ELLIPSIS

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McGill University, Montréal

May, 1989

A Thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of
Master of Music

ABSTRACT

Ellipsis is a composition for electric string quartet, tape, and female singer, formally organized into three large structural units or cycles entitled: "The Age of Darkness", "Creating A New Space", and "The Age of Resonance". The work is concerned with using timbre as a form-bearing element in the compositional design, and draws on research conducted in the area of linguistics and timbral perception. This paper discusses how the elements of language create a timbral model for composition, and how timbres for both the live and taped components were organized and created. It presents a detailed analysis of the formal, timbral and pitch relationships of the composition. The timbral analysis includes descriptive inserts outlining the underlying story of the cycles suggested in the titles above, which are based on the development of women's spiritual power, rooted in the ancient traditions of lunar mythology.

RÉSUMÉ

Ellipsis, composition pour quartet d'instruments électro-acoustiques à cordes, bande et chanteuse, comporte trois unités principales qui ont pour noms "L'âge des ténèbres", "Créer un nouvel espace" et "L'âge de la résonance". Construite avec le timbre comme élément de base dans la composition, l'oeuvre exploite les résultats de recherches en linguistique et perception des timbres sonores. Cet essai montre comment les éléments de langage servent à établir un timbre de base pour la composition, comment les timbres de l'interprétation sur scène et ceux des éléments enregistrés furent organisés et créés, et il présente une analyse détaillée des relations de forme, timbre et hauteur de notes au sein de la composition. L'analyse des timbres inclut quelques allusions à l'histoire évoquée par les titres des trois unités thématiques principales. Cette histoire est celle du développement du pouvour spirituel des femmes, selon d'anciennes traditions de mythologie lunaire.

PREFACE

For many years, the desire in my compositional work has been to explore how the abstract parameters of sound can be used to create art relevant in people's lives, and specifically relevant to women's experience in a patriarchal culture. My approach has been to use various symbols which have had significant importance in women's history and appropriate them in creating musical structures. The symbol of the spiral, an image found carved on large stones in several ancient goddess worship sites, is currently being used by many contemporary feminist artists and writers in their collective effort to create a body of artistic work which breaks through women's cultural silence. When adapted to the area of composition, the spiral symbol suggests an approach to the organization of sound parameters in time in which events are continually recurring in altered form. This has led me to create musical structures which use the concept of "cycles" as formal units. Within a cycle, musical events unfold in an organic and spatial manner. **Ellipsis** is one in a series of compositions which have been dedicated to these ends.

I am indebted to the work of Judy Chicago and her book Through the Flower, which inspired me to pursue this path. Many of the ideas for the underlying story of spiritual empowerment in **Ellipsis** come from Susan Griffin and her book Women and Nature: The Roaring Inside Her, which has been invaluable to me as a guiding force. Thanks are due to b.h. Yael whose artistic vision and loyal friendship has contributed greatly to my understanding of how women's experience can be a motivating force in creative work. Helen Hall has provided me with collegial companionship, pointing me towards a greater understanding of the sensual nature of sound and how issues of perception can contribute to the development of a compositional model.

The tape was composed using the resources of the Synclavier II digital synthesizer both at Gerr Electro-Acoustics in Toronto, and at McGill University's Electronic Music Studio, with technical help received from Bob

Snelgrove and Eric Johnstone, respectively. Other equipment used, a Roland S-550 digital sampler and the Yamaha DX7 and TX81Z digital synthesizers, belong to the composer. Tape sequences were digitally recorded using either the Synclavier's "Memory Recorder" or the "Performer" program for the Macintosh micro computer, and then recorded and mixed to tape at the Music Gallery, Toronto, and the Electronic Music Studio, McGill University. The string parts were also composed using the "Performer" program and transferred to "Professional Composer" to create the notated score. The string instrument samples were collected from Ruth Hoffman, Richard Armin and Paul Armin. A preliminary version of **Ellipsis** for tape, singer and dancer, completed in May 1987, was performed by Ivy Lerner-Frank (singer) and Carolyn Shafer (dancer), who contributed greatly towards the final realisation of the composition.

Helpful comments on the written text were received from Lauren Pratt and Rick Sacks assisted in the editing and printing of the score. I am thankful to my advisor Alcides Lanza, who has always supported my work and offered invaluable advice in the many stages of this thesis preparation. Brian Walsh and Jubal Bartley-Walsh have daily encountered the consumate energy required to complete this work and I am grateful for their patience and support.

TABLE OF CONTENTS

INTRODUCTION 1

I - Language as a Model for Timbral Composition 9
- A - TIMBRAL PERCEPTION 9
- B - CARRIERS AND TRANSITORS 11
- C - SPECTRAL FORM AND FREQUENCY CONTENT 11
- D - VOWEL AND CONSONANT CHARACTERISTICS 13

II - Timbral Design 16
- A - TIMBRAL RELATIONSHIPS 16
- B - CHARACTERISTICS OF FUSION TIMBRES 17
- C - CREATING FUSION TIMBRES 18
  - Possibilities with Sampling Technology 18
  - Techniques Used in Ellipsis 20
- D- TIMBRES CREATED BY FM SYNTHESIS 22

III - Timbral Sources In "Ellipsis" 24
- A - VOCAL TIMBRES 26
- B - STRING TIMBRES 28
- C - SAMPLED TIMBRES 29
  - Treatment of String Sources 30
  - Fusion Timbres from Mixed Sources 33
  - Sampled Timbres from Non-String Sources 34
- D - FM SYNTHESIS TIMBRES 34

INTERLUDE 38

IV - Formal Analysis 39

V - Timbral Analysis 43
A - DEFINITIONS OF CATEGORIES 43
Spectral Form 43
Frequency Content 44
Chart I 44
B - ANALYSIS OF FREQUENCY CONTENT 45
Vocal Sources 46
Instrumental Sources 48
Sampled Sources 49
Synthesized Sources 49
C - TIMBRAL CHARTS 50
D - DESCRIPTIVE ANALYSIS BY FORMAL UNIT 54
Cycle One 55
Cycle Two 62
Cycle Three 68
E - SUMMARY 74

VI - PITCH ANALYSIS 76
A - PITCH MATERIALS 76
B - DESCRIPTIVE ANALYSIS BY FORMAL UNIT 78
Cycle One 78
Cycle Two 80
Cycle Three 84
C - SUMMARY 86

CONCLUDING REMARKS 89

APPENDIX I 91

BIBLIOGRAPHY 94

APPENDIX II (bound separately)

Chart I..... 1

Chart II..... 8

Chart II-i..... 9

Chart III..... 10

Chart IV..... 10

Chart V..... 11

Chart VI..... 11

Table of Abbreviations..... 12

"Each of us is part of a vast physical-mental-spiritual web of previous lives, existences, modes of thought, behavior, and perception...We are filaments of a universal mind; we dream each others' dreams and those of our ancestors. Time, thus, is not linear, but radial."(Rochberg, 1973)

ELLIPSIS

INTRODUCTION

The assertion that time "is not linear, but radial" is a direct challenge to much of the classical instrumental music tradition in Western culture. In his article entitled "Concepts of Musical Time and Space", George Rochberg defines music which follows a linear progression, establishing "a melodic continuity or melodic discourse" as "speech-form." (Rochberg, 1984) p. 125. In most concert music written before 1945, this model of composition predominated, patterning itself after the nature of speech with expressive gestures constructed in states of tension and release. The large formal structures, built around tonal relationships and periodic phrase structures, defined musical space or height in terms of melody and accompaniment.

In the opening quotation, Rochberg contrasts the linear understanding of time with a view he suggests is more true to our experience of reality. The "radial" concept of time he proposes opens up several possibilities for exploration and application in musical composition. The word "radial" itself defines a particular shape characterized by several rays or projections emanating from a central core or axis. Using a word which identifies a particular shape suggests a spatial approach to composition, in which the composer conceives of the musical terrain as a large map upon which bands

or blocks of sound can be placed. This has indeed been the approach taken by many composers in the twentieth century, in which the elements of sound such as timbre, dynamics, attack, register, density and durational proportions have come to be regarded more as entities in their own rights, and not subservient to the larger expressive melodic line. In his article cited above, Rochberg defines such a sound structure as "space-form".

The characteristics of the radial shape suggest an interconnection between elements. In the opening quote, Rochberg uses this word to define a particular way of perceiving past events and history, likening the interconnection between the present and the past to a web structure. This understanding of time in which the past is always perceivable in the present can be used to develop ways of organizing musical structures. Not only does the word "radial" suggest a spatial approach to composition, but it also points to a model which will take into account previous events. The interconnectedness suggested by the term "radial" points towards spatial models that are circular in nature. One characteristic of the radial shape is its central core, but many other types of circular shapes can be explored as possible compositional models.

One such circular shape is developed in the composition **Ellipsis**, the subject of this paper. The word "ellipsis" derives from the word "ellipse", the shape created by a closed plane curve. It is also the shape created by the orbit of the moon around the earth in which the moon passes through three phases: waxing moon, full moon and waning moon. Once this pattern has been completed over the course of twenty eight days, the moon returns to darkness before the next occurrence of the pattern.

The characteristics of the lunar orbit suggest a circular shape which begins at a certain point, and by passing through varying gradations of shape, separate and distinct phases are created before returning to the common point of departure. Within this model there is reference to uniqueness and interconnection - separateness and unity. The entire composition of **Ellipsis** can be thought of as one complete cycle. Hypothetically, once the ending of

the piece is reached, one could imagine a return of the opening bars with a subsequent repeat of the entire composition. This is hinted at in the compositional materials used at the beginning and ending of the piece. However, the composition itself is built upon three large units, each representing a particular stage in the lunar cycle. Each unit can be seen as separate but yet bound to the larger whole. Because of this quality, the units are defined in the composition as cycles. Each of these three cycles contains within itself three smaller sections, which are further subdivided again into smaller parts. These divisions are outlined in chart form in section IV.

Working with a spatial model not only has implications for the formal design of a composition, but as discussed earlier, suggests an entirely different approach to the parameters of sound, focusing on elements such as timbre, density, and register rather than on melody and harmony. The model of the moon passing through distinct gradations of shape can be applied in a musical context to the idea of timbral change over time. Within a given time unit, the unfolding of events may occur either as a gradually shifting process, or events may signal abrupt changes, creating areas with varying degrees of contrast. Using timbre as the central organizing feature in a composition was explored by Arnold Schoenberg in his notion of *klangfarbenmelodie*. His desire to move away from using pitch relationships is expressed in the following quotation:

> **If it is possible to make compositional structures from timbres which differ according to height (pitch), structures which we call melodies, sequences producing an effect similar to thought, then it must be also possible to create such sequences from the timbres of the other dimension from what we normally and simply call timbre. Such sequences would work with an inherent logic, equivalent to the kind of logic which is effective in the melodies based on pitch. All this seems a fantasy of the future, which it probably is. Yet I am firmly convinced that it can be realized. (Schoenberg, 1911) p. 471.**

The central focus of this paper is to develop a theory for timbral composition upon which an analysis of **Ellipsis** may be based. Much of the recent work conducted in the area of timbral composition has been based in linguistic and phonological theory. In order to determine how timbre can function as a form-bearing element in music the research-composer team of Stephen McAdams and Kaija Saariaho (McAdams and Saariaho, 1985) at IRCAM have investigated the role timbre plays in speech, and specifically how the timbral qualities of vowels, consonants, and phonemes contribute to how we discern meaning and form in the spoken word. How the principles and elements of language can be applied on the formal level to timbral composition is discussed in Section I - "Language as a Model for Timbral Composition".

The methodology used for the organization of timbral resources and procedures followed in the creation of new timbral sources is discussed in Section II -"Timbral Design". The actual sources used in Ellipsis are outlined in Section III - "Timbral Sources in Ellipsis" and are organized according to the language model theory. An in-depth and detailed timbral analysis of the composition based upon the theory developed in this paper takes place in Section V. An analysis of the pitch materials can be found in Section VI, and the entire paper closes with the "Concluding Remarks". **Ellipsis** is scored for electric string quartet, (preferably performed using the RAAD instruments designed by Richard Armin), tape, and female singer. The performance may also include choreography for two dancers. Section III begins with a discussion on the characteristics of the RAAD instruments and how their capabilities are utilized in the composition.

For Schoenberg, the vision of using timbre as a form-bearing element in composition went beyond a technical concern for devising a system of logic that would aid the organizing of musical parameters. The quote cited above concludes with a reference to how composing with timbre will affect the listener.

I am convinced that [it] would dramatically increase the sensual, intellectual, and soul pleasures which art is capable of rendering. I also believe that [it] would bring us closer to the realm which is mirrored for us in dreams; that, in fact, it would expand our relationships to those things which seem not yet alive to us by giving from our life to the life which appears dead to us only because we have so little connection with it. (Schoenberg, 1911) p. 471.

Schoenberg is suggesting that musical structures organized around the parameter of timbre will help the listener access a different level of consciousness - one which is experienced in dreams. His reference to the dream world creates an interesting parallel to Rochberg's opening quote regarding a radial time model. As discussed earlier, the model implies the interconnectedness of past and present, and that one way this connection to the past can be experienced is through dreams. This model also suggests a spatial approach to composition, which implies a focus on timbral relationships. There seems to be a consensus between the ideas of Schoenberg and Rochberg that timbral composition opens up or points towards other levels of awareness that often are only attainable in the dream world and have some connection to past history or experience.

The cyclical pattern of the moon's orbit around the earth not only provides a structural and timbral model for **Ellipsis**, but also functions in the composition on a more symbolic level. Many ancient goddess and fertility rituals associated the waxing moon, full moon and waning moon with the three life cycles of woman: virgin, mother, and crone. Although these meanings have been largely lost from the consciousness of our culture, contemporary adaptations of this tradition have expanded the meaning of these three stages to represent the process of spiritual empowerment. (Noble, 1983)

virgin: the power of beginnings, untamed and hidden possibilities

mother: the power of fruition, burgeoning with life, possibilities becoming realized

crone: the power to end, the accumulation of wisdom, possibilities of rebirth

Ellipsis continues in the ancient tradition of associating stages of growth with the three lunar phases and creates another three-fold story of woman, chronicling the spiritual and psychological empowerment of woman's collective consciousness as it has evolved through time[1]. Within the story itself, articulated in the composition through the timbral relationships, the ancient knowledge of the past is brought forward into the present, enlightening the spiritual journey. The image of the moon and its orbital characteristics which are featured in **Ellipsis**, create connections between timbral composition and ancient rituals which have meaning for the present when one understands time as a radial process. The story of Ellipsis, outlined below, is articulated fully in the context of the timbral analysis in Section V and also appears as Appendix I.

The Age of Darkness:

Cycle one tells the story of woman growing inside the darkness, every day moving closer to self understanding. Hearing the voices of the past, she begins to put the ancient pieces together, rediscovering her lost heritage.

[1] Inspiration for this story was derived from Woman and Nature: The Roaring Inside Her by Susan Griffin (New York: Harper & Row, 1978).

Creating a New Space:

Caught in the midst of a circling, spiralling motion, and confused by endless possibilities and barriers, she finds an opening and begins to create a matrix of her own sounds. From there she propels herself into a full-bodied celebration of that discovery.

The Age of Resonance:

Cycle three is the age of resonance. Standing face to face with the holiness of wisdom and pure sound, "Old Woman" crosses time-lines and speaks. Her words and her sounds illuminate life. The ending becomes the beginning.

Another connection to ancient traditions can be found in the style of vocal singing used in **Ellipsis**. In many early cultures, language and music functioned as a single entity, as in the example of the ancient Greek artforms of poetry and drama. Choral singing, one of the elements of Greek drama, was characterized by "an inarticulate outpouring of emotion, a form of verbal anarchy relying on exhilaration and frenzy as part of an elaborate ritual to purify the soul...It penetrated into buried levels of consciousness, describing all active and living forces in sound and evoking the elemental substratum of magic in language." (Hall, 1988) p. 21.

Over the last twenty five years, performer Meredith Monk has evolved a particular singing style which is built upon a wide variety of vocal timbres, all created by changes in the mouth shape or tongue location, similar to the way vowel and consonant sounds are created in any given language. Through her explorations, she has uncovered vocal resources which, unknown to her at the time, are found in many different cultures. (Monk, 1988) p. 9. These "human universal sounds" are for the most part wordless, similar to the Greek choral style described above.

Using this particular vocal style in **Ellipsis** allows the singer to be engaged fully with the resources of the strings and the tape in the development of timbral relationships. Although the underlying story of **Ellipsis** is never verbally articulated through words or phrases, the focus on timbral changes in the voice creates a more powerful mode of communication.

> **The voice itself is a language that speaks louder than words. It deals with emotions that we don't have words for. It works between the cracks...The very direct way the voice can reach people on a heart-to-heart level seems more to the point for me than limiting it by words. (Monk, 1988) p. 9-10.**

The **Introduction** of this analytical study of **Ellipsis** has given the reader an overview of the basic organizational principles used in the piece and closes with a final quotation from Through the Flower by Judy Chicago. The quotation summarizes how the author Anais Nin approached the issue of tying together the technical and formal concerns of an artwork with references to human experience as lived now or in other times.

> **"I want my art to be as close as possible to the lifeflow. I must install myself inside of the seed, growth, mysteries...art must be like a miracle. Before it goes through the conduits of the brain and becomes an abstraction, a fiction, a lie. It must be for woman more like a personified ancient ritual, where every spiritual thought was made visible, enacted, represented." (Chicago, 1988) p. 176.**

I - Language as a Model for Timbral Composition

> **Research in the field of linguistic phonology has revealed much about the sound shape of languages: the meanings, functions, and values of distinctive sonic features in creating the special sonic character of a particular language or linguistic utterance. We find many parallels (if not complete congruency) between musical and linguistic sound and more especially, we find in linguistic phonological analysis a stimulating model for defining sonic features and their interrelationships. The creation of sound shape thus lies at the very core of languages and music - sound shapes that in both domains now stand revealed by analysis. (Cogan, 1984) p. 5.**

One of the most compelling parallels between language and music is that in both fields, humans ascribe meaningful distinctions based upon timbral differences. In language, the timbral qualities of vowels, consonants, and phonemes contribute to how we discern meaning and form in the spoken word. In music, we rely primarily on our subjective perceptual abilities to distinguish one timbral quality over another. The fact that we can do this is easily understood and accepted. How this mechanism works has been the subject of many studies. Our knowledge of how language functions on a sonic level contributes to our understanding of how timbral differences are perceived. This understanding can lead to the development of a model for timbral composition.

A - TIMBRAL PERCEPTION

Much of the research on perception of timbral differences in music derives from work on the perception of speech. Changes in vowel quality are due to changes in the formant region or frequency structure of different vowel types.

A formant is a peak in the spectral envelope that occurs at a certain frequency, and is often associated with a resonance in a sound source which in vowels occurs in the vocal tract. From this knowledge, it can be asserted that perceptual differences in timbre are linked to changes in the spectral formation. For many years, the theories of Hermann Helmholtz which describe the nature of the spectrum solely in terms of a fundamental pitch and its overtones or partials have been widely accepted. This theory was based on Ohm's Law of acoustics, which Helmholtz expanded to state the following: "Every motion of the air which corresponds to a composite mass of musical tones, is, acccording to Ohm's law, capable of being analysed into a sum of simple pendular vibrations, and to each such single simple vibration corresponds a simple tone, sensible to the ear, and having a pitch determined by the periodic time of the corresponding motion of the air." (Helmholtz, 1877) p.33. Both the work of Ohm and Helmholtz was developed out of Jean Fourier's method of spectral analysis, which concerned itself primarily with determining which partials were present and at what amplitude.

The computer music experiments of Jean-Claude Risset (Risset, 1985) at Bell Laboratories initially focused on attempts to digitally synthesize instrumental tones based on the accepted acoustics treatises of Ohm's and Helmholtz. He discovered that the tones produced by merely recreating the spectrum were dull and lifeless, and thus began a study to determine what features other than a correctly synthesized spectrum were necessary to give life-like sounds. By analysing instrumental tones, he discovered that an evolution in time of the individual harmonics' amplitudes produced a more accurate recreation of the instrumental sound. He discovered that other features such as attack time, a quasi-random frequency fluctuation, and a peak in the spectrum between 1KHz and 1.5 KHz also contributed to a life-like sound, but the temporal evolution of spectral envelope was the most significant factor in timbral differentiation.

Another important factor in timbral perception is the element of register. Philosopher-scientist Ernst Mach observed that even though a sine tone has a consistent spectrum in all registers, there is a noticeable change in tone colour

in the different registers. (Cogan, 1984) p. 12. The timbre in the lower registers is dark and dull, similar to the [u] and [o] vowels. In the upper registers, the timbre is bright and acute, similar to the [i] vowel. Based on these observations of a sine wave, he concluded that not only was the spectral envelope important in timbral differentiation, but where the fundamental occurs in the overall registral area also plays a significant role.

While temporal evolution in the spectral envelope is important in distinguishing between specific timbres, register can provide contrast even within the confines of one timbral type of spectral envelope. These features are an important beginning for understanding how timbre can function as a form-bearing element in musical composition, and it brings the discussion back to the issue of how the differences in vowels and consonants can contribute to timbral composition.

B - CARRIERS AND TRANSITORS

One way of approaching the composition of a large sonic structure with primarily the concerns of timbral change in mind would be to understand the entire composition as one large spectral envelope that changes slowly over time. Within that structure, smaller units could either change quickly or be more static in nature. This approach parallels the function that vowels and consonants play in speech formation. Vowels are steady-state sounds, whereas consonants are quickly executed articulations or transitions betwen the vowels. These two types of sound characteristics are described in the research being conducted by McAdams and Saariaho as carrier (vowel) and transitor (consonant).

C - SPECTRAL FORM AND FREQUENCY CONTENT

McAdams and Saariaho have chosen two main aspects of sound - what they call "spectral form" and "frequency content" - as areas in which to develop musical applications derived from the timbral qualities of speech. Register, as discussed above, can be understood as the placement of any given set of

spectra in the musical space. Different ways of measuring events in the registral space include range, density, spacing, and band width. These categories will determine the spectral form of the composition.

Creating a spectral form with slowly evolving changes in these elements, much like moving from one vowel sound to another without any consonants occurring in between, would result in a musical texture with carrier characteristics. A spectral form that had many quick changes in range or density, for example would be similar to a series of consonants, thus creating a texture with transitor characteristics. Adding a consonant between two vowel sounds creates a vowel-consonant pair, and can be understood as containing both transitor and carrier qualities. A musical structure that uses a steady state environment (often referred to as a "drone") to serve as a background to foreground material that contains more quickly changing elements can be defined as transitor/carrier.

In looking to define frequency content, it is necessary to first consider the three basic categories of spectral formation. The first category contains only the fundamental, as is found in the sine tone. The second category consists of sounds whose partials are whole-number multiples of the frequency of the fundamental, and stand in harmonic relationship to each other. This harmonic spectrum is characteristic of vowel sounds and the majority of pitched musical instruments. The third category consists of sounds whose partials are not whole-number multiples of the fundamental and are considered inharmonic. The final category, defined as noise, consists of those sounds which contain a very large number of frequencies that have no relationship to each other. Noise is an extension of inharmonic sounds in that it contains many more frequencies and can be created by filling in the gaps between the partials of the inharmonic sounds.

The frequency content of the spectral envelope can be defined as a continuum that ranges from sine-harmonic-inharmonic-noise. In analysing the frequency content on a spectrograph, it is possible to distinguish between those partials that appear as individual strands and those that appear as

bands, covering a wide region of musical space. These characteristics can be further classified as compact (individual strands) and diffuse (bands).

A carrier section would contain primarily timbres of one particular classification, which would either remain constant or slowly move within one specific region: from harmonic compact to harmonic diffuse, for example. Passages of transition would contain timbres from contrasting regions of the continuum: progressing from harmonic diffuse to noise diffuse, for example. (McAdams and Saariaho, 1985).

D - VOWEL AND CONSONANT CHARACTERISTICS

Differences in the frequency spectrum of vowels and consonants are created through changes in the shape of the oral cavity. Mode and location of articulation become important features in creating a model for organizing timbres. An in-depth discussion of timbral design and the creation of timbral relationships of non-vocal sounds will take place in Section II below. Before that discussion begins however, it is important to explore the model of timbral grouping inherent in the creation of vowel and consonant sounds.

Vowels can be ordered in relation to height (openness of the mouth cavity), advancement (placement of the tongue), and retroflexion (curving of the tongue toward the roof and drawing the tongue toward the rear of the mouth). These characteristics of vowels can be placed on a timbral map organizing their timbral characteristics into categories such as brightness, acuteness, laxness, tenseness, nasality, etc. (McAdams and Saariaho, 1985) p. 371. These differentiations in vowel sounds are due to the type of formant structure associated with various mouth shapes and tongue positions. Listed below are eleven standard English vowels, which are grouped in three different ways according to the mode of production. (McAdams and Saariaho, 1985) p.370. For example, as the tongue moves from the front to the rear of the mouth, a certain progression of vowels is produced. This progression is presented in the Advancement chart. As the mouth cavity procedes from closed to open, another ordering of vowels is produced, and is notated in the

Height chart. A third series results from changes made by curving the tongue and is represented in the Retroflexion chart. The first column of "advancement" includes the phonetic symbols for these vowels based on the Kenyon and Knott system. (Kenyon and Knott, 1953)

Advancement		Height	Retroflexion
/o/	go	glue	glue
/u/	glue	hood	go
/ʊ/	hood	sheet	father
/ʌ/	mud	hit	had
/a/	father	great	great
/ɔ/	bought	bet	mud
/e/	great	mud	hit
/ɪ/	hit	go	bet
/ɛ/	bet	bought	hood
/æ/	had	had	bought
/i/	sheet	father	sheet

Consonants can also be mapped according to mode of production, by manner (stopped, fricative), place (of constriction by tongue or lips), orality (nasal or oral), and voicing (presence of vocal cord vibration at the beginning of consonant production). (McAdams and Saariaho, 1985) p.370. These characteristics are by nature rapid articulations of sound. The chart below lists the consonants as voiced or unvoiced plosives and fricatives, or sonorants, which of course are all voiced, and include both nasal and oral consonants.[1] The consonants are listed below according to location of articulation, moving from the front of the mouth (bilabial position) through to the back (velar position).

	Plosives		Fricatives		Sonorants	
Unvoiced	/p/	pop	/f/	fife		
Voiced	/b/	bib	/v/	verve	/m/	mime
Unvoiced	/t/	tot	/θ/	thigh		
Voiced	/d/	did	/ð/	they	/n/	nine
Unvoiced	/k/	kick	/s/	cease		
Voiced	/g/	gag	/z/	zoos	/ŋ/	singing
Unvoiced	/tʃ/	church	/ʃ/	shush		
Voiced	/dʒ/	judge	/ʒ/	azure	/j/	yes
Unvoiced			/h/	how		
Voiced					/w/	way

[1] The two other consonants /l/ and /w/ are categories not used in this composition.

II - Timbral Design

A - TIMBRAL RELATIONSHIPS

One way to develop structural relationships in timbral composition as suggested by the model described above is to create timbral groups or families. Research in the area of timbral perception conducted by John Grey, James Moorer, and David Wessel (Risset and Wessel, 1982) has shown that those sounds which are perceived as similar also share similar spectral evolution, whereas timbral dissimilarity due to different kinds of spectral evolution is described as 'timbral distance'.

An approach to the concept of timbral relationships taken by F. Lerdahl (McAdams and K. Saariaho, 1985) p. 372 is to develop timbral hierarchies of spectral colour by creating families, sub-families, and super-families of similar sounds. Timbres are evaluated in terms of the subjective characteristics of tone colour and sound quality rather than by the more objective criteria provided by the data of spectral analysis. In Lerdahl's approach, degrees of contrast and of distance are made, as well as a sense of relationship between timbres which function as "dominant" or "consonant", juxtaposed to those timbres that function as "dissonant".

McAdams and Saariaho suggest that a sense of musical motion can be created through the use of a 'timbral interval', similar to the traditional melodic interval. In this way, when one timbre is followed by another timbre, a sense of direction is created as we move along in time. The motion is dependent on both the direction and size of the interval, just as in melodic intervals. Coming out of this concept has been their work in creating relationships among timbres using techniques of fusion. (McAdams and K. Saariaho, 1985) p. 373-74 and (McAdams Oct. 1985).

B - CHARACTERISTICS OF FUSION TIMBRES

Fusion timbres are those sounds which have been created by the combining of separate parts so that the individual components are imperceptible as separate entities. This is only possible when the individual parts share similar critical band widths. When the partials of each component are in separate band widths, it is extremely difficult to hear them as one single object. These would more appropriately be called timbral 'chords'. Thus fusion is easier to achieve when dealing with denser sounds since there is more possibility of band width overlap.

One of the main considerations in creating a fused timbre is synchronizing the onset times of each of the separate components. In order that the final sound be perceived as a fused entity, the difference in onset time should be no greater than 30 milliseconds. Anything greater than this results in perceptual awareness of the separate events, resulting in an arpeggio-like effect. This is particularly evident once the 500 millisecond boundary has been crossed. However, between these two outer limits of 30 and 500 milliseconds, one can create a series of timbres which vary from each other by making small changes in the onset times. For example, differences in timbral quality are perceived between a fused sound whose elements begin 80 milliseconds apart, and one whose elements begin 100 milliseconds apart (using the same components). This is one area in which families of sounds can be built up.

Other techniques which MacAdams and Saariaho have developed in the creation of fusion timbres is to 1) vary the order of onset; 2) splice off the attack portions of the sounds, since this is where a great deal of timbral differentiation information is revealed; 3) create arpeggiated timbres through the process of separating the elements. This latter technique is a step away from fusion, but is useful when designing timbral families, as it is one way of creating a timbre that is distinct from a completely fused version, but yet maintains common characteristics.

C - CREATING FUSION TIMBRES

Possibilities with Sampling Technology

The technology that was used to compose fusion timbres for the tape element of **Ellipsis** was that offered by sampling synthesizers. Essentially, sampling an acoustic sound source requires the creation of a digital recording. The computer does this by taking several thousand snapshot-like pictures, or samples, of the waveforms of any given sound. If the sampling rate of a particular synthesizer is 40 KiloHertz, for example, that would mean the computer takes 40,000 samples every second. This ensures a fairly accurate representation of the discrete changes occurring in the sound source over the course of time so that the sampled sound is as true to the original as possible. The higher the sampling rate, the more samples are taken, and the more accurate the sound representation will be.

One of the main editing features available in sampling software is the ability to mix two or more sounds together. This can be done in a variety of ways, depending on the software. The Signal File Manager program of the Synclavier II system offers an editing feature which enables the user to mix, splice, reverse or extract any portion of the sound source, and add vibrato or ring modulation. The program allows for the maximum editing of up to twelve separate sounds together at any one time, and for the specification of the volume level of each sound. Once this sound is mixed together, it creates a new sound file to which another eleven sounds could be added, if so desired.

Using this program, various possibilites of creating fusion timbres were explored. The first experiment involved the splicing of a violin attack onto the decay portion of a piano sound. The second type involved splicing the steady-state portions of four different notes, each at 524 Hz, and each one performed using different types of bow pressure on a violin: light, medium, heavy, and extreme pressure. The result of the splicing is the creation of one

note which smoothly progresses through this pressure continuum. A third experiment was to mix together several copies of a glissando on the G string of a violin by varying the onset times, all of which were under the critical 500 millisecond limit.

A fourth area of experimentation involved the extraction of any portion of a sound, splicing multiple copies of that sound together, and then merging or fusing the new sound together with the original, with other portions of the original, or with a different sound altogether. Another possibility following this approach was to extract the individual waveform from a sampled sound and splice multiple copies of it together to create a new sound. This procedure results in a sound with a static quality resembling that of an oscillator waveform.

Once sounds have been created in the Edit feature of the SFM program, they can be sent over to the synthesizer keyboard via the Patch feature. Sounds for **Ellipsis** were sampled and edited using both the older monophonic software releases of the Synclavier II and the later updates (as of January 1987) for the polyphonic sampling SFM program. In the monophonic version, twelve sounds could be patched in any configuration on the keyboard. For example, Sound File #1 could be placed between **C1** and **B1**; Sound File #2 between **C2** and **B2**, and so on. In the polyphonic releases, it became possible to create four separate and individual patch set-ups that could be accessed at any one time. This feature allows the user to create different layerings and overlaps of sounds. For example, three different sound files can be patched between **C1** and **B1** which would then sound as one unit when the keyboard is played between **C1** and **B1**.

The envelope properties on the Synclavier are defined as Initial Delay, Attack, Initial Decay, Final Decay, Sustain and Peak. The first four properties are programmed according to time values (milliseconds), and the latter two according to volume. Complete control over these properties is possible for each separate component, as are features such as chorus, stereo effects, vibrato, volume level, tuning, and real-time effects.

The keyboard can be set in different tuning relationships by adjusting what is known on the Synclavier as the Octave Ratio parameter. Essentially, this feature divides the keyboard octave into smaller or larger units. If for example the Octave Ratio was programmed at .5, the distance between C3 (middle C) and C4 on the keyboard would be a tritone, with the distance of a quarter tone occurring between C3 and C#3. It is also possible to program the velocity sensitivity so that if one plays with a heavy attack, it will trigger all four sounds. If one plays with a light attack, it will trigger only one of the sounds.

Techniques Used in "Ellipsis"

Essentially three techniques were used in the creation of the fusion timbres for the piece. One type of sound was made by varying the onset times. Several copies of one particular sound were mixed together, staggering the onsets of each component. A variation of this, particularly in working with glissandi, was to fuse the glissandi derived from the different strings, thus creating a sound with a wide band width. Because the pitch in a glissandi is always changing, it is possible to achieve a fused timbre when using those glissandi from different strings without perceiving the separate components. Reverse glissandi (made by reversing the sample) were combined with other normal glissandi.

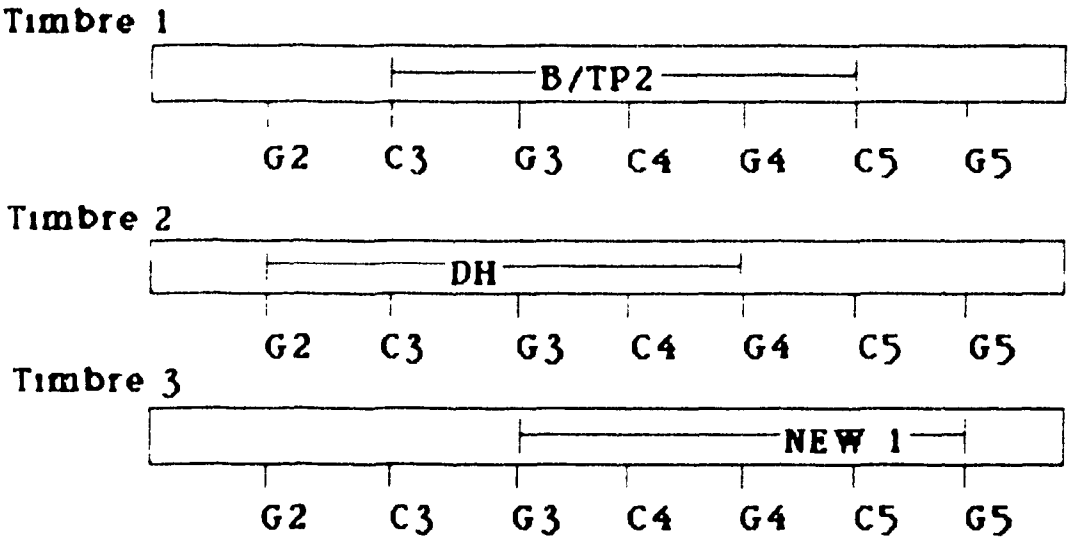
The second type of fusion timbre was created by combining two or three different sound sources together and eliminating the attacks of either one or all of the components. This always required a good deal of experimenting with the amount of attack to be eliminated. Once the desired fused sound was achieved, the program allowed for the addition of an attack and decay to the new sound.

The third technique was in the area of keyboard layering. As mentioned above, the polyphonic sampling program of the Synclavier II allows the user

to layer three different keyboard patch setups simultaneously. The following diagram gives an example of one such setup. See the "Table of Abbreviations" in Appendix II to decode names of timbres.

The synthesizer keyboard ranges from G2 upn to G5. The first timbre named B/TP2 is patched on the keyboard from C3 to C5. The second timbre, DH, is patched from G2 to G4; and the third timbre, NEW 1, from G3 to G5. The following sounds result when the patch is performed in different keyboard areas:

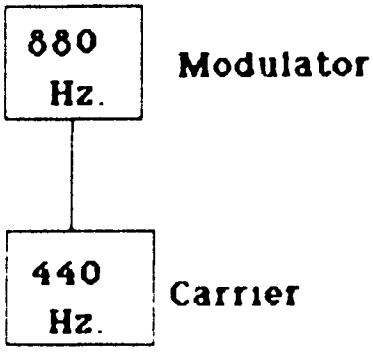
from G2-C3:	DH sounds
from C3-G3:	DH and B/TP2 sound simultaneously
from G3-G4:	DH, B/TP2, and NEW 1 sound simultaneously
from G4-C5:	B/TP2 and NEW 1 sound simultaneously
from C5-G5:	NEW 1 sounds



Once any note is sampled and patched to the keyboard, it is possible to play that sample transposed both above and below the original note. As other notes are played on the keyboard further away from the originally sampled note, the sound changes in quality due to the transposition of the spectral envelope, thus slowing down or speeding up the activity of the individual partials. In order to achieve 2 - 3 octaves of an accurate string sound performed with normal bowing, for example, it was decided to sample several notes within that range, usually at the interval of a perfect fifth.

D- TIMBRES CREATED BY FM SYNTHESIS

Both the Synclavier II and DX7 digital synthesizers allow for the programming of sounds using Frequency Modulation synthesis techniques. This synthesis technique allows the user to create timbres with both harmonic and inharmonic spectrum, creating sounds containing specific spectral components. Essentially this is accomplished by the placing of at least two frequencies (called carrier and modulator - see diagram below) in a particular ratio, creating changes in the spectrum of the carrier frequency, which is heard as a change in timbre. Both the frequency and amplitude of the modulating frequency will affect the number and frequency of harmonics (called sidebands) created in the new spectrum. If the two frequencies have a ratio which uses integral numbers (ie 1:2, representing for example a carrier frequency of 440 Hz. and a modulator frequency of 880 Hz.), then the resultant spectrum will contain partials from the harmonic series. If the ratio of the two frequencies is one using non-integral numbers (ie- 1:1.37, representing the respective frequencies of 440 Hz. and 602 Hz.), then the resultant spectrum will contain partials in a non-harmonic relationship to each other, which is heard as a inharmonic timbre. The number, frequency and amplitudes of the partials can be determined by applying various formulas, including the Bessel Function charts, which determine the relative amplitudes of the partials.



Ratio of 1 2 creates "harmonic" sidebands

III - Timbral Sources In "Ellipsis"

The RAAD string instruments are the preferred choice for the performance of the composition **Ellipsis**. The instruments are a unique design created by Richard Armin which look very different from normal instruments, but have a realistic sound and retain the traditional instrument proportions. The pick-up or transducer is placed inside the instrument under the top plate at a carefully measured distance from the bridge. The transducer receives the sound waves directly and by reflection from the borders of the top plate. (Armin, 1984) p. 3.

The advantage of using string instruments of this nature in the composition **Ellipsis** has to do with the overall sound of the piece that is desired. In this composition, the tape element plays a major role, and is present almost entirely throughout the full duration of the piece. This means that amplified sound is a dominant characterisitic. With any type of amplified sound, the intimate details of the sound source are readily apparent. However, with traditional string instruments, most of the energy of the performers is focused on sound projection. However, the intent of RAAD designer Richard Armin is to create an instrument that can allow the performer to "pay attention purely to the intimacy that is demanded by the composer...You don't invest your energy in the ability to project a sound into space, you simply set levels of the processing equipment so that you've established a healthy dynamic range, and then you have the ability to create tremendously large and very intimate sounds." (Armin, 1984), p.4. Not only can a better balance be achieved between strings, voice and tape in **Ellipsis**, but the string sounds are on a more equal footing with the tape sounds. This is particularly important as many of the sound sources used on the tape are sampled string sounds.

In the course of the spectral analysis work of Frank Opolko, he discusses the fact that of all traditional instrumental sounds, the strings produce the timbres that most closely resemble those of vowels. (Opolko, 1982). He has completed a spectral analysis of several string sounds and has found correspondance in these spectra with spectra of various vowel types. Similar

comparisions could be extended to consonant sounds by comparing modes and location of attack on the string instruments with different consonant types. There is an inherent similarity between the timbres of the string quartet, and the vowel and consonant sounds of the voice. In order to stretch the boundaries of the timbral space further, it was decided to use sampled string sounds from both the violin and cello, and to use some of these sources for the creation of fusion timbres.

In order to create a sense of timbral space containing timbral groupings or families, the resources of voice, string quartet, sampled and synthesized timbres were grouped along a particular continuum of sound which ranged from harmonic spectra to noise. Within each of these four groups, sounds were also grouped according to the continuum. What follows below is a detailed outline of all timbral resources used, and how they are grouped into timbral families according to mode and location of articulation.

voice -- strings -- sampled timbres -- FM synthesized timbres

harmonic spectra----------noise

A - VOCAL TIMBRES

The vocal timbres used in the composition are divided up into the categories of vowels, consonants and vowel-consonant pairs (indicated as V-C pairs). The vowels are organized according to various progressions used through both the retroflexion and height charts. The "mixtures" grouping below refers to a mixing of the progressions through either the retroflexion or height charts.

(In the score, these vowel indications are given as basic landmarks for the singer, but allowing room for the performer to make her own subtle changes and gradations as she moves from vowel to vowel, according to the individual mouth shape and oral cavity.)
The few individual consonant sounds used are organized according to mode of articulation (plosive, fricative, sonorant), voicing, and location of articulation (moving from the labial to the lateral position).

The V-C pairs are listed in terms of progression through both the vowel and consonant charts. The V-C pair vowels proceed horizontally according to the height chart, whereas the V-C pair consonants use the same ordering as the consonant sounds.

Vowels	retroflexion		e-a-o-u
			u-o-a-ae-e-i
			i-ʊ-ɛ-a
			a-e-i
			e-a/a-e
			a-ae
	height		u-ʊ-i-I-e
			a-ae-o
			u-i
	mixtures		a-e-o
			e-i-o
Consonants	plosives	Voiced	b, tʃ, d
	fricatives	Unvoiced	f, s,
		Voiced	v, z,

V-C Pairs	plosives	V.			bʌ					
		Unv.	ta				tI			
		V.					dI			du
		Unv.	ka	ko						
		Unv.							tʃi	
	fricatives	V.	va		vʌ					
			za							
			ʒa	ʒo	ʒʌ	ʒe				ʒu
		Unv.	ha	ho		he				
	sonorants	Nasal	na	no		ne			ni	
			ɳɑ	ɲo						
		Oral	ja	jo	jʌ					
			wa		wʌ					

B - STRING TIMBRES

Fundamental to timbral differences in vowels and consonants is the manner and location of articulation. Thus the strings sounds used in the composition are organized into these two categories, attempting to follow the harmonic-noise continuum:

Manner of Articulation:	legato bowing
	glissando
	harmonics
	tremolo
	tremolo/glissando
	jeté (attack with pressure)
	pizzicato (pluck with pressure)
	bowing with heavy pressure
Location of Articulation:	normal position
	sul tasto
	sul ponticello

C - SAMPLED TIMBRES

The string sounds chosen for sampling purposes should be viewed as extensions of the categories listed above under STRING TIMBRES. They will first of all be listed according to manner and location of articulation, and then be followed by a description of how each sampled source was trea.ed according to the fusion techniques and editing procedures available on the Synclavier discussed in the section entitled "Possibilities with Sampling Technology".

Manner of Articulation: glissandi

harmonics

natural harmonic glissandi

artificial harmonic glissandi

bowed attack through Digital Delay Line

fingernail pizzicato

Location of Articulation: tailpiece

sul ponticello

between pegs and fingerboard

between bridge and tailpiece

Treatment of String Sources

Code names are listed in bold following the description of each technique. These will be used during the Timbral Analysis in Section V. The separate appendix provides a ready index to all code names used throughout the remainder of the paper.

Glissandi: Layering techniques were used with the following four sources:

source1: ascending glissandi from the A violin string
source 2: ascending glissandi from the E violin string
source 3: one ascending and descending glissando from E string
source 4: reverse of E string asc. & desc. glissando

These were layered on the keyboard using the following plan:

source 1: normal
source 2: delayed by 80 milliseconds, tuned down 35 Hz.
source 3: delayed by 160 milliseconds, tuned down 36 Hz.
source 4: delayed by 24o milliseconds, tuned up 20 Hz.

The sequence was recorded with the keyboard programmed in an Octave Ratio of .481, which is slightly smaller than a quarter tone ratio at .5.
Lay/Gliss

Harmonics: A range spreading from D3 to E6 was sampled, looped and patched to the keyboard with a chorus setting of 0.943.
Har

Natural Harmonic Glissandi: The sound that results from this type of glissando is an arpeggio on the overtone series. The following sources were used:

1. ascending and descending glissandi from all four open strings of the violin, performed in a fast tempo resulting in three ascending-descending pair
2. ascending glissandi from all four open strings of the violin, each five seconds in length

(a) The four sources listed under #1 above were mixed together, splicing off the attack portions of each. Then four separate extractions were made from different areas of this mixed source and patched on the keyboard.
HarGl1

(b) The four sources from #1 were mixed by delaying the onset times of each component by 20 milliseconds. Thus arpeggio2 would begin 20 milliseconds after arpeggio1, arpeggio3 40 milliseconds after arpeggio1, and arpeggio4 60 milliseconds after arpeggio1. The final timbre was created by making an extraction from this mixed file.
HarGl2

Artificial Harmonic Glissandi: As the finger slides up and down the string, several harmonics in different registers emerge. The sources used were performed in two different tempos:

1. glissandi on violin string G, D and cello A in a slow tempo
2. glissandi on cello strings C, G, D and A in a fast tempo
3. glissandi on violin strings D, A and E in a slow tempo.

(a) The three sources listed under #1 above were layered on the keyboard.
AHarGl1

(b) All four glissandi listed under #2 were mixed by delaying the onset times by 20 milliseconds. The attacks were subsequently spliced off.
AHarGl2

(c) The three sources listed under #3 were mixed, but no delays were applied.
AHarGl3

Bowed Attack through Digital Delay Line: One feature of a digital delay unit allows the user to sample .5 seconds of an attack and create a continuously sounding timbre by looping that sample and sending it through the delay system. The looping and echoing causes an increase in the amplitude of all the partials, changing the character of the harmonic spectrum into one that more closely resembles an inharmonic spectrum. Three such sounds were created using the following notes from the cello:
C1 - **DL**; G2 - **DM**; and E4 - **DH.**

Fingernail Pizzicato: Since a range of 5 octaves was desired, it was necessary to sample several examples of the fingernail pizzicato. Four variations of this sound were created:

1. vibrato added
2. vibrato effects delayed in the attack
3. mixed with synthesized inharmonic timbre
4. mixed with synthesized harp timbre

FPizz1,2,3,4 (respectively)

Tailpiece: The sample of a bowed tailpiece was processed through several generations of equalization to amplify the frequencies of its spectrum. The sequence was recorded using an Octave Ratio of .310.
TP

Sul Ponticello: Several samples were taken to cover a three octave range. Four variations of this keyboard patch were created using different chorus settings. This results in the presence of beating frequencies, creating a richer spectrum. The four chorus settings used are: 1.018, 1.264, 2.018, and 2.333.
Pont1, Pont2, Pont3, Pont4 (respectively)

Between the Pegs and the Fingerboard: A quick arpeggio-like figure ranging over all four violin strings was sampled in this location. Two copies were mixed together, delaying the onset times.
P/FB

Between the Bridge and the Tailpiece: Playing in this position on the D string of the cello produced a series of pitches, each following the other in succession. Two extractions were made of this sound. The first extraction was made of a low pitch, which, when played on the keyboard an octave below the originally recorded tone, generates a grainy quality. The second extraction was made of inharmonic tones sounding in the high register. These tones were transient in nature, behaving somewhat like a multiphonic on a woodwind instrument .
B/TP1 (low grainy sound)
B/TP2 (high multiphonic-like sound)

Fusion Timbres from Mixed Sources

1. The ponticello notes on B5 and E5 were fused with **DM**. The attacks were spliced off to create better fusion.
NEW1

2. NEW1 was fused with **DH.**
NEW2

3. By layering techniques, a patch was set up combining **NEW1, DH,** and the **B/TP2** timbre. These sounds were not intended to fuse into one unit, but to sound distinct, creating a timbral chord when any given key is pressed on the keyboard.
TimCh1

Sampled Timbres from Non-String Sources

1. Four different types of vocal sounds were sampled:

VOC1	a) a phrase of phonemes improvised by a female adult voice
VOC2	b) a phrase of phonemes from a two year old child
VOC3	c) excerpt of laughter from a two year old child
VOC4	c) sung vowels performed by female adult voice

Types a to c were looped in order to bring out the internal rhythms and dynamism of the phrases.

2. To extend the palette of percussive timbres noted above (ie-string pizzicatos), various sampled drum sounds were used **(DR)**, as well as sampled harp **(HP)**. These were reinforced with synthesized instrumental timbres of the same type.

3. Three different types of panflute sources were mixed together.
PFL

4. Samples of Thai gongs were also used. This acoustic source has an inharmonic spectrum containing a precise attack.
TGNG

5. Sampled and synthesized string timbres played in ordinary position.
LB

D - FM SYNTHESIS TIMBRES

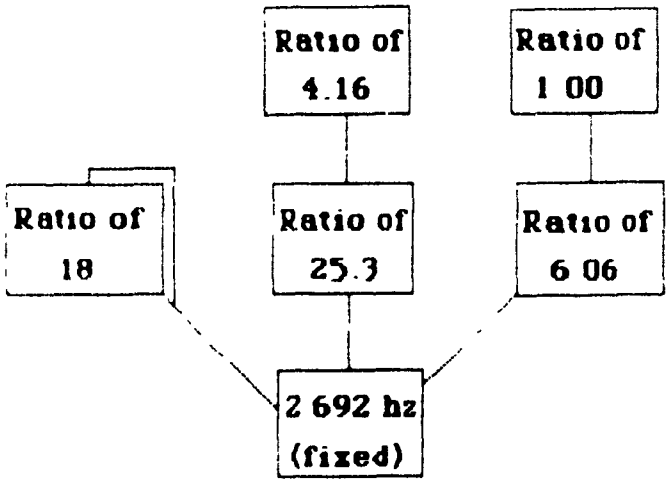
Essentially the synthesized timbres used in the composition function as drones, giving a specific spectral palette over which other elements are imposed. Depending on the context, timbres with either harmonic or inharmonic spectra were used, and depending on the ratios used, timbres

could be achieved that had wide spectral gaps between the partials, creating either compact or diffuse characteristics.

Nine different FM timbres were used in the composition. A detailed description is given below for two of these timbres, one on the DX7 (and a subsequent variation of this sound), and the other on the Synclavier synthesizer. An additional example is given showing ways of varying an FM timbre on the Synclavier. The discussion of FM timbres concludes with a listing of the remaining sounds used, with a brief description of their characteristics.

Example One - DX7

On the DX7, the programmer chooses how the oscillators will be configured (called the algorithm) as to carrier and modulators. The following diagram shows the relationship of the oscillators as well the the frequency ratios for each.



Algorithm 16

The carrier is set at a fixed frequency of 2.6 Hz., which is outside the audible range, and remains constant despite the pitch played. The frequencies of the other operators (DX7 terminology for oscillator) are determined by multiplying the frequency of the note played by the ratio given. As stated earlier, it is possible to determine precisely which sidebands will occur, but that is beyond the scope of this paper. Further information on this process can be obtained in Chowning and Bristow, 1986. Suffice it to say, that using a low frequency carrier causes beating to occur because of the reflected sidebands which in turn create a very rich spectrum. (Chowning and Bristow, 1986), p.100. With the timbre in question, specific locations on the keyboard would produce a timbre in which two distinct pitches were heard a major second apart and an octave above the note played. Thus if **D3** was played, both **D4** and **E4** would be heard. The fundamental of the played pitch is below the audible range, and only the reflected frequencies which create the bitonal character of this timbre are heard. In the lower registers of the keyboard (**C1** to **G2**), the reflected frequencies combine in such a way that only **E0** is heard. Between **G2** and **C3**, complex inharmonic timbres can be heard. This timbre was used in bar 16 of the composition.
FM1

A variation of this timbre creating a stronger sense of inharmonicity was achieved by changing the frequency ratios of operators three and four.
FM2

Example Two-Synclavier

Another example of a timbre with an inaudible carrier frequency was one of the drones created on the Synclavier. The frequency ratio used was -604.2. (Other than specifying the ratio, no other features of the relationship between carrier and modulating oscillators is programmable on this synthesizer.) The sequence was performed on the keyboard set at an octave ratio of 1.059. Thus three features contributed to the beating phenomenon to create the rich spectrum.

(a) inaudible carrier frequency
(b) FM ratio slightly below an integral ratio (which would be at -600 in this example)
(c) the Octave Ratio when performing two simultaneous pitches an octave apart
FM9

One example of how FM sounds can be varied on the Synclavier to create a series of related timbres is to change the tuning of the fundamental. This occurs in two drones, one tuned at 220, the other at 1760, each with an FM ratio of 1.209.
FM5 and **FM6** respectively

Other FM Timbres
A list of other FM timbres with some distinguishing features are listed below:

FM3 - DX7 sound; each operator with slowly evolving envelope; dense sound created by several notes sounding simultaneously.

FM4 - Synclavier sound; Octave Ratio of .310; slowly evolving envelope.

FM7/FM8 - DX7 sounds, upper harmonics reinforced; used in a particular rhythmic and pitch structure to create timbral density (see Pitch Analysis under Cycle Two - Part 1).

INTERLUDE

A detailed analysis of the composition Ellipsis will now be undertaken, and will focus on three specific areas. The first area will concentrate on the formal and structural design of the piece, outlining the smaller formal units and phrases. The second area of analysis, the timbral analysis, will demonstrate how timbre becomes a form-bearing element in this composition. The use of the timbral resources introduced in Section III will also be discussed. The third area of analysis will deal with the underlying pitch relationships of the piece.

IV - Formal Analysis

To restate what was discussed earlier in the **Introduction**, the composition **Ellipsis** is designed around the concept of the three stages in the lunar cycle, creating 3 separate cycles within the piece, having the following associations:

	MOON CYCLE	MYTHOLOGICAL	ELLIPSIS
Cycle One:	waxing moon	virgin	The Age of Darkness
Cycle Two:	full moon	mother	Creating a New Space
Cycle Three:	waning moon	crone	The Age of Resonance

Each of the three cycles is again subdivided into three Sections, (titled Section A, B & C), each of which is subdivided again, into either two or three smaller Parts (titled Part One, Two & Three). Some of these smaller Parts are again subdivided into three. This creates a nesting type of structure: 3 within 3 within 3 within 3. This suggests the idea of a smaller structure being contained within a larger one, thus alluding to the circular shape, which holds smaller units within itself. This is a further expansion of the ideas suggested by the ellipse shape as well as the radial time model which was discussed in the **Introduction.** These formal Sections and Parts reflect the changes in timbral resources and relationships and are further reinforced by the pitch relationships. The following chart gives the sectional divisions and durations for **Ellipsis** with timings and measure indications:

Cycle One

time: 11' 45"

bars: 1-141

	Intro	Section A		Section B			Section C		
time:	1'35"	5'00"		3'00"			2'10"		
bars:	1-19	20-79		80-115			116-141		
		Part 1	Part 2	Part 3	Part 1	Part 2	Part 3	Part 1	Part 2	Part 3
time:		1'25"	2'15"	1'20"	1'05"	50"	1'05"	20"	40"	1'10"
bars:		20-36	37-63	64-79	80-92	93-102	103-115	116-119	120-127	128-141

	a	b	a	b	c	a	b	c	a	b	—	—	—	—	a	b	c		
time:	25"	1'	50"	65"	20"	25"	25"	30"	30"	35"					20"	20"	30"		
bar:	20	25	37	47	60	64	69	74	80	86					128	132	136		

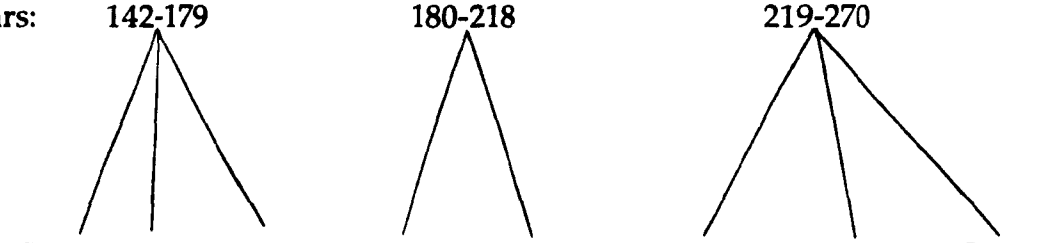
only beginning bar number is notated here.

Cycle Two

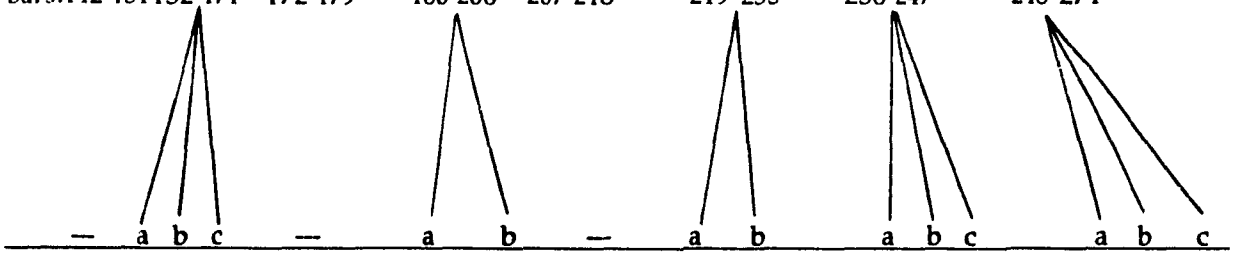
time: :0'45"

bars: 142-270

	Section A	Section B	Section C
time:	3'10"	3'15"	4'20"
bars:	142-179	180-218	219-270



	Part 1	Part 2	Part 3	Part 1	Part 2	Part 1	Part 2	Part 3
time:	50"	1'40"	40"	2'15"	1'	1'25"	1'	1'55"
bars:	142-151	152-171	172-179	180-206	207-218	219-235	236-247	248-271



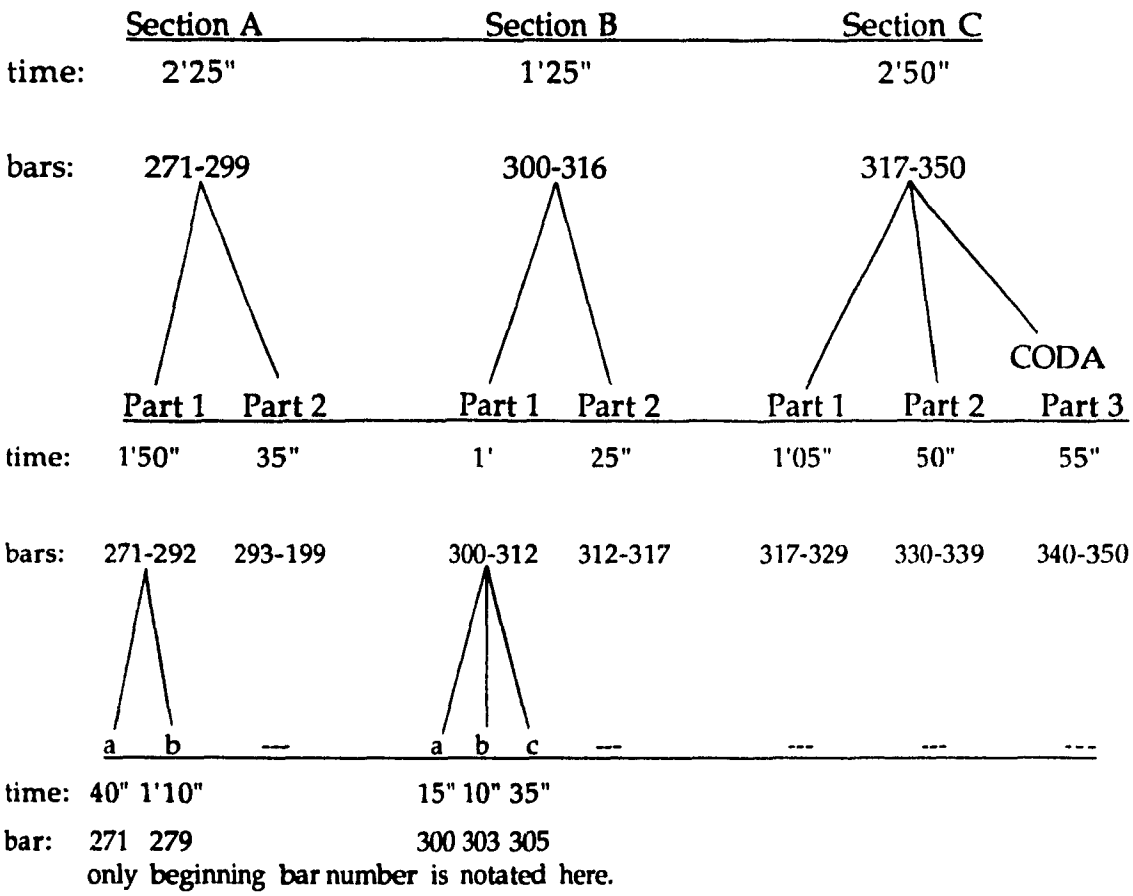
	—	a	b	c	—	a	b	—	a	b	a	b	c	a	b	c
time:		1'	20	20		1'05"	1'10"		55	30	25	20	15	30	50	35
bar:		152	164	168		180	193		219	230	236	241	245	248	254	264

only beginning bar number is notated here.

Cycle Three

time: 6'40"

bars: 271-350



V - Timbral Analysis

The timbral form of **Ellipsis** is analysed using the two main categories of spectral form and frequency content discussed in Section I-C. The definitions of the various elements that make up these two categories are listed below. The characteristics of these elements have been developed by Robert Cogan in his book New Images of Musical Sound. (Cogan, 1984) p. 134-139.

A - DEFINITIONS OF CATEGORIES:

SPECTRAL FORM

1. Grave/acute: Derived from linguistic terminology for vowels, these terms define the activated regions within the overall range of a piece. Those vowels which activate sonic energy in the lower register are called grave, with their corresponding timbre being described as dull and dark. Vowels which activate sonic energy in the upper register are called acute, creating timbres which are described as bright. The area between these two polarities is described as neutral.

2. Extreme/centered: The outer limits of the grave and acute regions can be further described as the "extreme" region, whereas the term "centered" indicates that neither extremity is activated.

3. Narrow/wide: A narrow sonority is one which has a span of less than half the width of the total spectral context.

4. Spaced/non-spaced: This category refers to possible gaps between spectral areas in any given sonic context.

5. Sparse/medium/rich: A sparse texture will have a minimal number of simultaneous elements present whereas a rich texture will be comprised of a large number of simultaneous elements. A medium texture falls between these two extremes.

FREQUENCY CONTENT

1. Compact/diffuse: Whereas narrow/wide refers to the total width of the spectral form, compact/diffuse refers to individual sonic elements. Each element can be a compact sound, where the partials are fused in strands to such an extent that only one pitch (generally the fundamental) is perceptible. These are vowel-like characteristics. Diffuse elements are those consonant-like sounds whose partials are spread over a wide area, creating gaps between the partials, and often resulting in more than one pitch being perceptible.

2. Harmonic/Inharmonic/Noise: The partials that are present in either a compact or diffuse sound are either whole or non-whole number multiples of the fundamental, creating harmonic and inharmonic structures. Noise structures are at the far end of the continuum of inharmonic relationships. There is no discernible fundamental.

CHART I

The graphs which appear in chart I demonstrate the application of the Spectral Form and Frequency Content categories. The span of registers used in the composition spreads over eight octaves, from G0 to C8. The grave registers span from G0 to G2, the neutral from G2 to G4, the acute from G4 to C8. The extreme grave is from G0 to G1, and the extreme acute is from G6 to C8. The width of any one sonic context is also mapped out on the chart as is the presence of any gaps in the spectral form. The combination of these

factors create various shaped blocks which are outlined in black on the graph. The blocks are filled in with one of three types of lines, which indicate whether the area has a sparse, medium, or rich texture.

Sparse	Medium	Rich
/ / / /	/\/\/\/\	//////////

The three areas along the Harmonic-Inharmonic-Noise continuum is further subdivided into compact and diffuse distinctions, resulting in six possible designations, which are graphed according to colour:

	harmonic compact	HC
▬▬▬▬	harmonic diffuse	HD
▬▬▬▬	inharmonic compact	IC
▬▬▬▬	inharmonic diffuse	ID
▬▬▬▬	noise compact	NC
▬▬▬▬	noise diffuse	ND

By combining the analysis of both the spectral form and frequency content, the sectional units of each cycle will be defined as either carrier or transitor. These indications will be noted on the chart and will be further elaborated upon in the descriptive analysis found in Section V, part D.

B - ANALYSIS OF FREQUENCY CONTENT:

All sound sources of the composition have been categorized below in terms of the harmonic-inharmonic-noise continuum. The larger categories along the continuum are vocal sources, instrumental sources, treated instrumental sources (according to the techniques outlined in Section III-C), and synthesized sources. The continuum is also operative within each of the four

categories. The "Instrumental Sources" category primarily contains the string timbres, but also includes the instrumental timbres which occur on the tape.

VOCAL SOURCES

"Vocal Sources" for the vowels are listed according to various progressions used in the composition from both the Retroflexion and Height charts. The vowels themselves are divided into three groups of four per chart according to the mode of articulation. For example, the first four vowels of the Retroflexion chart are classified under the heading "Top" as they are performed by positioning the tongue at the top portion of the mouth cavity. The vowels performed by positioning the tongue at the mid and bottom portions of the mouth cavity are listed under "Mid" and "Bottom" respectively. The vowels in the Height charts are divided into "Closed", "Mid" and "Open" according to the position of the lips during performance.

retroflexion:	Top (u-ae)	Mid (e-ɪ)	Bottom (ɛ - ɹ)
	T	M	B
height:	Closed (u-i)	Mid (I-ʌ)	Open (o-a)
	C	M	O

The vowel progressions used in the composition pass through different regions of each chart. These progressions are listed below with the appropiate abbreviations. The consonants are listed according to mode of articulation and voicing, as discussed earlier in Section I. The V-C pairs are categorized both by their consonant and vowel characteristics. In this case, vowels are limited to the Height chart. The resulting combination is given an abbreviation and is listed below under "Combination".

Vowels	retroflexion	u-i	Ref: T-B
		i-a	Ref: B-T
		a-i	Ref: M-B
		e-u, e-a	Ref: M-T
		a-e	Ref: T-M
		a-ae	Ref: T
	height	u-e	Hgt: C-M
		a-o	Hgt: O-M
		u-i	Hgt: C
	mixtures	a-e-o	Mix1
		e-i-o	Mix2
Consonants	plosives	Voiced	PL-V
	fricatives	Unvoiced	FR-Unv
		Voiced	FR-V

V-C Pairs:	**Consonant**	**Vowel-Height**	**Combination**
	plosives	open (a-o)	PL-O
		mid (ʌ-I)	PL-M
		closed (i-u)	PL-C
	fricatives	open	FR-O
		mid	FR-M
		closed	FR-C
	sonorants	open	SON-O
		mid	SON-M
		closed	SON-C

INSTRUMENTAL SOURCES

legato bowing	LB
(tape source)	**LB**
normal position	NP
glissando	Gl
harmonics	Hrm
(tape source)	**PFL**
tasto	Tas
(tape source)	**TGNG**
ponticello	Pt
tremolo	Tre
tremolo/glissando	T/Gl
jeté (attack with pressure)	Jt
(tape source)	**HP**
pizzicato (pluck with pressure)	Pizz
(tape source)	**DR**
bowing with heavy pressure	HP

SAMPLED SOURCES

vowels	**VOC3**
	VOC4
glissandi	**Lay/Gliss**
harmonics	**Har**
natural harmonic glissandi	**HarGl1, HarGl2**
artificial harmonic glissandi	**AHarGl1, AHarGl2, AHarGl3**
attack through DDelayLine	**DH, DM, DL**
tailpiece	**TP**
phonemes	**VOC1**
	VOC2
bridge & tailpiece	**B/TP1**
ponticello	**Pont1, Pont2, Pont3, Pont4**
mixed source	**NEW1**
	NEW2
pegs & fingerboard	**P/FB**
bridge & tailpiece	**B/TP2**
mixed source	**TimCh1**
fingernail pizzicato	**FPizz1, FPizz2, FPizz3, FPizz4**

SYNTHESIZED SOURCES

The FM sounds described in Section II are listed along the continuum:

FM4 - FM9 - FM1 - FM2 - FM8 - FM7 - FM5 - FM6 - FM3

C - TIMBRAL CHARTS:

The following chart lists where the timbres occur in the formal design of the piece. Instrumental string timbres are in normal position (NP) unless otherwise noted.

CYCLE ONE

	Measure	Vocal	Instrumental	Treated	Synthesized
I	1-7			HarGl2	FM1
N	2/3-7			HarGl1	
T	7-12		LB		FM2
R	12-20		LB		FM1
O	12-16			HarGl2	
	20-27				FM3
	25-28		Tre		
	28-36		LB		
	36-40		Tre		
A	37-42				FM3
	37-51	Ref: M-T/G			
	47-60		Hrm		
	51-53	Ref: T-B			
	53-86				FM4
	54-57	Hgt: C-M			
	57-60	Mix1			
	60-64	Ref: T			
	64-73			TP	
	64-65	Mix2			
	67-69	Ref: T-B			
	69-70	Ref: M-T			
	70-74	Ref: T			
	74-79	Son: O-M-C			

	Measure	Vocal	Instrumental	Treated	Synthesized
	80-86			**AHarGl1**	
	86-90			**AHarGl2**	
	87-93			**AHarGl3**	
				P/FB	**FM5**
B	93-101			**B/TP1**	
				P/FB	**FM6**
	101-107				**FM5 & FM6**
	103-116			**TimCh1**	
	107-110				**FM6**
	116-117		Tre		
	117-120		Tre/Glis		
	120-142		LB		
C	128-132			**Pont1**	
	131/4-133			**Pont2**	
	132/3-136			**Pont3**	
	136-138			**Pont4**	
	137/2-140			**Har**	
	139-141			**Har**	

CYCLE TWO

	Measure	Vocal	Instrumental	Treated	Synthesized
	142-151				**FM7**
	152-165				**FM8**
	154-164		Pizz		
A	164-169		Jt		
	164-172			**FPizz1**	
	169-172		Tre		
	172-179		Pt	**FPizz2,3,4**	
	180-207		LB		
	180-185	FR-Unv&V			
	186-191	Ref: M-B			
	192	FR: C			
	193-196	PL&FR-V			
	196-199	PL: O-C			
	199-207	FR& SON: O-C			
	207-219	PL: C-O	Tre	**LB**	**LB**
B		FR: C-O	Hrm, Gl		
			T/Gl		
			Tas, Pt		
			HP		
	219-249	Son: C-O		**PFL**	
		Fr: M			
	227-271			**DR**	**DR**
C	236-249	Son: O-M	LB		
	249-271			**HRP**	**HRP**
				TGNG	
	254-271		LB		
	255	Mix1/G			
	256-260	Mix2/G			
	260-262	Ref: T			
	262-270	FR: M,O-M			
	266-270	Son: O-M-C			

CYCLE THREE

	Measure	Vocal	Instrumental	Treated	Synthesized
	271-295				**FM9**
A	271-293	Ref: T-B/B-T			
	293-94	Son: O			
	293-303		Hrm		
	300-317			**DH**	
B	304-312			**Lay/Gliss**	
	305/3- 314			**VOC1**	
	312-317			**VOC2**	
	312-339			**DR**	**DR**
	317-340		LB		
	317-321	FR: M-O			
		SON: M-O			
	321-330	PL: M-O			
C		FR: M-O			
	330-334	PL: M-O			
		SON: M-O			
	334-340	FR: PL: SON: M-O/G			
	330-344			**VOC3**	
	330-342			**VOC4**	
	(CODA)				
	339-350			**NEW2**	

D - DESCRIPTIVE ANALYSIS BY FORMAL UNIT:

Based on the graphs outlining spectral form and frequency content, and the Timbral Charts of Part C above, a detailed analysis of the timbral design of **Ellipsis** will be made. As stated in the **Introduction**, timbral relationships have been designed on the basis of phonological theory. Thus, the conclusions drawn will attempt to show how the composition is divided into carrier and transitor sections, which are parallel to vowel or consonant characteristics. Although at times in the composition the individual elements may be changing rapidly, decisions regarding carrier and transitor distinctions will be based on blocks or units of sound, and how quickly or slowly these blocks change spectral form (SF) and frequency content (FC).

As it is the underlying story of **Ellipsis** which binds the timbral relationships together into an artistic whole, a descriptive outline of that story, outlined in bold lettering, will begin the analysis of each individual section.

CYCLE ONE

Introduction: TRANSITOR

Bars 1-19

THE AGE OF DARKNESS

She is surrounded by mystery, stillness, and silence

In these first twenty bars, four different areas of FC are introduced, travelling from IC-NC-HD-IC. The register also quickly travels from the neutral area to both the acute and grave areas. The bands are narrow, with spacing occurring between different registral areas. The texture constantly fluctuates between medium and rich.

Section A: CARRIER

Bars 20-79

Groping inside the darkness,
she pierces through the surface,
discovering traces of forgotten times

Beginning with a spectral form that has a slowly evolving FC, the entire section maintains this characteristic throughout. Within the first 7 bars of Section A, (around bar 25) there is an abrupt shift in FC from ND to HC. However, it is not abrupt as may appear on the FC graph as the pitches that emerge in bar 25 highlight specific frequencies contained in the wide band of noise. Other than the occurrence of the opening ND timbre, the timbres chosen throughout this section are either HC or HD to further reinforce the vowel-like or carrier characteristics of this section.

Part One: (20-36)

The rich density of the **FM3** timbre covers a wide registral area, the neutral spreading down into the grave. Three bands in this area are highlighted when the strings emerge in bar 25. The high degree of rhythmic activity in the HC region (strings-LB) continues the rich density, although the spectral bands are considerably narrower and the FC has changed. When the noise timbre (**FM3**) returns at the end of this part in bar 36, it fills in the registral gaps generated by the HC section. It can be noted on the graph however that timbral fusion does not occur between the ND and HC timbres. Although the registral gap is filled in when the ND timbre begins, a separation between the two timbral types is perceptible. The wide band that is created in bar 36 with the merger of the two timbres ascends up from the grave/neutral areas to the neutral/acute areas.

Part Two: (37-63)

The voice emerges as a single strand from the dense texture which has just preceded it on a vowel sequence from the retroflexion chart, running from Mid to Top. (Refer to pg. 39-40). The vowel sequences begin by using the glottal stop as their mode of articulation on a descending portamento, adding a more rhythmic element to the otherwise smooth movement between vowels. Although the texture changes to sparse at bar 43 and the width of the spectral form must be considered narrow, the wide registral characteristics of Part One can be considered to continue into Part Two in the sense that the vowels articulated by the voice are open, wide vowels. The narrow band widens with the addition of string harmonics in bar 47, moving the spectral

form into the acute region. With the addition of **FM4** in bar 53 the registral gaps are filled in as the band continues to widen, although as before, no timbral fusion occurs as the two timbres are perceived separately.

Part Three: (64-79)

With the introduction of the **TP** timbre in bar 64, the vowel changes in the voice become more rhythmic by returning to the glottal stop articulation, imitating the melodic-rhythmic gestures of the **TP** timbre. These quick vowel changes have transitor characteristics which play off the steady state carrier qualities of the drone. The vowel progressions are all derived from the Retroflexion chart.

If the opening and concluding vowel sequence of e-a is analysed from the height chart, there is a move from the open to mid position of the mouth cavity. This choice of vowel progression is an imitation on the micro level of the overall movement in register from wide to narrow in Section A: bars 20-42 (wide); 42-79 (narrow-widening-narrowing-narrow). This move to a very narrow band from bars 74 to 79 is further emphasized by the use of a nasal timbre in the voice, which highlights the upper frequency regions. The bright quality of this nasal timbre serves as a transition to Section B, which abounds in timbres that emphasize these high frequencies.

Section B: TRANSITOR/CARRIER

Bars 80 - 115

Hearing the voices of her lost heritage calling out,
she begins to put the ancient pieces together,
remembering what might have been

Both characteristics of transitors and carriers are functioning in this section. The use of FM drones creates a constant spectral backdrop, which allows for the more transitor-like activity that occurs within each of the "Treated" timbres. Since these sources are all sampled timbres and are played from the keyboard, various leaping melodic gestures emerge, increasing the transitor-like qualities of disjunct movement in this section.

Part One: (80-92)

The timbres from the **AHarGl** family generate a constantly changing FC, thus introducing the transitor characteristics of this entire section, and creating a formal division between Sections A and B. The SF of Part One covers the area from high neutral up into the acute region. The texture increases at bar 86 to medium with the addition of **AHarGl2**. Once the **P/FB** timbre is added beginning in bar 87, the transitor characteristics are further reinforced All the activity from bar 87 to 92 is carried out over the constant drone **FM5**. This drone appears to be somewhat imperceptible in the overall texture, but is noticeable in its absence. Thus it functions as a spectral backdrop, with the elements in the foreground highlighting the various frequencies of the drone. Thus the FC of bars 87 to 92 can be viewed uniformly (ie-carrier) and are classified as ID, while the individual elements create the transitor characteristics.

Part Two: (93-102)

Continuing the transitor/carrier characteristics of Part One, the new drone (**FM6**) adds an additional frequency component which creates two bands separated by a spectral gap. The timbral content of the transitors is limited to **B/TP1** and **P/FB**, but still maintaining a medium texture. Part Two ends with only the carrier features sounding as the gap is filled in with the addition of **FM5** to the already present drone **FM6**.

Part Three: (103-115)

Using the **TimCh1** timbre with its three individual components, each having a FC of NC, the entire registral area from grave to acute is covered, although each of the timbres is individually perceptible. The registral area is articulated by wide and disjunct melodic leaps until the activity gradually winds down, decreasing the spectral form to a narrow area by the end of Part Three and of Section B.

Overall the section has moved from a narrow band in the acute region which gradually widens throughout the neutral region, and then narrows down again in the lower neutral region.

Section C: CARRIER

116-141

The knowledge of what she is becomes clearer,
as each day she moves closer to the sun,
closer to herself

Part One: (116-119)
The abrupt shift in register from the lower neutral area (Section B) to the acute region (Section C) serves a transitor-like function to demarcate the formal divisions between these two sections. This is further emphasized by the change in FC from NC to HC and the change in texture from medium to rich. Once the acute region is articulated, this short segment of four bars in Part One moves the register quickly down by using glissandi into the neutral region before Part Two begins. As such, this part can be viewed as a transitor within the overall carrier section of bars 116-141.

Part Two: (120-127)
The FC remains consistent with Part One, and the major change is the use of arpeggio figures to articulate what is, up to this point, the widest registral spread in the composition. This activity gradually shifts to a narrow band in the neutral region. The pitches chosen for this section are based on the formant frequencies of the eight main English vowel types, thus making another reference to the carrier qualities of this section. This will be analysed further in Section VI.

Part Three: (128-141)
The changes in register in this part constitute the most extreme to date. Beginning with the narrow band in the central neutral region, the SF travels to the extreme regions of both the acute and grave areas, changing texture, and introducing spectral gaps or spacing as it moves. With the addition of the

timbres from the **Pont** and **Har** families, the FC gradually changes from HC - HD - ID - NC - ND, creating a fusion between the tape timbres and string timbres.

Overall in this section, there have been sharp contrasts in the band widths, moving from narrow, quickly to wide, down to narrow again, and slowly back up to wide with spectral gaps. This last feature can be viewed as a variation on the idea of narrow bands, which now are spread over a larger registral expanse.

Overall characteristics of Cycle One can be stated as follows:
(a) covers the full registral scope of the overall composition
(b) large shifts in height between narrow and wide registral bands
(c) predominant areas of diffuse frequency content

CYCLE TWO

Section A: TRANSITOR

142-179

CREATING A NEW SPACE

The spiralling journey circles the void of darkness
She travels through the maze of confusion,
the space where what was inside stands revealed
And this lights her way

Section A can be analyzed as a transitor on both the micro and macro levels. It contains several units, each with distinct identities in terms of the FC and SF. The progression of these contrasting units can be likened to the transitor qualities of a series of consonants. Looking at the micro level, each of the individual units contain within themselves highly active elements which are percussive in nature, as are consonants.

Part One: (142-151)
Sounding in the extreme regions of both the acute and grave registers, **FM7** is categorized as ND. As the registral shift moves toward the central neutral region, the same timbre becomes ID. This area is an example of how pitch and rhythm materials help create a timbral unit. Isolated on its own, the FM7 timbre could be classified as IC. When used in a sequence characterized by layered bands of pitches moving in rapid succession, the timbral quality

changes dramatically. (The construction of these layers will be analysed in Section VI). The SF of Part One extends the registral areas that ended CYCLE ONE with the only change coming in the area of texture.

Part Two: (152-171)

Returning to the "motive" of a narrow band in an extreme register that was encountered in Part One, the **FM8** timbre, a variation of **FM7**, creates one band of an increasingly rich texture as it descends to merge with another band in the neutral region. This latter band, made up of various contrasting elements from the family of percussive string timbres (Pizz, Jt, and Tre), also develops in terms of texture, as well as registral width. Once these two bands merge, a third dense band in the extreme grave region emerges, also made up of individual percussive elements from the **FPizz** family.

One feature of the percussive qualities of consonants is that the noise quotient in their FC is high. The FC of the band in the central region remains constant at NC as it increases in width and texture. The FC of the band in the extreme acute area is constant in character and can be classified as IC. Once the two bands merge the individual FC of each band remains perceptible. The central band continues to change from NC - IC - ID while the **FPizz** timbres in the extreme grave region can be classified as ID. The two bands merge in bar 172, the beginning of Part Three.

Part Three: (172-179)

This part begins as the lower band merges with the central band, creating an extremely rich texture spread over a large registral span in the neutral and acute regions. This band gradually begins to separate, ending in five distinct narrow bands, spreading out from the extreme areas of both the grave and acute regions. The texture in these separate areas continues to be rich.

When the two bands of Part Two merge, the FC changes to ND, as fusion occurs between the two. The lower half of the wide fused band changes to ID, then to HD. As this occurs, five separate bands emerge: the top one continue to be ND, while the other four continue to sound as HD.

Section B: TRANSITOR/CARRIER

180-218

In her circling motion, she finds an opening
Space is changed
She begins to live in a matrix of her own sounds

In CYCLE ONE, Section B was also analyzed as transitor/carrier because both elements were present simultaneously - the carrier as background to the transitor activity in the foreground. Section B in CYCLE TWO is similar in concept, although the characteristics of the SF and FC in each of the two cycles is quite different.

Part One: (180-206)
The FC of the carrier background has the most harmonic content of the entire composition with sustained notes performed with LB. In the foreground, the voice is engaged with a series of consonants, beginning with unvoiced fricatives, moving to voiced, and then gradually to open vowels. A sequence of consonants moving from plosives to fricatives continues before vowels and consonants are merged to produce a series of V-C pairs, first using plosives (bar 196-199) and then fricatives mixed with sonorants (bar 200-206). This sequence maintains a consistent vowel movement from open to closed. From bar 180 - 187, the FC of the foreground is classified as ND (the consonants), changing to HC with the emergence of the vowels and vowel-consonant pairs. The carrier/transitor quality of this section can be viewed on the macro level as a V-C pair, a mixture of vowel and consonant characteristics.

The activity of the SF is sparse and begins with a narrow band in the grave region. This gradually opens up into the neutral region and then extends up further into the acute region. This part ends by returning to two narrow bands, one in the grave region, the other in the neutral region.

Part Two: (207-218)

The carrier continues now only in the grave region (LB), while both the strings and voice become engaged in the transitor activities. While the voice continues to move between sequences of V-C pairs which combine plosives and fricatives with closed-to-open vowel movement, the strings also become engaged in a series of contrasting timbres. This creates two distinct bands of activity, one in the neutral region, the other in the acute. In the neutral region, the band moves from narrow and sparse to medium texture covering a wider registral area between the lower neutral and the lower acute. The FC of elements contains both NC and HD timbres which are not fused, (although they cover the same band width), as there is a constant fluctuation between the plosives and fricatives in the voice and the series of timbres in the strings moving from Tre to HP. This is indicated in chart I with both the red and blue lines. The narrow band in the acute region is HC in its FC. At bar 217, three narrow bands emerge all containing a sparse texture: one in the acute region with a FC of HD; one in the central neutral region with a FC of NC; and the third in the upper grave region with a FC of HD. This latter band continues into Section C.

Section C: CARRIER

219-270

The time of her silence is over
She flies through the night,
feeling the pulse of ancient stones
drumming in her head

Although rhythmic relationships play an important role in this section, this occurs only on the micro level. Timbrally, Section C is quite uniform, with changes occurring only between the larger units or parts as noted below, thus justifying the definition of "carrier" for this section. Instrumental timbres dominate, thus reducing the possibilities of FC primarily to HC and HD.

Throughout the entire section the registral scope begins with a narrow band in the upper grave region and gradually expands in width and as it increases in texture. Part Three concludes the entire section and CYCLE TWO with the maximum textural activity encompassing a full bandwidth primarily within the neutral region extending into the lower acute.

Part One: (219-235)
The registral scope begins with a narrow band in the upper grave region of sparse texture, expanding upwards with the change to medium texture. The register extends up to include the full neutral region beginning in bar 230.

The vocal part continues with V-C pairs which are less percussive than those used in Section B - using sonorants and the unvoiced fricative /h/ as consonants, resulting in timbres whose FC are classified as HC. The **PFL** timbres are classified as HD. The noise element (NC) on the chart arises from the **DR** timbres, as well as taking into account the presence of noise in the **PFL** timbres.

Part Two: (236-247)
The SF continues to spread upward in register while increasing the texture to maximum. The FC remains constant, adding a stronger presence of HC timbres with the addition of the strings. The V-C pairs continue to use non-percussive and thus less noisy consonants from the sonorant category.

Part Three: (248-270)
The registral scope is now at its fullest, extending from the upper grave to the acute region. The texture decreases at the beginning of this part, but returns to maximum in bar 254 with the addition of the strings **LB**.

The primary shift in Part Three is the change in FC. The addition of the **TGNG** timbre adds an element of inharmonicity and is classified as IC. Once the strings return in bar 254, both the HC and IC qualities are individually perceptible, and since both cover the full range, they are indicated on the graph using alternate lines. The **HRP** timbre contributes both the percussive noise element and to the HC quality as well. The voice contrasts the percussive elements of the **TGNG, DR** and **HRP** timbres by using vowel sequences (Mix1 and Mix2), and a series of V-C pairs that use sonorants and the unvoiced fricative /h/ as consonants. The vowel sequences however do participate in the rhythmic-percussive nature of this part in their use of the glottal stop on a downward portamento, similar to when the voice first emerged in CYCLE ONE.

Overall characteristics of Cycle Two can be stated as follows:
(a) movement from the extreme registral areas to the focusing of activity in the central neutral areas
(b) the overall move from the use of narrow registral band widths and the presence of spectral gaps to wide non-spaced registral areas
(c) predominant areas of compact frequency content, the majority of it harmonic

CYCLE THREE

The formal divisions in CYCLE THREE are shorter and reduced in number as the duration for this cycle at 6'35" is significantly shorter than the first two cycles. Thus sectional and part divisions are not as broad in scope as they were previously in the other cycles. This cycle is to be viewed as both a combination and synthesis of elements from CYCLES ONE and TWO. The parallels are noted below.

Section A: CARRIER

271-299

Parallel to CYCLE ONE Section A Part 2

THE AGE OF RESONANCE

Old Woman stands
Her ancient wisdom and holiness,
Her inner resonance,
Sounding-vibrating through

Part One: (271-292)
The SF is uniform throughout this part in the central neutral region with sparse activity. The **FM9** timbre is one which is created with a long, slowly evolving envelope, so that the carrier distinction is inherent within the choice of this timbre. The accompanying voice creates a similar type of

envelope by moving gradually from vowel to vowel along the Reflection chart from Top to Bottom and Bottom to Top. The FC of the combination of these two elements is classified as HD.

Part Two: (293-299)
The SF changes shape slightly by expanding into the acute region with the addition of the strings (LB). The carrier characteristics of long sustained activity is further reinforced by the use of a Digital Delay Line on the string sounds. The FC is HC.

The similarities between this section and the parallel section in CYCLE ONE include the slowly evolving envelopes in both the FM timbres and the use of changing vowel sequences from the Retroflexion chart in the voice. The string sections are both in high registers with long sustained notes.

Section B: TRANSITOR

300-316

Parallel to CYCLE ONE Section B, CYCLE TWO Sections B & C

Knowing it is the turbulence of the sea that sustains life,
she acts now out of passion
Crossing barriers,
illuminating life

Emerging out of Section A, a monophonic melodic line continues as a drone throughout Section B. Its narrow band spans the central neutral region while a series of transitor-type activities commence in registral areas both above and below it. Thus this timbre functions like a carrier background to the transitor foreground material, similar to Section B in both CYCLE ONE and TWO. This section has not however been labelled Transitor/Carrier as the others were, due to the fact that this "carrier" timbre has more rhythmic movement in it, and thus its sustained quality isn't as pronounced as in the other two cycles.

The **DH** timbre in the carrier background is classified as HD and is used to create the melodically-patterned drone. The series of transitor activites in the foreground each create their own narrow textures. The first band occurs in the lower acute region: its FC is NC with a rich texture. The second in the lower neutral begins as a series of V-C pairs and can be classified as HC , but due to the type of rhythmic activity, the FC changes to ND. The texture is also rich. In bar 112, two new bands appear, one in the grave area, the other in the lower acute region. The latter is medium in texture and has a FC of HC. The former is also medium in texture and by using the **DR** timbre, the FC is classified as NC. The band in the central neutral region changes from medium to sparse texture.

Section B contains elements from:

Drone	CYCLE ONE/Section B Part3	timbres from Delay (**DH**) family
Band1	CYCLE ONE/Section B Part1	timbres from the **Gliss** family
Band2&3	CYCLE TWO/Section B	consonants---V-C pairs
Band4	CYCLE TWO/Section C	rhythmic/percussive element (**DR** timbre)

Section C: CARRIER

317-350

Parallel to CYCLE TWO Section C, CYCLE ONE Introduction

Her voice now living full inside her,
she carries on with memories:
of other times,
other places

Part One: (317-329)
As in its parallel section (CYCLE TWO/Section C), the SF and FC is constant throughout. The register covers primarily the neutral region with medium texture. The FC is HC with the addition of the percussive **DR** timbre. The vocal mixes all three types of V-C pairs: first using a series of fricatives, moving to plosives and fricatives, concluding with plosives, fricatives and sonorants. The vowel progression in the V-C pairs remains relatively similar, moving from mid to open. The glottal mode of articulation on a downward portamento appears one final time to conclude the vocal line, thus linking the ending to the initial vocal articulation in CYCLE ONE, Section A, and to the beginning of Part Two, Section C, CYCLE TWO.

Part Two: (330-339)
The only change in this second part in SF is the addition of a narrow band in the acute region, using the **VOC4** timbre beginning first with a sparse texture, moving to medium to rich and back again to medium. **VOC4** is a parallel timbre to the opening **HarG11** timbre in CYCLE ONE, Introduction and its FC is classified as IC. It sustains through the diminishing band of strings and **VOC3**, (which is fused together as a HC timbre), acting as a bridge to the concluding Part Three, the Coda.

CODA

Change is a door hanging open

Part Three: (340-350)
The composition concludes with the same melodic material with which it opened. It occurs in the same registral area as the opening seven bars, a narrow band in the neutral region. The texture is sparse and the melody is articulated with the **NEW2** timbre, classified as ID.

Overall characteristics of CYCLE THREE can be stated as follows:
(a) consistently remains in the neutral region, with some expansion into the lower acute and upper grave regions. The activity is generally sparse, with spectral gaps occurring only in the transitor section, Section B.
(b) frequency content is primarily diffuse, either harmonic or inharmonic moving to compact in Section C. The Coda returns to the diffuse character.

E - SUMMARY:

The overall movement of the composition in terms of carrier and transitor sections can be listed as follows:

	Intro	Section A	Section B	Section C
CYCLE ONE	Transitor	Carrier	Trans/Cr	Carrier
CYCLE TWO		Transitor	Trans/Cr	Carrier
CYCLE THREE		Carrier	Transitor	Carrier

It can be observed that all three Section C's maintain a consistent pattern - a carrier structure. This characteristic of a consistent sectional pattern occurs also with the Section B's, with a variation to this pattern occuring in CYCLE THREE. The similarity in structure of Section B, CYCLE THREE to the other two cycles was noted above in the discussion of the section in question, although it was not labeled similarly. In a general way, it can be said that all three cycles maintain a consistent structure in Section B as well, that of a transitor/carrier structure. The variation occurs in the Section A's, alternating carrier-transitor-carrier. Further generalisations could be made in terms of the overall timbral movement of **Ellipsis** by reducing the overall features of each cycle to one general characteristic.

CYCLE ONE as Carrier/Transitor: This cycle is the most ambiguous of the three in terms of giving it one classification or the other, as there are many elements of both the carrier and transitor categories contained within it, thus the split label. It could be said that in this opening cycle, all the features of the composition are presented; they are elaborated upon as the piece continues. This is standard practice in melodic/harmonic composition where the opening section often contains the seeds of the overall harmonic development and the motivic ideas that will be elaborated upon throughout the course of the work.

This feature also corresponds to the meanings inherent in the title "The Age of Darkness". It is a time in the overall spiritual journey when a search for meaning among many possibilities is embarked upon.

CYCLE TWO as Transitor: Although Section C is labelled entirely as carrier, it is characterized by a strong rhythmic pulse and quickly paced sequences. On the micro level, it could be classified as transitor, since it has a strong percussive element, similar to consonant characteristics. The carrier characteristics of the Section arise from the fact that in terms of SF and FC, there is little change. With this in mind, a general statement could be made that CYCLE TWO contains predominantly transitor features.

"Creating a New Space" seems to suggest a great deal of activity, first of all on the level of leaving one space and travelling (via the spiral like movements) to another, and secondly upon arrival, the activity of discovery leading to full celebration.

CYCLE THREE as Carrier: In the discussion of this cycle, it was shown how elements of the other two cycles emerge in this final stage, so in one sense it could be concluded that this is the cycle that contains both transitor and carrier features. However, despite the fact that it does contain parallels with previous transitor sections, the movement in this cycle is much more static than in the previous ones. The only section where much movement occurs is in Section E, but in terms of the overall duration of this cycle, it provides a brief contrast to the otherwise slowly changing characteristics.

"The Age of Resonance" is one of reflection and calm acceptance, with connections to the past, and links to the future - the repeating of the cycle.

VI - PITCH ANALYSIS

As Arnold Schoenberg has stated, "the sound becomes noticeable through its timbre and one of its dimensions is pitch. In other words: the larger realm is the timbre, whereas the pitch is one of the smaller provinces. The pitch is nothing but timbre measured in one direction." (Schoenberg, 1911), p. 471. Thus the pitch relationships of **Ellipsis** can be viewed as an extension of the timbral relationships already discussed. The fundamentals of the compact timbres can be precisely notated, as can the fundamentals of diffuse harmonic timbres. Frequency components of inharmonic timbres are also discernible and thus a meaningful analysis can be undertaken, relating the structural elements of pitch to the larger formal units already outlined. At certain occasions in this analysis, reference will also be made to important rhythmic elements that feature in the creation of particular timbral units.

The analysis of pitch relationships can be found in Chart II and follows the Schenkerian model, (Schenker, 1954) reducing the pitch materials to the unfolding of two short melodic lines: one in the upper voice and the other in the lower voice, or bass. These lines function on three structural levels, what Schenker calls foreground, middleground, and background. The foreground material is outlined in Line A of Chart II, with a reduction to the middle ground is outlined in Line B. A background level reduction is found in Chart II-i. The pitches which make up the melodic progressions are defined in the following analysis as structural pitches.

A - PITCH MATERIALS:

The majority of the pitch materials for the composition are derived from the frequencies of the first three formants of eight particular English vowels listed below. (Ladefoged, 1975) p. 170. Visual representations of vocal sounds can be made with an instrument called a sound spectrograph. These "spectrograms", as they are called, display the component frequencies of the sound on an axis of frequency against time. Formant regions of vowels appear as dark, horizontal bands out of which a center frequency can be

determined. Those center frequencies cited below are the results of a spectrogram which analyzed the pronunciation of the following words in British English by phonetician Peter Ladefoged: heed, hid, head, had, hod, hawed, hood, who'd. These frequencies were then converted into pitches found in the equal-tempered tuning system and are listed in chart III.

		First Formant	Second Formant	Third Formant
Group 1	/i /	280 Hz.	2.25 KHz.	2.89 KHz.
Group 2	/ɪ/	400 Hz.	1.92 KHz.	2.56 KHz.
Group 3	/ɛ/	550 Hz.	1.77 KHz.	2.49 KHz.
Group 4	/ae/	690 Hz.	1.66 KHz.	2.49 KHz.
Group 5	/a/	710 Hz.	1.10 KHz.	2.54 KHz.
Group 6	/ɔ/	590 Hz.	880 Hz.	2.54 KHz.
Group 7	/ʊ/	450 Hz.	1.03 KHz.	2.38 KHz.
Group 8	/u/	310 Hz.	870 Hz.	2.25 KHz.

B - DESCRIPTIVE ANALYSIS BY FORMAL UNIT:

The pitch analysis below will refer primarily to Line A in the voice leading chart II, and follows the formal structural divisions of the composition. Line B summarizes the structural pitches and will be discussed below in Part C - Summary. **C3** is middle C.

CYCLE ONE

Introduction:

The opening melody is oriented around **F#**, and is split between different registers and timbres. This melody will reappear in the coda, oriented around **A**, within one register and a uniform timbre. Because of the bi-tonal nature of **FM1**, the secondary pitch-orientation is around **E**. The pitch **F#** was chosen as the opening tonal center because it represents the highest frequency in the vowel charts, and is found in the first vowel of the eight, in Group 1.

Section A:

Because the section begins with a ND timbre, there is no definite pitch reference, but coming out of that timbre, four pitches are highlighted: **F#1-A2-D3-G4**. Through the ascending movement of the rapid string patterns, **A4** and **E4** emerge, the latter pitch picked up in the vocal line. Continuing in the voice, the melody tumbles down through **A3** to **F#3** to **F#2**, where it sits throughout the duration of this section. From bars 45-59, the string pitches, derirved from the **F#** overtone series, reinforce the **F#** center. They conclude using pitches found earlier in the vocal line: **F#4-A4-E5**. The vocal line continues by outlining the **F#**minor triad: **F#2-A2-C#3**, resting on **A2**.

Section B:

The timbres used in this section are predominantly diffuse, but since they are used in a sequence performed on a sampling keyboard which is tuned in an equal-tempered tuning system, certain melodic patterns do emerge. The

motive which emerges at the end of Part Three concludes on an **A#** which continues over into Section C.

Section C:

The **A#** continues over into Section C. The strings enter on a chord containing **A#4** as the lower note and **A#5** as the upper note, which then descends through glissandi to a series of arpeggio patterns beginning on the pitches **D#3-A3-B3**. The pitches for these arpeggio patterns are derived from all pitches present in the vowel groups, which have been spread over a four octave range, from **G#2-E6**. This can be seen in chart IV. Through a series of transpositions and a fragmentation of the melodic patterns, the range narrows down, touching on the **F#3-E4** span encountered earlier in the opening vocal line and the string chord in bar 57. The range narrows further in bar 128, using only the pitches **F#-G#-A-B-C#**, notes containing the **F#** minor triad, returning once again to the **F#** tonal center. At this point, the tape enters, reinforcing the pitches found in the strings, yet adding a more diffuse quality to these pitch references, due to the timbres chosen (**Pont** and **Har** families).

Through another series of transpositions, motivic fragmentation and durational lengthening, the pitches ascend, expanding the registers once again, concluding on the notes **C#1 & F6** in bar 139 using a sustained chord. The use of these pitches can be seen as a variation of the **F#** tonality, with the **F** now appearing as a natural. The changing of the **F** from a sharp to a natural creates a juxtaposition between these two pitches which reoccurs throughout the section. In fact, the juxtaposition between the **F#** and **F♮** is present even in the final chord, as the pitch cluster on the tape includes all notes from **C6** to **F#6**. The high **F** is picked up at the opening of Cycle Two, and the low **C#1** moves up to the **D#2**.

CYCLE TWO

Section A:

The pitch materials for this entire section are built around a spiral-like motive (see chart V) using the pitches from the eight vowel groups. The range over which these pitches span has been reduced to a major seventh, between **C3** to **B3**. The motive gradually unfolds the pitches progressing through the vowel groups in the order 8-7-1-2-3-6-4-5.

In Part One of Section A, as discussed earlier in the timbral analysis, the SF begins in the extreme regions of both the grave and acute registers and moves to the neutral central region. The "Spiral Motive" is used extensively to create this section and will hereafter be refered to as SMot. The eight vowel groups are also used in this section: Groups 1-4 are assigned to the top half of the register, and Groups 5-8 to the bottom half. Chart VI indicates in which registral area each of the eight vowel groups are located, and how the three pitches from each of the vowel groups are distributed. The pitches from the vowel groups function as beginning notes for the SMot, which is repeated several times in a steady rhythm at a very quick tempo. The motive first begins in Vowel Group 1 on **F 7** and is quickly followed by the SMot beginning on **C#7**, and then by a third SMot on **C#6**. Spiral motives then commence on each of the three pitches of Group 8, followed by those on Group 2, etc. The entrances and exits of each SMot are overlapped, so that a gradual movement to the neutral central region is achieved. By using the **FM7** timbre, the actual pitches are obscured and results in a thickly-textured effect.

In terms of structural pitches, the **F** (now **F7**) which is continued over from CYCLE ONE, is the beginning pitch for the SMot in the extreme acute region using the pitches from Group 1. The **C#1** of CYCLE ONE moves up to a **D#** (now **D#0**) which is the beginning pitch for the SMot for Group 8. The beginning pitches for the SMot, all derived from groups 1-8, ascend or descend through the space, arriving on a series of beginning pitches from Groups 4 and 5 that span from **F3** to **E4**, a pitch structure encountered in

CYCLE ONE as **F#-E**. Standing next to the **F3** is an **F#3**, and next to the **E4** is a **D#4**, again a continuation of the **F-F#** juxtaposition encountered at the conclusion of CYCLE ONE.

The SMot is used again in Part Two, creating the material for the tape timbres **FM8, FPizz1,2,3,** and **4** as well as the for the string timbres Pizz, Jt, Tre and Pt. In the string parts, the SMot begins on the pitches noted in chart II, which are derived from Group 8 (bars 154-160), and the combination of Groups 2&7 (bars 160-165) and Groups 3&6 (165-169). The SMot is heard in its entirety, either repeating itself from the same opening pitch, or is transposed to begin on another opening pitch. It also generally adheres to the syncopated rhythm first encountered in the viola, bar 154. Between bars 165 and 169, it can be observed that the the **F#-E** pitch structure reappears again, and it is at this point that the SMot begins to undergo a process of fragmentation and a contraction of the syncopated rhythm to continuous 16th note patterns. The low **C#** (**C#1**) returns in the grave register in the tape (bar 164) as a beginning pitch for the SMot. This line continues to ascend and is joined in bar 172 with two other layers of the SMot, and which also continue to ascend until the end of Section A.

By bar 170 all four string parts are proceeding synchronized with each other on a fragment of the SMot. It is at this point that the structural pitches in chart II begin to reflect the ascending movement of this fragment in the outer register rather than the beginning pitches of the motive. The last such beginning pitch in the top register was **A#4**, which in the fragment rises to an **F#**. The structural pitches rise by steps until bar 172, when the strings dissipate the ascending synchronous motion into individual lines which descend in various patterns. The chordal structure which commences this dissipation - **A4-F5-A5-C5**, is an inverted form of an F triad. Again the semitone juxtaposition seen earlier in the **F♮-F#** reappears at this point in an extended form: **F♮-F#, A♮-A#, C♮-C#**. An **E** appears as the note to which violin 1 descends, and forms an open fifth with the cello note **A** as a leading progression into Section B.

Section A contains the most complex pitch relationships of the composition, with many changes and movements. These changes coincide with timbral changes, adding another layer of meaning to the transitor characteristics of this structural unit.

Section B:

While the many changes of the previous section reflect the somewhat chaotic nature of this spiritual journey through the maze, the "change of space" beginning in Section B and the stationary characteristics of a carrier section are reinforced by the static pitch structures, which center around the structural pitches of **D-A**. In traditional harmonic language, this structure can be seen as a tonic resolution of the dominant open fifth **A-E** which concluded Section A. It also functions as a grounding center for the duration of the composition, thus reinforcing the sense that from this point on, a new course has begun - "space has changed".

In Part Two, beginning in bar 205, the **D-A** structural pitches remain, filled out by an **F♮** and **F#**. The appearance of the pitches **C** and **G**, which are adjacent pitches to the **D** and **A** suggest a modal quality. This feature is developed more fully in Section C. The appearance of the major-minor triad on **D** and its reinforcement throughout this section marks a significant shift from the **F#** triad which has dominanted the pitch structure from the opening of the composition, although both triads have the **F** in common, either as a natural or sharp. The juxtaposition between these two notes functions on the larger structural level.

Section C:

In Part One, the pitches that comprise the modal groupings beginning in bar 220 are oriented around the two predominant whole tone juxtapositions of **D-E** and **A-B**. The open fifth feature of **A-E** at the end of Section A and **D-A** at the beginning of Section B returns, appearing as **E-B** and **A-E** in the vocal line. Beginning in bar 236, with the addition of the strings, chart II reflects the transpositions that occur in the structural pitches of the larger units. Moving from the **A-D** to **B♭-E♭** to **A-D**, Part Two concludes with a return to the **D**

center surrounded by pitches **C** in the treble and **E** in the bass, reflecting on the structural level the modal characteristics encountered in this section.

Again, for Part Three beginning in bar 248, the feature of whole tone pairs continues, beginning in bars 248-255 with the structural pitches of **C-D**. This entire section is transposed up (bar 256) in such a manner that the modal characteristics give way to include pitches from the entire major scale on **D**. These pitches are noted on chart II in terms of the way they create melodic phrases that in the upper register move from **C#-D-F#**. This pattern is repeated throughout the entire registral span. This block is again transposed up to an **E** major center in bar 258, and again in bar 260 to an **F#** major center. These transpositions are further emphasized in the vocal line. The **F -F#** juxtaposition returns again, linking this point of the composition to other areas of **Ellipsis** such as the end of CYCLE ONE. This juxtaposition becomes a motivic feature in bar 265, in both the upper and lower registers. The **F#** is also part of the unit **G#-B-F#**, a unit spanning a minor seventh, parallel to the **F#-E** unit encountered earlier. Part Three ends on a **G#-B-D#** chord, with the **F** ♮ occurring in the bass. Ending on this **G#** center is yet another ascending transposition, continuing the pattern established earlier in bar 258, and provides a link into CYCLE THREE - the **D#** up to the **E** and the **F** down to the **E**.

CYCLE THREE

Section A:

The centering pitch of the first phrase of FM9 is **E** and the voice uses **B2** as the fundamental pitch for the vowel exploration. This picks up on the open fifth idea encountered previously at the end of Section A, CYCLE TWO, and the vocal line in Section C, CYCLE TWO. The second phrase of FM9 is centered around **D**, with the voice on **A**. The **D** is approached by a reference to the **E**.

Part Two beginning in bar 294 extends the **D** center, first of all with the open fifth structural pitch of **A** occurring in both outer registers, and secondly by the use, in the strings, of the upper pitches of the overtone series on **D**. Earlier in the timbral analysis, a parallel was made between the Section A's of CYCLES ONE and THREE. (See pg. 68 - 73). In bars 45-59, the string pitches were derived from the overtone series on **F#**. Another parallel is made between these two sections in terms of pitch material, as well as strengthening the connection between the structural pitches of **F#** and **D**.

Section B:

Because the FC of this section is more diffuse in character, the only reference to pitch material that can be made here is in terms of the **DH** timbre, which is used in a slowly moving and repetitive melodic pattern, centered around **A**, with an adjacent structural pitch of **G**. Again, parallels between this section and Section C of CYCLE TWO are further reinforced by the repeat of the feature of the whole tone relationship between two pitches.

Section C:

The modal features introduced in Section B continue on into Section C, similar to the parallel section of CYCLE TWO. Here in CYCLE THREE, **D** continues as the centering pitch, as well as the **A** of the previous section. The unit centered around **D-A** in bars 317-324 is transposed down a whole tone to **C-G** in bars 324-329, and then back up again to **D-A**, with a high **D** appearing in the upper register in bars 329-340. The **A** is picked up as a linking pitch to

the Coda, which features the opening melody of the **Introduction.** In the Coda, **A** is now the centering pitch of this melody, whereas previously it had been heard with **F#** as the centering pitch. The last pitch heard in the coda is the **A**, rather than a **D**, which concludes the composition with a feeling of open-endedness rather than a feeling of complete "at-rest" resolution. This helps to strenghthen the notion of returning to yet another unfolding of the overall pattern or journey that has transpired throughout the course of the composition **Ellipsis.**

C - SUMMARY:

Up to this point in the discussion, little reference has been made to the second line of each system in chart II which functions as a summary of the first line by outlining the structural pitches. A discussion of the how this line moves follows below, and includes remarks regarding how the pitch relationships reinforce the underlying story of the composition. A more condensed summary of the structural pitches can be found in chart II-i.

CYCLE ONE introduces the first structural pitch of **F#**, primarily heard in the tape material, and reinforced in the string parts. When the strings emerge fully in Section A, the upper register moves from a **G** to an **A** which is a micro version of the whole tone-modal characteristics developed later on. The lower register moves from the **F#** up to a **G#**, which becomes the structural pitch of the conclusion of CYCLE TWO. The voice first pierces through on an **E**, which continues as a structural pitch throughout the composition, and finally settles down on the **F#**, returning to the opening pitch center. Thus in these opening 37 bars, the foundational material upon which the rest of the pitch relationships are created has been introduced. The structural pitch changes from **F#** to **C#-F** by the end of the cycle.

CYCLE TWO, linked to CYCLE ONE by the upper **F♮**, continues on through to the **A-E** open fifth, before descending to the structural pitch of **D**, where it remains for almost the entirety of the cycle. The **F#** references are picked up in the remaining bars of the cycle, and the occurrence of the high **A#** is connected to the opening **A** mentioned above in CYCLE ONE. The re-appearance of the opening **G#** ends the cycle.

An important observation to make at this point is to note that the overall movement in the composition has been from **F#-E-D**, with the **E** serving more the role of passing tone. It is interesting to note that from the appearance of the **F#** in bar 260, highlighted by the voice, and continuing on until bar 294/5, a compressed version of the main structural pitches **F#-E-D** has occurred. Thus the enfolding of all previous times of the composition

has occurred in these few moments, which symbolically in the story-line lead into the encounter with wisdom and the appearance of Old Woman, a mythological figure representing all times and places.

CYCLE THREE begins with the **E** structural pitch, linking to the **E** in Section A, CYCLE TWO, touching on the **A**'s in both registers, before settling down on the **D** pitches. The **A** returns in the Coda, linking first of all with the point in CYCLE ONE just prior to the initial vocal entry; secondly, with the concluding bars of CYCLE TWO, in which all three elements of voice, strings and tape have been extremely active; and then finally with both Sections A and B of CYCLE THREE. This pitch relationship between the **A**'s serves as another way of linking the conclusion of the composition with prior moments. Also, the **A** has appeared in relationship with all the other structural pitches:

the **F#** in the unit **F#-A-C#-E**
the **E** in the unit **A-E**
the **D** in the unit **D-A**

By ending the composition using the single note **A**, reference is made to all other relationships that have preceded this final note.

Chart II-i gives the final reduction of the structural pitches, elucidating the background layer. What results in the upper voice is the movement from **F#-D -A**, while in the lower voice the movement is from **F#- D**. The progression in the upper voice from **F#** to **D** proceeds by semitone steps, but overall the three structural pitches create an arpeggiation of a **D** major triad. The movement from **F#-D** in the lower voice creates another arpeggiation of the **D** major triad, but the **A-C#** that intervenes functions like a dominant to the **D** triad, especially considering it is paired in the upper voice with an **E**.

Within the context of a composition exploring the timbral domain, the pitch materials follow more traditional harmonic relationships, giving a sense of continuity and coherence over the large span of the entire composition.

In using the Schenkerian-based model which defines pitch relationships as the unfolding of structural notes, a link has been made with one of the aesthetic approaches in this composition, namely, the intent to make connections between present and past events. In the **Introduction**, Rochberg's use of the word radial was mentioned as suggesting a model of composition in which the past can be perceived in the present. The Schenkerian model for pitch analysis demonstrates how particular pitches reappear in the composition and provide a link with previous sections. As noted above, this occurs particularly at the end of CYCLE TWO and in the use of the note **A** in conjunction with many of the structural pitches. This aesthetic is summarized in the following quotation.

> **Reality is comprised of discrete, momentary "occasions" of experience. Each present occasion inherits the entire past, and it is through its inheritance that "an actual entity has a perfectly definite bond with every item in the universe."**
>
> **The aesthetic power of contrasting the past and present creates two qualities of music. One is a feeling of inclusive breadth; time boundaries are broken down. The other is the sense of compressed time, which results from the unity of the composition. All times are caught up together and enfolded into the present moment, in a kind of musical fusion. (Beyer and Parker Beyer, 1983) p. 7.**

CONCLUDING REMARKS

In the course of the discussion of the composition **Ellipsis**, a model for timbral analysis based in phonological theory has been developed. At this point in the course of musical theory and compositional practice, models such as these are in the experimental stages. Further work in the direction of timbral composition could include the use of precise spectographical analysis of the various timbres leading to specific computerized programs which would evaluate timbral relationships and categorize timbres into family units. Composing entirely with full digital control of the spectral form and frequency content would also be extremely helpful in this pursuit. Using sonic elements primarily from acoustic sources thus limited the ability to precisely determine and change the spectrum as would be possible with digital sound synthesis. Nevertheless, the model presented is applicable for any style or genre of music, and need not be limited only to those compositions composed with full digital control. A variety of examples of how this is possible is explored in R Cogan, New Images of Musical Sound

The other facet of this analysis, the discussion of pitch relationships, showed how the pitch structures reinforced both the formal divisions and the overall flow of carrier-transitor distinctions.

Finally, the underlying references to a journey of spiritual growth, rooted in the ancient goddess rituals celebrated in concurrence with the passing of lunar phases, were discussed as they related to both the timbral and pitch structures used in the course of the composition. As stated earlier in the quote by Arnold Schoenberg on page three, the development of timbral relationships can recapture the world of the subconscious which we glimpse through our dreams, expanding our relationships to those things which seem not completely within our grasp.

A dream story, one of the initial kernals for the composition **Ellipsis**, concludes the paper.

I had a dream of a voyage through rough waters. We passed by an island filled with wind-swept Tom Thomson trees. I distinctly heard the wind and waves as the sea was fast becoming a swollen nightmare. A large rock structure containing an arch-like hole appeared in front of myself and my companion. Suddenly alone, the swirling waters carried me through the hole, and emerging on the other side, I turned and saw Her. Name Her Shekina, Sophia, Mary, Durga, Aphrodite, Isis, Demeter...She was Mountain.

She rose tall and strong, her power flowing down to where I was sitting alone in my tiny boat. Rising high above the main stone and sitting on her crest was a cropping of rock that resembled a crown. I climbed up to the top and sat with her.

Her voice came from the sea and as I listened I began to hear a choir of voices dancing high above the low roar of the surf. When I awoke, the overtones created by the mass of low fundamentals were clear and pure in my mind. I knew I had been visited that night by someone speaking out of an ancient time: someone who was speaking in the primal language of chant, using the fundamental elements of sound to communicate across time-lines.

(Bartley, 1987) p.15

APPENDIX I

THE STORY OF "ELLIPSIS"

Adapted from "Women and Nature" by Susan Griffin

THE AGE OF DARKNESS

She is surrounded by mystery, stillness, and silence

Groping inside the darkness,
she pierces through the surface,
discovering traces of forgotten times

Hearing the voices of her lost heritage calling out,
she begins to put the ancient pieces together,
remembering what might have been

The knowledge of what she is becomes clearer,
as each day she moves closer to the sun,
closer to herself

CREATING A NEW SPACE

The spiralling journey circles the void of darkness
She travels through the maze of confusion,
the space where what was inside stands revealed
And this lights her way

In her circling motion, she finds an opening
Space is changed
She begins to live in a matrix of her own sounds

The time of her silence is over
She flies through the night,
feeling the pulse of ancient stones
drumming in her head

THE AGE OF RESONANCE

Old Woman stands
Her ancient wisdom and holiness,
Her inner resonance,
Sounding-vibrating through

Knowing it is the turbulence of the sea that sustains life,
she acts now out of passion
Crossing barriers,
illuminating life

Her voice now living full inside her,
she carries on with memories:
of other times,
other places

Change is a door hanging open

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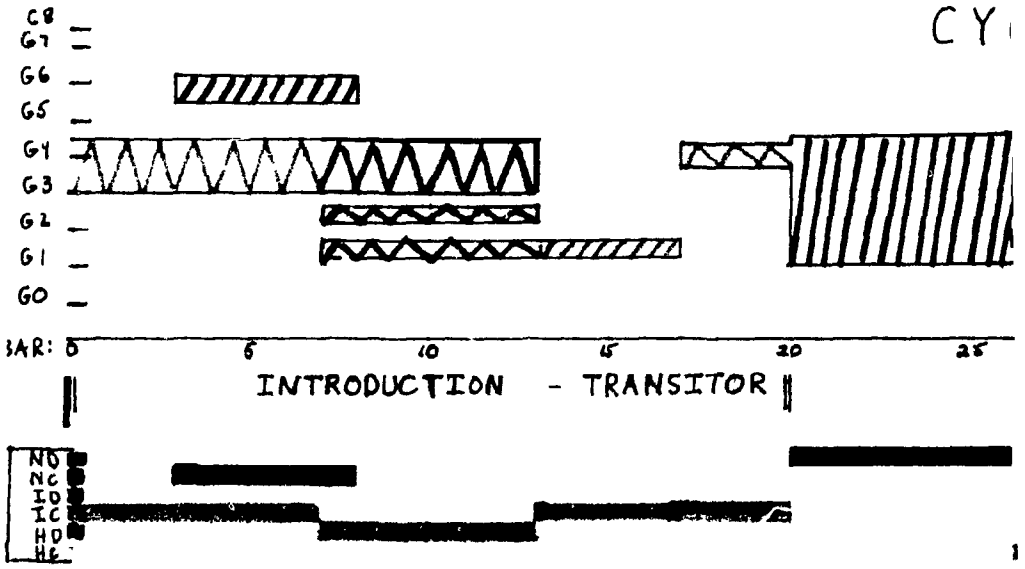
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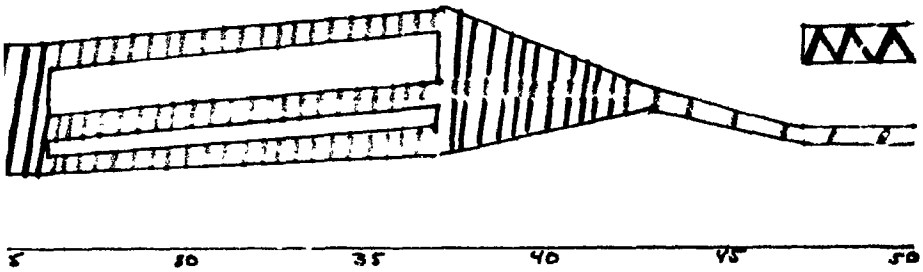

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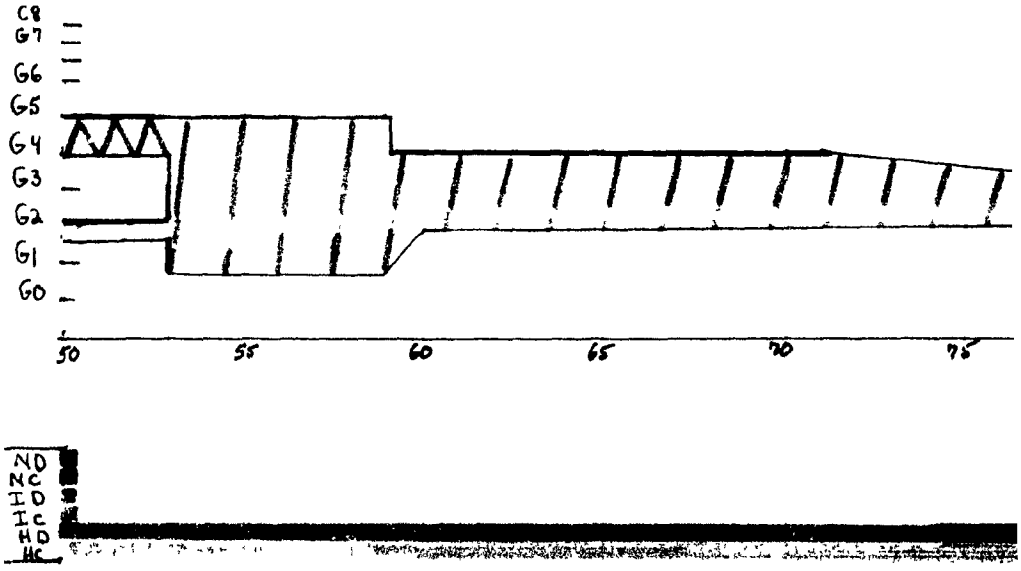
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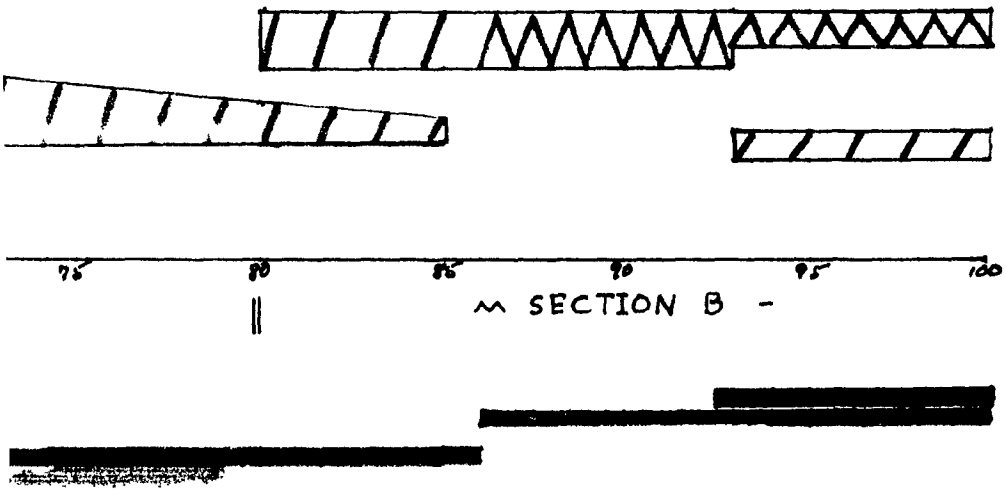
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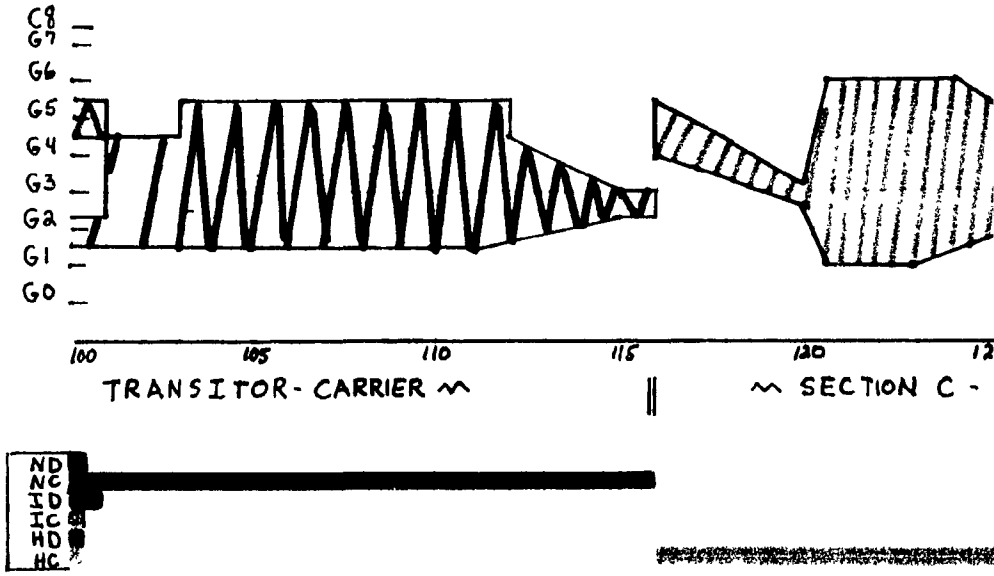
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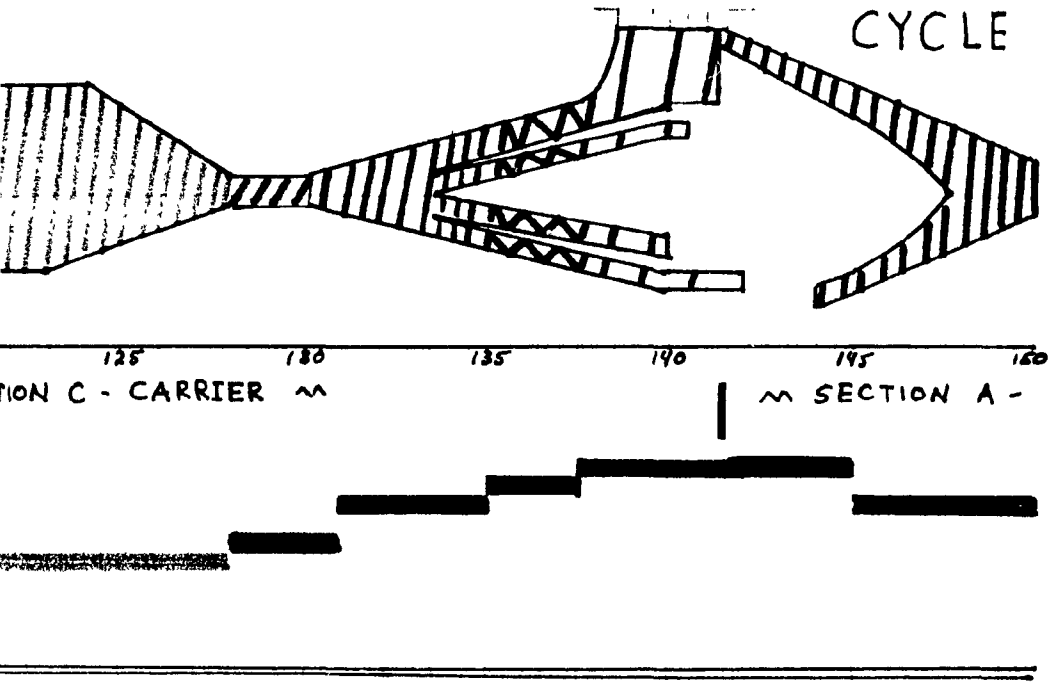
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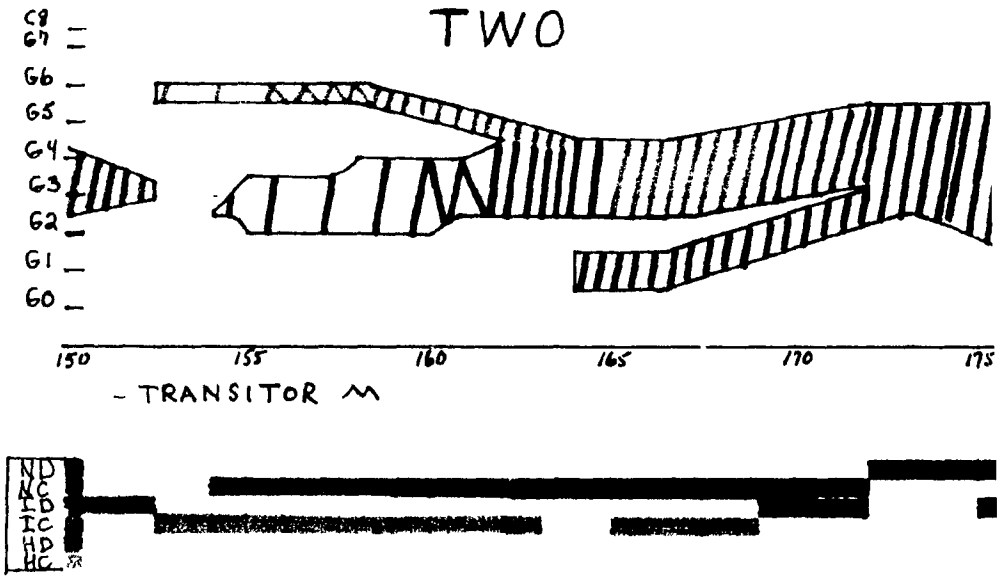
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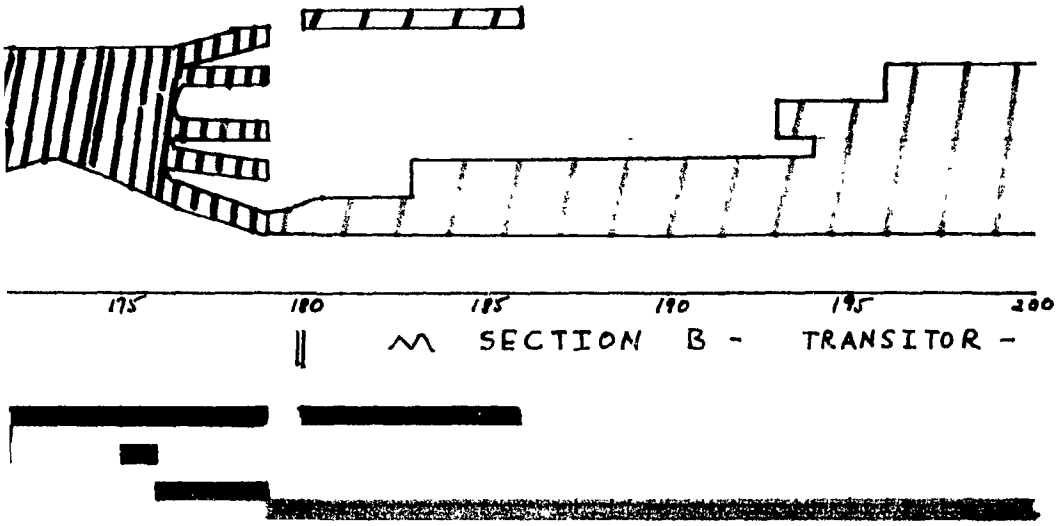
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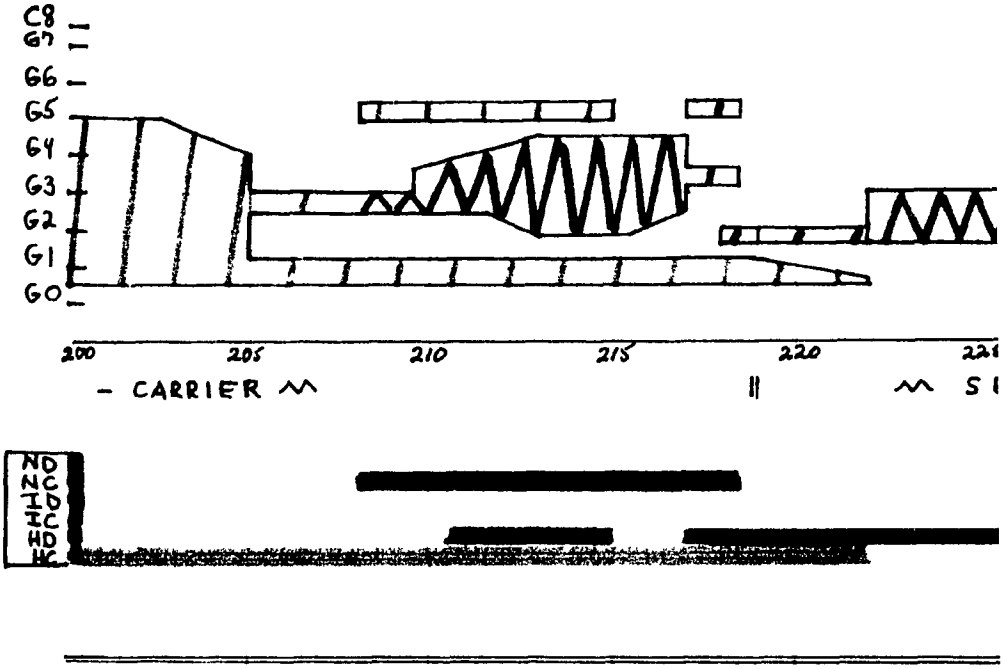
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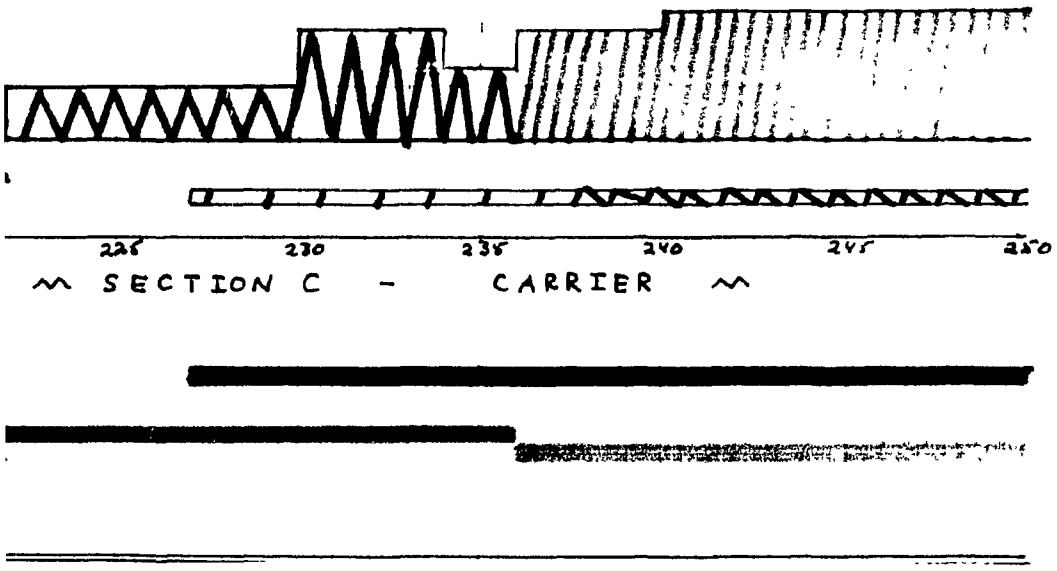
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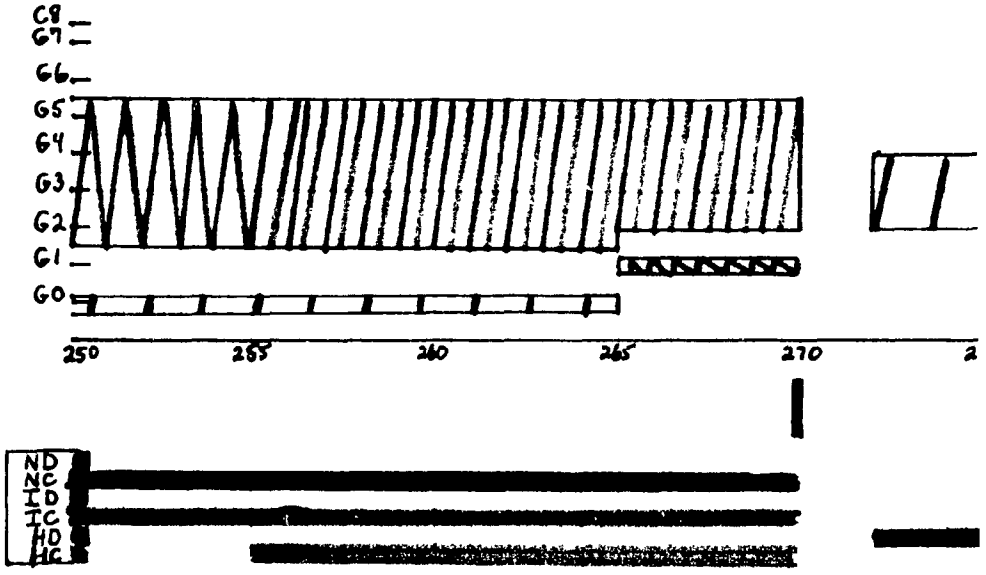
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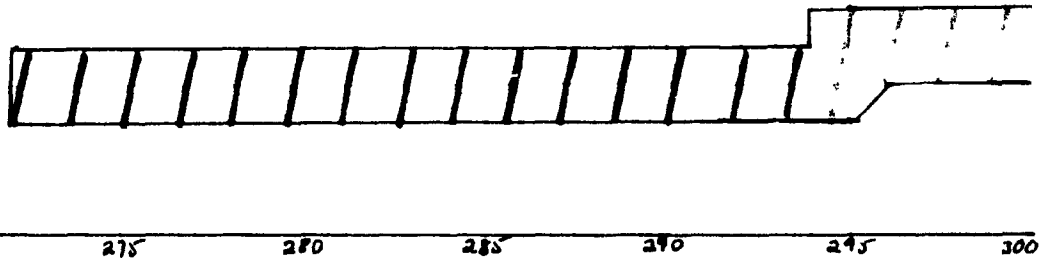

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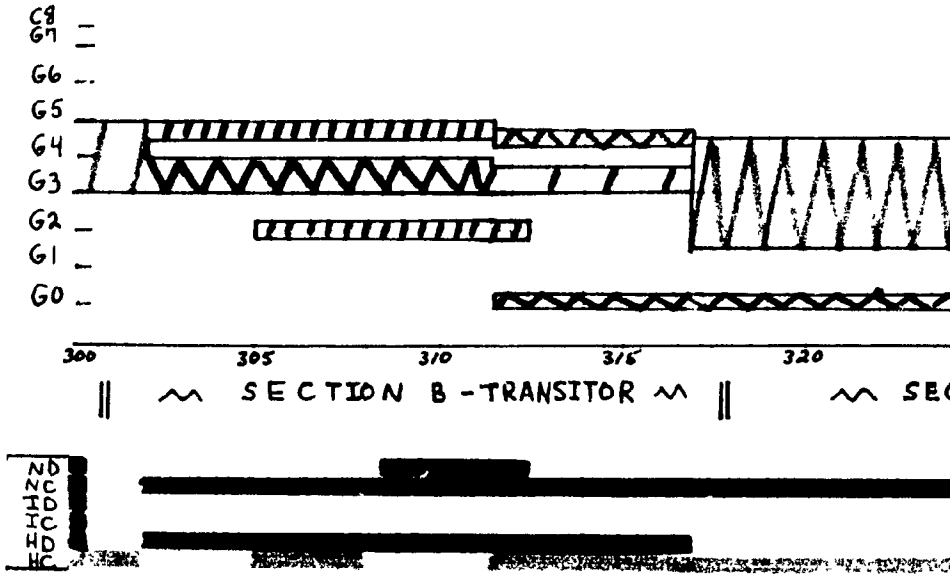
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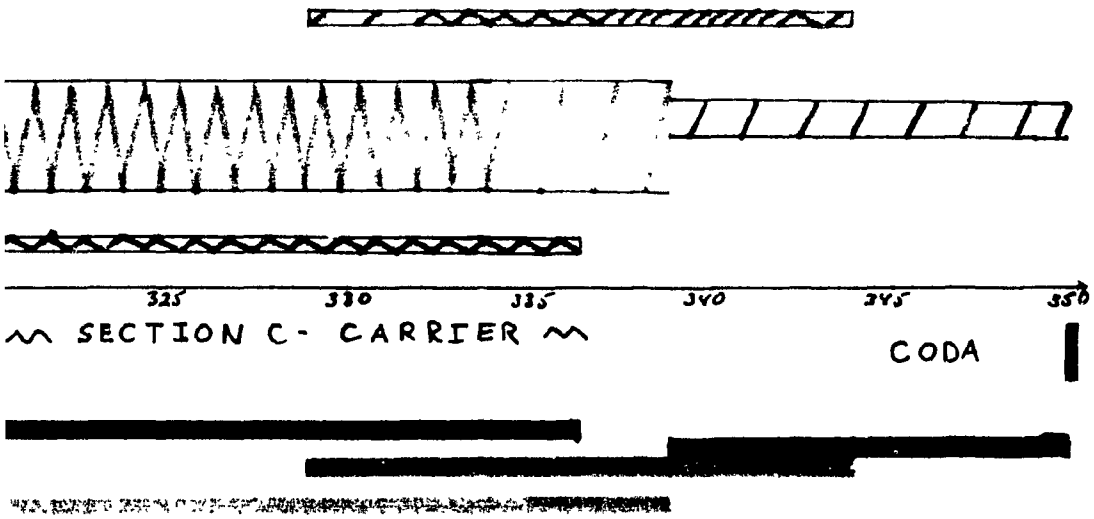
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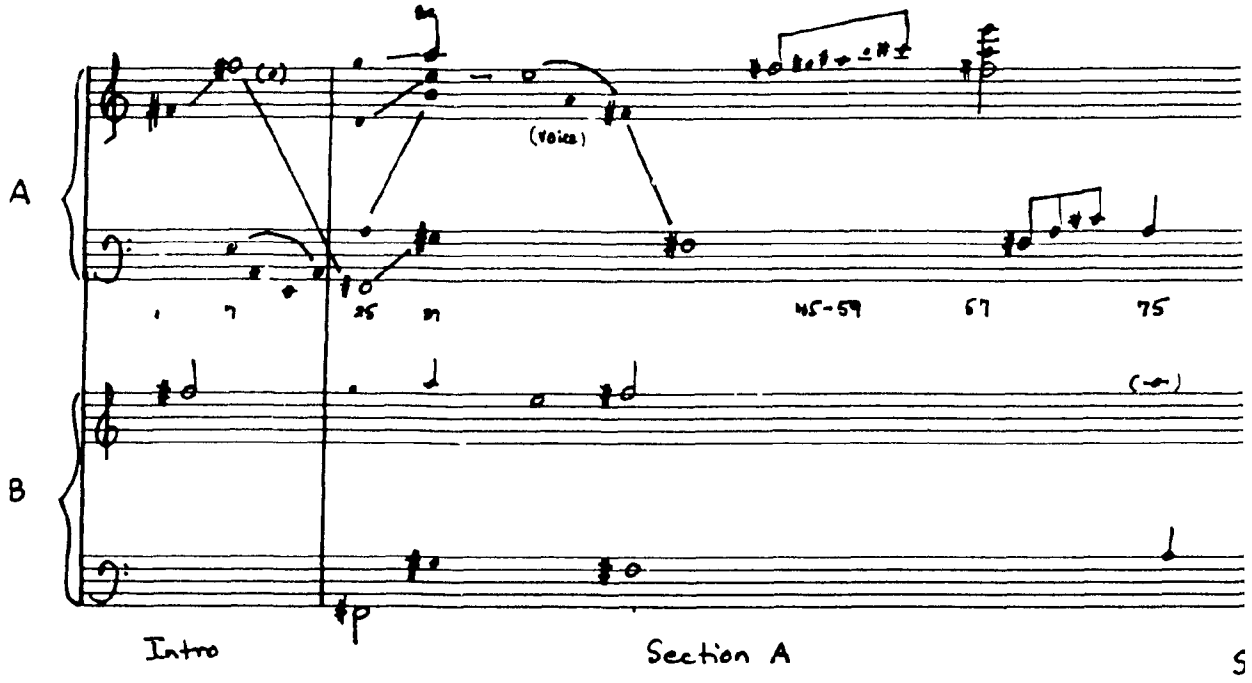

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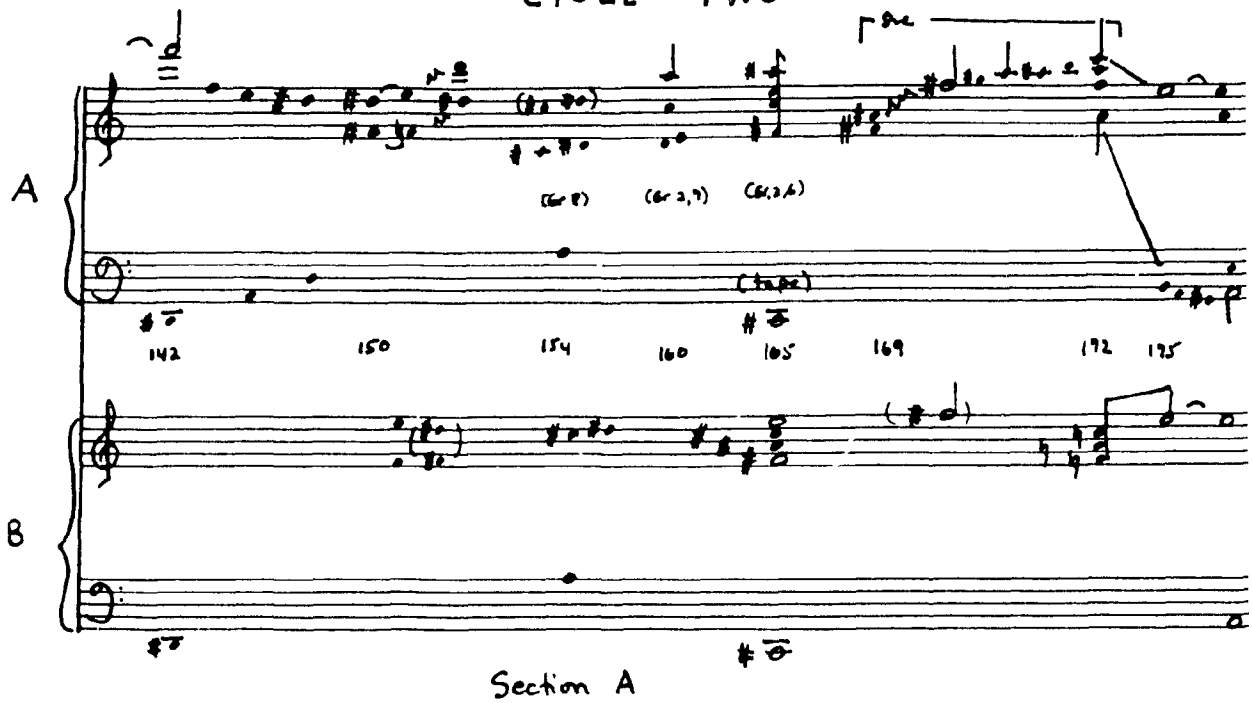

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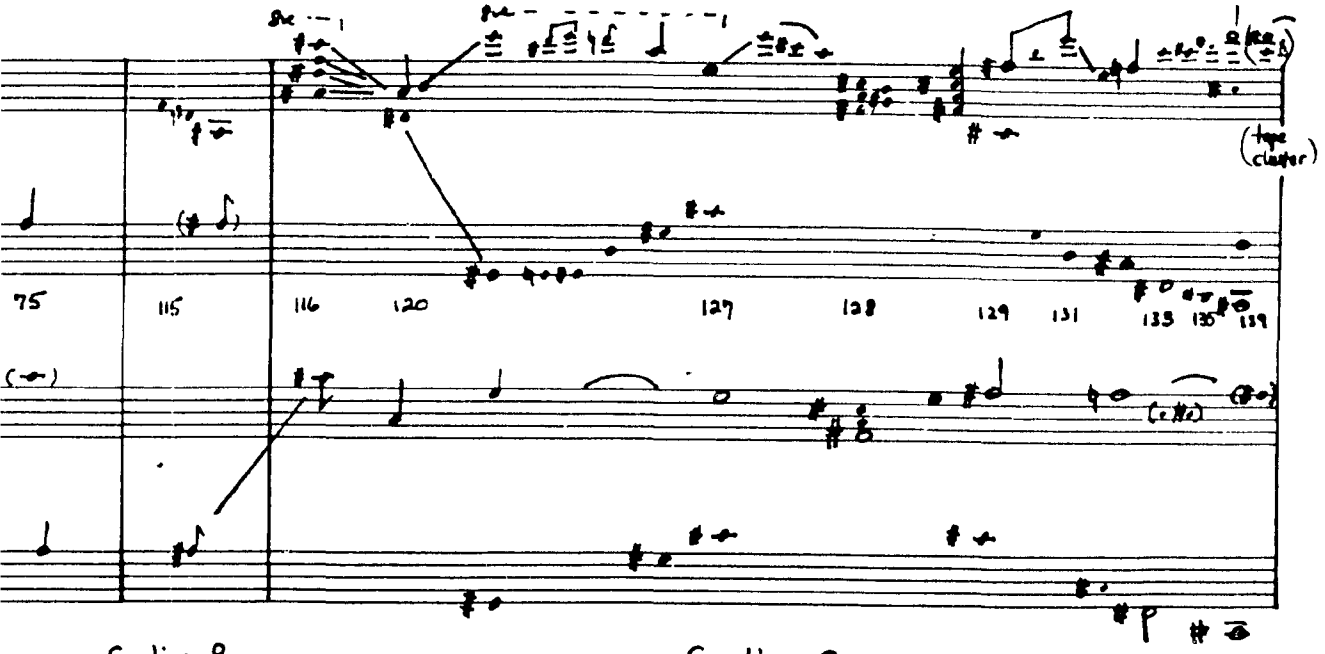

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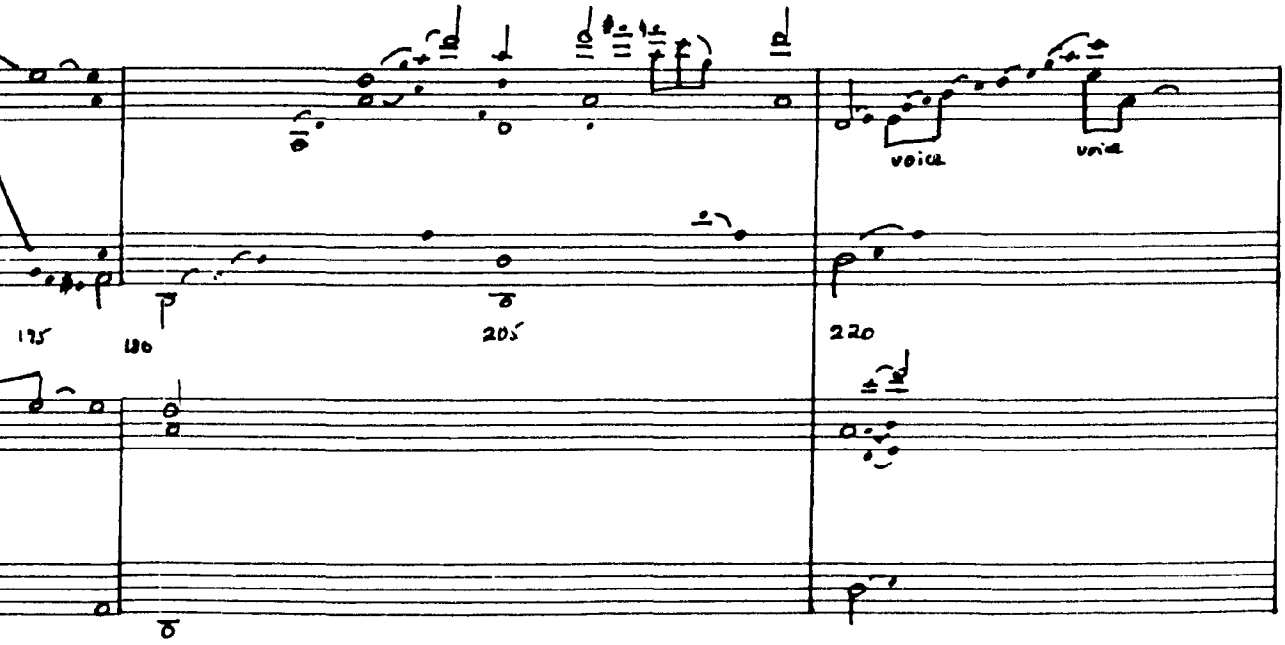

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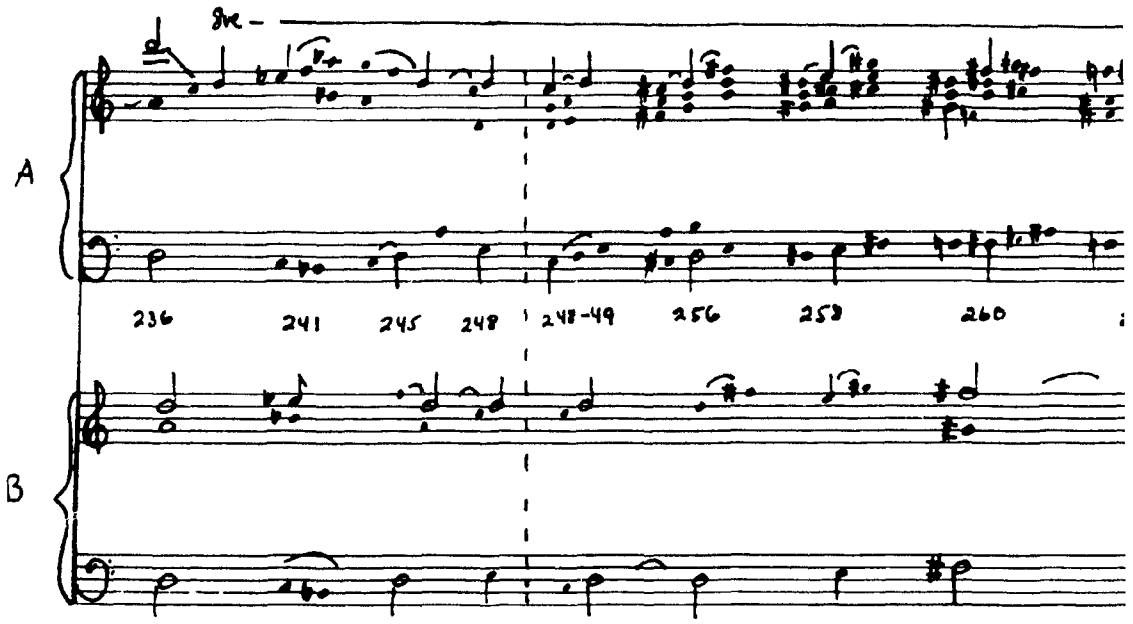

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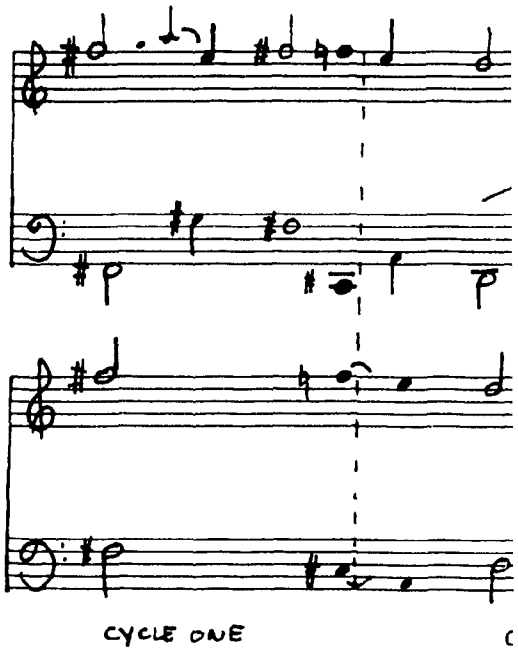

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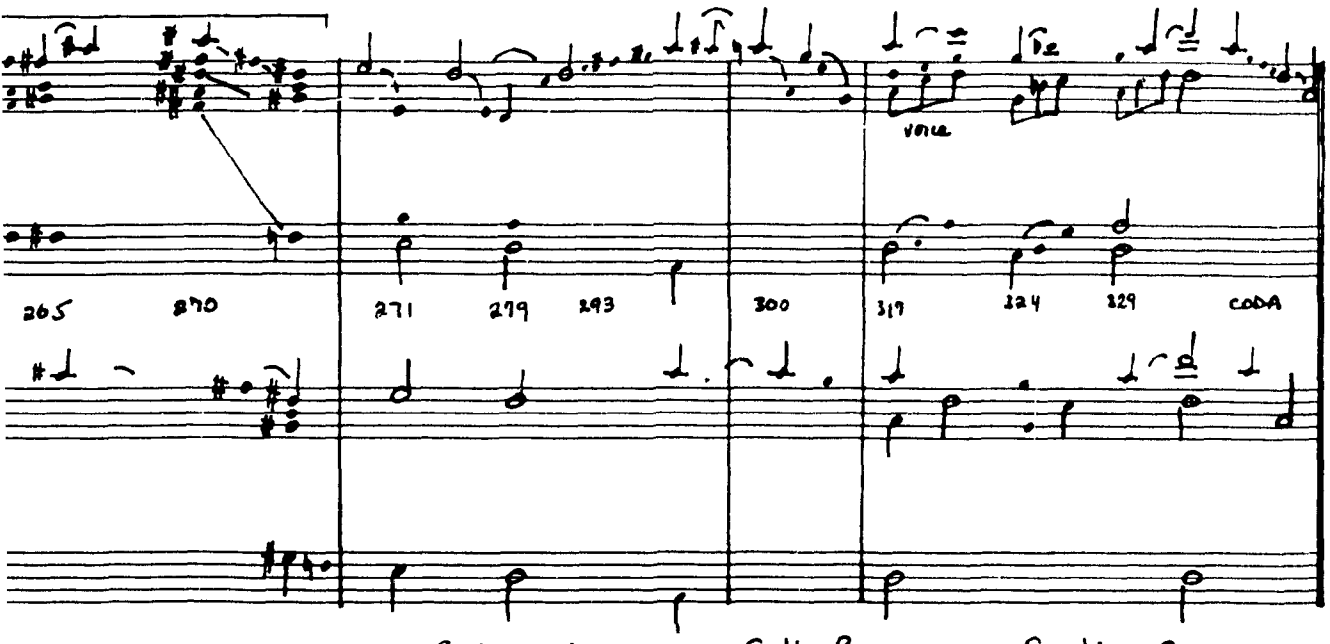

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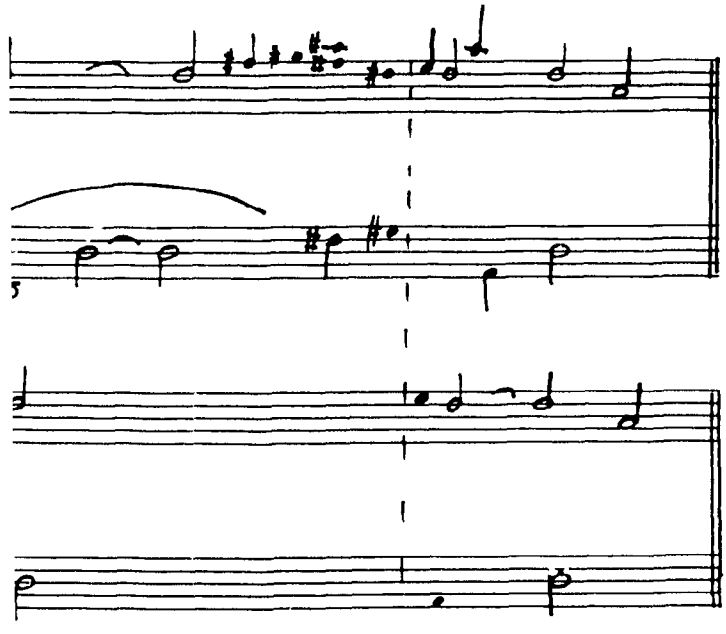

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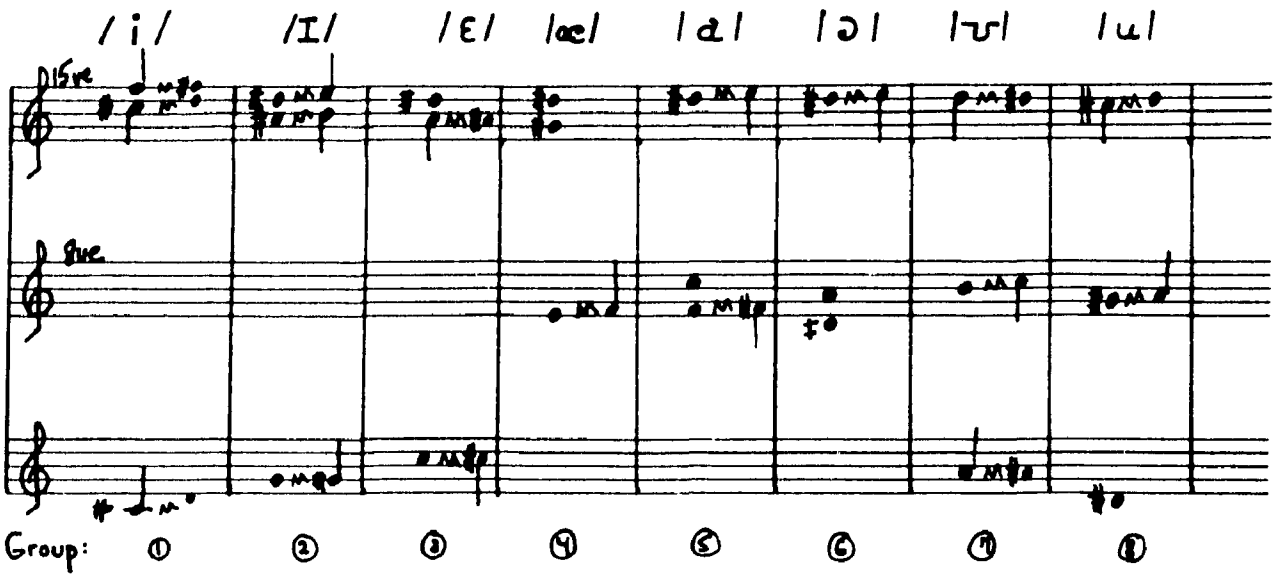

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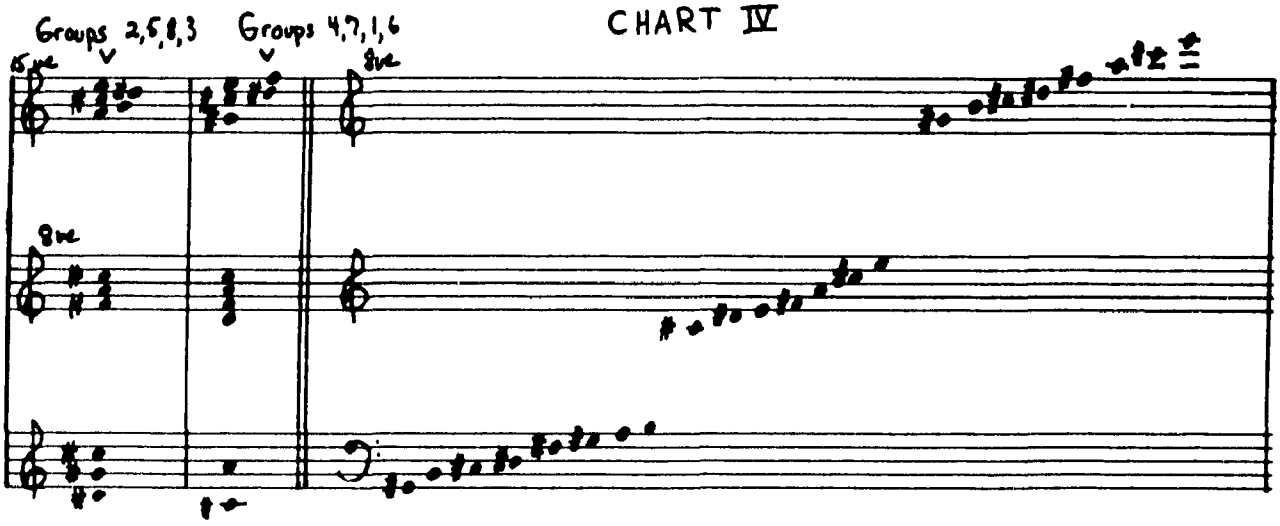

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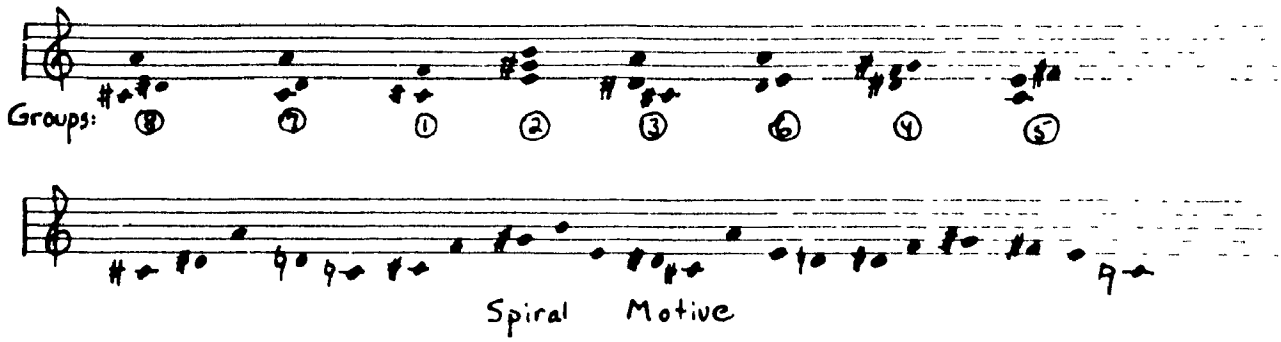

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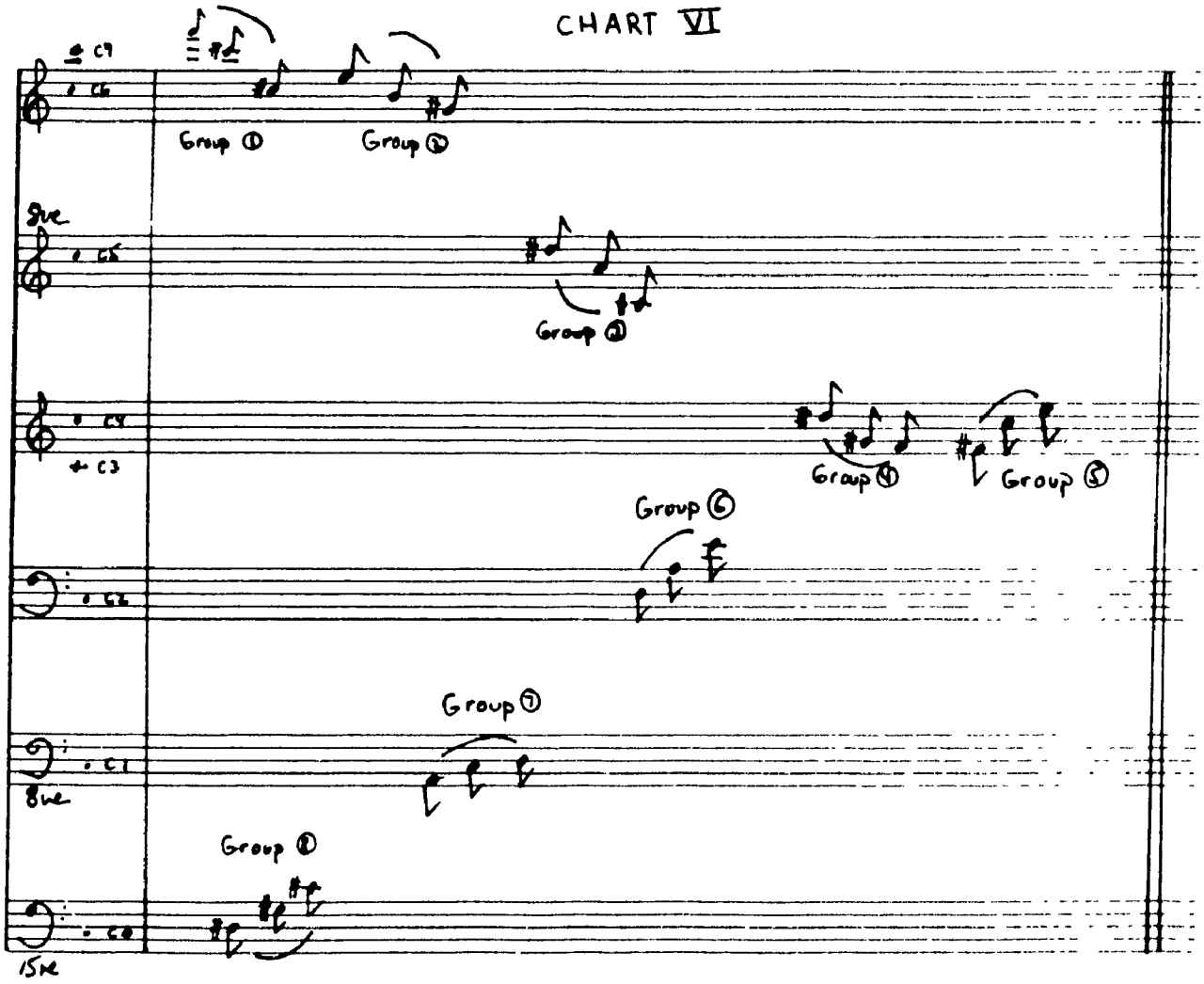

TABLE OF ABBREVIATIONS

INSTRUMENTAL AND SAMPLED SOURCES

(bold format indicates tape source)

artificial harmonic glissandi	**AHarGl1, AHarGl2, AHarGl3**
bridge & tailpiece	**B/TP2, B/TP1**
attack through DDelayLine	**DH, DM, DL**
drums	**DR**
fingernail pizzicato	**FPizz1, FPizz2, FPizz3, FPizz4**
glissando	Gl
glissandi	**Lay/Gliss**
harmonics	**Har**
harmonics	Hrm
natural harmonic glissandi	**HarGl1, HarGl2**
harp	**HP**
bowing - heavy pressure	HP
jeté	Jt
legato bowing	LB
legato bowing	**LB**
mixed source	**NEW1, NEW2**
normal position	NP
panflutes	**PFL**
pegs & fingerboard	**P/FB**
ponticello	Pt

ponticello	**Pont1, Pont2, Pont3, Pont4**
pizzicato	Pizz
tailpiece	**TP**
tasto	Tas
Thai gongs	**TGNG**
mixed source	**TimCh1**
tremolo	Tre
tremolo/glissando	T/Gl
phonemes	**VOC1, VOC2**
vowels	**VOC3 , VOC4**

SYNTHESIZED SOURCES

Frequency Modulated Timbres 1-9:

FM1 - FM2 - FM3 - FM4 - FM5 - FM6 - FM7 - FM8 - FM9

VOCAL SOURCES

VOWELS

Reflection:		Ref			
Top	T	Mid	M	Bottom	B
Height:		Hgt			
Closed	C	Mid	M	Open	O

CONSONANTS

Plosives	Voiced	PL-V
Fricatives	Unvoiced	FR-Unv
	Voiced	FR-V

V-C PAIRS

plosives	open	PL-O
	mid	PL-M
	closed	PL-C
fricatives	open	FR-O
	mid	FR-M
	closed	FR-C
sonorants	open	SON-O
	mid	SON-M
	closed	SON-C

CATEGORIES FOR TIMBRAL ANALYSIS AND CHART I

Spectral Form	SF
Frequency Content	FC
harmonic compact	HC
harmonic diffuse	HD
inharmonic compact	IC
inharmonic diffuse	ID
noise compact	NC
noise diffuse	ND

TERMS FOR PITCH ANALYSIS

spiral motive	SMot

ELLIP

Wende Bartley

LIPSIS

de Bartley, 1988

ELLIPSIS

for Electric String Quar

and Female Voi

by Wende Bartley,

Ellipsis is a work which attempts to embody a ritual celebration of spiritual power, rooted in the ancient traditions of lunar mythology. One of the most important symbols in this tradition is the meaning given to the unfolding of the lunar cycle, with its three stages of waxing. full and waning moon. Traditionally these stages have been associated with three images of woman: virgin, mother, and crone. **Ellipsis** builds on this tradition, creating another three-fold story of woman. Cycle one tells the story of woman growing inside the darkness, everyday moving closer to herself. Hearing the voices of the past, she begins to put the ancient pieces together. Cycle two creates a new space, where in the midst of the circling, spiraling motion she finds an opening and begins to create a matrix of her own sounds. Cycle three is the age of resonance. Standing face to face with the holiness of wisdom and pure sound, 'Old Woman' crosses time-lines and speaks. Her words - her sounds illuminate life.

Ellipsis is scored for electric string quartet, tape, and female voice, and in performance may include choreography for 1-2 dancers. In an ideal concert setting, the string parts should be performed using electric instruments (for example, the RAAD instruments designed by Richard Armin of Toronto). If this is not possible, regular acoustic instruments may be used with amplification. Attention should be given to the distribution of the two sound sources (tape and strings) through the speaker system. Ideally, the strings and tape should come from separate sets of stereo speakers, with additional sets of stereo speakers available for live diffusion of the tape during the performance.

LLIPSIS

ring Quartet, Tape

male Voice

Bartley, 1988

The performer required for the voice part should have a range that extends from F#2 (middle C is C3) to F#4, and have experience with both jazz and non-Western music. The singer should not use vibrato, avoiding the expressive operatic style and concentrating on creating a pure tone. During the long sustained vowel sequences, she should feel free to make her own subtle changes by varying the mouth shape and attempt to bring out the changes in the upper harmonics which occur when changing from one vowel type to another. This technique is often refered to as "harmonic singing". The singer should also be amplified, preferably using a remote lavaliere microphone, to allow her to move freely around the space, interacting visibly with the sound environment as suggested by the underlying drama of the composition described above. Some facility with acting would be an asset to the performance.

Props, lighting, costumes, and choreography can all be used to further enhance the unfolding of this story. If the performance is to include choreography, attention should be given to the interaction between the singer and the dancer(s), as their movements and sounds should reinforce the **Ellipsis** story. A poetic outline of the story is included with the score.

Additional information regarding interpretation of the score is listed below:

1. The tape is in open reel format, 15 ips, tails out. It contains 5 cues, separated by leader tape, whose entries and exits are notated in the score. The score itself contains cues of the tape contents, some of which are in diagrammatic form, others using musical notation. When the timbres on the tape are harmonically complex, x-shaped noteheads are used for durations traditionally using blackened noteheads (ie-quarter, eighth, etc.), and diamond-shaped noteheads are used for durations traditionally using white noteheads. (ie- half, whole, etc.) Most of the tape cues in the score are notated for a few bars, with arrows indicating the duration of that activity. When new cues are added that overlap ongoing material, they are introduced using square brackets: [----].

2. String harmonics are indicated in the score at sounding pitch. The player will need to determine how to perform them, using either natural or artificial harmonic fingering techniques.

3. During the sections of rapid patterns, such as in bars 28-36, 120-132, and 172-178, accidentals which repeat within the bar appear according to the following plan:

> (a) in repeating patterns that have more than six notes in the pattern, the accidentals do not reappear for the second repeat. When the pattern repeats for a third time, the accidentals do appear, functioning as a reminder. If the pattern repeats a fifth time, the accidentals appear again.
>
> (b) accidentals are notated for those notes which appear in more than one octave: for example a C# appearing at C3 (middle C) and C5 are both notated with sharps.

4. Those sections containing rapidly moving patterns in bars 28-36, 120-132, and 172-178 are all to be performed using legato bowing. In bars 154-172, the sections marked pizzicato, tremolo, and jeté are to continue until a new change is indicated. The groupings for the tuplet configurations are notated at the beginning of each bar as well as when a change occurs (i.e.- from 5 to 6). When these changes occur, the grouping indications appear twice.

5.  - indicates a non-pitched clef
DDL - abbreviation for Digital Delay Line, used from bars 293-302. Use a setting that allows the sound to be heard 3 seconds after note is released.

6. Vowel and consonant sounds for the singer are notated using symbols of the International Phonetic Alphabet. Their correlations into the English language are notated below. Instructions for glottal singing appear in the score and refer to a type of tremelo singing from the throat common in Balkan folk music, for example.

VOWELS:

/o/	go	/u/	glue	/ʊ/	hood	/ʌ/	mud	/a/	father
/e/	great	/I/	hit	/ɛ/	bet	/ae/	had	/i/	sheet

CONSONANTS:

/p/	pop	/f/	fife	/b/	bib	/v/	verve
/t/	tot	/θ/	thigh	/d/	did	/ð/	they
/k/	kick	/s/	cease	/g/	gag	/z/	zoos
/ʧ/	church	/ʃ/	shush	/ʤ/	judge	/ʒ/	azure
/m/	mime	/n/	nine	/ŋ/	singing		
/j/	yes	/h/	how	/w/	way		

THE STORY OF "ELLIP

THE AGE OF DARKNESS

bars 1-19: She is surrounded by mystery, stillness, and silence

bars 20-79: Groping inside the darkness,
she pierces through the surface,
discovering traces of forgotten times

bars 80-115: Hearing the voices of her lost heritage calling out,
she begins to put the ancient pieces together,
remembering what might have been

bars 116-141: The knowledge of what she is becomes clearer,
as each day she moves closer to the sun,
closer to herself

CREATING A NEW SPACE

bars 142-179: The spiralling journey circles the void of darkness
She travels through the maze of confusion,
the space where what was inside stands revealed
And this lights her way

bars 180-218: In her circling motion, she finds an opening
Space is changed
She begins to live in a matrix of her own sounds

bars 219-27

bars 271-29

bars 300-31

bars 317-33

bars 340-35

The story has been adapted by the composer from *Women an*
by Susan Griffin, Harper & Row, New

Y OF "ELLIPSIS"

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bars 219-270:

The time of her silence is over
She flies through the night,
feeling the pulse of ancient stones
drumming in her head

THE AGE OF RESONANCE

bars 271-299:

Old Woman stands
Her ancient wisdom and holiness,
Her inner resonance,
Sounding-vibrating through

bars 300-316:

Knowing it is the turbulence of the sea that sustains life,
she acts now out of passion
Crossing barriers,
illuminating life

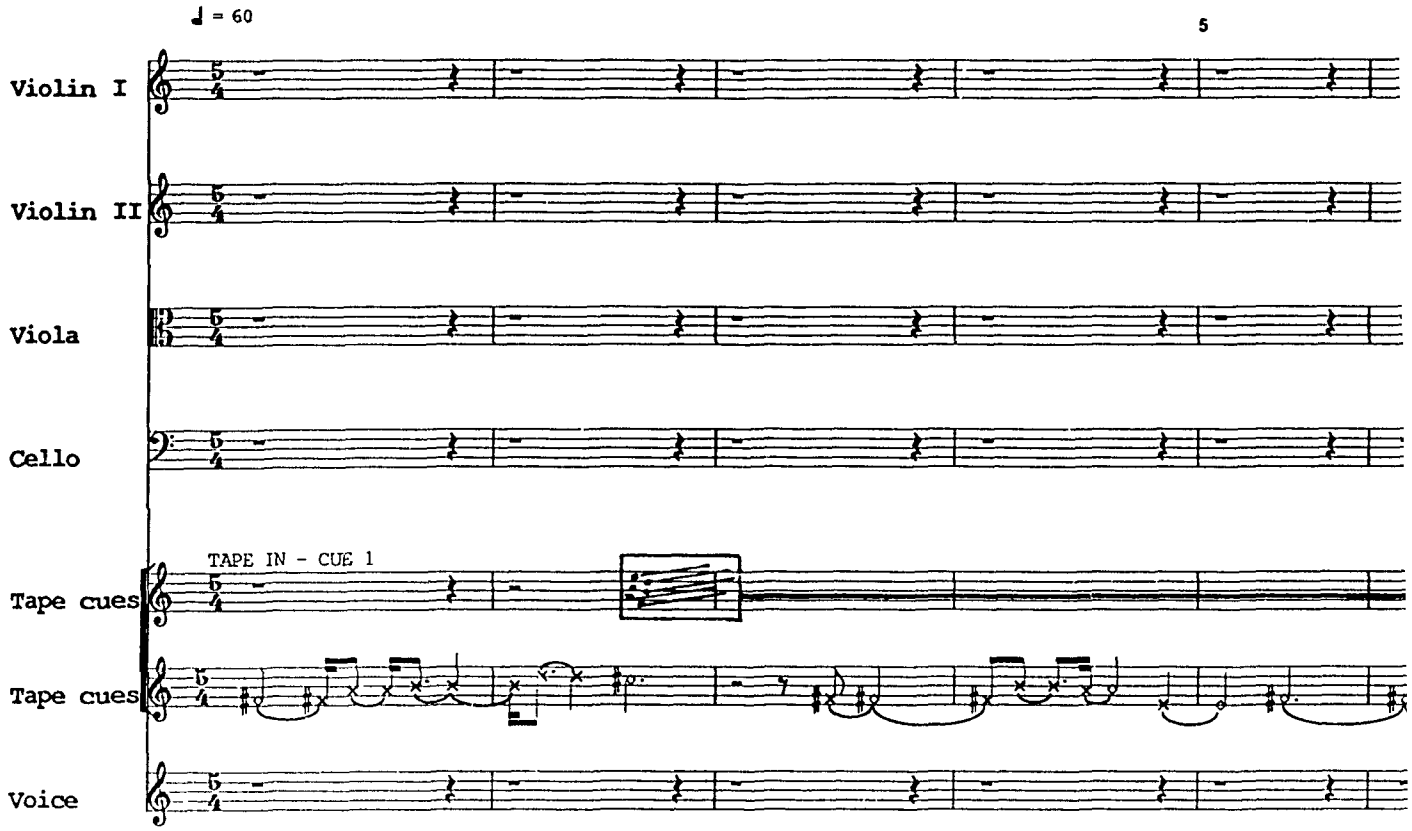
bars 317-339:

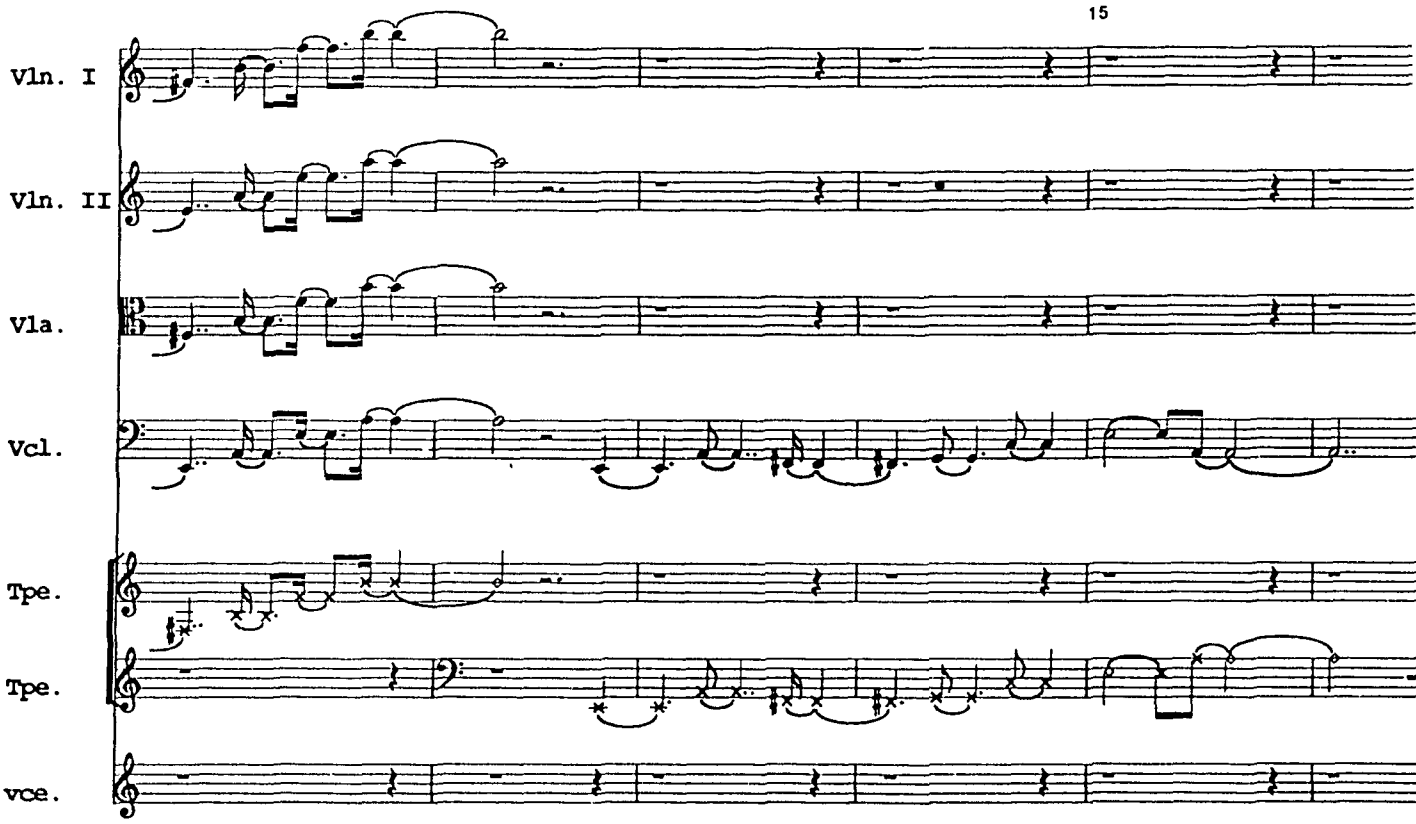
Her voice now living full inside her,
she carries on with memories:
of other times,
other places

bars 340-350:

Change is a door hanging open

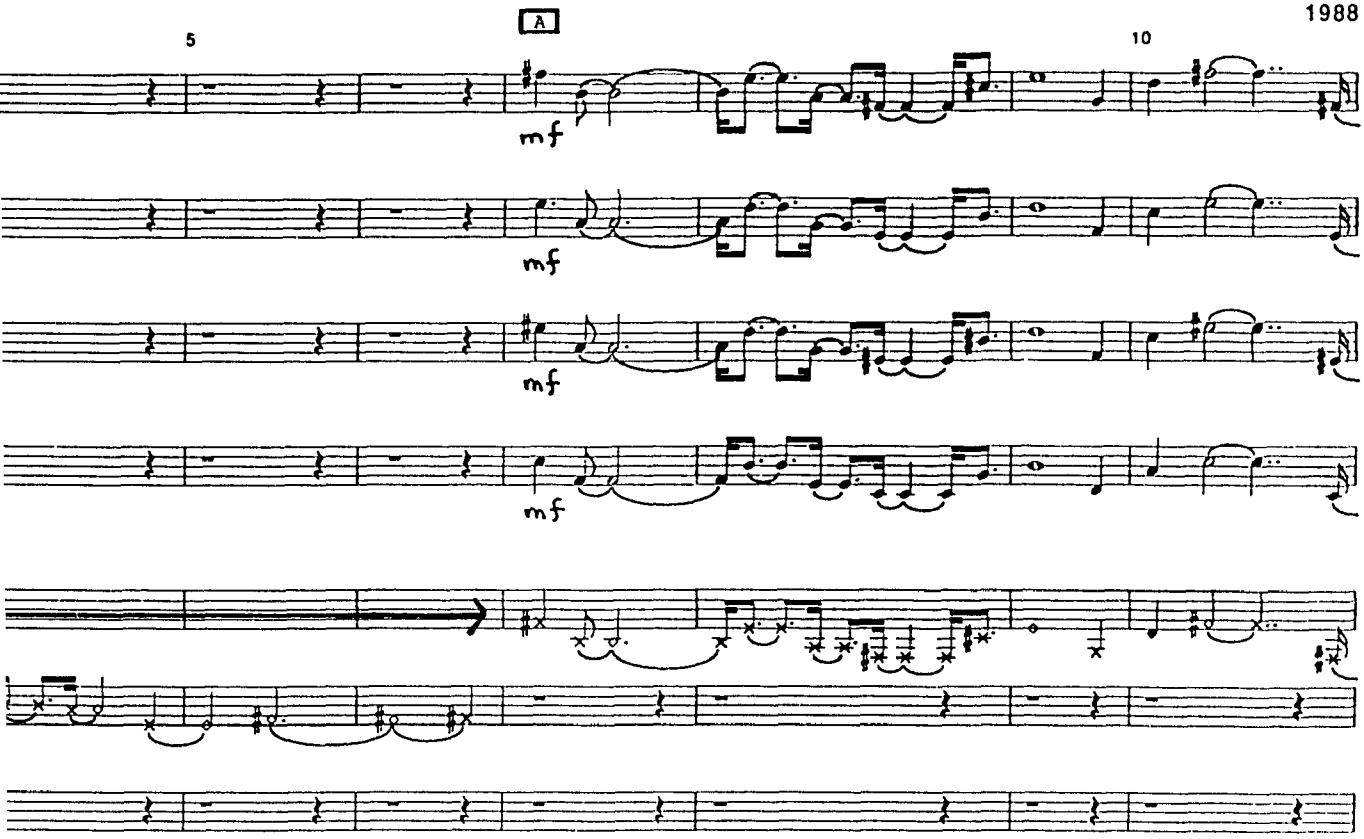
composer from *Women and Nature: The Roaring Inside Her*
riffin, Harper & Row, New York, 1978.

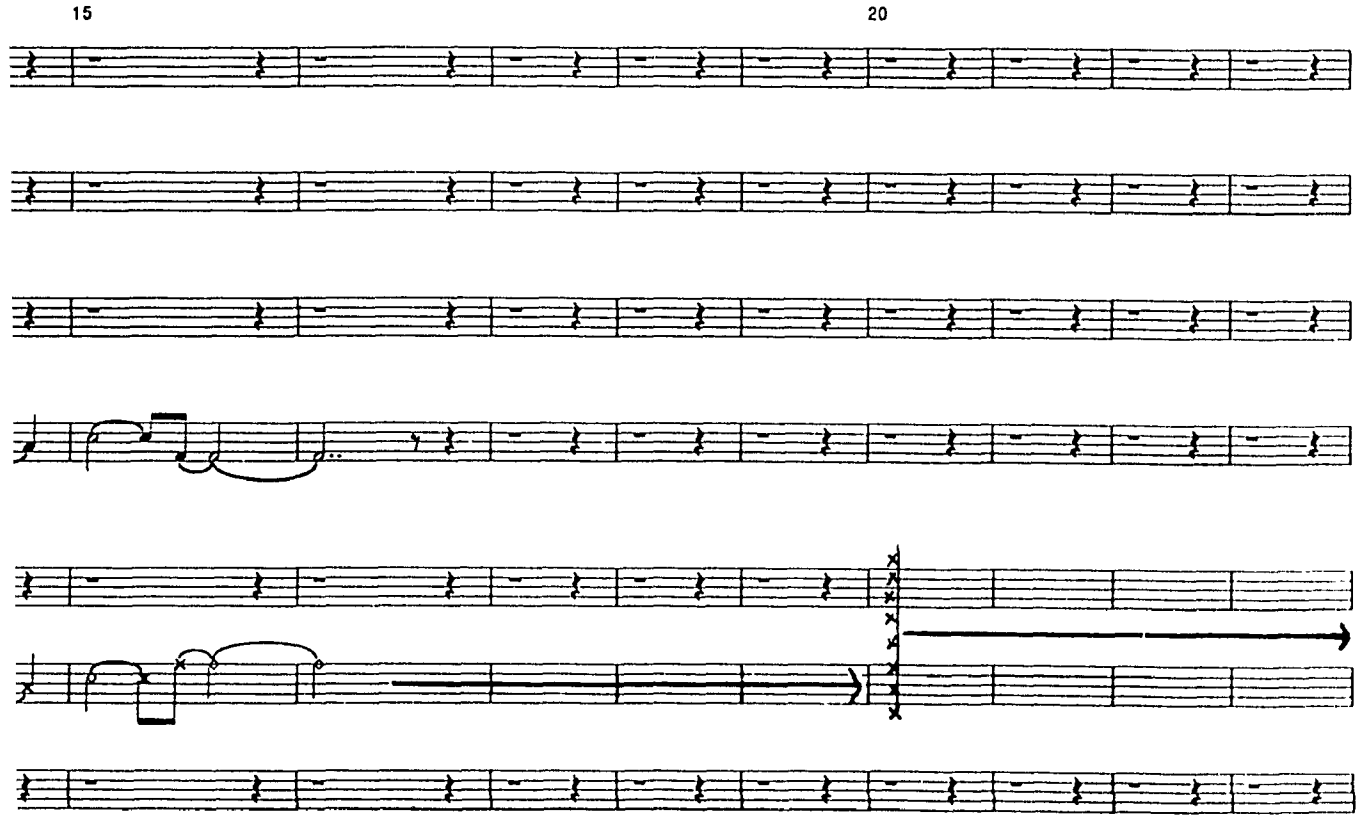

♩ = 60
5
Violin I
Violin II
Viola
Cello
TAPE IN - CUE 1
Tape cues
Tape cues
Voice

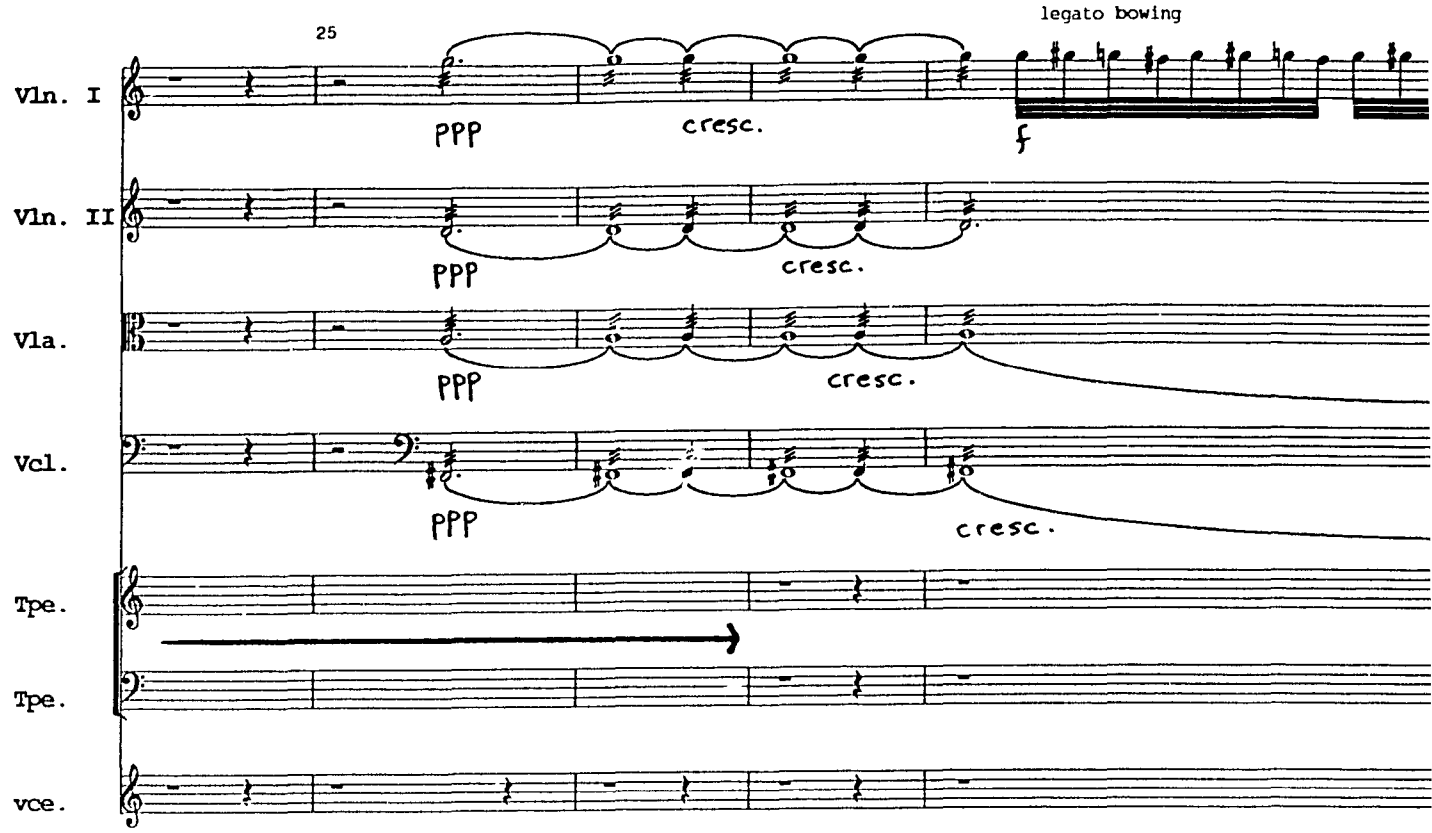

15
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

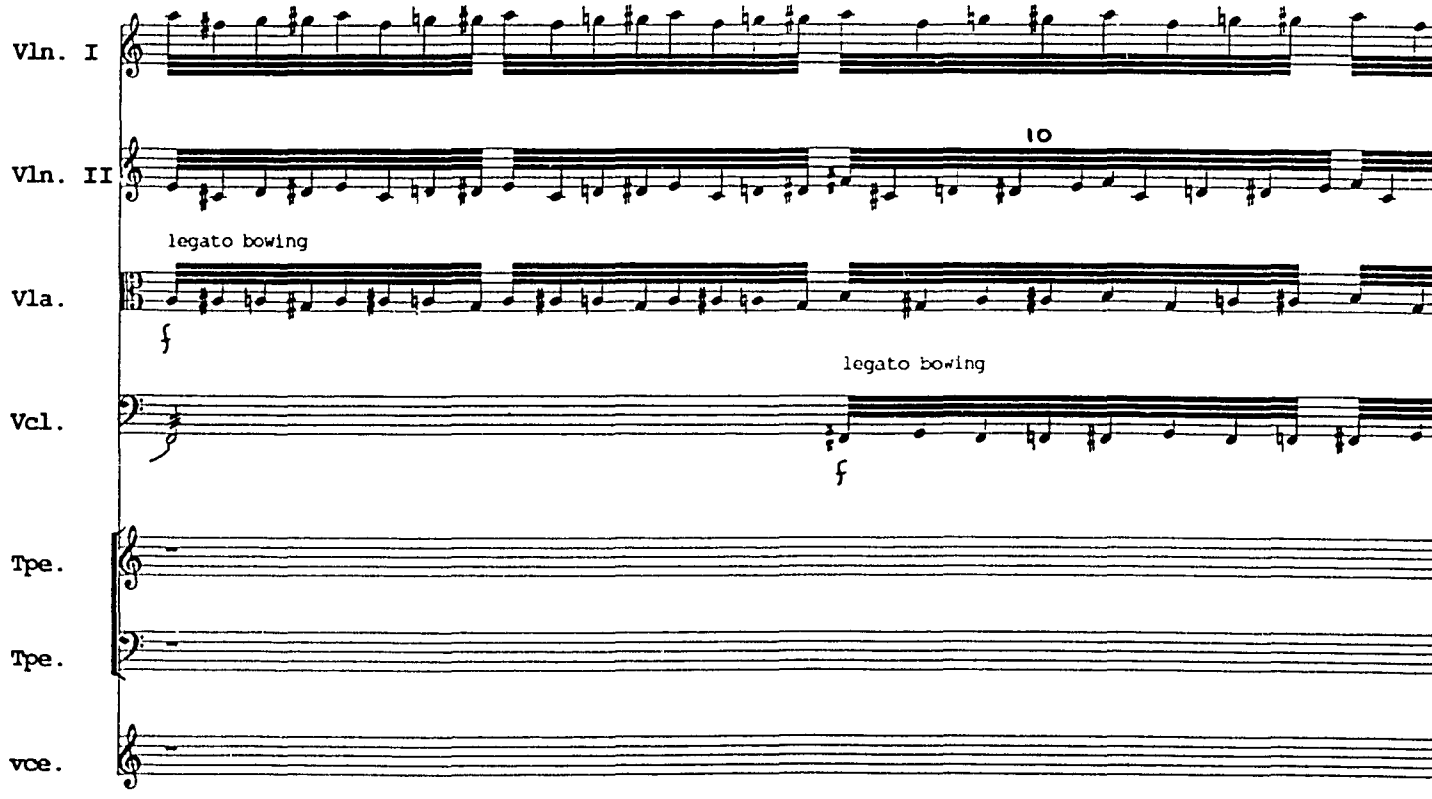
ELLIPSIS

Wende Bartley
1988

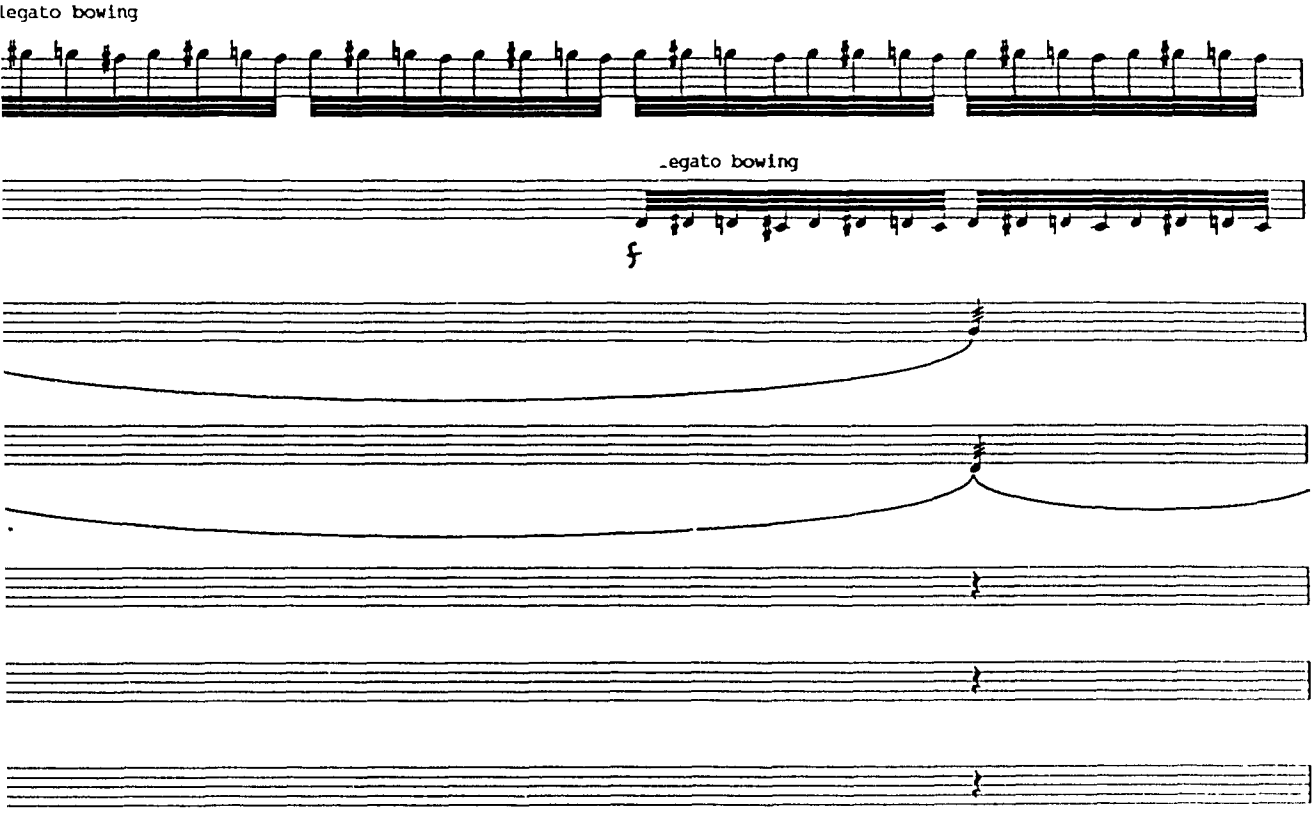





25
legato bowing
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
PPP
cresc.
f

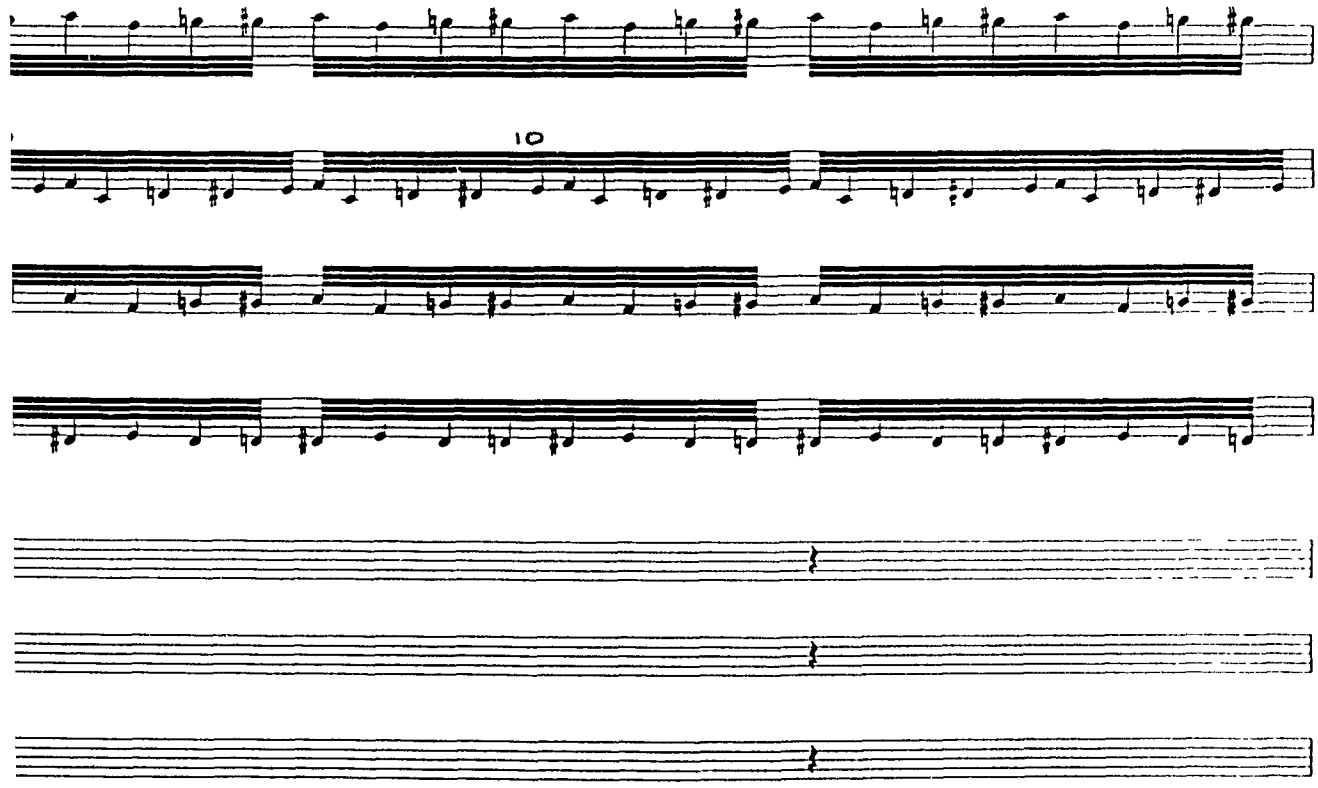

Vln. I
Vln. II
10
legato bowing
Vla.
f
legato bowing
Vcl.
f
Tpe.
Tpe.
vce.

legato bowing



legato bowing

f



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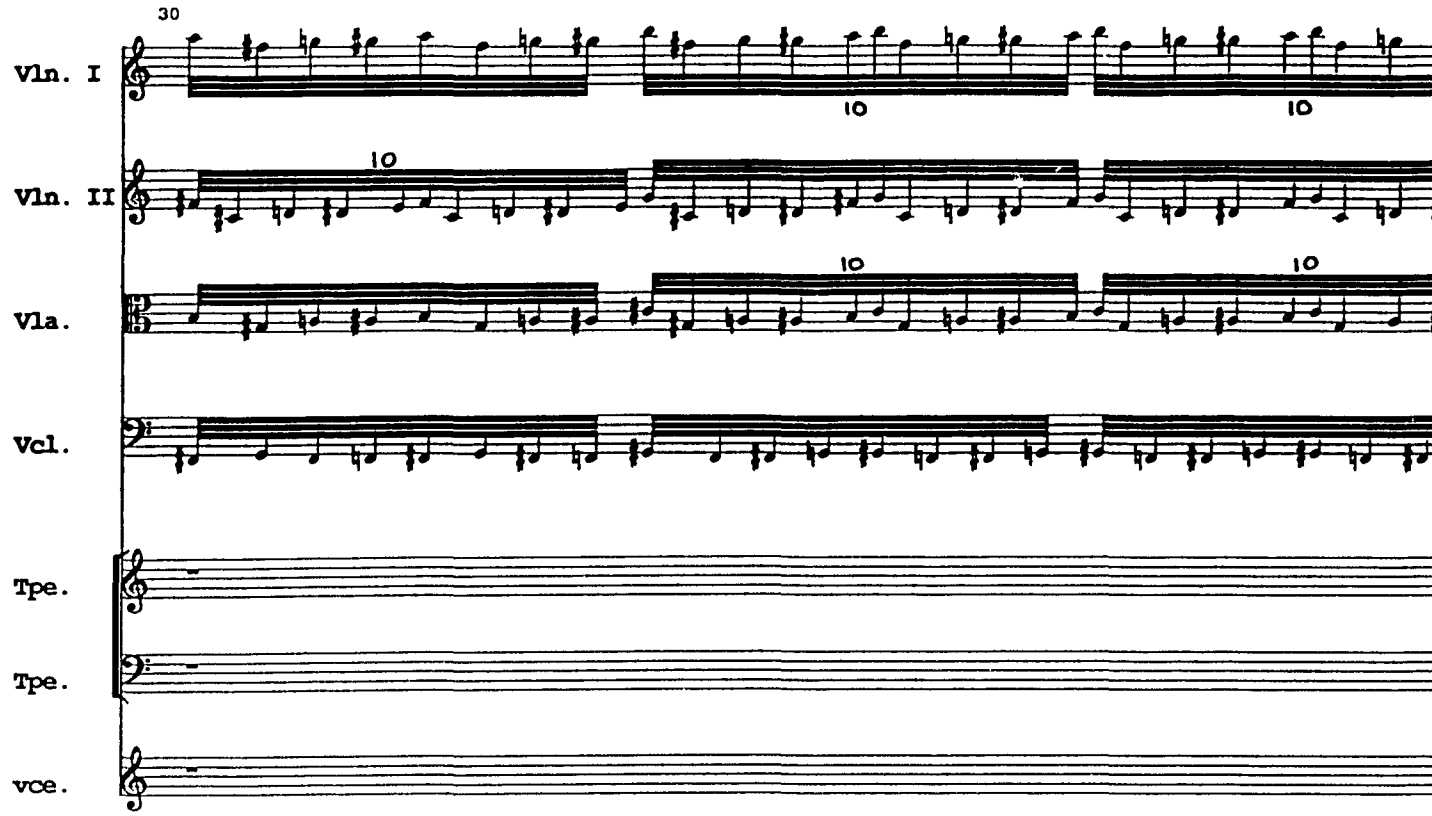
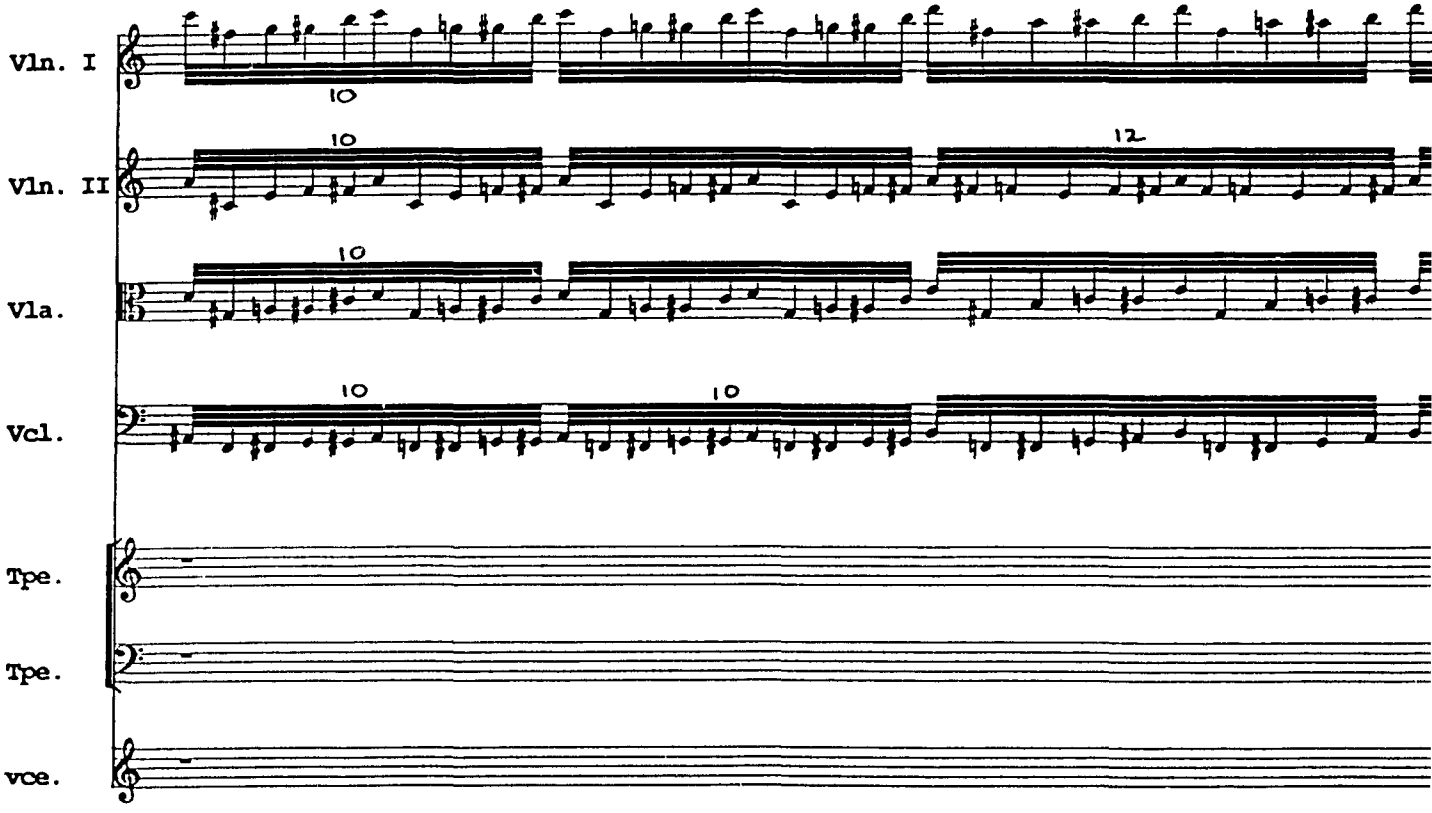
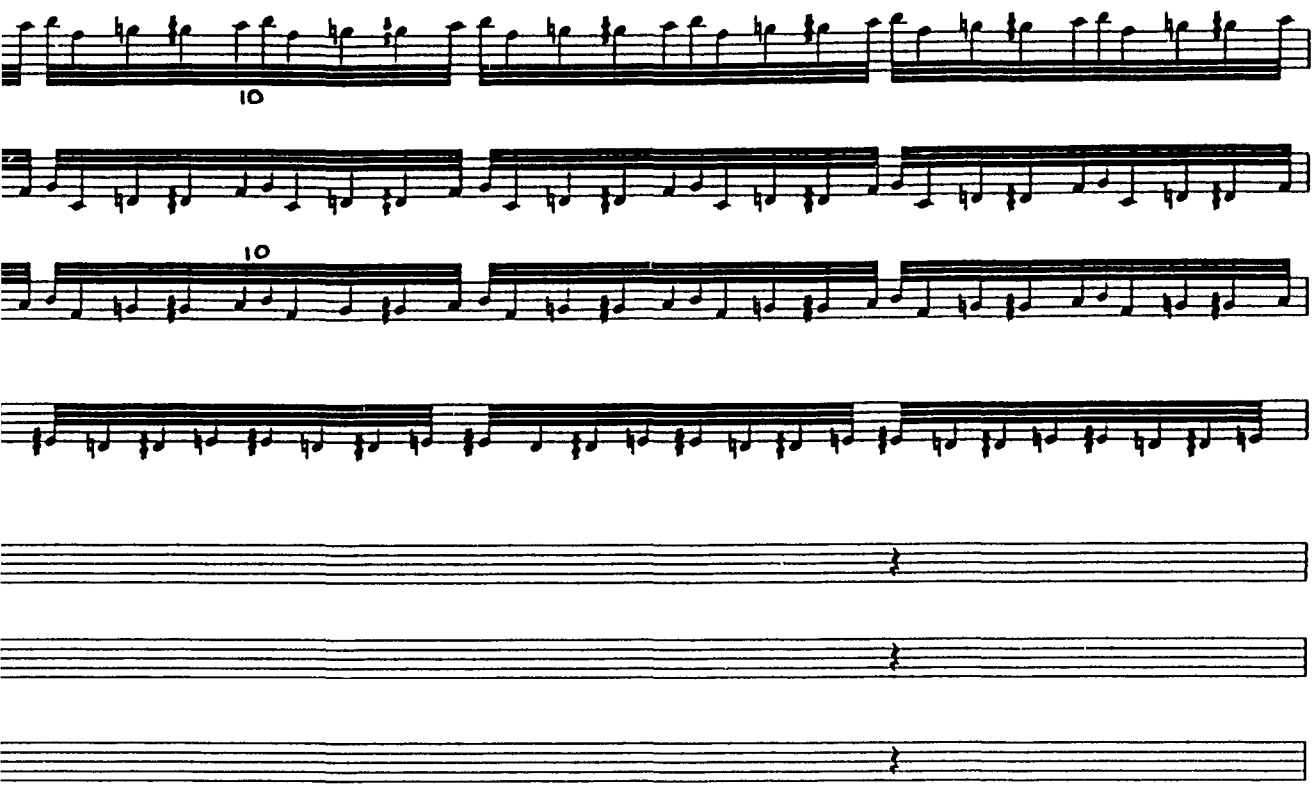
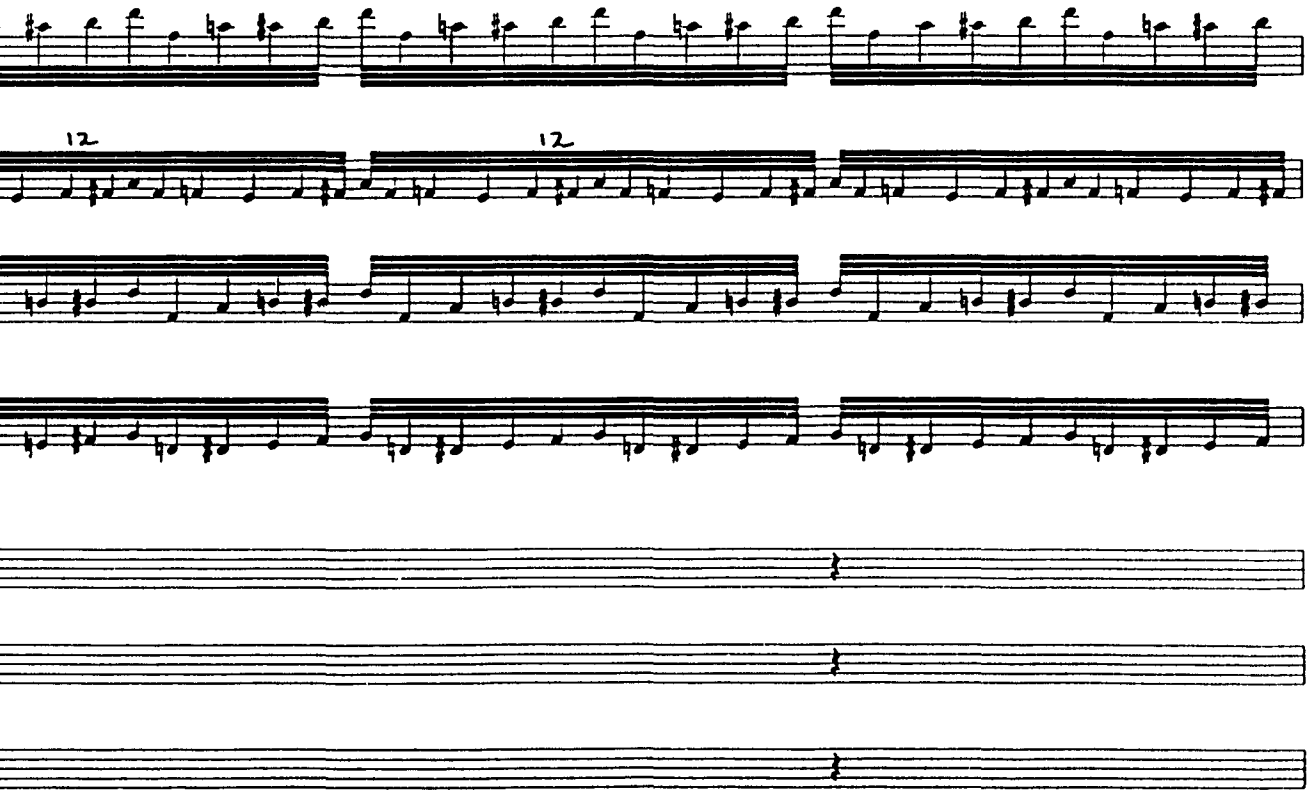
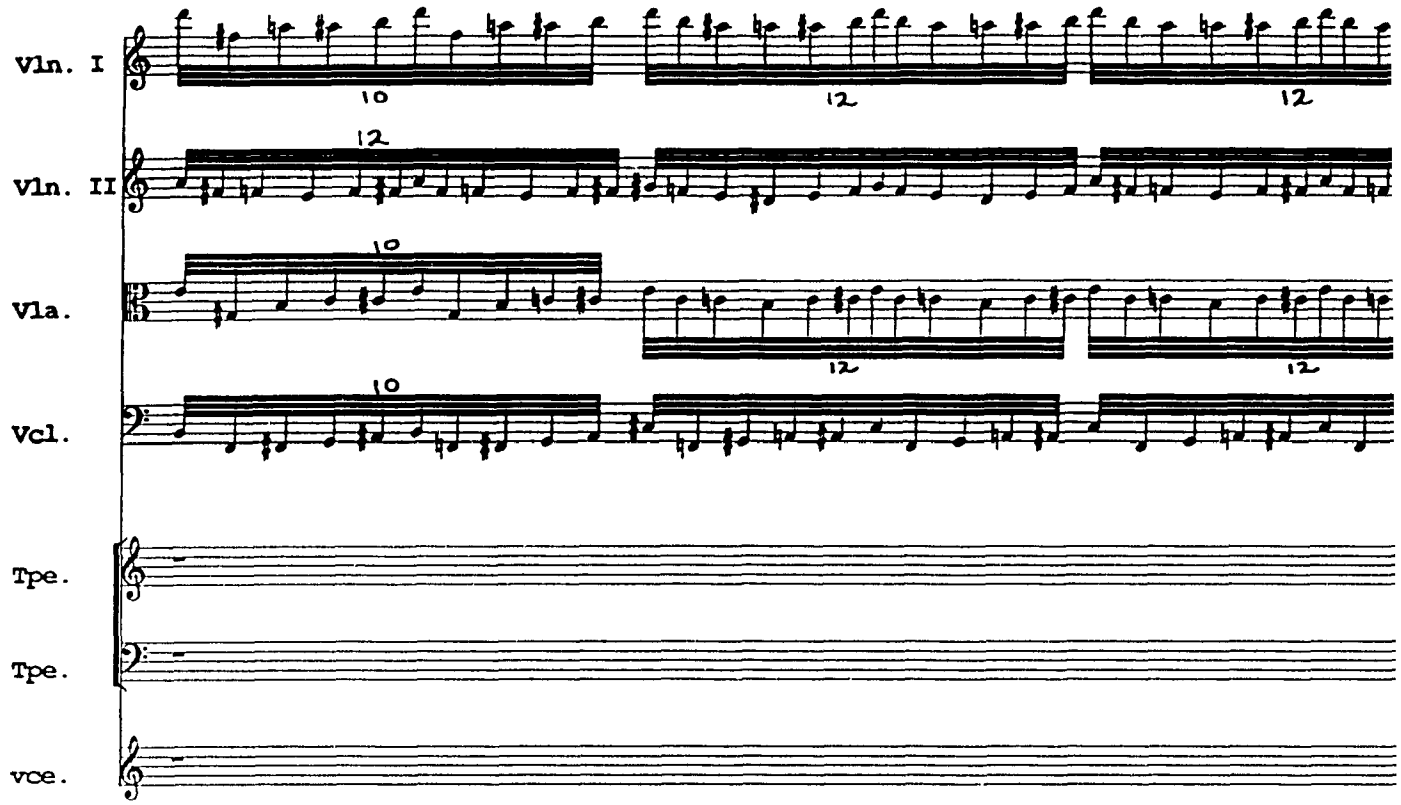
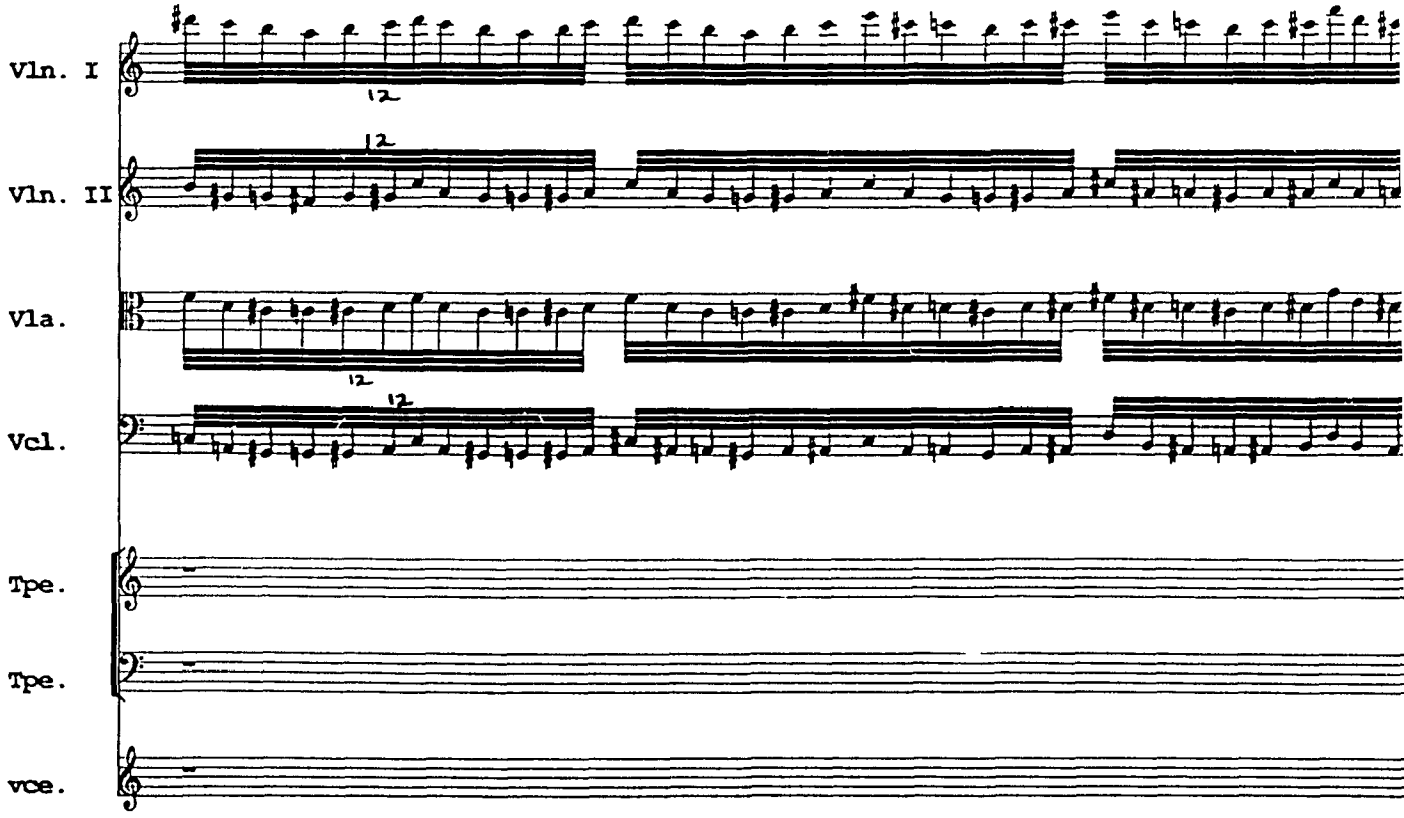

30
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

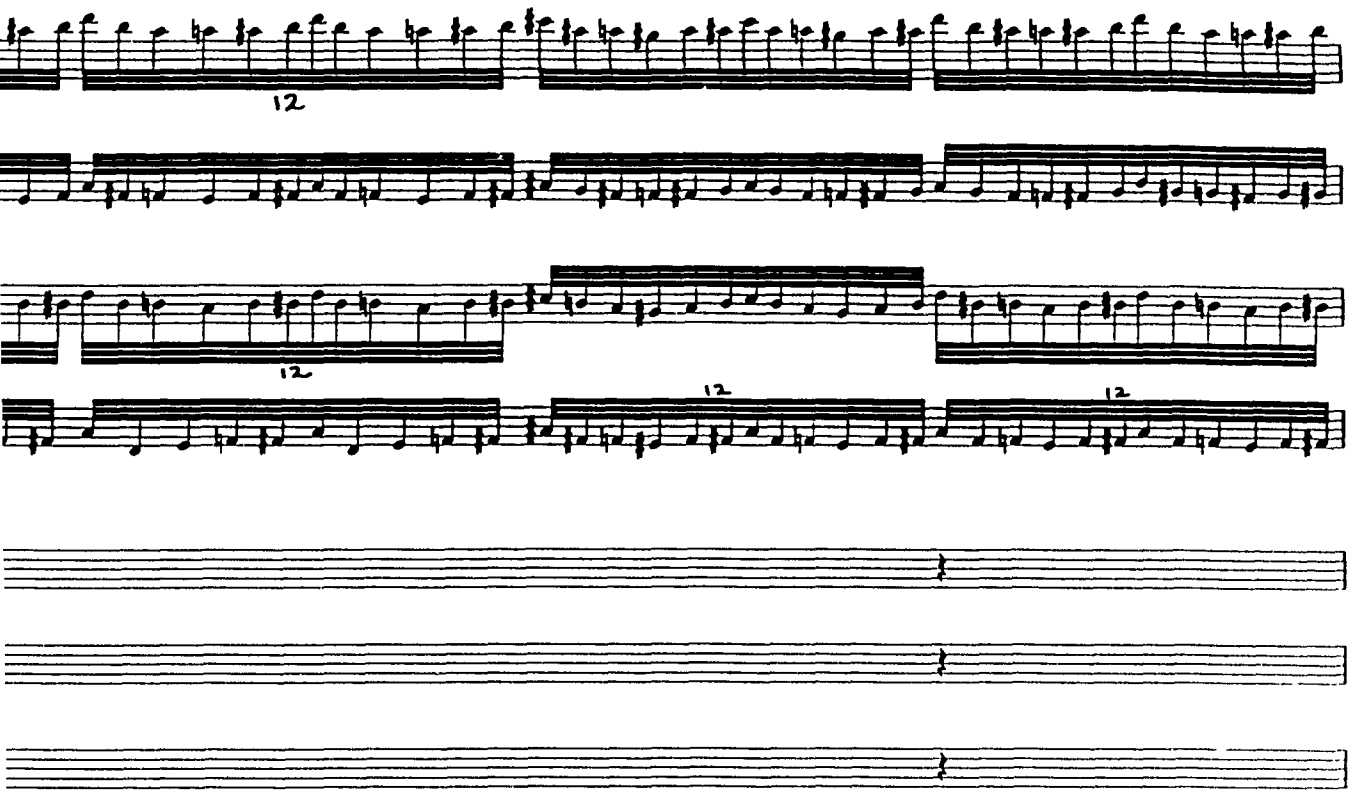

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

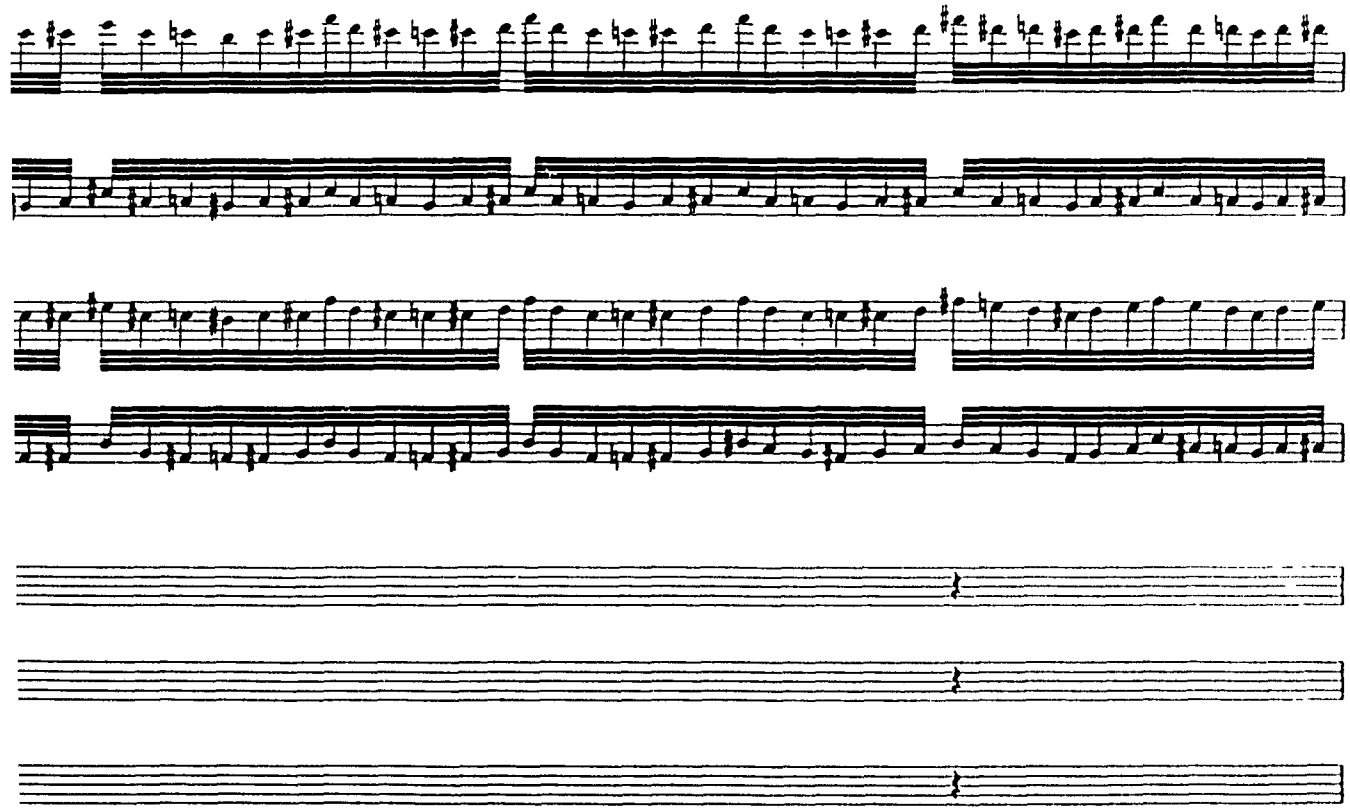

10
10

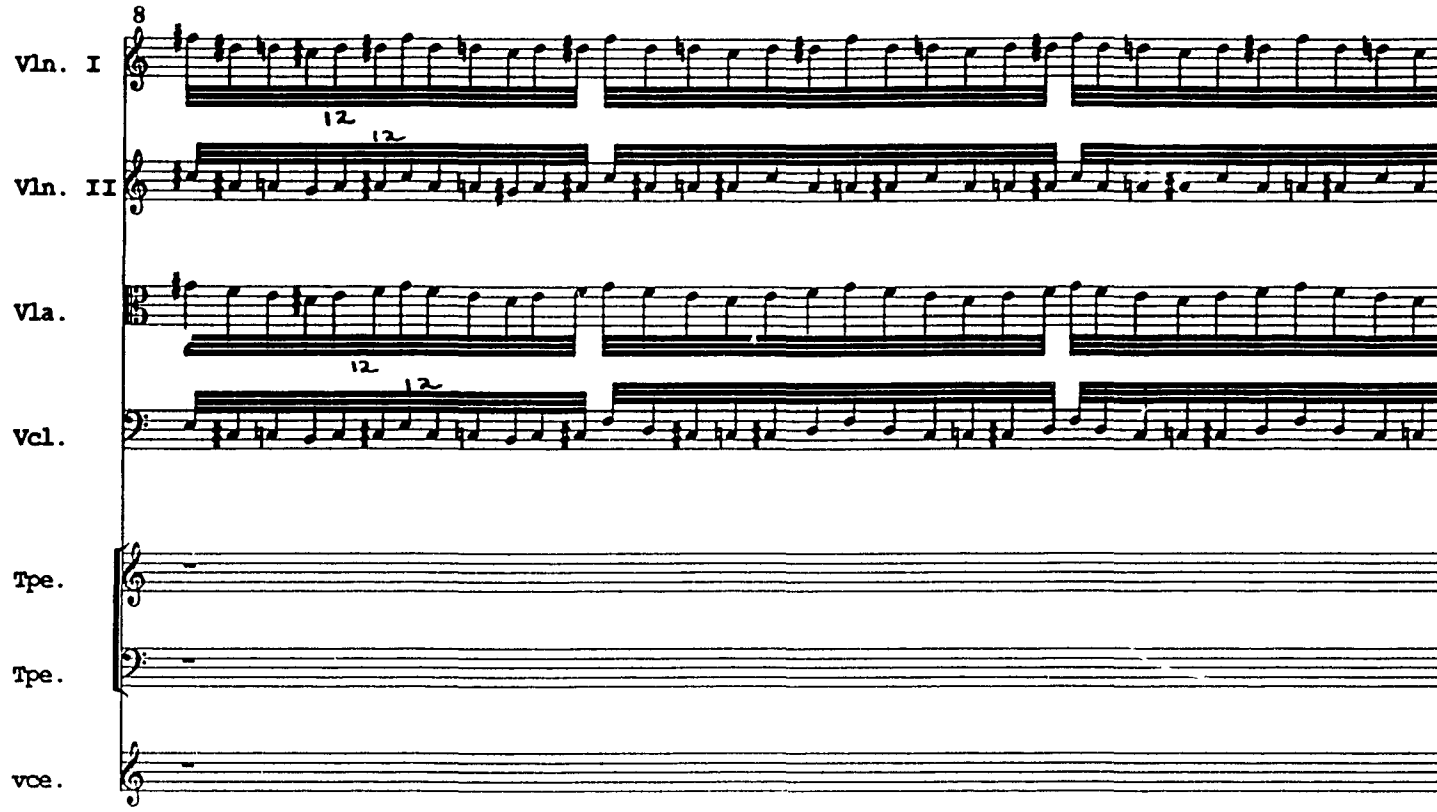

12
12

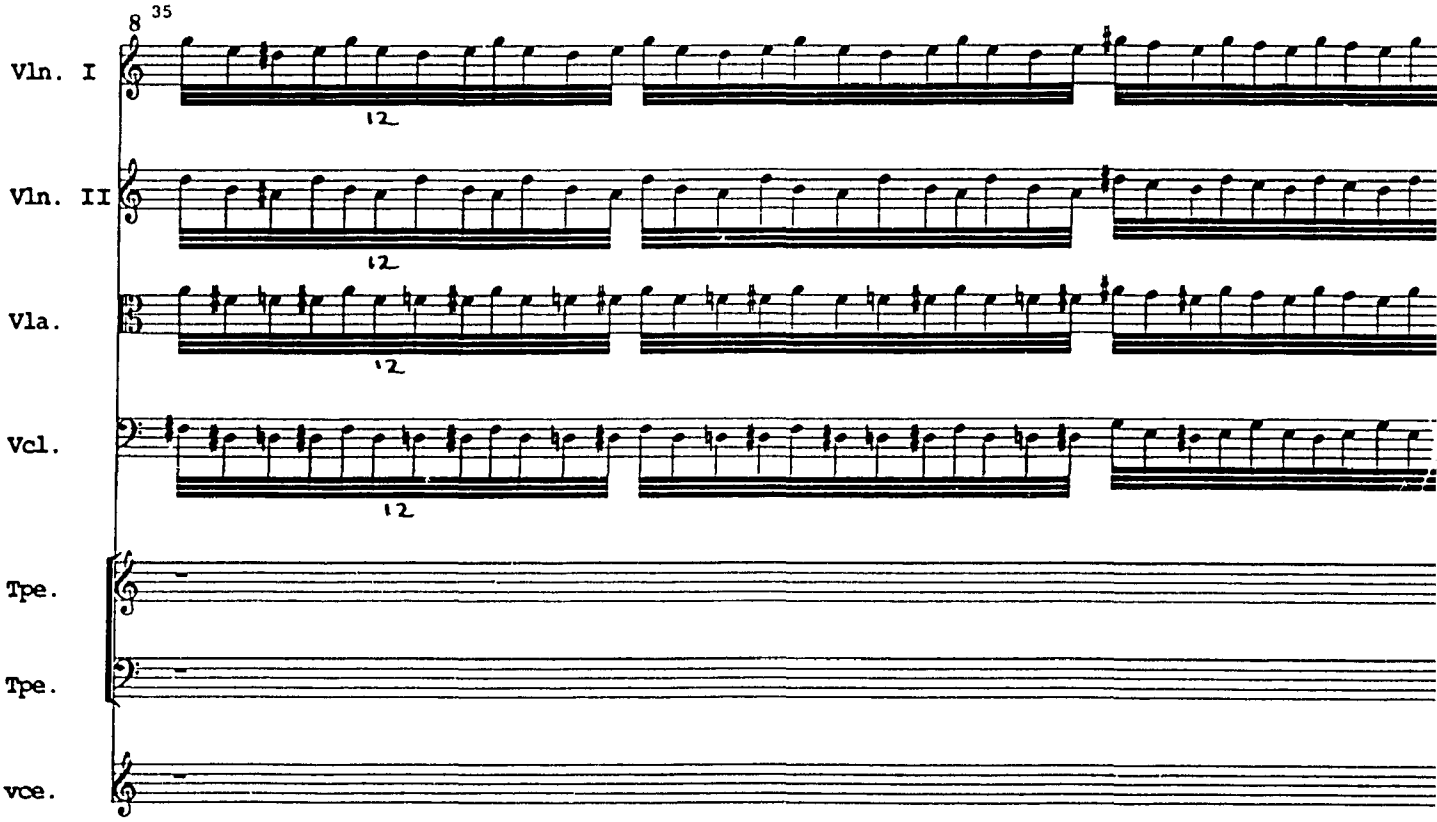

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

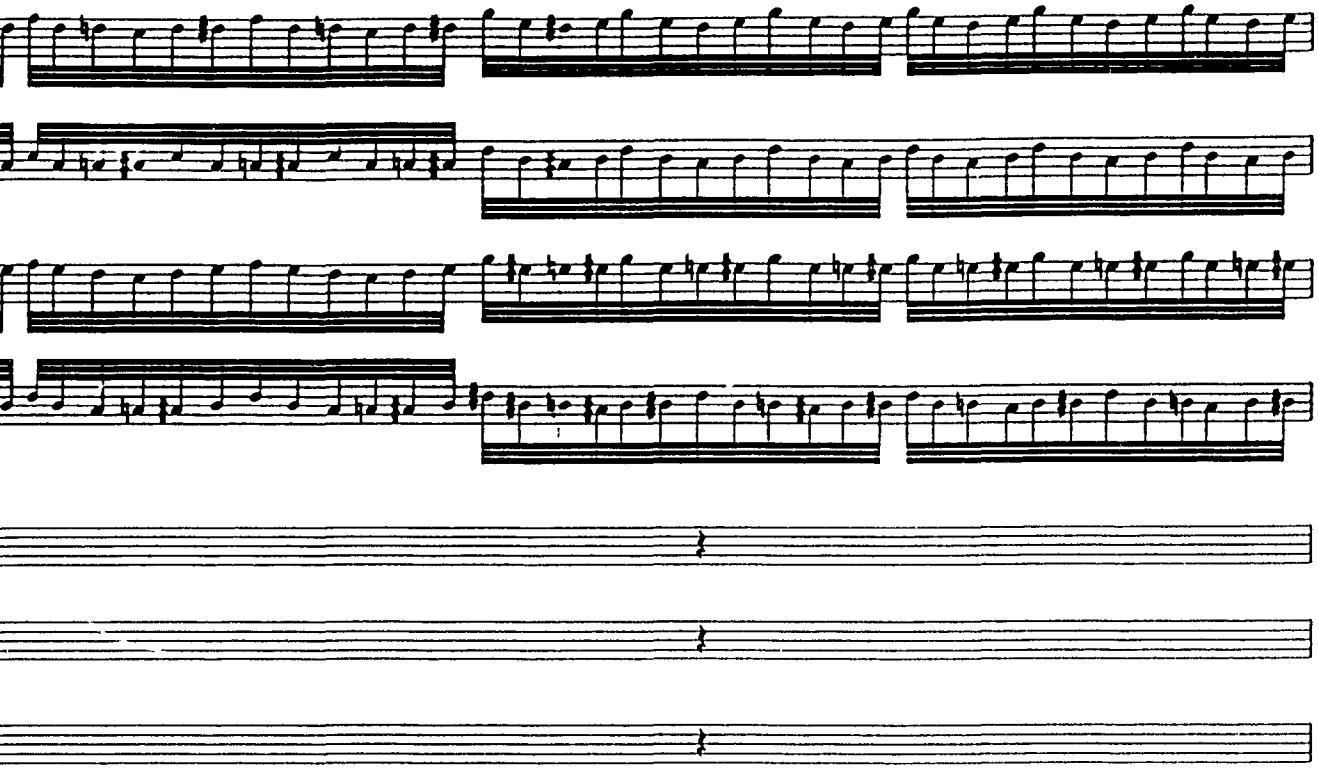

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

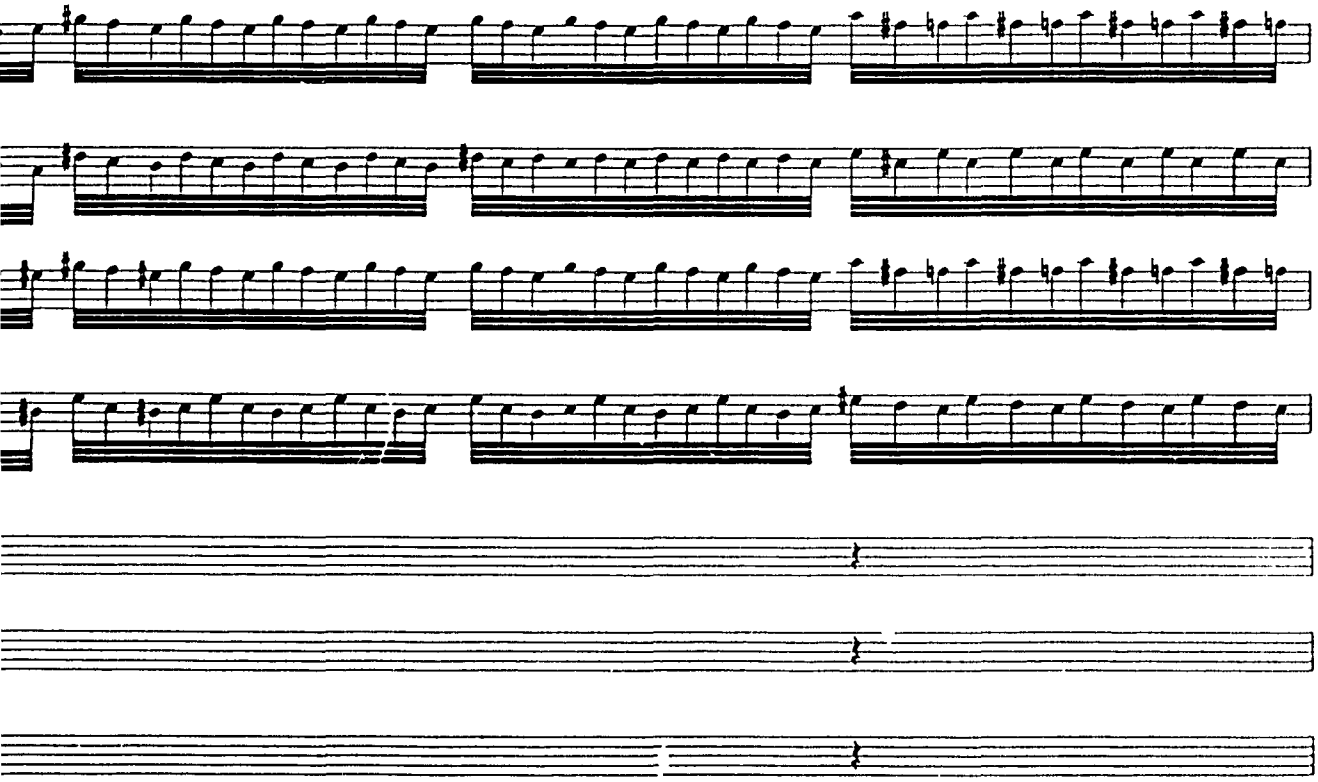

12
12
12
12

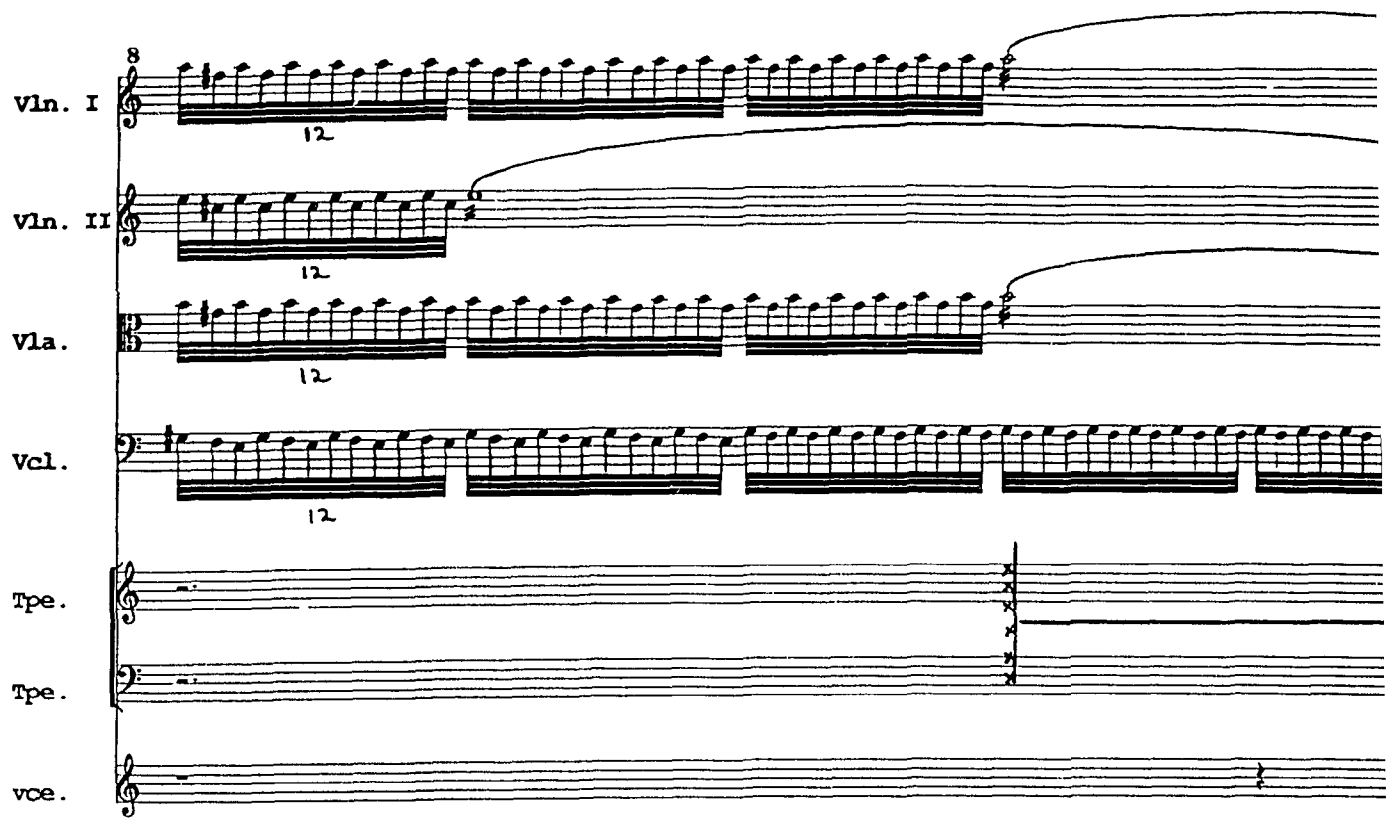


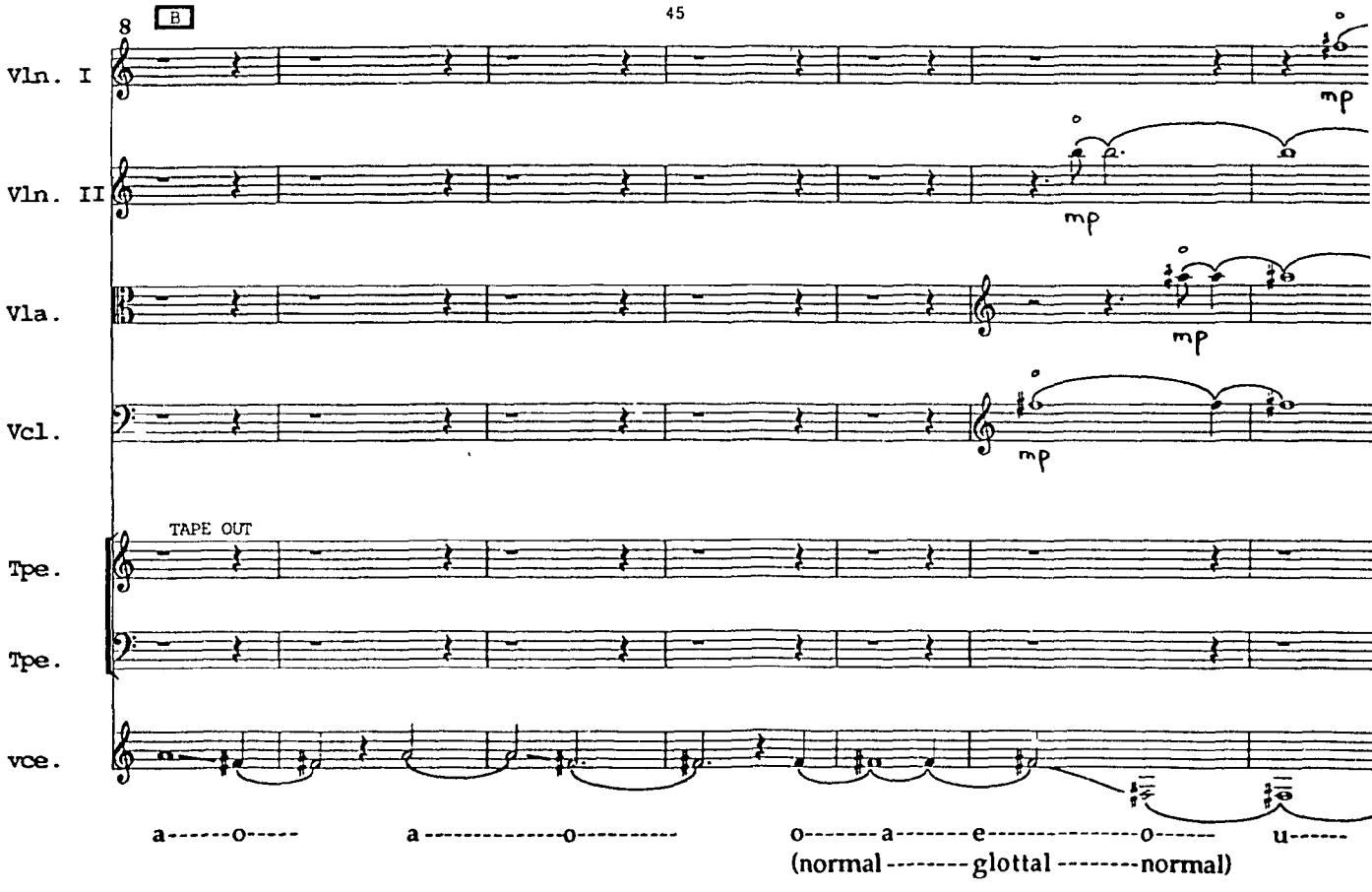

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

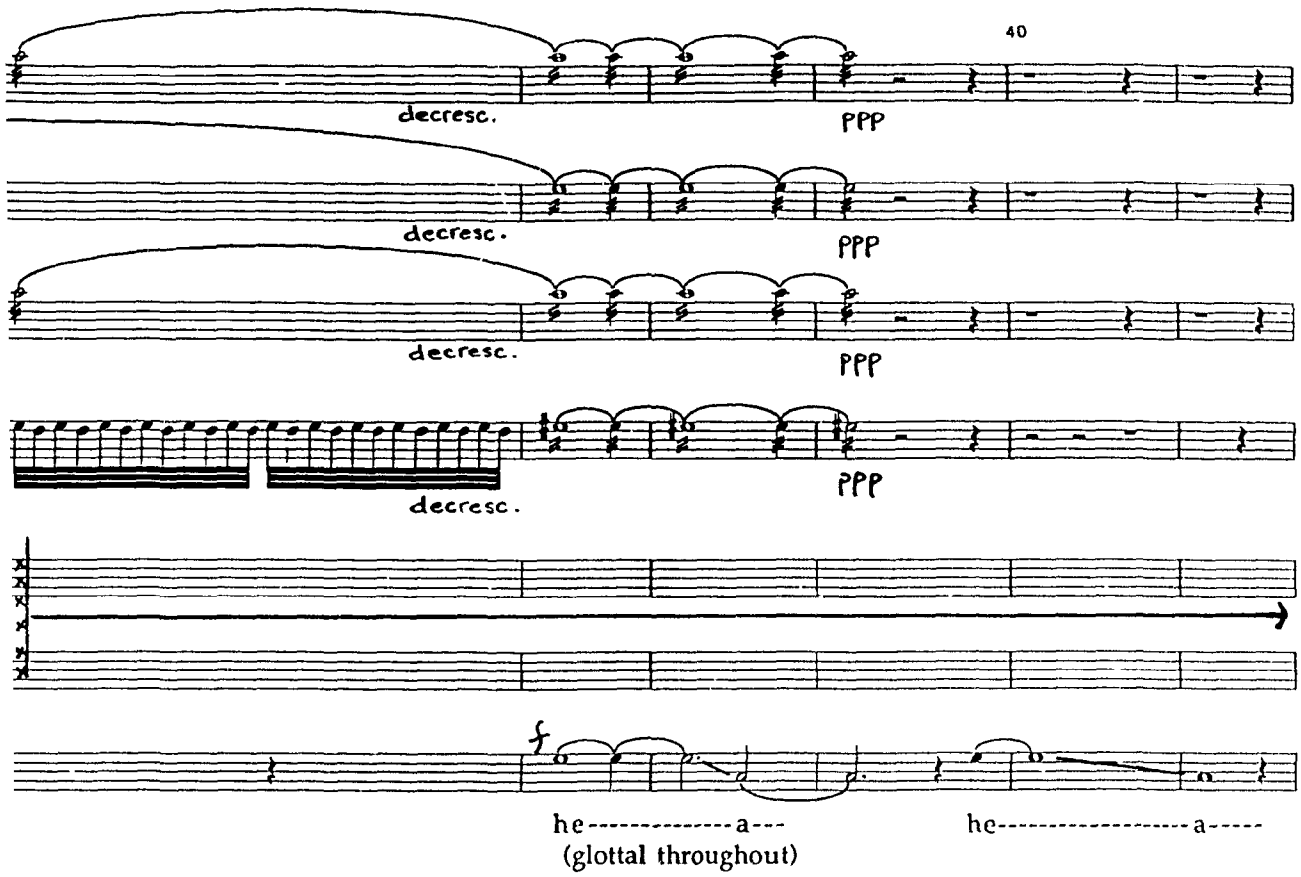

8
35
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

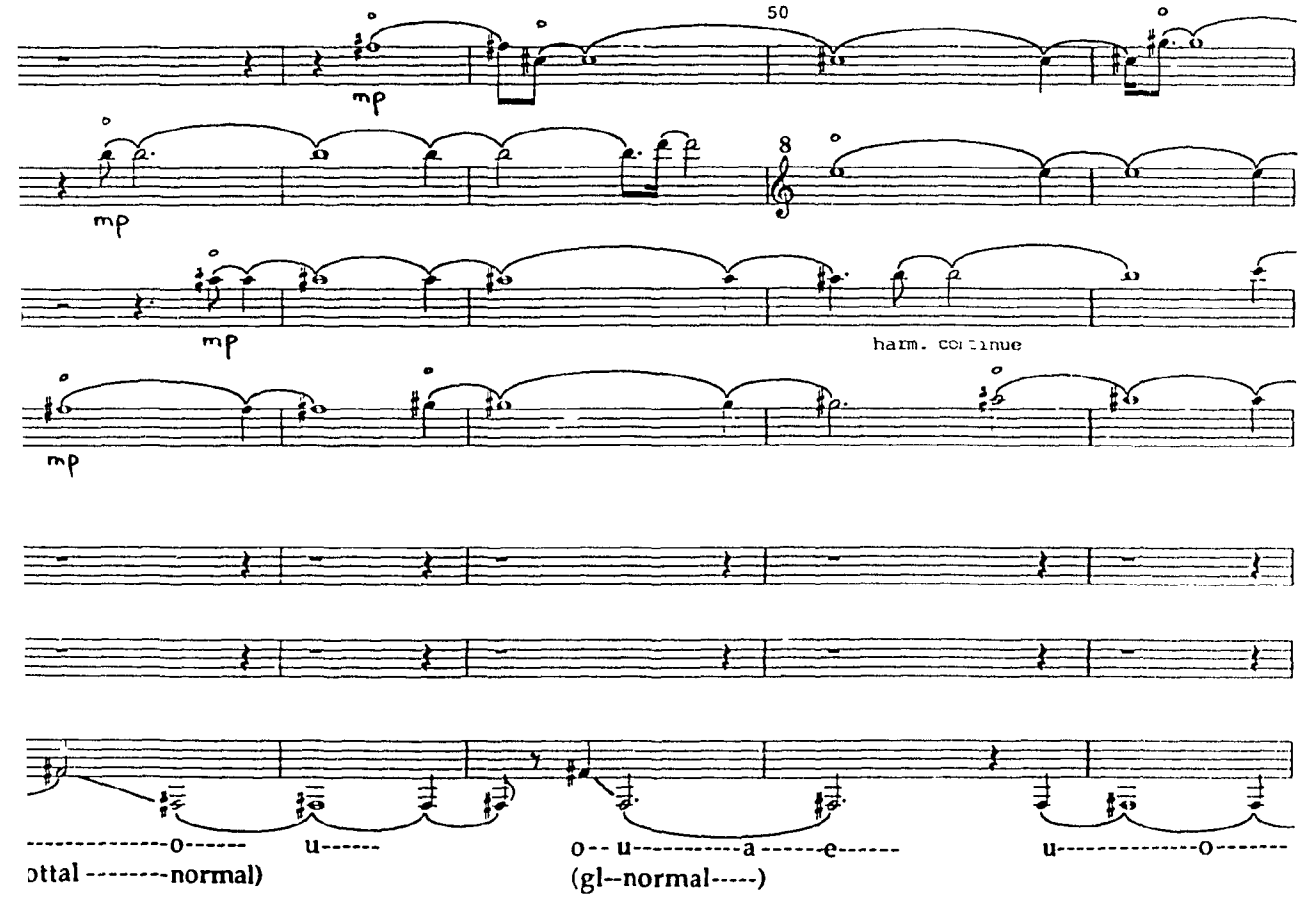


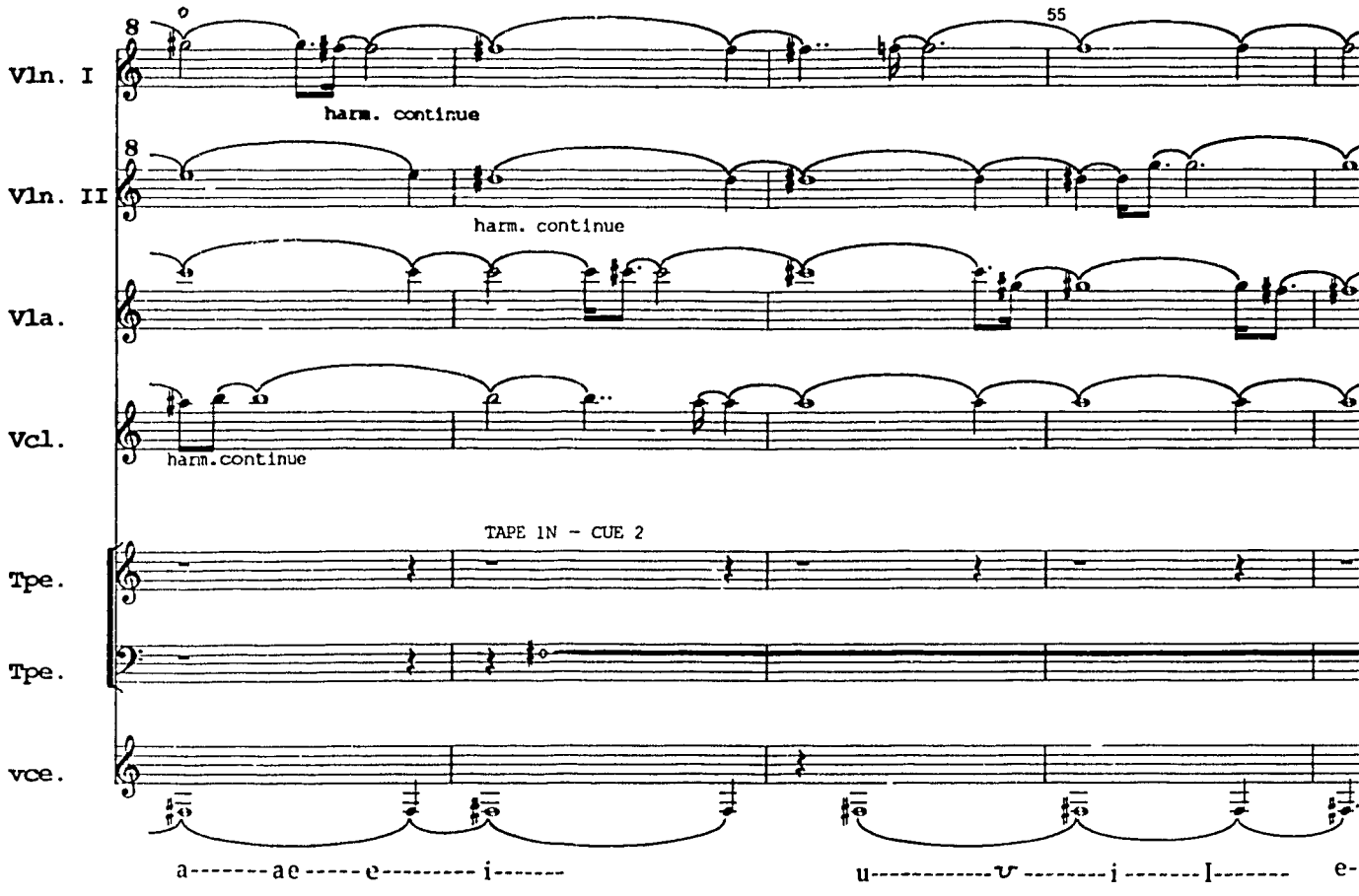


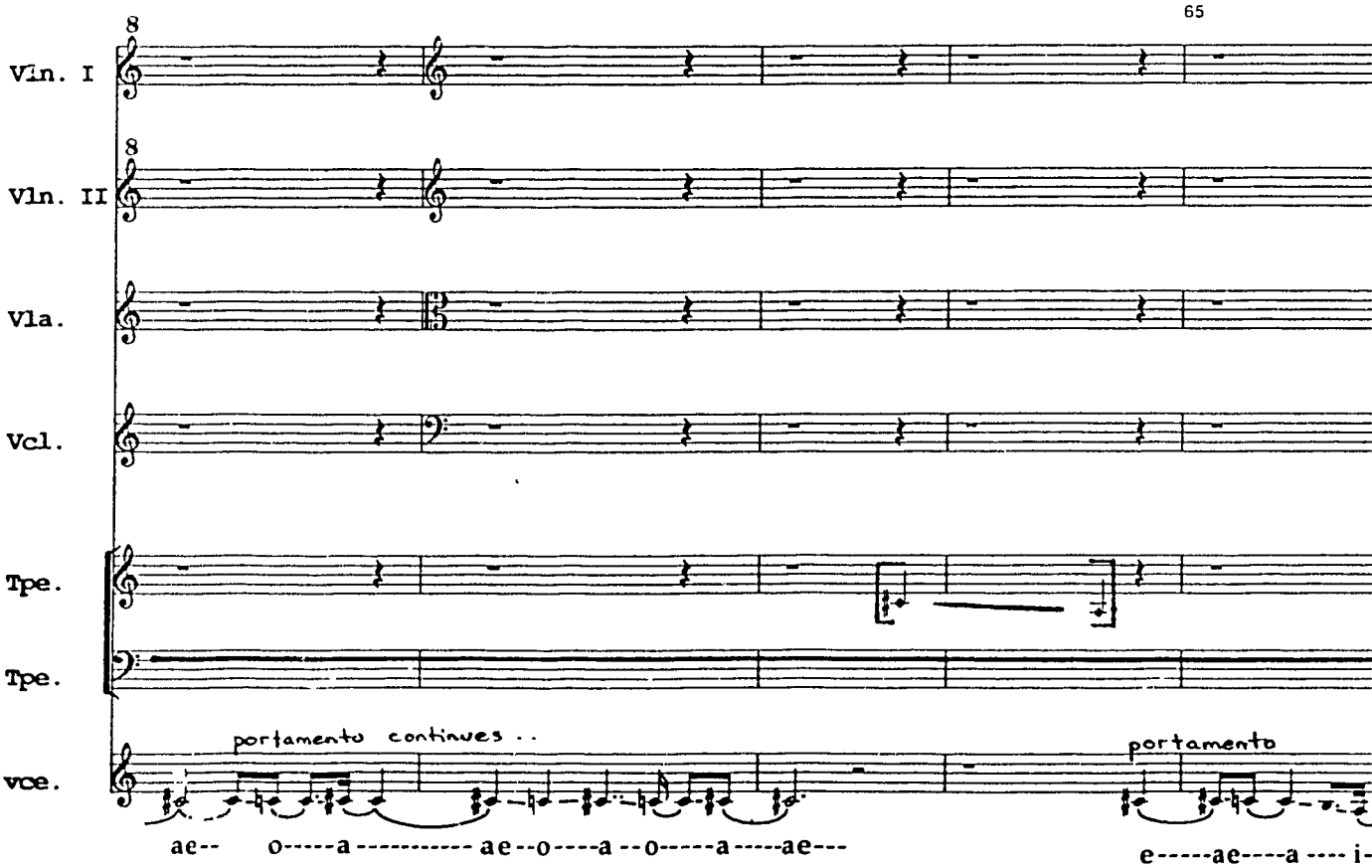

8
Vln. I
Vln. II
Vla.
Vcl.
12
Tpe.
Tpe.
vce.

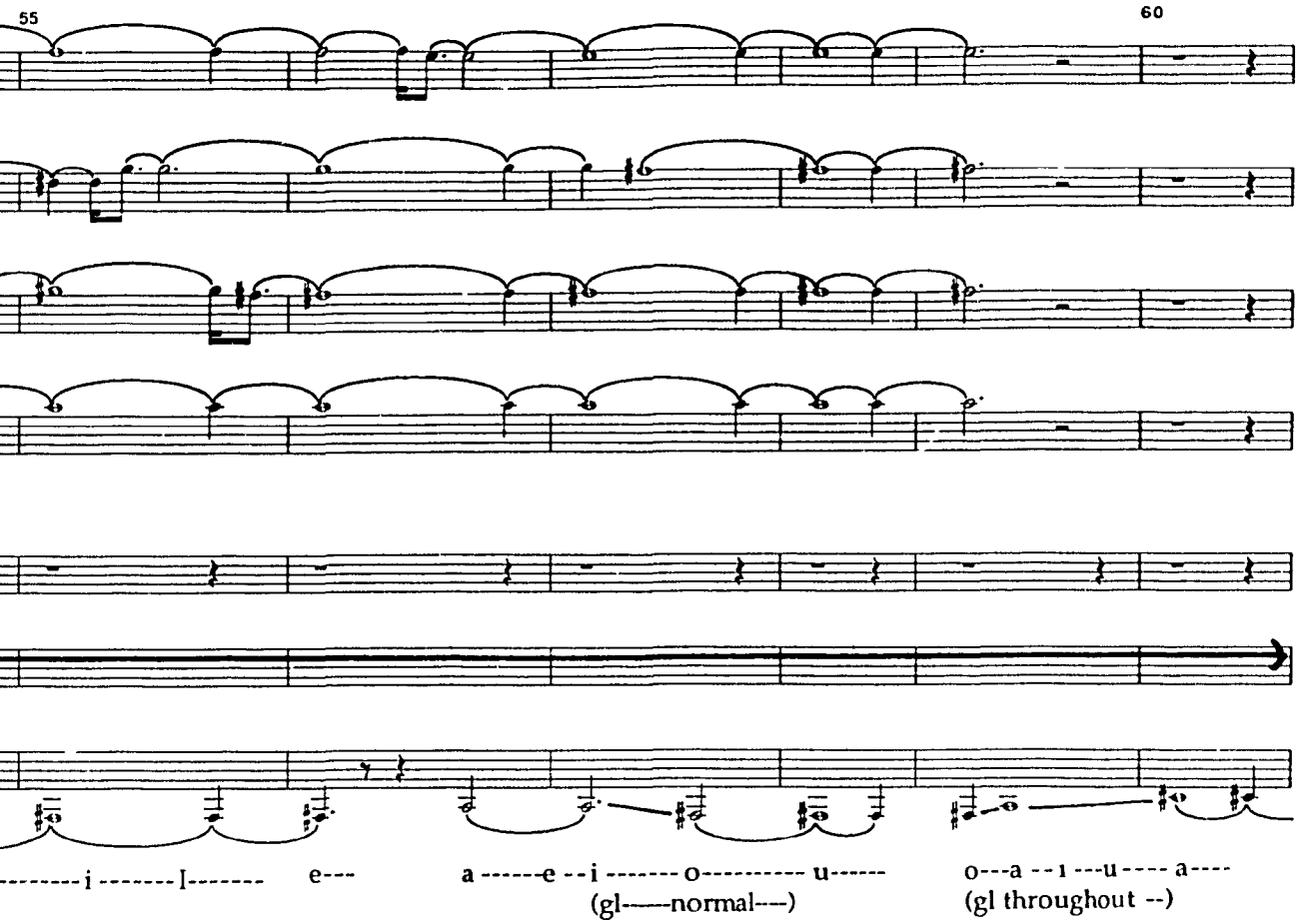

B
45
8
Vln. I
Vln. II
Vla.
Vcl.
mp
TAPE OUT
Tpe.
Tpe.
vce.
a------o-----
a----------o----------
o-------a-------e----------o------
u------
(normal--------glottal--------normal)

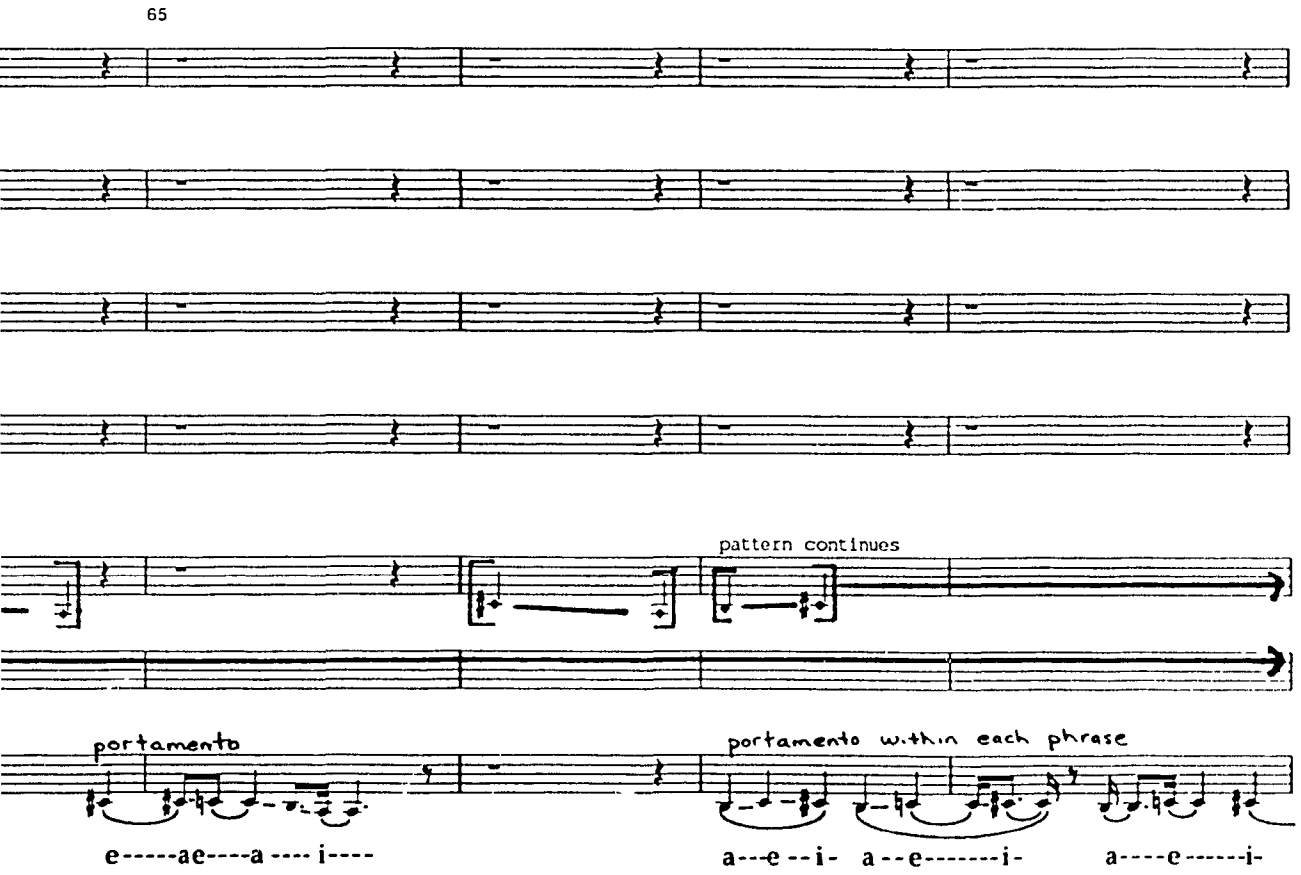

40
decresc.
PPP
decresc.
PPP
decresc.
PPP
decresc.
PPP
f
he----------a---
(glottal throughout)
he----------a-----

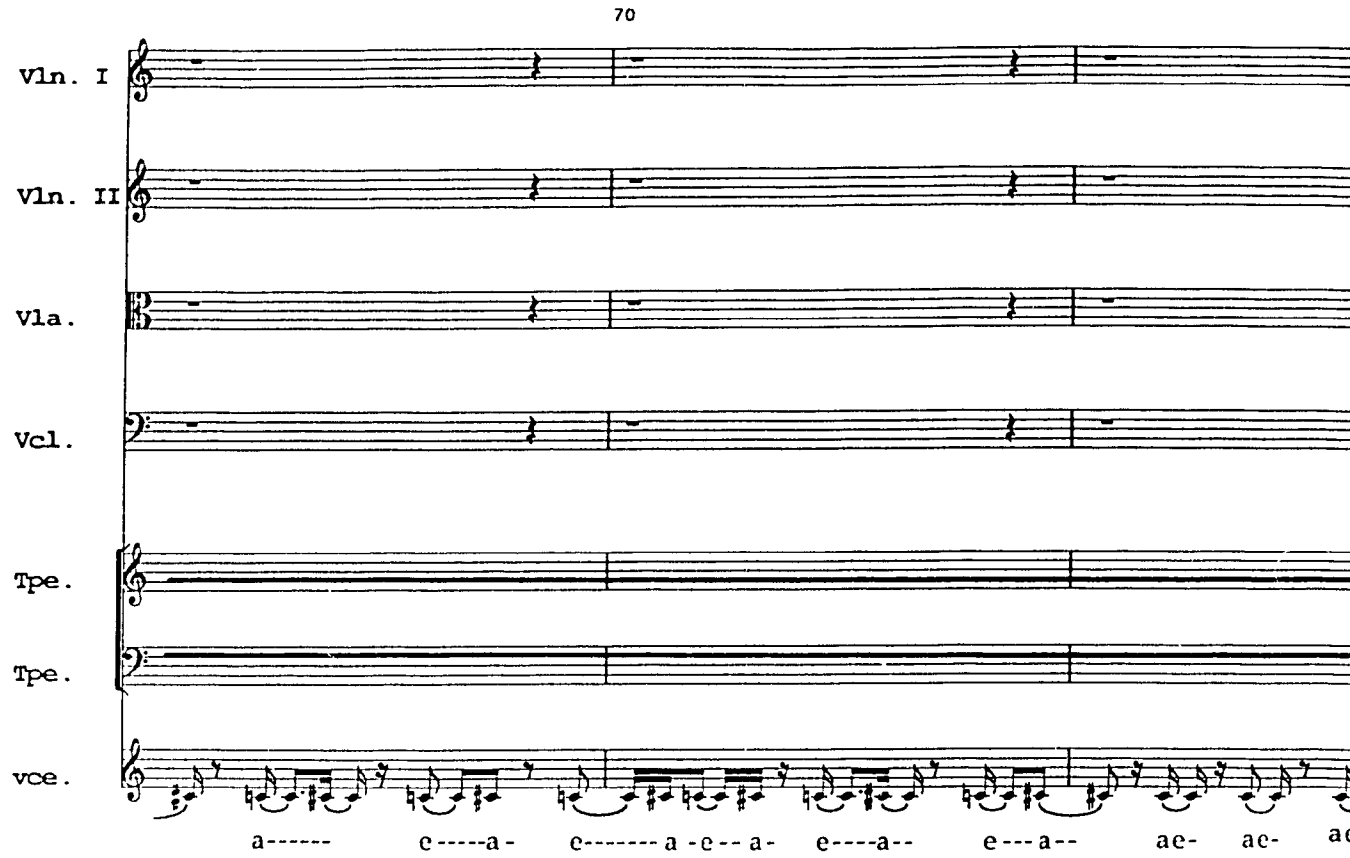

50
mp
mp
8
mp
harm. continue
mp
----------o------
u------
o-- u----------a------e------
u----------o------
ottal --------normal)
(gl--normal-----)

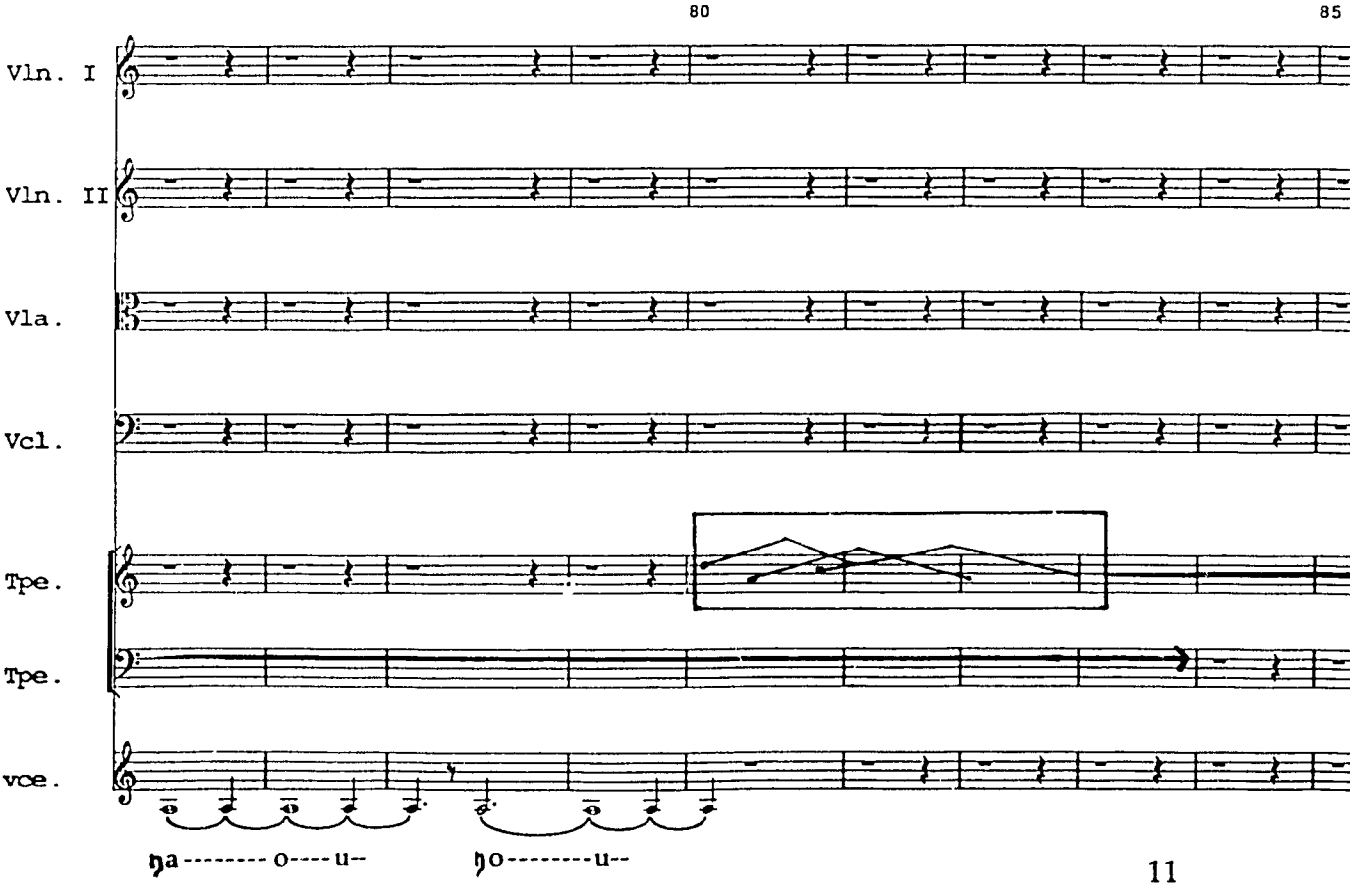

55
Vln. I
harm. continue
Vln. II
harm. continue
Vla.
Vcl.
harm.continue
TAPE IN - CUE 2
Tpe.
Tpe.
vce.
a-------ae-----e--------i-------
u----------v--------i-------I-------
e-

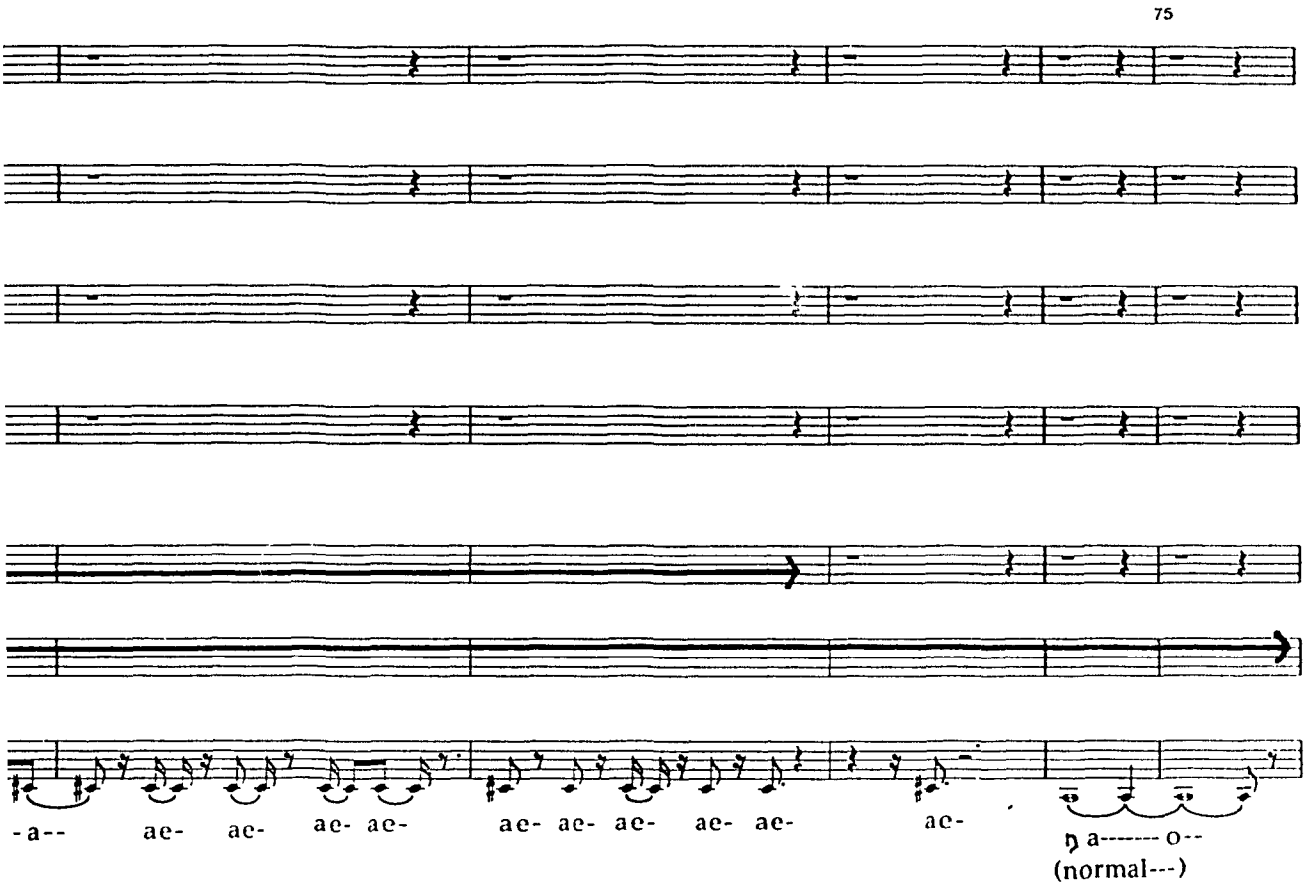

65
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
portamento continues . .
portamento
vce.
ae-- o-----a---------- ae--o----a--o-----a-----ae---
e-----ae----a----i-

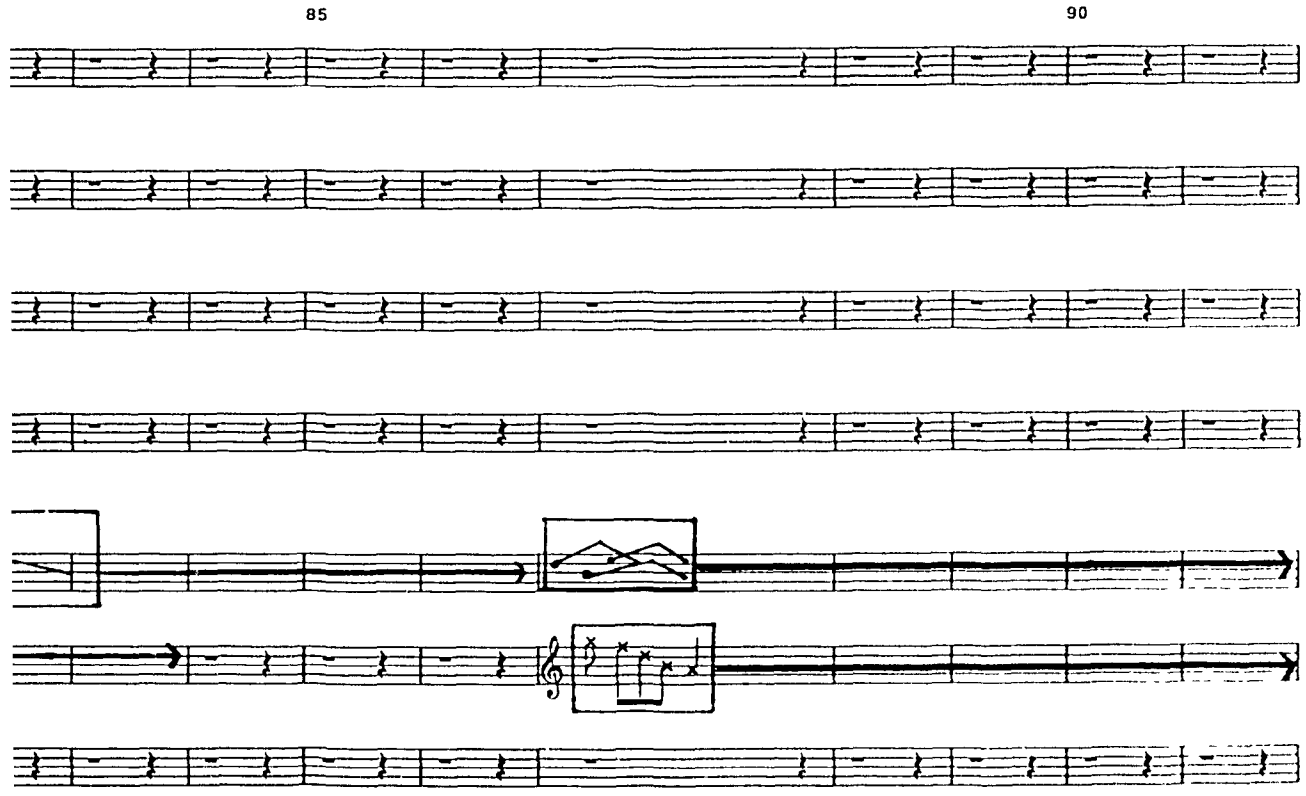

55
60
-------i -------l------- e--- a ------e --i ------- o---------- u------
(gl-----normal----)
o---a --ı ---u ---- a----
(gl throughout --)


65
pattern continues
portamento
portamento within each phrase
e-----ae----a ---- i----
a---e --i- a --e-------i- a----e------i-


70
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
a------ e-----a- e-------a -e--a- e----a-- e---a-- ae- ae- a


80
85
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
ŋa-------- o---- u-- ŋo-------u--


75
-a-- ae- ae- ae- ae- ae- ae- ae- ae- ae- ae-
a------ o--
(normal---)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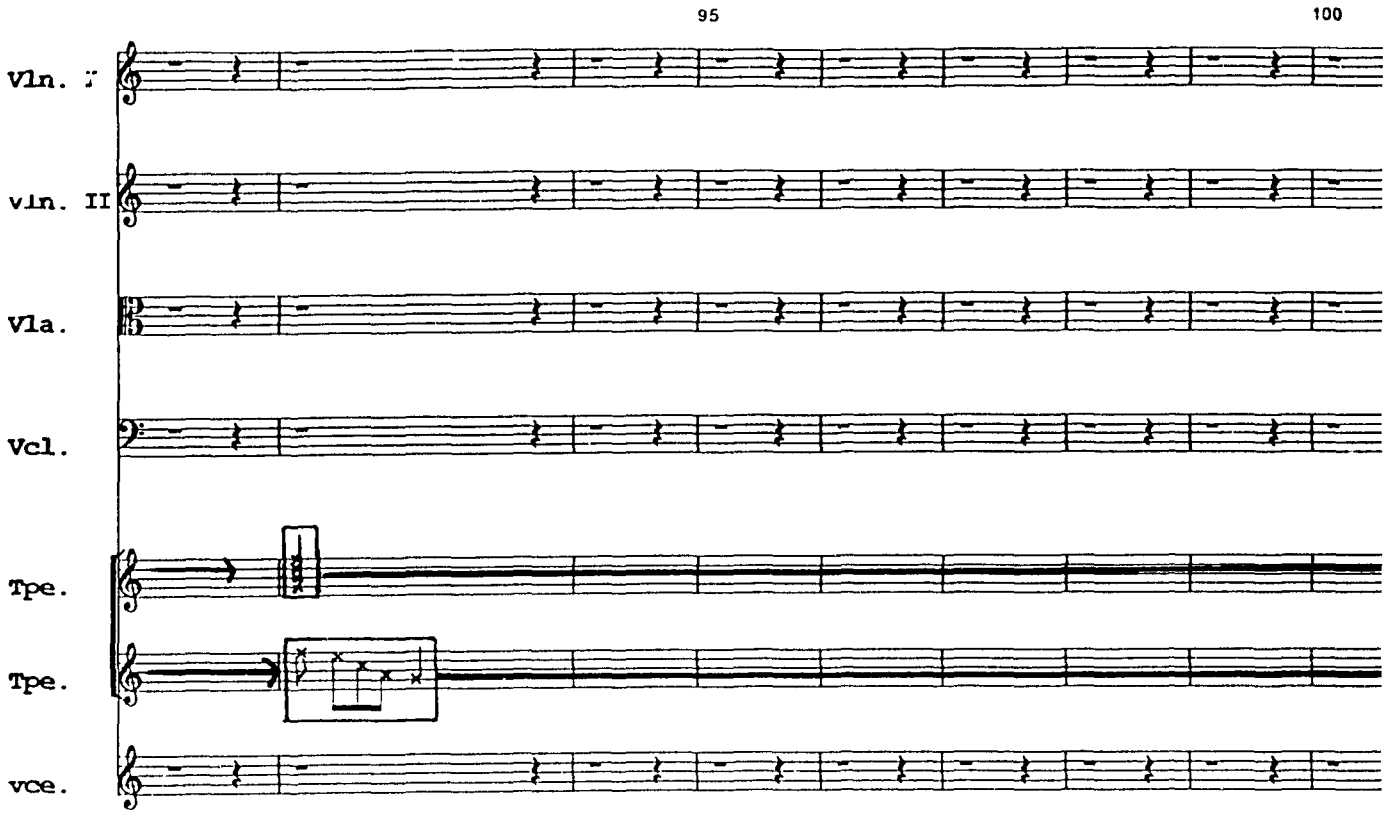
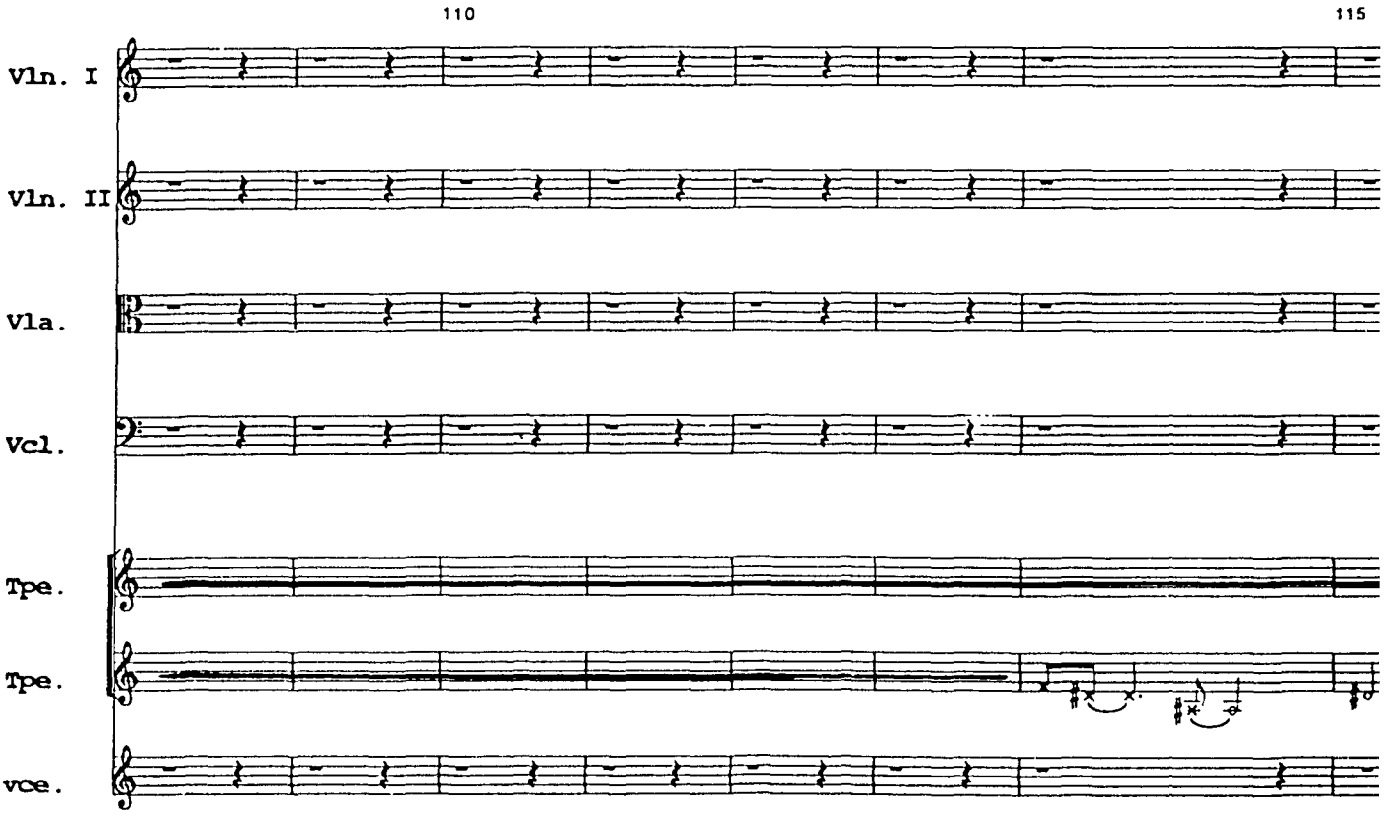
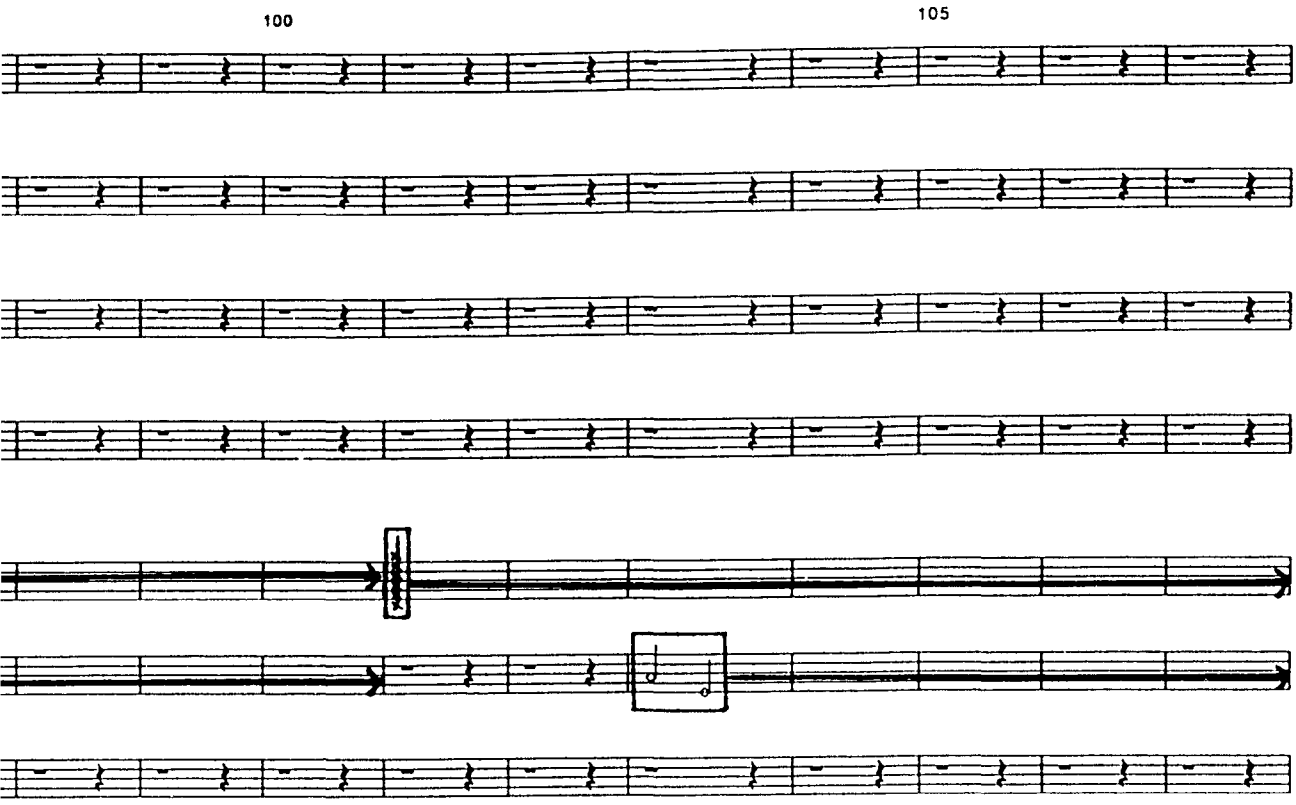

95
100
Vln. I
vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.


110
115
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.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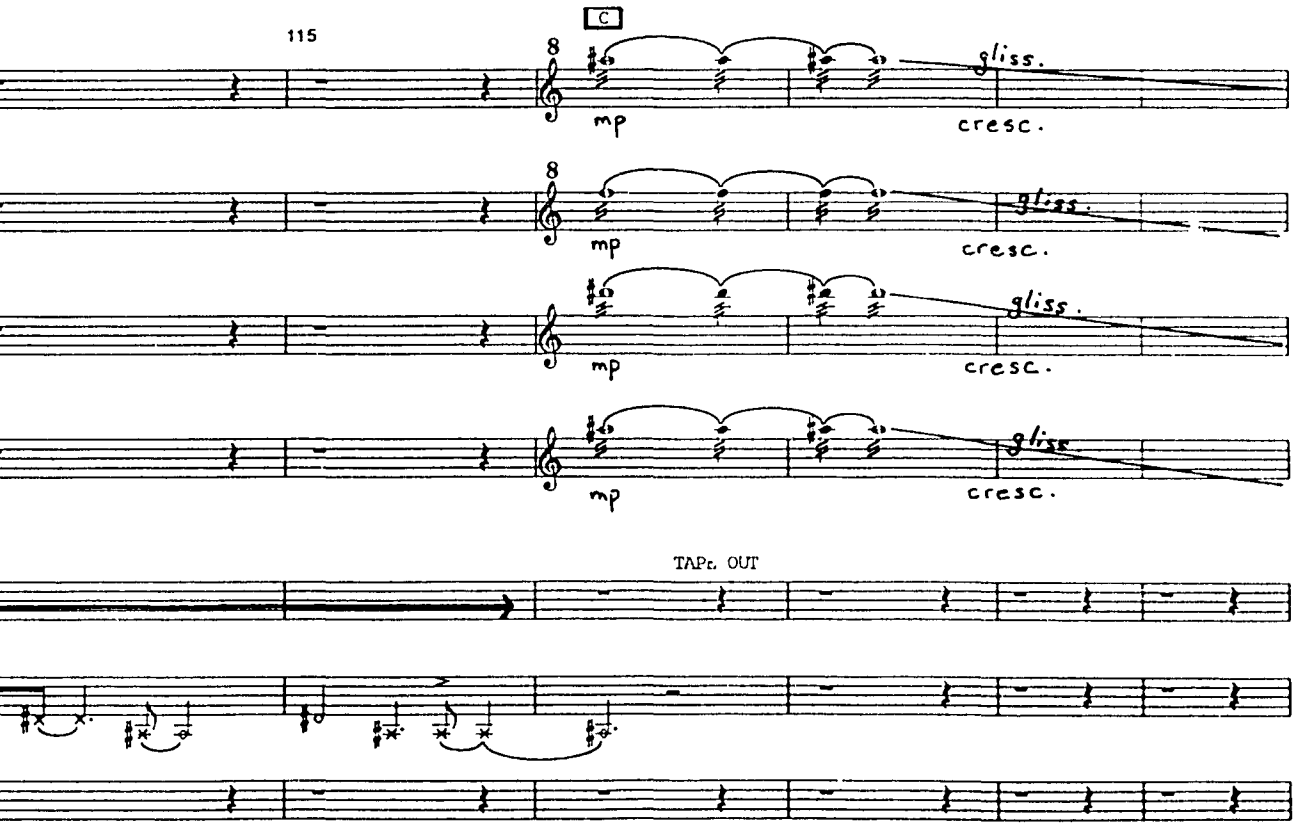
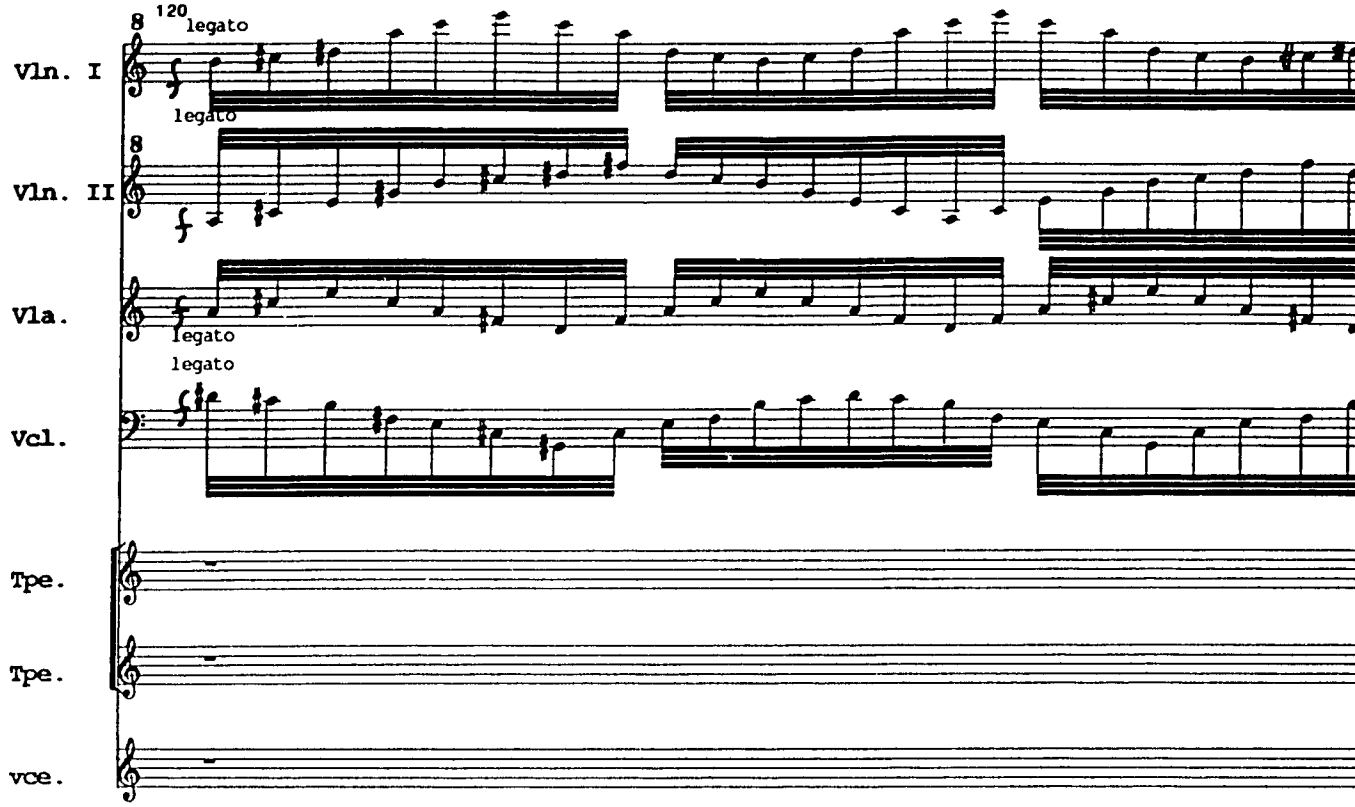
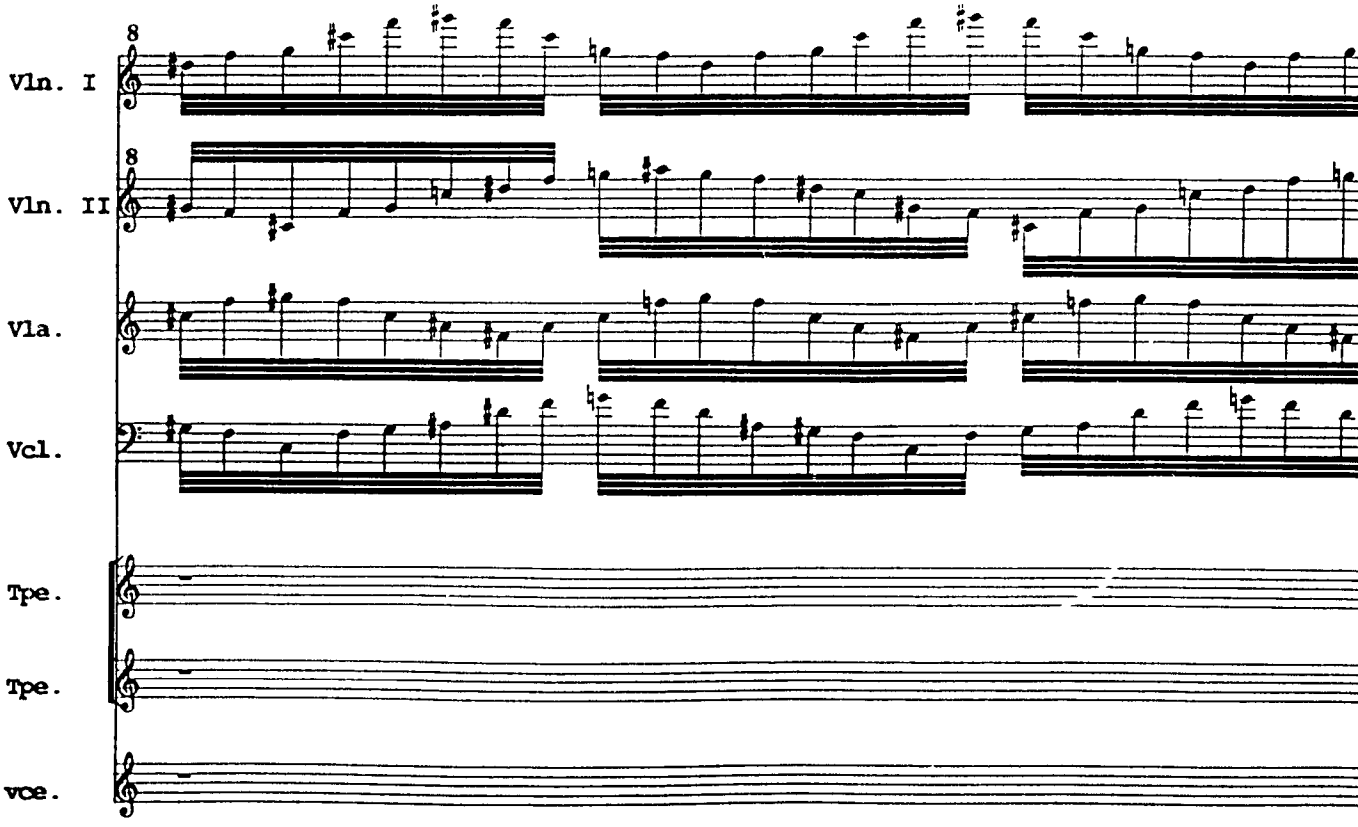
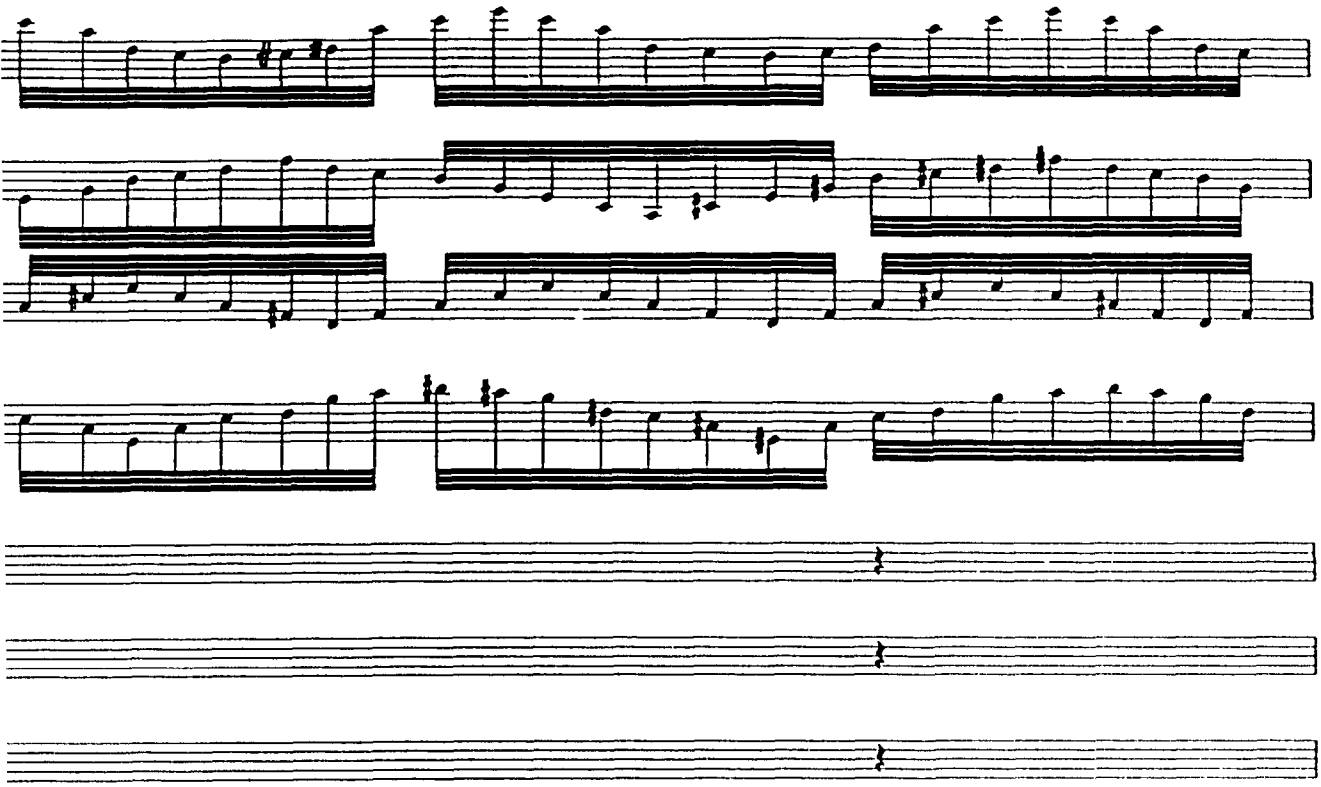
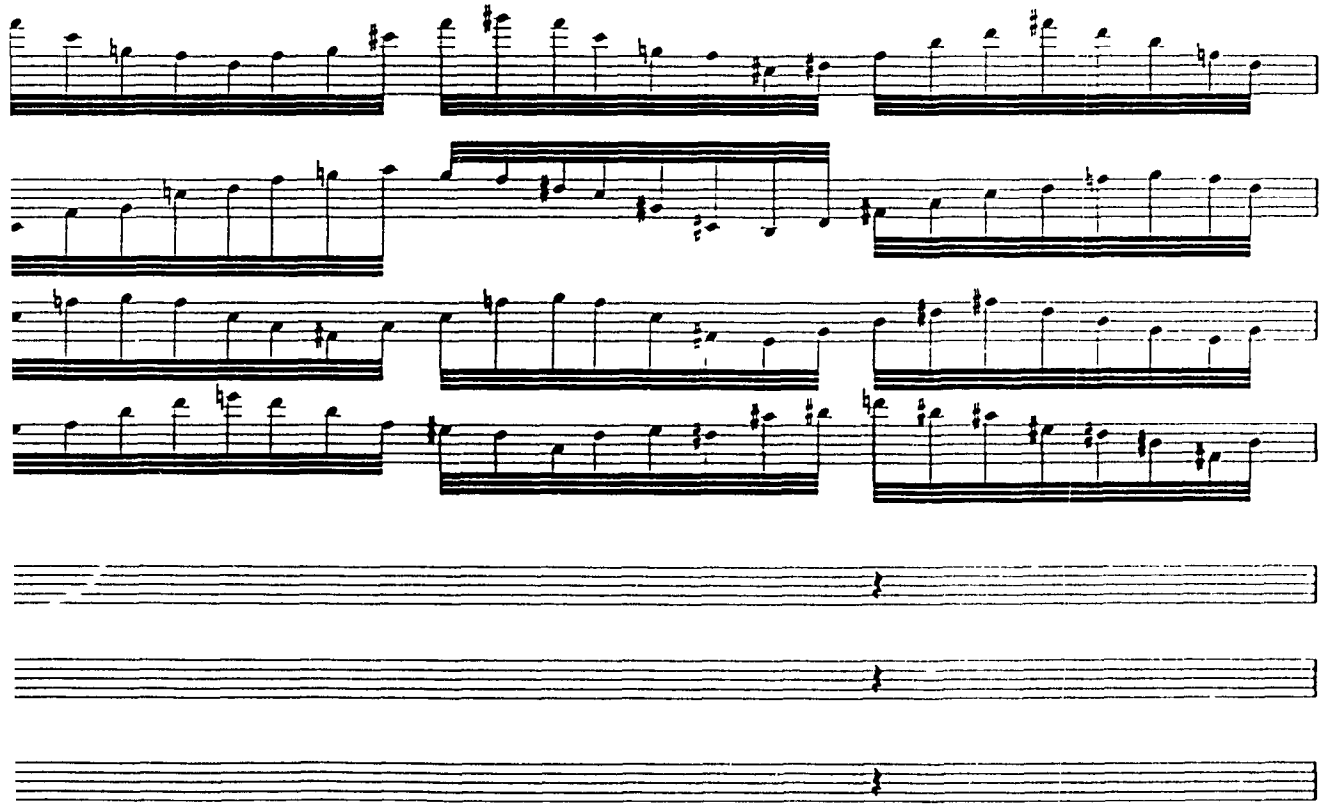
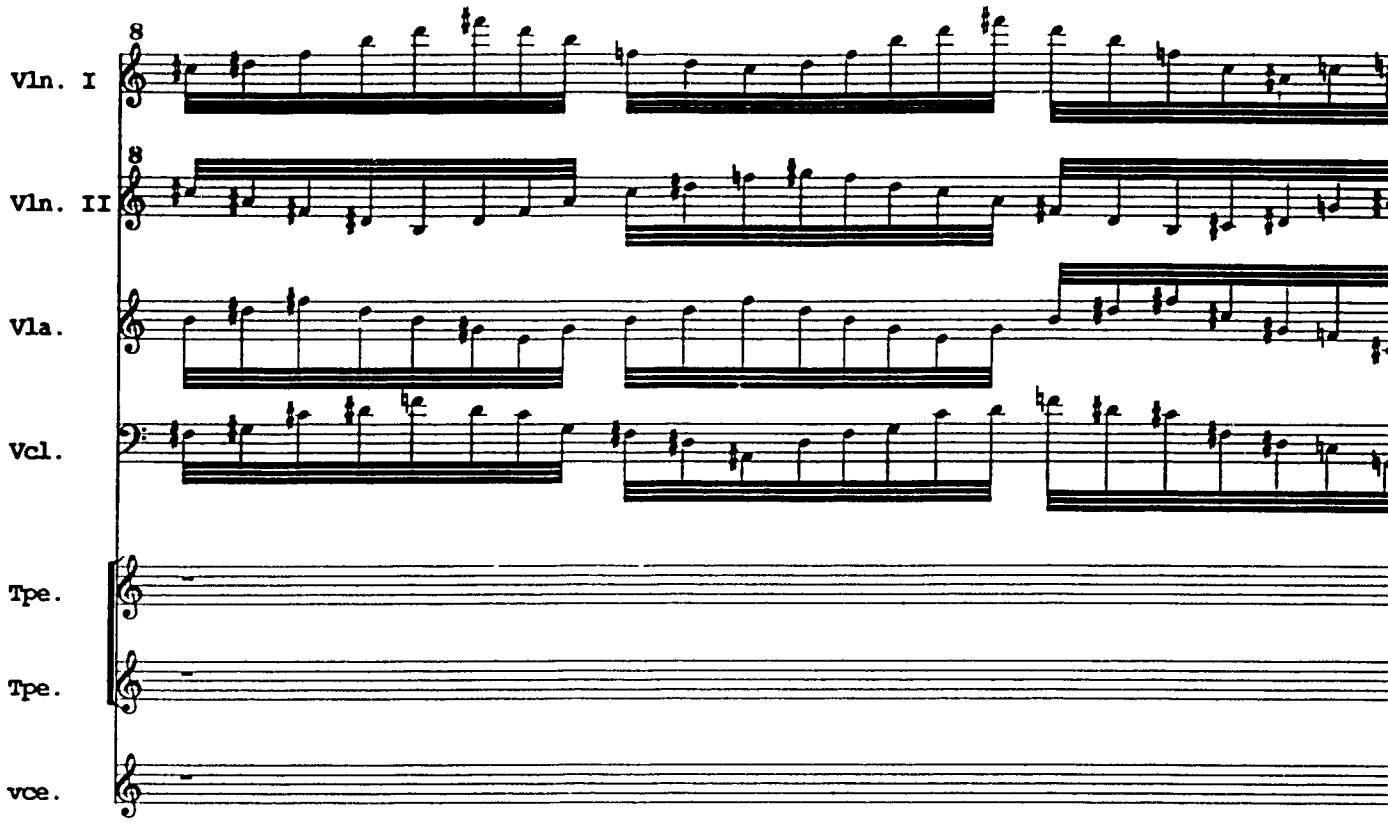

115
C
8
mp
gliss.
cresc.
TAPr. OUT

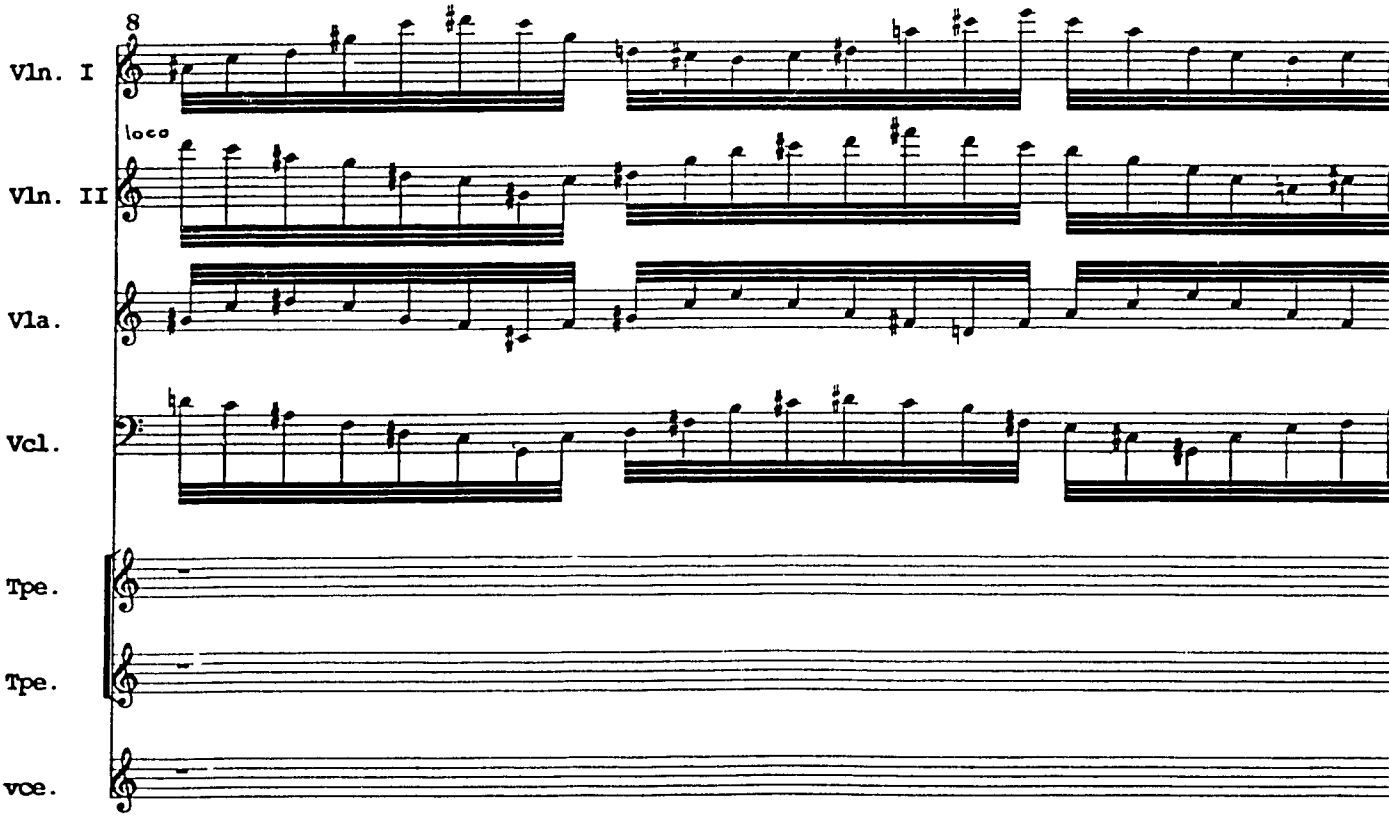

120
legato
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

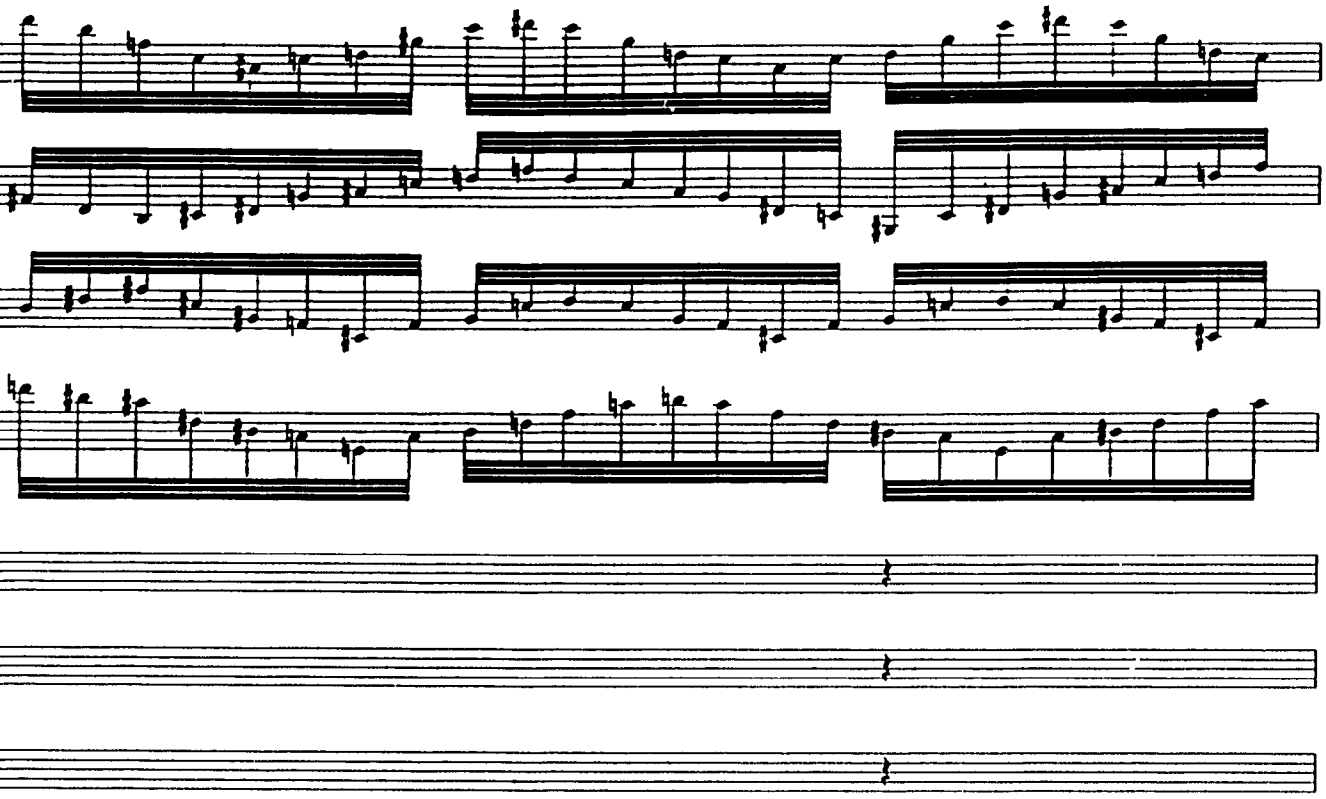

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

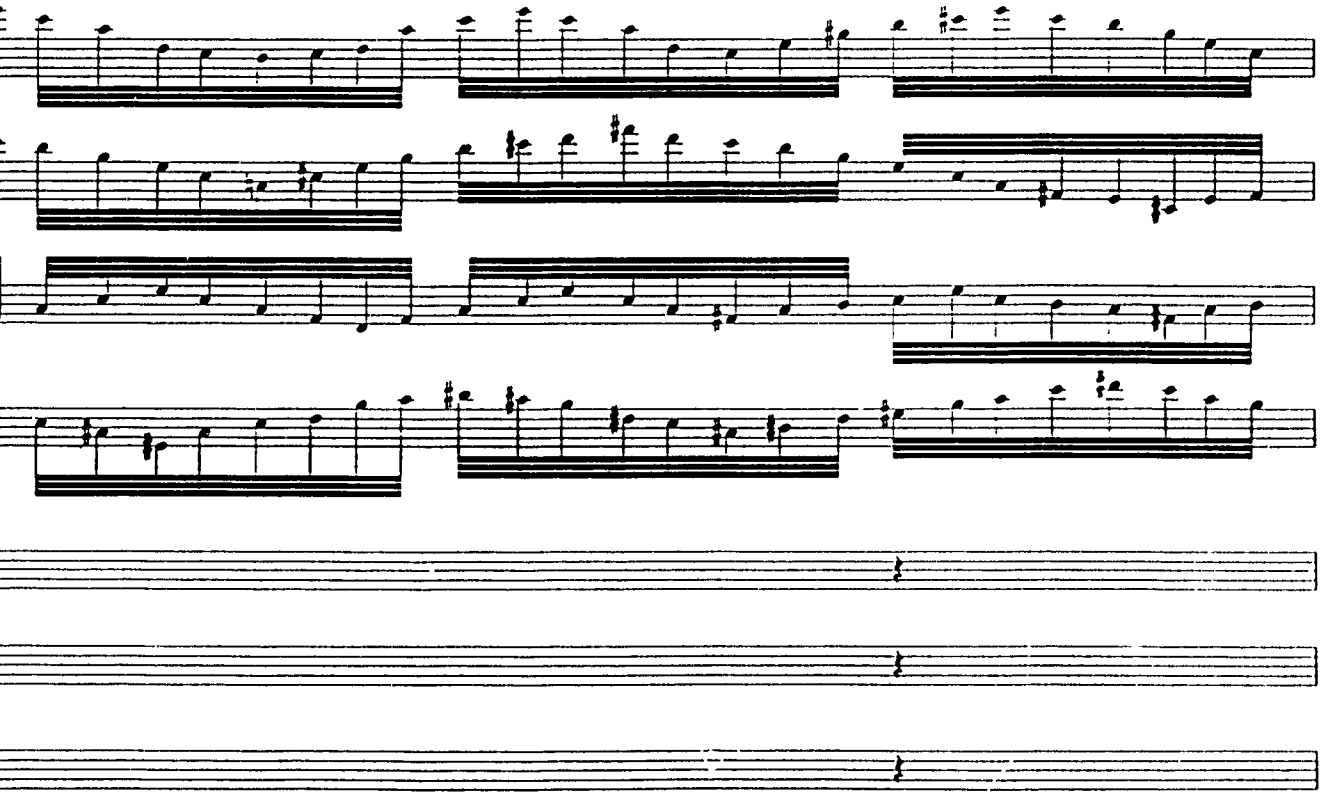


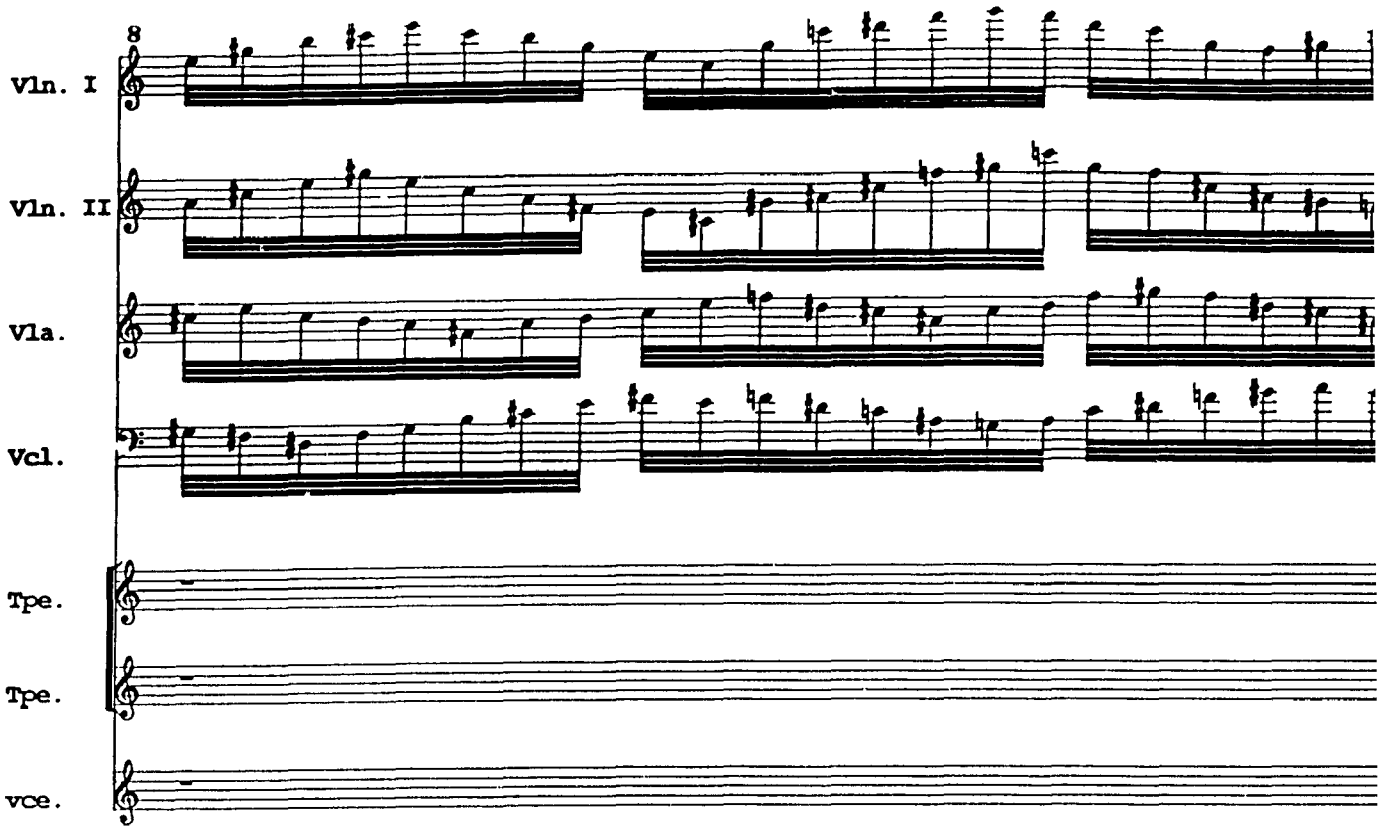


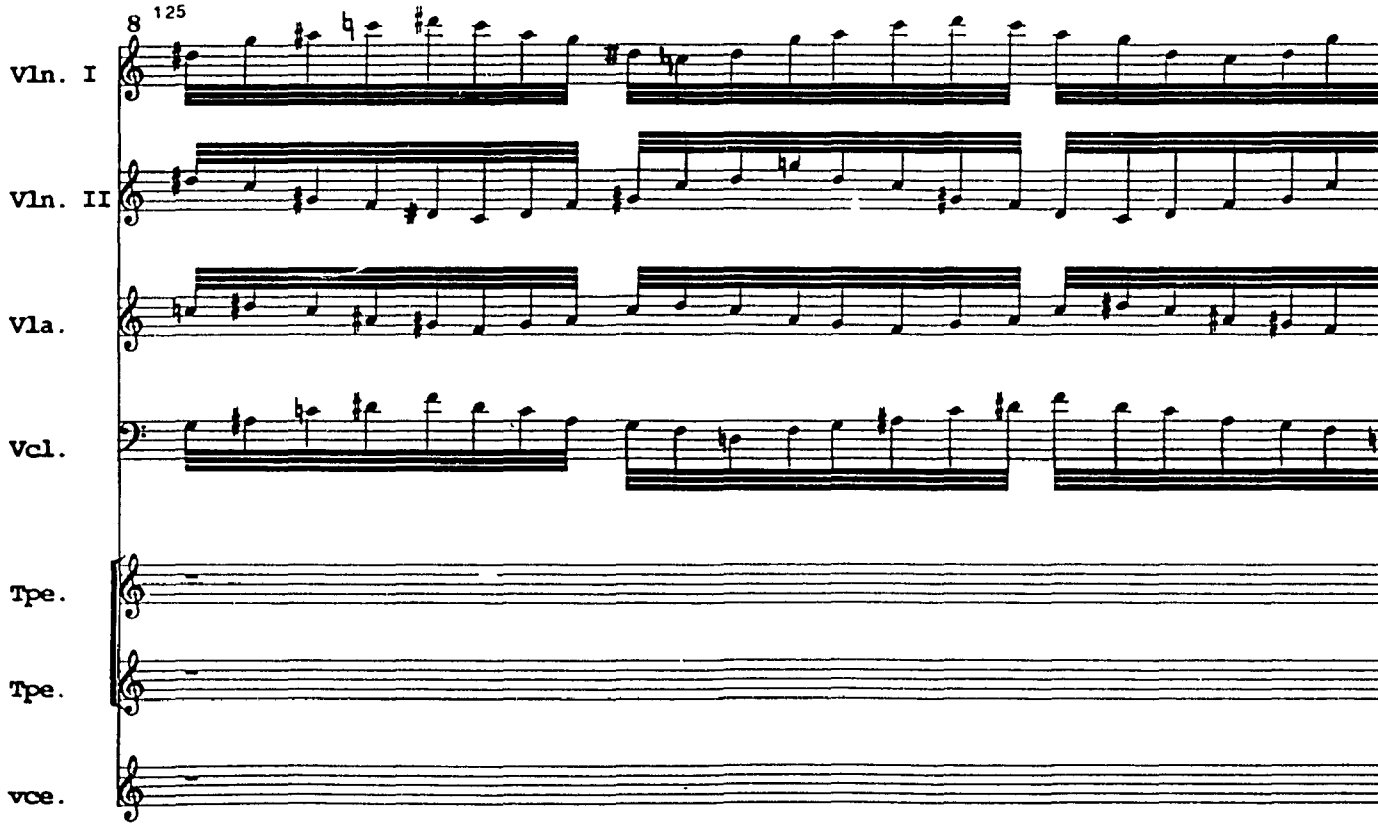

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

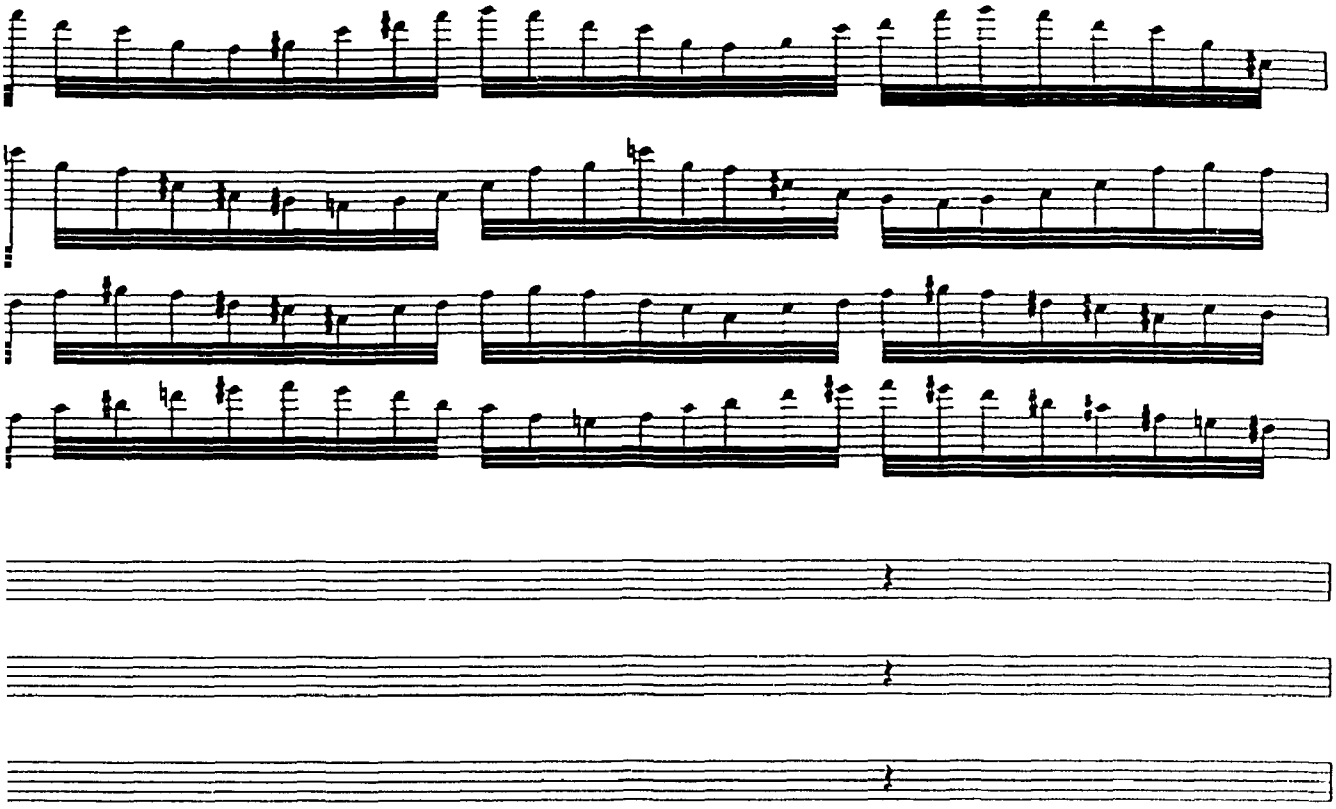

Vln. I
loco
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

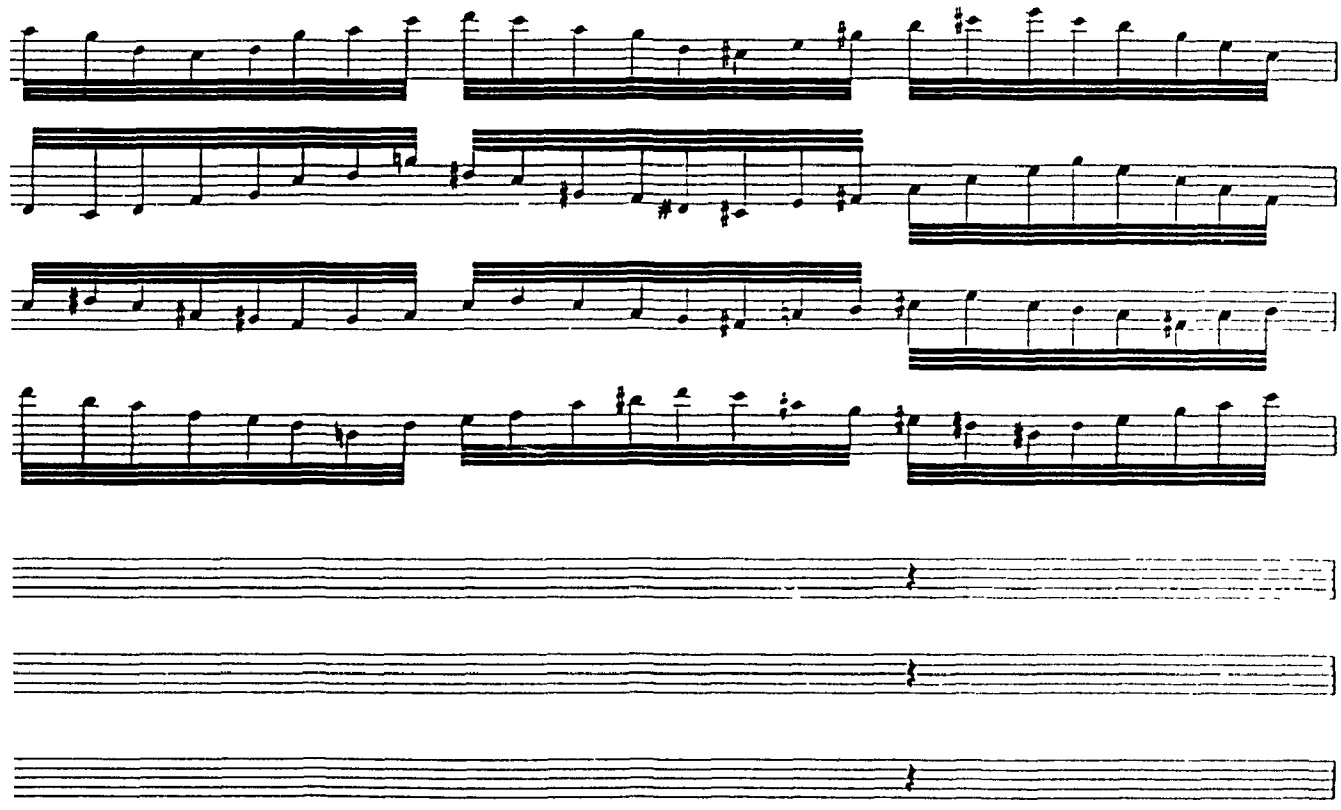


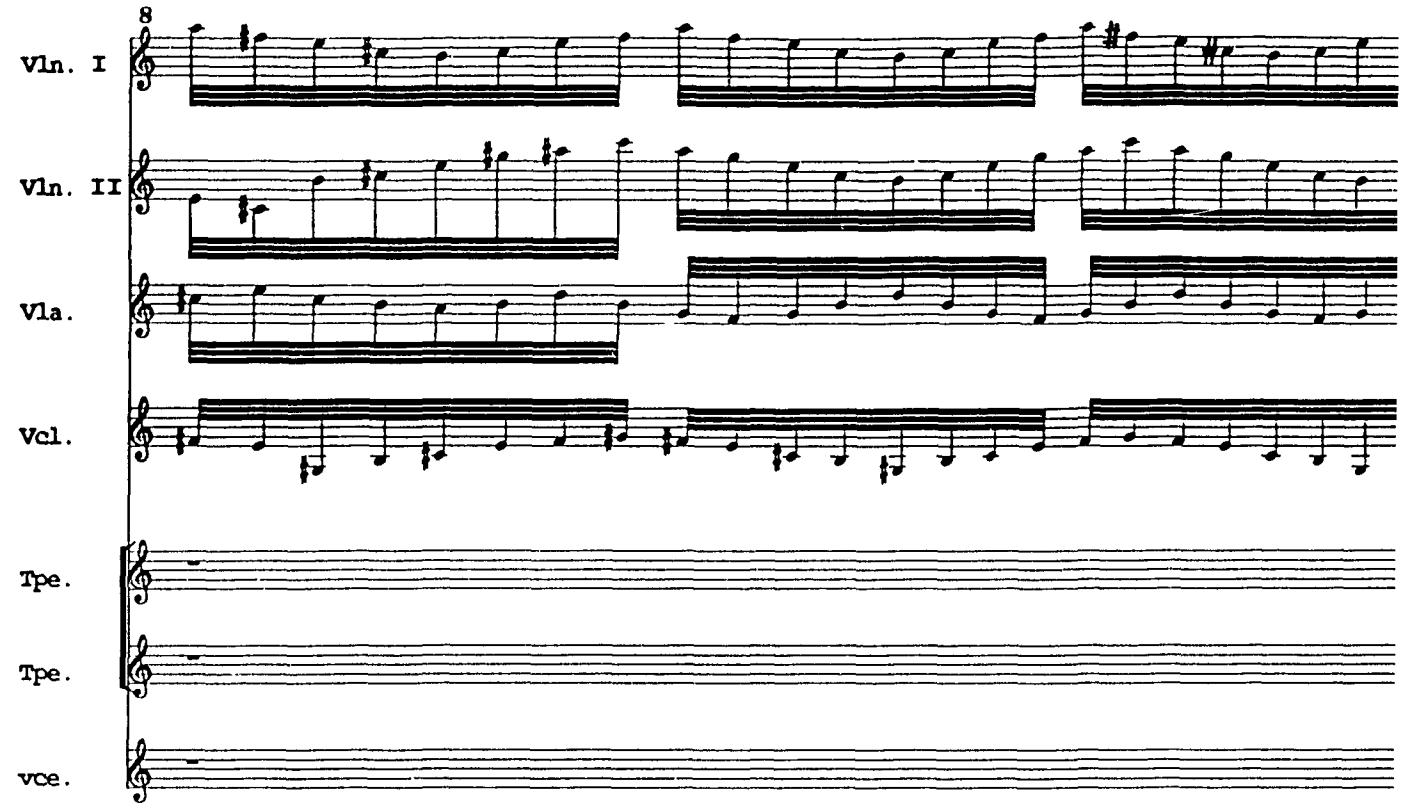


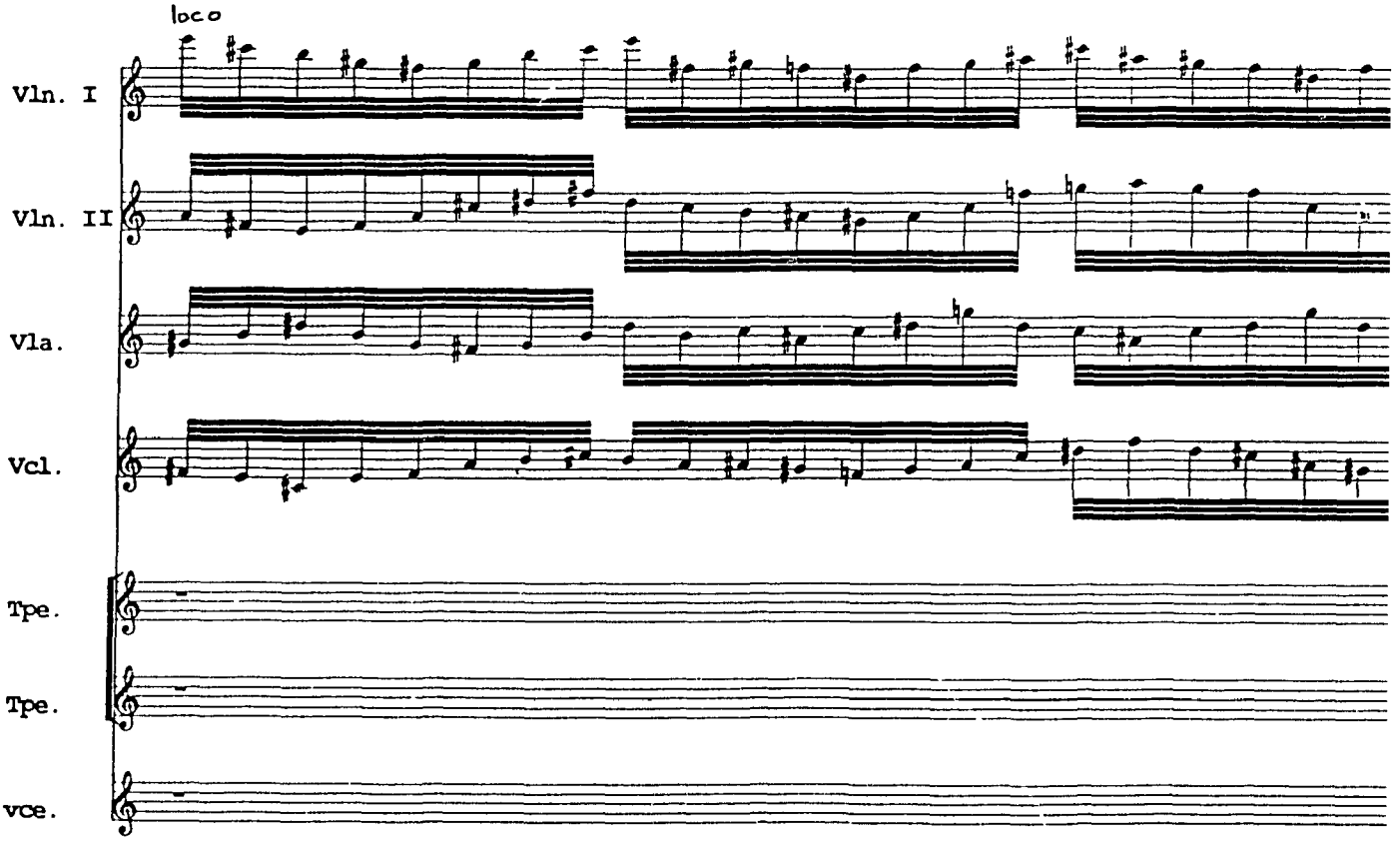

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

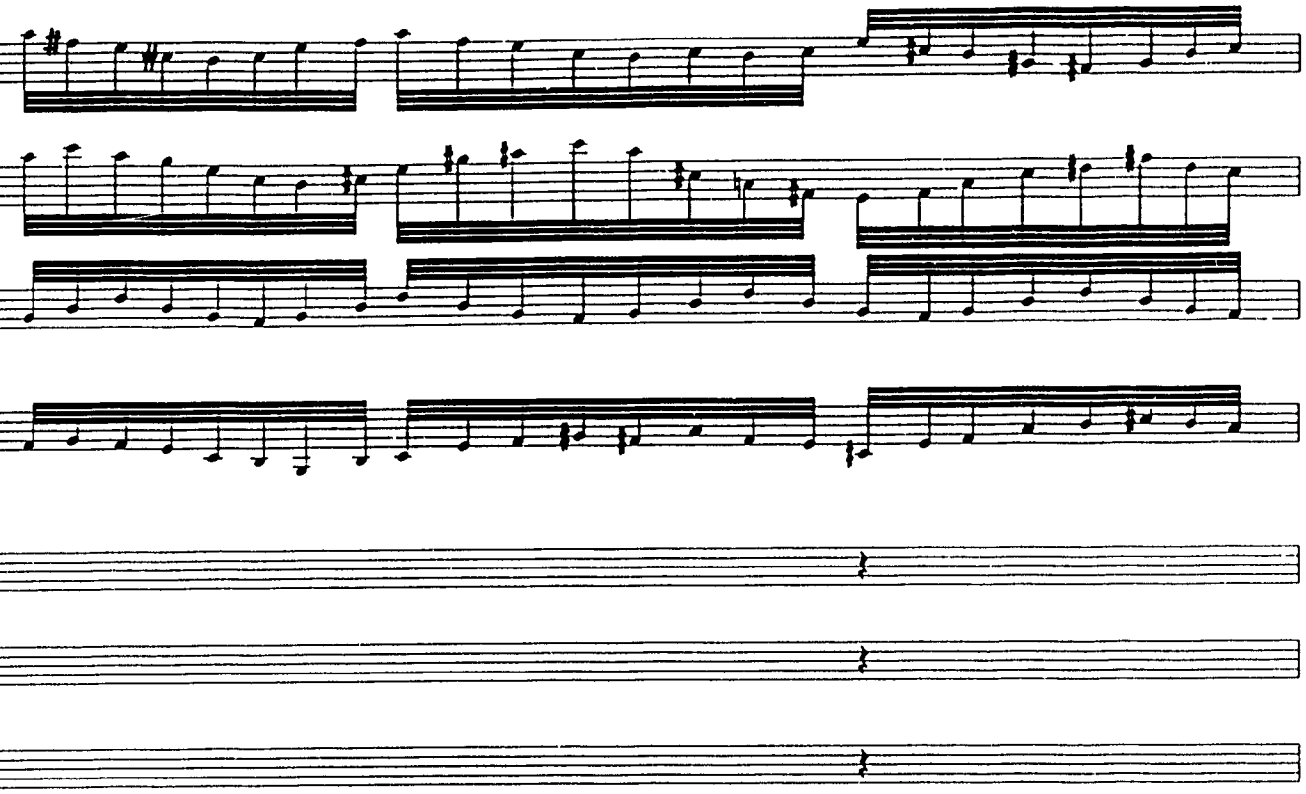

8
125
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

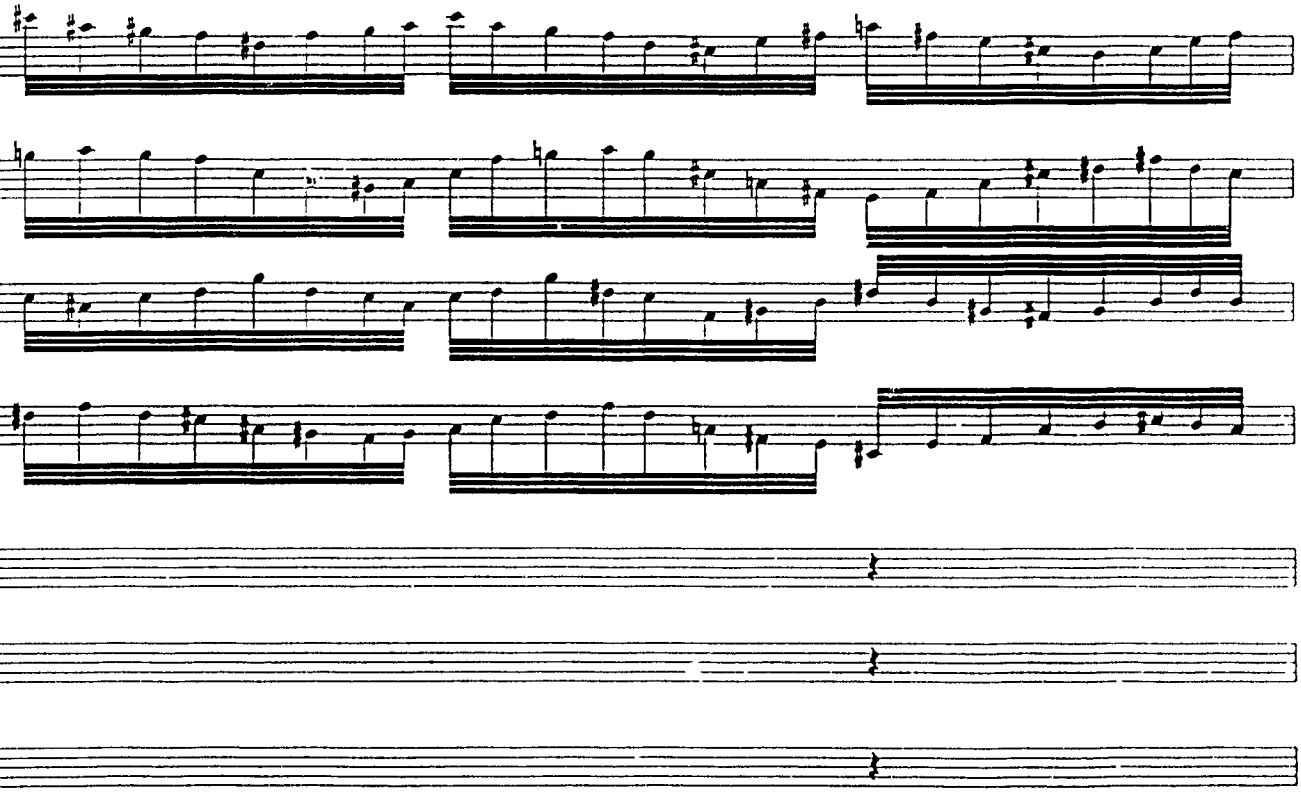


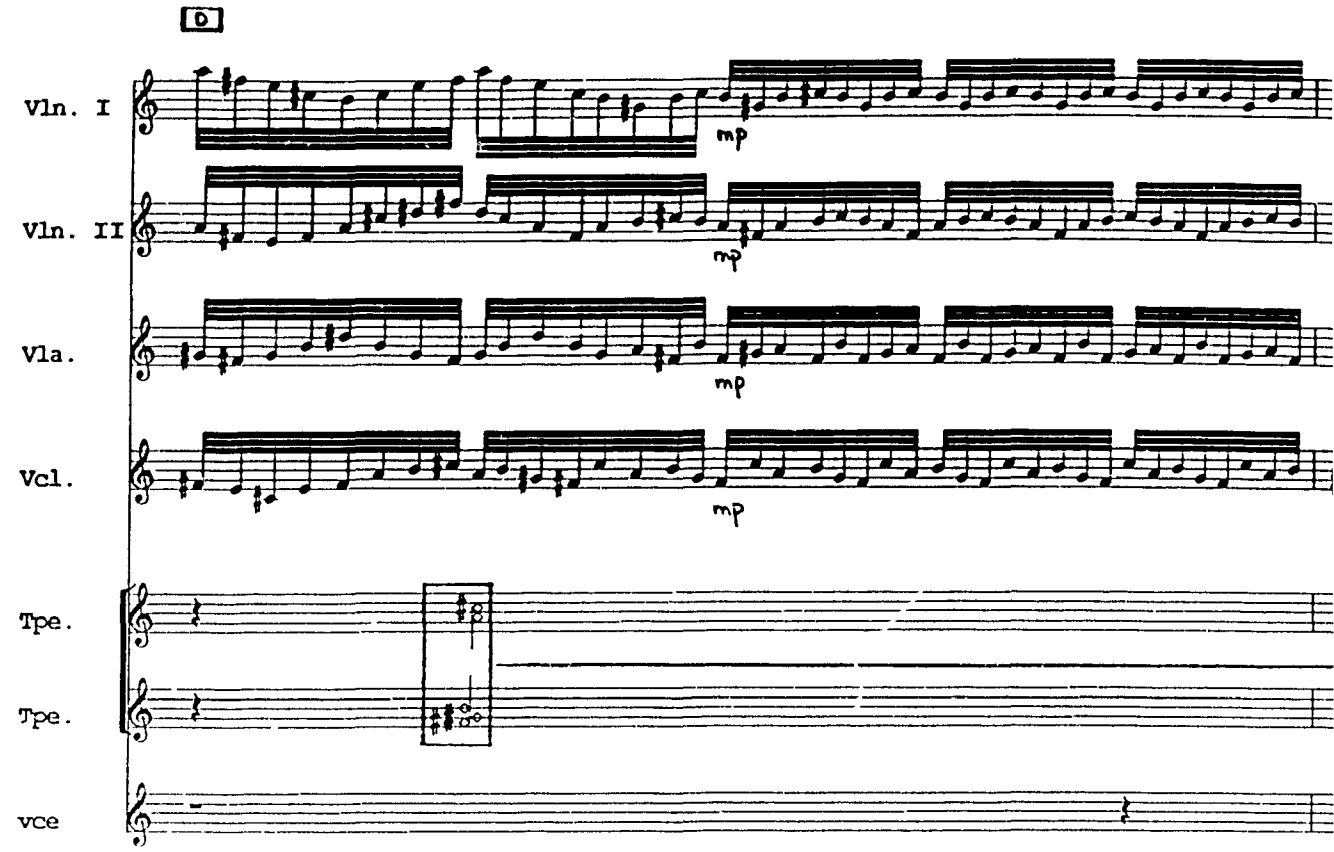


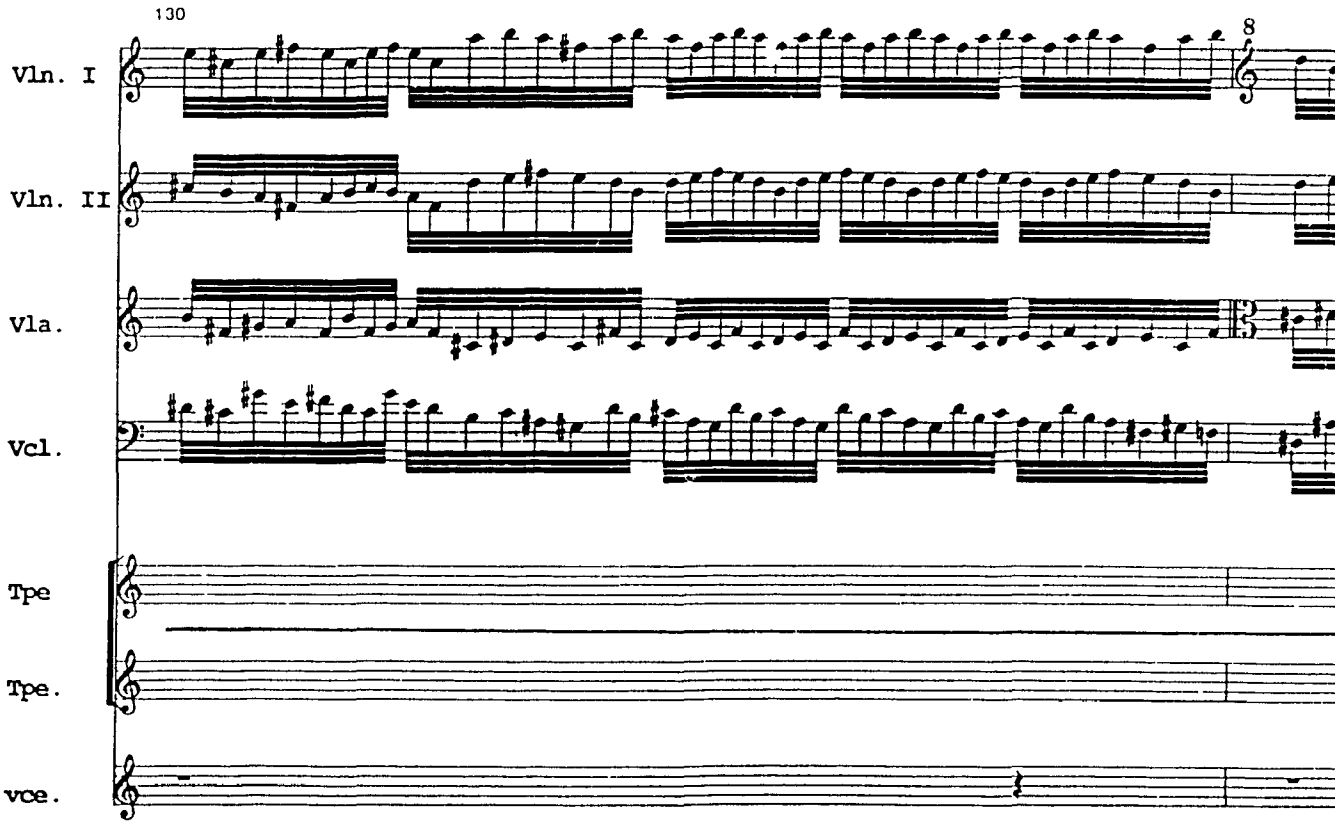

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

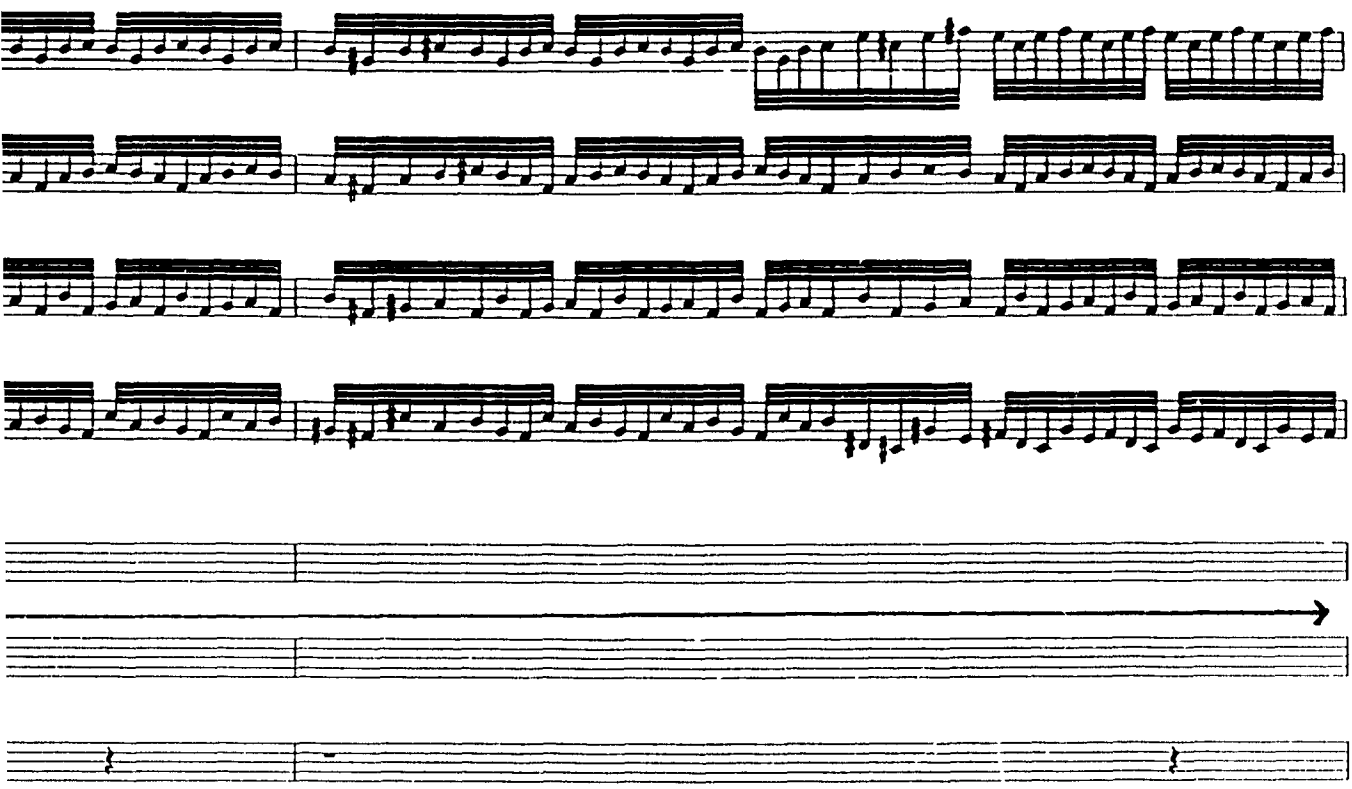

loco
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

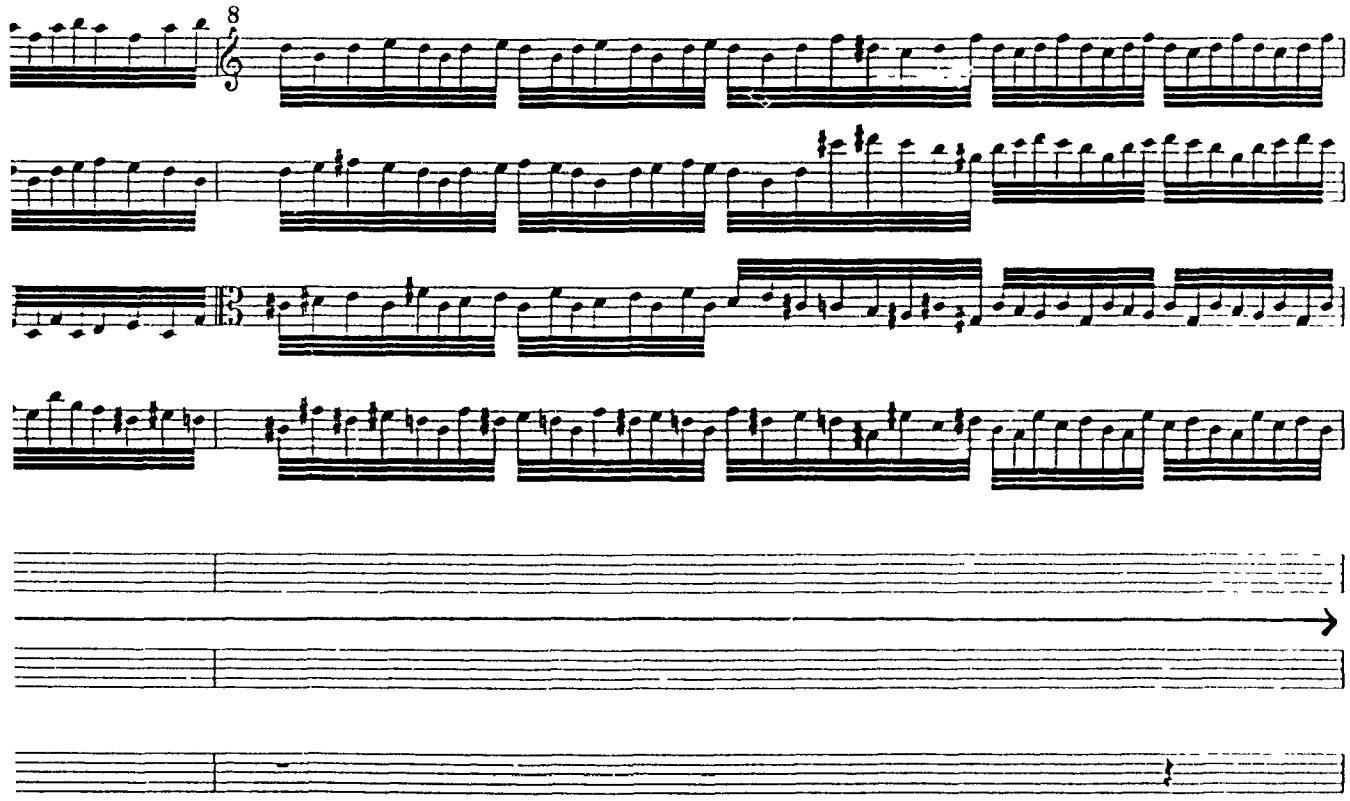


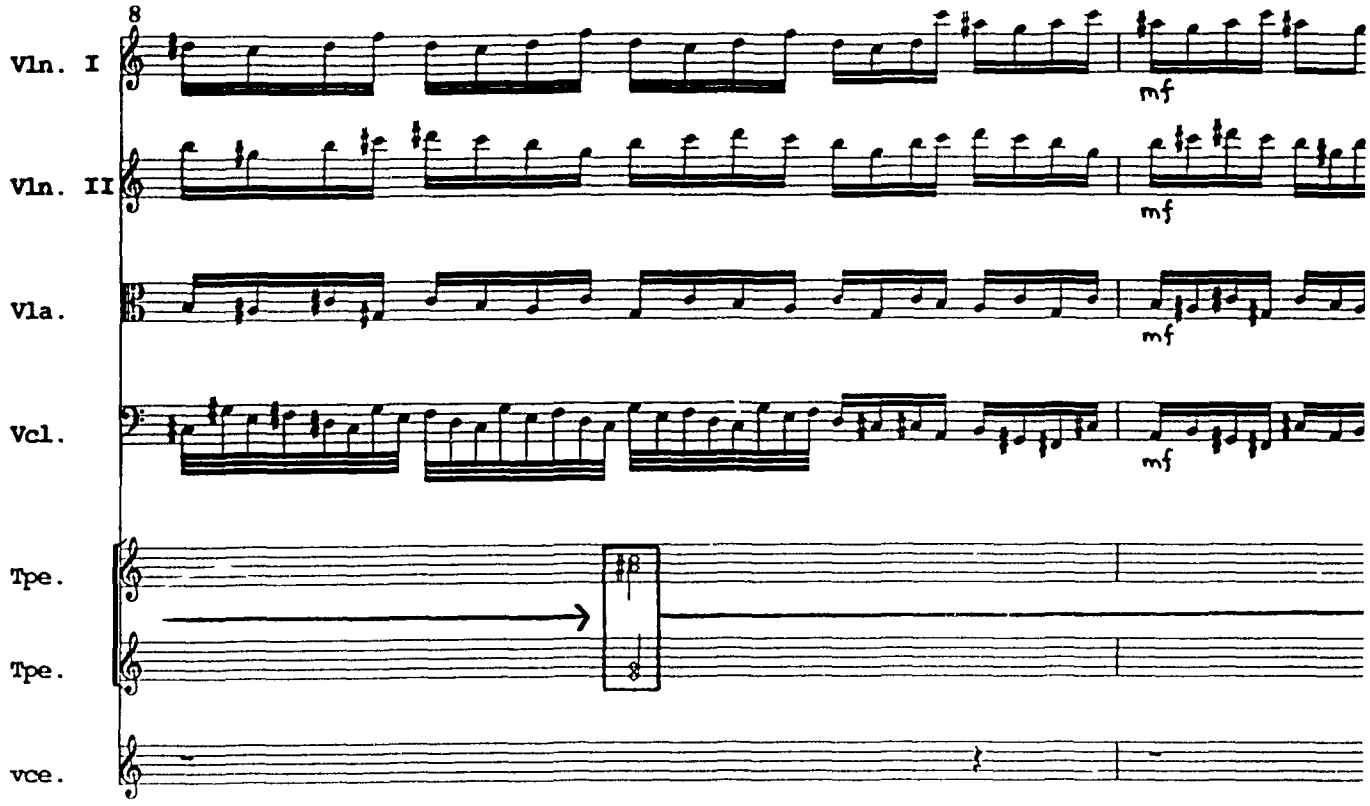


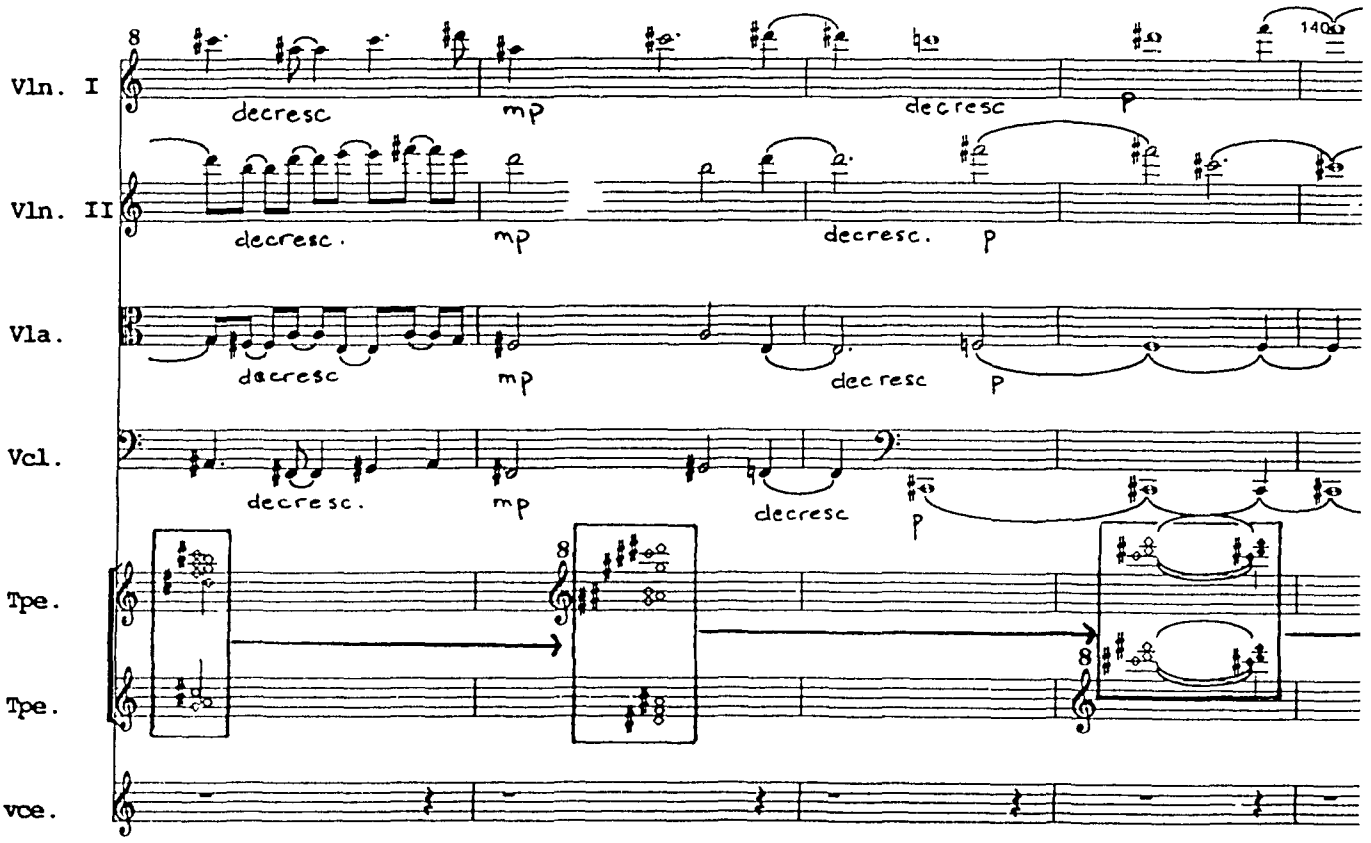

D
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce
mp
mp
mp

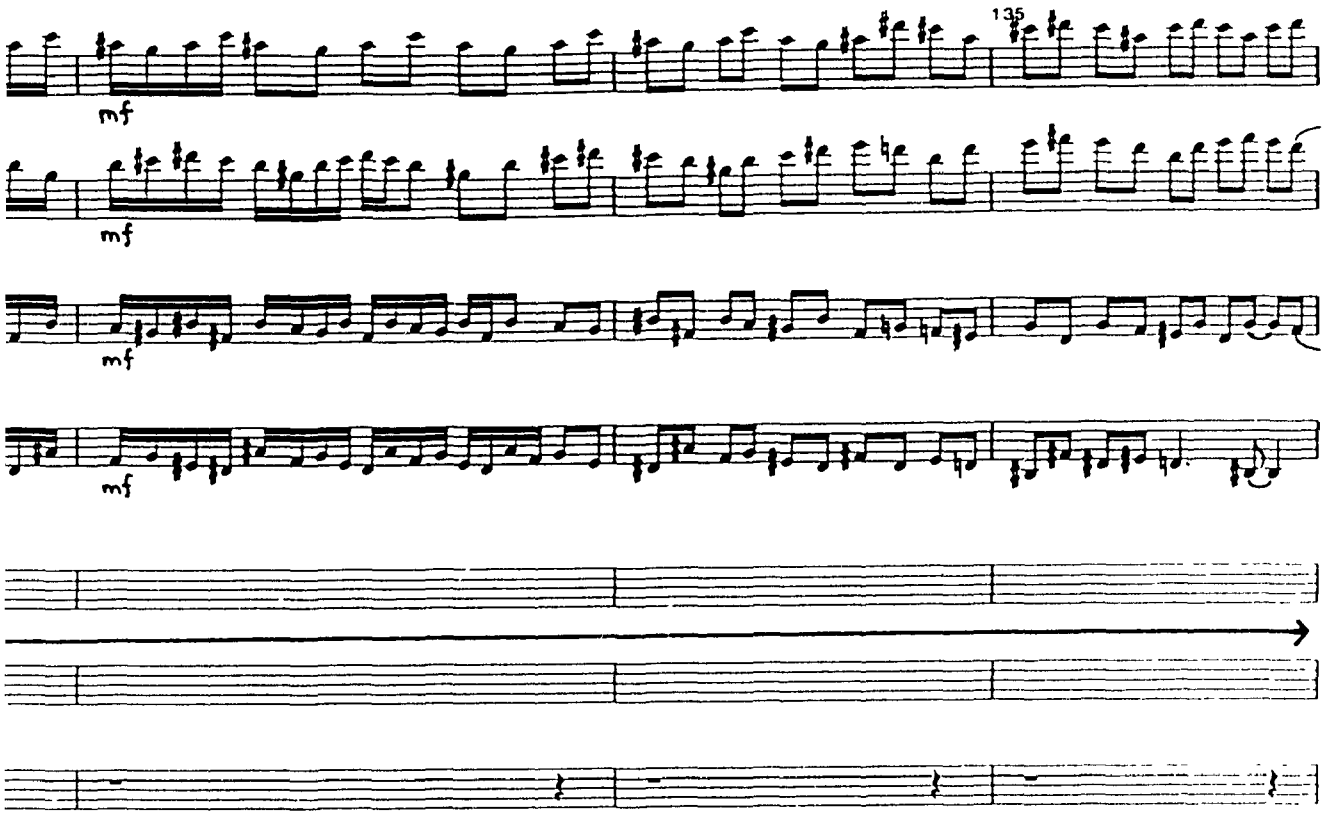

130
8
Vln. I
Vln. II
Vla.
Vcl.
Tpe
Tpe.
vce.

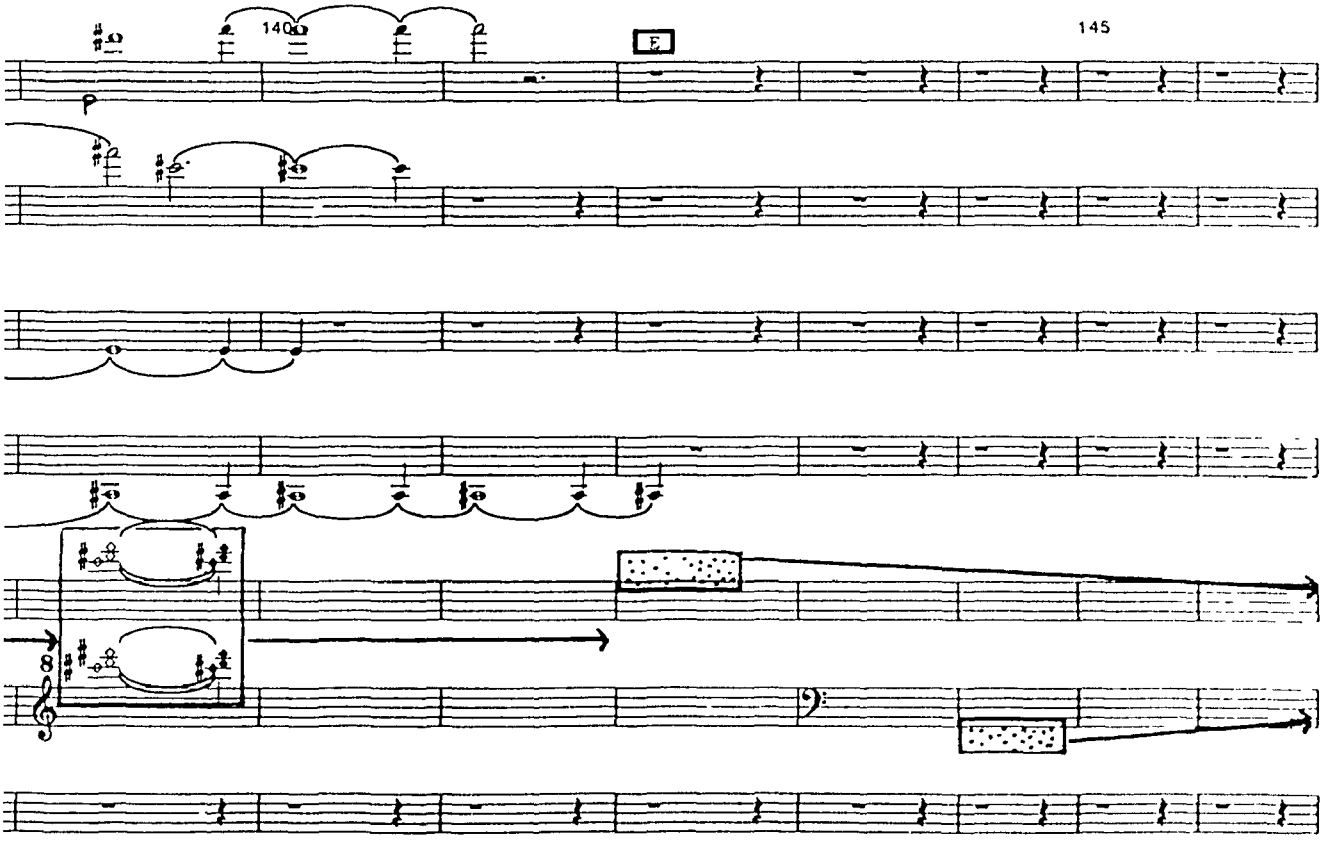


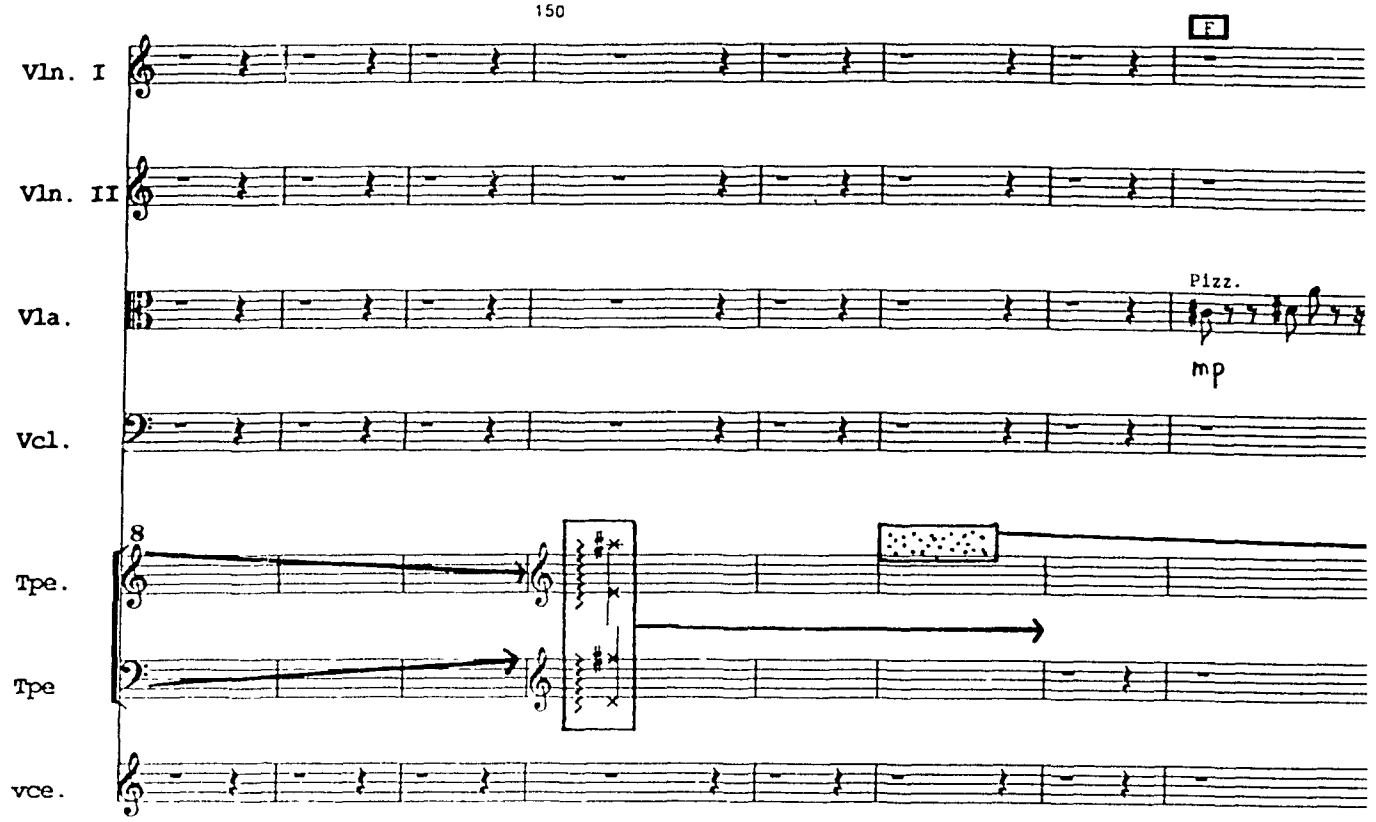


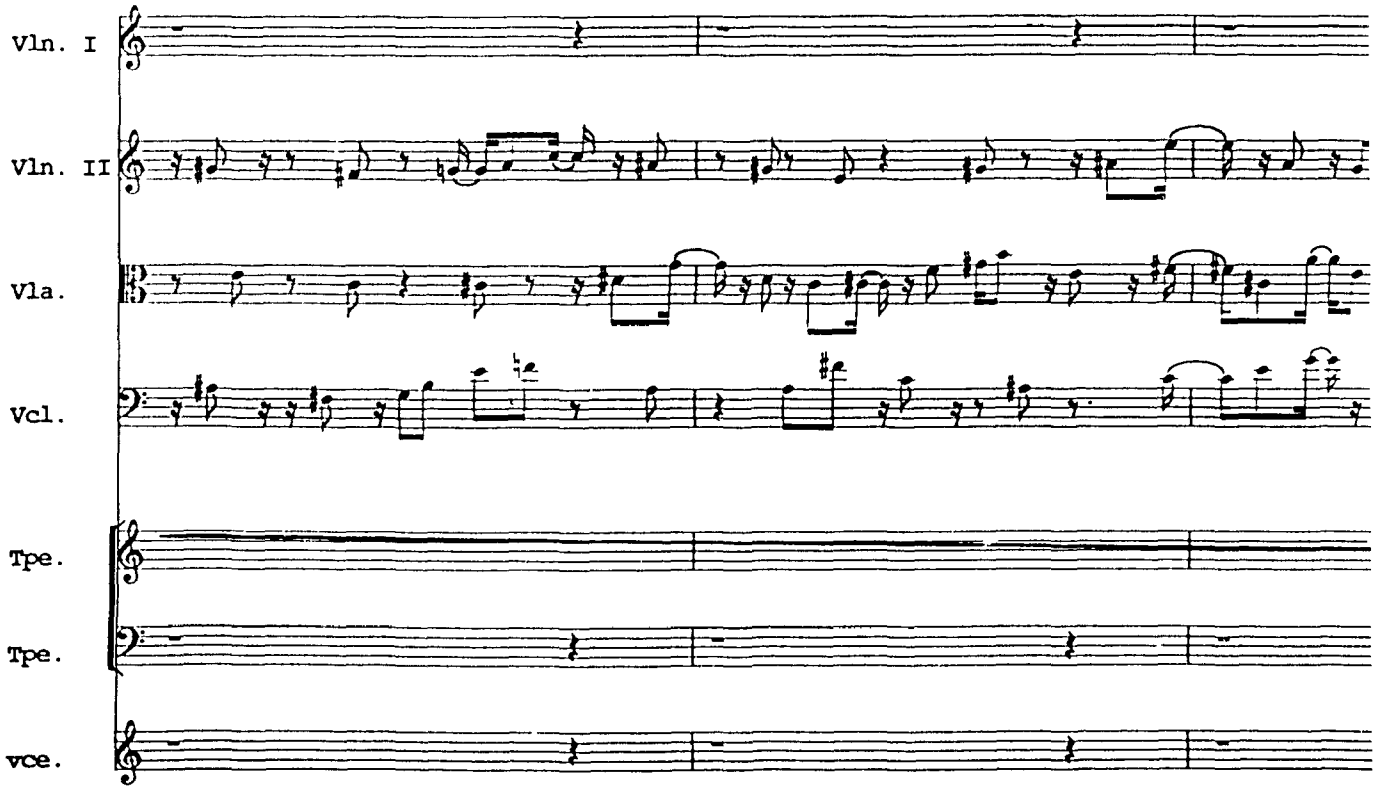

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
mf
mf
mf
mf

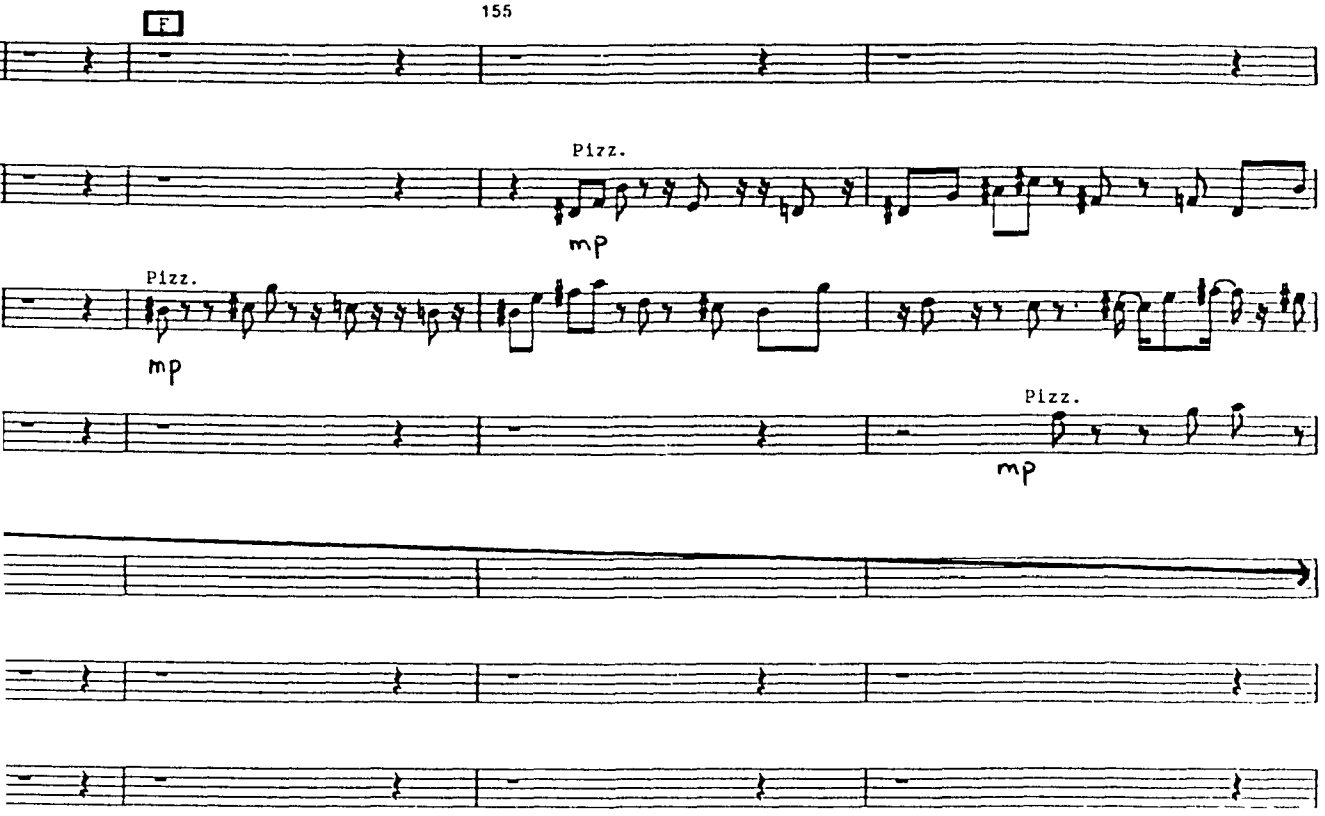

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
decresc
mp
decresc
p
140
decresc.
mp
decresc.
p
decresc
mp
decresc
p
decresc.
mp
decresc
p

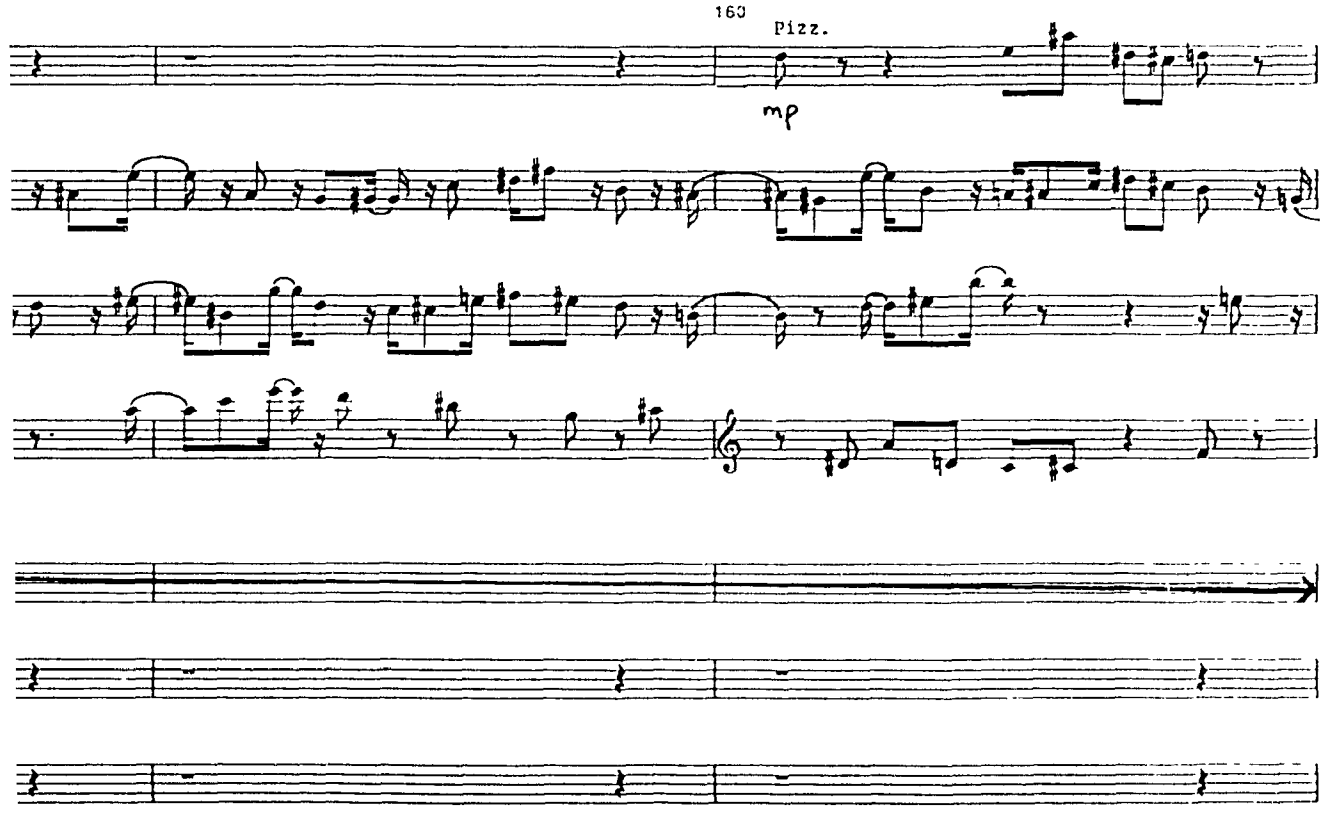

135
mf
mf
mf
mf

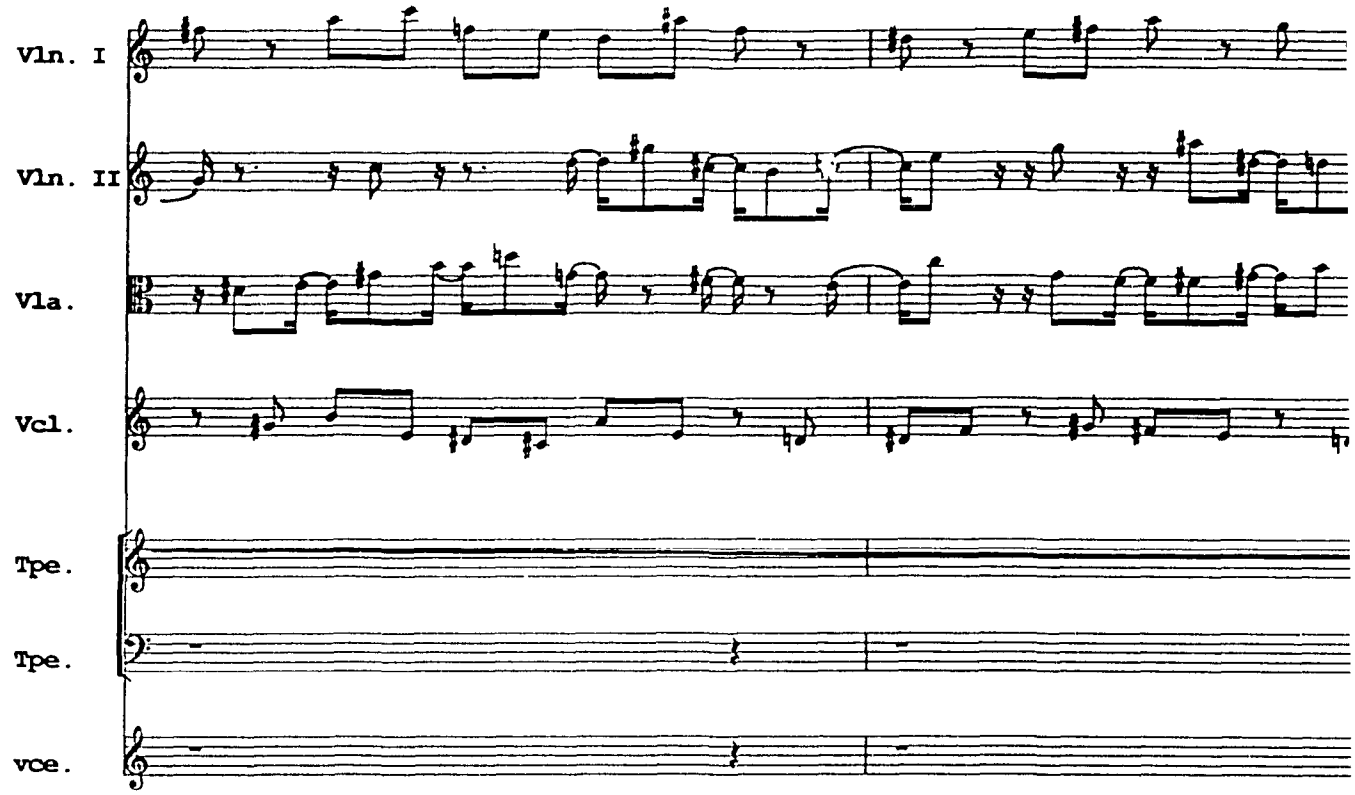

140
E
145
p
8

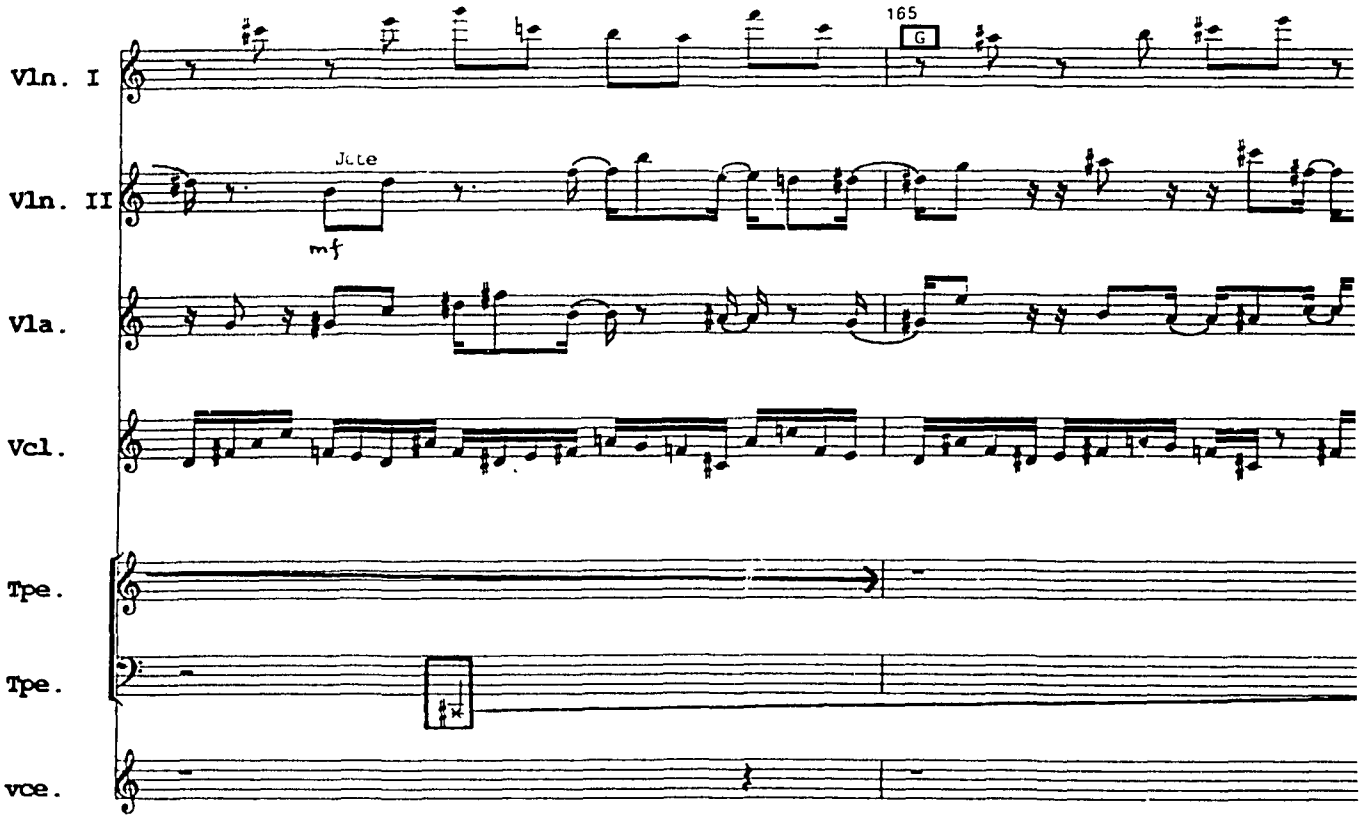

F
Vln. I
Vln. II
Vla.
Pizz.
mp
Vcl.
8
Tpe.
Tpe
vce.

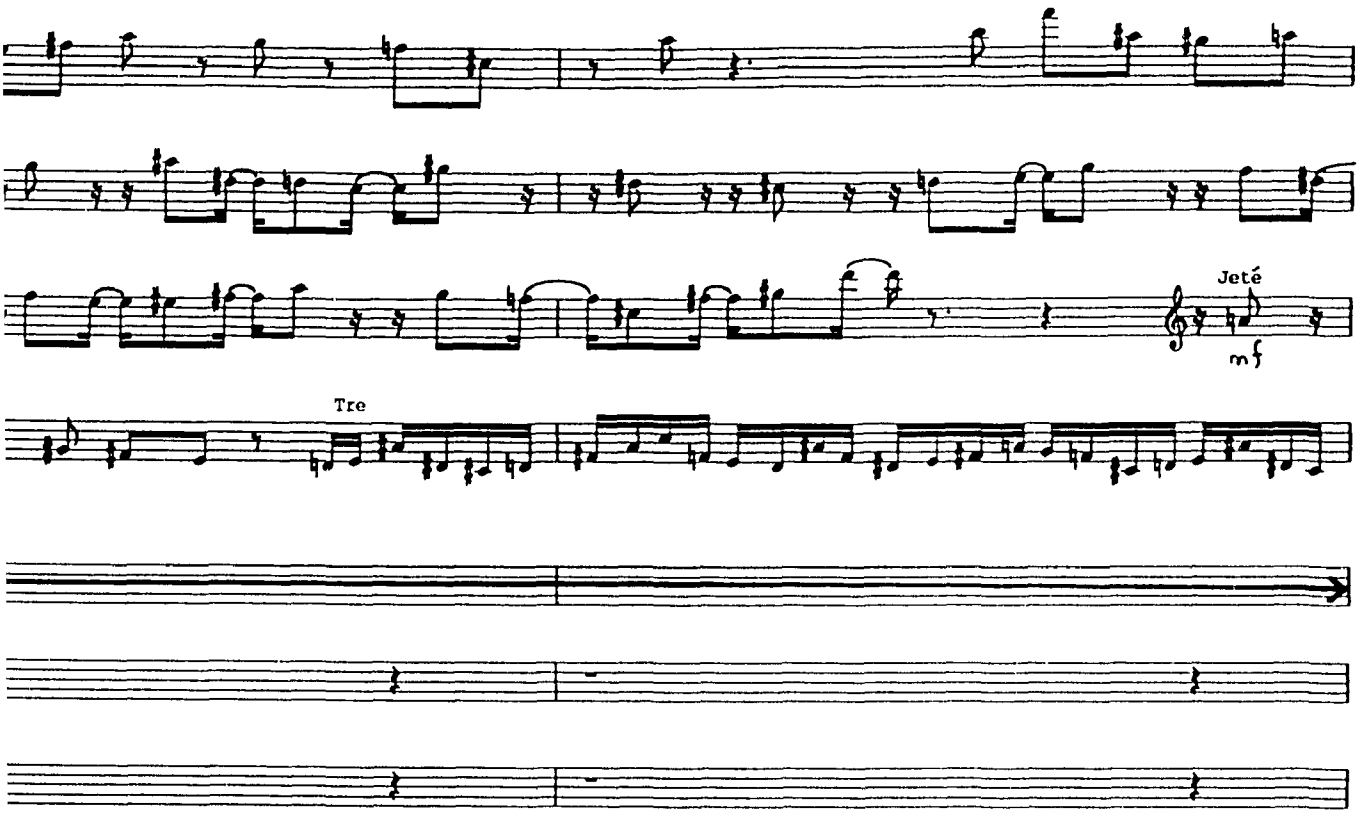

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

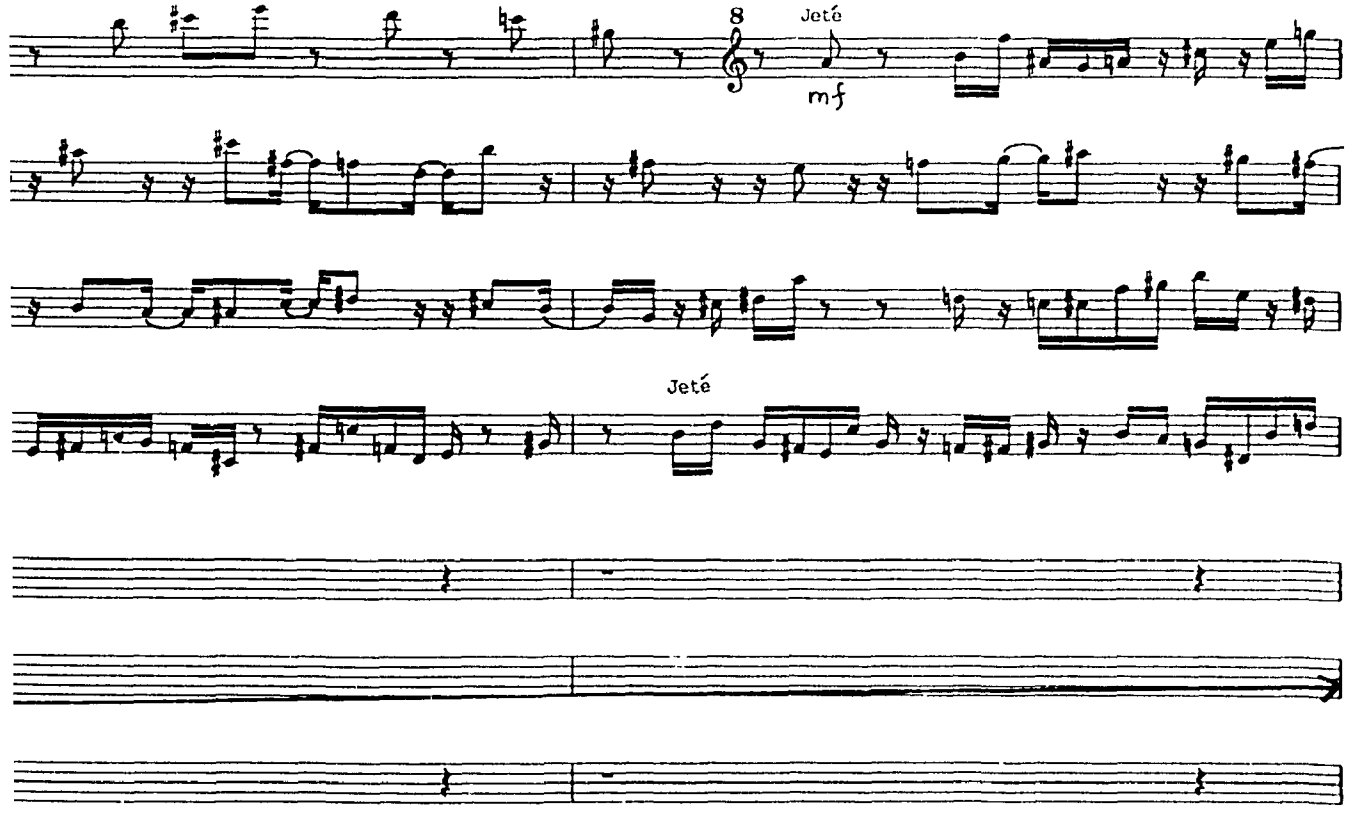

F
155
Pizz.
mp
Pizz.
mp
Pizz.
mp

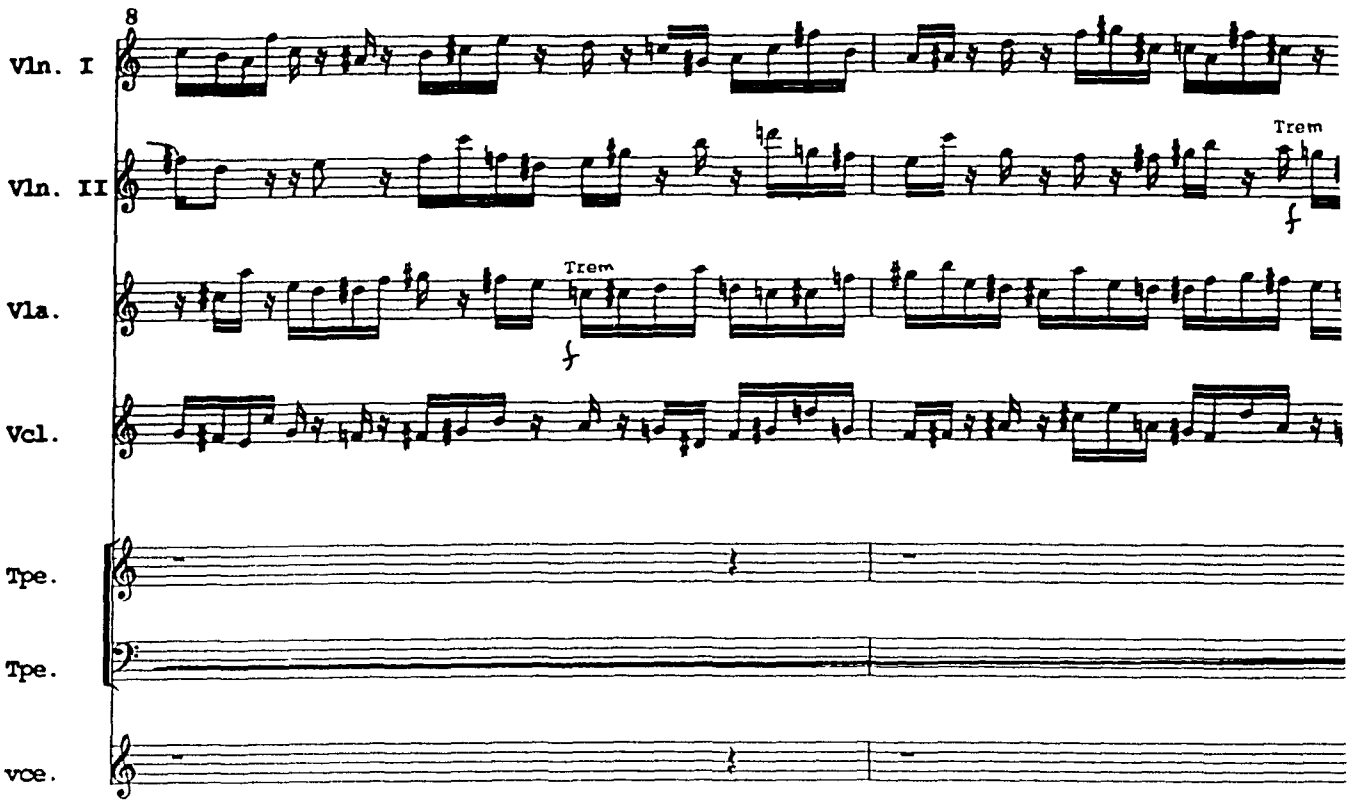

160
Pizz.
mp

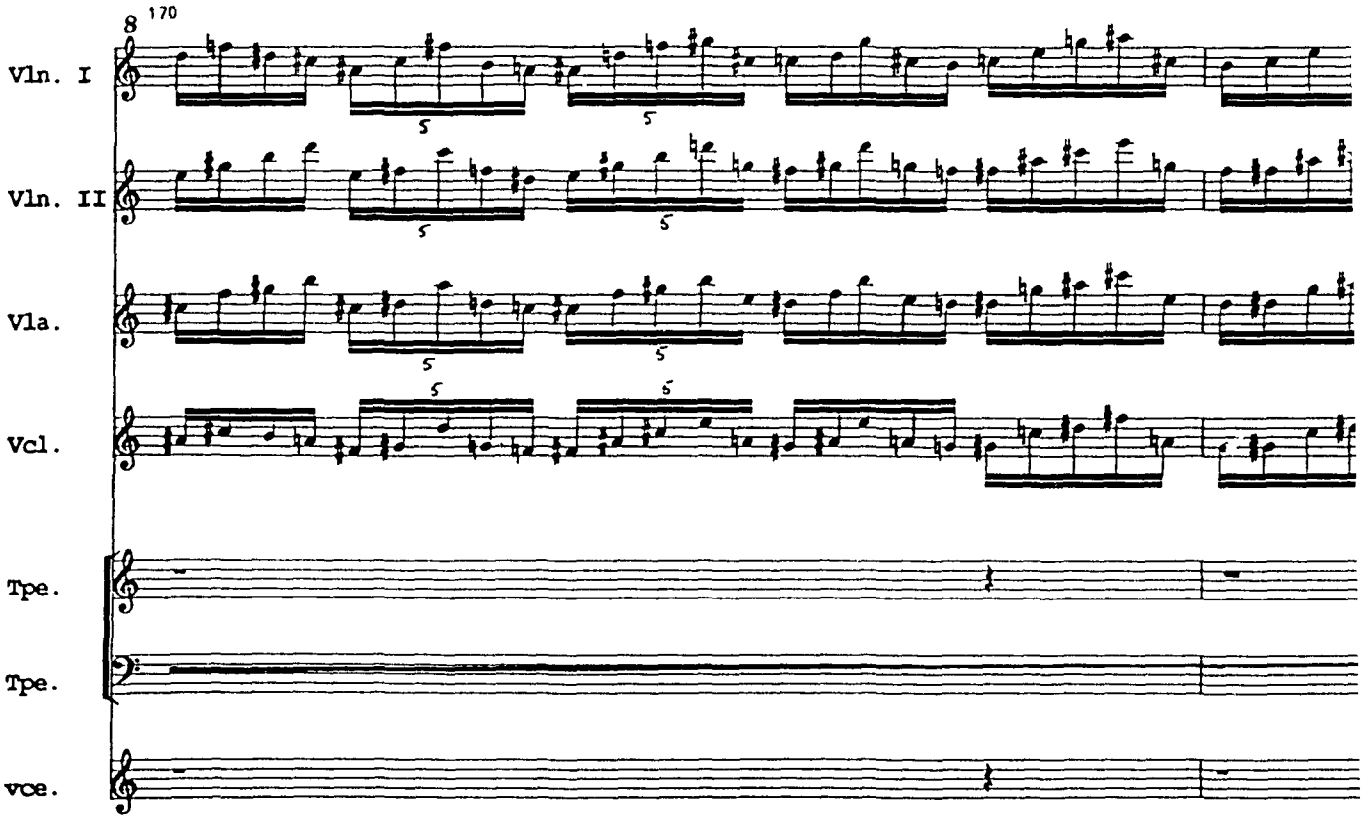

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

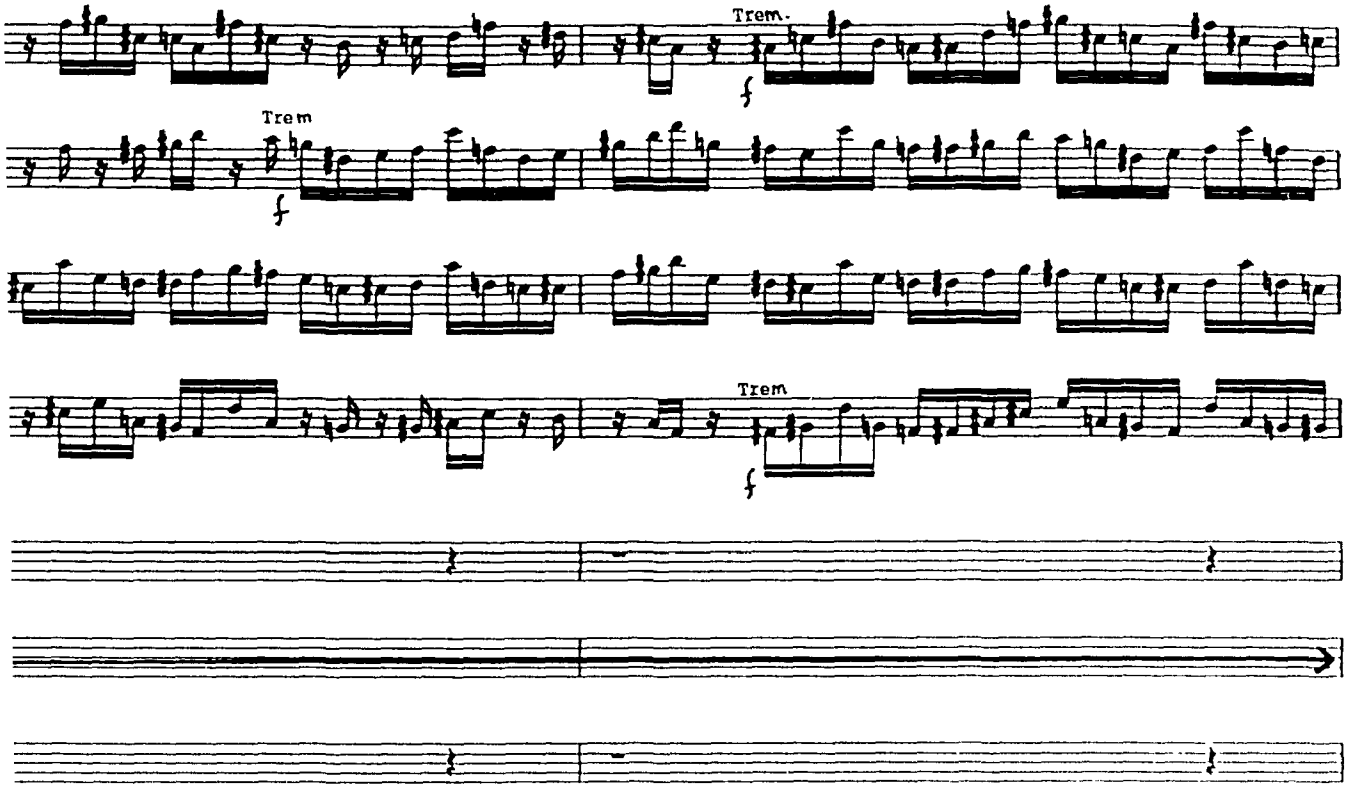

165
G
Vln. I
Vln. II
Jute
mf
Vla.
Vcl.
Tpe.
Tpe.
vce.

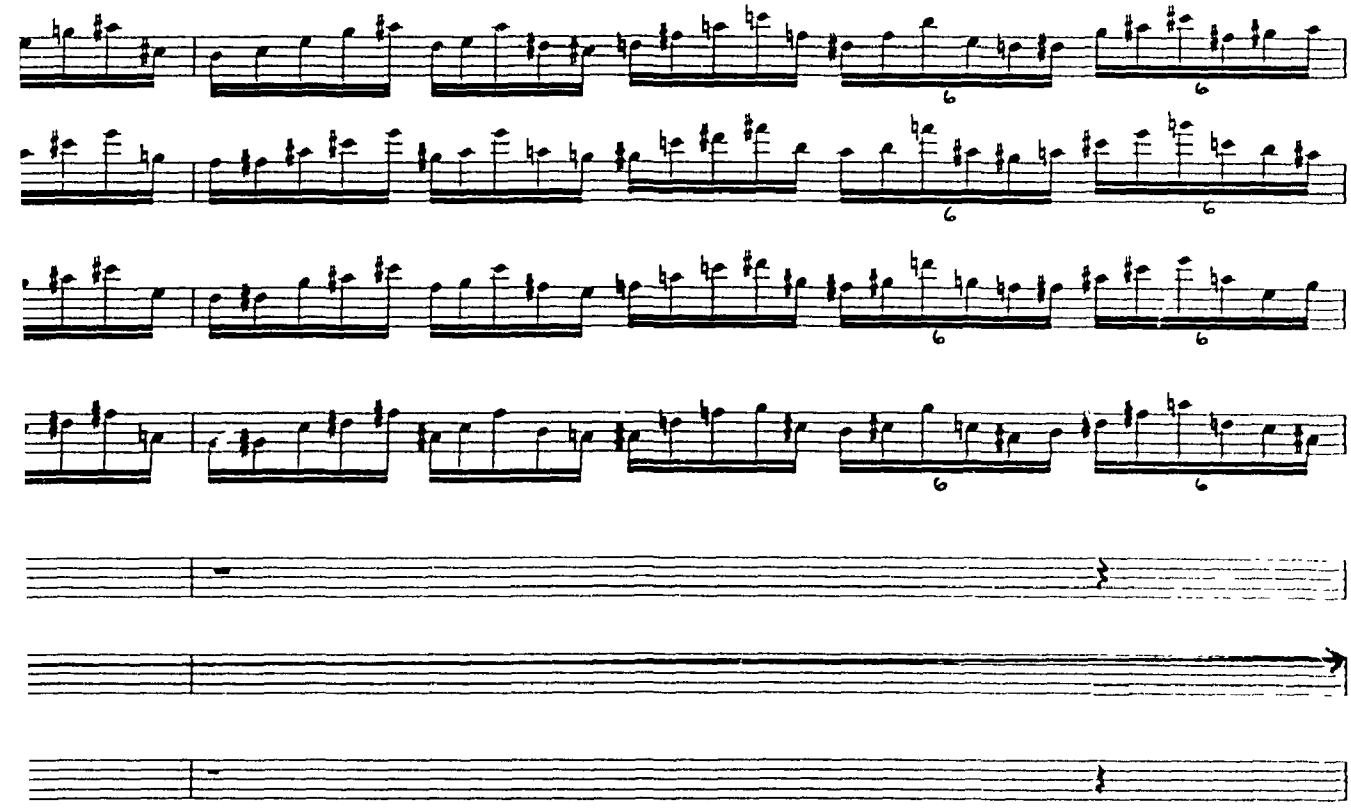

Jeté
mf
Tre

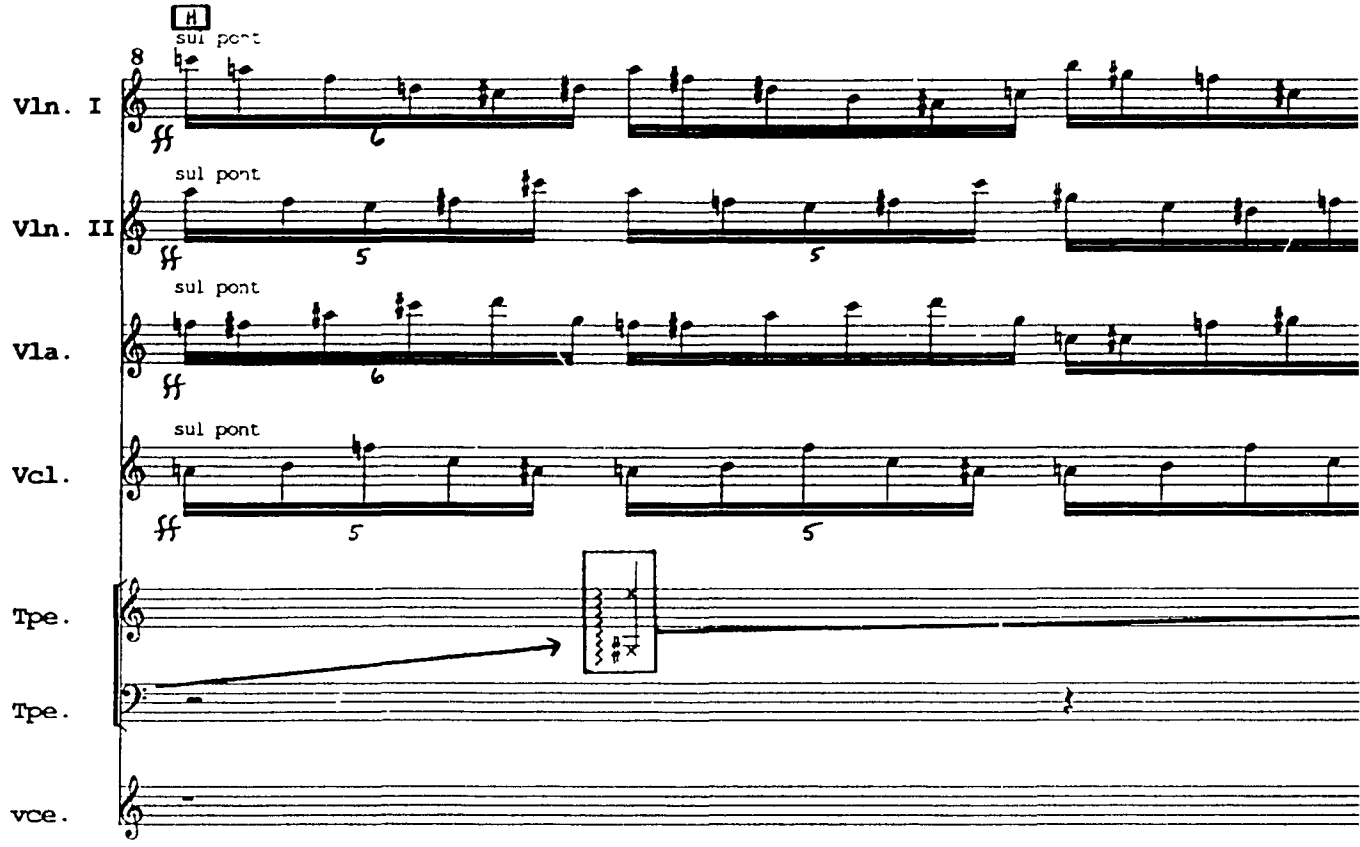

8
Jeté
mf
Jeté

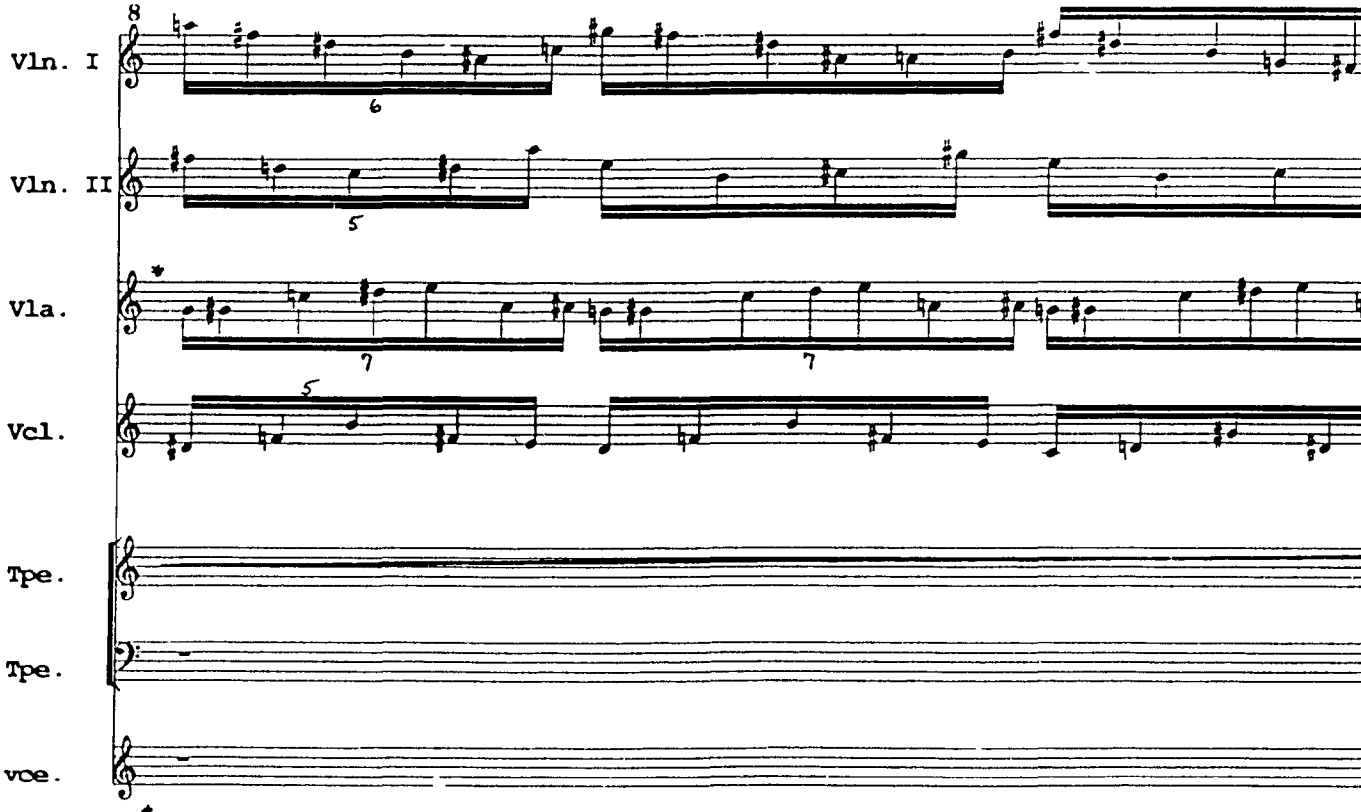

8
Vln. I
Vln. II
Trem
Vla.
Trem
Vcl.
Tpe.
Tpe.
vce.


8
170
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

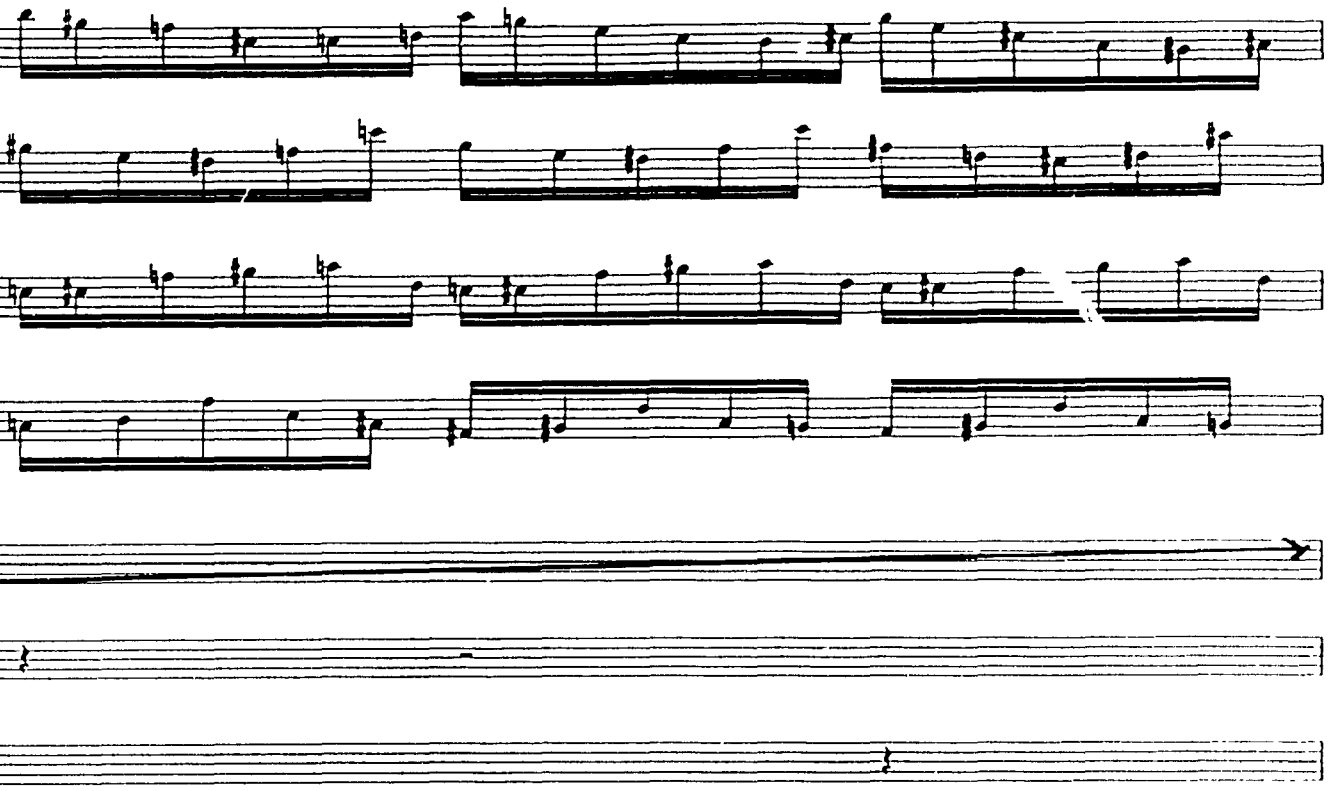

Trem.
Trem
Trem

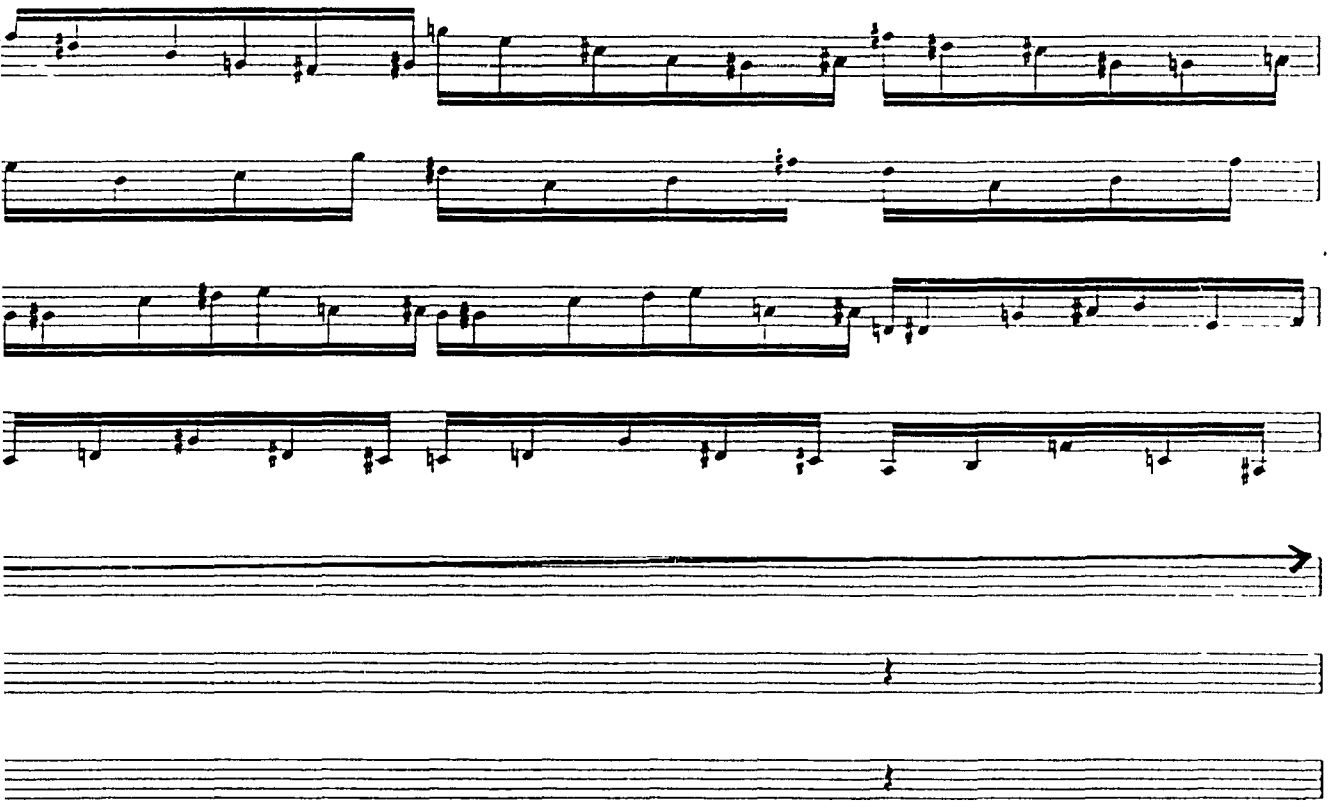




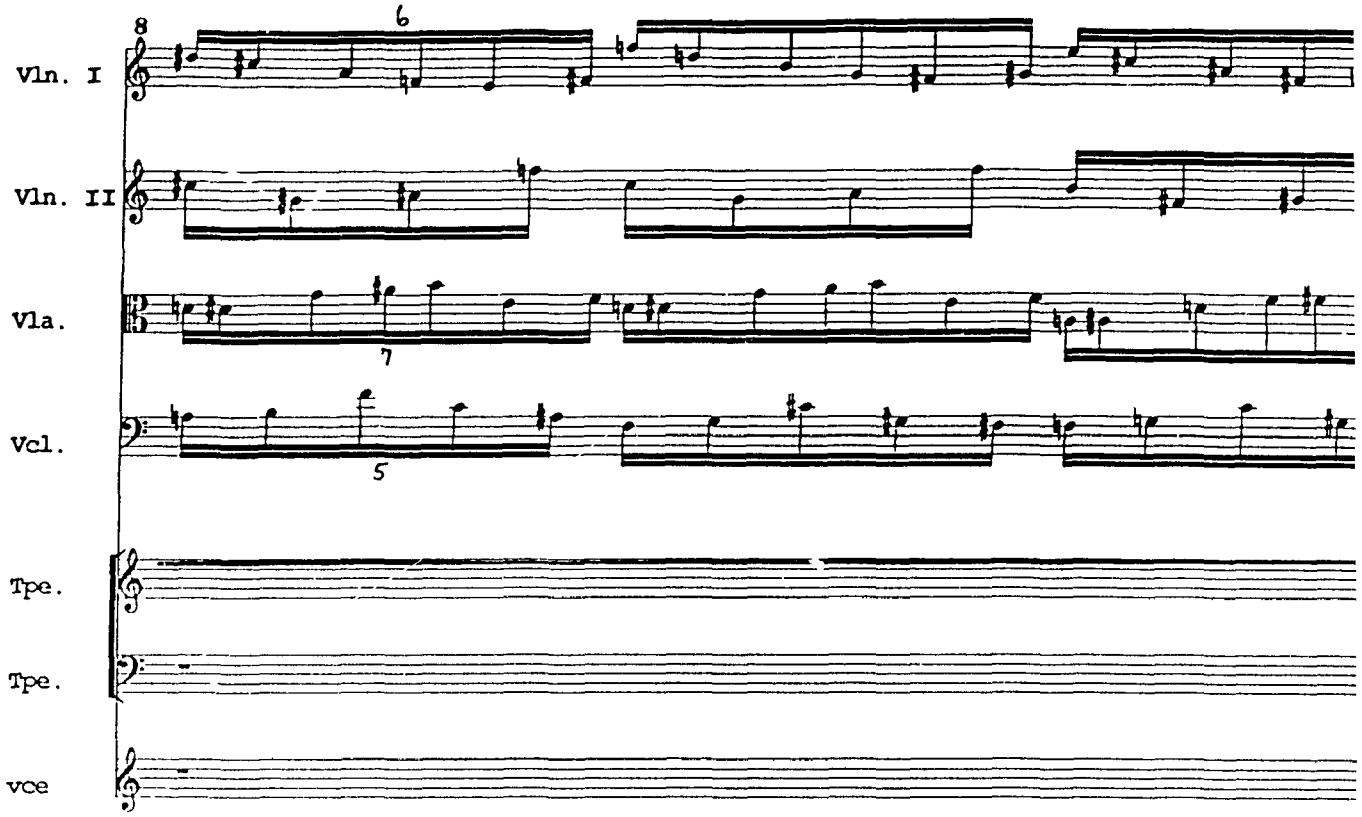


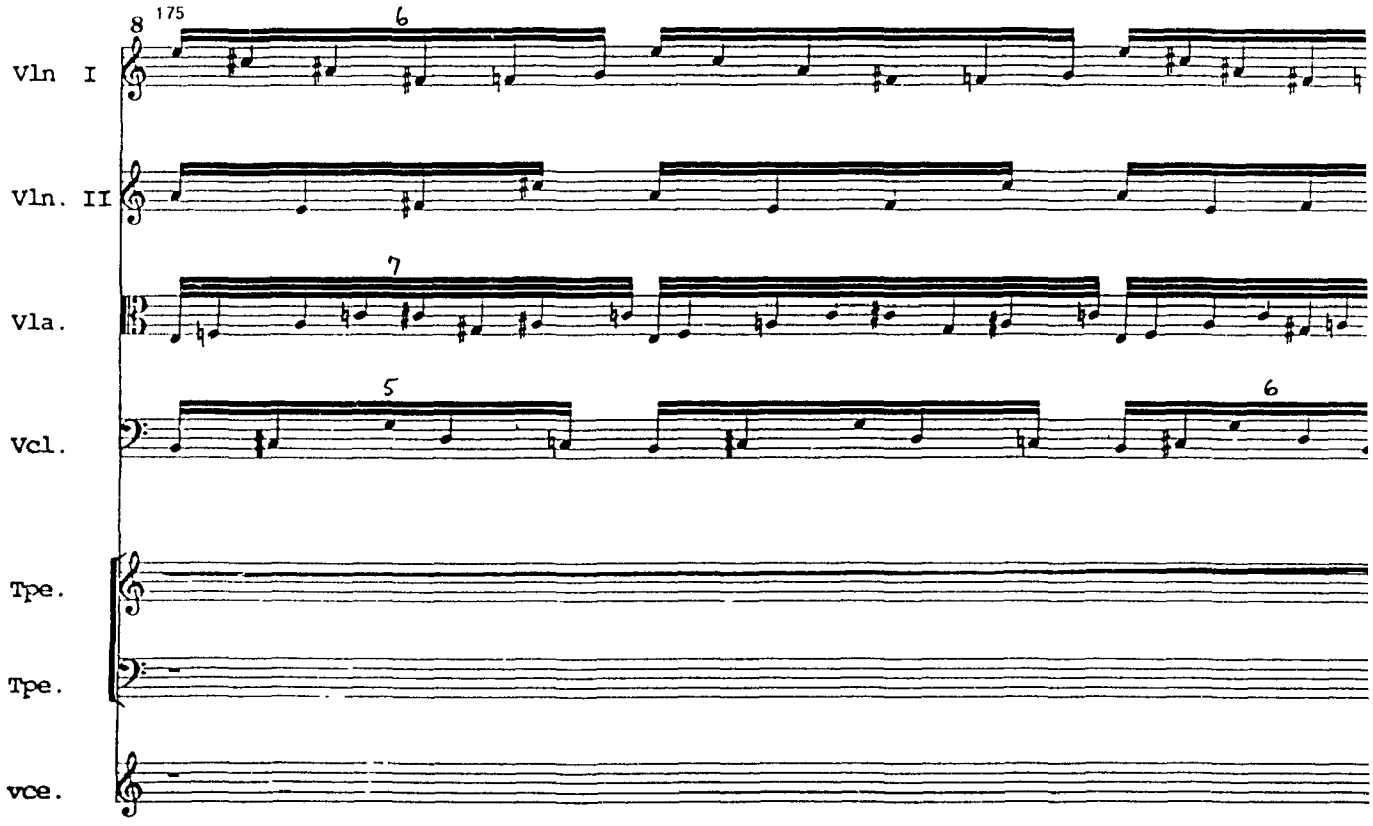
* the irregular spacing of these septuplets are due to the manner in which the computer program spaced the notes they are to be performed as regular tuplet figures with equal duration for each note.

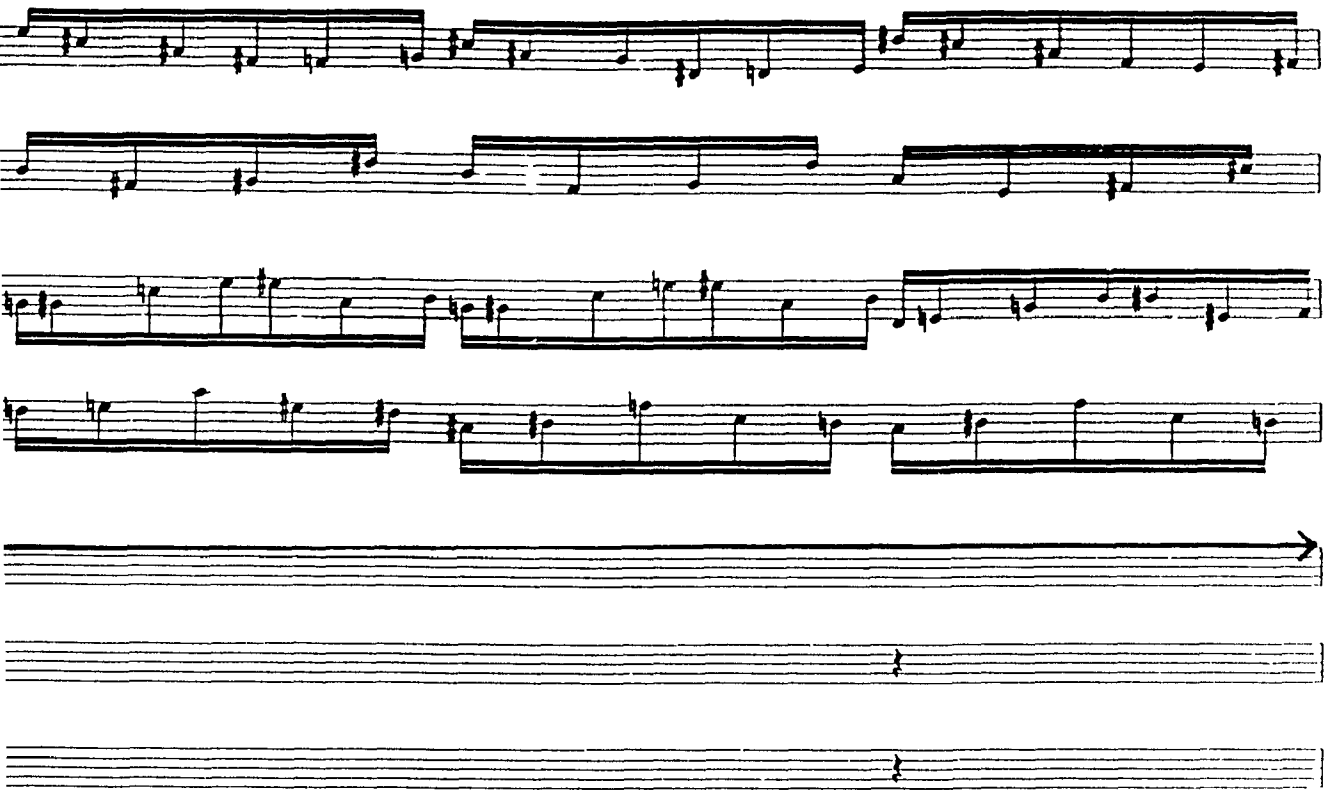


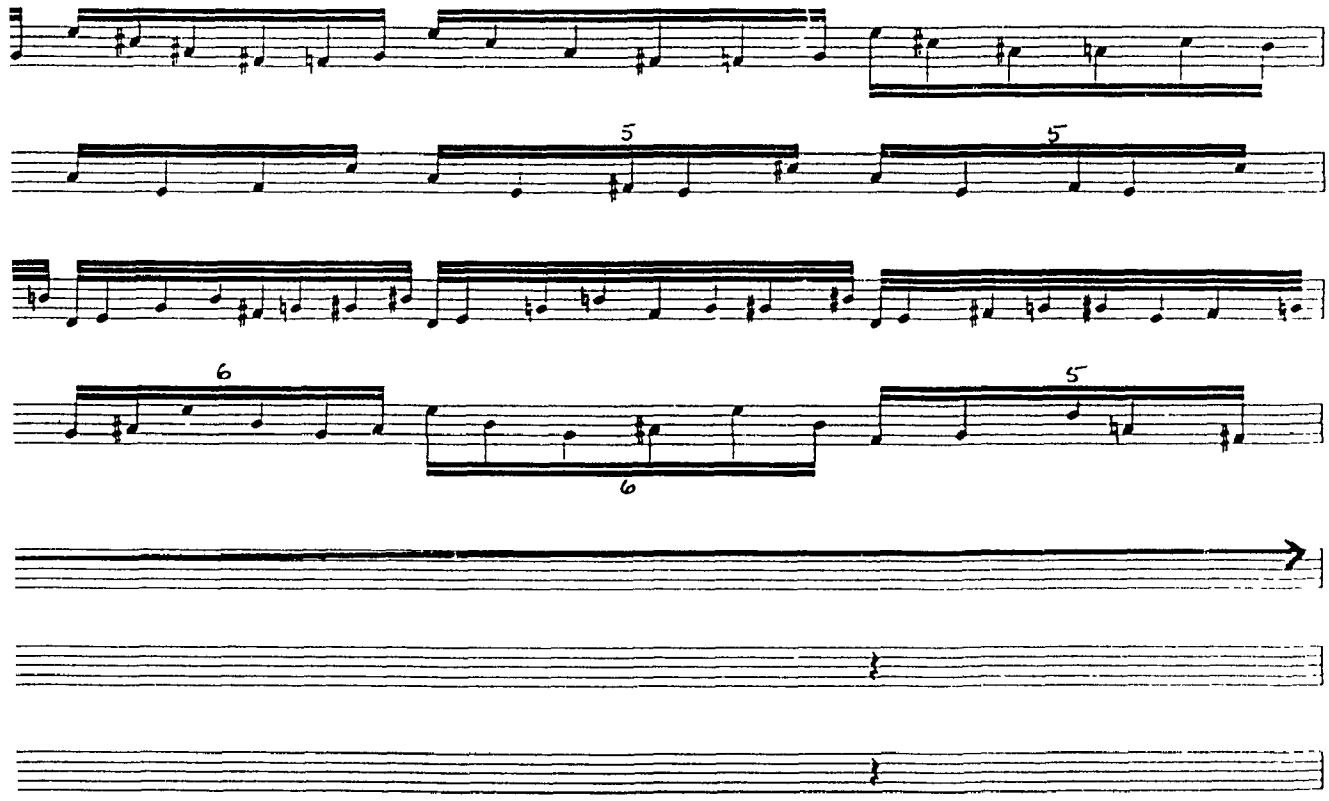


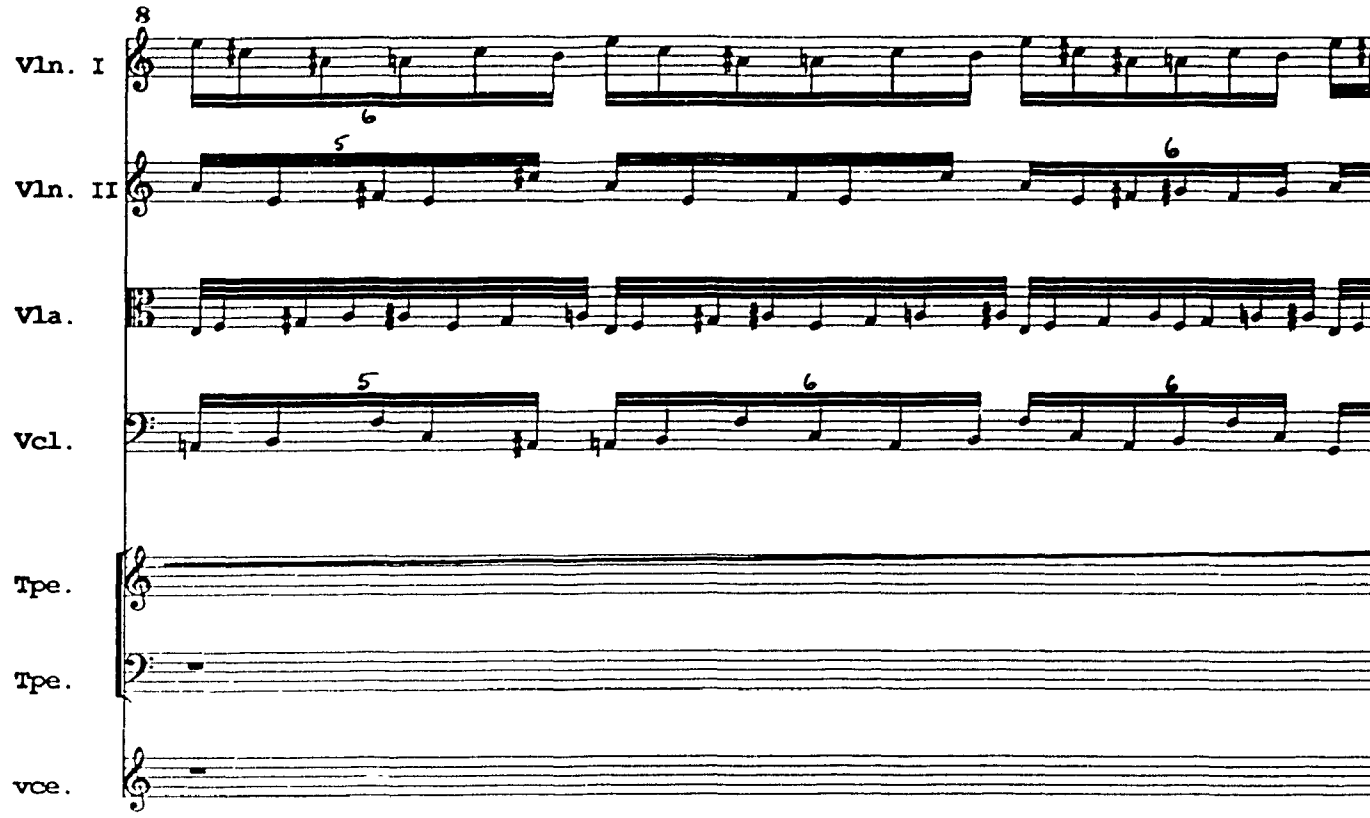
uter program spaced the notes in relation to the other tuplet figures
ote.

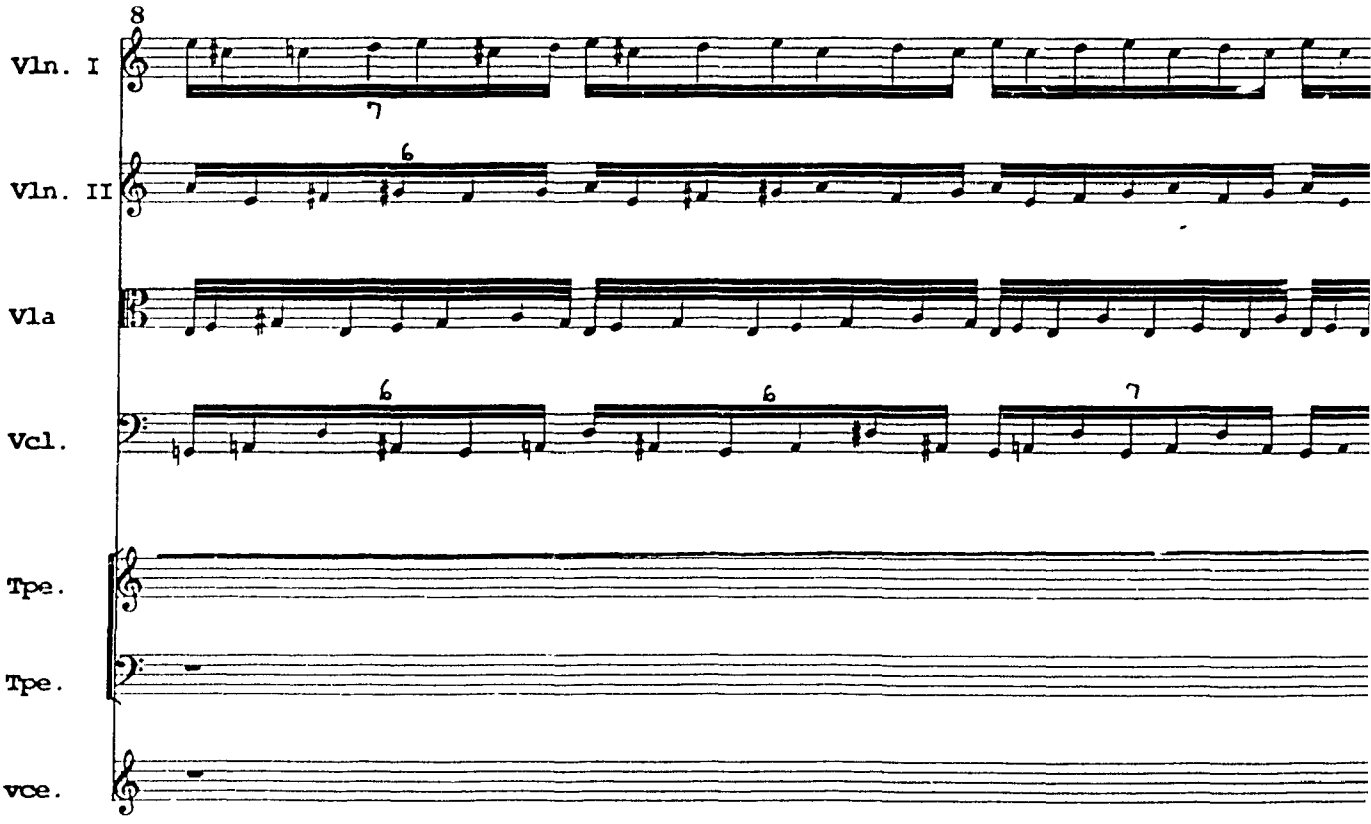

8
6
Vln. I
Vln. II
Vla.
7
Vcl.
5
Tpe.
Tpe.
vce

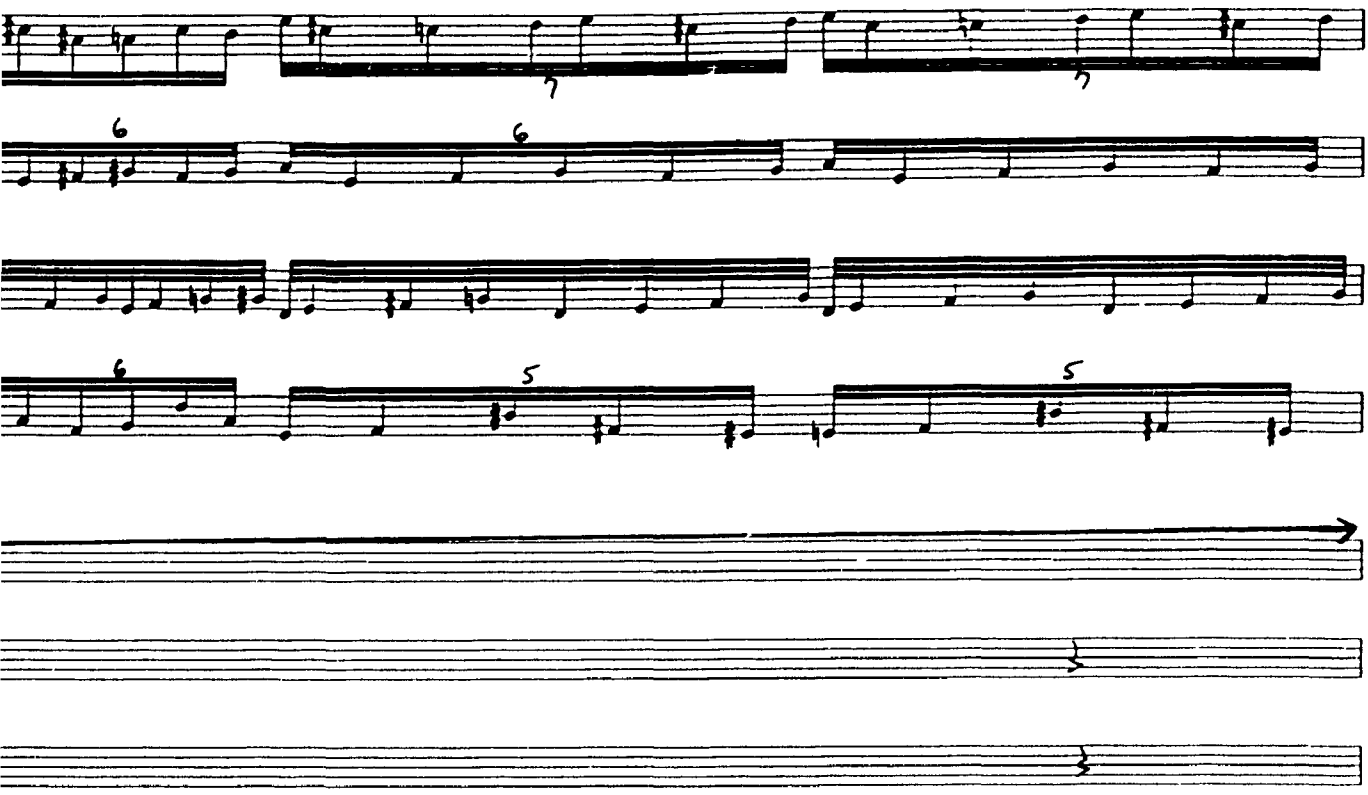

8
175
6
Vln I
Vln. II
7
Vla.
5
Vcl.
6
Tpe.
Tpe.
vce.

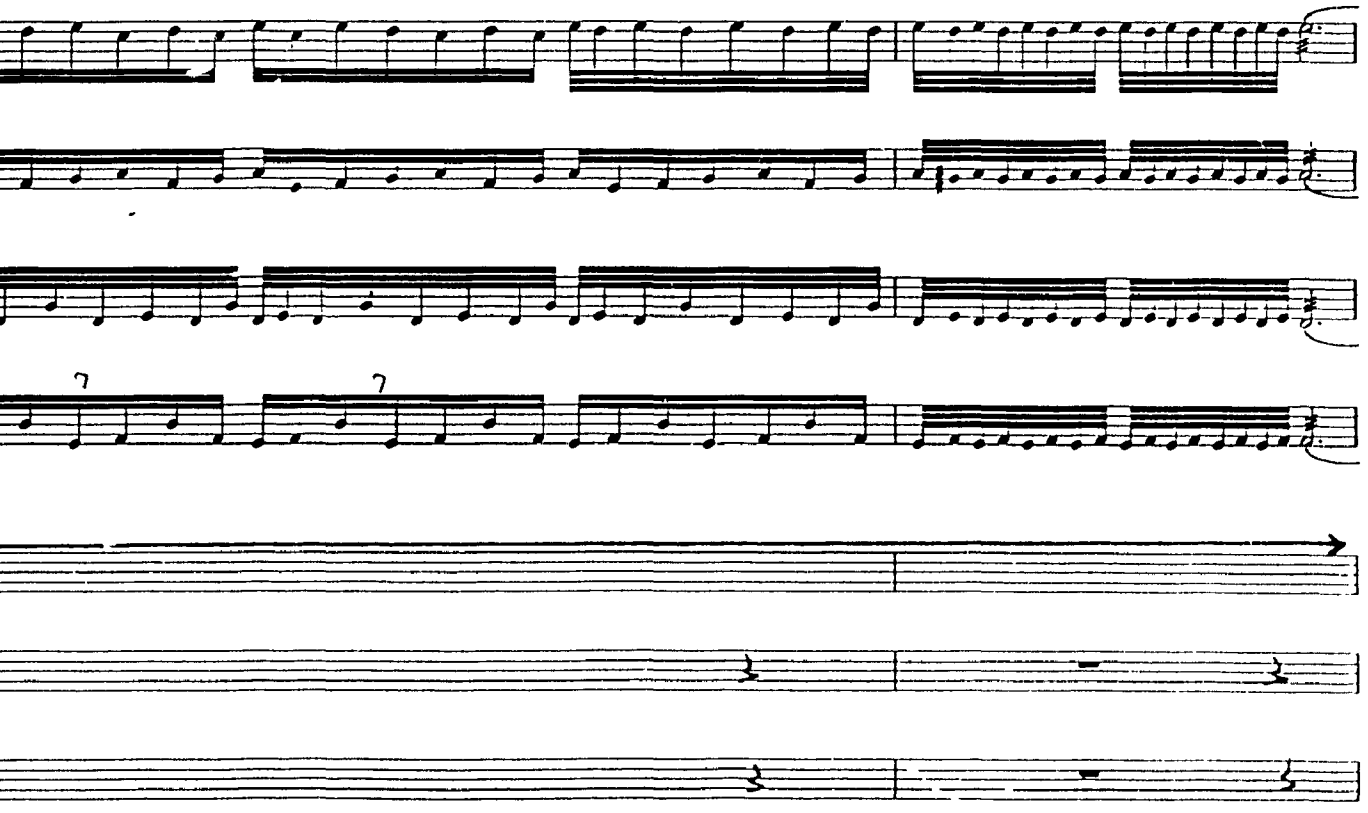


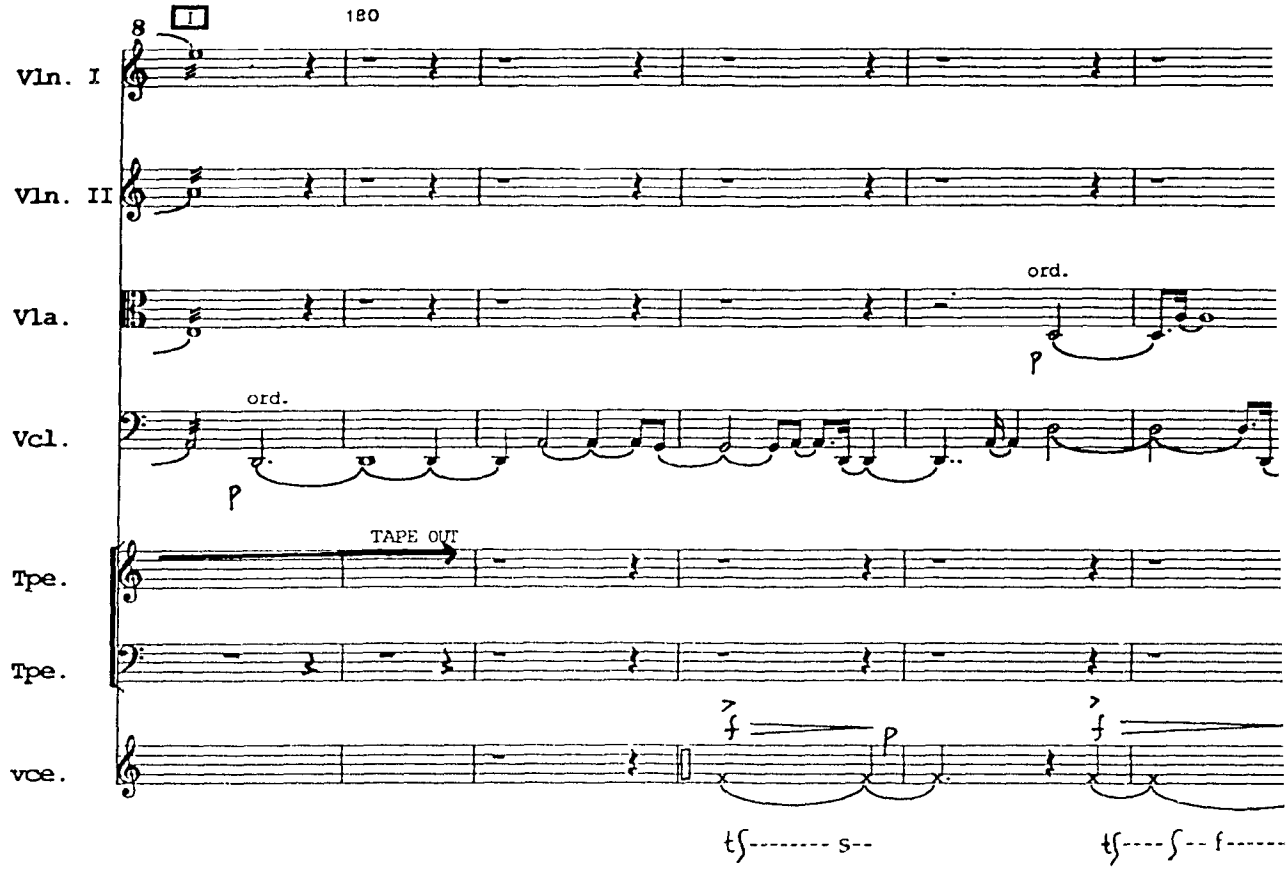

5
5
6
6
5

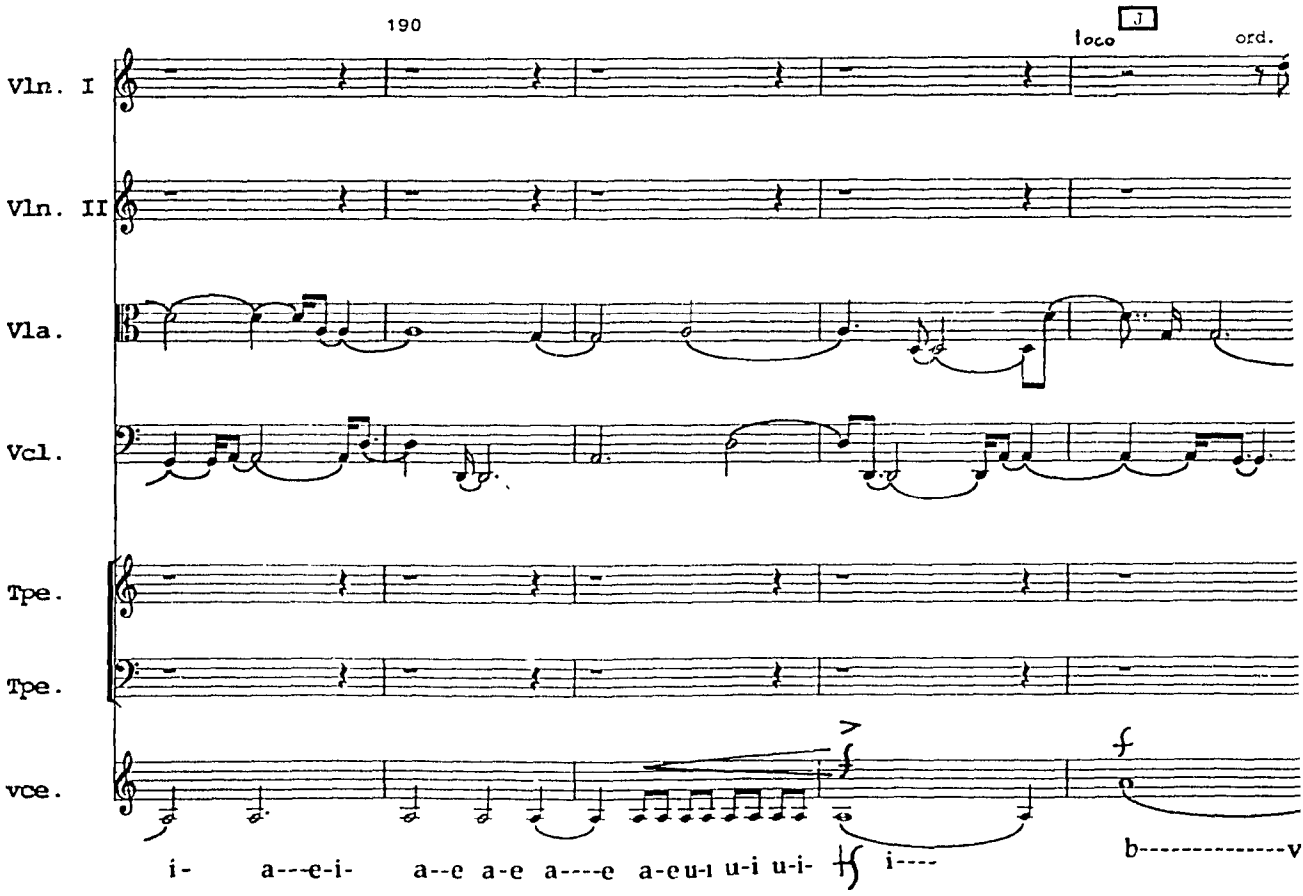

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

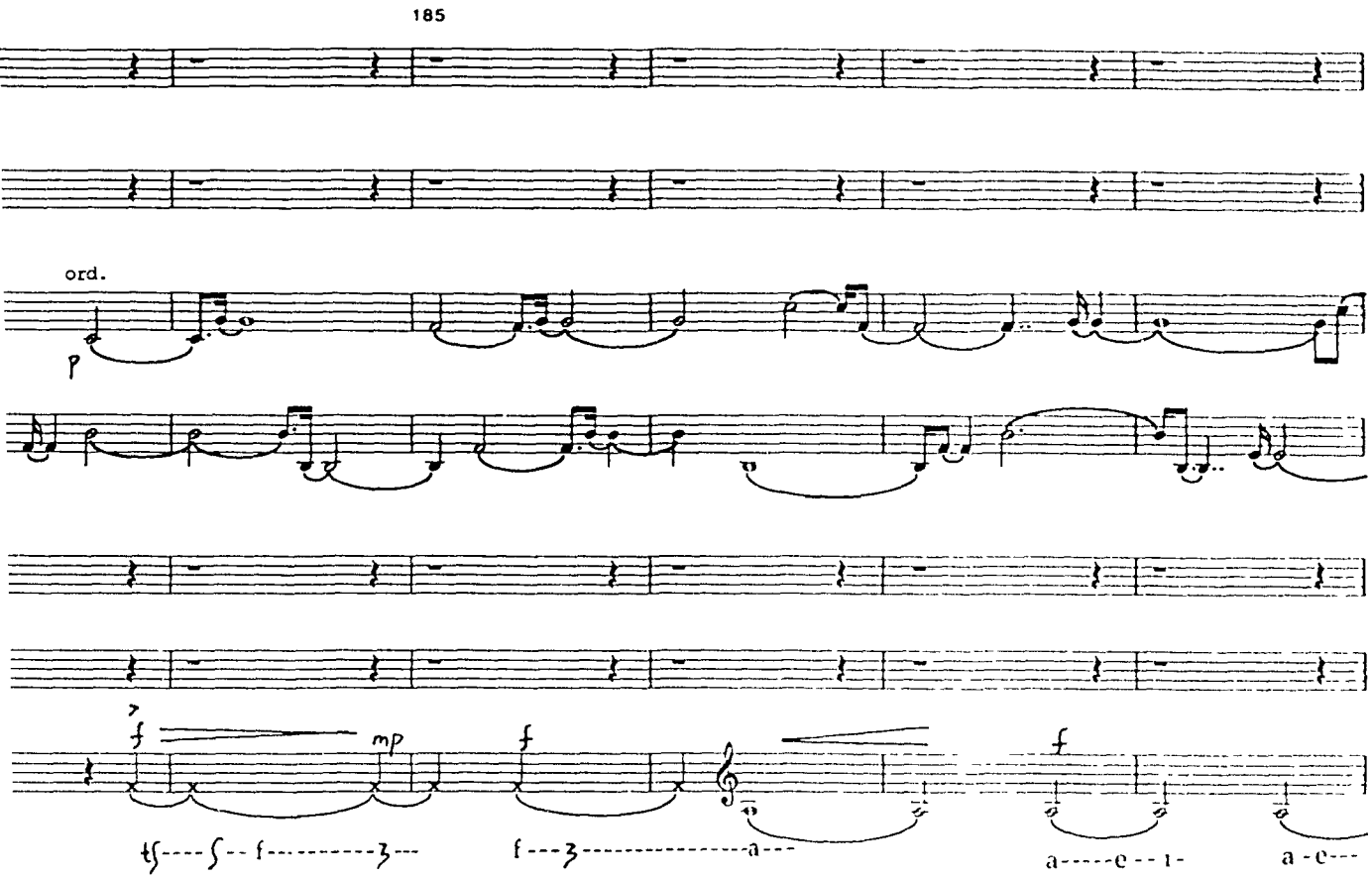

8
Vln. I
Vln. II
Vla
Vcl.
Tpe.
Tpe.
vce.

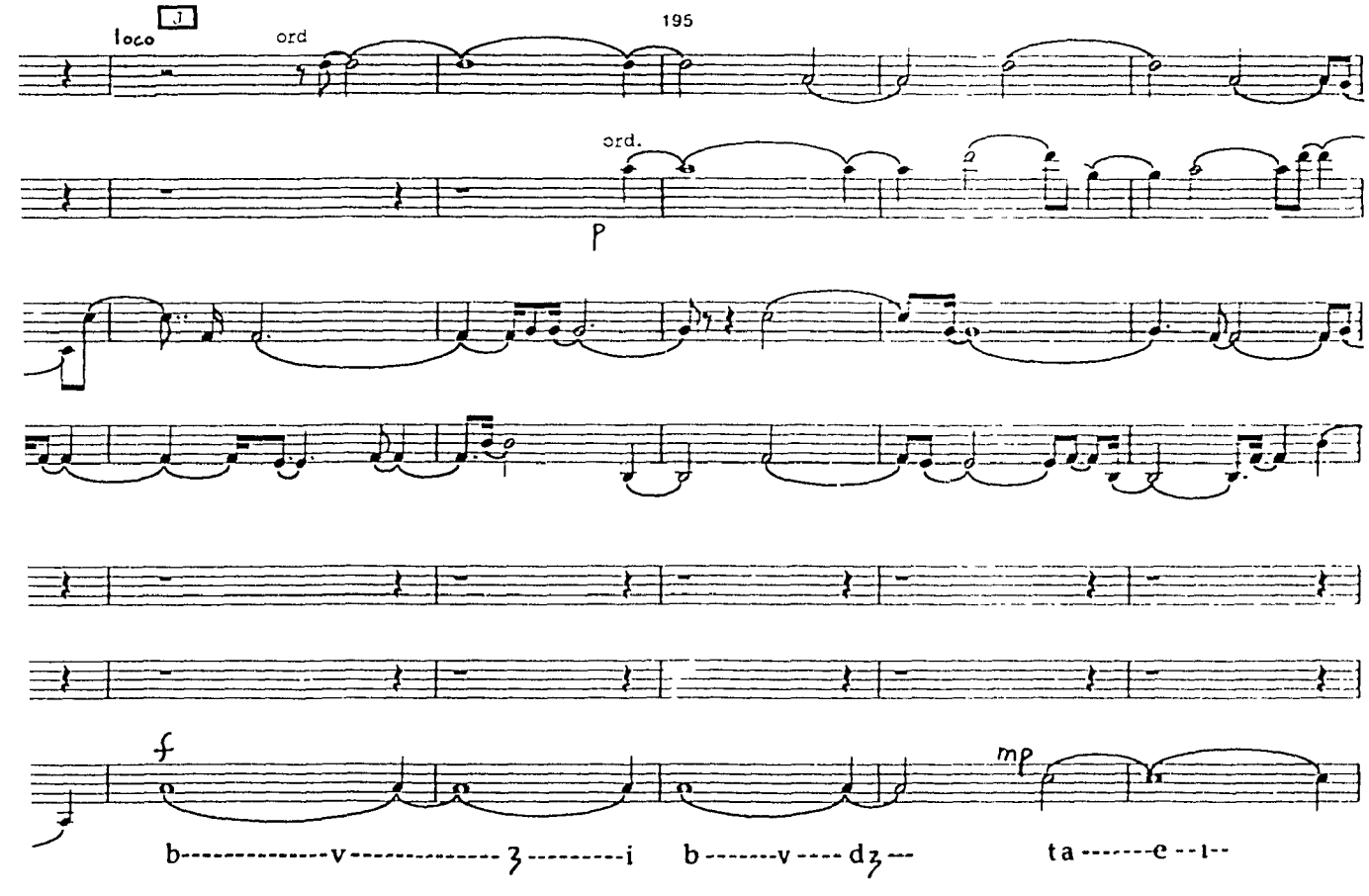


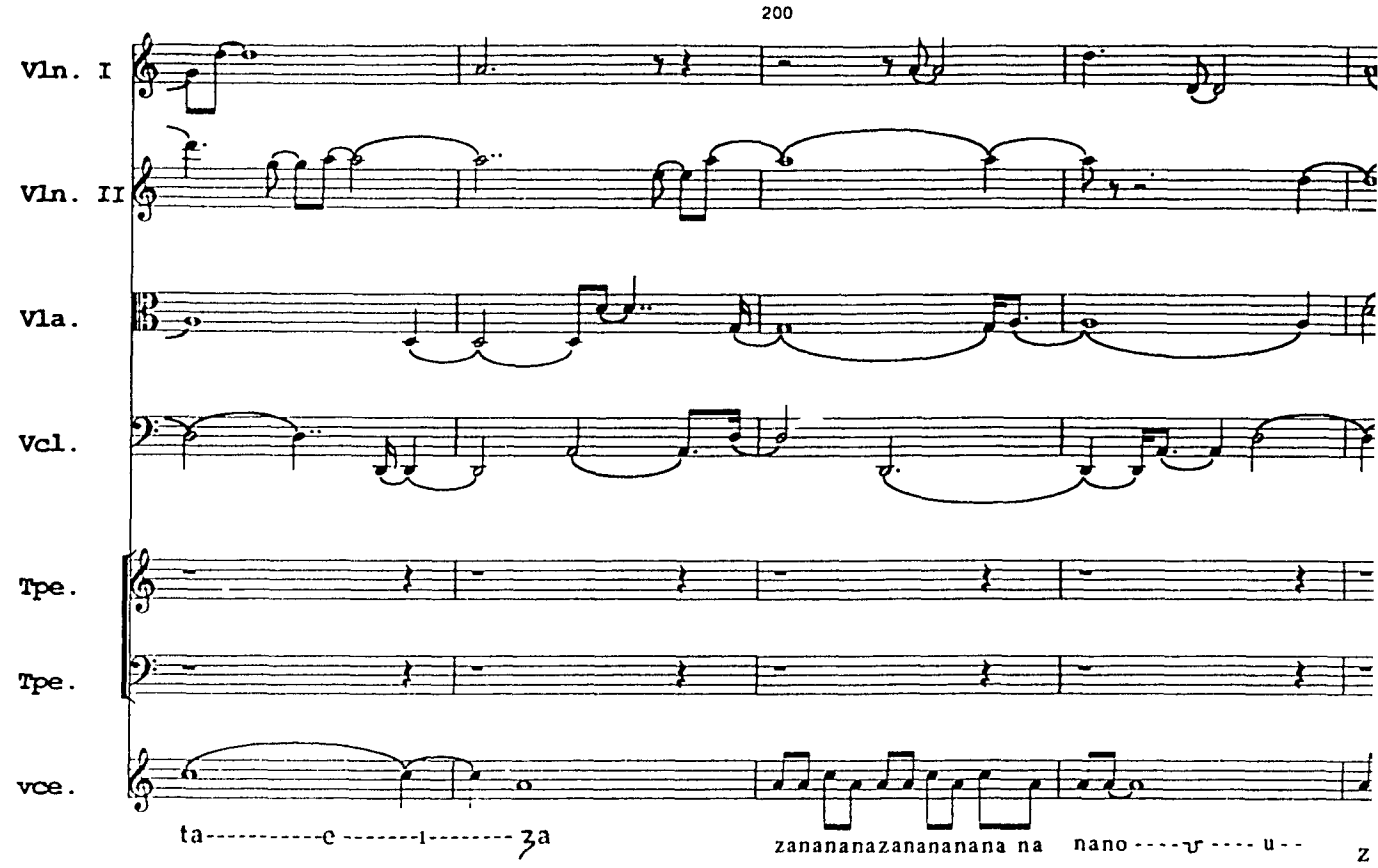


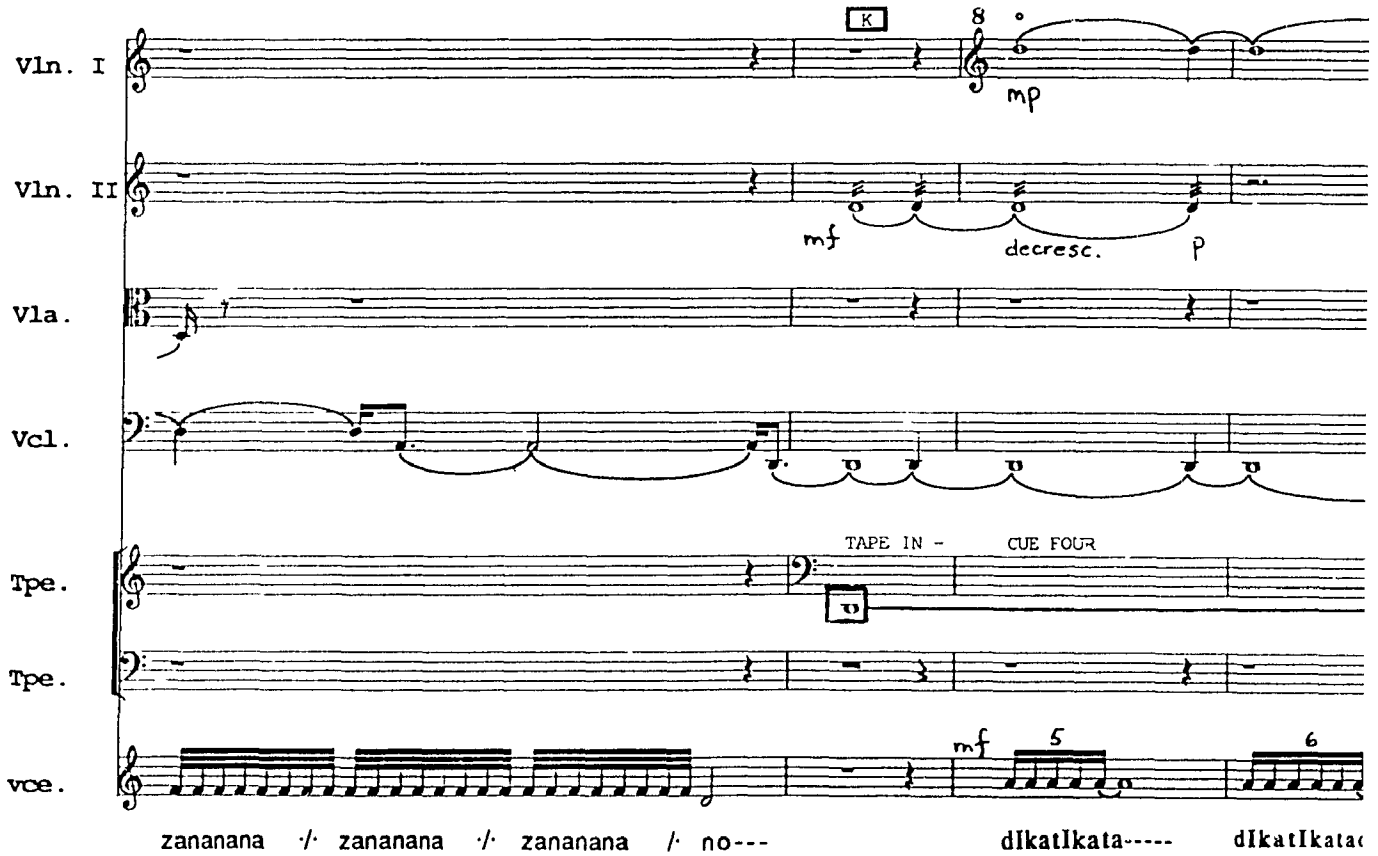

I
180
8
Vln. I
Vln. II
Vla.
ord.
p
Vcl.
ord.
p
TAPE OUT
Tpe.
Tpe.
vce.
f
p
f
tʃ-------- s--
tʃ----ʃ-- f------

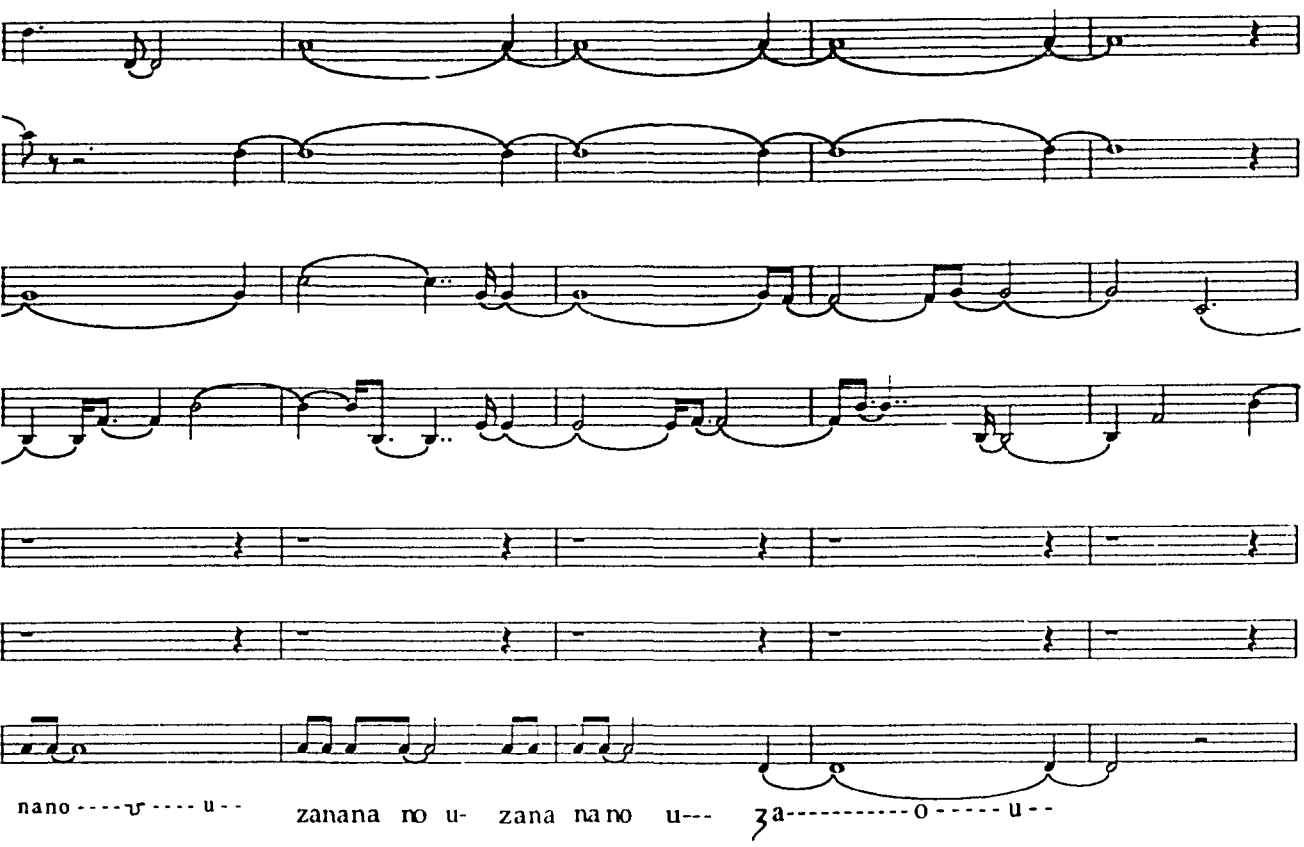

190
J
loco
ord.
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
i- a---e-i- a--e a-e a----e a-eu-ı u-i u-i- i----
b----------v

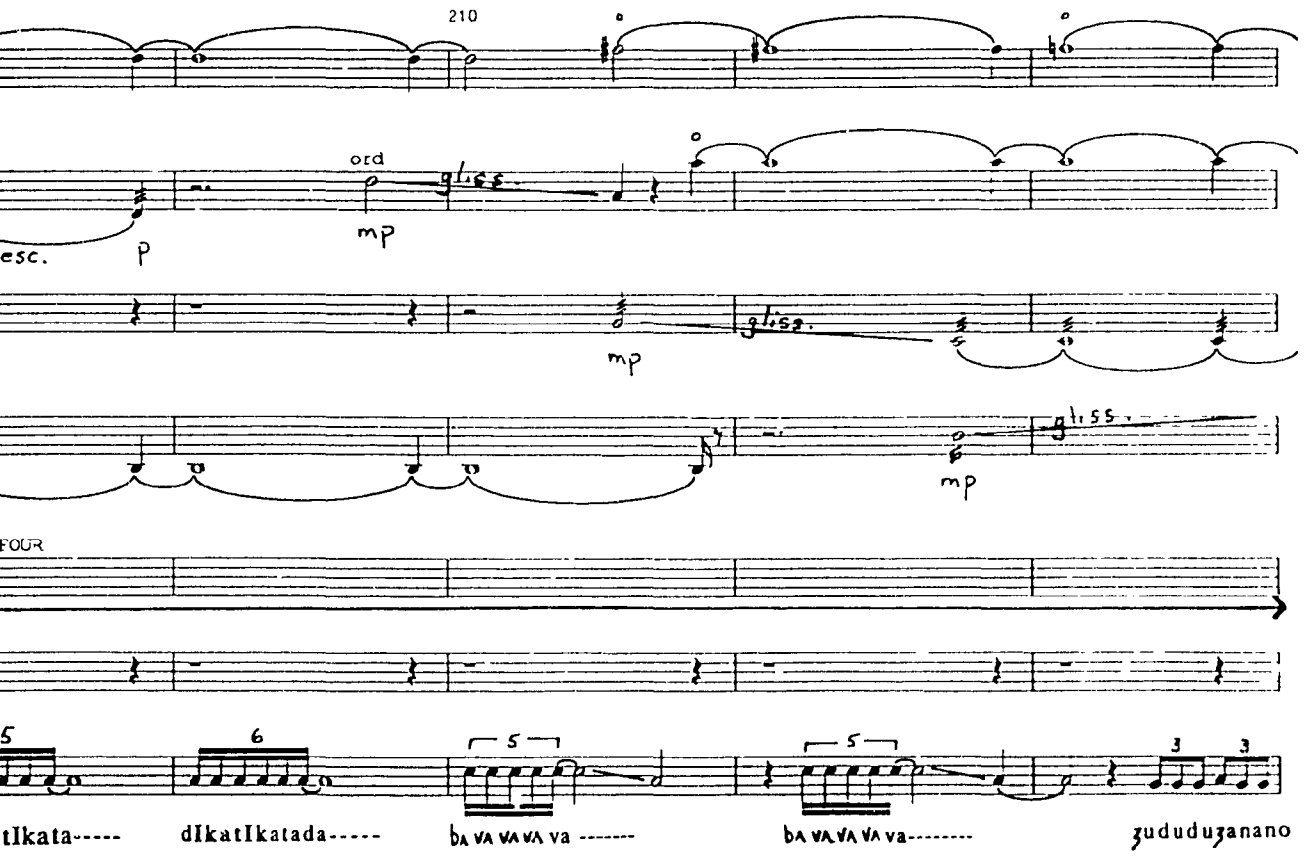

185
ord.
p
f
mp
f
f
a
a - e

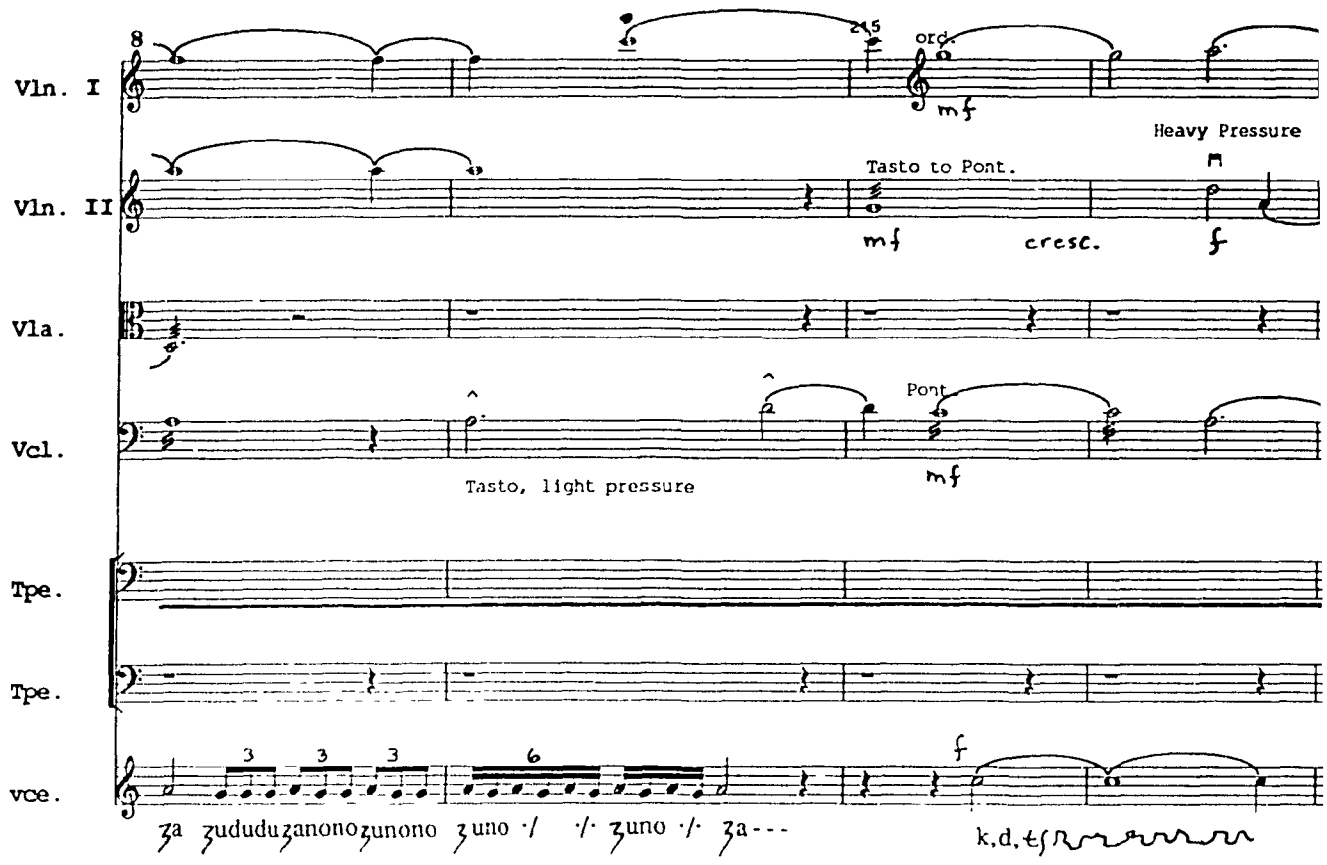

loco
J
ord
195
ord.
p
f
mp
b
v
i
b
v
ta
e

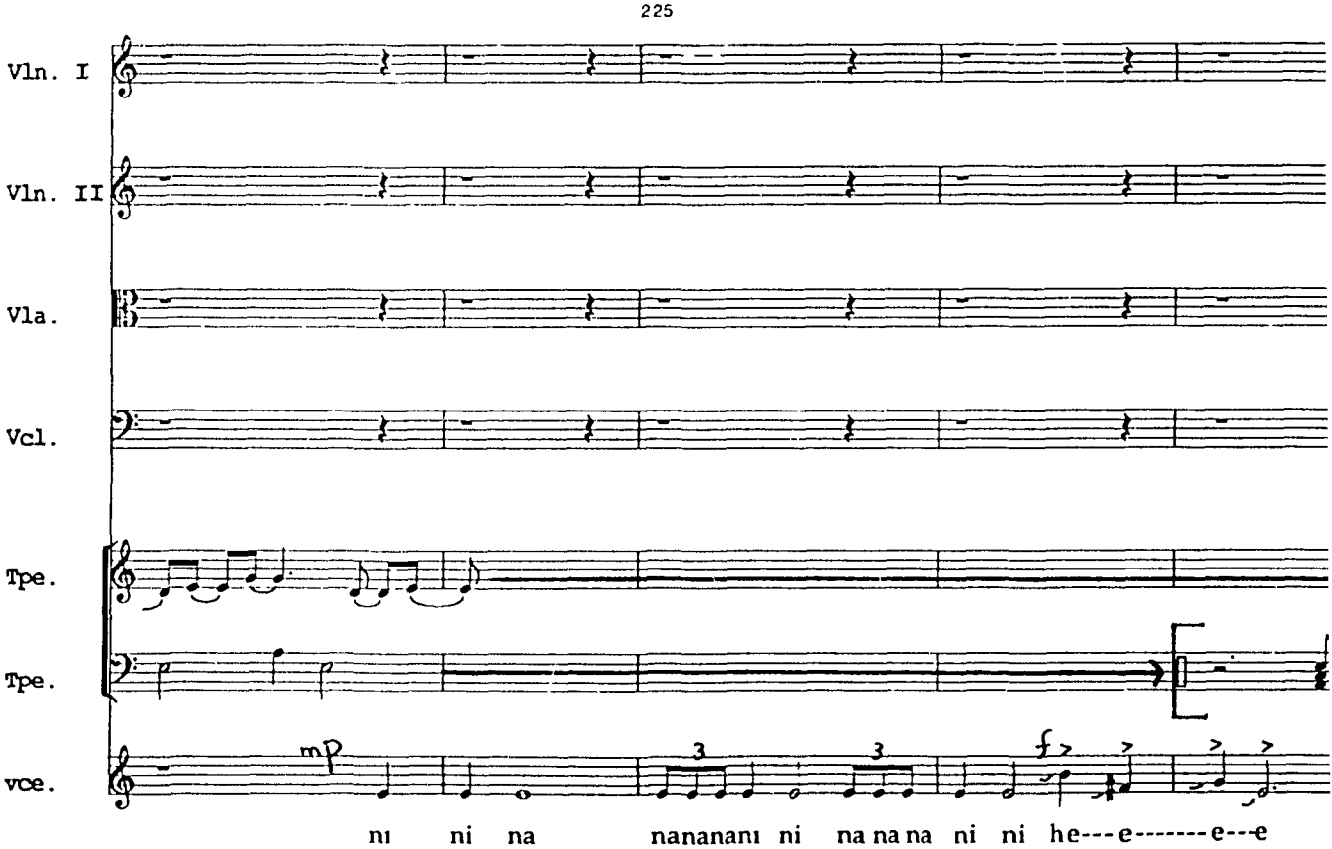

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
ta----------e-------i--------za
zanananazananananana na nano----u----u--
z

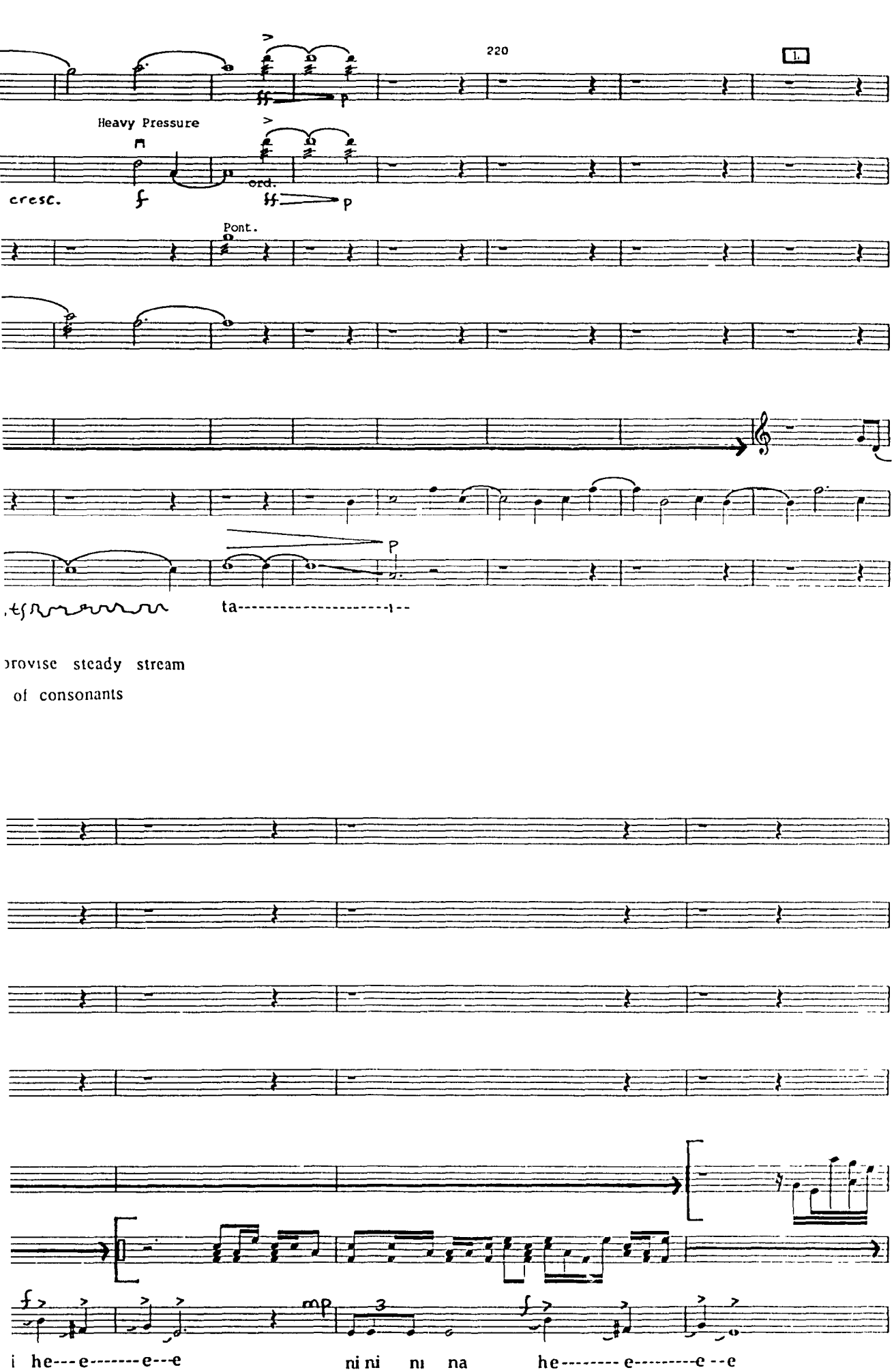

K
8
mp
Vln. I
Vln. II
mf
decresc.
p
Vla.
Vcl.
TAPE IN - CUE FOUR
Tpe.
Tpe.
mf
5
6
vce.
zananana -/- zananana -/- zananana /- no---
dIkatIkata-----
dIkatIkata

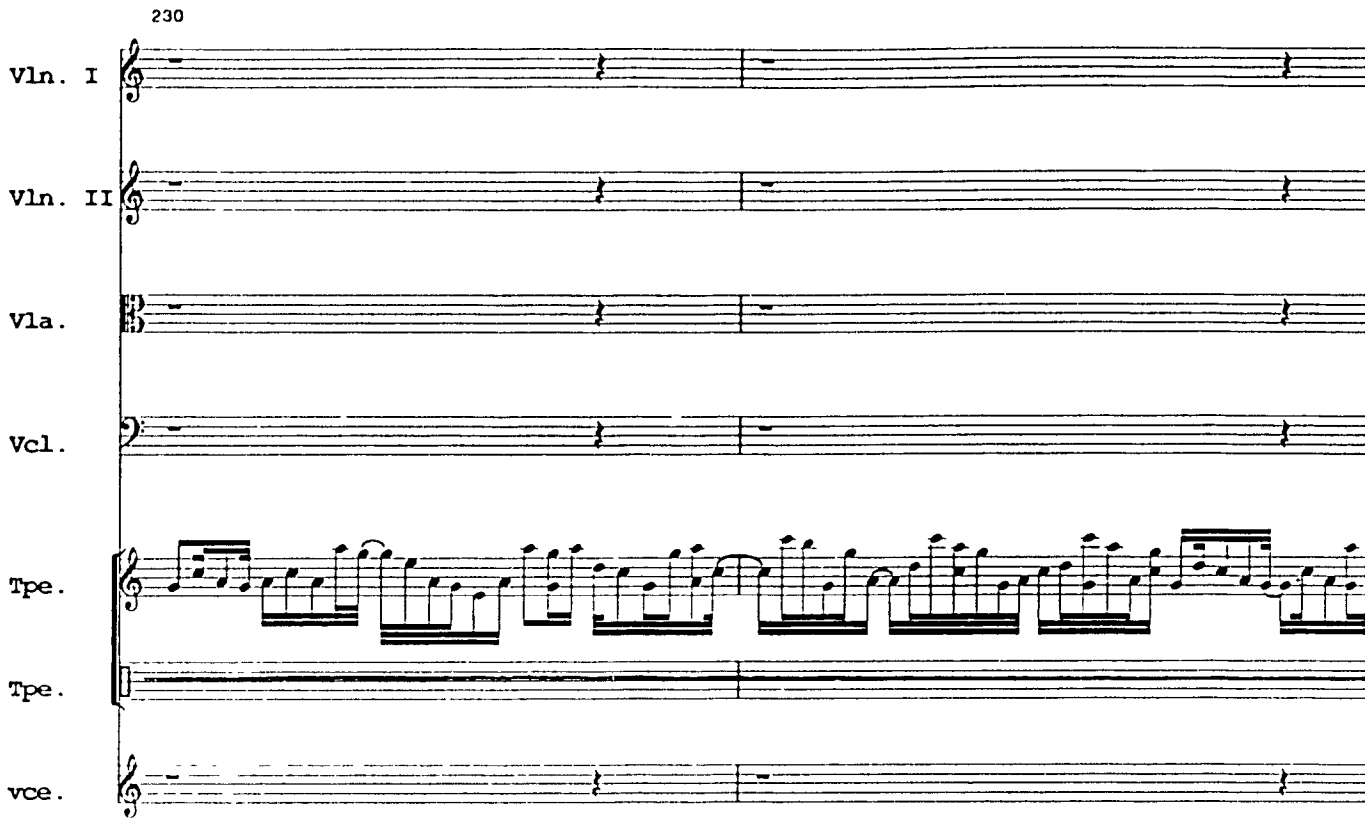

nano----u----u--
zanana no u- zana nano u---
za----------o-----u--

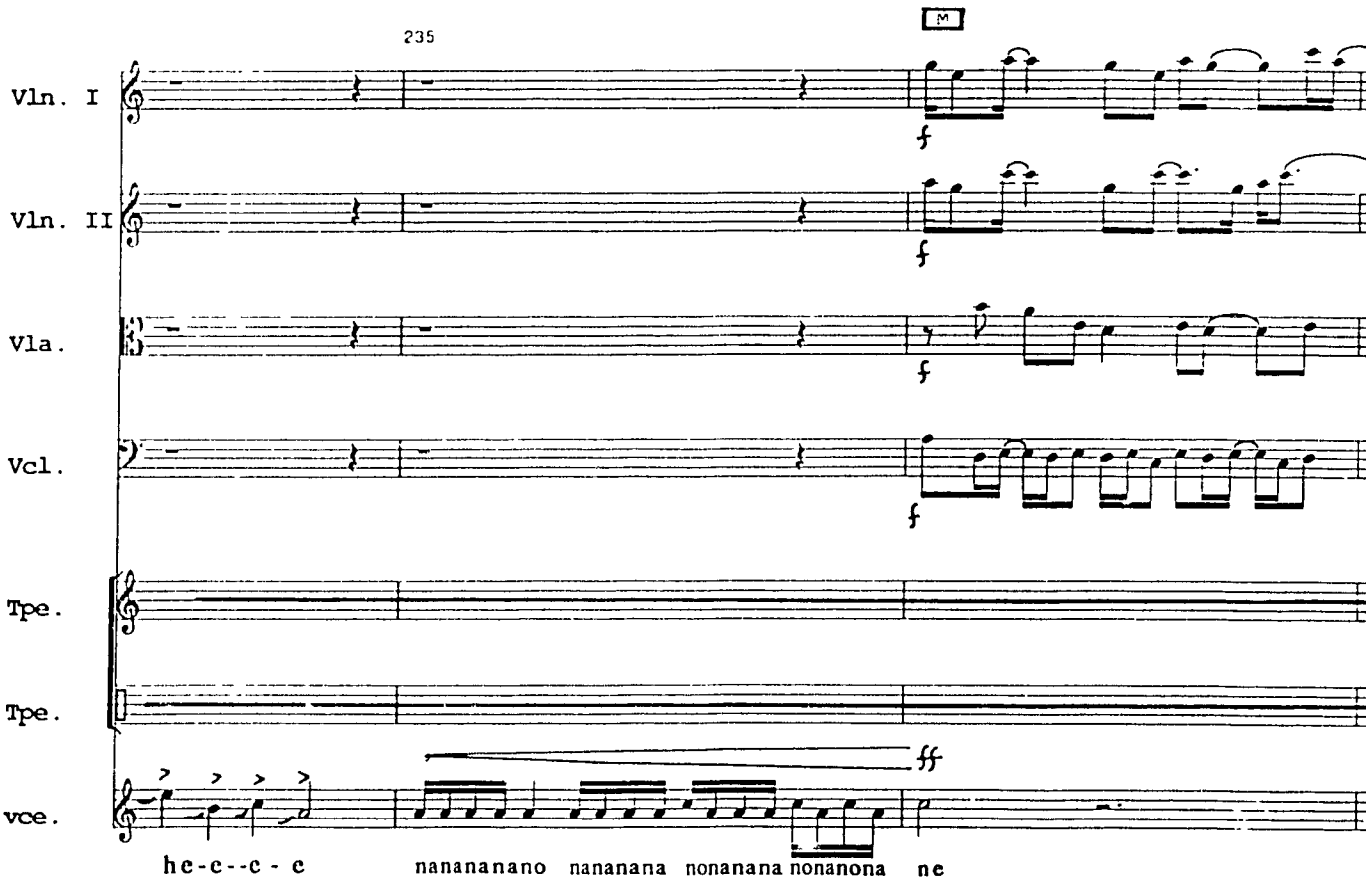

210
ord
gliss.
mp
esc.
p
mp
gliss.
mp
gliss.
FOUR
5
6
5
5
3
3
tIkata-----
dIkatIkatada-----
ba va va va va -------
ba va va va va--------
zududu zanano

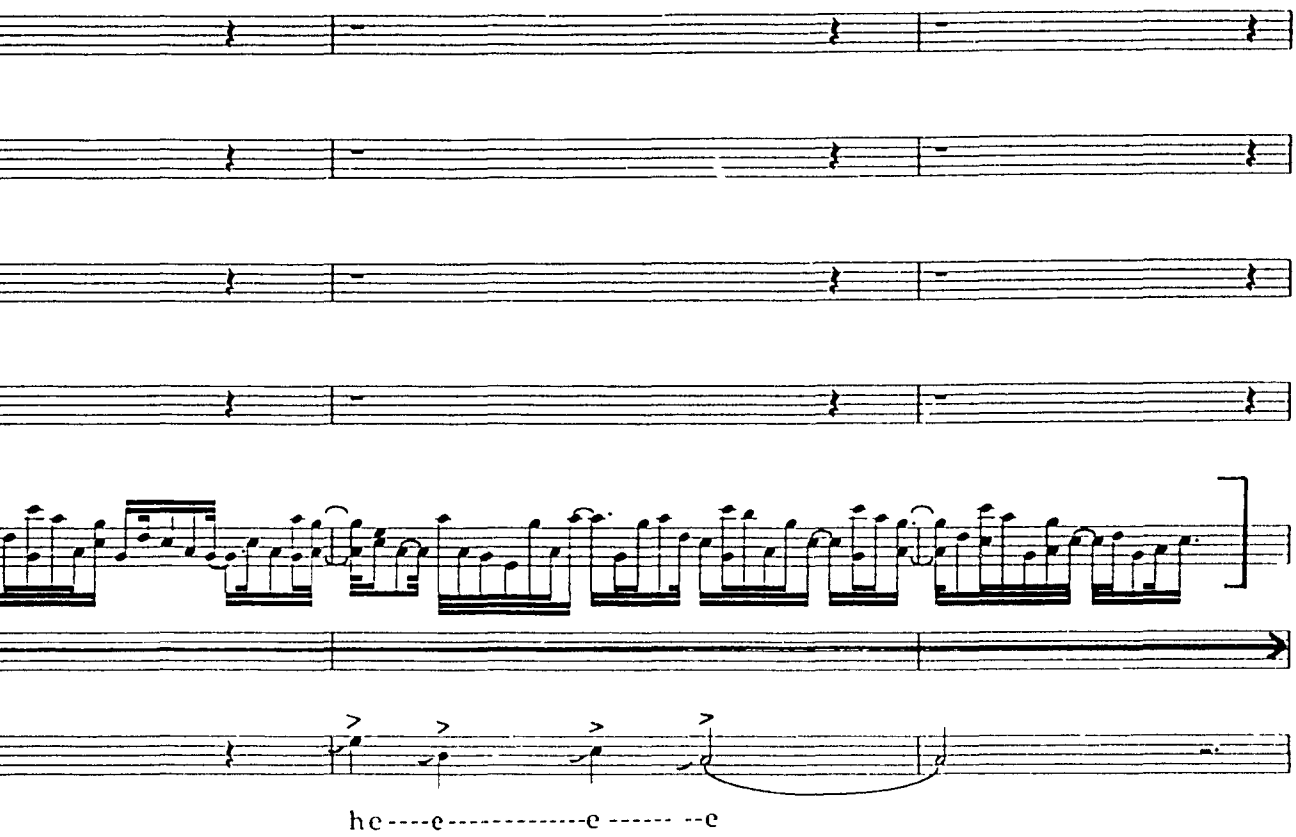

Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
8
ord.
mf
Heavy Pressure
Tasto to Pont.
mf
cresc.
f
Pont
mf
Tasto, light pressure
3
3
3
6
f
za zududu zanono zunono zuno · / · / · zuno · / · za---
k,d,tʃ
improvise steady stream
of consonants

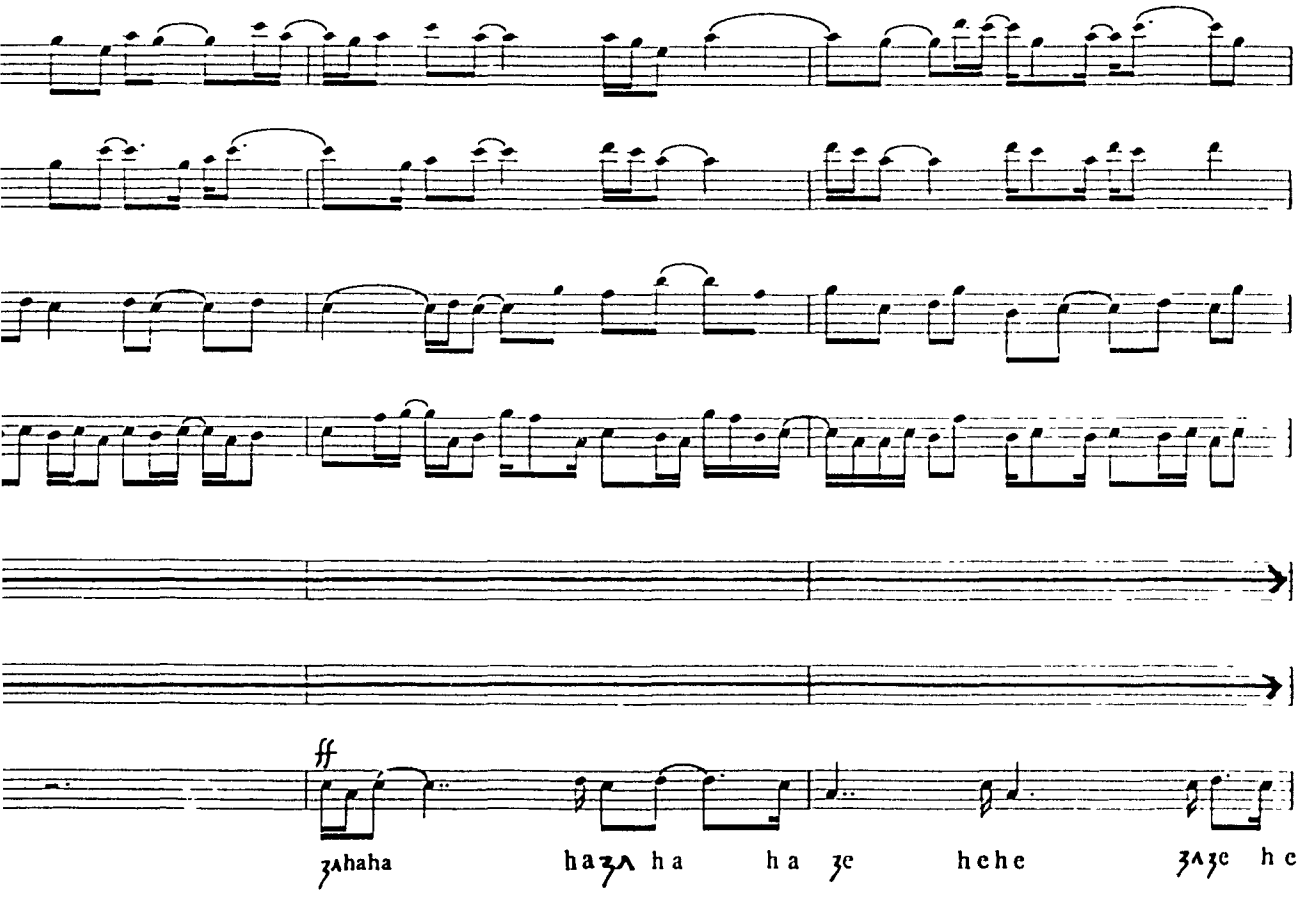

225
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
mp
3
3
f
ni ni na nananani ni na na na ni ni he---e-------e---e

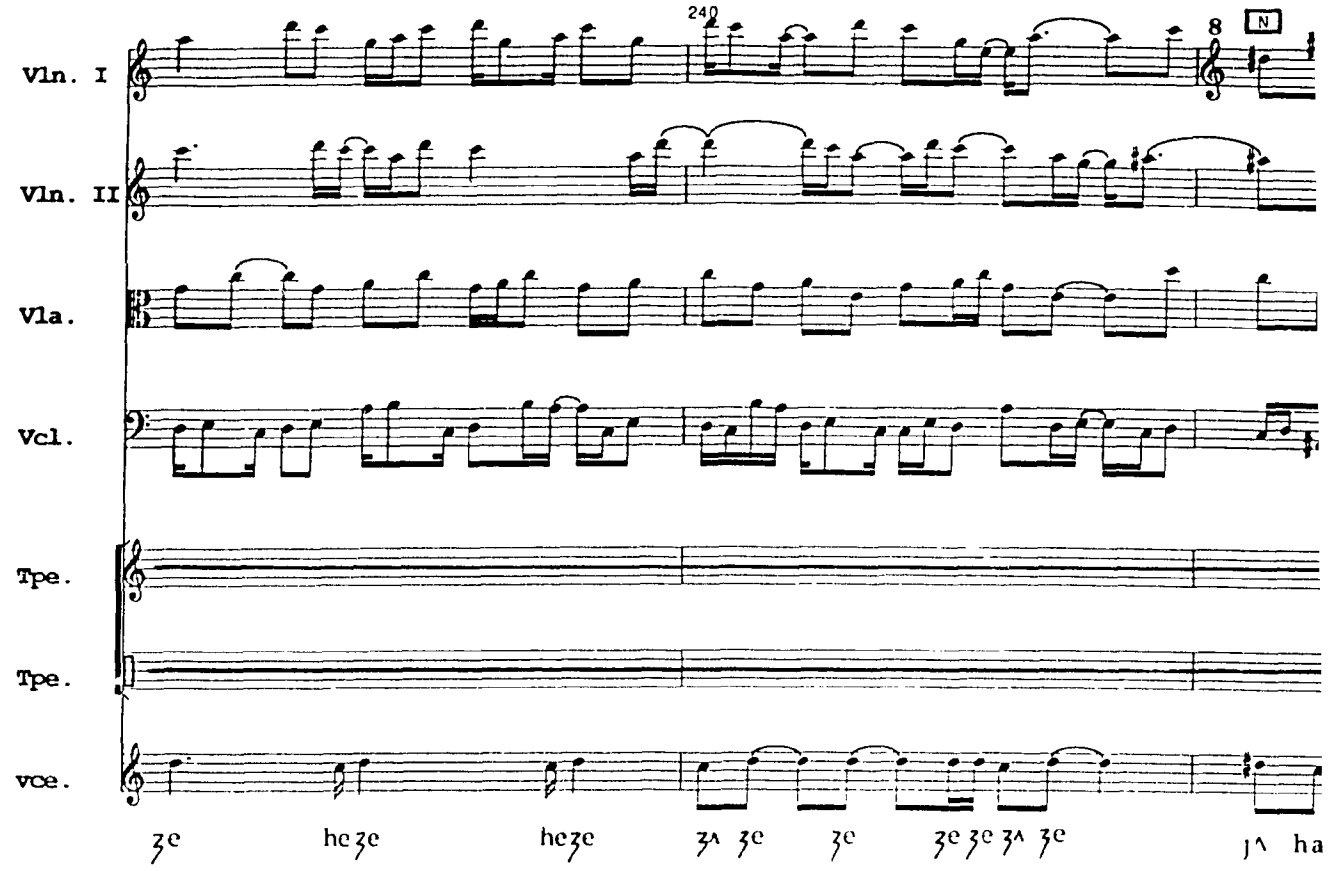

220
1.
Heavy Pressure
cresc.
ord.
Pont.
ta
provise steady stream
of consonants
i he---e-------e---e
ni ni ni na
he--------e---------e--e

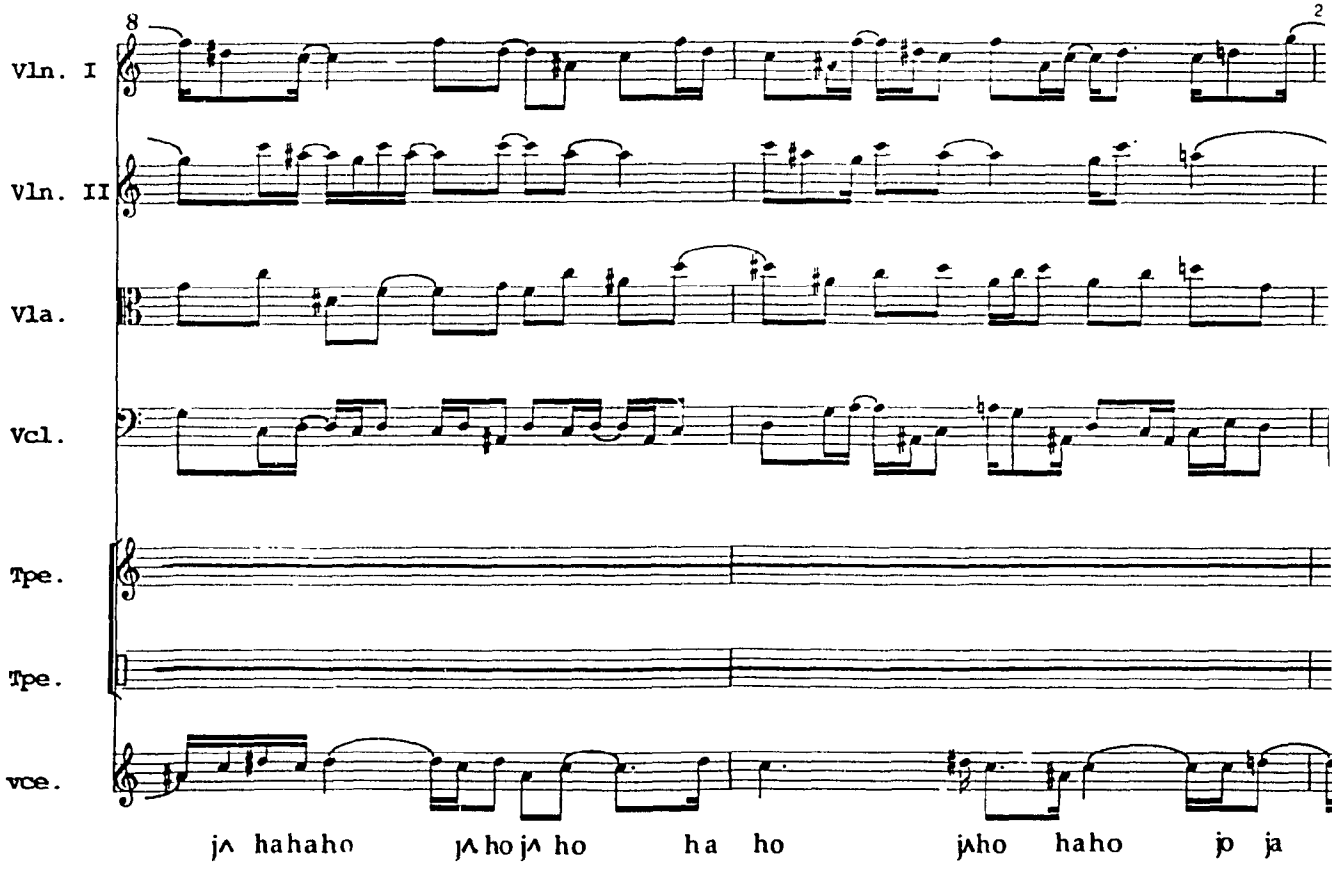

230
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

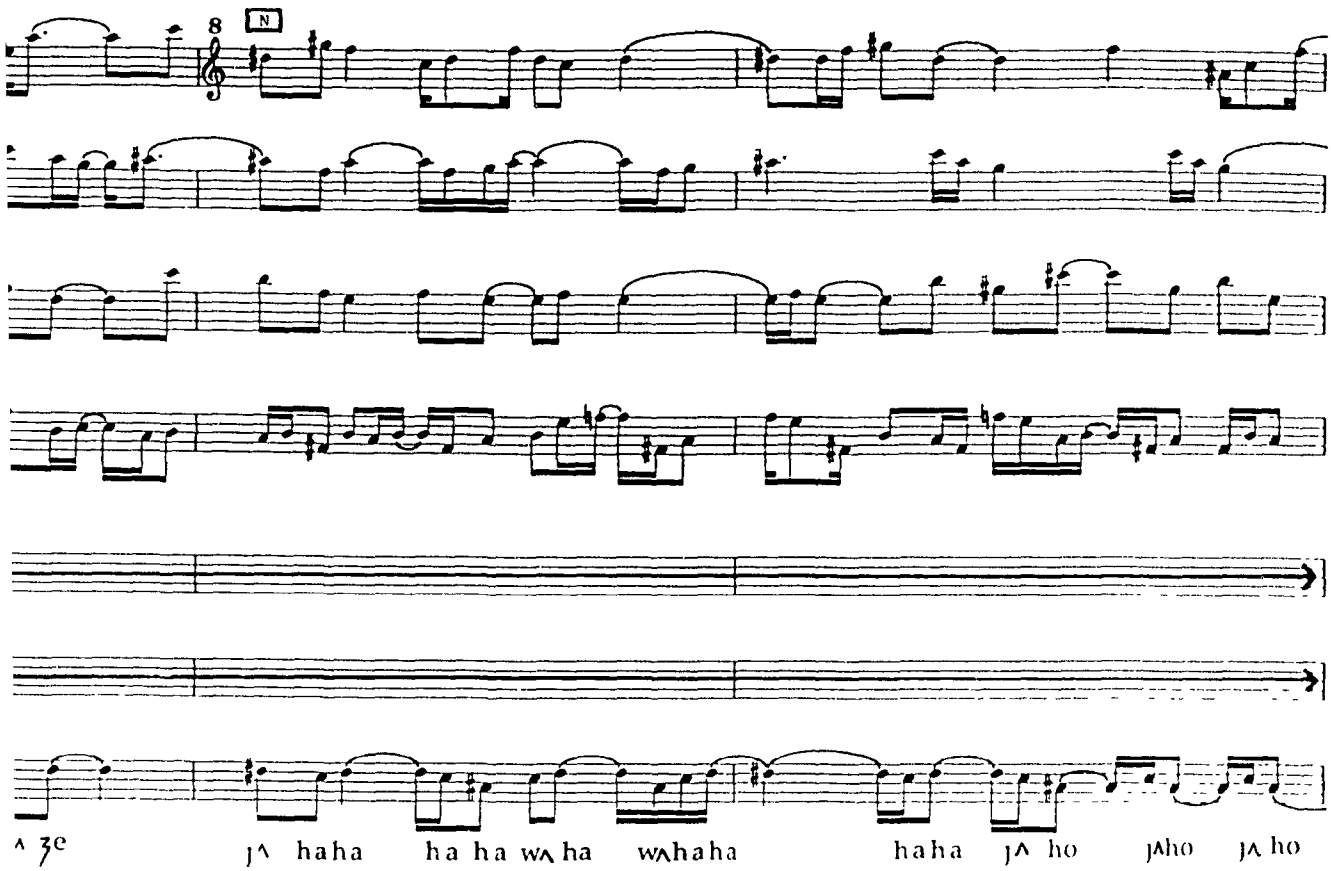

235
M
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
f
ff
he-e--e-e
nanananano
nananana
nonanana
nonanona
ne

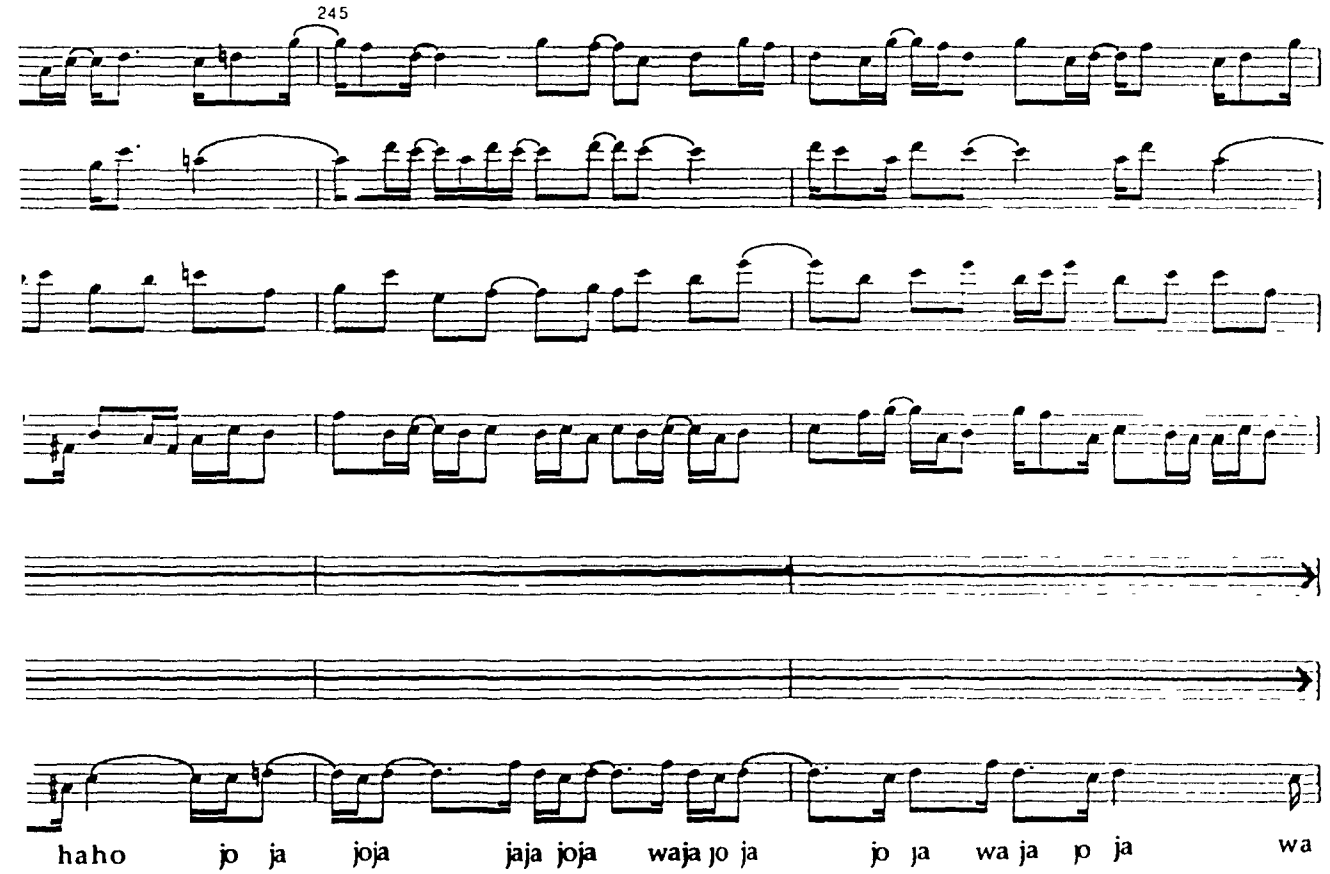

he----e----------e------ --e

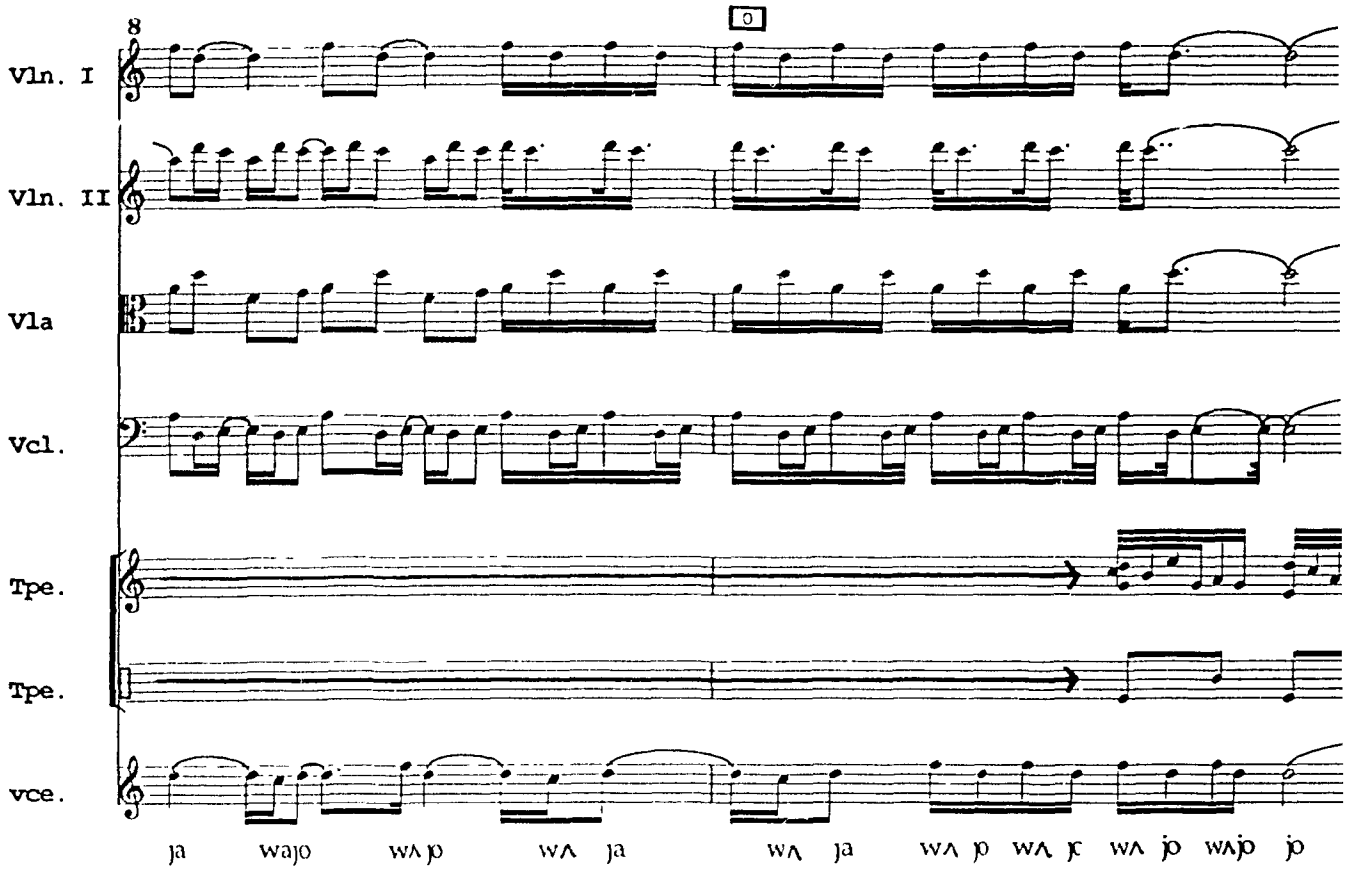

ff
ʒʌhaha
haʒʌ ha
ha ʒe
hehe
ʒʌʒe he

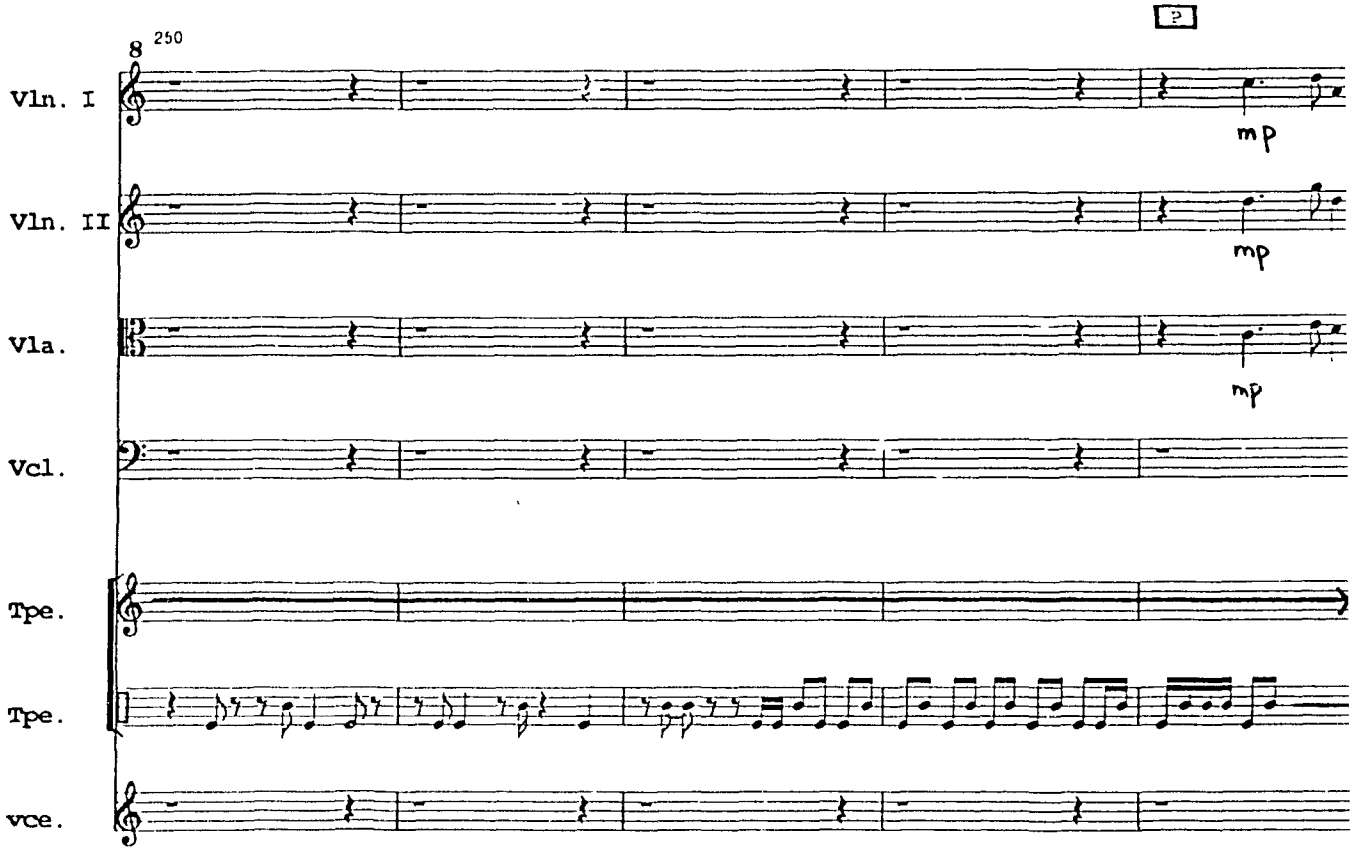

240
8
N
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
ʒe heʒe heʒe ʒʌ ʒe ʒe ʒe ʒe ʒʌ ʒe jʌ ha

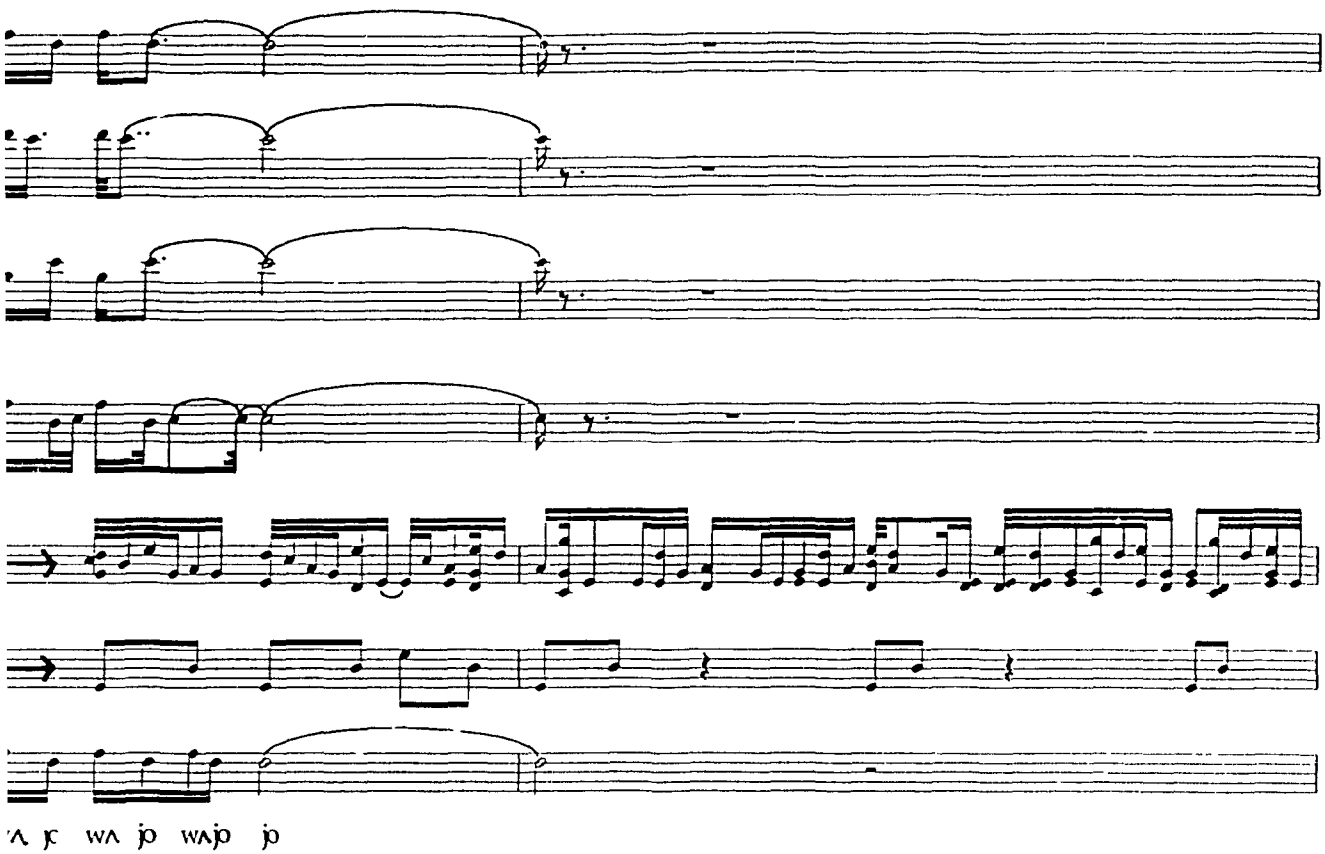

8
2
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
jʌ hahaho jʌho jʌ ho ha ho jʌho haho jo ja


8
N
ʌ ʒe
jʌ haha ha ha wʌha wʌhaha haha jʌ ho jʌho jʌ ho

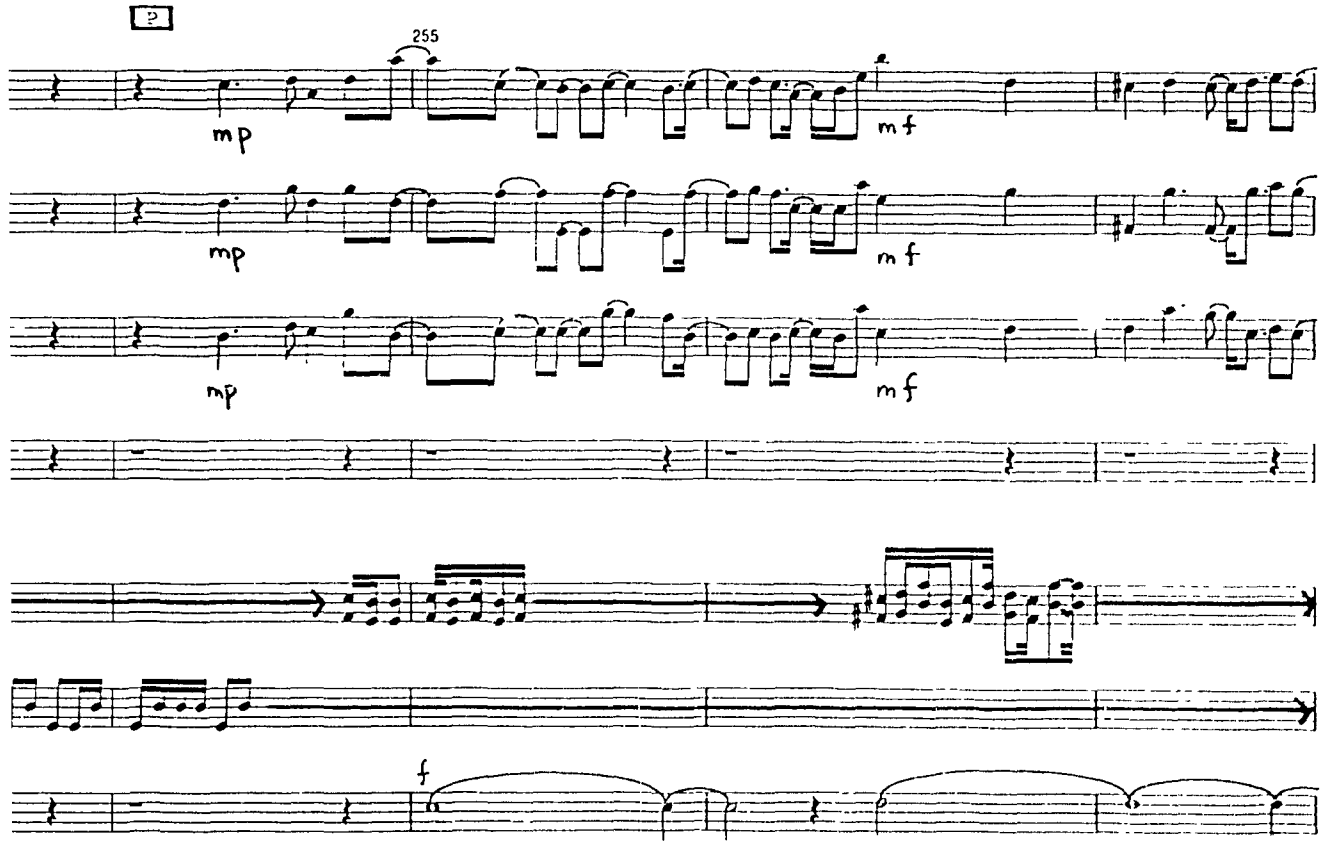

245
haho jo ja joja jaja joja waja jo ja jo ja wa ja jo ja wa


8
Vln. I
Vln. II
Vla
Vcl.
Tpe.
Tpe.
vce.
ja wajo wʌjo wʌ ja wʌ ja wʌ jo wʌ jo wʌ jo wʌjo jo

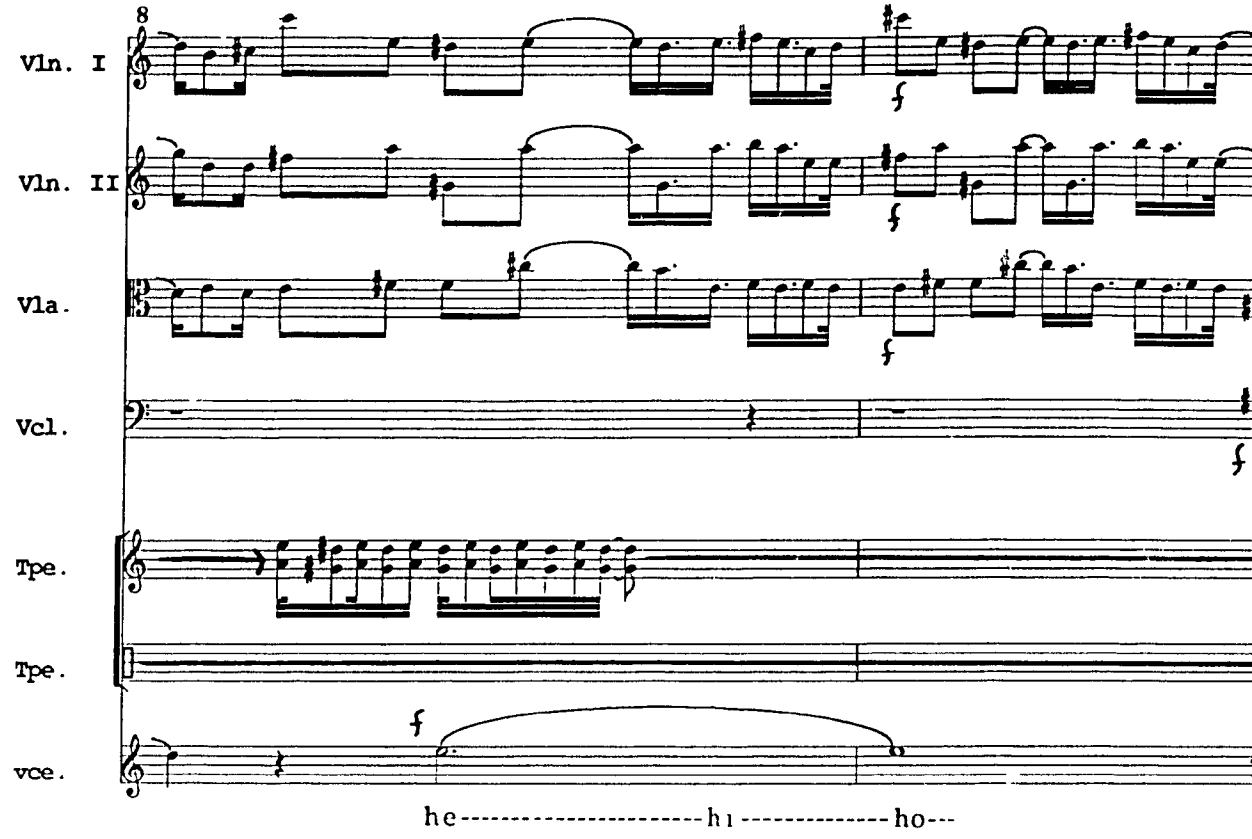

8
250
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
mp
mp
mp

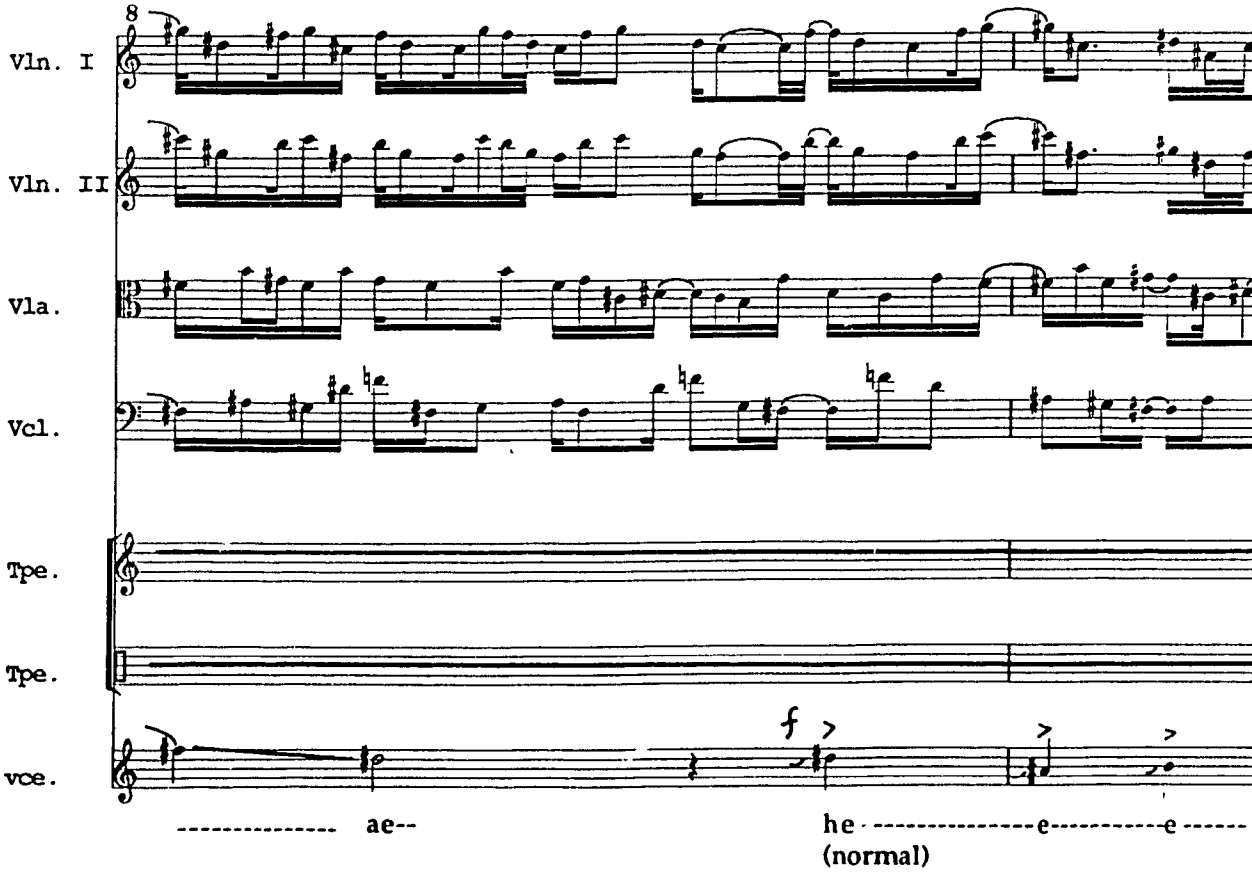


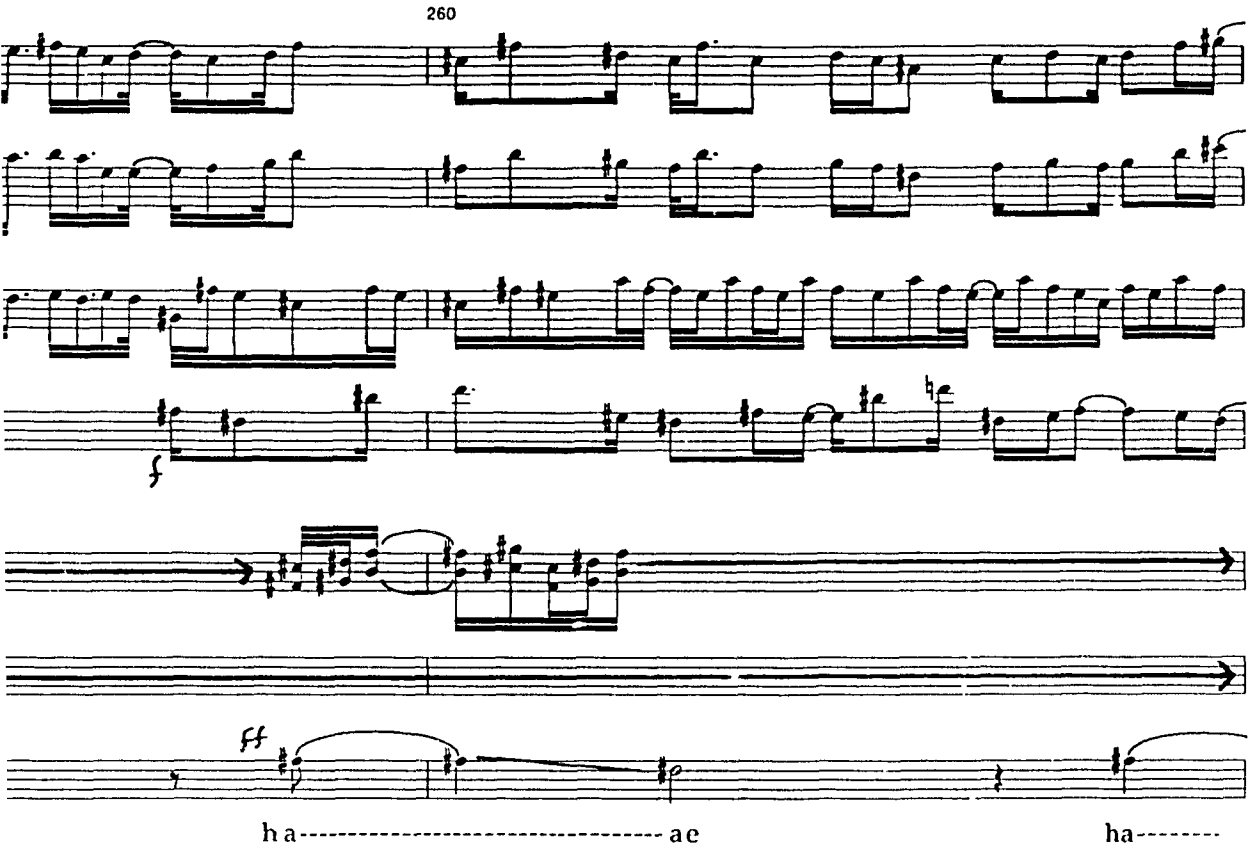
ʌ ɟ wʌ jo wʌjo jo

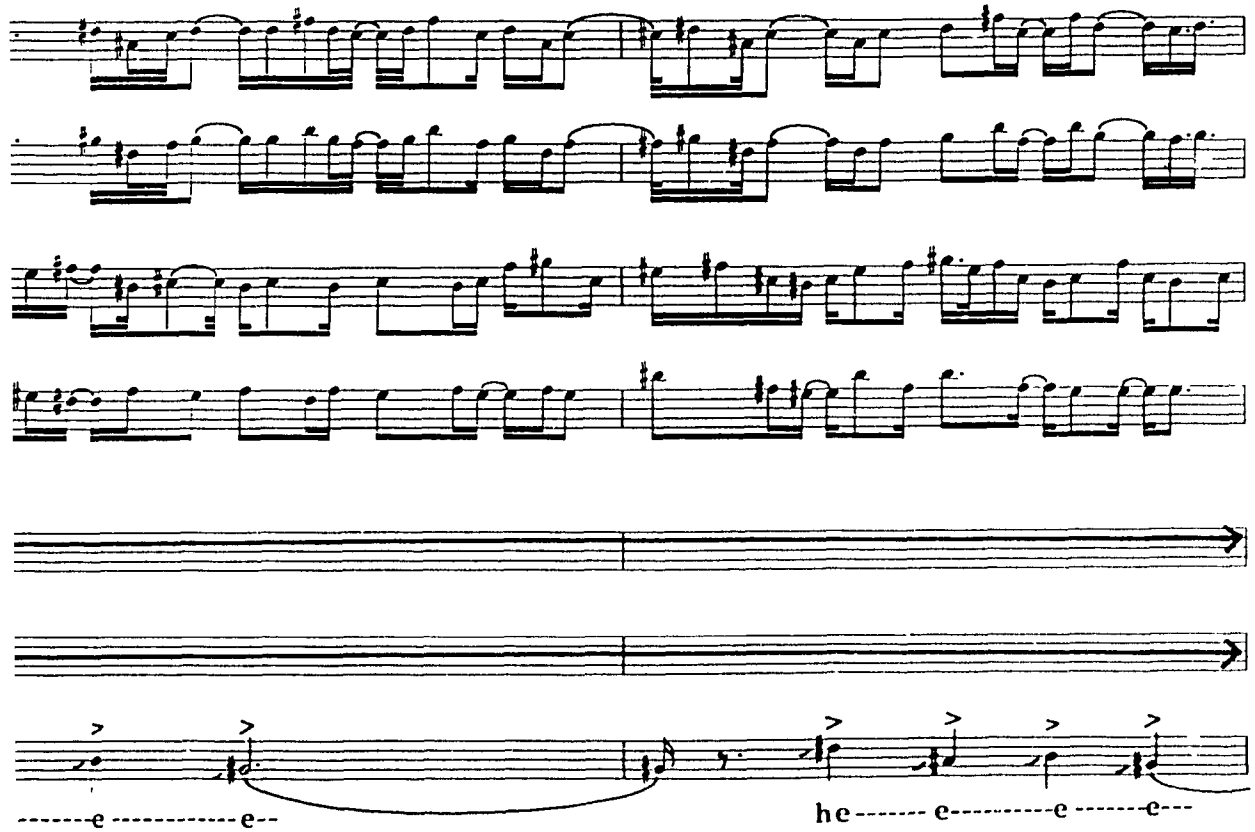


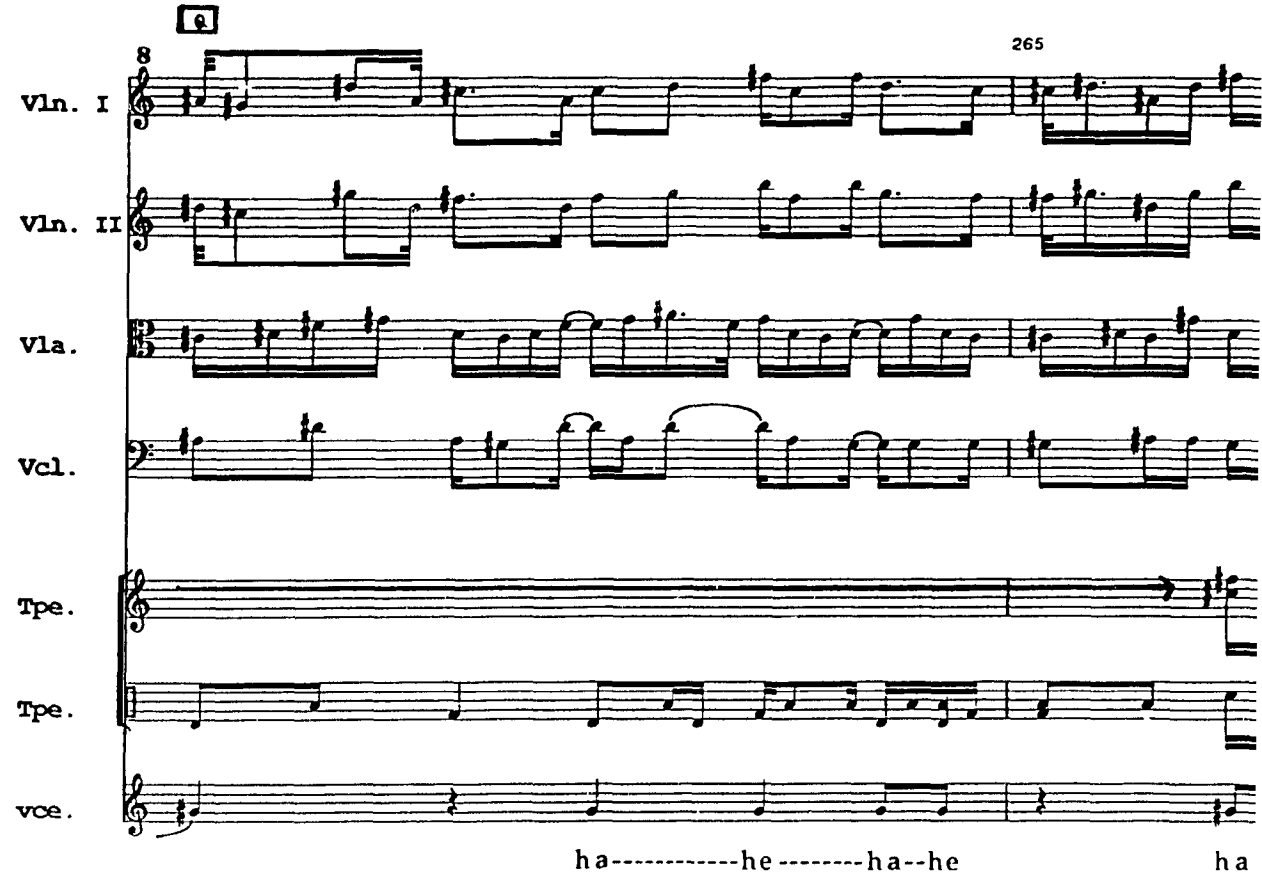
ha----------he------ho-- he ----------hi---------- ho--
(glottal throughout----)

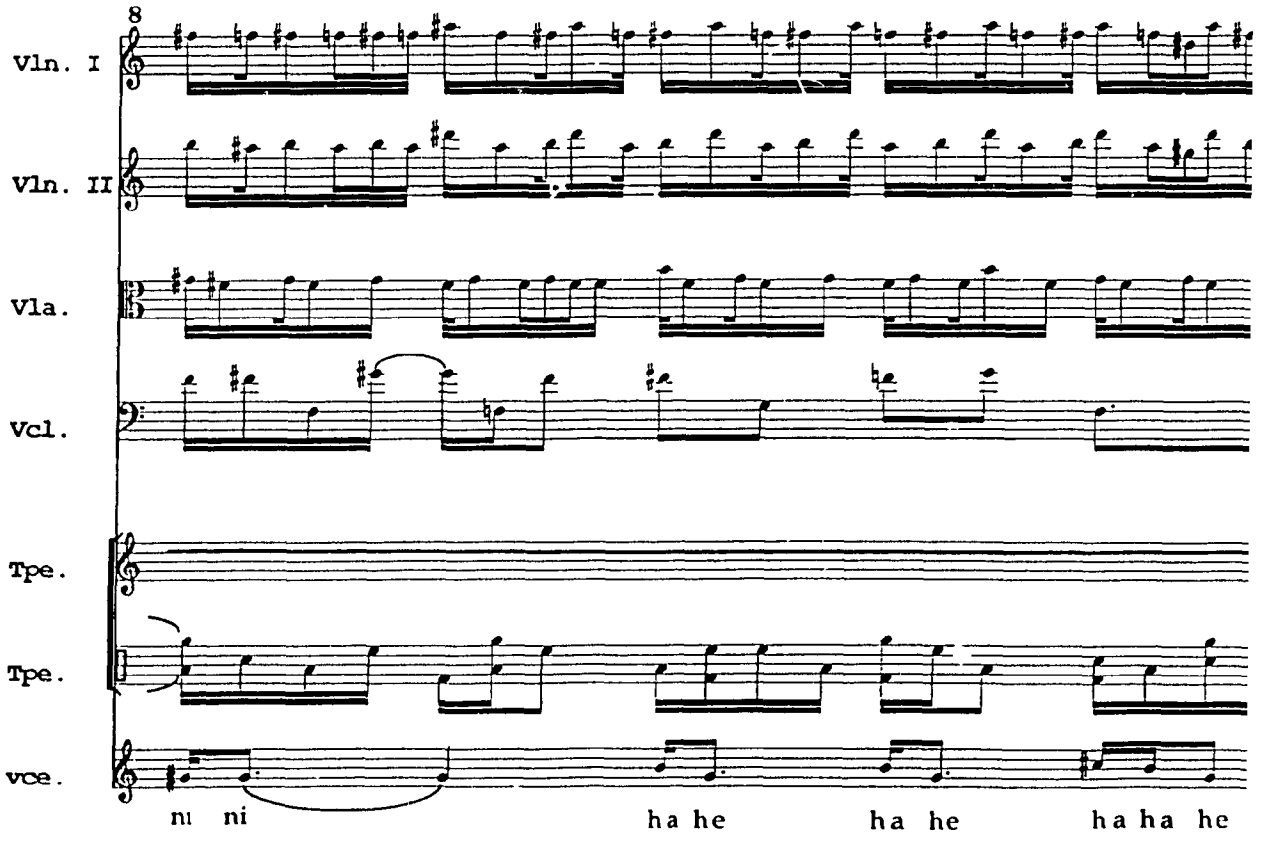

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
f
he---------hi---------ho---

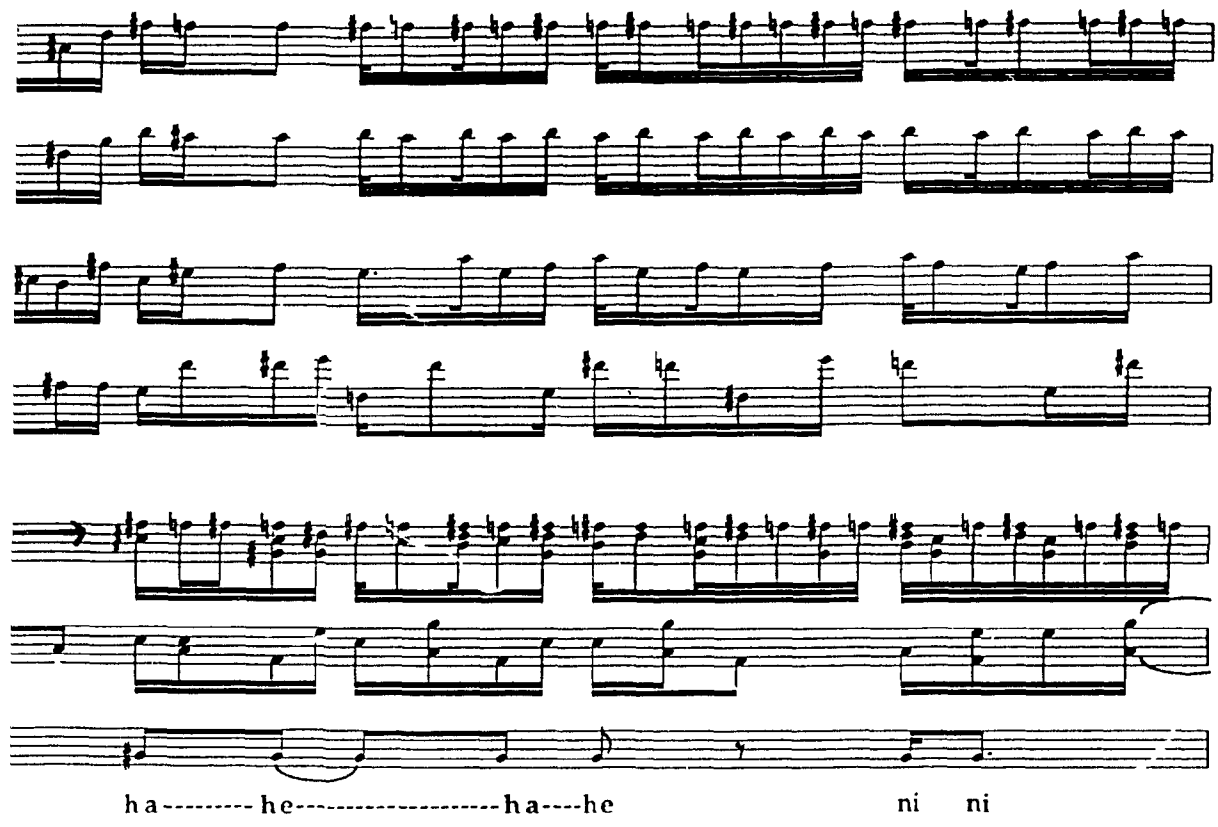

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
f
---------- ae--
he----------e----------e-----
(normal)

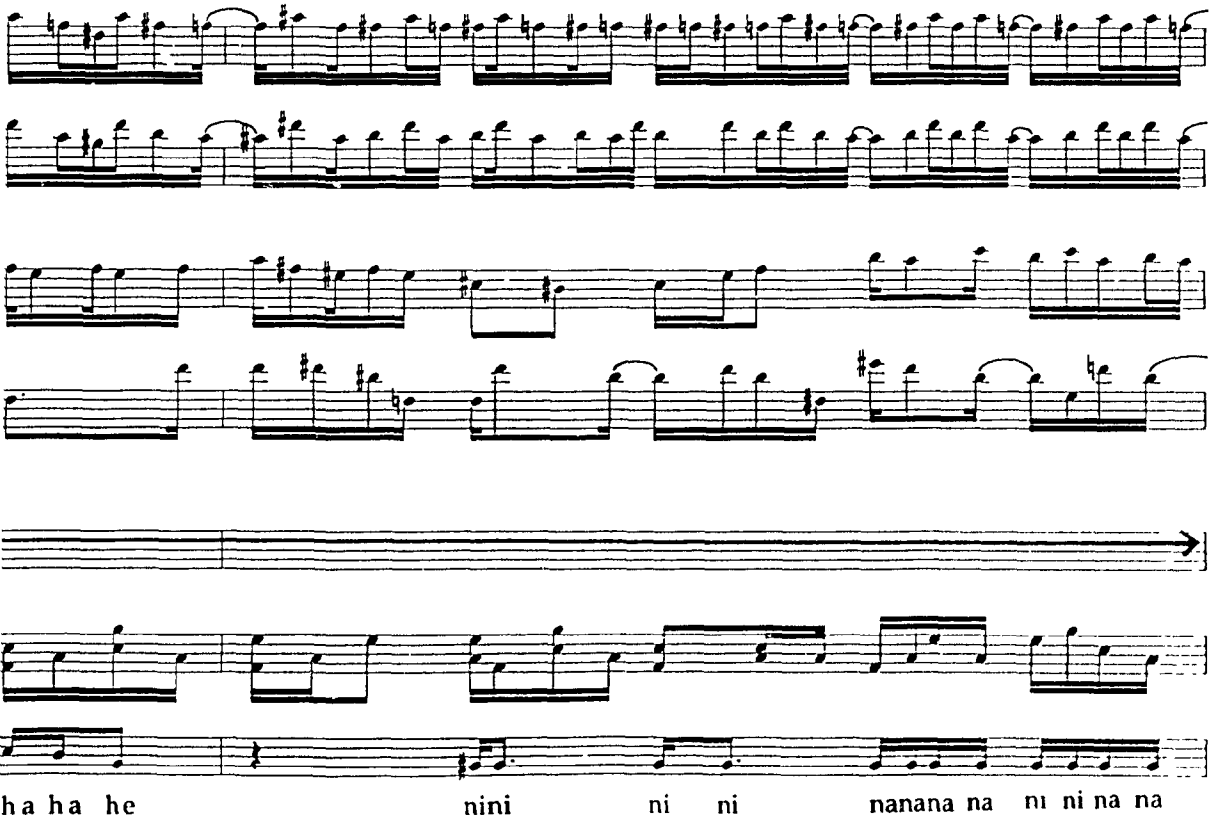

f
ff
ha---------- ae
ha--------

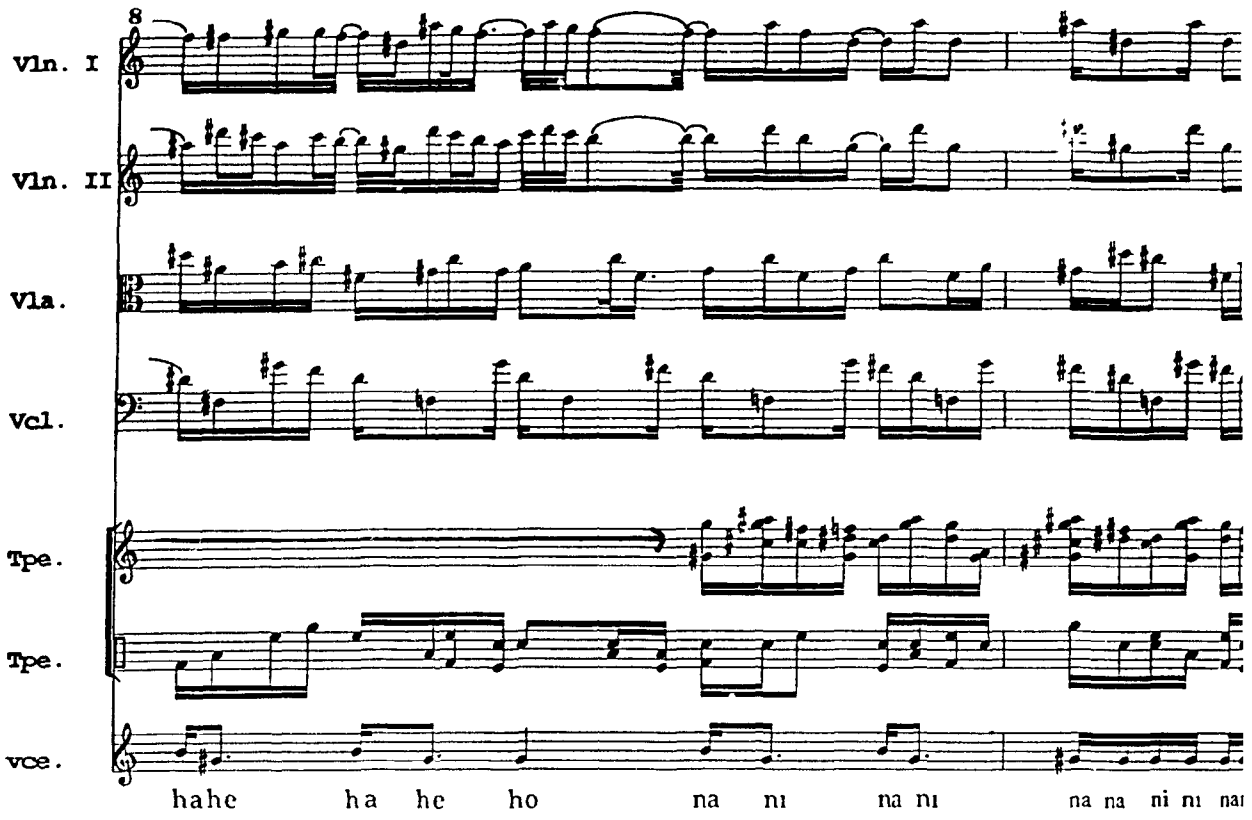

-------e ---------- e--
he------- e---------- e ------- e---

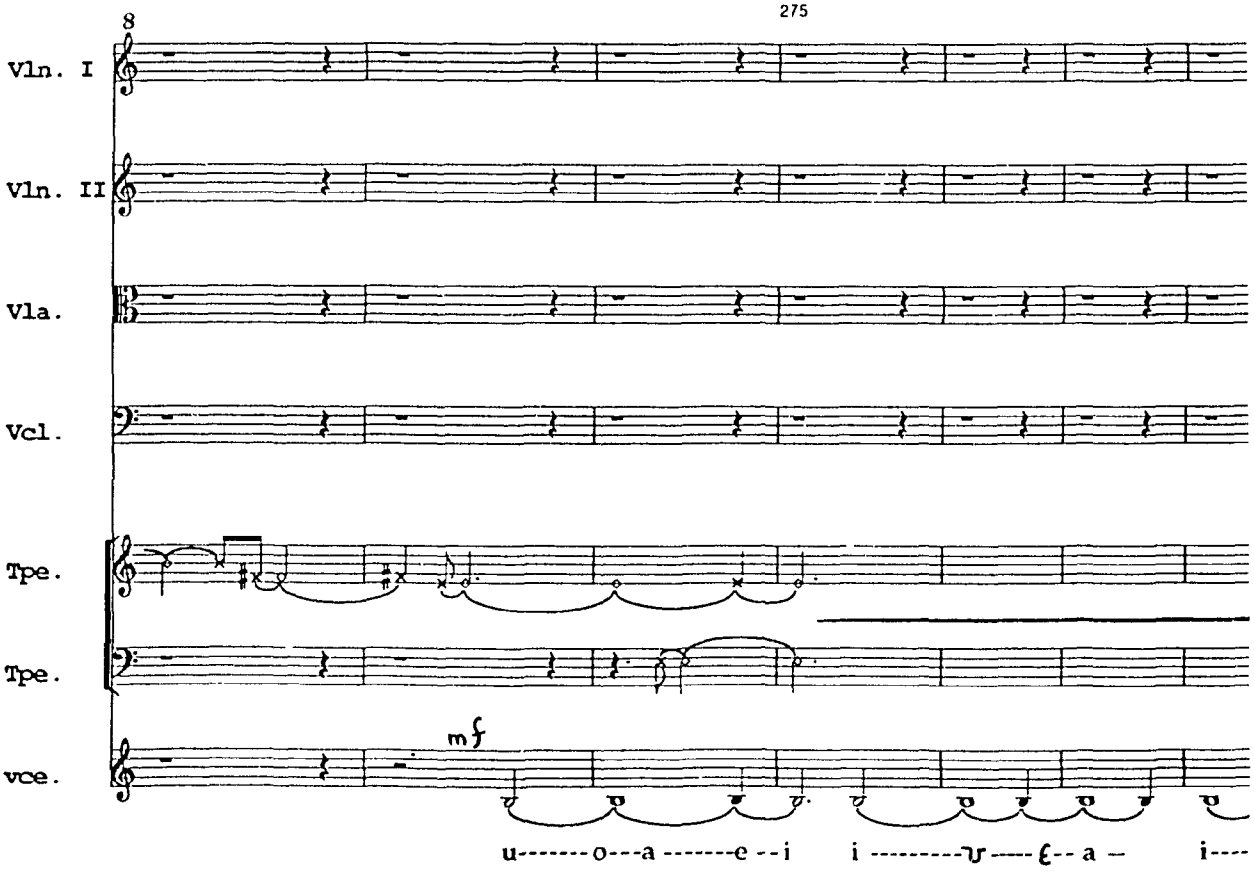

Q
8
265
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
ha----------he--------ha--he
ha

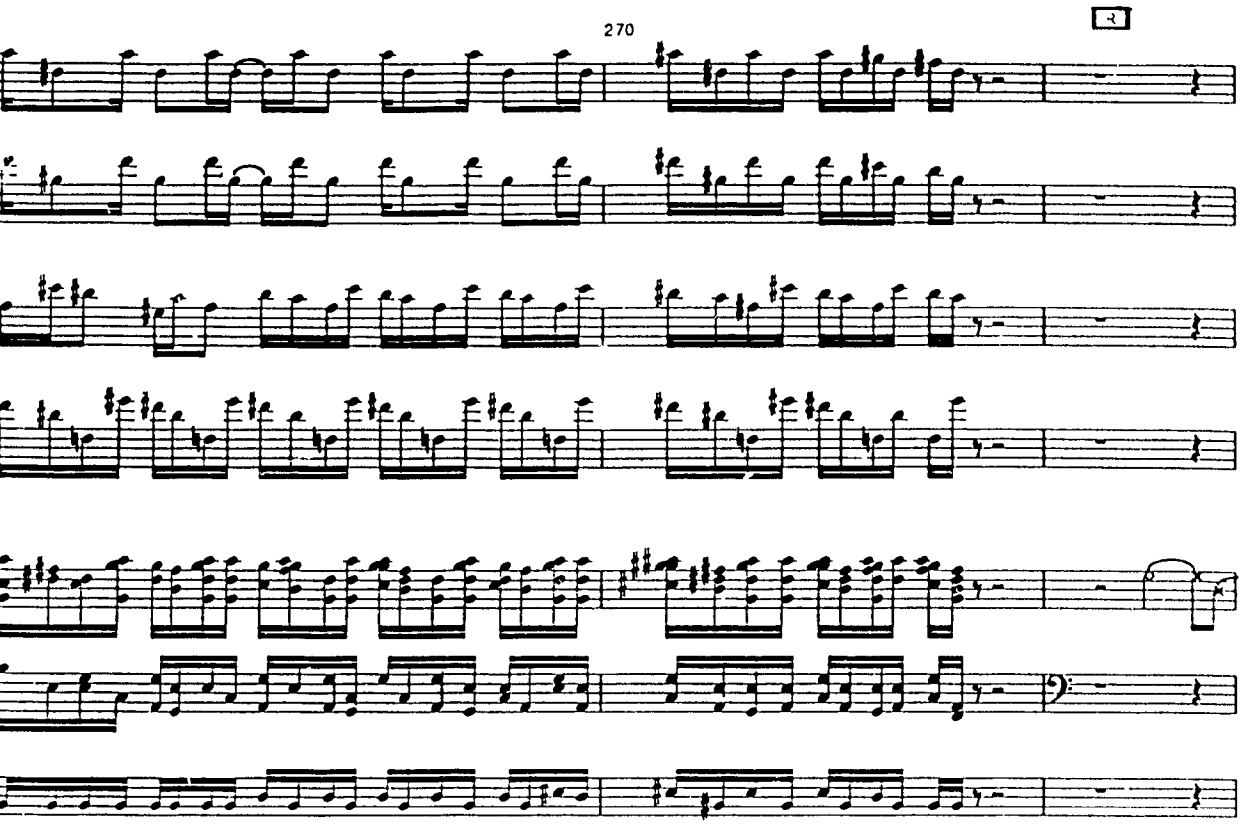

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
ni ni
ha he
ha he
ha ha he

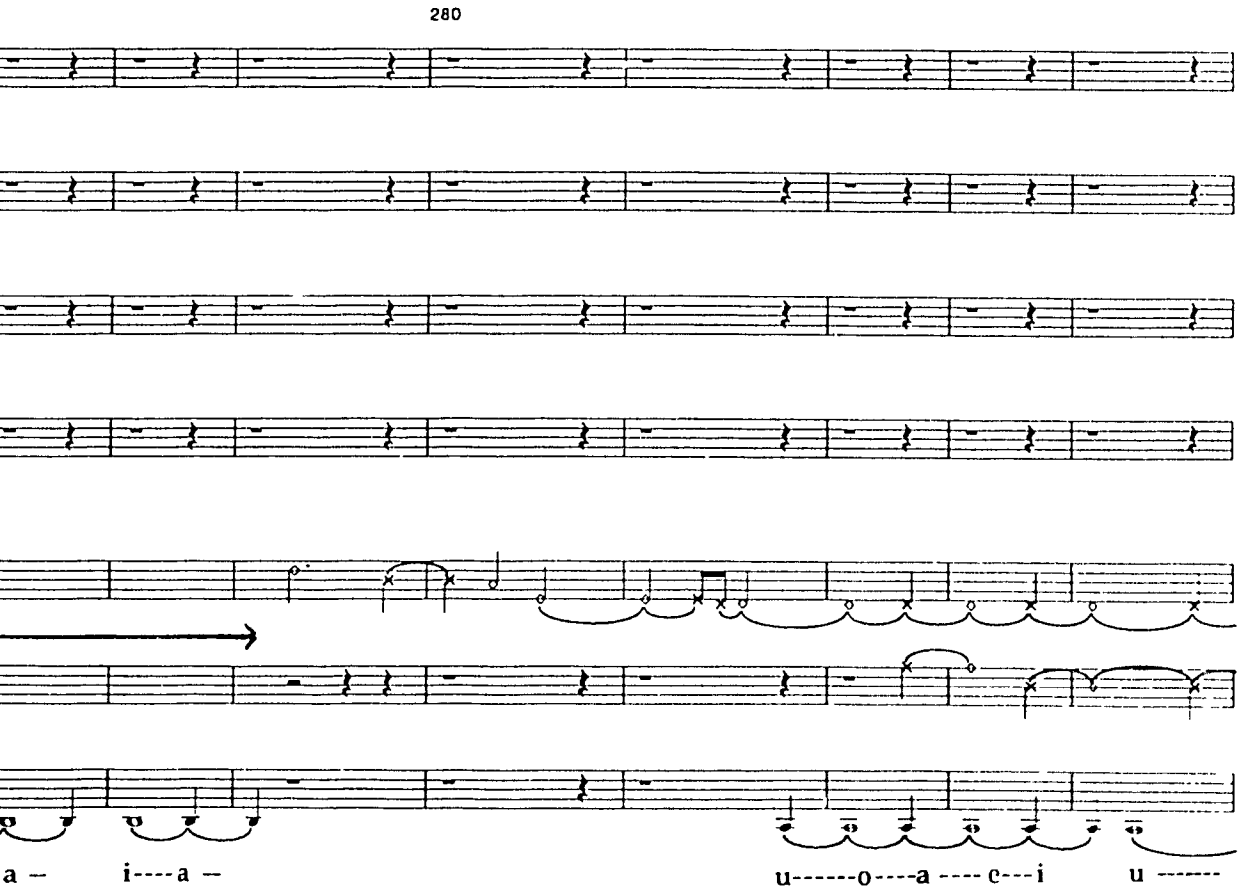

ha--------he----------ha----he ni ni

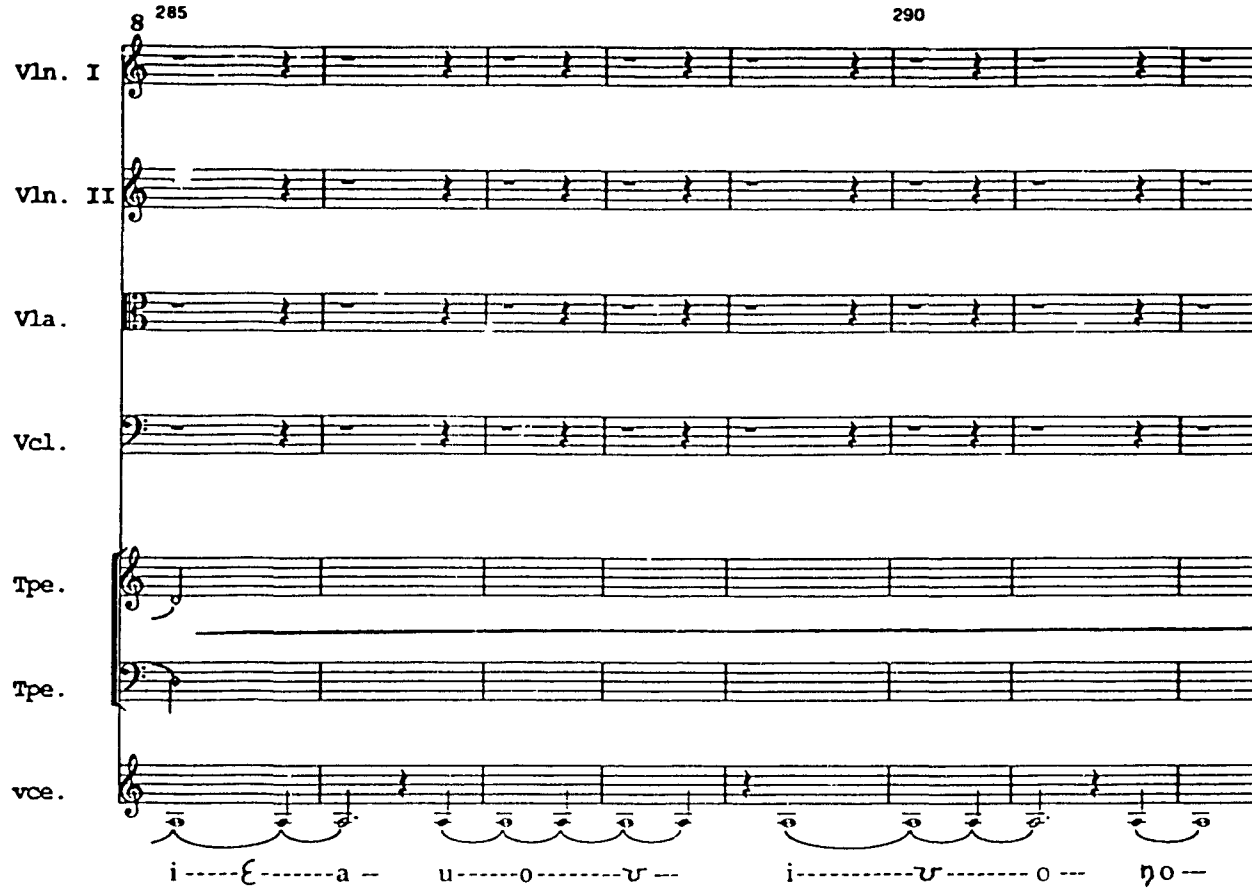

ha ha he nini ni ni nanana na ni ni na na

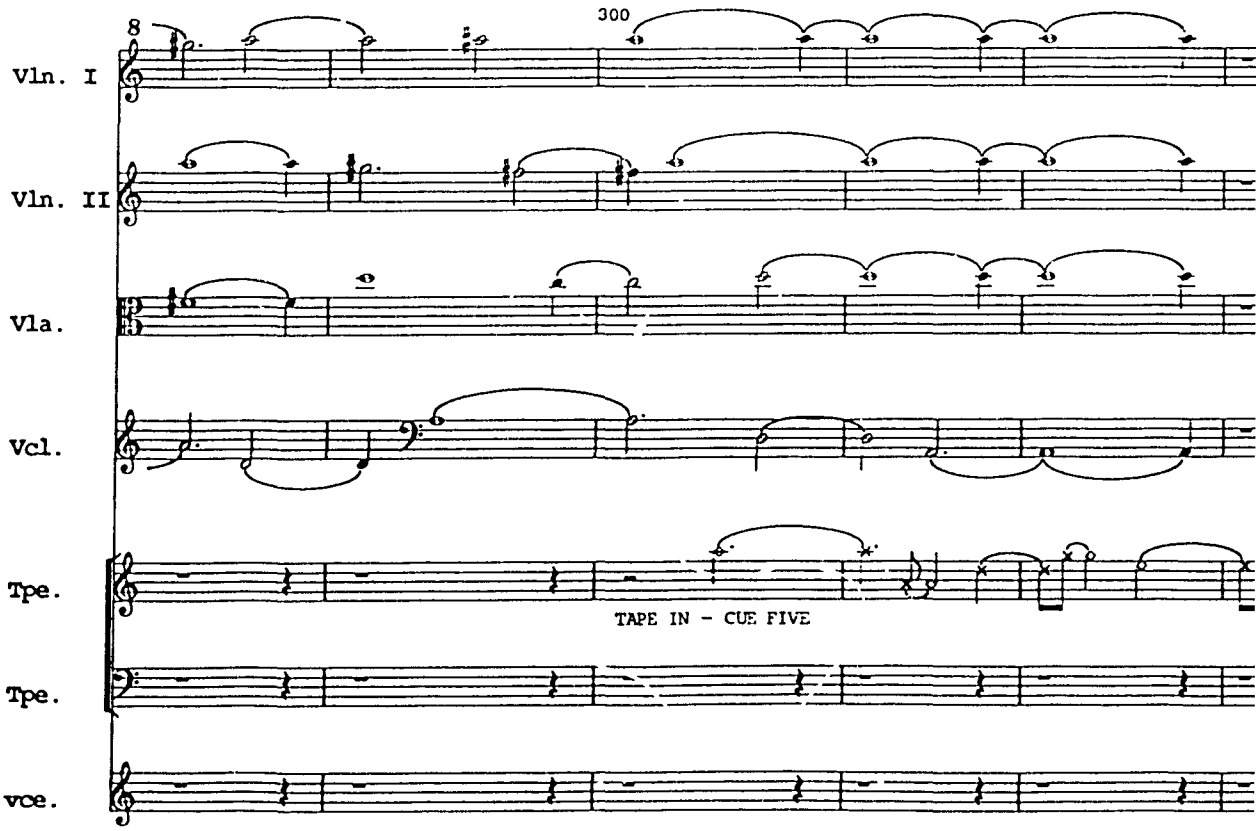

8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
hahe ha he ho na ni na ni na na ni ni nai

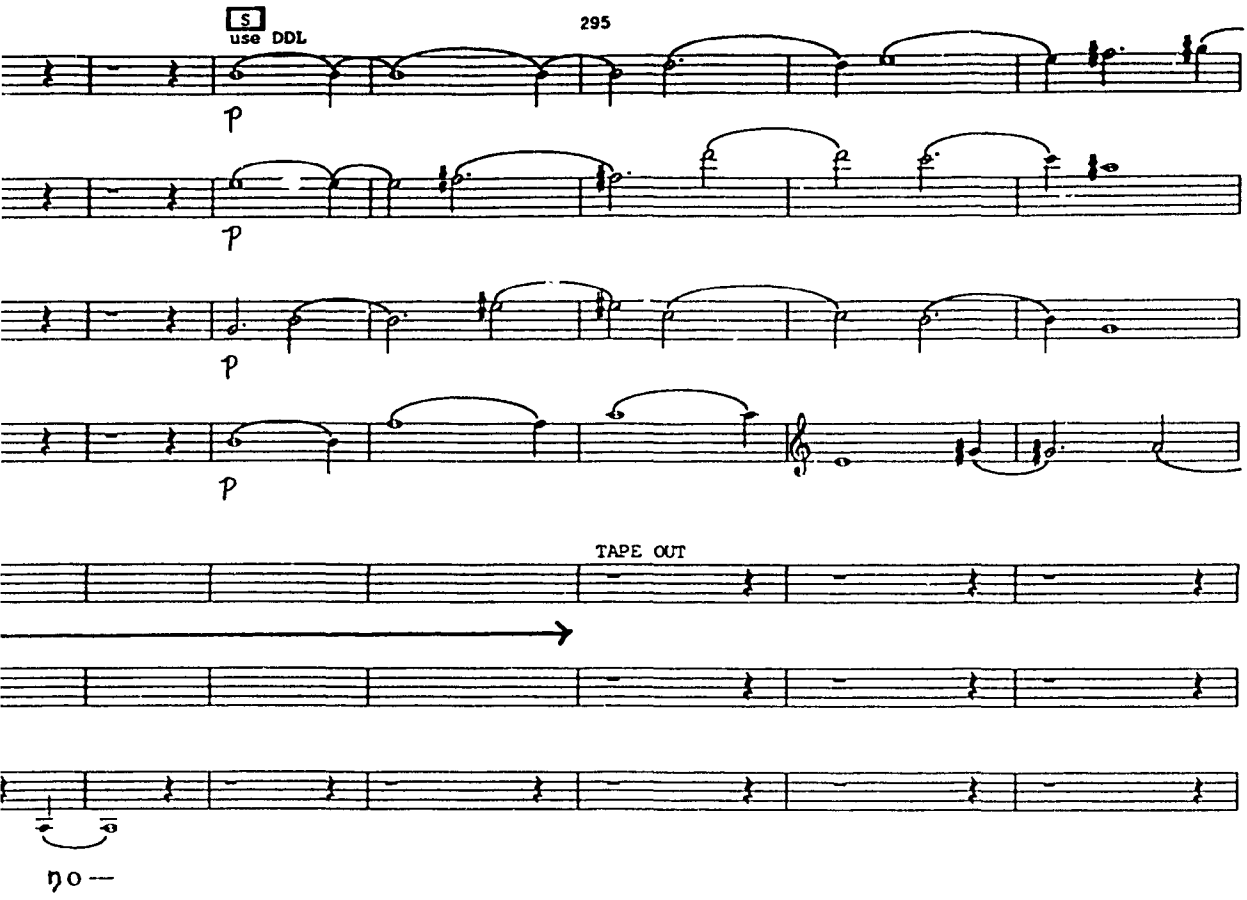

275
8
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
mf
u-------o---a -------e --i i ---------ɤ---ɛ-- a – i----

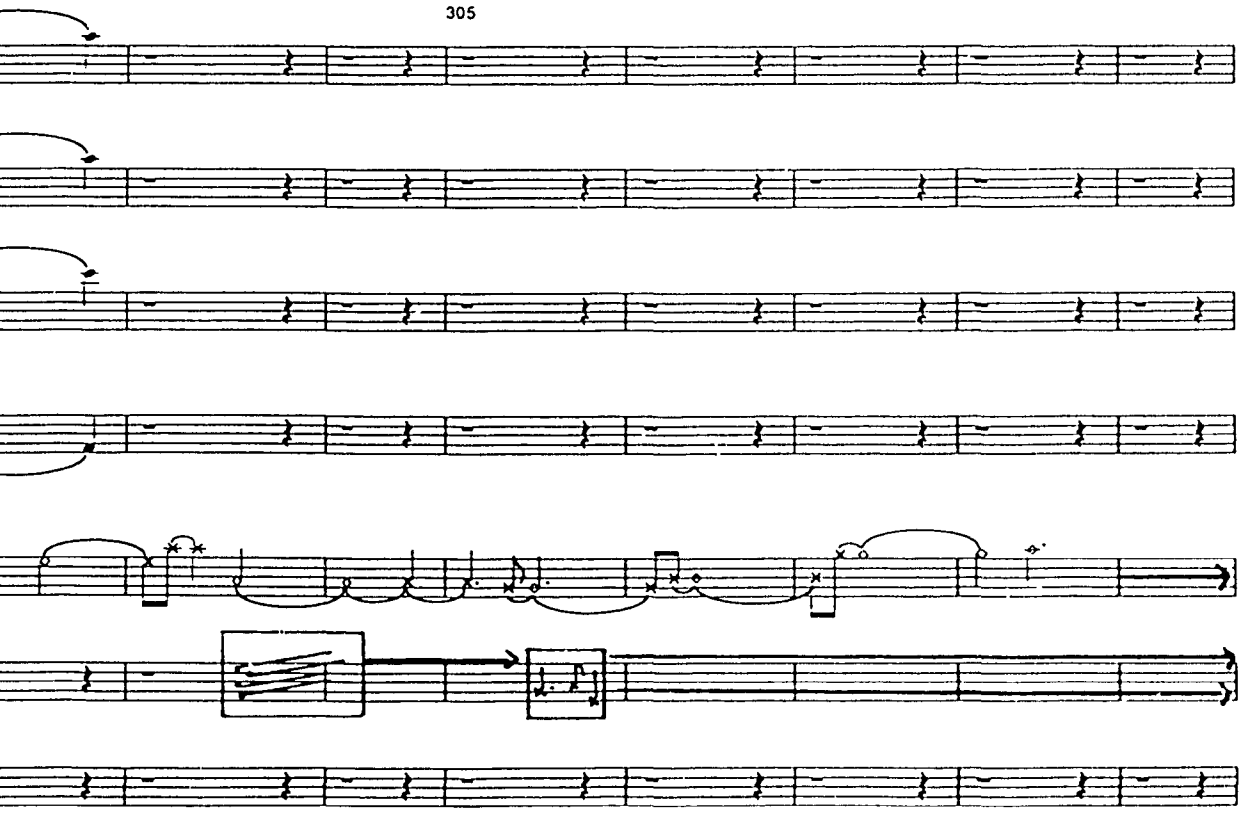

270
na na ni ni nana nini nana nini nani nani nani heho he na hena henahana nini

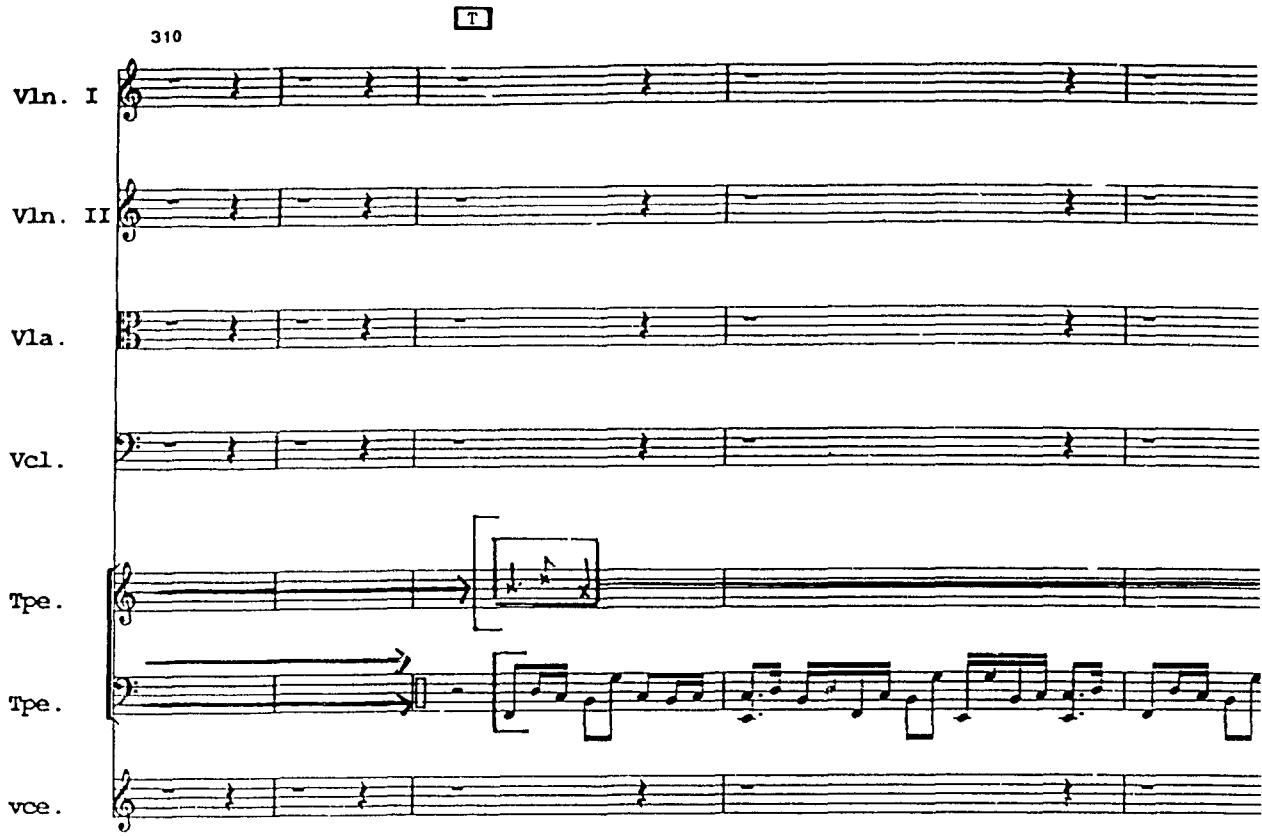

280
a — i---a — u------o----a ---- e---i u ------

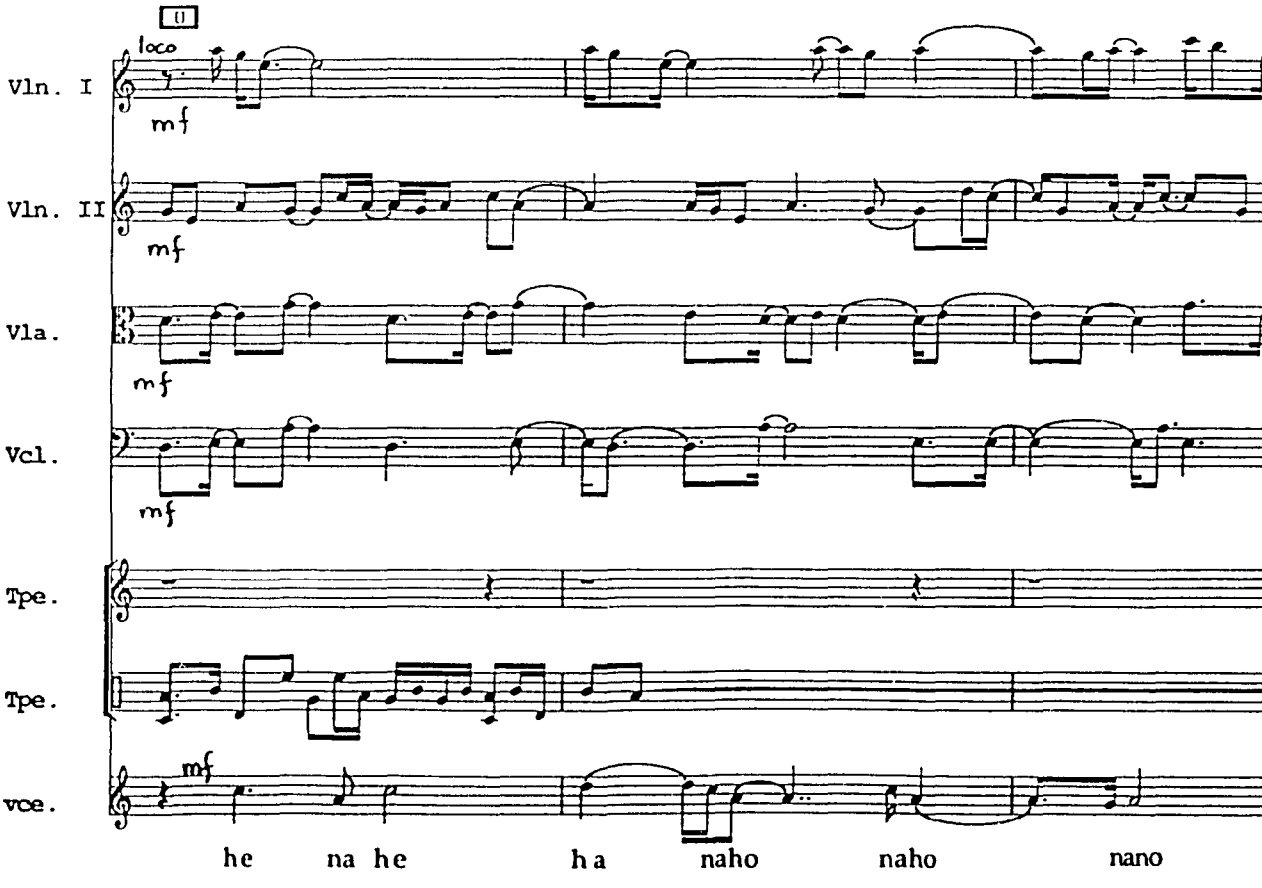

8
285
290
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
i -----ɛ-------a – u------o--------ʊ -- i----------ʊ--------o --- ŋo —

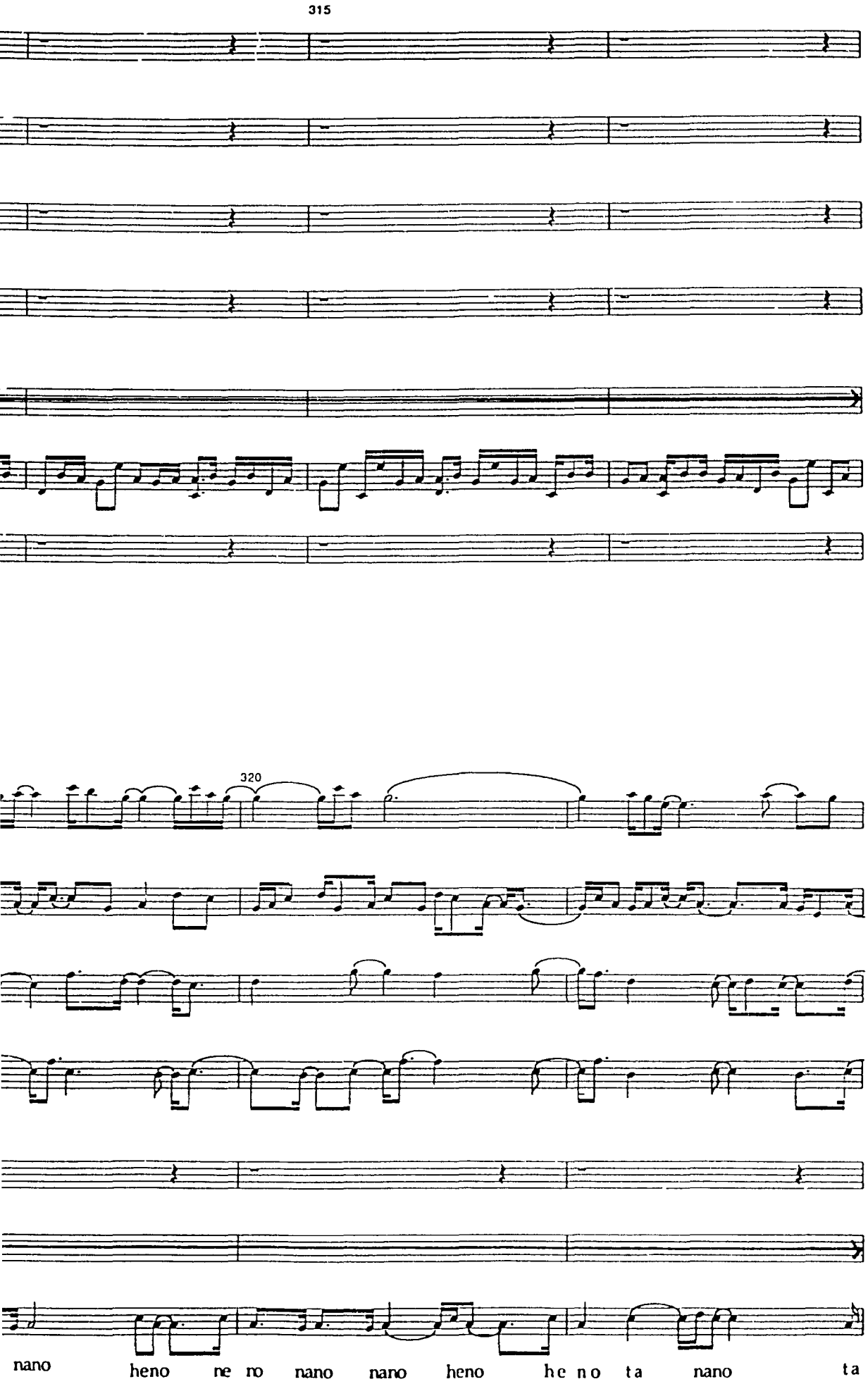

8
300
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
TAPE IN - CUE FIVE
Tpe.
vce.

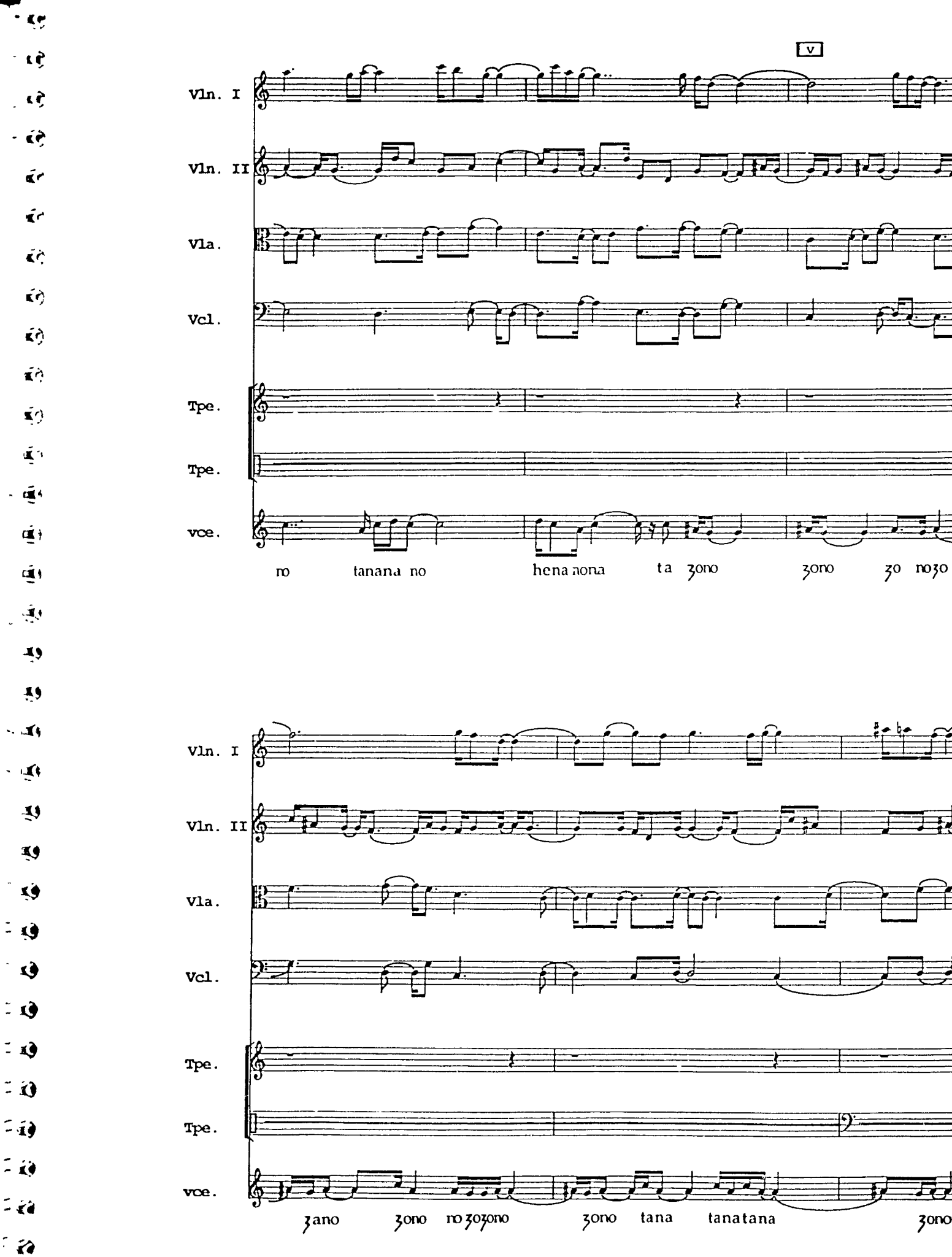

S
use DDL
295
p
p
p
p
TAPE OUT
no —

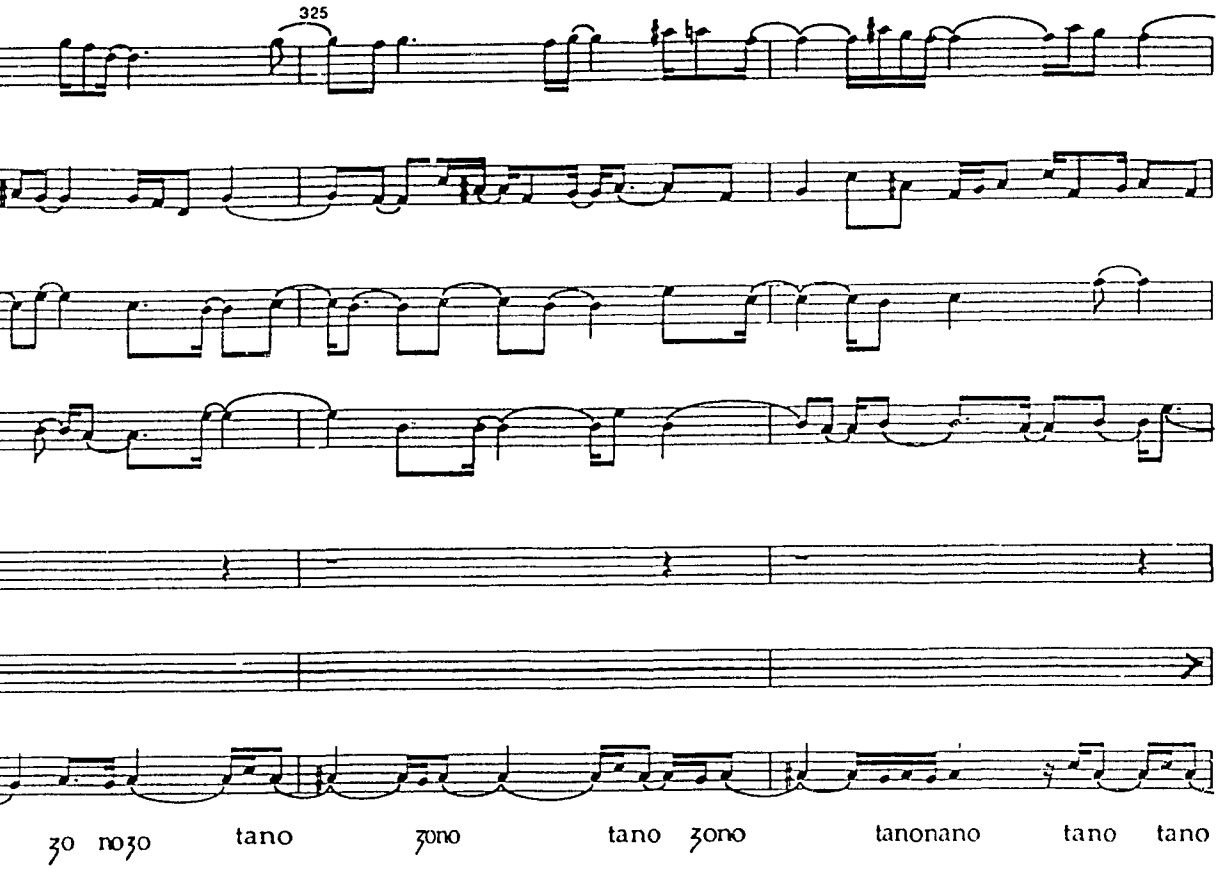

305
S

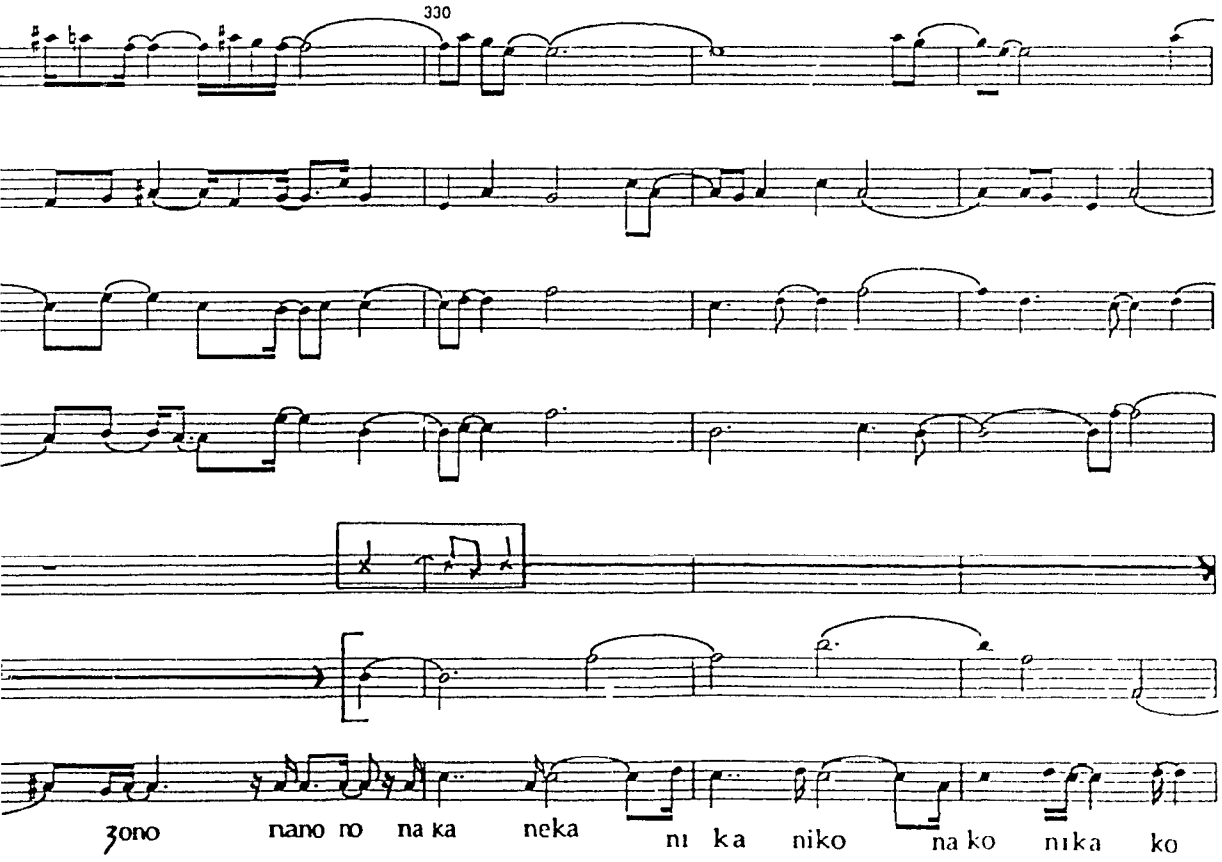

T
310
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.

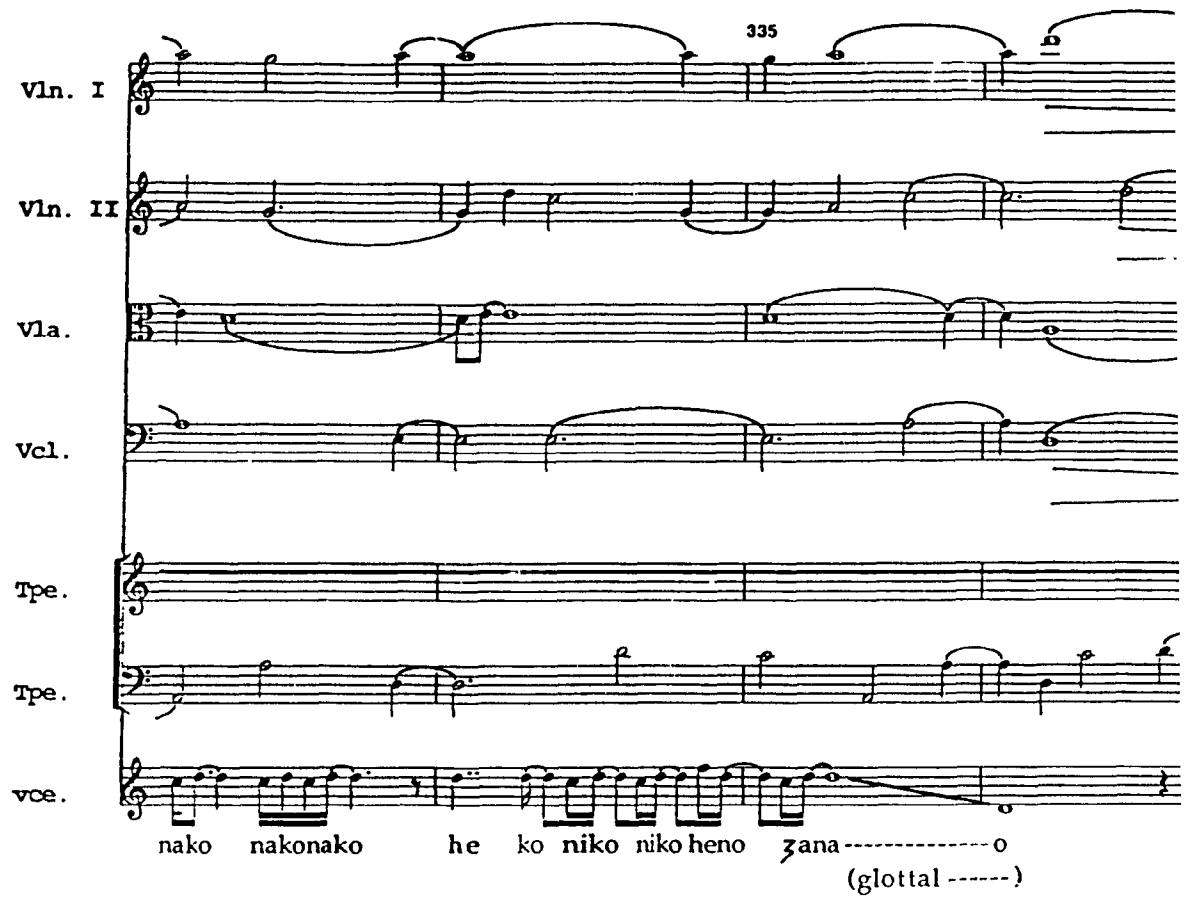

U
loco
mf
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
he na he ha naho naho nano

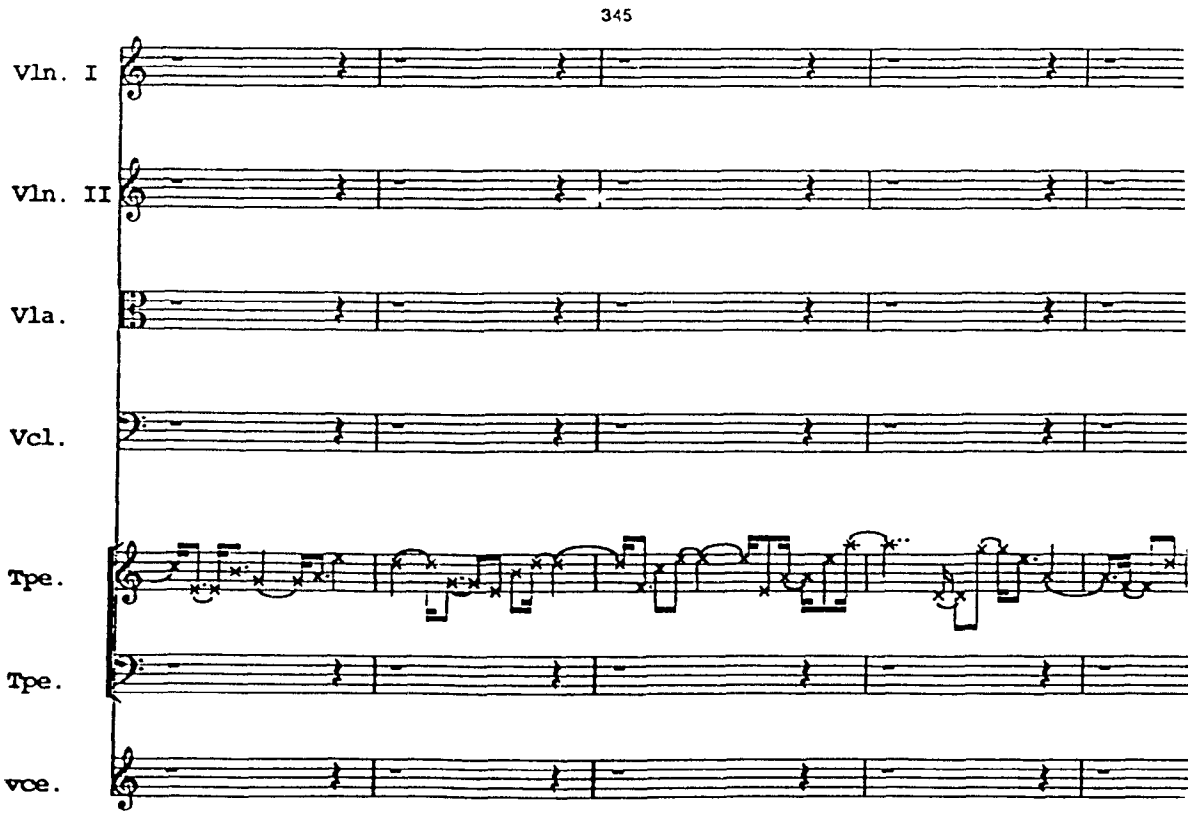

315
320
nano heno ne ro nano nano heno he n o ta nano ta

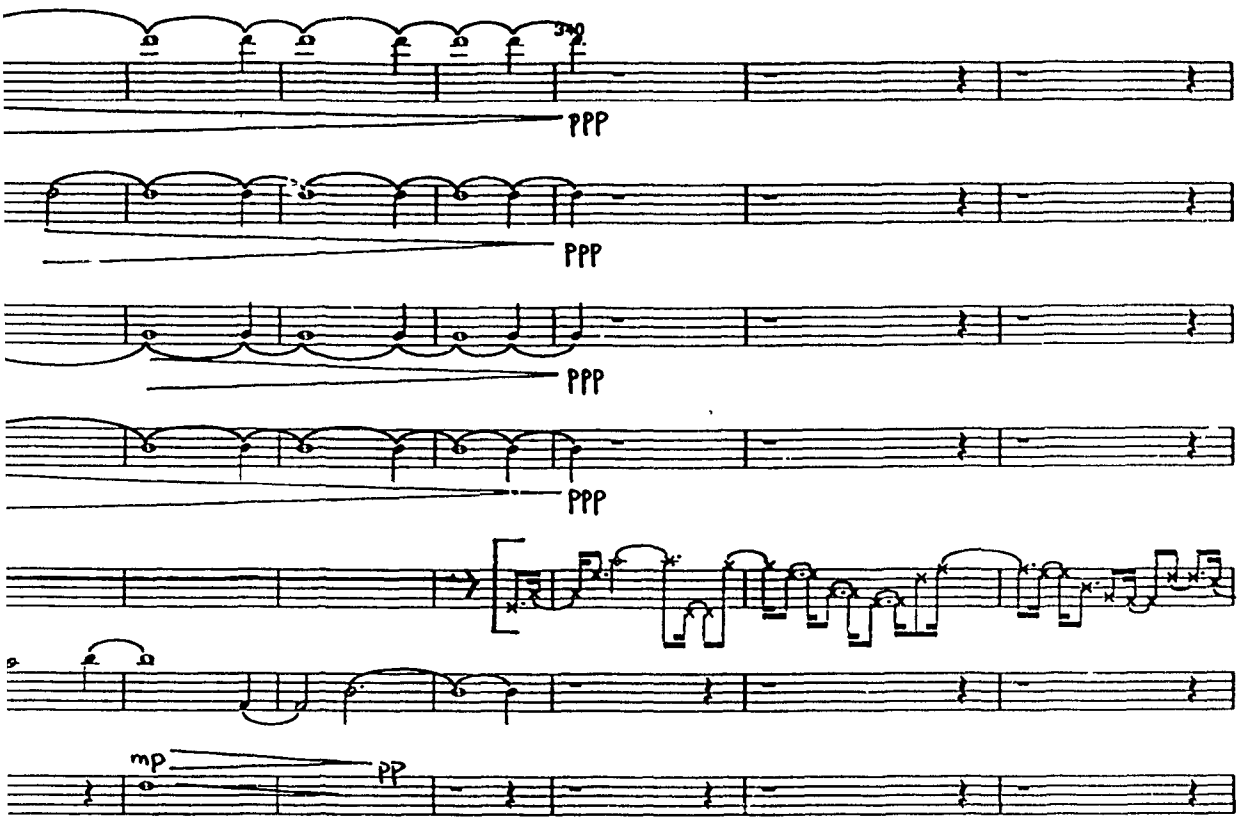

v
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
voe.
no tanana no hena nona ta zono zono zo nozo
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
voe.
zano zono nozozono zono tana tanatana zono


325
zo nozo tano zono tano zono tanonano tano tano


330
zono nano no na ka neka ni ka niko na ko nika ko


335
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.
nako nakonako he ko niko niko heno zana----------o
(glottal ------)


345
Vln. I
Vln. II
Vla.
Vcl.
Tpe.
Tpe.
vce.



ha----------
(glottal)