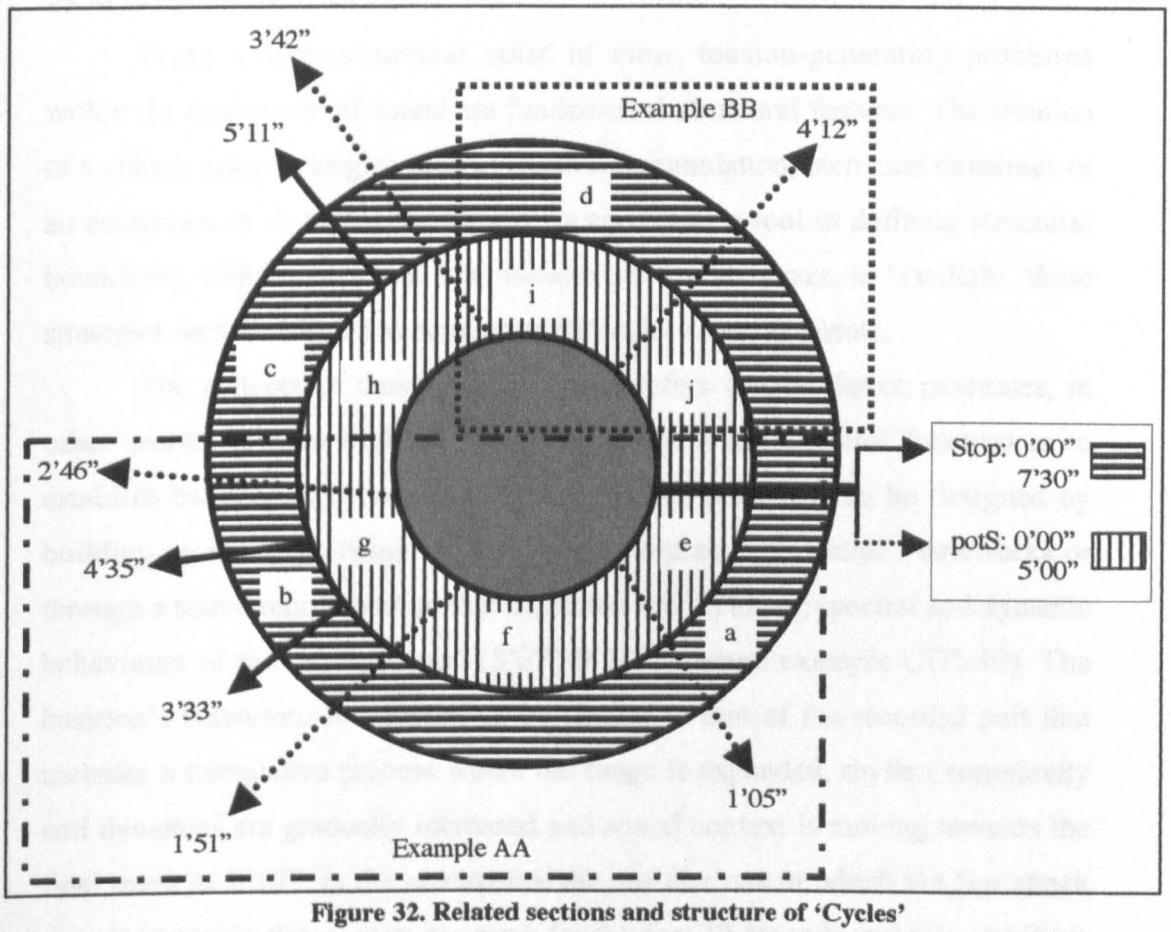


Figure 32. Related sections and structure of 'Cycles'

Another concept that can be deduced from the circular diagram (Fig.32) is the general equivalences in the grids used to structure the piece. Within each section of 'Stop' particular gestures and textures were used that are linked to those included in their related section(s) in 'potS'. For example, in the square containing example "BB" the long noise-based texture of section "d" is intended to slow down the rate of change in the first movement. In the second movement,

at the intersection point of sections "i" and "j" which are shown in the circles as related to "d", the sense of rapid change and motion is also clearly slowed down at 4'10". The final section ("j") is a clear reminiscence of the noise-based sound from section "d" plus the radio-like waves at the end.

3.1.3 Macro- and microstructural ideas in 'Twilight'

In order to control the stream of musical information, structural decisions in 'Twilight' were made using two strategies, the principal focus being the time frame within which they occur.

From a macrostructural point of view, tension-generating processes within the continuum of sound are fundamental structural features. The creation of a climax using strategies such as spectral accumulation, increased dynamics or an escalation in rhythmic complexity, is an effective tool in defining structural boundaries within the stream of musical elements. However, in 'Twilight' these strategies were combined to emphasise particular sound elements.

The concept of tension in the piece refers to cumulative processes, in other words, tension building sound blocks whose structural function is to establish boundaries between musical segments. Sections can be designed by building up rhythmic complexity, utilising contrasting spectral frameworks or through a sound representation that illustrates the rhythmic, spectral and dynamic behaviours of the recorded part (8'37"-9'10") (Sound example CD2-40). The bassoon's behaviour is intended to be similar to that of the recorded part that includes a cumulative process where the range is expanded, rhythm complexity and dynamics are gradually increased and sound context is moving towards the final event at 9'10". In the electroacoustic part the rate at which the fast-attack sounds appear in this section increases for the first 10 seconds and then stabilises when new longer sustained sounds commence. However, rhythmic complexity again increases for the last 6 seconds.

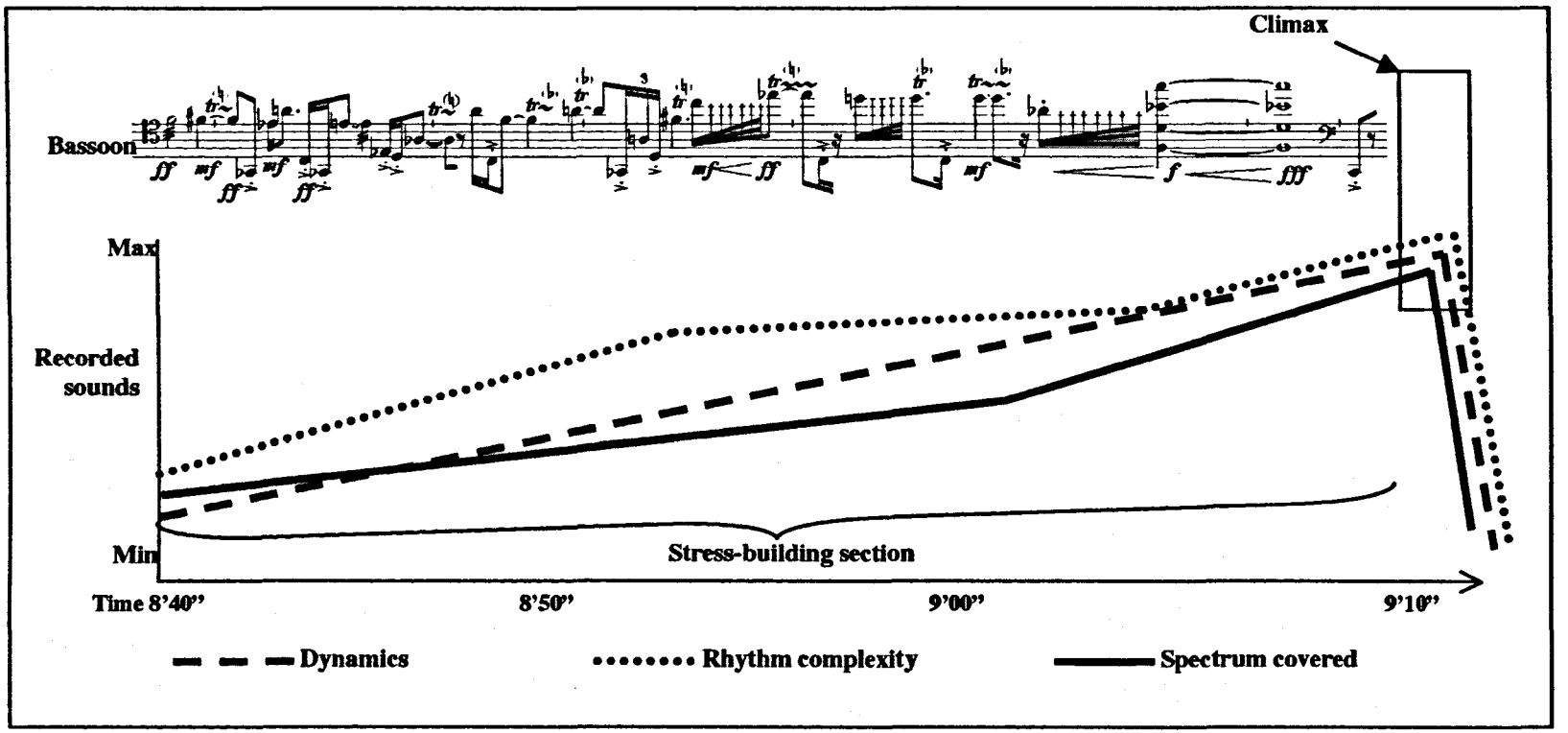


Figure 33. Building tension in 'Twilight'.

The last 10 seconds of the example focus on a greater diversity of sound materials rather than on increasing spectral complexity. In this last fragment (9'00"-9'10") the sounds used are mainly originated from the bassoon and are present throughout the entire piece as spectral links.

There is a constant dynamic increase until the climax at 9'10". Then, dynamic, rhythmic complexity and spectral range are suddenly reduced. The spectrum becomes emptier yet constrained (the rate of new attacks is very low and all material is performed at much lower volume). The instrumental material also reflects this change through difference in timbre and articulation (eolic sounds after 9'10"). Figure 33 shows the notation of the bassoon part and a graphic representation of the general dynamic context of the section.

Tension is different from a climactic point in the sense that the former can be a process that represents change over time whereas the latter is part of a musical context. Although, from a structural point of view, sections can have a climactic function, a climactic point is the result of both a cumulative process and a contrasting emphasized event. Whereas a tension-building section will be perceived as a musical segment of building strain, it need not necessarily conclude on a climactic point.

In summary, the process of building tension occurs on a wider temporal basis, and climax can be considered a structural element that can be localised at a particular moment in time.

Regarding the design of a microstructural approach, 'Twilight' explores two methods to generate a coherent internal sound hierarchy for short-term musical ideas. Both are based on an exploration of the repeated placement of similar compositional elements.

1) Foreshadowing

This is based mainly on varying the morphological features of similar sounds. In this way sounds can be used as "cues" to indicate similarities of structural elements. A sound can be repeated within a short period of time with different imposed morphologies which work to consolidate the internal coherence of the musical fragment. By foreshadowing a sound prior to its variation,

morphological transformations are emphasized as being relevant at a microstructural level.

An internal bonding of the morphological features assists in defining the boundaries of musical sections. As shown in Figure 34 (Sound example CD2-41), "A" is an extension of the bassoon sound that begins at 1'29". From 1'32" a new morphology of the same sound is introduced in the background when the new bassoon material commences at 1'34". "A" is then extended and gradually fades away when "B" is incorporated into the foreground. In this way a reminder of the initial morphologies is maintained until 1'47"."B" is mostly a tool for emphasising the bassoon's *glissando*, its key feature being the augmentation of dynamics and a simultaneous descending pitch sequence. Finally, "C" comprises different short noise-based sounds that are always in the background until the last seconds of the segment (1'48") when they gradually coalesce with the *crescendo* in the bassoon part and its corresponding sound (B), with increasing dynamics in the recorded part. This helps to prepare the contrasting change in the sound environment at 1'52" that marks the beginning of a new fragment.

Short fragments create a general atmosphere where morphological features of sounds are foreshadowed, preparing to some degree for what occurs later. They are also a prevalent structuring method where short bassoon-generated sounds reappear with close morphological transformation.

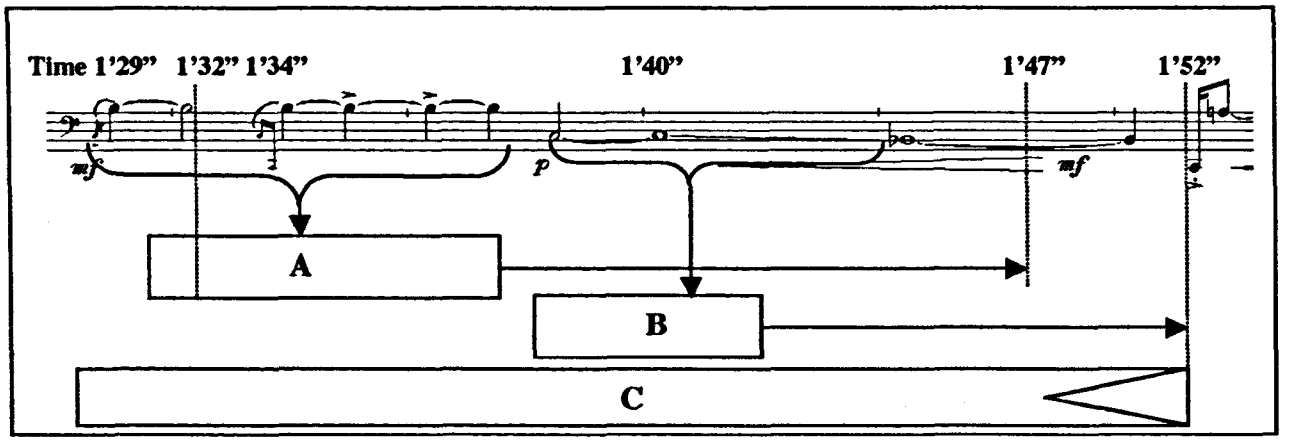


Figure 34. Foreshadowing of morphologies.

2) Sound markers

A sound marker occurs when a particular parameter serves to define the boundaries of a gesture or musical phrase. They are events which determine the flow of information and the rate of development of musical ideas.

In 'Twilight' sound markers involve the controlled alteration of a sound's dynamic characteristics. In this way, the articulation of musical material is delimited throughout the piece by short, louder sounds in either medium. Moreover, the use of contrasting changes in the dynamic range of particular sounds within the continuum creates a sense of temporal development. Although an emphasized dynamic is common to all sound markers they can additionally be grouped according to their source and spectral characteristics. Table 4 includes the principal sound markers throughout the piece. Although the markers can be analysed and grouped according to various characteristics, their contrasting dynamic levels was the sole criterion for their use as microstructural events.

Sound markers have two functions: firstly, to create the inner articulation of short phrases by defining the internal tension curves of the sounds, and secondly, as events to release tension.[12]

[12]Although it does not influence the resulting sound world, a third way of using the markers was to guide the live performer.

Time	Description	Medium	Source [i]	Relative dynamic level	Timbre group [ii]
0'44"	Fast low-register grace notes	Instrument	n/a	low	a
1'29"	Fast mid-register grace note	Instrument	n/a	low	a
1'52"	Low *staccato* note	Instrument	n/a	low	a
1'55"	Fast *crescendo*	Mixed	Male voice	mid	b
2'15"	Low *staccato* note	Instrument	n/a	low	a
2'27"	Fast voice-like sound with four note gesture	Mixed	Male voice	low	b
2'31"	Non-harmonic mid-to- low register	Recorded	Bassoon	low	c
2'55"	Low *staccato* note	Instrument	n/a	low	a
3'04"	Fast-attack mid-register sound	Recorded	Bassoon	mid	c
4'19"	Multiphonic	Instrument	n/a	low	a
4'24"	Pitch changing attacks	Recorded	Bassoon	low	c
4'38"	Fast high-pitch and notes	Mixed	Bassoon	mid	d
4'42"	High-pitch sound and notes	Mixed	Bassoon	mid	d
4'51"	High -pitch notes	Mixed	Bassoon	mid	d
5'15"	Fast high-pitch and notes	Mixed	Bassoon	mid	d
5'38"	Low *staccato* note	Instrument	n/a	low	a
6'00"	Low *staccato* note	Instrument	n/a	mid	a
6'09"	Low fast attack	Recorded	Bassoon	low	a
6'20"	Fast-attack mid-register note	Mixed	Bassoon	mid	d
6'34"	Fast-attack low-register sound	Recorded	Bassoon	mid	c
6'47"	Fast-attack low-register sound	Recorded	Bassoon	low	c
6'49"	Key attack and low-register sound	Mixed	Bassoon	mid	d
6'53"	Fast-attack low-register sound	Recorded	Bassoon	mid	c
6'49"	Key and mid-register note and low-register sound	Mixed	Bassoon	high	d
6'57"	Mid-register and low- sound	Mixed	Bassoon	mid	d
7'07"	Low-register reverb sound	Recorded	Bassoon+ Male voice	mid	c
7'18"	Non-harmonic register	Recorded	Bassoon	low	c
7'27"	Fast mid-register grace note and low sound	Mixed	Bassoon	high	c
7'50"	High -pitch note	Instrument	n/a	high	a
9'10"	Low-register sound and *staccato* note	Mixed	Bassoon	high	d
9'27"	Key and low reverb sound	Mixed	Bassoon	mid	d
9'29"	Low register sound	Recorded	Bassoon	mid	a
9'48"	Eolic sound	Instrument	n/a	mid	a
10'07"	Low sound and bell	Recorded	Bassoon + Bell	High	b
10'24"	Staccato and low-register reverb sound	Mixed	Bassoon	high	d
10'56"	Low sound and bell	Recorded	Bassoon + bell	high	b
11'08"	Bell	Recorded	Bell	high	b
11'13"	Bell	Recorded	Bell	mid	b
11'23"	High pitch note and bell	Recorded	Bassoon + bell	mid	b
11'28"	Bell	Recorded	Bell	mid	b
11'37"	Voice-like sound with bell	Recorded	Male voice + bell	low	b
11'41"	Low sound and bell	Recorded	Bassoon + bell	mid	b
11'56"	Low sound and bell	Recorded	Bassoon + bell	low	b
12'05"	Four note gesture	Instrument	n/a	low	a
12'24"	Low register sound	Recorded	Bassoon	mid	c
12'50"	Low-register reverb sound	Recorded	Bassoon	mid	c

i) **Source**: refers to the original source when the sound marker occurs on the recorded part.
ii) **Timbre groups**: **a)** non-transformed bassoon sounds; **b)** other sources with or without bassoon sounds; **c)** bassoon only transformations; **d)** bassoon and bassoon-originating transformations occurring simultaneously.

Table 4. Principal sound markers in 'Twilight'.

3.2 Segmentation

When listening to music from an analytical point of view, we are confronted with a "taxonomic listening" (Delalande, 1998 p.17), selecting elements and defining units in order to feed the need to pick up shapes, symmetries or any other variables in the search for organisational patterns. If the piece includes sounds with identifiable sources these will be regarded in a particular way but when the sounds do not have a recognisable source, morphological criteria will be applied, for example in looking for contrasts and discontinuities in energy (op. cit.).

It is possible to say that any event and its elements will have a structural and contextual function that will help define it as an individual segment or musical unit. Segmentation could thus be defined as the set of decisions taken to define elements of musical material with a particular identity. When any element is transformed or developed certain variables are identified and aurally highlighted so the musical idea and the contained segment will be identifiable due to its own developments throughout the piece.

Two approaches to segmentation are to be considered here:

1) A structural approach: defining individual elements for the construction of musical ideas, considering their functionality and usefulness within a context that goes beyond their internal characteristics, for example, filtering a sound in order to use it as a spectrally contrasting element that delimits a musical section.
2) A contextual approach: "In a contextualist analysis a segment is defended principally on the basis of its gestural identity in the music" (Doerksen, 1999 p.337). Defining units and fragments, considering them as part of phrases or motives, takes into account their individual function as musical elements within a musical idea. For example, transforming a voice-like sound and dividing it into shorter sounds, with the intention of linking a musical idea in different sections, is an approach that considers gestural behaviour as a segment-defining element.

Both structural and contextual approaches are constantly present throughout the compositional process, structural because within each section

individual elements are identifiable as units as they are repeated, selected and placed due to different structural functions or relationships, and contextual because they are are internally transformed to make their own development evident.

3.2.1 Sound and structural contexts

A context can be described as the group of links and relations between different attributes in any particular segment. A context where independent variables can be transformed, highlighted or suppressed is useful for building a sound world where phrases and events are linked together coherently. Relationships between fields like space, pitch, tempo, spectral characteristics and rhythm can be identified as the main variables that influence how previously independent sounds might now be perceived as part of the musical continuum.

1) Sound context

   Pitch and spectral characteristics can be identified regardless of the rhythmic or gestural context, and they can be modified independently in order to re-map their internal relations. For example, one can identify a sound that is mainly pitch-based or with specific highlighted harmonics without knowing how it will evolve in time or its duration, and one can also recognise a change in the pitch of a sound previously heard.

2) Structural context

   Tempo and rhythm are variables that need patterns of events in order to make transformations or developments evident. They are defined when particular events are repeated or when the rate in the flow of transformation is identified. Therefore, identifiable patterns determine the flow of information and the rate at which musical events are happening and being transformed. Natasha Barrett refers to an "internal flow" where such flow is determined by intrinsic characteristics of the material, and to an "external flow" which occurs when, due to the lack of intrinsic characteristics, listeners impose a flow combining their own sense of timing with features derived from a memory of the wider musical context (Barrett, 1999 p.15).

What is left out from the above categorisation of sound contexts is that independent musical events have their own identity regardless of their structural function, and sound context can be considered independently of time connotation. One can identify characteristics of the sound world at any particular instant without the need for further information about time. For example, a pitch-based sound on the upper end of the spectrum together with a noise-based slow attack texture could define a particular context that can be identified throughout the piece whenever this particular combination or their principal spectromorphological characteristics, are repeated even if the duration changes.

Structural context depends on the fact that time is an intrinsic issue when dealing with repetitions and patterns. The resulting time-based set of relationships is an attractive field of compositional development when enough information is available to compare transformations and musical functions with previous musical events.

3.2.2 Segmentation in 'Cycles'

'Cycles' provided a particularly good ground for exploring the problems of segmentation and their influence upon the way a piece is structured and discourse generated. There is a particular interest in dealing with the possibilities offered by contrasting levels of sound density. Sections are defined by changes in the number of simultaneous sounds and how much of the spectrum they embrace. The slowly accumulating energy and its release triggered by different short-high-energy sounds is the basic strategy which defines section borders.

Figure 35 (Sound example CD2-42) is part of the initial movement of the piece ('Stop') and illustrates an event that can be explained in terms of the segmentation methods. Although the events here happen over a relatively short period of time (about 26 seconds), the fragmentation approach is easy to identify on listening.

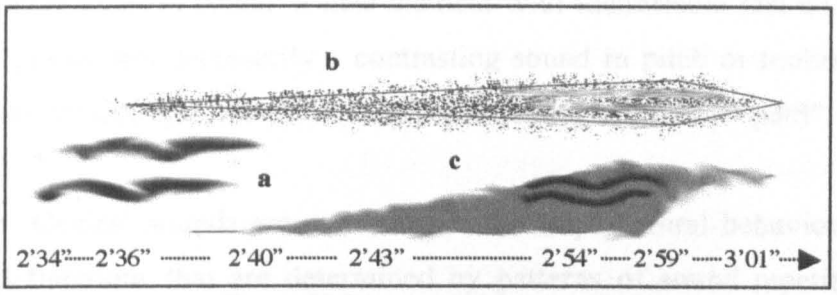


Figure 35. Segmentantion in 'Cycles'.

Segment "a" consists of independent short units (discussed earlier in the text in section 2.3.1) related to each other by transposed repetition and a common source (sound at 2'34"). It is also present throughout the piece as a structural element which links musical ideas, for example at 4'49" in the first movement, and 4'34" in the second movement.

Segment "b" is a texture-based sound with internal transformations and noise-based sound quality. Its internal sound density changes towards the end of the section. The sound defines the internal gestural identity of this particular section as one of relatively fast evolution towards a high-energy event. Therefore it could be considered as a contextually defined unit.

Segment "c" is a vocal-like sound that can be identified as independent but which has a clear structural function marking sound boundaries for the section. It also has internal transformations when it is heard again later in the piece.

The concern in 'Cycles' was to explore combinations in order to achieve different contexts within a coherent and interesting musical discourse. The idea was to work with sounds that are identifiable as separate elements of the musical discourse due to three principal characteristics:

1) Contrasting sound: a sound with contrasting pitch, timbre or spectral characteristics that "invades" the overall texture of that particular section, for example, the bass drum sound (e.g. at 0'35" in 'Stop').
2) Change inside the sound: a change in spectromorphological characteristics. This can be a slow or fast process that also helps transmit the feeling of time flow. For example, the long vocal-like gesture between 4'08 and 4'34" in 'Stop'.

3) Previously unheard sound: a new element with identifiable fast attack and decay points, not necessarily a contrasting sound in pitch or timbre but in duration, for example, the short noise-based sounds at 0'28" in 'potS".

In 'Cycles' sounds are combined to develop gestural behaviours, and structural functions that are determined by patterns of sound repetitions or transformation. A good example is the voice-like sound at 2'34" in 'Stop' which is always used to trigger new sections in both movements. It also has a particular spectral colour due to its recognisable origin that influences the sound context when present.

3.2.3 Defining sections in 'Twilight'

In 'Twilight' the subdivision into equivalent sections preceded a pre-planned structural map. A section, although it could be related to other sections in the piece, is a self-contained unit comprising a dominant event which regardless of duration, is preceded by new material, resolves coherently, and defines sound colour in the piece.

The compositional process was heavily influenced by the timbral characteristics of the bassoon, which guided the piece's structural development. Either the recorded part or the live instrument can lead the change in sound colour of each particular section. Furthermore, timbral sections were conceived as a method of achieving a balanced musical discourse in which both media interact.

An example of a self-contained timbral scene is the section between 2'55" and 4'24" (Sound example CD2-43). New sounds are introduced in the recorded part after the event at 2'55" which delimits the end of the previous section. Vocal-like material together with highly active low-pitched sounds work as a framework for a section that essentially emphasises the timbre of the bassoon's mid-to-upper register. Although morphologies are varied, the scene is based on the overlapping of similar bassoon-originated timbres whereas the recorded part is used mainly to extend the sounds introduced by the live instrument through elements chosen for their similarity in sound colour. In this way, the section develops at a steady pace and the different morphological

characteristics of similar timbres emerge as prominent definers of discourse. For example, the colour trills in the bassoon part and their close transformation heard on the recorded part at 3'17", constrain the timbral framework of this section and prepare for the mixing of the multiphonics which, due to their loudness and wider spectral content, are perceived as prominent timbral events.

Later in the piece, the section between 7'04" and 7'50"[13] (Sound example CD2-44) is a further example of a musical scene defined by its timbral characteristics, where three main timbres create the sonic thread:

a) 7'08"-7'13" (Sound example CD2-45): the initial key sounds with their transformations sounding simultaneously.
b) 7'13"-7'34" (Sound Example CD2-46): the sustained high-pitched bassoon sound between 7'13" and 7'18" undergoes a morphological transformation (fast *frullato*-like sound) presented in the foreground from 7'19". It reappears identically at 7'27" then followed by a low Eb with slow *vibrato* (7'28") and a low C with *frullato* (7'31").
c) After 7'35" (Sound example CD2-47) the timbral framework is again based on short and fast attack sounds but, as opposed to "a", the sounds are mainly in the bassoons's low register. Therefore, the continuum here is fragmented due to the absence of longer transformations or sustained live bassoon notes. The sound world is very much defined by the transformations which are recognisable as computer originated.

In conclusion, subdividing the dramatic continuum of the piece to create sound episodes defined by their timbral characteristics is a strategy for generating a successful macrostructural design for the piece.

[13]It is possible to say that a superimposition of scenes occurs between 6'57" and 7'04". The vocal sounds belong to the previous sections but some of the key sounds that define the new scene are already present.

3.3 Time

Any piece is a constant stream of information created by presence or absence of sound, a continuum of sound and silence which form a time-grid. The divisions and subdivisions (namely the segmentation) of the stream require this grid in order to be perceived, compared and understood as carriers of structural meaning. The composer's work resides in creating such a continuum even when his own creative process is not linear. One of the challenges of composing is to be able to abstract the relationships and independent elements in order to make them work within a continuous stream.

Listeners, in searching for musical meaning, divide the continuum into shorter units. These units are then stored into short-term memory and are constantly compared and related with other units throughout time (Dowling & Harwood, 1986). Thus, the composer's intention is to abstract the structural importance of these units before designing the flow of musical ideas wherein the listener's experience is a real-time segmentation of the discourse. Structure is therefore revealed as the musical stream progresses and the perception process accumulates the units and is able to establish or identify deeper and more complicated relationships and links between materials.

Although the perception of a piece's structure is constrained by its own time flow, there are multiple levels at which structural concerns are always present. At a microstructural level sounds have internal relationships and therefore contain the possibility of development and pattern definition through repetition. On the other hand at a macrostructural level, sounds can be grouped together as elements of musical sections. However, these sounds cannot be identified as such without sufficient comparison with other sections of a similar nature.

For example, at a microstructural level 'Tolerance' relies on the musical materials as elements of short-term structural design. The short instrumental units and vocal sounds are identifiable units that work as "anchor" material. At a macrostructural level the piece's grouping of musical material into longer sections is based on points of climax.

A particular pre-compositional approach to structural design in 'Tolerance' was the construction of a discourse based on similar behaviours, pitch

content and spectral activity. That is why emphasising their differences and singularities contradicted the preconceived idea of the piece.

3.3.1 Tempo and rhythm in 'Cycles'

In 'Cycles' the approach to identifiable sounds triggered the development of a concept of tempo for the piece.[14] The rate at which the different elements and repetitions are layered, together with the constant building of contained energy waiting to be released led to a conception of tempo defined by two main ideas:

1) Long cycles. From a long-term point of view, the placement of easily recognisable sounds defines the main musical phrases Therefore, these repetitions and their duration define the general tempo due to their direct influence on the rate at which the musical material is heard.

2) Short events. Independent sound events (e.g. Bass drum or a voice saying "stop") influence how the internal flow of the music is perceived and therefore also influence tempo.

Figure 36 (Sound example CD2-48) shows a stereo spectral history of the first two sections in 'Stop' (from 0'00" to 5'00", sections "a" and "b" described in 4.1.2). The boxes marked "A" and "B" are the bass drum hits that define a long cycle. On the other hand "C" is an internal development section composed of short events that intend to trigger the release of the accumulated energy. This shows how a recognisable sound like the bass drum can be used as a boundary marker for long sections and how it helps define a general sense of tempo. The short events contained within "C" have an internal level of activity of their own which is constantly being increased and are an example of the internal rhythmic developments or cycles of short events throughout the piece.

In 'Cycles' there are various sections with contrasting time characteristics. Nevertheless, the overall flow of time within each section is clearly identifiable (see the description for each section below). Levels of activity were achieved by variations in the rate at which elements are introduced and

[14]It also gave me the idea for the title and the movements.

repeated. Therefore, the internal tempo and rhythmic information in a sound also reflects its own speed or in other words, the rate at which patterns of internal elements are developed or transformed.

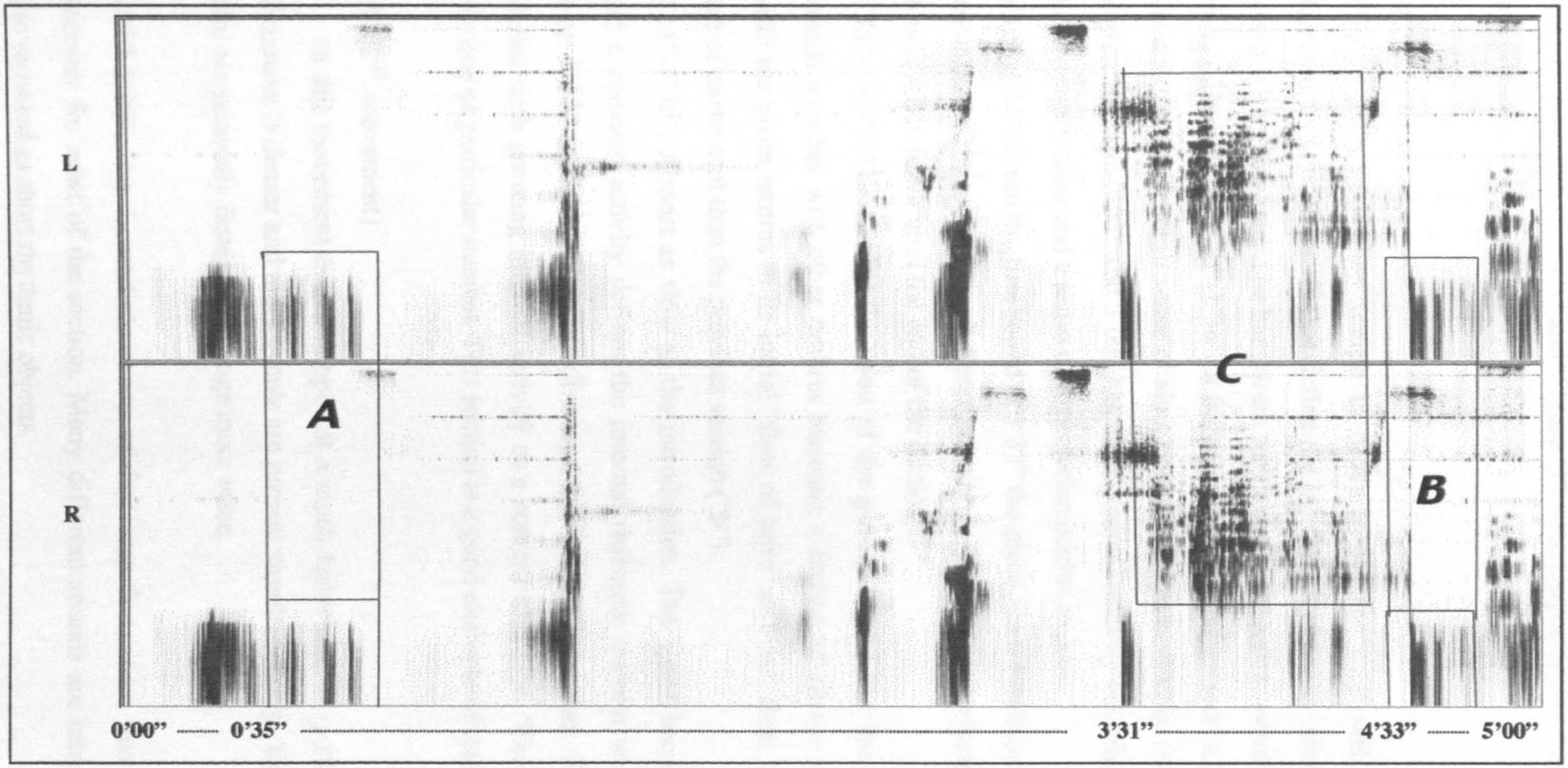


Figure 36. Spectral history in 'Stop'.

The following descriptions are intended to clarify the different levels of activity within each section, and Figure 37 is a comparison of each of the section's rhythm and tempo.

'Stop' (1st. movement):

a) 0'00"-3'31": Very slow tempo in order to set the high and low pitch framework. New elements that define the internal rhythm are introduced at a constant but slow rate. The bass drum sets a clear sense of slowness. Towards the middle section (1'30"-1'36") a faster but rather short gesture is introduced. Nevertheless the overall sense of slow evolution is immediately restored. The section between 2'35" and 3'00" has more internal activity but after 3'00" the piece is again slow and a sense of expectation begins to grow.

b) 3'32"-4'34": From the first sound at 3'32" the piece has a much faster internal movement. Due to the overall faster activity and voice-like gestures, the time flow is much faster until the end of the section.

c) 4'35"-5'09": There is a relaxation of the general speed but the high pitch sounds together with other timbres maintain a feeling of slower movement. Until the piece returns to its initial "flow of time" at 5'10" there is a slower rate of movement than the previous section ("b").

d) 5'11"-7'30": Almost as slow as the introduction. The space becomes wider and a constant activity defines the internal rhythmic interest which grows from 5'30" onwards. The overall tempo is slow until the end. The idea of sounds with growing internal activity in a context of a slow "flow of time" was one of particular interest. This section is a good example of this idea.

'potS" (2nd. movement)

In this movement events happen at a much faster rate. It is 25% shorter, the discourse is denser and more events are present simultaneously. The levels of activity are generally faster and change more often.

e) 0'00"-1'05": An immediate sense of fast transformation that keeps its intensity for most of the section. Many different sounds are introduced but also repeated as short rhythmic objects.

f) 1'06"-1'51": Slower than the previous section. There is a sense of growing

activity.

g) 1'52"-2'45": Tempo in this section is the fastest of both movements. Some of the sounds here develop an "internal acceleration" and the overall sense of a fast movement stays until 2'45".

h) 2'46"-3'41": Activity continues but at a slower rate. A feeling of the initial tempo of the 1st. movement is present. Towards the end a growing tension leads to the next section.

i) 3'42"-4'11": Very fast with some of the sound and rhythmic behaviours of section "c".

j) 4'12"-5'00": The tempo clearly slows down towards the end and the rate of internal activity gets slower. A quick recapitulation of some previously heard sounds is intended to create a sense of "perpetual" rhythm and tempo changes after the piece is over

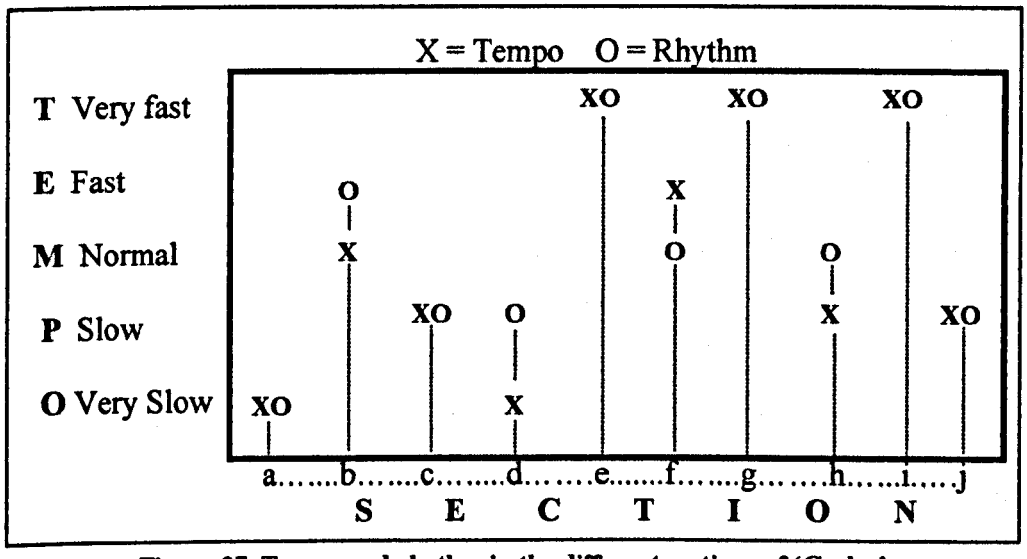


Figure 37. Tempo and rhythm in the different sections of 'Cycles'.

3.4 Behaviours

The internal behaviour of musical sections is decisive in order to create coherent structure and discourse. Morphologies influence directly how sounds can interact with each other and therefore form the basis for the design of behaviours for the entire duration of the piece.

In the case of 'Twilight', prior to the first stage of the compositional process when the source sounds were recorded, a plan for the organisation of the musical material was drafted. This was mainly guided by the idea of achieving a dramatic musical discourse of balanced proportions.

Although the piece's four main parts are not necessarily perceived as independent, four sections with contrasting internal behaviours formed the initial structure. These sections were based on four definitions for different stages of a sunset used in astronomy which are intended to apply the idea of a progressive transformation of light into a sound environment. The astronomical terminology works as an analogy for the internal sound behaviour of the four principal parts of the piece. Although they refer to the amount of light, these progressive steps are an example of a comprehensive process of transformation with contrasting ends and multiple internal sections.

Figure 38 shows the four sections and the instrumental events that mark the boundaries.

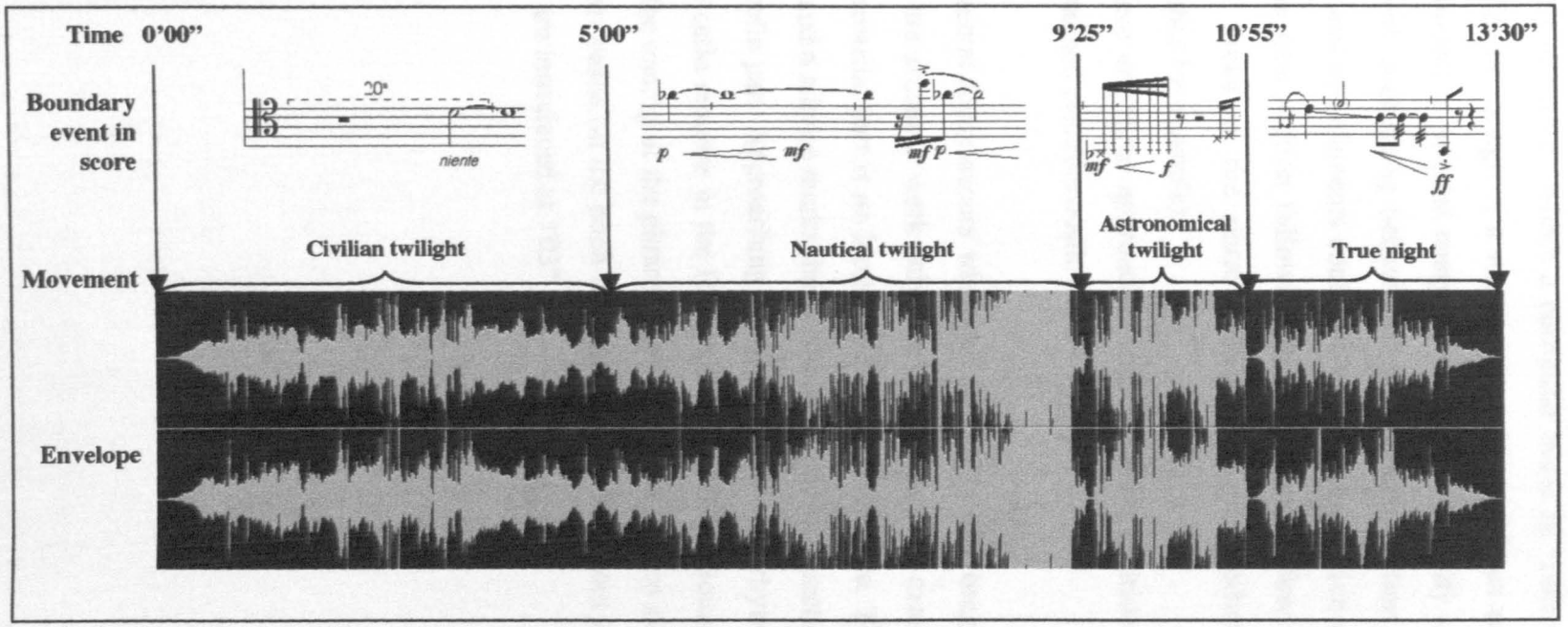


Figure 38. External structuring ideas in 'Twilight'.

3.4.1 Contrasting behaviours in 'Tolerance'

The amount of activity within a particular event in 'Tolerance' was the main guideline for the design of a structure based on gestures and points of climax. Similar amounts of internal energy or densities of activity led to the creation of sections with contrasting behaviours. A particular section that slowly gathers new short and fast elements could grow into a very active musical idea. In this way, if the new section following has considerably fewer short sounds, the perceived focus of the phrase could shift to another feature (spectral characteristics for example).

There are three approaches regarding the relative importance of the instrumental and electroacoustic parts:

1) Instrumental focus occurs when the cello is in the foreground and recorded sounds are absent or work only as a background. For example, from 6'30" the electroacoustic part is no longer tied to the instrument. The cello finishes the phrase and a silence marks the beginning of the new section which starts with a solo cello part. Approaching 7', vocal sounds with rhythmic interest appear, and the cello remains in the foreground. Figure 39 (Sound example CD2-49) shows the ending of the phrase before 6'55" fading into silence. Then the solo cello part based on the pitch target of D# also fades out just before the vocal sounds are introduced at 7'03".

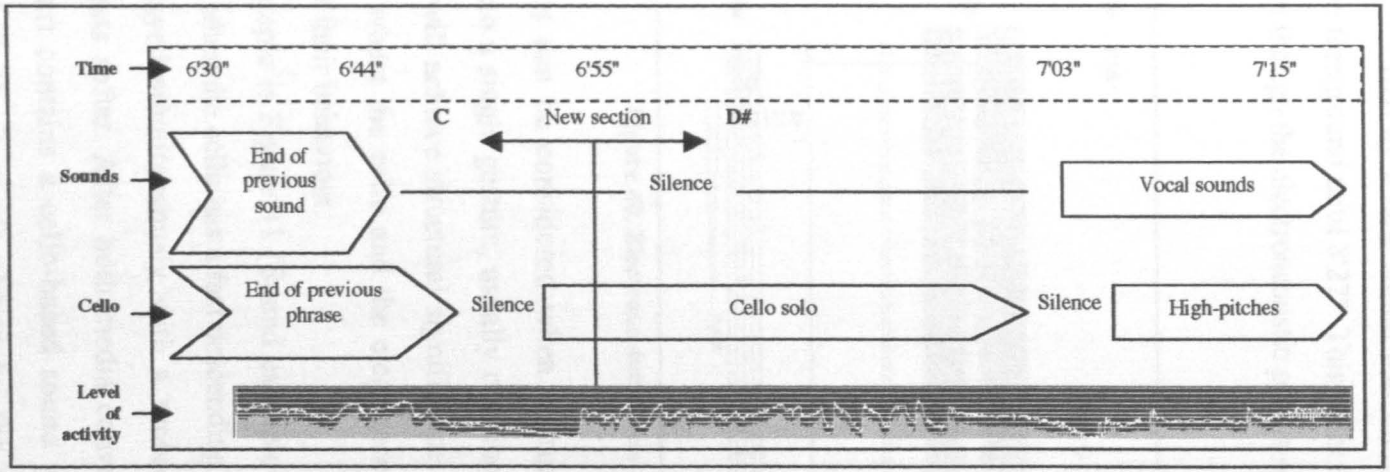


Figure 39. Instrumental focus in 'Tolerance'.

2) Electroacoustic focus occurs when the internal activity of the sounds is what defines their contrasting behaviours and in turn, some sections are defined by changes in the internal movement of the recorded part. For example, Figure 40 (Sound example CD2-50) shows how the electroacoustic part changes after 8'18". It is followed by a new sound that increases in spectral width and is clearly in the foreground until 8'27". This point is the start of the new C-based section, even though the electroacoustic part is still louder than the cello.

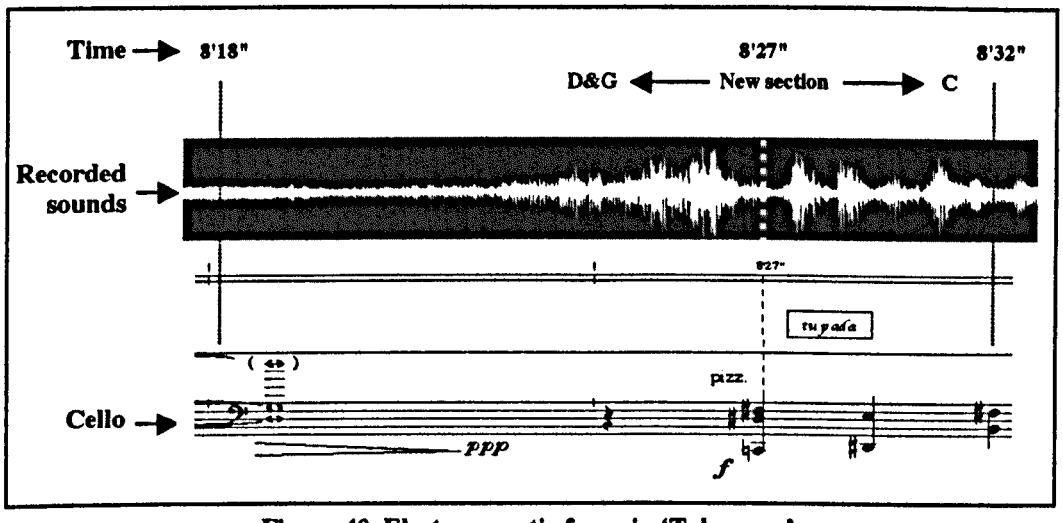


Figure 40. Electroacoustic focus in 'Tolerance'.

3) Mixed focus can be considered when instrumental and recorded sounds converge into a single gesture, usually creating a recognisable link between media that will achieve structural significance. There are many instances in 'Tolerance' where the cello and the electroacoustic parts are linked by the similarity of their behaviour.

An example is Figure 41 (Sound example CD2-51) where an imitation takes place when the cello has a fast descending scale (5'36") that moves from *ff* to *mf*, played simultaneously with a recorded, noise-based sound that gradually gets softer. After both media converge in the *diminuendo*, the recorded part contains a cello-based sound whose increase in amplitude coincides with the *tremoli* played by the cello. What is of structural importance is that immediately after this, both media separate and there is no longer a gestural convergence. This will usually be perceived as a change in the relationship between the media.

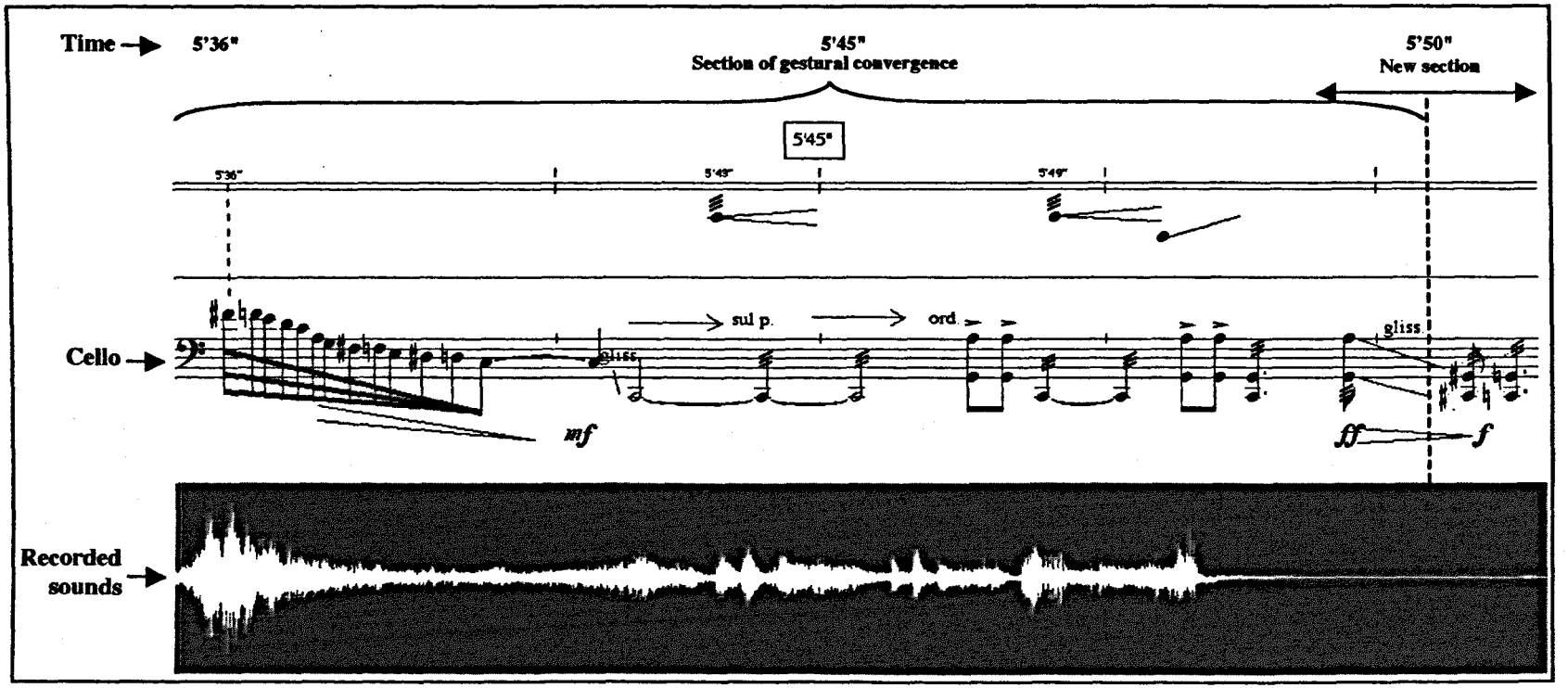


Figure 41. Gestural convergence.

In summary, the three strategies and their related examples show how certain musical moments were composed as structural markers. Events of contrasting behaviours are used to create phrases and independent musical elements. Musical ideas are identifiable as units due to the events that precede and follow them. In other words, the end or beginning of gestural convergence or a contrasting level of activity in the cello or recorded part are basic ways of delimiting musical ideas that will help create a dramatic discourse.

3.4.2 Exclusive vs. inclusive sound contexts in 'Rimbarimba'

In order to incorporate effectively the marimba in an homogeneous sound world, contrasting sound environments were created. Two approaches were defined in terms of the elements which guided computer transformations and the composition of the instrumental part:

1) Inclusive: where the marimba is immersed in the electroacoustic transformations as another layer of information. In these sections there was a conscious intention to avoid recognisable sources in order to define the role of the live performer as only one more stream of musical activity, thus avoiding emphasising it as a source of new musical ideas.

   In the passage shown in Figure 42 (Sound example CD2-52) the marimba is incorporated into the sound world of the electroacoustic part. This was achieved using three different techniques:

   a) The *tremolo* of the marimba extends the pitches and blends with the resonance and longer sounds in the recorded part.
   b) The initial *tremolos* are incorporated with a recorded sound consisting of similar pulsations and the descending trajectory at 11'30" is also mixed with an increase in the amplitude of the recorded part.
   c) After 11'34" constant changes in the dynamics and the musical pulse occur in the recorded part. In this section the marimba is performing a soft *tremolo* in order to create a sonic background of limited rhythmic interest.

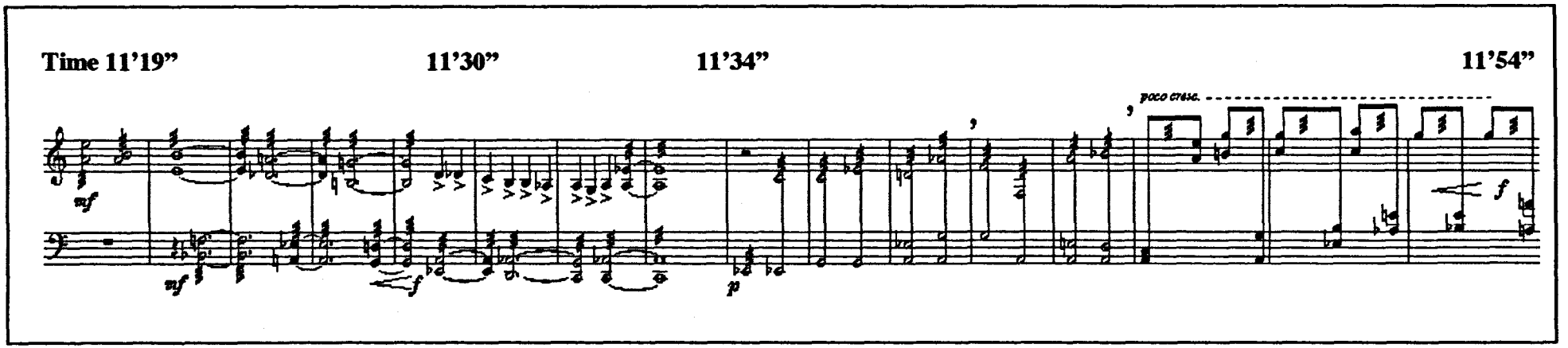


Figure 42. Inclusive marimba passage.

2) Exclusive: when generating such contrasting sound worlds, the hierarchical functions had a direct impact on the piece. As shown below, there are sections where the marimba's dominance is central to the sound world. This departure from the otherwise uniform role as a spectrally and rhythmically related element, produced sections where the idea of a virtuosic solo performance is emphasized. Therefore, the overall sound world of the electroacoustic part ceases to include (excludes) the marimba as an element generating timbral information.

An example of this approach occurs from 14'19" until the end of the piece. Here the instrumental part has a predominant role in terms of introducing pitch and rhythmic material. Figure 43 (Sound example CD2-53) shows two of the instrumental ideas introduced by the marimba at this point. From the triggering event at 14'19" the electroacoustic part is generally limited to two functions: firstly, it has non-transformed marimba sounds in order to re-introduce some of the previously heard instrumental passages, thus accumulating activity towards the end of the piece. Secondly, the electroacoustic sounds are dynamically separated from the instrumental performance and are introduced as short reactions to the fast material presented by the marimba.

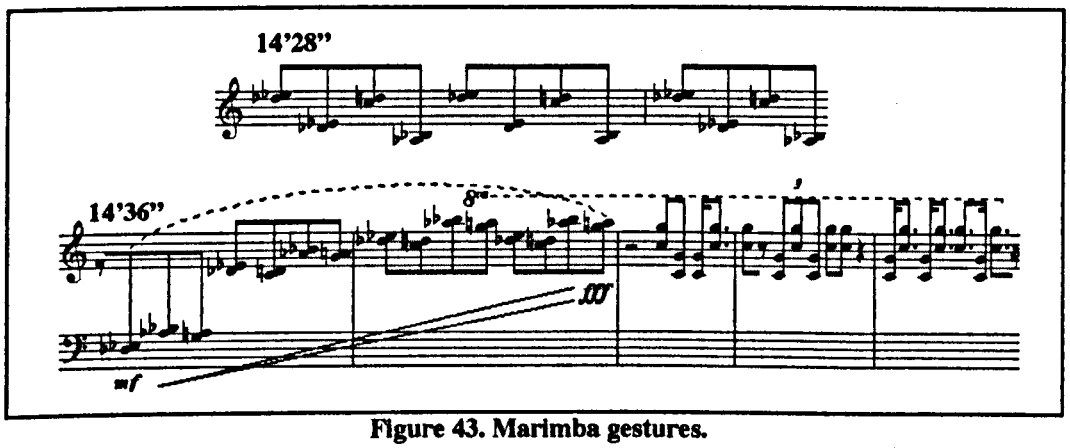


Figure 43. Marimba gestures.

3.4.3 Contrasting approaches in 'Rimbarimba'

In 'Rimbarimba' the exploration of electroacoustic transformations and sound behaviours was intended to create two contrasting approaches to establishing relationships between instrumental and electroacoustic parts. The first, based on the creation of various cross-media rhythmic objects and the second, based on generating texture-based sections where artificial sustainment was achieved through computer means.

1) Rhythm-based context: patterns can be considered as a multiplicity of simultaneous parameters that generate entities suitable for independent manipulation. Thus, the approach to building sections containing a high amount of rhythmic information and energy within the piece is based on short intense gestures and a fast reaction in the opposite medium (marimba or electroacoustic).

   The fast tempo fragments in both media create rhythmic objects that consciously avoid a solo-led relationship thereby emphasising the resulting rhythmic grid obtained from the repetition of short attacks found in the material for both media.

   Figure 44 (Sound example CD2-54) shows a section of the piece where the patterns obtained from the mix of both media are the most important feature. Here the marimba part has notes in a constant rhythmic pattern based on the *staccato* repetition of the same harmonic interval (a second) in different octaves. These are mixed with the introduction of non-cyclic and more complex rhythmic patterns in the recorded part that increase the rhythmic complexity of the section.

Figure 44. Cross-media rhythm objects.

2) Texture-based sound worlds: as an opposite method the piece has sections with prominent textural characteristics. Here it was possible to explore the methods of extending the timbres in either medium in order to obtain longer sections with a reduced amount of rhythmic complexity.

An example of this approach is shown in Figure 45 (Sound example CD2-55) where the overall sound world of the piece is based mainly on the long electroacoustic sounds and where the instrument's material is one of pitch repetition and slow introduction of new pitches in the background (performed *piano*). Towards the end of the section (5'20") there is a *crescendo* intended to generate tension which is then released by the louder attack at 5'31". This section can also be described as repetition-based, lacking any prominent dynamic feature.

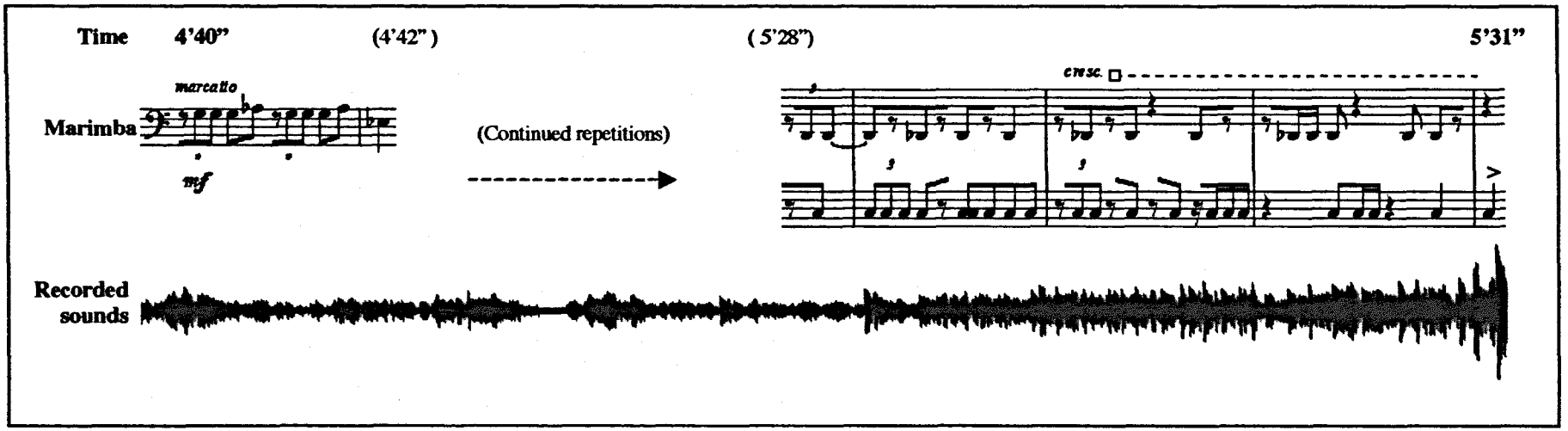


Figure 45. Texture-based sections.

3.5 Pitch and timbre

Spectral and pitch contours are important tools for controlling energy and to design links between musical materials. The integration of multiple varied morphological entities into a single unified and coherent discourse (with regard to the timbre or pitch) would only be possible through a process of constant recontextualisation of the sound world. By relating pitch-based structures to the internal properties of elements, the complexity of the relationships can be increased in order to emphasise pitch or timbre as structural priorities.

On the other hand, the composer can define an harmonic context based upon a pitch hierarchy defined in advance. In this case, the timbral or harmonic structural contents are directly influenced by a pre-designed grid to obtain the desired functionality.

In the pieces discussed below timbre and pitch are regarded as structural parameters with influence upon the segmentation processes.

3.5.1 Timbres, pitch and framework in 'Cycles'

In 'Cycles', long and slowly evolving sounds were intended to contrast with sounds of short and fast attack. In this way, the overall sound world was mainly defined by extended texture-based sections or sound surfaces that are suddenly interrupted by sounds with faster attacks and increased dynamics.

Timbres were selected not only for their individual characteristics but also for their possible combination with others. For example the vocal-like sounds, choirs and the ethnic instrument (see section 1.2.1) have a particular contrasting timbre within the context of long textures and heavily processed sounds. They were selected not for their particular spectral complexity but for their suitability as elements of sound contrast. The final musical function of the contrasting timbres was to create sections of accumulating energy that are intended to again release their energy suddenly when triggered by short sounds and then start a new cycle, accumulating energy and tension.

Figure 46 (Sound example CD2-56) represents three sections of accumulating energy and release in the first movement from 1'24" until 3'05".[15]

[15] The triggering sounds occur at 1'34" and 2'58".

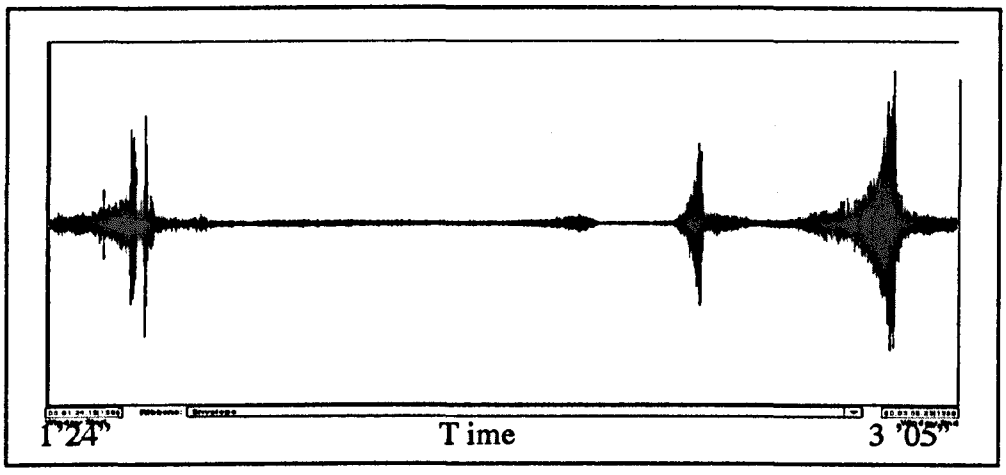


Figure 46. Three energy-release events in 'Cycles'.

There is a sometimes overwhelming influence attributed to pitch by listeners due to the fact that they have been much more exposed to pitch- and rhythm-based approaches to musical structure. In 'Cycles' some sources have an intrinsic pitch that influenced particular sections of the piece, while other pitch-oriented sounds are the result of particular transformations. Examples of each case could be:

Pitch from the source:

1) Bass drum (first movement at 0'36"): Although this is not exactly pitched, there is a clear "weight" towards the lower end of the register.
2) Choir (second movement at 1'05"): The choral voices always sound at their original pitch.

Pitch resulting from transformation:

1) Transformed sound in 'Stop' (3'30"-4'10"): A sound poor in harmonic content, with energy and a clear sense of constant motion. Pitch changes are evident and seem to change randomly. Thanks to this sound's behaviour pitch content moves to the foreground in this particular section.
2) Transformed sound in 'potS' (0'34"): Although the pitch changes this is a clearly pitch-based sound that resulted from studio transformations.

From the beginning of the piece a very wide spectral framework was established. Low sounds work as a constant limit out of which slow

transformations are intended to grow. At the top of the spectrum there is a clearly defined sound (Sound example CD2-57) that acts as a "sound roof" towards which some sounds evolve and from where thinner textures grow to fill the gap in the middle of the spectrum. This gap or idea of "absence of sound" which is gradually being filled with less pitch-oriented sounds, works as musical material that helps to link different sections creating an important character throughout the piece. One is constantly reminded that the pitch-space framework acts as a structural element. Cyclical appearances of this spatial framework are present throughout both movements, for example at 5'07" in 'Stop' (Sound example CD2-58) and at 3'00" in 'potS' (Sound example CD2-59), helping to explore arrival and departure events for the principal musical gestures. The short re-appearances in the foreground of these two pitches creates an idea of "return" or a reminder of the sound environment defined at the beginning where the initial timbres for the piece are exposed.

3.5.2 Pitch targets

The design of the structure for 'Tolerance' emerged from considering three main aspects: sections of contrasting internal behaviours, spectral activity, and the use of pitch targets. Pitch targets result from the exploration of the initial material and were used as means of delimiting sections of the piece, and can be considered as a method of spectral structuring. Contrary to the idea of contrasting behaviours discussed earlier (section 3.4.1), the concept of pitch targets was adopted during the process of composing and organising the material, and act as a set of markers which define the range of the cello. This does not imply that the listener would necessarily identify pitch targets as harmonic resolutions or as containing all the harmonic interest of the piece, and they are not necessarily perceived by the listener as climactic due to other related variables such as dynamics or duration.

Figure 47 is a detailed structural analysis of the piece showing pitch targets and how they were used. The box marked with an "X" represents the section after 5'05" which lacks any obvious predominant pitch. During the subsequent 40 seconds (5'05"-5'45") (Sound example CD2-60), the previously heard F# is no longer present in the foreground.

The gesture shown inside the box marked "Y" has as its pitch target a low C. Structurally, this C is used to create contrast and sound activity which is suddenly reduced to a cello-based tremolo and a mid-to-high-pitched sound in the electrocoustic part. Here, cello and electroacoustic sounds are clearly constrained by a non-changing spectral and dynamic framework. The intention of placing a low register pitch target within a less dense sound context was to create a sensation of reducing the speed of the discourse. In this way, the cadenza-like[16] section that follows in the cello part will be identifiable as a different musical section. The C was selected due to the fact that the gesture preceding it is a fast descending scale that needs to go as low as possible. This C is also used as a "home" pitch throughout the piece, appearing as the marker for new independent sections at 2'45", 3'40", 5'45", 8'27" and 8'50" together with an F# (see the corresponding boxes in Fig.47). Thus, the pitch target C (at 5'45") was used as a structural marker, and its placement was selected to define the end of one section and the beginning of the next. It broadens the range of the instrument, preparing it for the short solo that follows. In other words, C was set as an "ending target" for the pitches involved in the previous section. The pitches change and move towards a fast descending scale that resolves with the lowest note of the cello which is also the section's harmonic fundamental. A feeling of arrival is therefore the trigger for the new section (box marked "Y" in Fig.47).

[16]Although the term *cadenza* has an implicit connotation, in this section it describes accurately the particular style of the cello's solo passage.

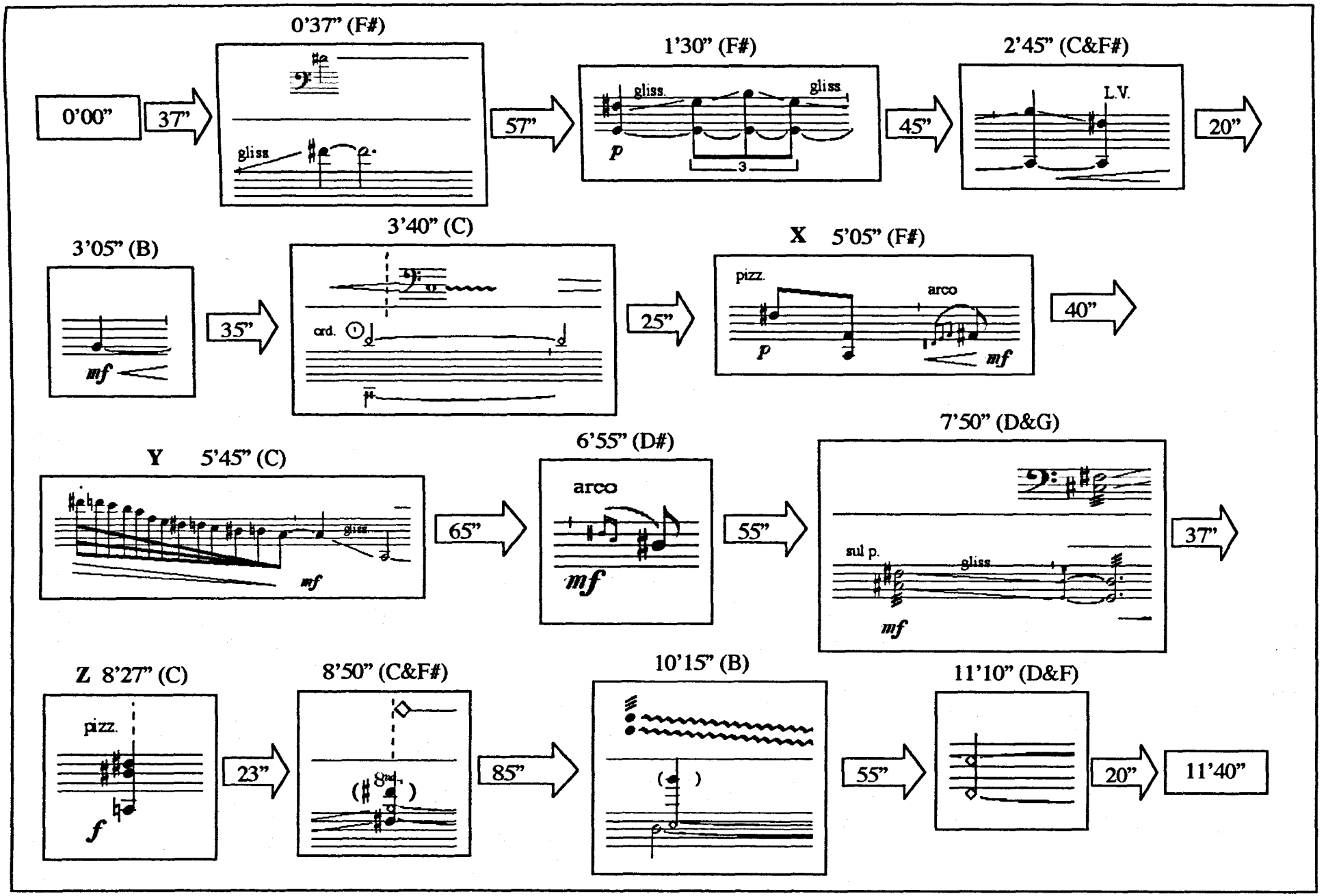


Figure 47. Pitch target structure in 'Tolerance'.

4. Performance Concerns

4.1 Dealing with a live performer

Mixed pieces have the intrinsic characteristic of having to deal with a visually based environment. In a performance the interest of the presence of a live source on stage will gravitate towards the fixed position of the instrumentalist.

Regardless of the composer's approach to the expectation generated by the proximity of the listener to the live performer in a concert environment, the central position of the performer in terms of space and source recognition will influence the development of musical material and discourse strategies. Together with the aural stream, the composer must deal with designing a method in order to address the visual links that will emerge during a performance. A large percentage of the total sounds used in the pieces discussed can be identified as originating from the cello, bassoon or marimba respectively. Moreover, the approach to the visual links between performer and resulting sound world is one where boundaries between instrument and recorded sound should be as indistinguishable as possible. It was a priority to generate sections of constant evolution and cumulative tension without revealing the exact medium from which each sound originated.

Sound boundaries were smoothed by creating an intermediate layer of non-transformed[17] instrumental sounds in the recorded part. This layer worked as an invisible aural bridge that makes the process of directly relating a visually perceived action by the performer to the resulting sound more difficult.

Figure 48 (Sound example CD2-61) is an example of this approach in 'Twilight', where the multiphonics occurring at 3'43" are extended in the recorded part and the bassoon can be perceived only as part of the whole sound world but not necessarily as triggering that particular event. The recorded sound (marked "A") commences a few moments after the attack on the real instrument at 3'43". In this case the sound duration was extended while the timbre was practically unaffected. Thus, the sound links the instrumental part with the

[17]These include close transformations consisting of slightly filtered sounds. In this way, the main spectral and morphological characteristics remain unaltered.

electroacoustic sound world by presenting a sound that can easily be confused as belonging to either medium.

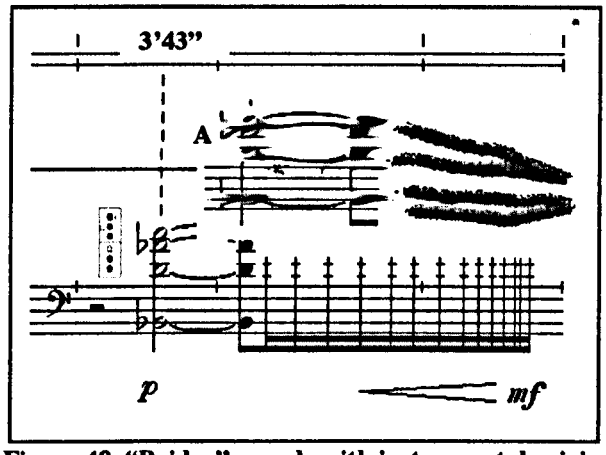


Figure 48. "Bridge" sounds with instrumental origin.

The non-evident actions of the performer in the mixed pieces favours the particular instrument as a source without emphasising its role as an event-triggering device. However, without the apparent link between the instrumentalist's action and the resulting event, the performer's role continues to vary throughout each of the pieces. This variation occurs in terms of the amount of physical activity by the performer related to the activity in the sound world. Therefore, there is also a direct link between the number of actions taking place in the instrument and the number of identifiable attacks emanating from the loudspeakers, even if they are not identifiable individually as isolated sound events (similitude in levels of activity).

This idea was explored in the middle section of 'Twilight' (from 6'00" until 9'30") (Sound example CD2-62) where fast-attacks in the recorded part and key sounds in the bassoon are the main sources for the sound world. Although it is impossible to pinpoint their source as recorded or performed live, there is an obvious link (visual and aural) between the amounts of activity in both worlds.

4.1.1 Performance problems

A mixed piece confronts the composer with the issues of a fixed recorded part on one hand and the need to incorporate live performance elements. The electroacoustic part must offer a sonic ground for the instrument to develop and should allow interaction in order to achieve a balanced set of relationships.

Meanwhile either medium can equally generate or react to streams of information from its counterpart.

Performance problems need to be considered from the initial stages of the compositional process if they are to be fully integrated as elements within the network of relationships. Their importance can be either highlighted or de-emphasized intentionally affecting the overall musical result.

In the case of the three mixed pieces, performance concerns influenced structural decisions and the manipulation of sounds. Their structural influence can be related to the inevitable trade-off between complex synchronisation and a more free and flexible performance environment for the instrumentalist. "Tolerance' and 'Twilight' dealt with this concern with regards to emphasising the performer's freedom in order to avoid performance-related problems due to complex synchronisation requirements. On the other hand, 'Rimbarimba', requires a tighter and more exactly synchronised performance in order to achieve the planned integral rhythmic approach of some sections.

The three pieces explored two approaches to the freedom of the performer in regard to the synchronisation required with the recorded material. Certain structural decisions were taken to control the level of synchronisation in each section of the pieces. Thus, the performer is able to switch between prioritising synchronisation aspects (sections characterised by strict tempo, complex rhythmical patterns and multiple attacks), or concentrating fully on interpretation (sections with a sound framework whose performance is relaxed and synchronisation can be achieved by listening to the recorded sound cues).

The example shown in Figure 49 shows the instrumental part of two sections in 'Rimbarimba' with contrasting approaches to performance implications. The first example ("a") (Sound example CD2-63) is a fast melodic section in the middle of the piece (8'27"). Here, a successful performance will require constant accurate synchronisation at both rhythmic and pitch level.[18] On the other hand, the second example ("b") (Sound example CD2-64) is part of a sound framework intended to slow down the tempo of the piece before the more active section which starts at bar 214. The performance is based on a soft texture-based articulation of multiple pitches that integrate fully with the recorded sound

[18]When accurate synchronisation is indispensable it is marked in the example (fig.49) with doted arrows.

context. The only required synchronisation is at the end of bar 213 (7'06") in order to begin accurately the following section.

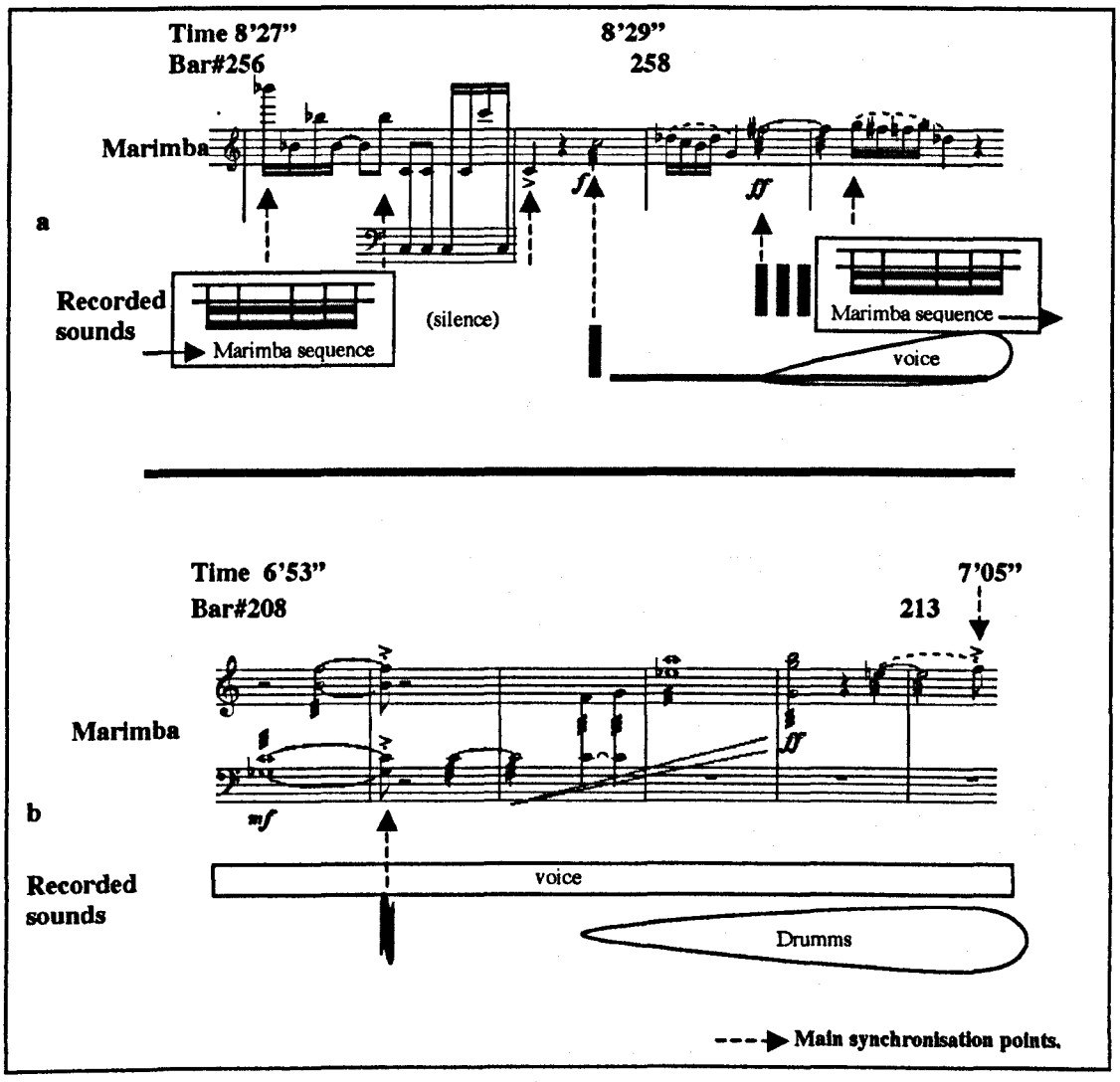


Figure 49. Structural influence of performance concerns in 'Rimbarimba'.

Secondly, in 'Rimbarimba' performance concerns indirectly influenced the resulting sound. The piece's idea for the general sound framework is one of constant changes in the role of the real instrument. Although this has been discussed earlier, it is necessary to underline that performance concerns had an important influence upon the way in which this strategy was implemented. The marimba emits sound from various points and its physical size influences how the sound is spatially projected and perceived in a live performance situation.

'Rimbarimba' requires from the performer a vast amount of physical activity.[19] Nevertheless it was also composed, like the other two mixed pieces, to provide an electroacoustic counterpart which integrates the instrument's characteristics into a unique sound environment. In this way, the resulting sound world consciously tried to avoid emphasis on the spatial position of the instrument or the use of drastic spatial movements in the electroacoustic material which could modify the listening focus for the audience.

4.1.2 Problems of synchronisation

Performing a piece in which the live performer must keep track of fixed pre-recorded material confronts the composer with an unavoidable compromise where music must be created according to a structured method of synchronisation. It also presents a problem representing synchronisation information in the instrumental score with enough accuracy without interfering with the freedom of interpretation.

Tolerance' was no exception and the concept behind the piece (and its title) was to create a set of relationships and an instrumental writing flexible enough to be performed following a time line marked on the score. The cellist can keep track of significant events throughout the piece by reading the CD display or a chronometer. The compromise of not demanding a constant and accurate complex synchronisation was deliberate. The live musician is relatively free to decide certain performance elements within certain time constraints. [20]

Figure 50 (Sound example CD2-65) shows the information regarding time for the performer. Although the time mark (X) is only a general guideline, the small time mark (Y) is supposed to be as accurate as possible. Nevertheless, the performance of this section has been dramatically different in each performance of the piece played by the same cellist, but the performances seem to maintain the sense of a relationship between both media mainly due to pitch and behavioural links.[21]

[19]Sections require constant walking due to the wide range of the instrument.
[20]This method was also explored in 'Twilight' for bassoon and electroacoustic sounds.
[21]The multiple *glissandi* create a textural-based and non-rhythmic contrast where similar basic units are repeated continuously in both mediums.

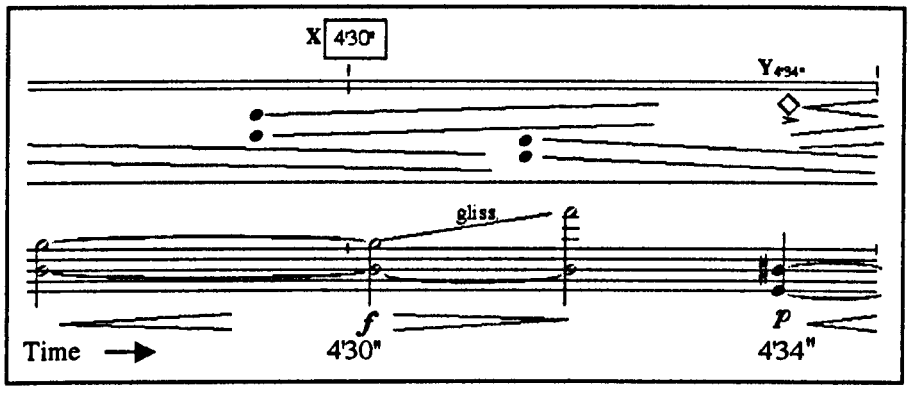


Figure 50. Time in the score of 'Tolerance'.

In the case of 'Rimbarimba' a different approach was selected in terms of obtaining an accurate synchronisation during live performance. The need for a more detailed rhythmic relationship between media in multiple sections of the piece, together with the required triggering of chord resonances in the recorded part by the marimba, resulted in a version of the piece that utilises a Max/Msp patch. In this way, through the use of a footswitch connected into the hard disk playback system the performer is able to trigger accurately the sound files throughout the piece.

Figure 51 shows the general interface of the Max/Msp[22] patch that the performer sees in order to know the file number being played on the recorded part. The number of the sound file can be represented in the score aiding the performer to achieve a tighter synchronisation.

[22]Help with the design of the Max/Msp patch was obtained from Thomas Gardner.

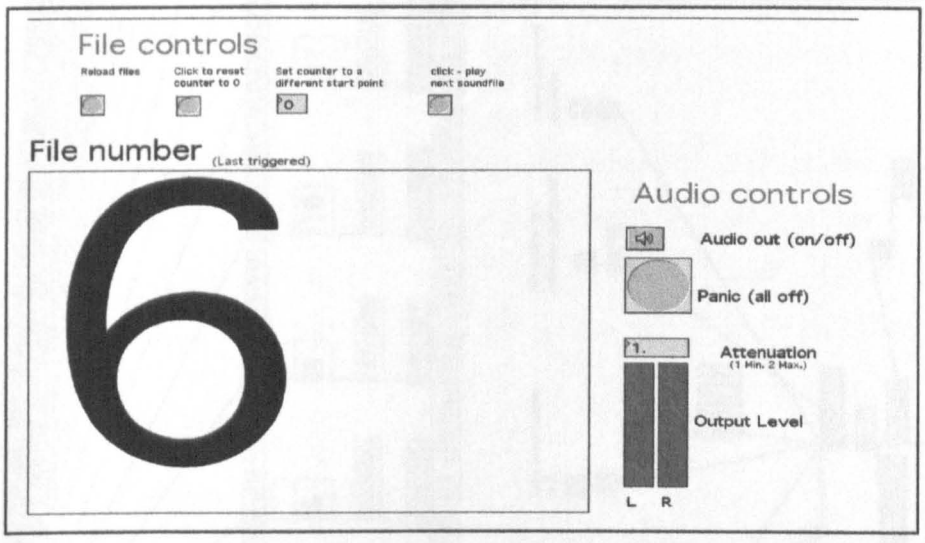


Figure 51. Max/Msp main screen for 'Rimbarimba'.

Finally, figure 52 illustrates the Max/Msp patch that controls the multiple independent sound files where the performer is able to decide the exact starting and ending point for each fragment triggered by the footswitch. In this way each performer is able to define the number of triggered events in the piece and alter the Max/Msp patch to suit personal preferences.[23]

[23]A detailed diagram of the connections required for the performance of the Max/Msp version of 'Rimbarimba' is included in Appendix C.

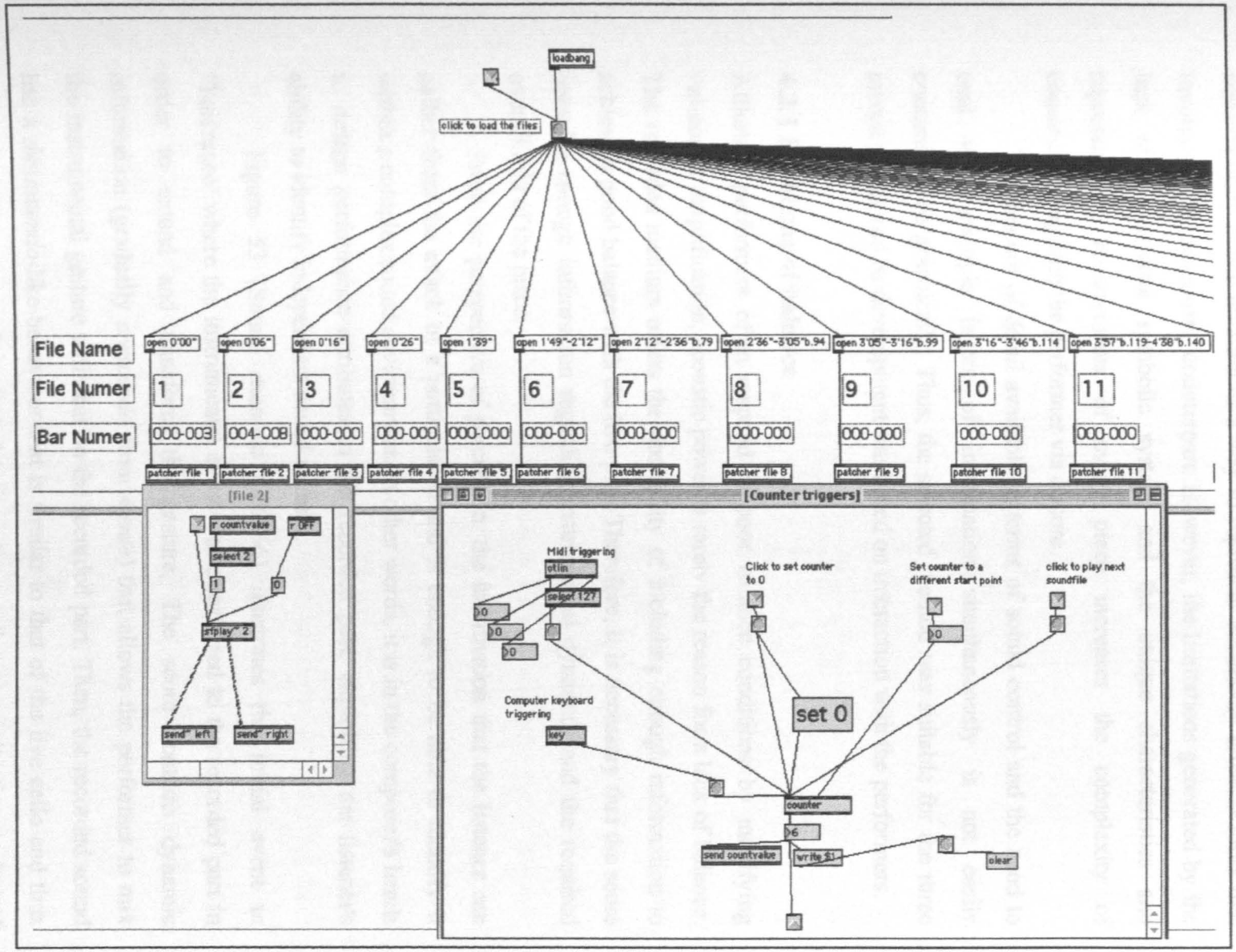


Figure 52. Sound file selection screen in Max/Msp for 'Rimbarimba'.

4.2 Encoding and decoding music

It is beyond the scope of this work to address in detail the problems of contemporary music notation as a way to represent accurately musical ideas that involve an electroacoustic counterpart. However, the limitations generated by the lack of a universal symbolic system and the unique characteristics and representation requirements of every piece increases the complexity of communicating with the performer via a score.

The amount of detail available in terms of sound control and the need to deal with multiple layers of information simultaneously is not easily communicated graphically. Thus, the selected method was suitable for the three mixed pieces and its development was based on interaction with the performers.

4.2.1 Problems of balance

Although performers often respond to poor balance conditions by modifying volume or amplification, acoustic power is rarely the reason for a lack of balance. The recorded medium offers the possibility of including enough information to achieve a good balance with the live part. Therefore, it is necessary that the score contains enough information regarding instrumental dynamics and the required overall mix of the piece.

From the perspective of perception, the information that the listener can gather from the attack of a particular sound is enough to be able to identify it within a complex sound environment. In other words, it is in the composer's hands to design performance attributes in the recorded part, exploiting the listener's ability to identify independent sound streams.

Figure 53 (Sound example CD2-66) illustrates the initial event in 'Tolerance' where the instrumental event was transferred to the recorded part in order to extend and transform the gesture. The score contains dynamic information (gradually *crescendo* from *niente*) that allows the performer to mix the instrumental gesture with that on the recorded part. Then, the recorded sound has a *diminuendo*-like behaviour that is similar to that of the live cello and thus helps to create a sense of musical phrasing. In a performance situation, technical problems regarding detailed control over the amplification or placement of the

loudspeakers can be offset by changes in the overall mix, the instrument's amplification, and variations in the performance or other real time modifications.

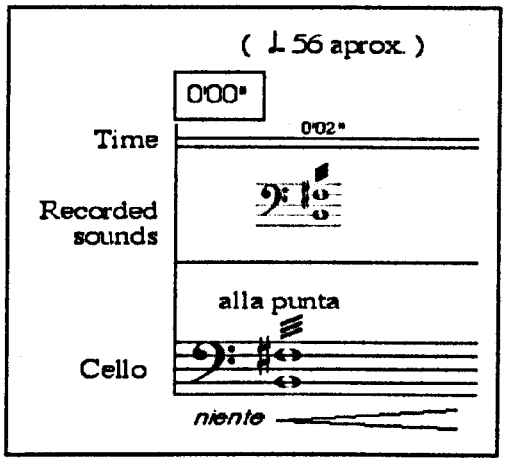


Figure 53. Initial event in 'Tolerance'.

4.2.2 Perception of the sound sources

It is possible to say that the performer's own style is present mainly through phrasing and other musical elements that are not contained in one single note (Morill, 1981). In the light of the pieces, where a detailed balance of sound sources is crucial for a successful performance, the accuracy with which phrasing and the performer's individual style mix with the sound source coming out from the loudspeakers is of vital importance. Therefore, physical space becomes a definitive element that affects the general balance of the piece.

Regarding the placement of the live sound sources (performer) in the three mixed pieces, blurring the identities of boundaries between media led to a somewhat constrained placement of the instrumentalist and loudspeakers as an ideal. In other words, the closeness of the sound sources together with some amplification of the instrument was intended to create the feeling of a singular wide source where the precise borders of the sound field could not be easily identified. This emphasized the chamber-like feeling of the piece which in itself was helpful in achieving a more spatially bonded mix of sound worlds.

4.3 Recording vs. live performance

The difference between the recorded version of a mixed piece and its live performance must be taken into account from the initial planing stages. The recorded medium confronts the listener with an acoustic space free of any visual information related to performance, and therefore lacks the possibility of using any recognisable spatial origin as a structural element.[24] On the other hand, a recorded mixed piece offers the option to separate the visual and aural aspects such that a recording could be mainly considered as an analytical tool to identify relationships (Emmerson, 1998).

The mediums for performance of a mixed piece can be complex and require great accuracy. Multitrack recordings and playback can be done through multiple speaker set-ups, mixing desks with unlimited outboard processors, live electronics with real time digital sound processing, etc. However, when recording a piece in order to distribute it in a standard general consumer product (CD, DVD, etc.) the possibilities are very much reduced.

The recorded sound medium is one that includes the listener physically and will implicate him in all of its detail. It is delivered in a multidirectional way by the loudspeakers and will allow a greater level of inspection with regard to the behaviours. Therefore, at a performance stage it is indispensable to determine how the identity of any musical idea will be maintained, and to define a strategy for the composer to direct the evolution of the musical material.

On the other hand, the visual layer present in mixed pieces will always result in maintaining a certain spatial separation and a relationship of distance between what is seen and what is actually heard. The visual information is unidirectional and will enforce the idea of a musical discourse being translated in real time by the performer. In other words, the decoding by the performer of the musical information will be permanent, dynamic and at multiple simultaneous levels with a constant unidirectional visual counterpart.

Awareness of the structural importance of spatiality in mixed pieces is gradually growing. However, space is one of the compositional fields that will be affected the most when a piece which was originally conceived for live performance is recorded. When a piece is recorded for the general public most of

[24] I am referring to CD or home-use recordings. Until 5:1 systems are widely available these formats are limited to the spatial image available through stereo systems.

the spatial ideas are lost or are at least modified in terms of the technical limitations and characteristics.

An obvious solution could be to create two versions of a piece, one for live performance where the available means are adequate and another for general distribution, possible broadcast, and performances where the original set-up is not available. A careful process of re-mixing and re-building the whole electroacoustic part is compulsory in order to achieve a new environment for the instrument suitable for two-track recording and playback through low-to-medium quality systems. In these instances, the piece will become a different work created mainly from the same sounds and confronting the same musical problems but with more limited spatial resources.

Furthermore a visual counterpart during a performance could be considered and used as a compositional variable and therefore be developed through the piece (the performer's movements on stage, lighting, etc). In these cases a recording in any audio-only medium will be also affected by the recording of the finished work, and a careful stream of decisions must be taken in order to re-compose a final version.

A completely faithful medium for distribution and performance of a mixed piece will never be developed due to the particular problems and techniques of composing each particular piece. The technical resources available for any creative project will help determine the final medium, and the intentions of the composer, in the case of a musical piece, must look to the principal objective of the piece in order to incorporate the characteristics of the technological means available.

5. Final Considerations

5.1 The compositional process

This thesis began by outlining the particularities of musical language when dealing with mixed or acousmatic pieces, and it examined the implications of this in the creation of a coherent set of rules that establish the grounds for the development of musical ideas at various levels. In developing this discussion reference was made to the two acousmatic and three mixed pieces, as well as to a three-stage process in the realisation of compositional goals. These three stages are the following:

1) Generating and selecting musical material.

   The composer's task is not only to define a valid language and musical context for the work but also to create and select musical material. He reacts to a particular combination of variables and establishes relationships in order to develop musical statements. The gathering of sources and their initial transformations is clearly the initial compositional stage of any piece, and it depends directly on the composer's personal means of qualifying and categorizing sound material.

2) Structuring musical material.

   Links between materials establish the foundation for any structural development and guide the design of musical syntax. Time, pitch, sound behaviour and segmentation are relevant concepts in dealing with the organisation of musical information from either a micro or macro perspective.

3) Performance.

   The performance realisation of a piece requires consideration throughout the compositional process. The decisions about the graphical representation of the score and the problems of synchronisation in mixed pieces are influential because they guide the development of some of the long-term musical sections. Dealing with a performer both as a source of sound material and as a generator

of broader musical information must be considered to be a definitive compositional influence.

5.1.1 Important influences in the creation of acousmatic and mixed pieces

Industrialisation and new technologies have transformed our sound environment. New sounds have appeared, they have transformed our concept of hearing and have modified our aesthetic criteria in a decisive fashion (Schryer, 1988). The tools have a direct influence on the compositional process not only as practical ways of achieving goals and making the processes more efficient, but they also reveal a whole new world of possible relations and musical materials that offer the composer the opportunity to construct an interesting and imaginative piece of music, presenting new aesthetic and practical problems.

Acousmatic music and the acousmatic elements in mixed pieces are composed and produced under very specific conditions, namely in the environment of the electroacoustic studio. The composer must perform his "creative duties" via different signal processors, recorders, synthesisers and computers and must generate, select, organise and act upon the sounds. Instrumental music on the other hand relies on the score to represent what the composer imagined and then to transmit it to the performer through the medium of a well-established symbolic system.

There are two issues that need to be taken into account when working on a mixed piece. Firstly, the influence on compositional decisions of the instrument's particularities regarding timbre, dynamics or performance techniques. Secondly, the tools available to the composer in the studio offer a way of listening to the recorded part during the process of composition, whereas the instrumental part requires a more conventional approach. The composer will have to design and compose the instrumental material based mainly on an ability to imagine sound and transfer that thought into notation for the subsequent process of decoding by a performer.

There are pieces that are the result of a specific experiment with composition (software or hardware) where limitations in the creative process emerge. To avoid the risk of creating less musically interesting results, the composer must remain focussed on the conception of a piece as a process of

creation rather than as a function of the software possibilities. On the other hand, in programming his own software, designed specifically for a particular pre-planned compositional idea, the composer is confronted with the most powerful tool to develop a personal language without being restricted by external limitations. Nevertheless, personal limitations as a programmer and the fact that this is a time-consuming process, removes the composer from one of music's most important qualities: spontaneity (Lansky, 1983).

5.2 Individual and common approaches

The systematic discussion of the pieces and the techniques involved in selecting and using sound material, their structuring processes and performance intends to provide a thematic thread that emphasises the consideration of general trends of composition rendering the concept of a piece as a self-contained unit less important. Each of the works tries to push further, similar musical ideas and approaches. Thus, the findings of such processes can be identified in the common compositional tendencies that go beyond the limits of any one individual piece.

It is possible to explore compositional strategies from two different perspectives, firstly, where all the implications are explained within the limits of one of the works and in this way a structural analysis and a detailed description of particular compositional methods can be discussed, and secondly, where the common issues concerning multiple pieces can be used to compare similar approaches within different contexts. The strategies discussed throughout the text can be divided as follows:

<u>One-piece strategies</u>

1) Timbral relationships.

   These were defined by considering particularities of the sound material in each piece. The idea of creating links between timbres in the mixed pieces was to explore the characteristics of the instrument, and in the case of the acousmatic pieces, the idea was to organise the initial sounds into groups. An example can be found in 'Twilight' (section 1.2.4), where the sound characteristics of the electroacoustic part were influenced by the timbral quality of the transformations obtained from the instrumental recordings.

2) Spatial concerns.

The role that the placement of the sounds acquires depends directly on the relationships established within the piece's duration. Spatial control in each piece was conceived as an element with which to achieve structural unity. For example, in 'Friction of things in other places' (section 2.1.1), the spatial placement of the sounds is described as one of the methods used to differentiate layers of simultaneous musical information.

3) Microstructural strategies.

These can be referred to as short-term compositional decisions that coherently relate the piece's musical material. Operations at a micro-level regulate the functionality of the elements creating building blocks of musical information, and defining the hierarchy of the piece's sound catalogue (section 3.1). The use of sound markers and foreshadowing in 'Twilight' (section 3.1.3) are examples of the piece's methods of achieving unity at a microstructural level.

Strategies common to more than one piece

1) Instrumental possibilities.

The exhaustive exploration of the instrument in each of the mixed pieces was definitive in guiding the recordings for the initial sound material, and influenced the instrumental writing in each piece. As the text describes (sections 1.3.1 and 1.3.2), the characteristics of the instrument were vital to the development of the final sound world.

2) Non-timbral relationships.

The development of relationships from a non-timbral perspective occurs in all the pieces. Although the examples of superimposition, imitation and hybrid morphologies were a crucial strategy to link materials in 'Twilight' (section 2.2.3), the use of equivalent methods can be identified in other pieces. For example, 'Cycles' (section 2.2.1) utilised similar transformations (superimposition of elements and imitation) to link sounds in different sound events in both movements.

3) Hierarchies.

The definition of hierarchies of compositional elements established the principles of order for the musical discourse. For example, in 'Rimbarimba' hierarchies of materials enabled the idea of "contrasting approaches" (section 3.4.3). In this case, the texture-based and rhythmic contexts were achieved through a categorisation of the sounds available for the piece. Another example is section 1.1.2, where the cataloguing of sounds for 'Friction of things in other places' was made according to their placement on Table 1.

4) Spectral framework.

The processes of organising spectral information in 'Tolerance' and in creating relationships in 'Rimbarima' can be compared to the use of the spectral framework in 'Cycles', where internal sound relationships are used as links between movements (section 3.1.2). From a macrostructural point of view, 'Tolerance' is organised by the extent of spectrum covered, and in 'Rimbarimba' the creation of links is influenced by the spectral characteristics of the sound material (section 3.4.2).

5) Segmentation.

The definition of morphological units is permanently influenced by the contextual and structural approaches described for the pieces (section 3.2). However, 'Cycles' and 'Twilight' showed two different perspectives in dealing with segmentation. In the case of the acousmatic piece (section 3.2.2), the units were defined by contrasting levels of sound density whereas in the mixed piece (section 3.2.3), the timbral characteristics of the bassoon guided the piece's structural development and the definition of musical units (timbral scenes).

6) Time-scales.

The discussion described the structural influence of time-scales, and outlined the importance of coherence at a micro and macro level. At the same time, the placement of focal musical events throughout the time-grid was shown as defining the rate at which musical information occurs in all the pieces.

7) Sound material.

Creating a sound catalogue is one of the main operations common to the five pieces. Each medium had particularities that influenced the process of selecting material and generating the basic structural ideas. Different approaches to sound source selection were described (section 1.2) with examples from different pieces where the morphological, gestural and spectral characteristics of the sound were identified as the main guideline for categorising sound material (e.g the timbral usefulness of sound material).

8) Performance concerns in mixed pieces.

The mixed pieces dealt with the problems of synchronisation and representation of the score in similar ways (sections 4.1.2 and 4.2).

5.3 Conclusion

This submission comprises five pieces that explore diverse methods of achieving musical unity and coherence. Although many interpretations of the processes discussed are intuitive they all emerged from the concrete experiences obtained during the composition of the five works. They share strategies and can be considered as a chronological experimentation with similar compositional concerns. The processes of gathering material, developing relationships, designing structures and resolving performance problems can take many different paths. However, general trends were identified through the description of the processes and the use of individual examples organised in groups following the three stages of the compositional process. As Berio said, "it is the musical processes that are primarily responsible for the narration" (Eco, 1989 p.4).

Appendix A

Contents of the composition portfolio[25]

1.

Title: **'Cycles'** (in two movements: 'Stop' and 'potS')

Instrumentation: For electroacoustic sounds

Duration: 12'30"

Composed: 1999

Technical requirements: Stereo piece on CD.

Programme note: Feelings and sounds coming back to our memory. 'Cycles' of ideas, transformations, processes and sounds. Composed in two movements organised in a similar way. 'Cycles' was composed at City University's Electroacoustic Music Studios in London and won the 1st. prize at the 1999 International Luigi Russolo Competition.

2.

Title: **'Tolerance'**

Instrumentation: For cello and electroacoustic sounds.

Duration: 11'40"

Composed: 1999-2000

Enclosed material: Score.

Technical requirements: Amplified cello and electroacoustic part on CD.

Programme note: There may be a place where two worlds are able to meet and co-exist. A sound world of intense and permanent relationships and behaviours. 'Tolerance' won an honorary mention at the 2000 Luigi Russolo Competition and is dedicated to Thomas Gardner.

[25]The five pieces were composed with funds from the Mexican Found for culture and the Arts (FONCA).

3.

Title: **'Twilight'**

Instrumentation: For bassoon and electroacoustic sounds

Duration: 13'30"

Composed: 2000-2001

Enclosed material: Score.

Technical requirements: Amplified bassoon and electroacoustic part on CD.

Programme note: Four continuous movements exploring four types of twilight (civil, nautical, astronomical twilight and true night). The piece explores these four stages within a sound world where the bassoon is the leader and the electroacoustic sounds define the boundaries of the relationships. Sound material for the recorded part and general musical ideas developed from bassoon gestures that try to evoke the daily and almost imperceptible process of light fading away and night covering the sky. Relationships which work as structural points experiment with the idea that light, specially sunlight, and sound are more closely related than we usually think. Sunset is not necessarily a slow-movement process. 'Twilight' was commissioned by the Spanish Ministry for Culture and composed at LIEM-CDMC in Madrid, Spain and at City University's Electroacoustic Music Studios. Premiered at the Reina Sofia Museum in Madrid in July 2001, the piece has also been performed in Hungary, Mexico, Argentina and USA by different bassoonists. I want to thank Peter Dodsworth, Gyorgy Lakatos and Dominique Deguines for their help with the piece. 'Twilight' won honorary mentions at the 2002 International Competition of Electroacoustic Music and Sonic Art, Bourges and at the 2001 Luigi Russolo Competition.

4.

Title: **'Rimbarimba'**

Instrumentation: For marimba electroacoustic sounds

Duration: 15'00"

Composed: 2001-2002

Enclosed material: Score.

Technical requirements: Amplified marimba and electroacoustic part on CD. Max/Msp patch with midi footswitch (optional).

Programme note: 'Rimbarimba' was composed as part of the project 'Far from silence' with percussionist Robert Esler. The creation of recognisable links between different media is one of the main concerns. The integration of rhythmic and spectral materials from the live instrument and the electroacoustic part are therefore central to the piece. 'Rimbarimba' can be considered as a mix between artificially generated sound worlds, layers of recorded sound related to the marimba and a human element that works as a "bridge" between multiple musical levels. 'Rimbarimba' was commissioned with funds from the USA-Mexico fund for Culture in 2001 and was created at the composer's studio.

5.

Title: **'Friction of things in other places'**

Instrumentation: For electroacoustic sounds

Duration: 8'00"

Composed: 2002

Technical requirements: Stereo piece on CD.

Programme note: When things occur simultaneously there will always be different levels of friction. Energy, disagreement, pitch, physical action are areas where difference can generate musical material. 'Friction of things in other places' explores various ways of structuring sound ideas through differences in material and sound sources. Created at the composer's studio with funds from FONCA.

Appendix B

Contents of the compact discs

Compact Disc # 1

"Electroacoustic Music"[26]

Track	*Title*	*Performer*
1	'Cycles' ('Stop')	n/a
2	'Cycles' ('potS')	n/a
3	'Tolerance'	Thomas Gardner
4	'Twilight'	Peter Dodsworth
5	'Rimbarimba'	Robert Esler
6	'Friction of things in other places'	n/a

Compact Disc # 2

Sound examples 1 (Please refer to the "Index of sound examples")

Compact Disc # 3

Sound examples 2 (Please refer to the "Index of sound examples")

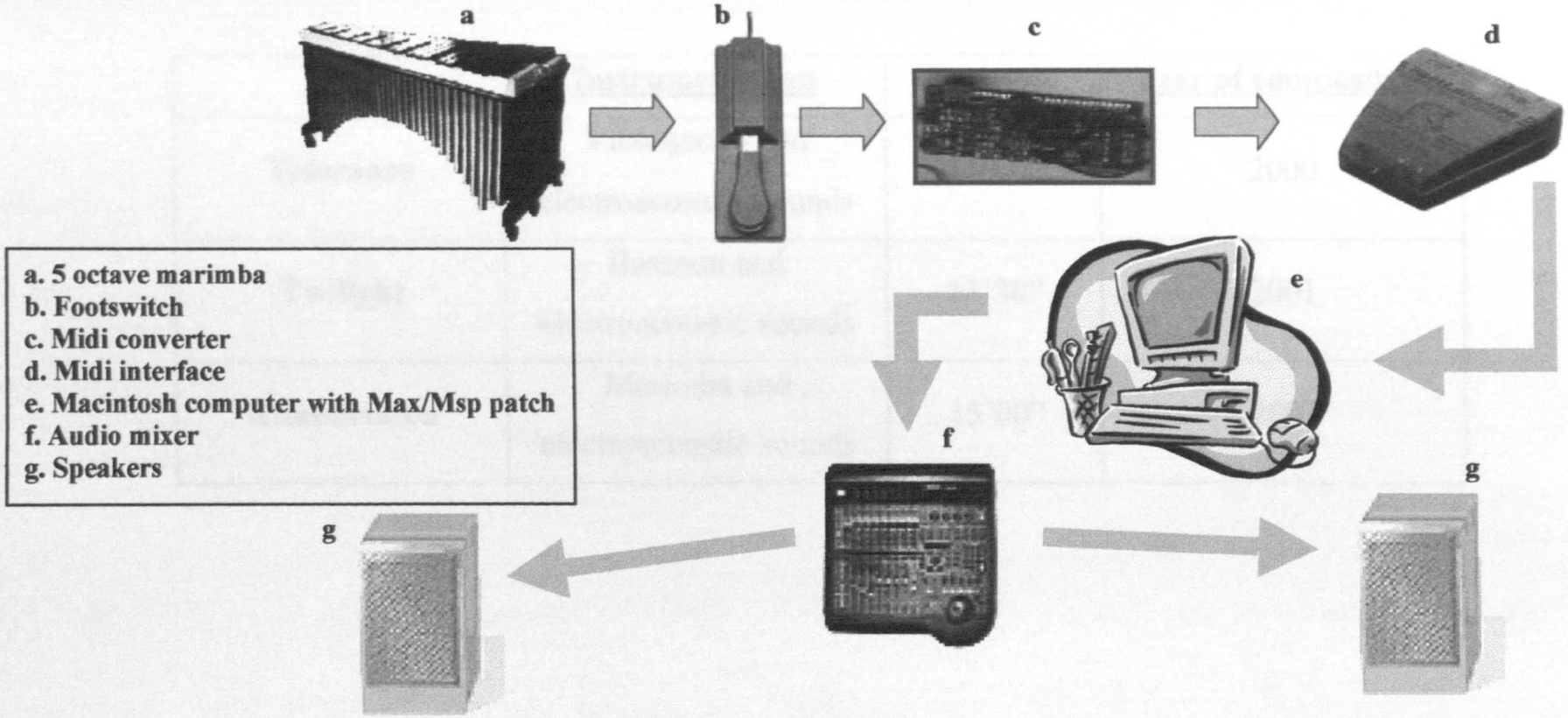
Compact Disc # 4

Max/Msp Patch and audio data for the Max/Msp version of 'Rimbarimba'
(the CD-r is for Macintosh only)

[26]Track #1 available from: XXI° Concorso Internazionale Luigi Russolo Di Musica Electroacustica 1999, Fondazione Russolo-Pratella, Italy, 1999, ef.er.P'99.
Track #2 available from: Electroshok Presents Electroacoustic Music Vol.VII, Electro Shock Records, Russia, 2002, ELCD026-027.

Appendix C

Max/Msp connections for 'Rimbarimba'



Appendix D

Study Scores

Piece	Instrumentation	Duration	Year of composition
Tolerance	Violoncello and electroacoustic sounds	11'40"	2000
Twilight	Bassoon and electroacoustic sounds	13'30"	2001
Rimbarimba	Marimba and electroacoustic sounds	15'00"	2002

Tolerance

Violoncello and electroacoustic sounds

...For Thomas Gardner

Rodrigo Sigal
Dur: 11'40"
08/2000
www.rodrigosigal.com

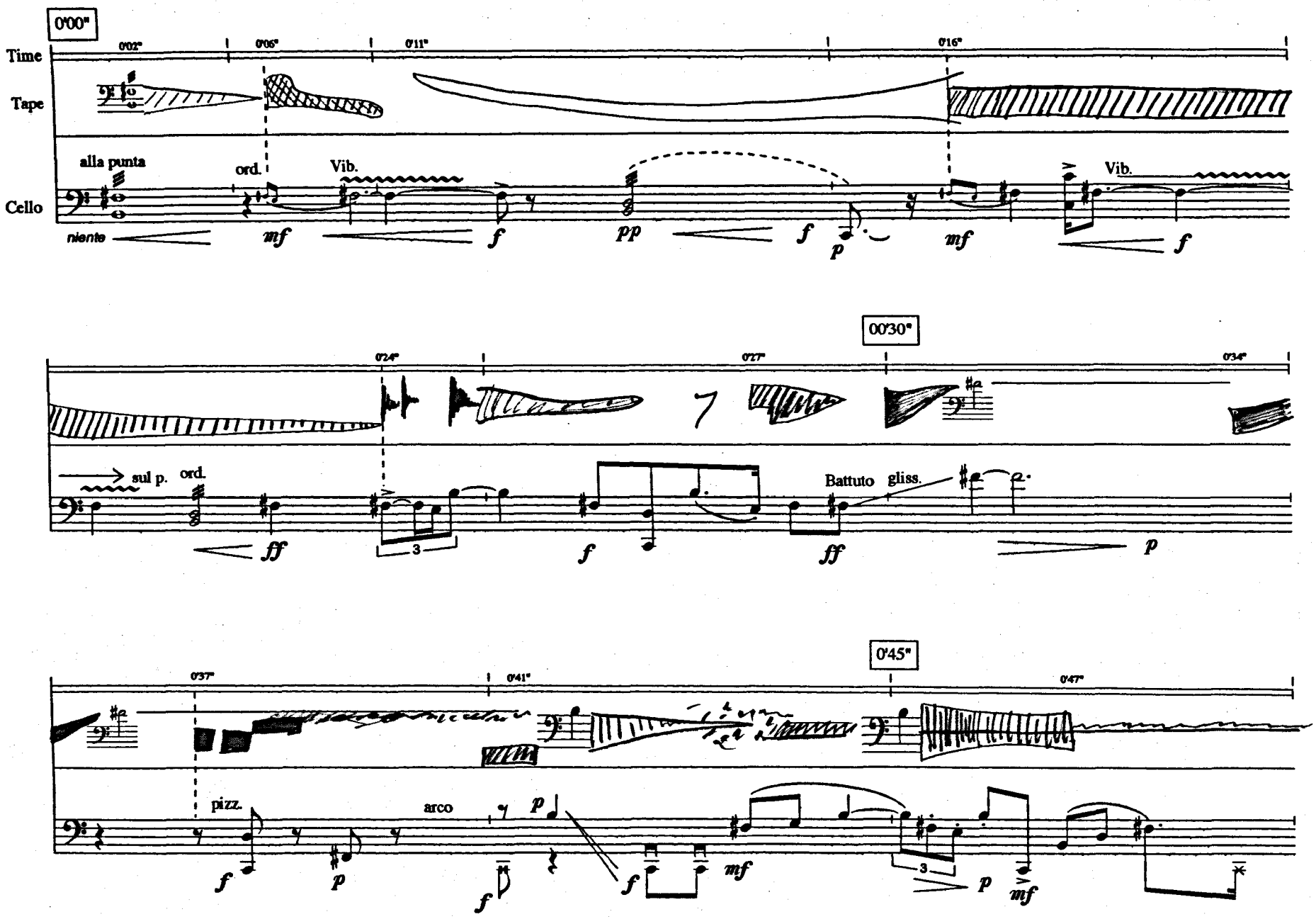
- This work was composed with funds provided by FONCA, Mexico.

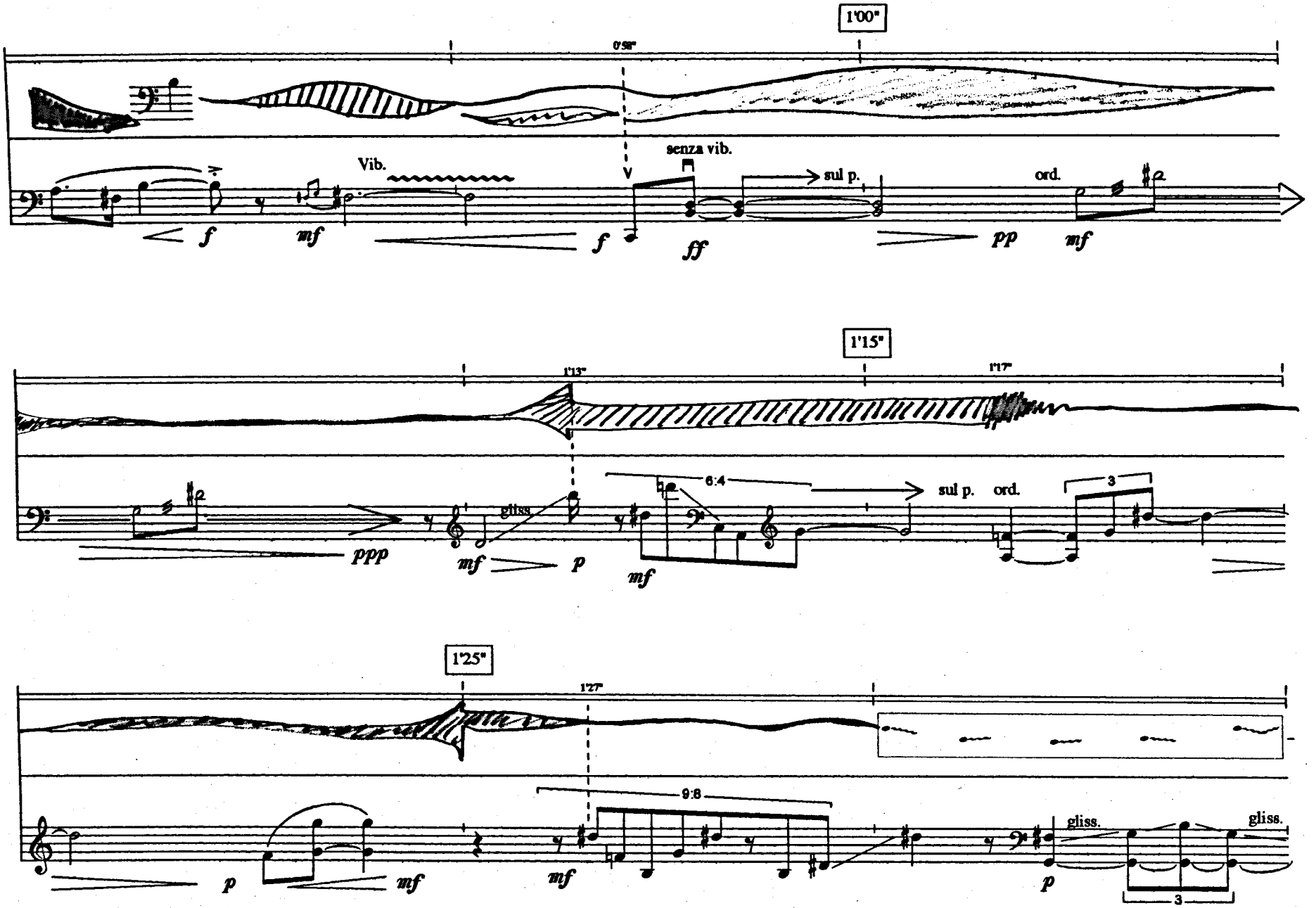
TEXT BOUND CLOSE TO THE SPINE IN THE ORIGINAL THESIS

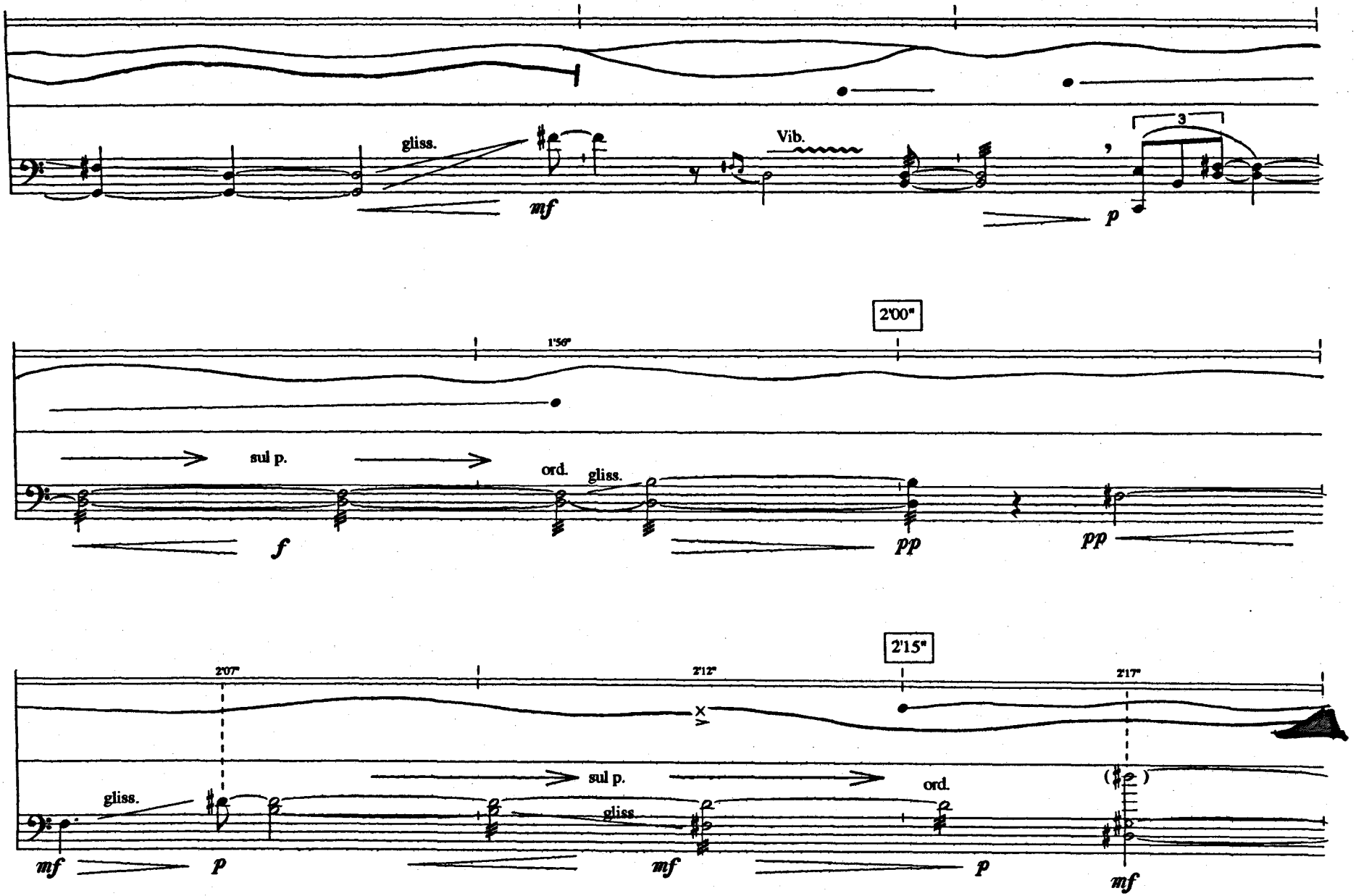
Tolerance

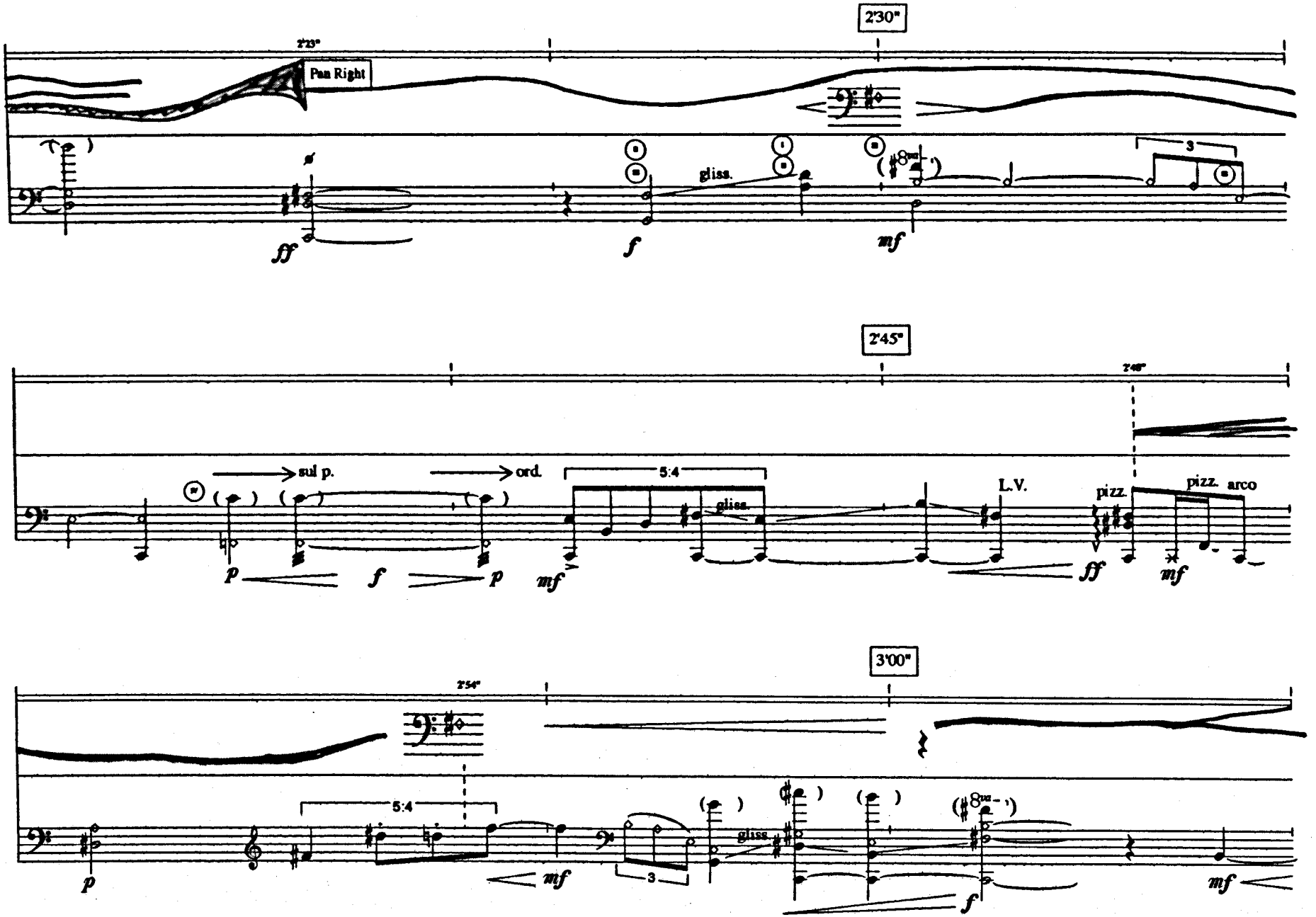
Rodrigo Sigal
London, 08/2000

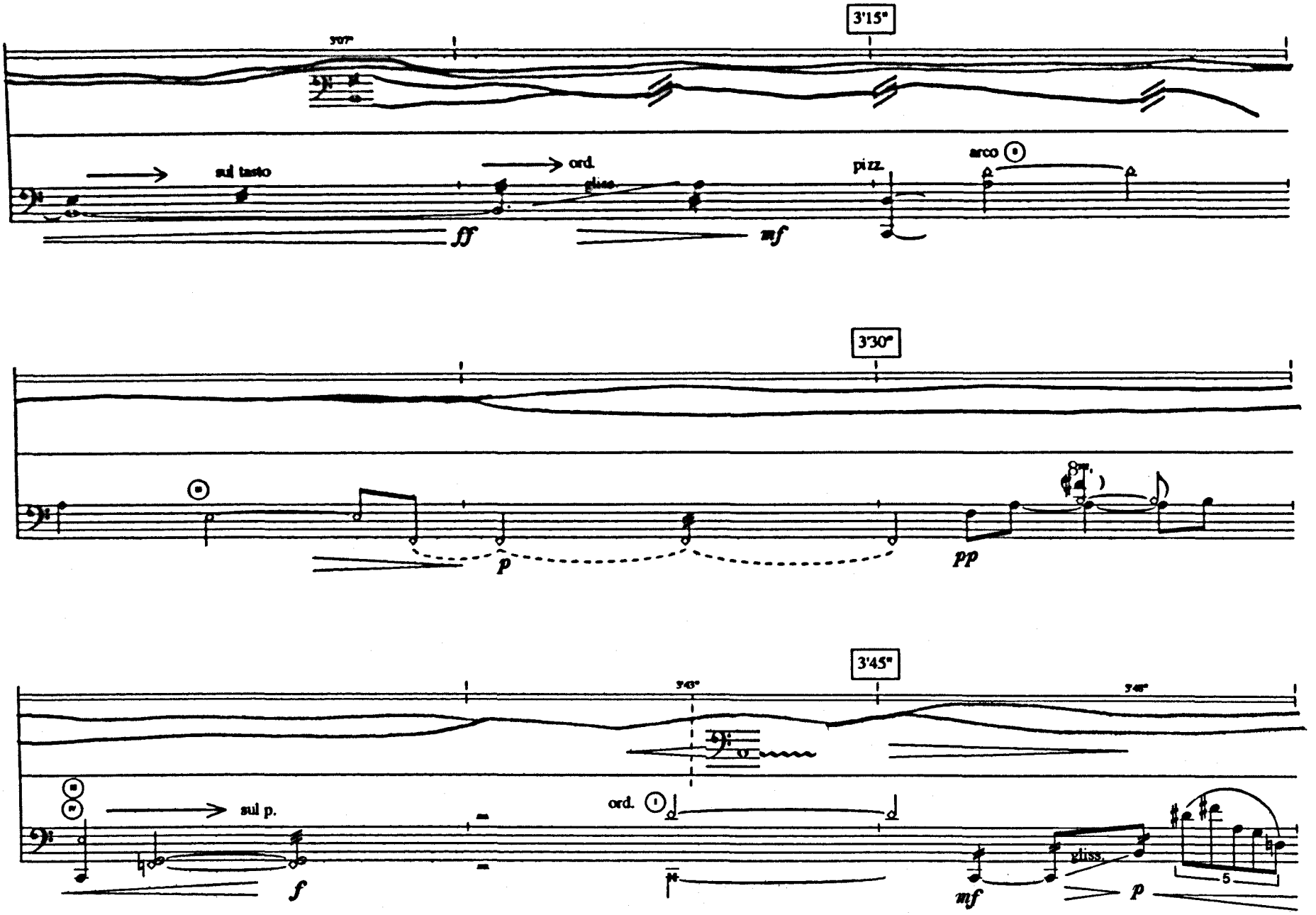
Dur: 11'40"

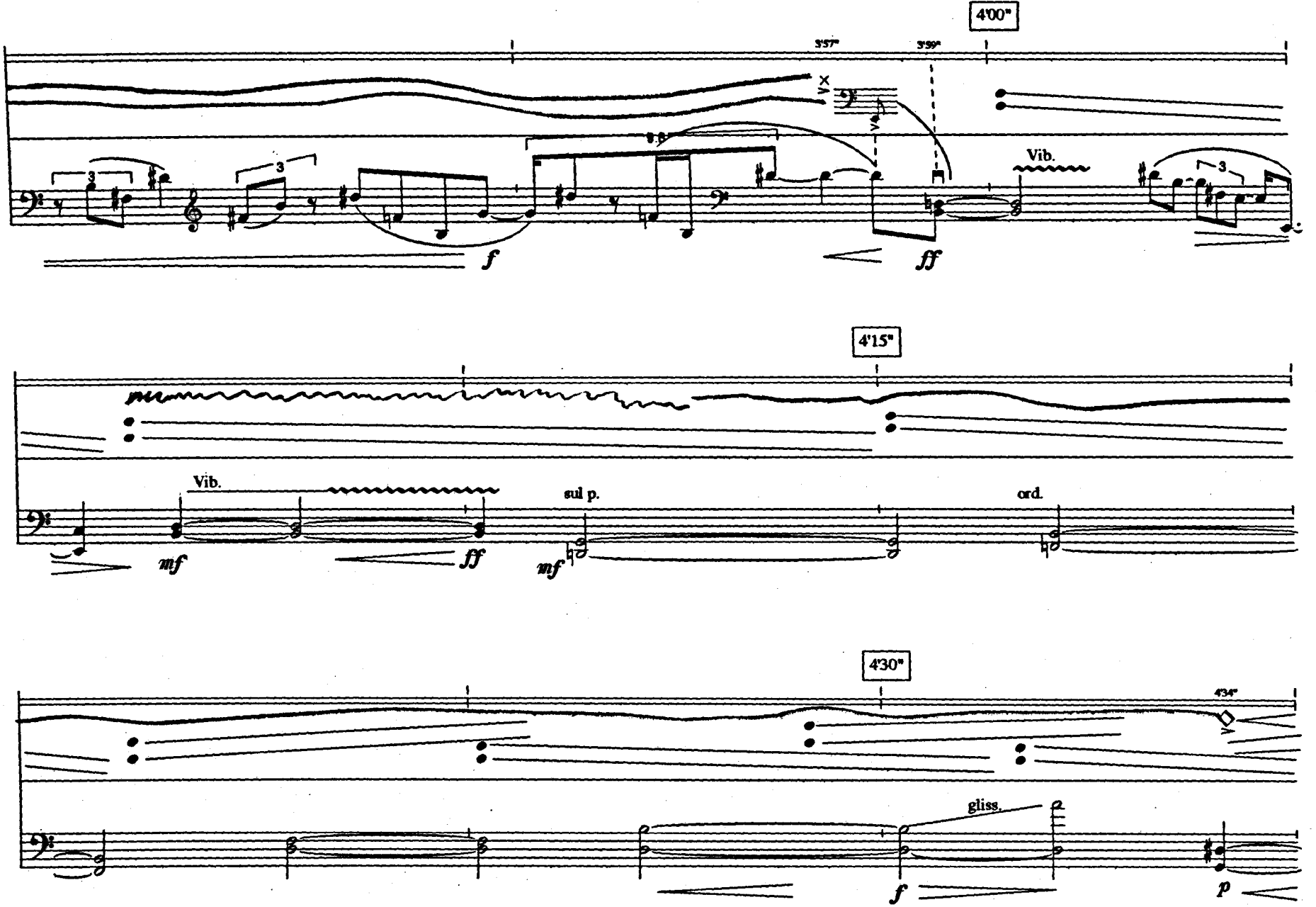


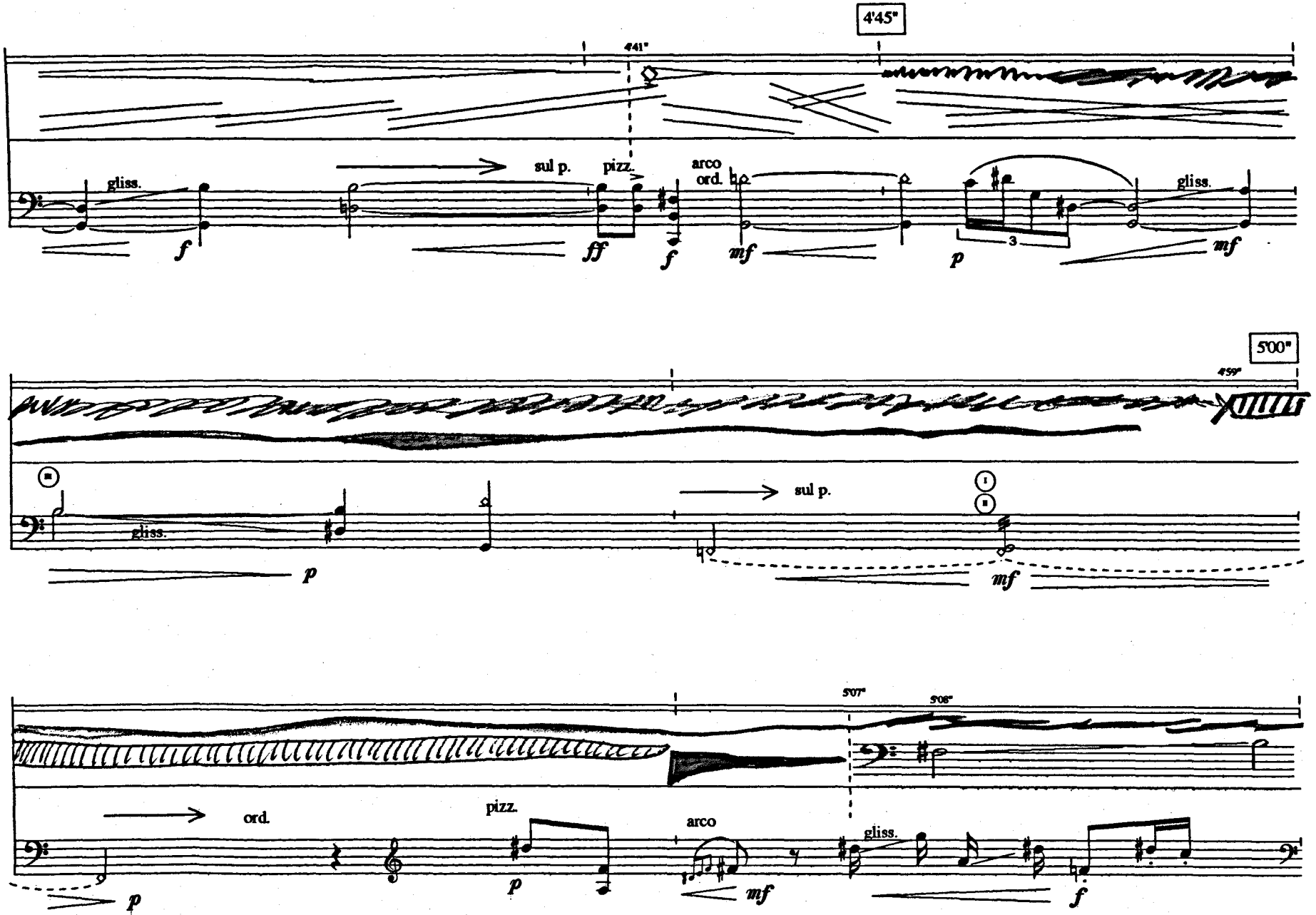

1'00"
0'58"
Vib.
senza vib.
sul p.
ord.
f
mf
f
ff
pp
mf
1'15"
1'13"
1'17"
6:4
sul p.
ord.
3
ppp
gliss.
mf
p
mf
1'25"
1'27"
9:8
gliss.
gliss.
p
mf
mf
p
3

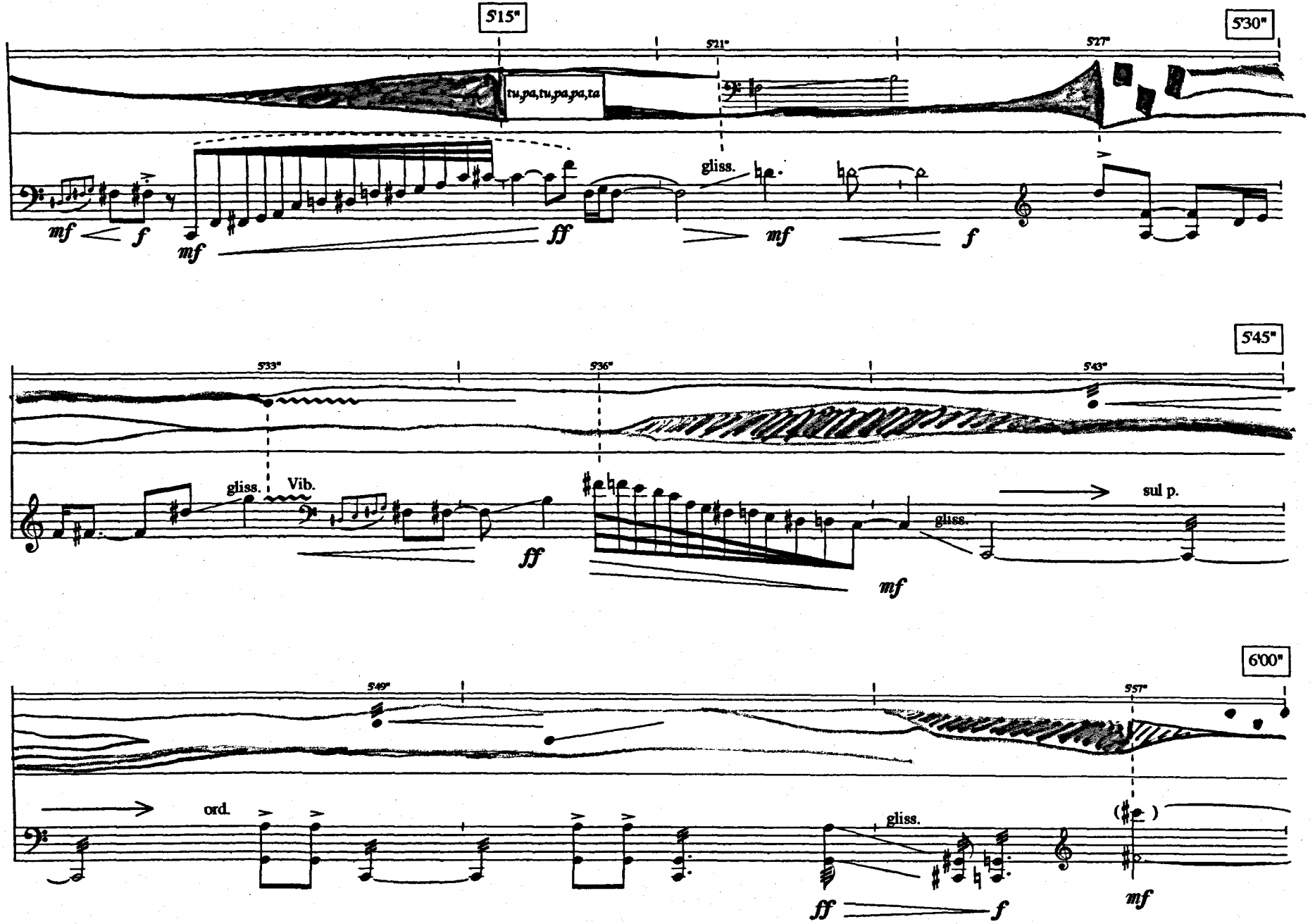

gliss.
mf
Vib.
3
p
2'00"
1'56"
sul p.
ord.
gliss.
f
pp
pp
2'15"
2'07"
2'12"
2'17"
sul p.
ord.
gliss.
gliss.
mf
p
mf
p
mf

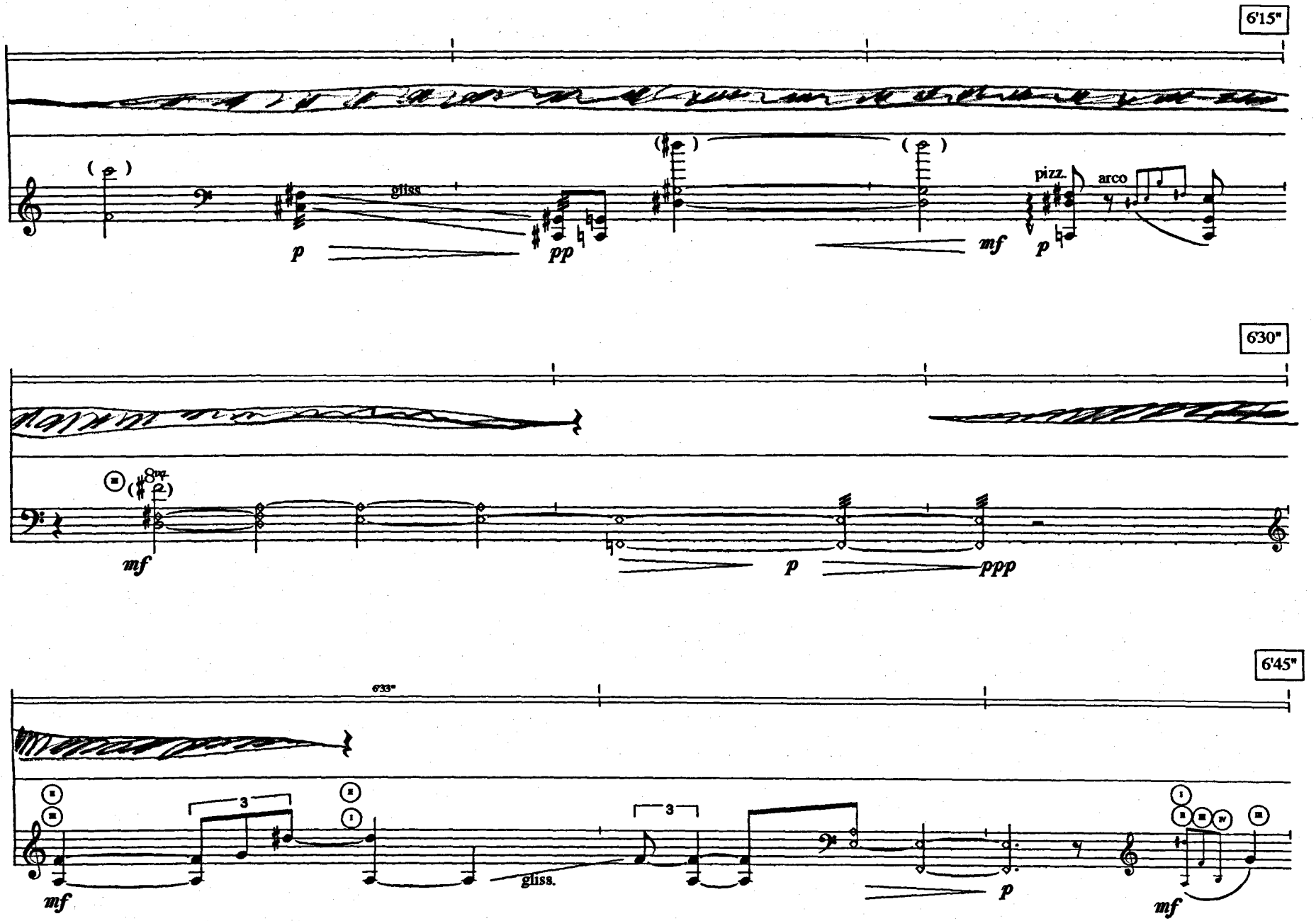

2'30"
2'23"
Pan Right
gliss.
3
ff
f
mf
2'45"
2'40"
sul p.
ord.
5:4
gliss.
L.V.
pizz.
pizz. arco
p
f
p
mf
ff
mf
3'00"
2'54"
5:4
gliss.
3
p
mf
mf
f
mf


3'15"
sul tasto
ord.
gliss.
pizz.
arco
ff
mf
3'30"
p
pp
3'45"
sul p.
ord.
gliss.
5
f
mf
p


4'00"
3'57"
3'59"
Vib.
f
ff
4'15"
Vib.
sul p.
ord.
mf
ff
mf
4'30"
4'34"
gliss.
f
p


4'45"
4'41"
gliss.
sul p.
pizz.
arco
ord.
gliss.
f
ff
f
mf
p
3
mf
5'00"
4'59"
gliss.
sul p.
p
mf
5'07"
5'08"
ord.
pizz.
arco
gliss.
p
p
mf
f


5'15"
5'21"
5'27"
5'30"
tu,pa,tu,pa,pa,ta
gliss.
mf
f
mf
ff
mf
f
5'33"
5'36"
5'43"
5'45"
gliss.
Vib.
ff
mf
gliss.
sul p.
5'49"
5'57"
6'00"
ord.
gliss.
ff
f
mf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p
pp
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p
pizz.
arco
6'30"
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ppp
6'45"
6'33"
3
3
mf
gliss.
p
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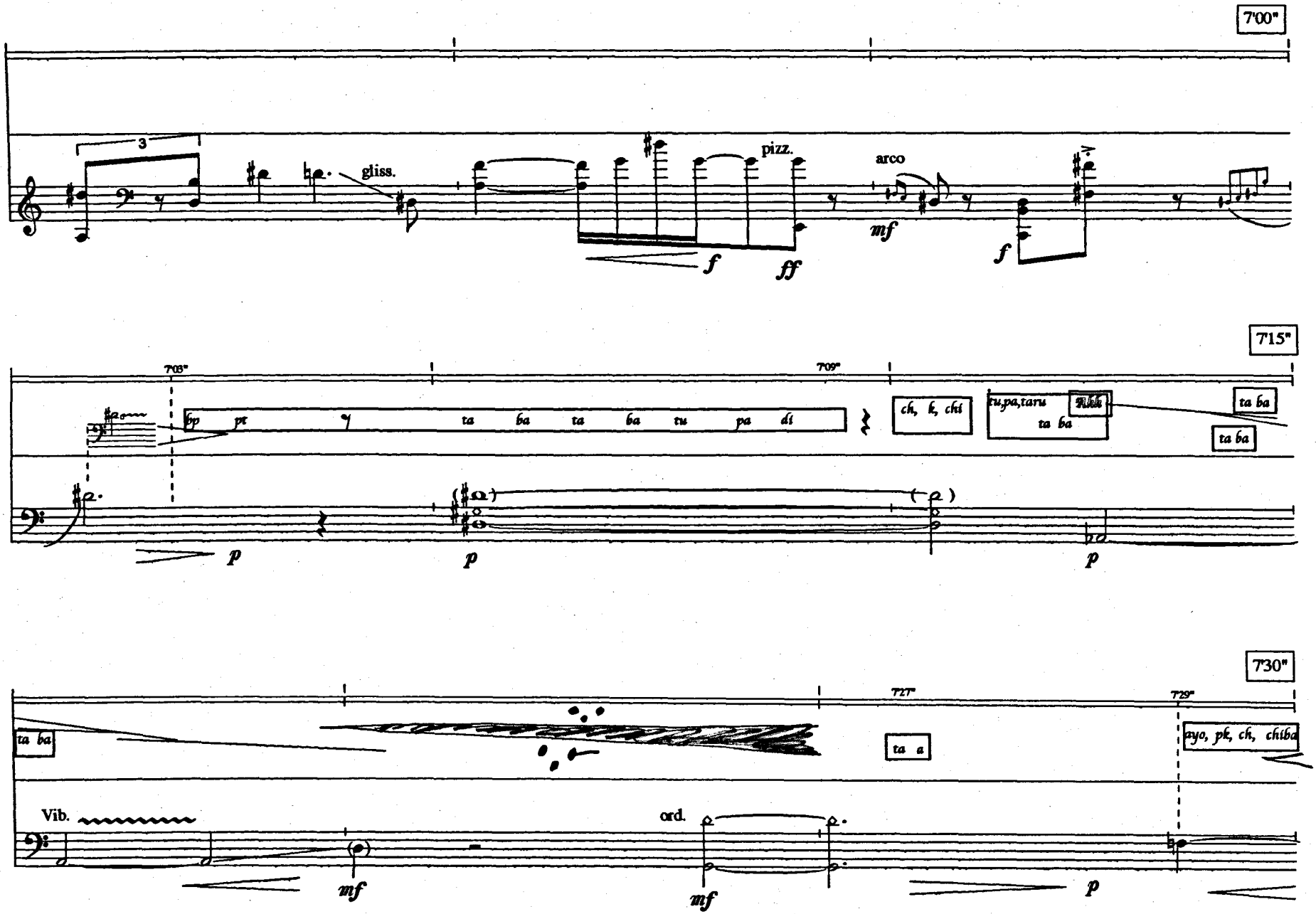
7'00"
3
gliss.
pizz.
arco
mf
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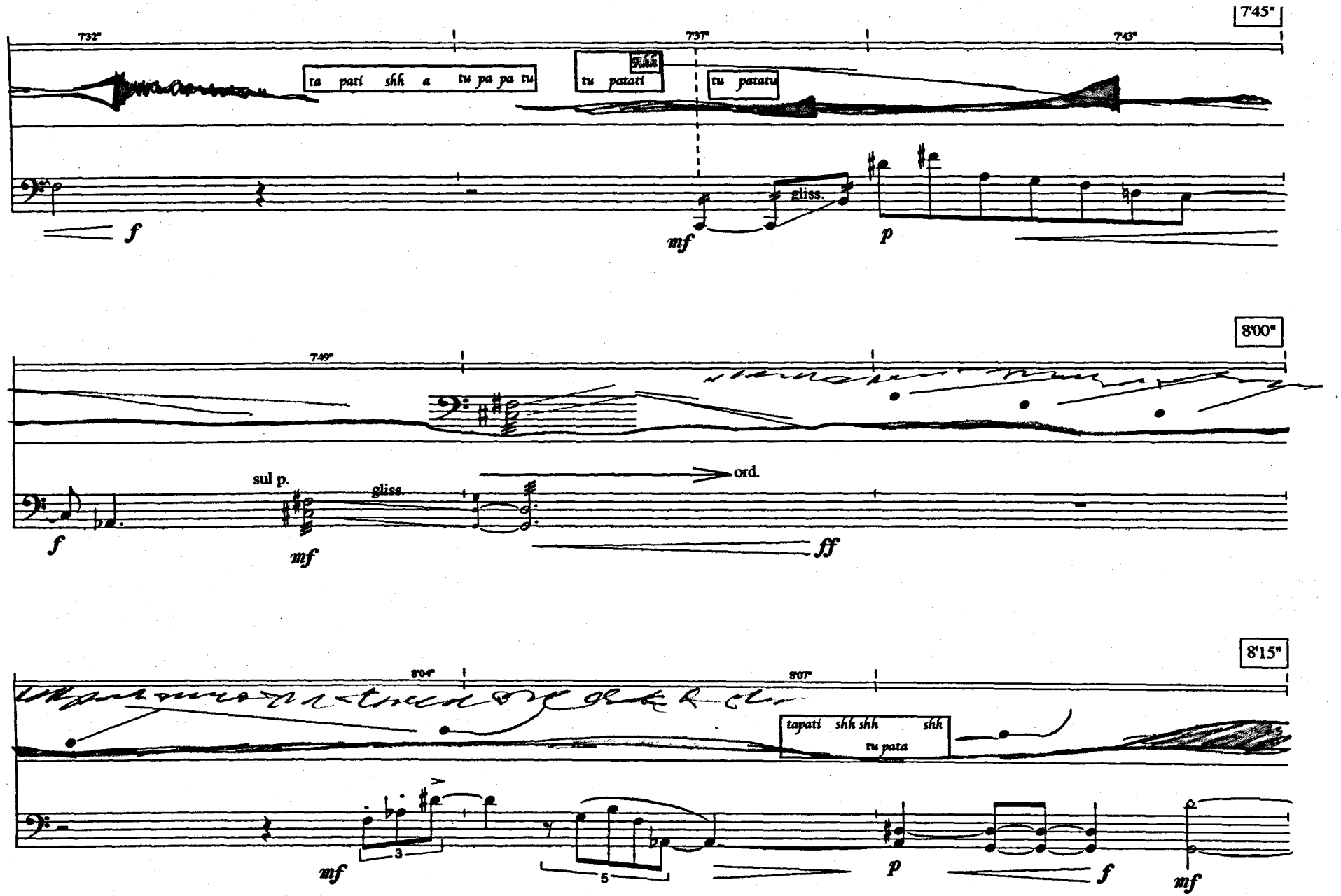
7'15"
7'08"
7'09"
bp pt ta ba ta ba tu pa di
ch, k, chi
tu,pa,taru
ta ba
ta ba
ta ba
p
p
p
7'30"
7'27"
7'29"
ta ba
ta a
ayo, pk, ch, chiba
Vib.
ord.
mf
mf
p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7'32"
7'37"
7'43"
ta pati shh a tu pa pa tu
tu patati
shhh
tu patatu
gliss.
f
mf
p
8'00"
7'49"
sul p.
gliss.
ord.
f
mf
ff
8'15"
8'04"
8'07"
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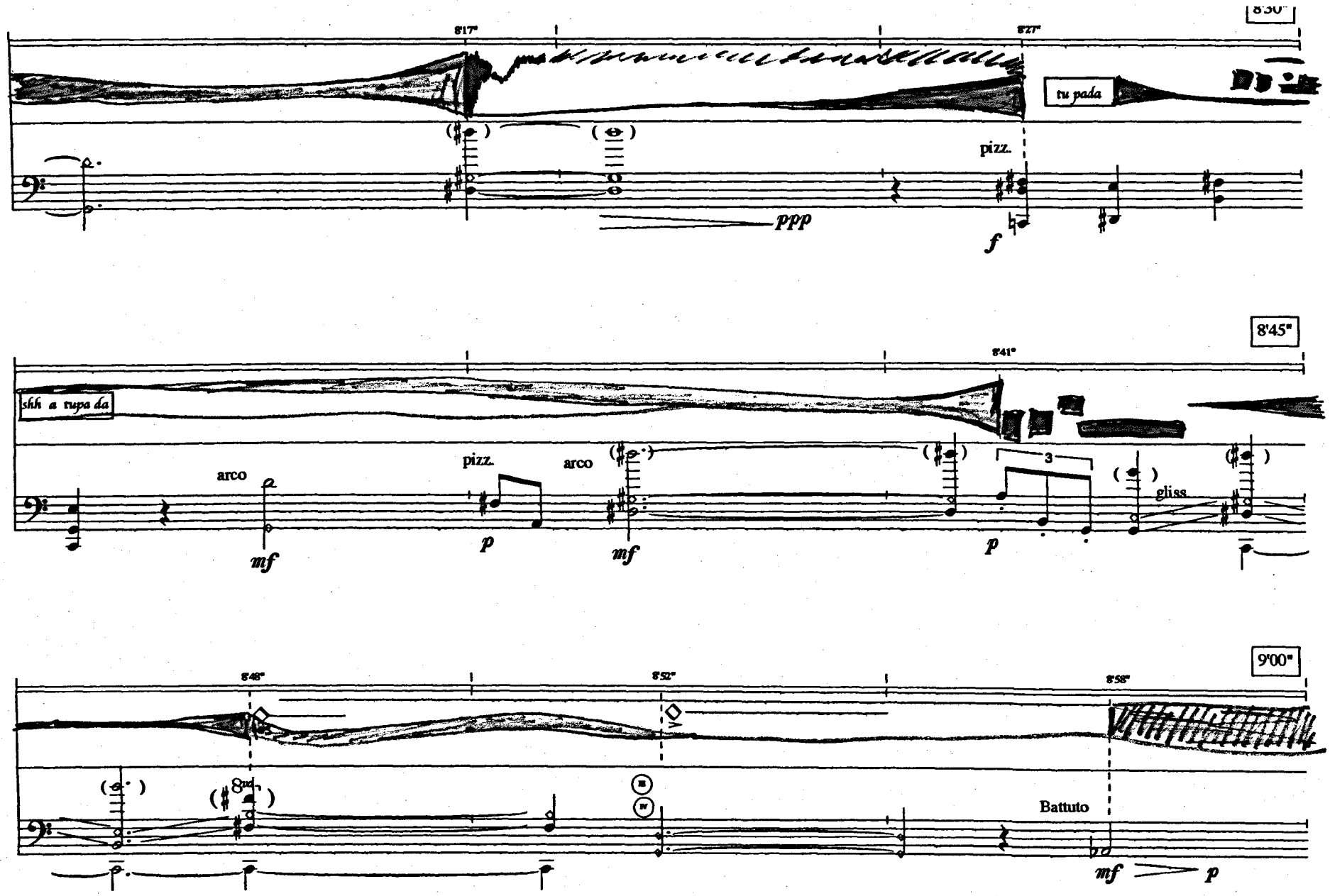
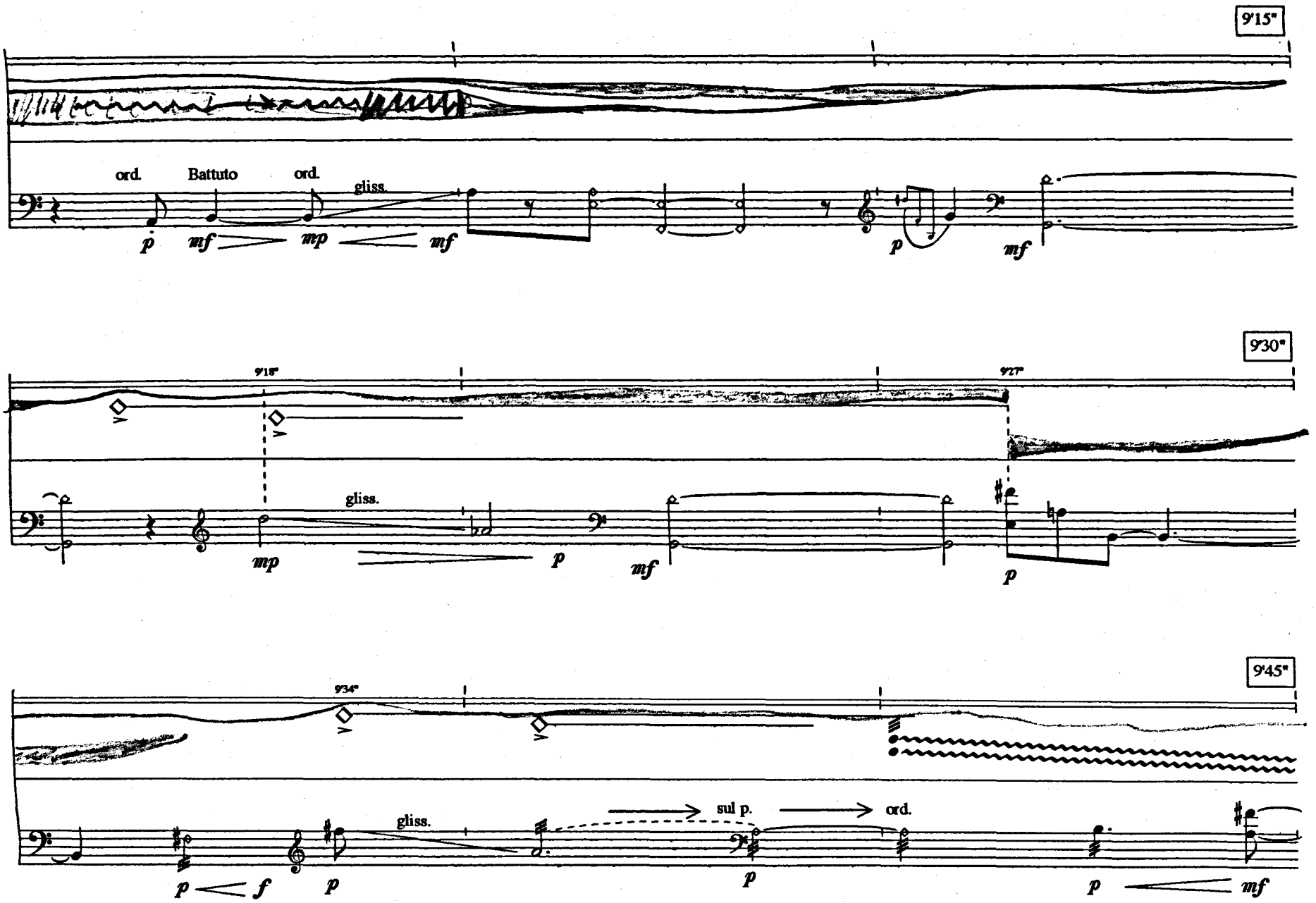
tu pata
3
5
mf
p
f
mf


8'30"
8'17"
8'27"
tu pada
pizz.
ppp
f
8'45"
8'41"
shh a tupa da
arco
pizz.
arco
3
gliss.
mf
p
mf
p
9'00"
8'48"
8'52"
8'58"
8va
Battuto
mf
p


9'15"
ord.
Battuto
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9'30"
9'18"
9'27"
gliss.
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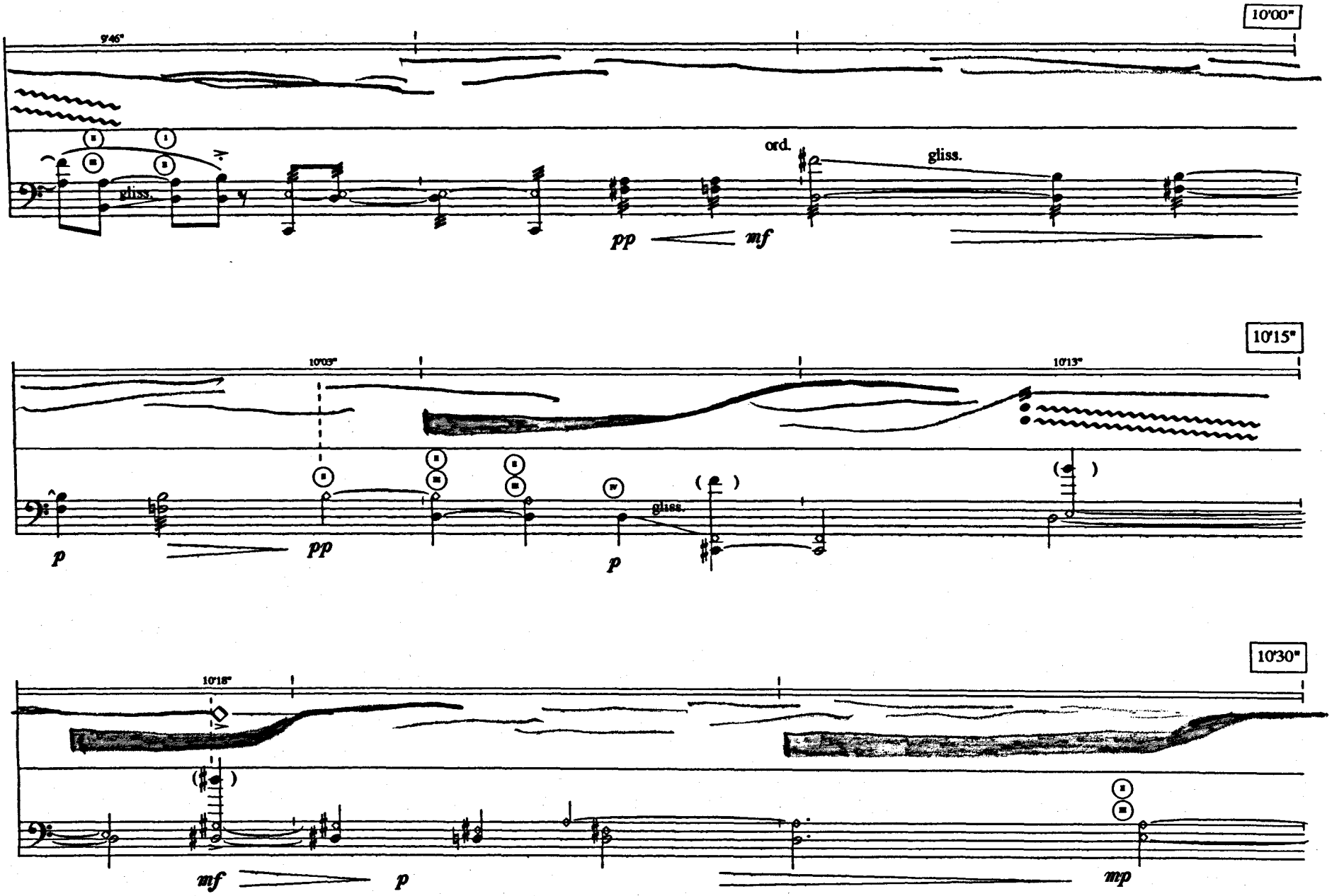
p
9'45"
9'34"
gliss.
sul p.
ord.
p
f
p
p
p
mf


10'00"
9'46"
gliss.
ord.
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mf
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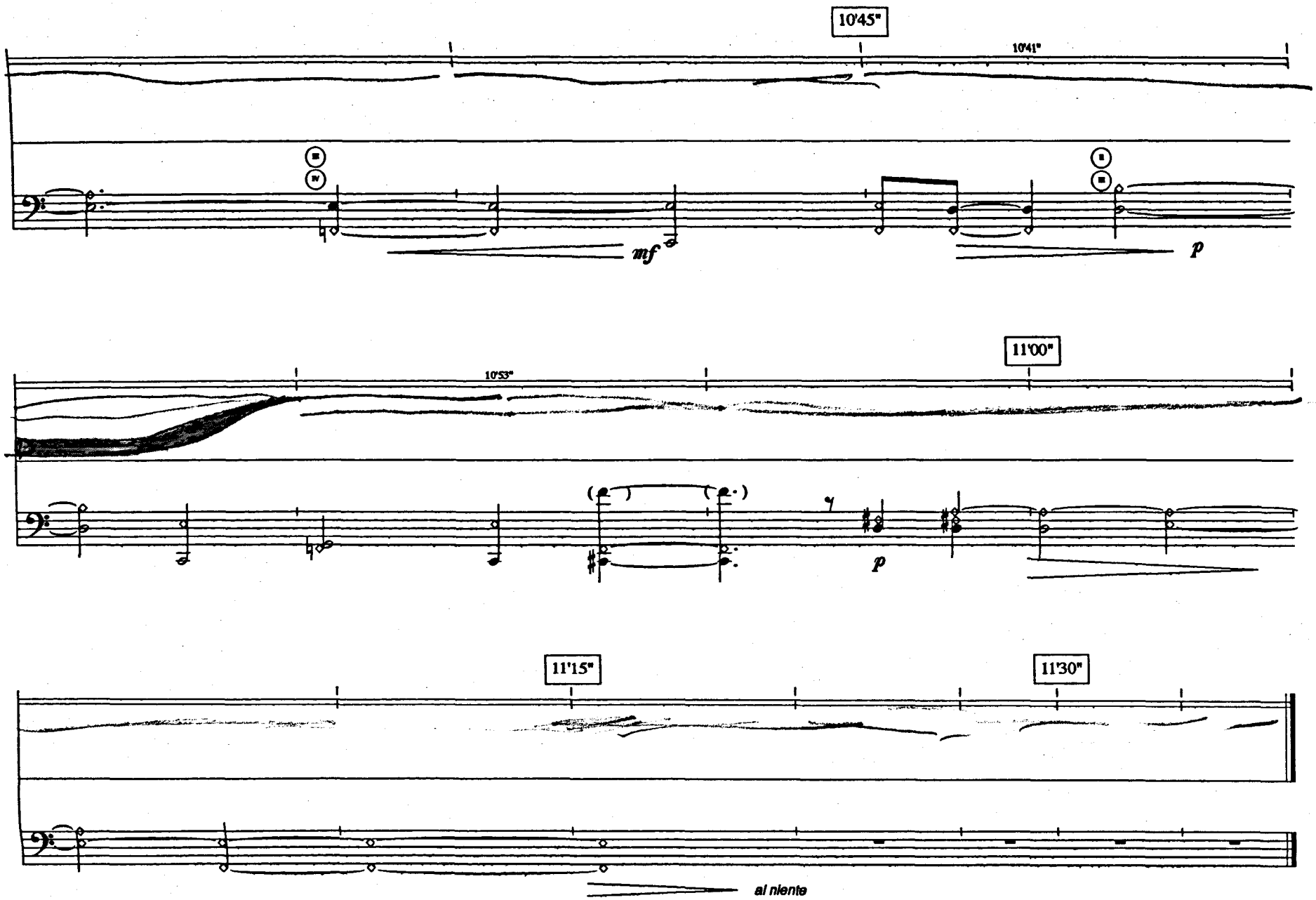
gliss.
10'30"
10'18"
mf
p
mp


10'45"
10'41"
III
IV
mf
III
II
p
11'00"
10'53"
p
11'15"
11'30"
al niente

Twilight

Bassoon and electroacoustic sounds

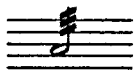
...For Wendy Holdaway

Rodrigo Sigal
Dur: 13'30"
05/2001
www.rodrigosigal.com

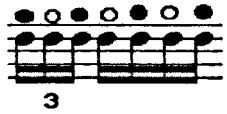
• This work was commissioned by the Spanish Ministry for Culture and composed at LIEM-CDMC in Madrid, Spain and at City University. Funds were also provided by FONCA, Mexico

Performance instructions

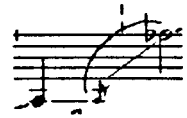
A chronometer is needed in order to follow the electroacoustic part. The performer can also use the time display on the CD player if possible.
Accidentals apply only to the notes they proceed, except in repetitions where they apply to the group (ex.1'56")
CL= Crook Lock
Apogiaturas must be performed as fast as possible.
Except for those glissandi with specified fingerings shown, all others must be played with the normal change of fingers.
The fingerings suggested on the score are only a guideline for the performer.



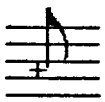
Flatterzunge.



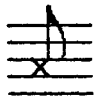
Colour trills.
Alternation between two fingerings for the same pitch.



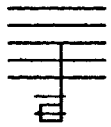
Portamento.
Play it as fast as possible.



Without the reed.

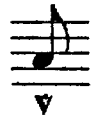


Key sounds.

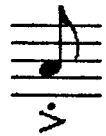


Only air.

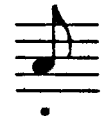
Gradually from one sound to the other.



Accent



Accent & staccato

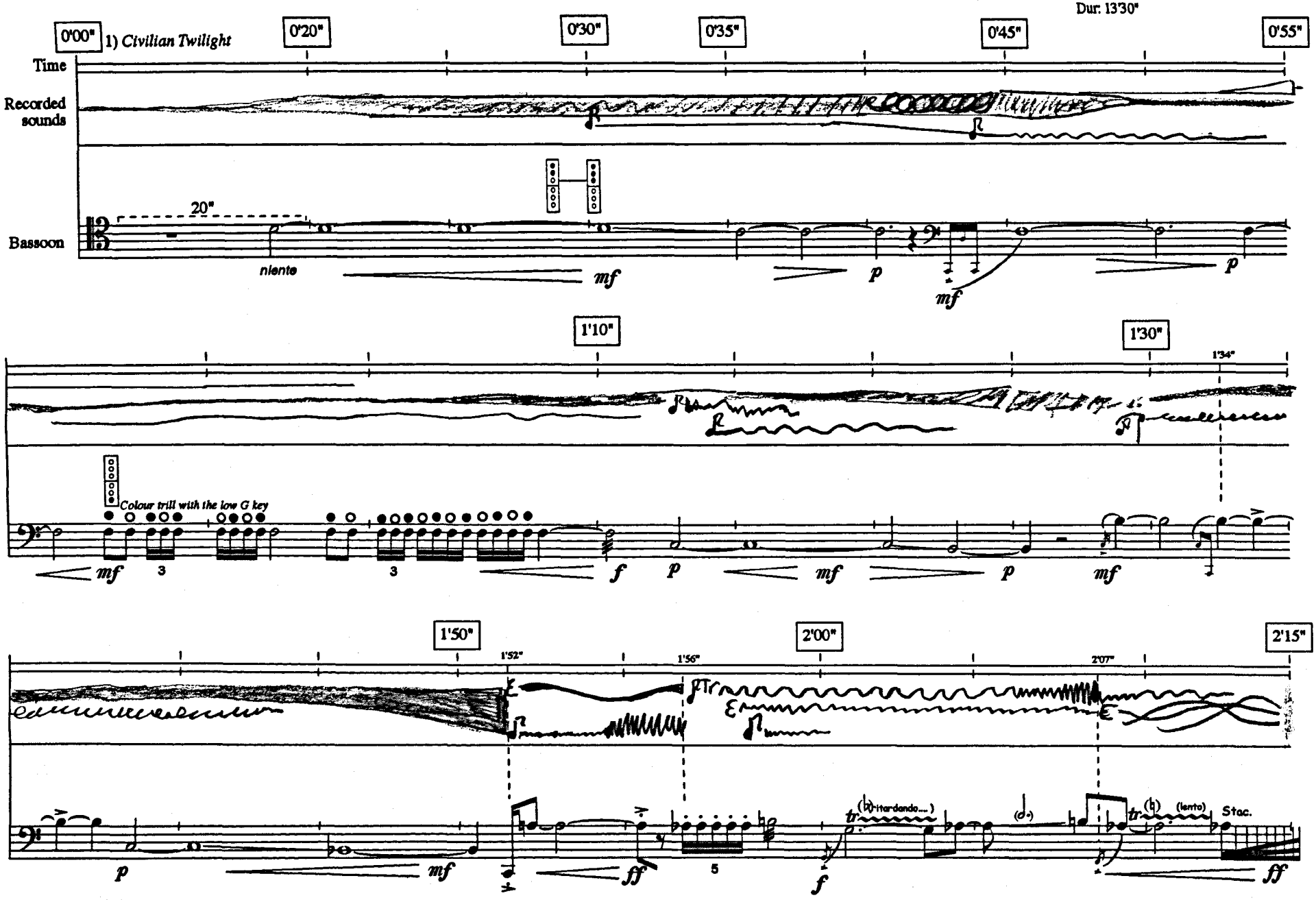


Staccato

Twilight

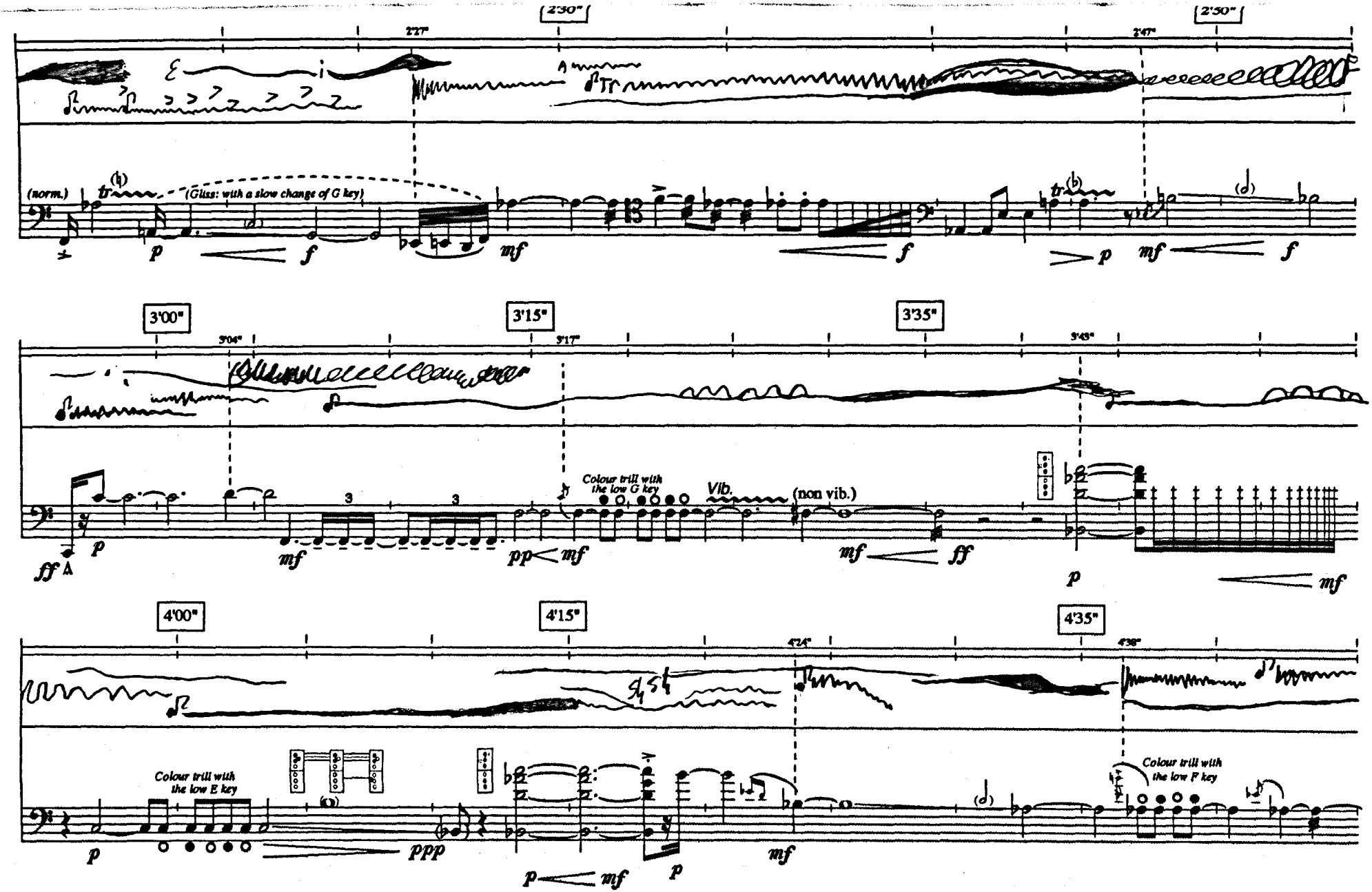
Rodrigo Sigal
London, 5/2001

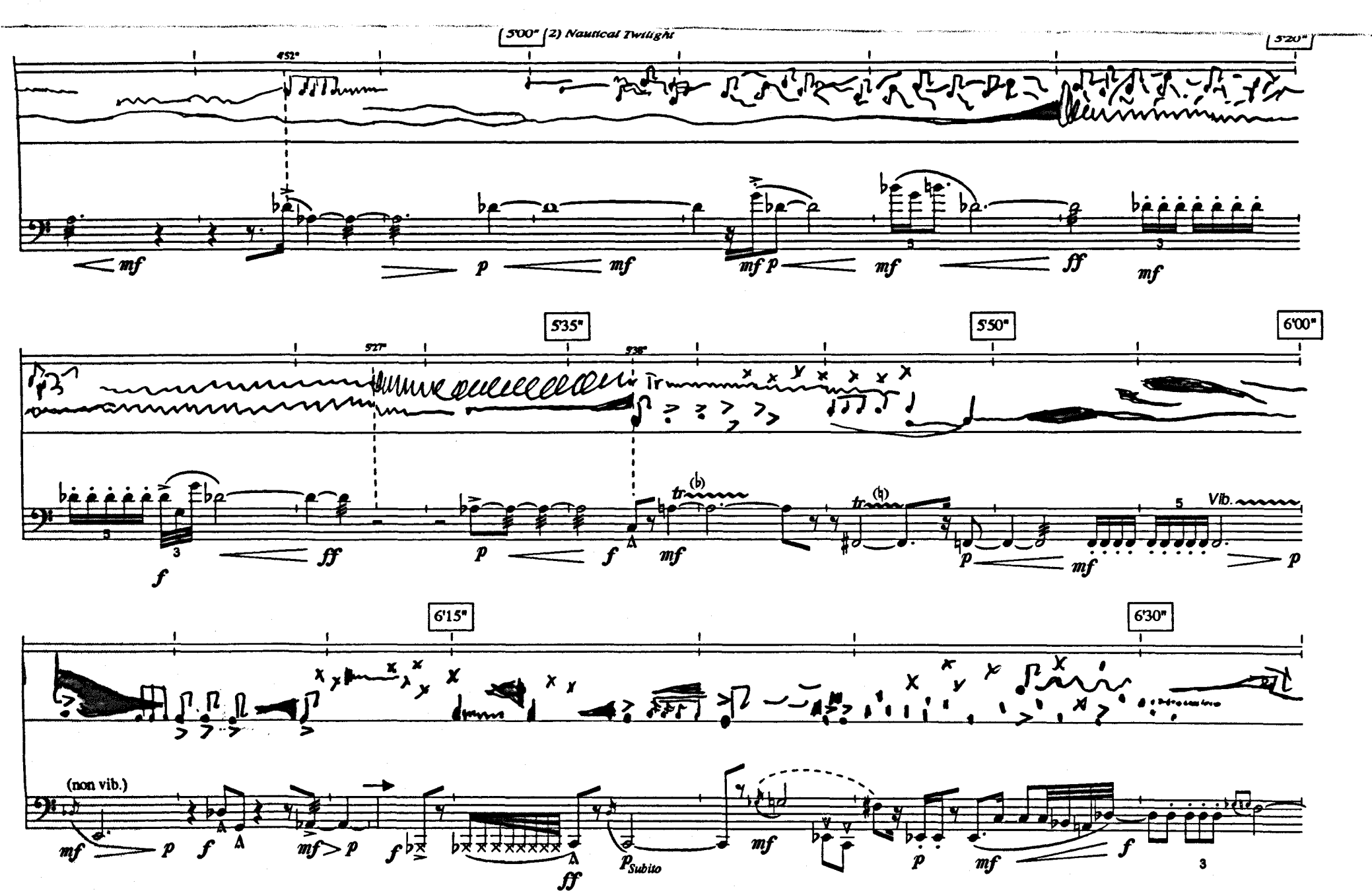
Dur: 13'30"

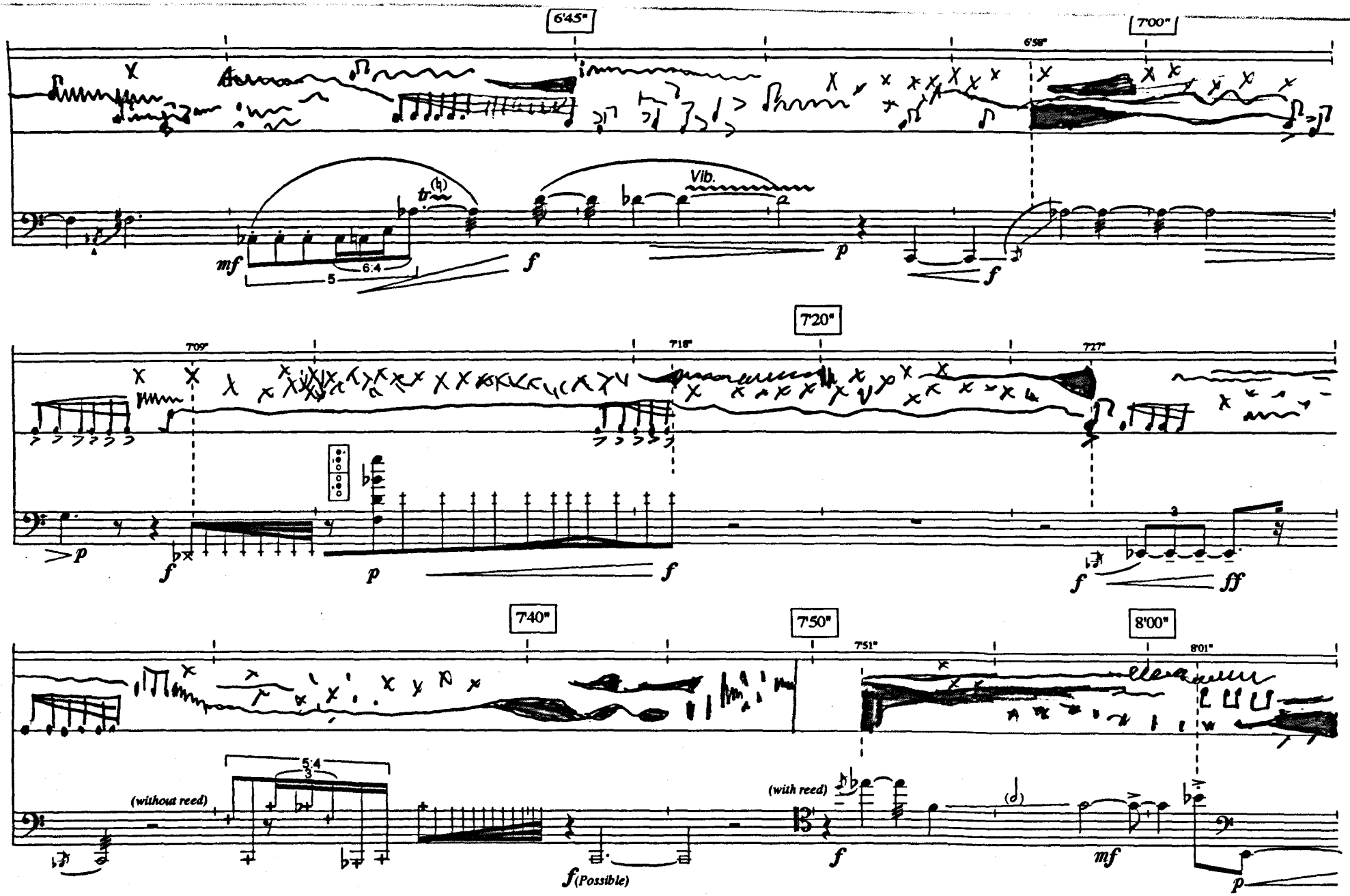


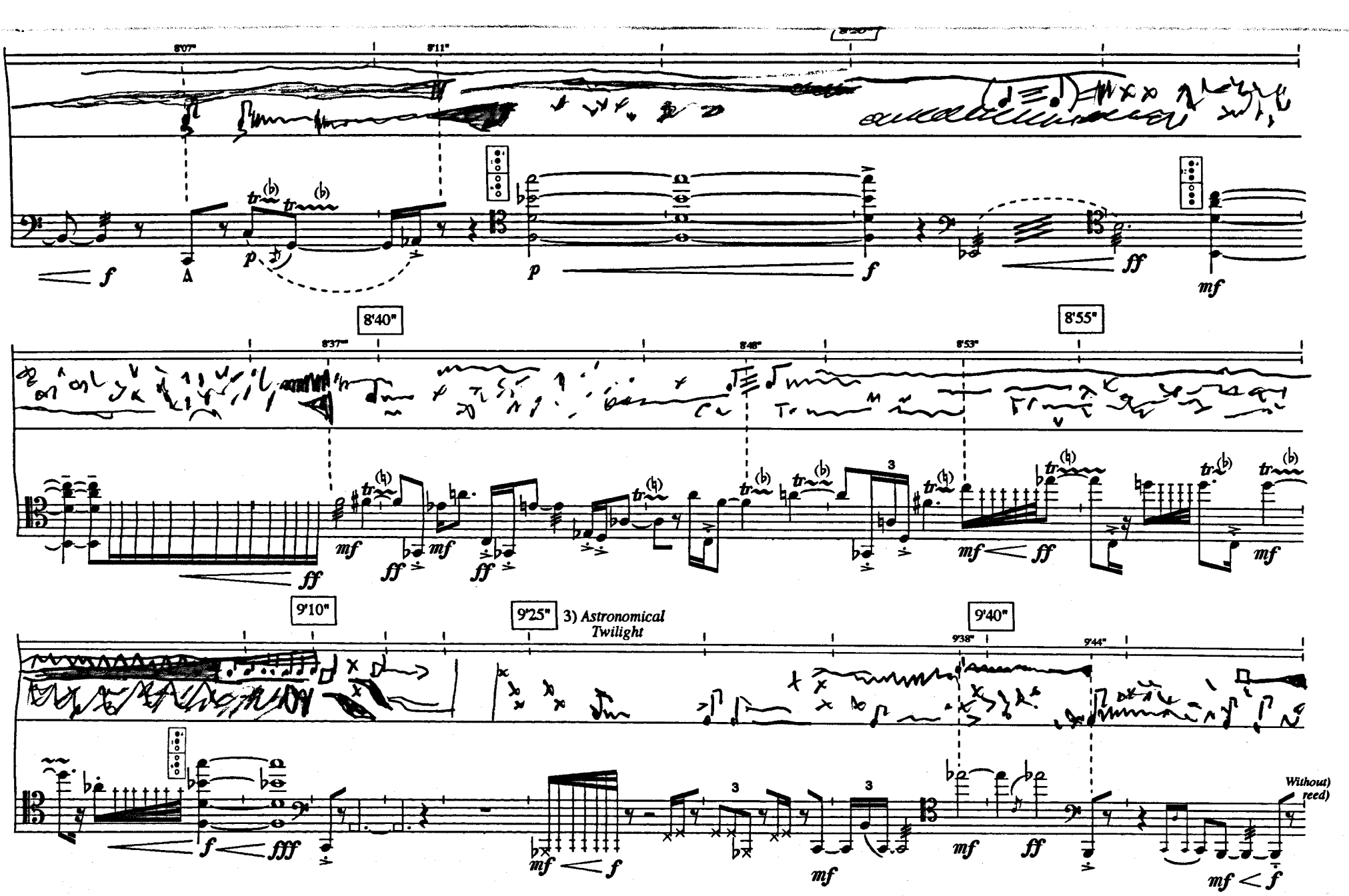
Twilight was created with help from the Spanish Ministry of Culture and Sports and the Mexican Counsil for the Arts.
Twilight fue creado con el apoyo del Ministerio de Cultura y Deporte de España y el Fondo Nacional para la Cultura y las Artes de México.

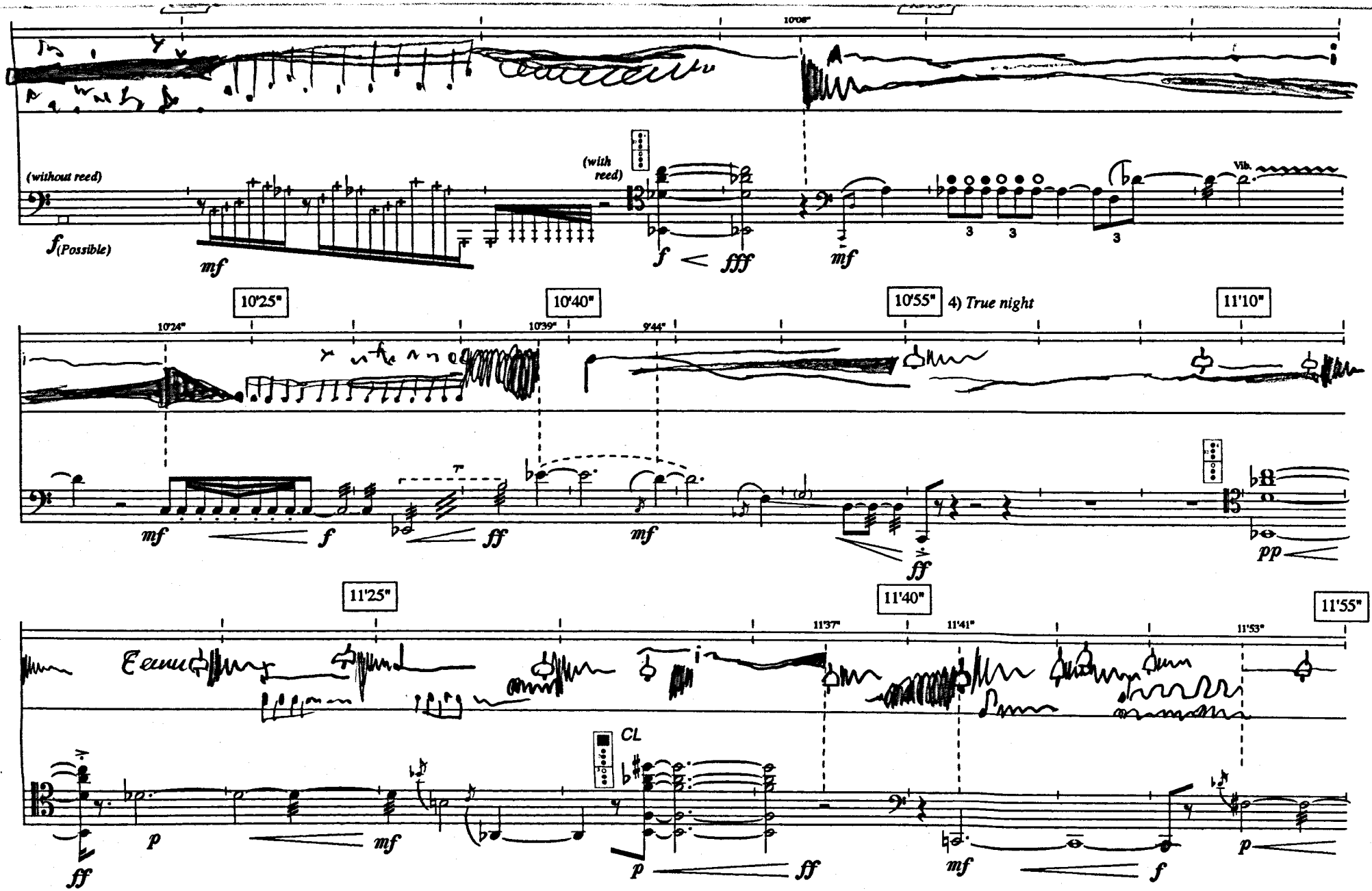
*Fingering help by: György Lakatos.
Thanks for their help with the piece to:
Peter Dodsworth and Dominique Deguines.

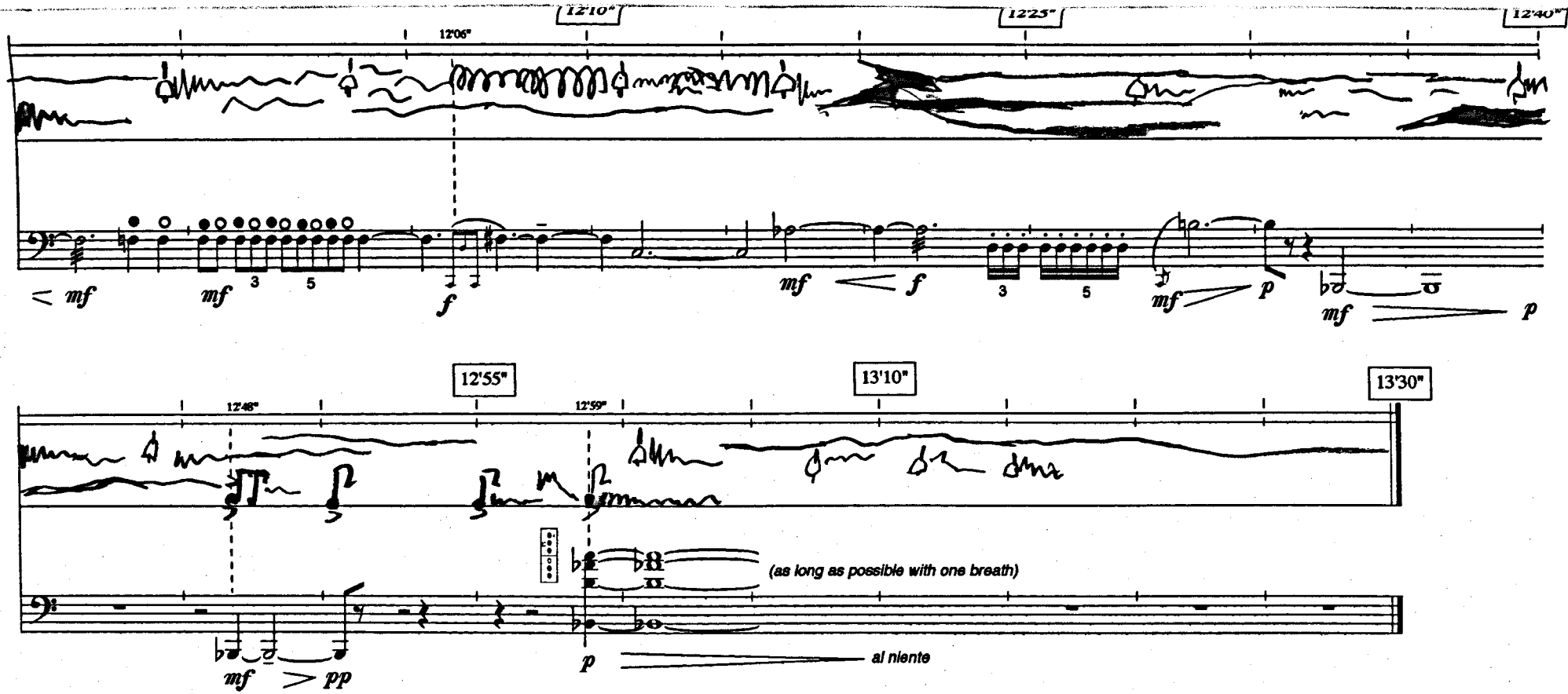

2'30"
2'27"
2'47"
2'50"
(norm.)
(Gliss: with a slow change of G key)
3'00"
3'15"
3'35"
3'04"
3'17"
3'43"
Colour trill with the low G key
Vib.
(non vib.)
4'00"
4'15"
4'35"
4'24"
4'38"
Colour trill with the low E key
Colour trill with the low F key


5'00" (2) Nautical Twilight
4'52"
5'20"
5'35"
5'27"
5'38"
5'50"
6'00"
6'15"
6'30"
(non vib.)
Vib.


6'45"
7'00"
6'58"
Vib.
tr
mf
f
p
5
6:4
7'20"
7'09"
7'18"
7'27"
fff
7'40"
7'50"
8'00"
7'51"
8'01"
5:4
3
(without reed)
(with reed)
f(Possible)


8'07"
8'11"
8'20"
8'40"
8'37"
8'48"
8'53"
8'55"
9'10"
9'25"
3) Astronomical Twilight
9'40"
9'38"
9'44"
(Without reed)


10'08"
(without reed)
(with reed)
Vib.
f (Possible)
mf
f < fff
mf
10'25"
10'40"
10'55"
4) True night
11'10"
10'24"
10'39"
9'44"
mf
f
ff
mf
ff
pp
11'25"
11'40"
11'55"
11'37"
11'41"
11'53"
CL
p
mf
ff
p
ff
mf
f
p


12'10"
12'25"
12'40"
12'06"
< mf
mf
3
5
f
mf
< f
3
5
mf
p
mf
p
12'55"
13'10"
13'30"
12'48"
12'59"
(as long as possible with one breath)
mf
> pp
p
al niente

RIMBARIMBA

"Lejos del silencio / Far from silence"

Marimba and electroacoustic sounds

...For Robert Esler

Rodrigo Sigal
Dur: 15'00"
04/2002
www.rodrigosigal.com

- This work was commissioned by RobertEsler with help from a grant by the FIDE Mexico-USA 2001/2002

Rimbarimba

Far from silence

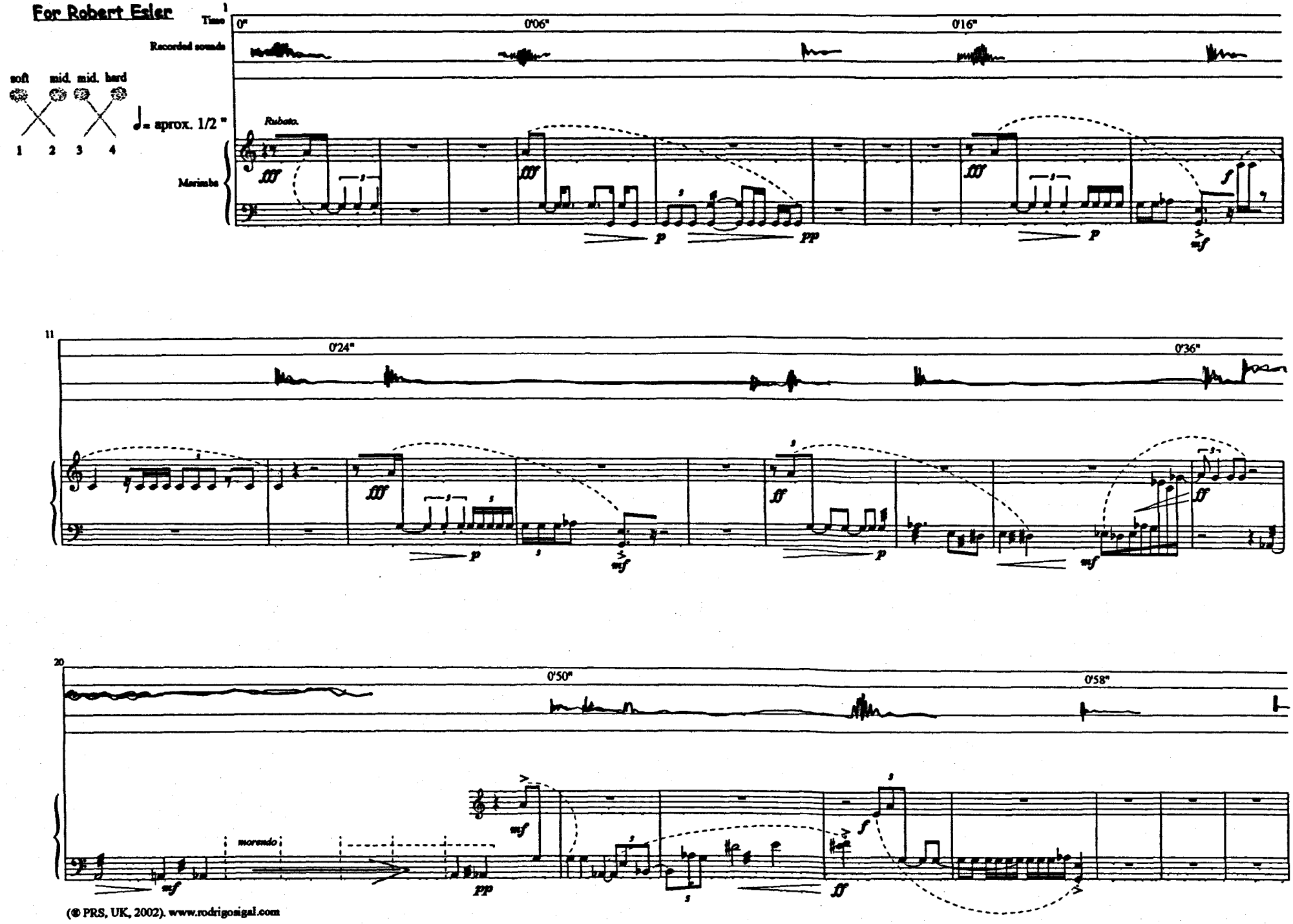
Rodrigo Sigal 4/2002

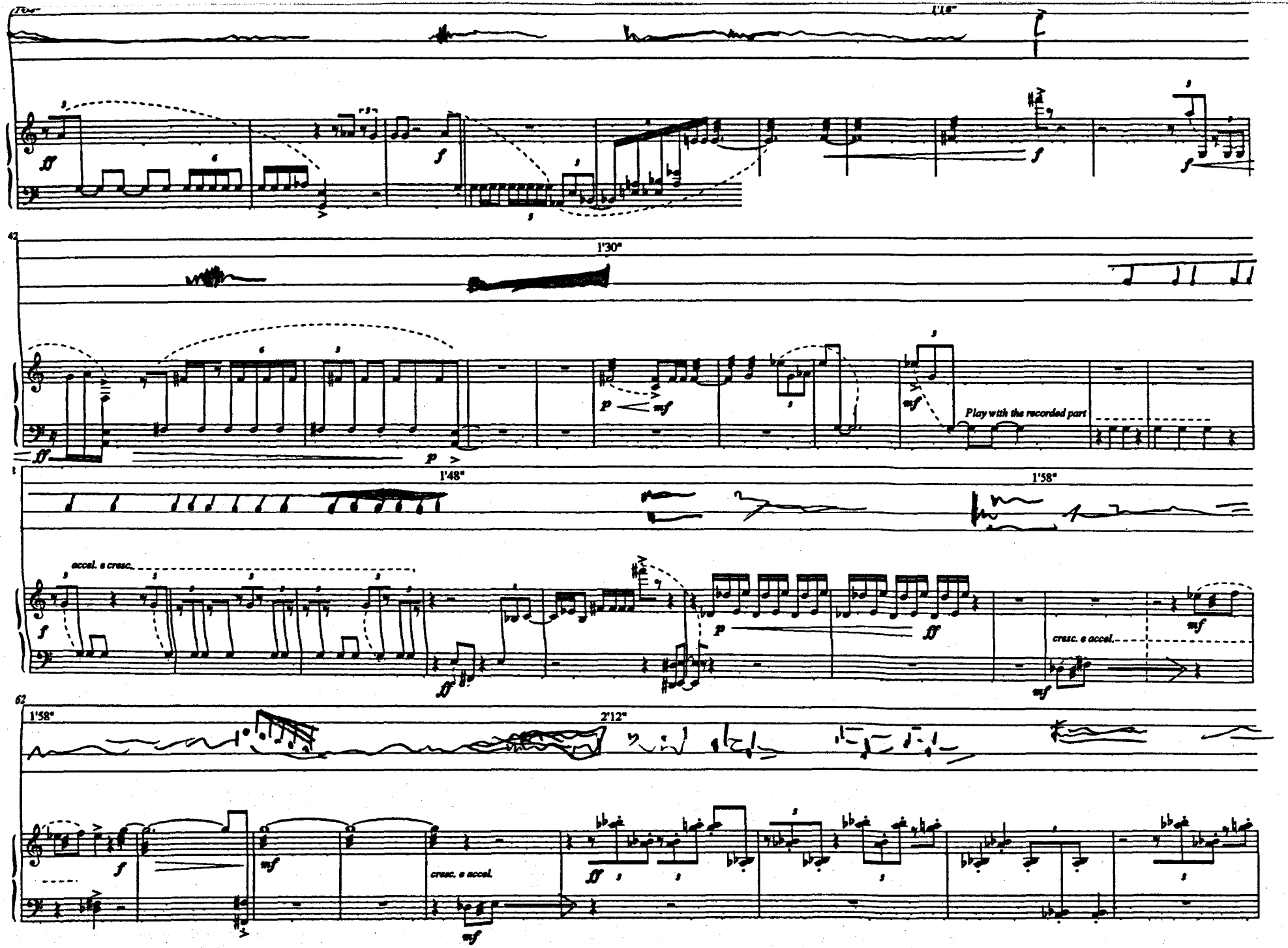
For Robert Esler

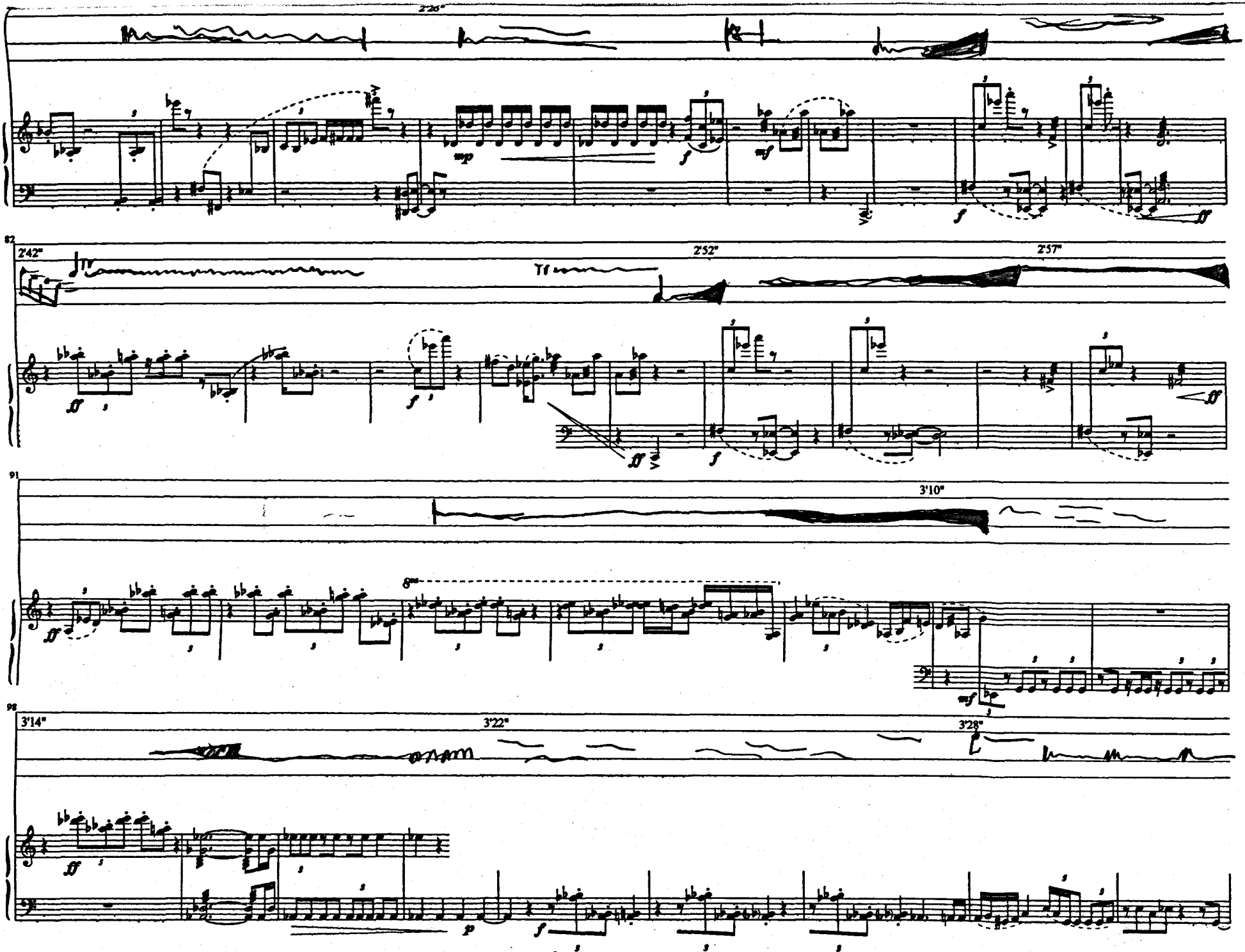
soft mid. mid. hard

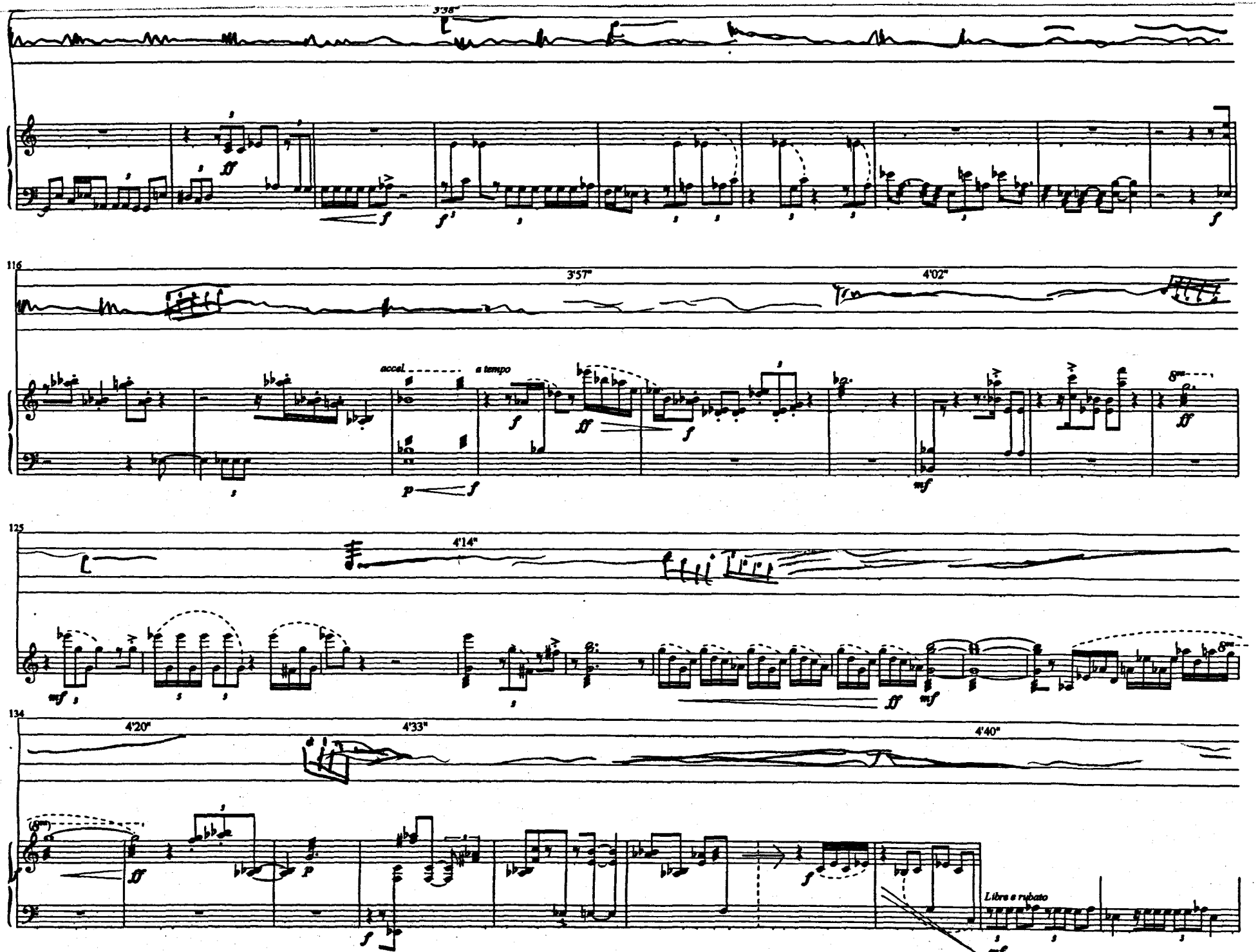
1 2 3 4

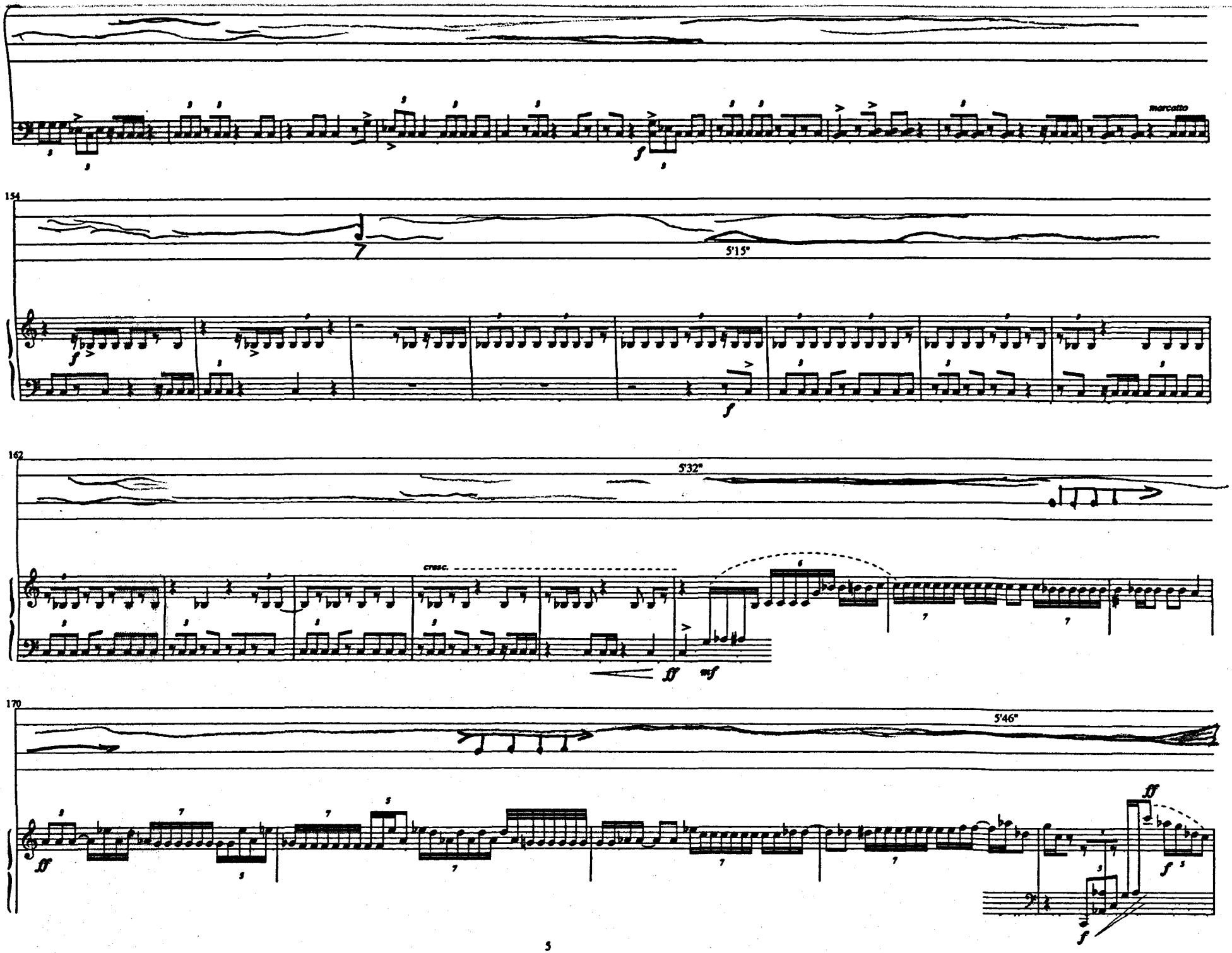
♩ = aprox. 1/2 "

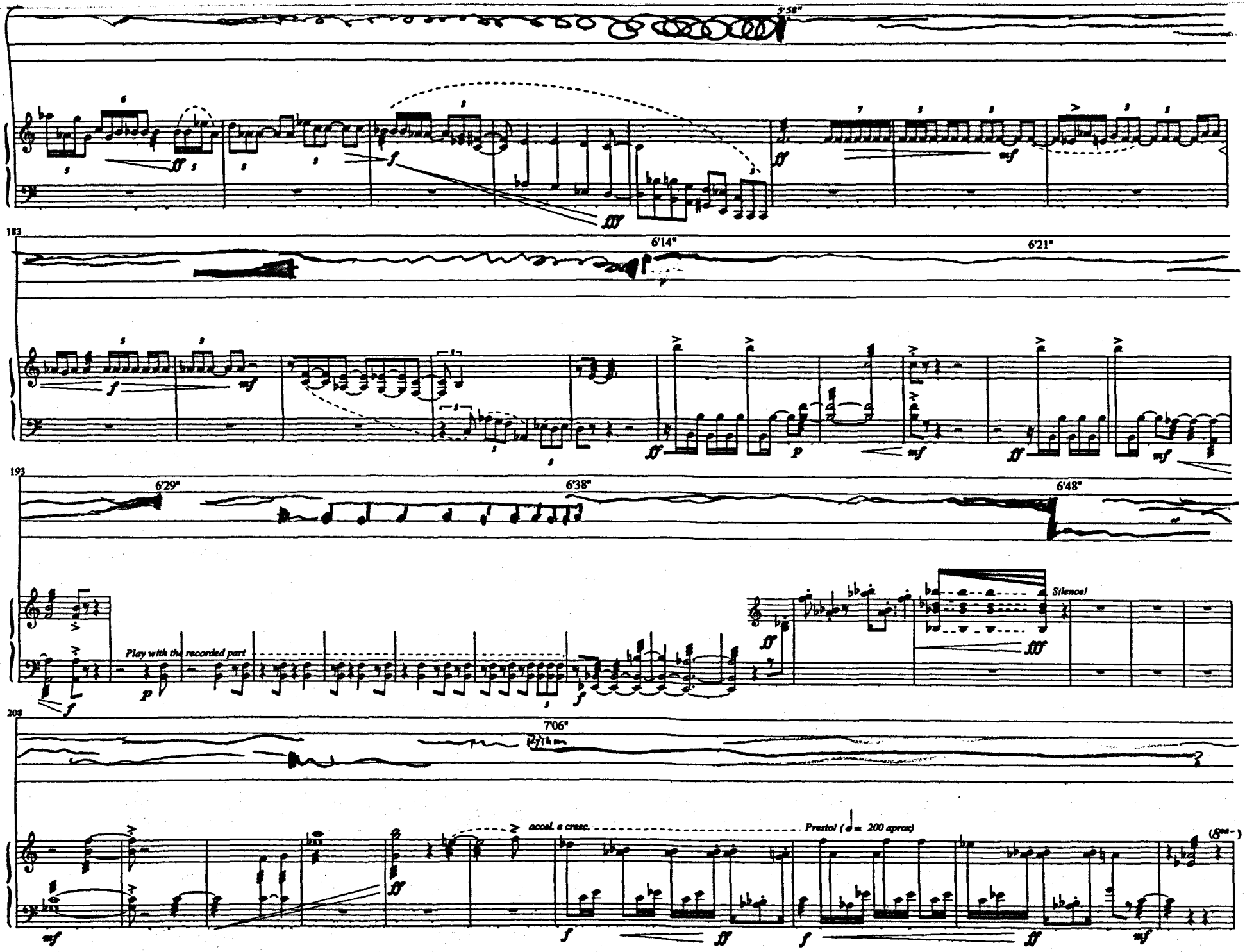


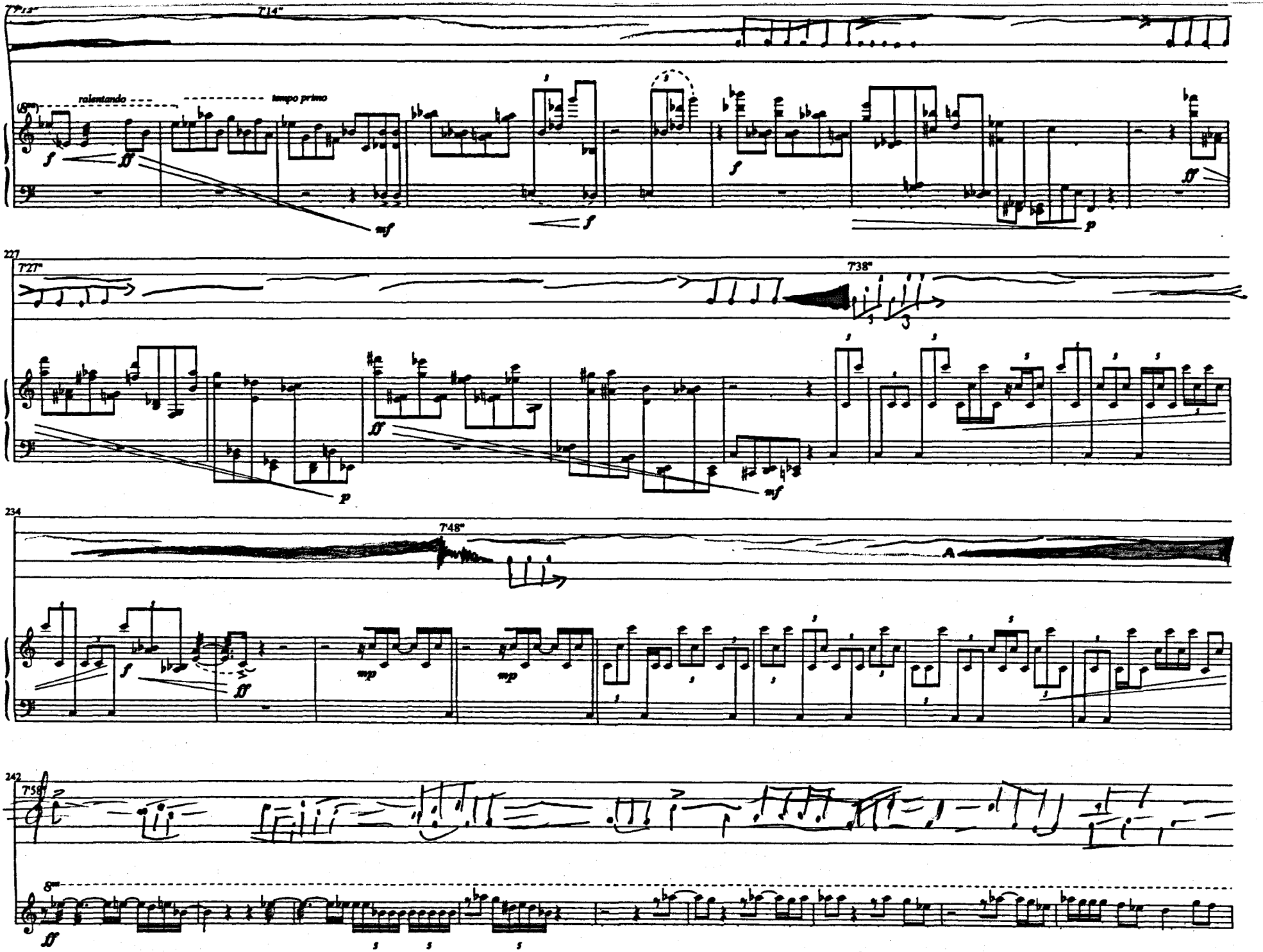

1'18"
ff
f
42
1'30"
p
mf
Play with the recorded part
ff
p
1'48"
1'58"
accel. e cresc.
f
ff
p
ff
cresc. e accel.
mf
mf
62
1'58"
2'12"
f
mf
cresc. e accel.
mf
ff

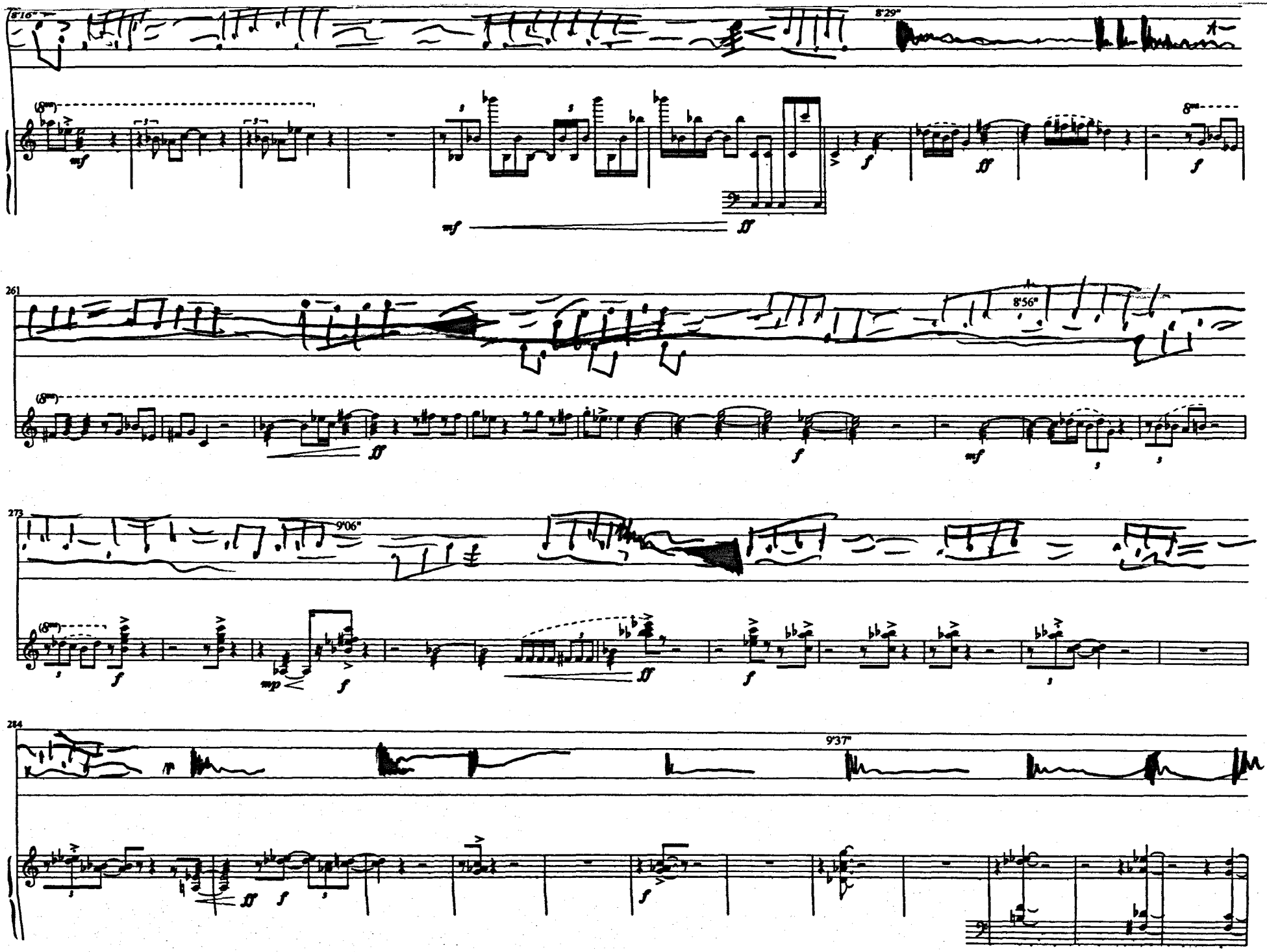

2'26"
mp
f
mf
f
ff
82
2'42"
2'52"
2'57"
ff
f
ff
f
ff
91
3'10"
8va
mf
98
3'14"
3'22"
3'28"
ff
p
f

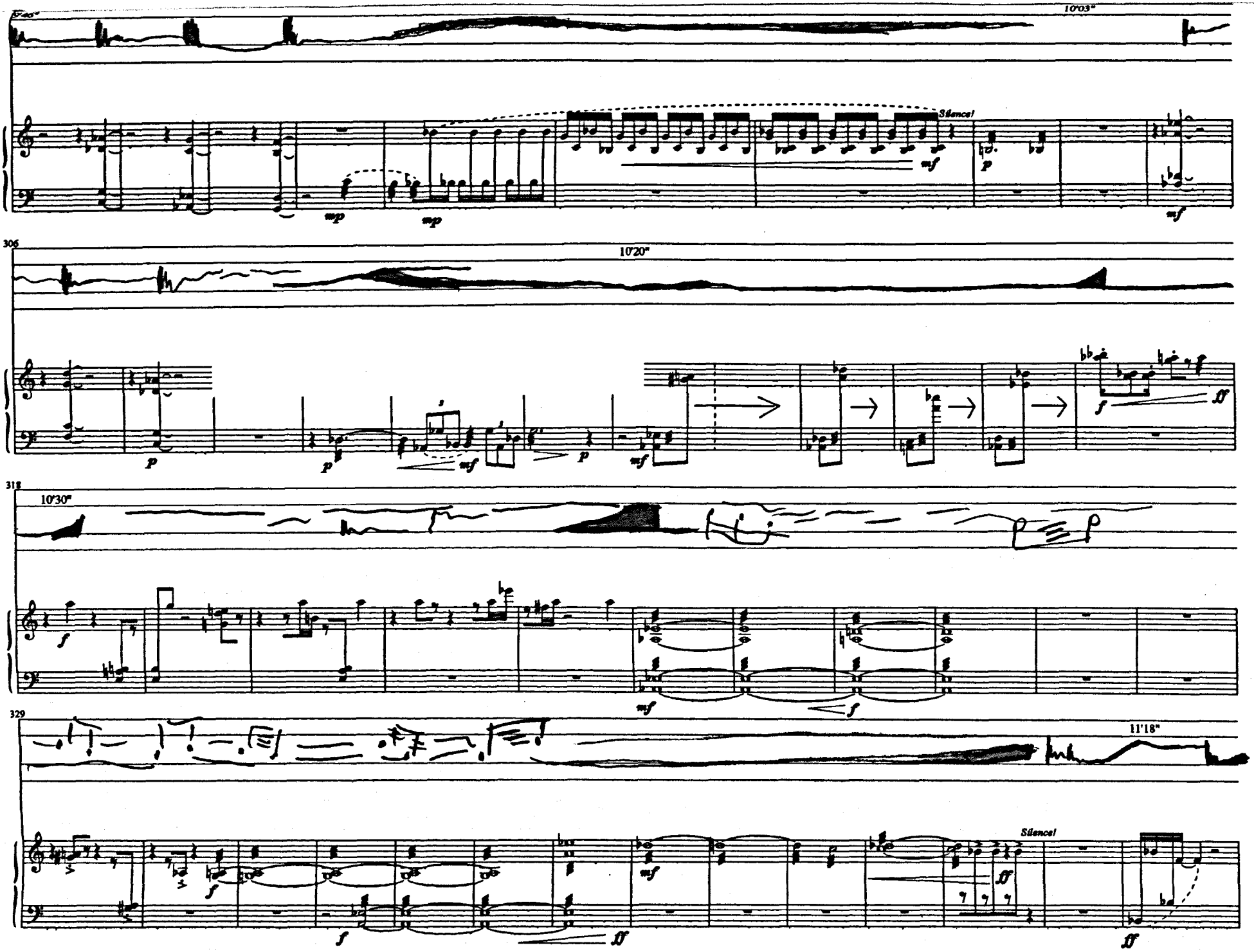

3'38"
116
3'57"
4'02"
accel.
a tempo
125
4'14"
134
4'20"
4'33"
4'40"
Libre e rubato

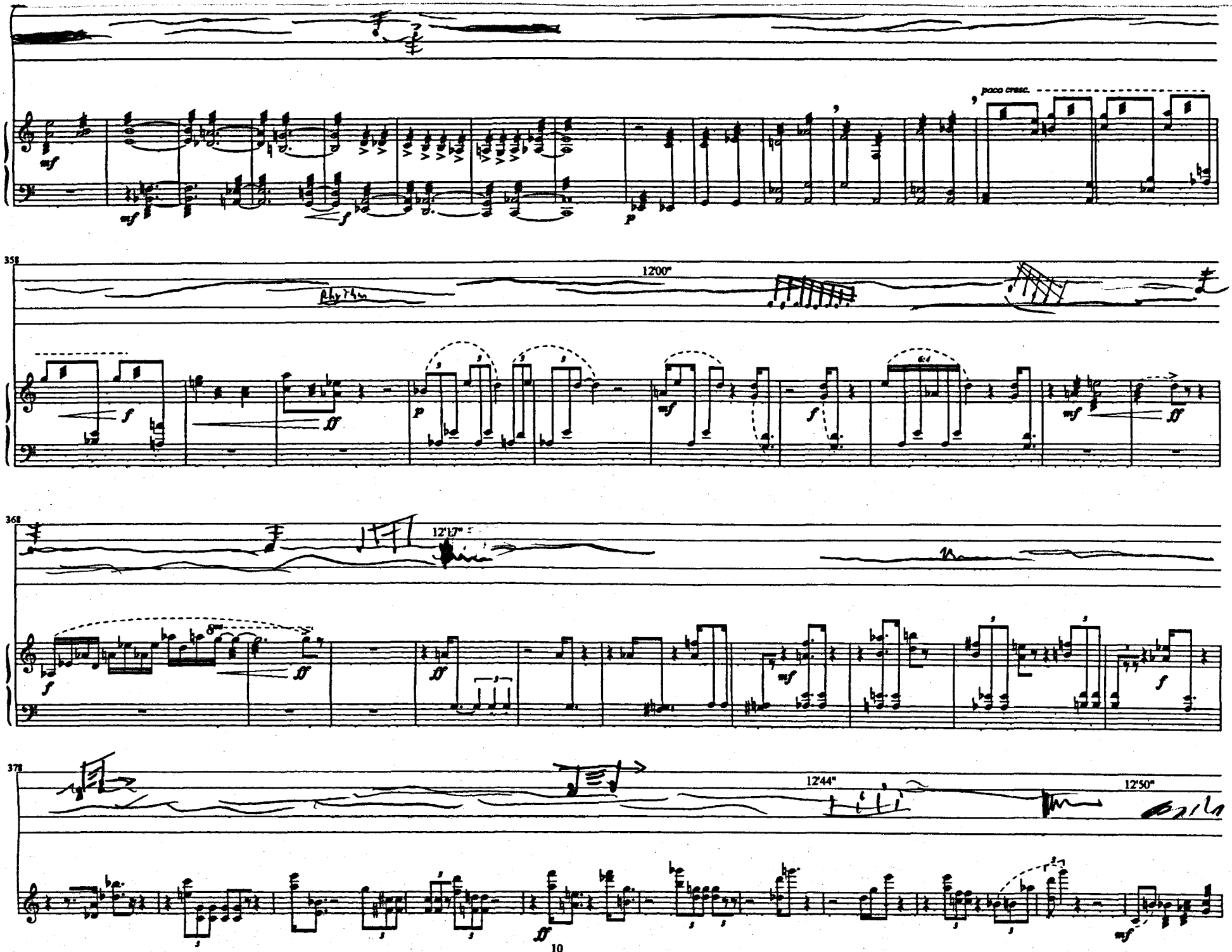

marcato
154
5'15"
162
5'32"
cresc.
170
5'46"

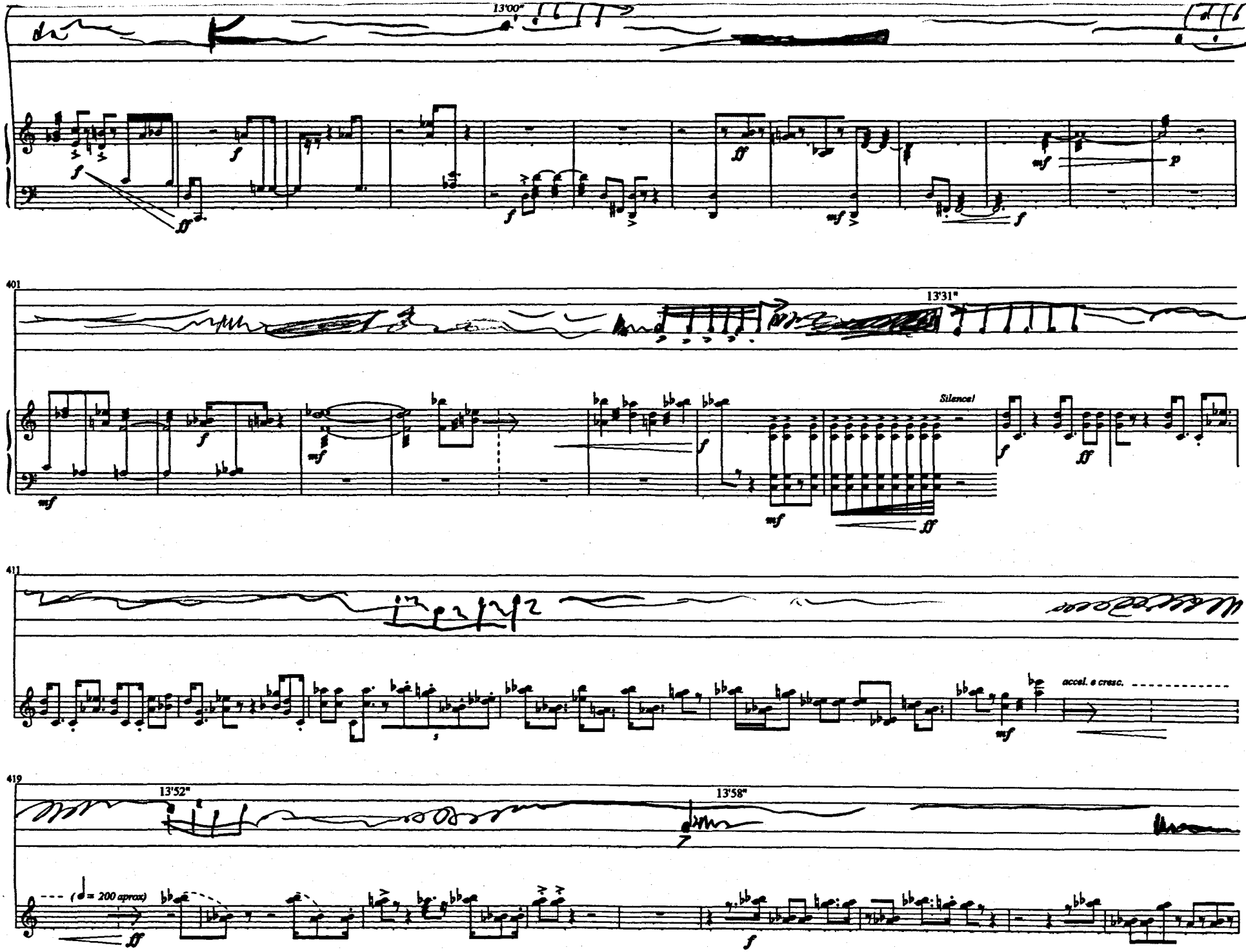

5'58"
183
6'14"
6'21"
193
6'29"
6'38"
6'48"
Play with the recorded part
Silence!
208
7'06"
Rhythm
accel. e cresc.
Prestol (♩= 200 aprox)

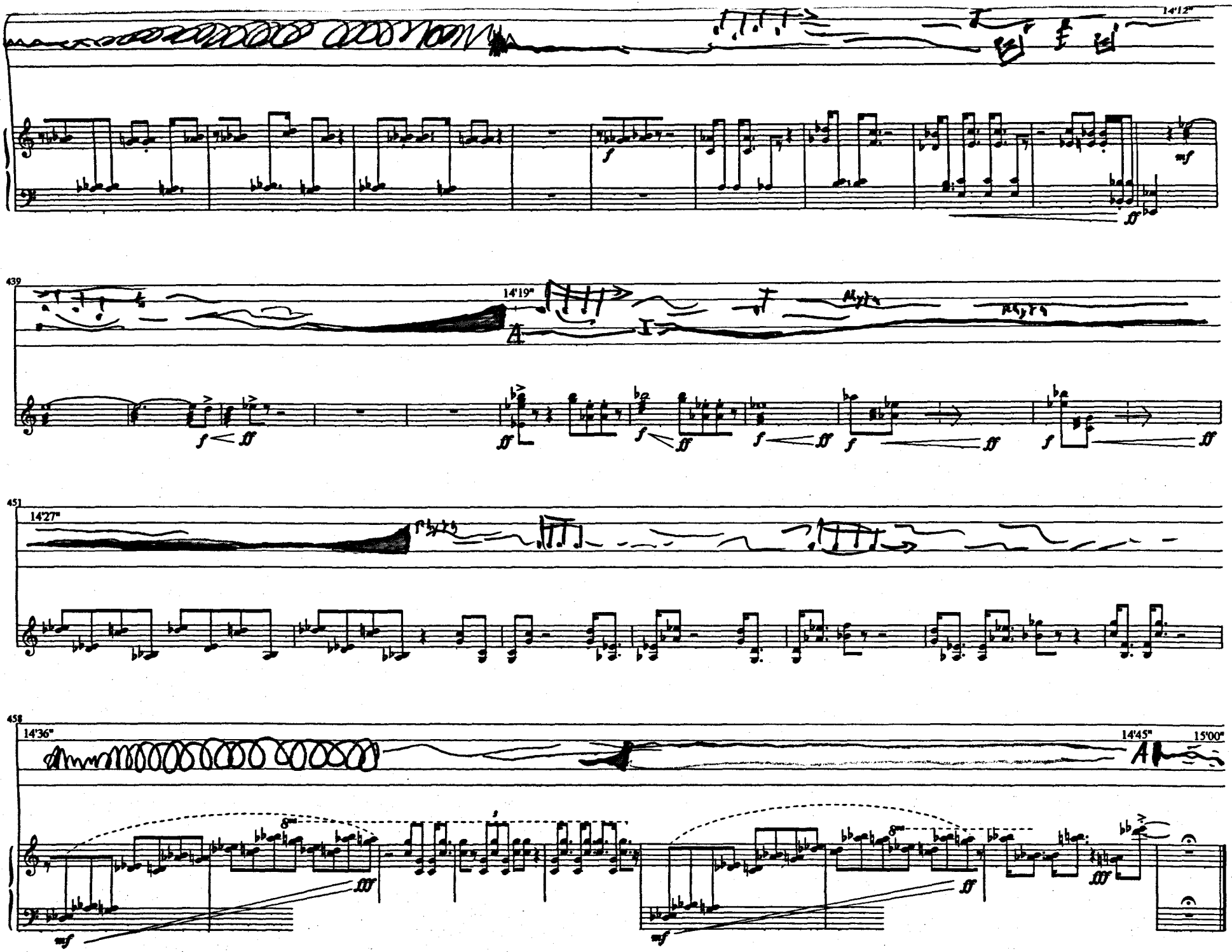

7'13"
7'14"
(8va)
ralentando
tempo primo
f
ff
mf
f
f
p
ff
227
7'27"
7'38"
ff
p
mf
234
7'48"
A
f
ff
mp
mp
242
7'58"
8va
ff


8'16"
8'29"
261
8'56"
273
9'06"
284
9'37"


10'03"
Silence!
306
10'20"
318
10'30"
329
11'18"
Silence!


poco cresc.
358
12'00"
Rhythm
368
12'37"
378
12'44"
12'50"


13'00"
401
13'31"
Silence!
411
accel. e cresc.
419
13'52"
13'58"
(♩= 200 aprox)


14'12"
439
14'19"
A
451
14'27"
458
14'36"
14'45"
15'00"
A

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