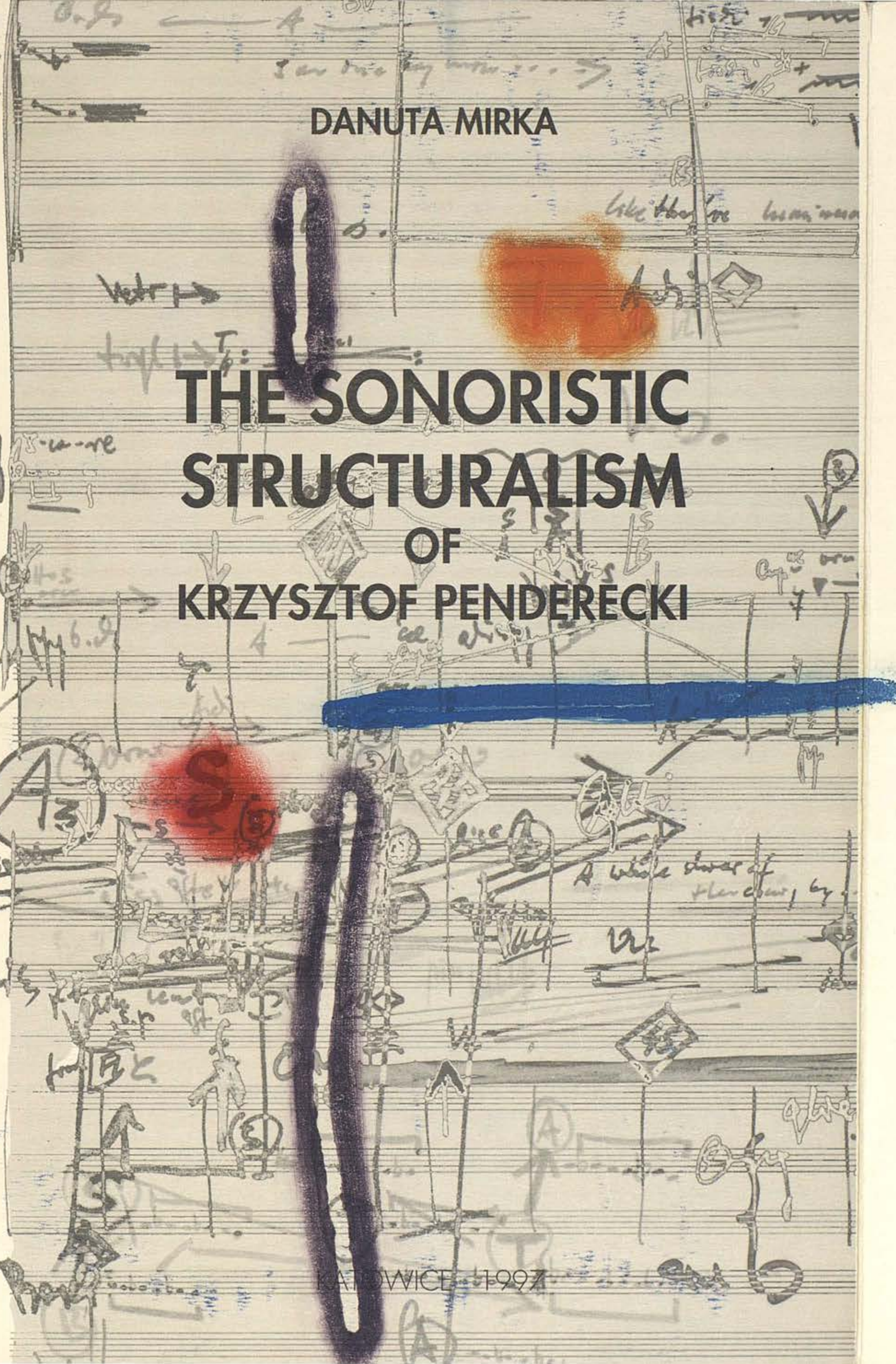
DANUTA MIRKA

THE SONORISTIC STRUCTURALISM OF KRZYSZTOF PENDERECKI



KATOWICE 1997

Danuta Mirka

THE SONORISTIC STRUCTURALISM OF KRZYSZTOF PENDERECKI

KATOWICE 1997

Publication of this volume was made possible by grants from the Music Academy in Katowice and from the University of Helsinki.

Music Academy in Katowice
Address: ul. Zacisze 3, 40-025 Katowice Poland

General Editor: Mateusz Bień

Copy Editor: Richard Littlefield

Cover: Grzegorz Biliński

Printed in Olkusz, Drukarnia 'TINTA' s.c.

ISBN 83-85679-35-9

To my parents

CONTENTS

Preface vii

INTRODUCTION

1. Polish Music at the End of the 1950s 3
2. What Is Sonorism? 7
3. Borders of Sonorism 17
4. In Search of a System 20

PART ONE: System (*Langue*)

5.1. Basic System 31
  5.1.1. Elementary Structures 31
  5.1.2. Morphology 53
  5.1.3. Syntax 57
5.2. Timbre System 63
  5.2.1. Elementary Structures 63
  5.2.2. Morphology 67
  5.2.3. Syntax 72
6. Articulation 77
  6.1. Articulation of Timbre System 79
  6.2. Articulation of Basic System 87
  6.3. Orchestration and Instrumental Techniques in Penderecki's Sonoristic Works 144

PART TWO: System at Work (*Parole*)

7. Expressive and Redundant Features 165
8. Analyses of Musical Texts 175
  8.1. *Anaklasis* (1959-60) 178
  8.2. *Dimensions of Time and Silence* (1960-61) 189
  8.3. *Threnody—to the Victims of Hiroshima* (1960) 209
  8.4. String Quartet No. 1 (1960) 216
  8.5. *Polymorphia* (1960) 223
  8.6. *Fluorescences* (1962) 241
  8.7. *Canon* (1962) 261
9. Evolution of Expressive Features 271
10. Evolution of the System 282
  10.1. Basic System in Growth 282
  10.2. Evolution of the Timbre System 293
11. Evolution of Articulation 294
  11.1. Evolution of Textural Effects 295
  11.2. Evolution of Sound Generation Processes and Orchestration 296
12. Subsegmental Regulations 300
13. Appendix: The Notation of Penderecki's Sonoristic Scores 311
  13.1. Notation of Sound Generation Processes 312
  13.2. Notation of Textural Effects 314
    13.2.1. Time Notation 317
    13.2.2. Pitch Notation 319

CONCLUSIONS

14. System in Penderecki's Sonorism 325
14.1. System and Sound Matter 325
14.2. System and Form 327
14.3. System and Expression 332
15. Penderecki's Sonorism in the Landscape of Contemporary Music 334
16. Periodisation of Penderecki's Output 338
16.1 Pre-sonorism(1956-59) 338
16.2 Sonoristic Period Proper (1960-62) 338
16.3 Choral Works 342
16.4 *Passion* 343
16.5 Late Sonorism (1963-73) 343
16.6 Post-sonorism 347
17 Penderecki and Structuralism 349
18 Postscript: A Semiotic View 353
References 358

PREFACE

At first glance, the reader may justifiably wonder why this book concerns the earliest works of Krzysztof Penderecki. Why not the most recent output of the Polish composer? Have not works such as *Threnody* or *Fluorescences* received enough discussion over the past few decades? To answer those questions, let me briefly explain the present enterprise.

Some five years ago, during the first year of my assistantship at the Music Academy in Katowice, I required students to analyse some of Penderecki's early, so-called "sonoristic" pieces. The outcome of that assignment proved unsatisfactory, however, because the students tended to describe Penderecki's pieces as chaotic assemblages of sound phenomena rather than as works of art. Only later did I realize that the same could be said of almost all the analyses of Penderecki's sonoristic works that I had read thus far. As a rule, they merely described things that anyone could easily see by looking at the scores. Such analyses offered the reader a *description* of the works, not an *explanation*. This situation did not seem to disturb the authors. From their perspective, Penderecki's sonoristic style was obviously meant to exemplify musical chaos, and an inherent property of chaos is that it does not admit any explanation. Yet this is exactly why, for a rationalist, chaos poses the greatest challenge. Indeed, Penderecki's sonorism aroused my analytical inclinations: If I have found previous analyses of his works unsatisfactory—I asked myself—can I do any better?

Provided chaos presents the greatest challenge, then there can be no greater achievement than to derive order from it, particularly when this order turns out to reside not merely in the mind of the analyst, but also in the object itself. To determine which of these two possible situations was the case with my own analyses, I visited Krzysztof Penderecki in April 1995, at his house in Cracow. I asked him whether the sonoristic system—discussed in the following pages and at that time already reconstructed by me—was an accurate model of the compositional procedures he had employed in writing his pieces of the early 1960s. The confirmation I received from the composer's own lips encouraged me to write the present book. Still, this book—which constitutes my doctoral dissertation—would not have come into being without the gracious help of several other people and institutions. To list them here is the author's privilege. First, I wish to thank my supervisor, Prof. Eero Tarasti, the head of the Department of Musicology at the University of Helsinki. I had the chance to work under his guidance thanks to the Centre for International Mobility (CIMO), the institution that twice—in the academic years 1993-94 and 1995-96—granted me a scholarship to Finland. As regards the mathematical aspects of my thesis, I am indebted to Leszek Bartłomiejczyk from the Silesian University in Katowice, Poland, for his worthy suggestions concerning fuzzy set-theory as a tool for representing the basic categories of Penderecki's sonoristic system. The person whose help was literally invaluable to me during the last months of work on this project is Richard Littlefield from Baylor University, Texas, who with infinite patience improved the English language of my book, while also taking into consideration all my stylistic wishes. For help in computer matters, I could always count on Mateusz Bień from the Computer Studio of the Music Academy in Katowice, Poland, who is also the editor of this volume. The publishing houses PWM and Schott have kindly granted me their permission to reprint excerpts from Penderecki's scores as musical examples in this book, and my home Music Academy in Katowice contributed financially to its publication.

In closing, my thoughts turn to my parents. Without the daily example of their persistence, without their constant encouragement and help in all practical matters, this book could never have been written. I dedicate it to them as a token of my gratitude and love.

Danuta Mirka

March 1997
Gliwice, Poland

INTRODUCTION

1. POLISH MUSIC AT THE END OF THE 1950S

The trend of sonorism in twentieth-century music was a highly confined phenomenon, both geographically and historically. If some musical currents of the post-war avant-garde lasted for decades in great international centres such as Paris and Darmstadt, sonorism was restricted exclusively to Polish music of the early 1960s. The identification of this style with Poland was so explicit for foreign reviewers that, as the eminent critic Krzysztof Droba noted, "the sonoristic acted then in the West and East as [defining what is] Polish" (1988: 31).[1] Thus to understand the nature and origins of sonorism one has to look at the situation of Polish music in the period immediately preceding its sudden appearance in 1960.

The Poland of those years saw abrupt changes as a result of the so-called political "thaw" after the insurrection of Polish workers in Poznań in October 1956. Culturally, the most spectacular result of the "thaw" was Poland's opening itself to the West and to the new artistic tendencies emanating from that area. This entailed a breaking down of the "information barrier" that had hitherto existed between Poland and the Western countries. To fulfill this process in music, the International Festival of Contemporary Music, called "Warsaw Autumn", came into being. The festival took place for the first time in 1956, then after a two-year hiatus, again in 1958 and annually since then. How thorough was the isolation of Polish music from general musical life before 1956 was evidenced by the program of the first "Warsaw Autumn", which listed, as "contemporary" works, music of Schoenberg, Berg, Webern, Stravinsky, Bartók, and Hindemith! It was as late as at the second "Warsaw Autumn" that one heard performances of works by Stockhausen, Boulez, Berio, Nono, Dallapicola, Carter, and Cage, works which truly represented the newest musical trends of the 1950s. Issues and problems in contemporary music started to be engaged also by the musical press, particularly by the quarterly *Muzyka* and the biweekly publication *Ruch Muzyczny*, the latter revived in 1957. Bogusław Schaeffer's *Nowa Muzyka* (1957), which was a compendium of current compositional techniques, became the "Bible" of young Polish composers. The return to contemporary musical life was made more formal by the admission of Poland to the Musical Council of UNESCO in the decisive year of 1956. The following year the Polish division of SIMC, previously dissolved by communist authorities, was reactivated.

The breakdown of the "information barrier" resulted not only in an influx of Western music into Poland. Rather, the free flow of information was bi-directional, which allowed Polish music entry into international musical life. For this process the "Warsaw Autumn", as a stepping-stone to international stages, again held significance of the first rank. At the "Warsaw Autumn" the foundations were laid that established the unquestionable position of Witold Lutosławski as a "contemporary classic" and one of the greatest masters in the history of music. It was also here where brilliant young composers such as Krzysztof Penderecki and Henryk Mikołaj Górecki started their artistic careers. Also, thanks to performances of their music at the festival, several other Poles, including Tadeusz Baird, Kazimierz Serocki, Włodzimierz Kotoński, Wojciech Kilar, and Witold Szalonek became known to the large contingent of influential foreign critics and publishers in Warsaw. Among the latter the most numerous and serious group consisted of Germans: Hermann Moeck, Otto Tomek, Heinrich Strobel, Ulrich Dibelius, Detlef Gojowy, Wolfram Schwinger. One cannot overestimate the crucial role those representatives of the German musical milieu played in the promotion and international advance of Polish music. These influential music literati from Germany viewed Poland as a veritable gold mine of talent, and their autumn visits to Warsaw

[1] In this book, all quotations from Polish and German sources were translated by the author.

usually resulted in the commission of new pieces by Polish composers and in invitations to prestigious contemporary music events in Germany. In the late 1950s the names of Poles thus began to appear in the programs of the Summer Courses for New Music in Darmstadt and of the famous "Musiktage fur zeitgenössische Tonkust" in Donaueschingen ("Donaueschinger Musiktage"). On those occasions, the German media broadcast interviews with Polish composers along with recordings of their works. Yet the international career of Polish music did not stop in Germany. From 1959 onward, compositions by Poles were awarded prizes almost yearly by the International Tribune of Composers UNESCO in Paris.

It was in those "boom" days of contemporary Polish music when the concept of a "Polish school" entered the vocabulary of Western (mainly German) reviewers. Though often and readily used, the term was never clearly defined by its inventors, and it remains rather enigmatic even today. The main problems were these: Never clearly stated was what musical properties determined the uniquely "Polish character" of music (as opposed to other contemporary music). Also never defined was what traits of the music produced by composers classified among the "Polish school" caused those composers to be perceived as a homogenous artistic group rather than as individual personalities. Such lack of definition gave rise, in following decades, to a suspicion that what the Polish composers had in common was merely their (almost) simultaneous appearance on the stage of international musical life.

> Composers such as Witold Lutosławski, Tadeusz Baird, Kazimierz Serocki, and Krzysztof Penderecki were perceived as a group right from the beginning. This perception was in part due to historical and cultural-political preconditions, which remain to be investigated. In 1956 Poland, which until then had been cut off from world-recognition, came to the fore suddenly and unexpectedly, with evidence of its rich intellectual life, of which one had had no inkling before that point in time. In the wake of this sudden appearance, even areas of diversity may have taken on the appearance of belonging together. (Gojowy 1975: 618)

Yet the sense of a general unifying characteristic of Polish musical output was too strong to be dismissed in this way. The unifying features of this music were sought chiefly on the aesthetic plane, in its strong, ardent expression and the dynamism of its formal processes. Both of these qualities were equally strange to the experimental "asceticism" of Western music in the 1950s and hence were all the more noticeable in the music coming from Poland. As a distinguished Polish critic of the time, Marian Wallek-Walewski, put it: "Between the Polish school in its emotional version and the tendencies of many foreign trends there was a gulf of expressivity. . . . Of course, [in Poland] one did not negate the syntax, its necessity, but it became not the predominating element of the young music" (Wallek-Walewski 1987: 39). It would, however, be a much more difficult task to indicate any definite set of properties constituting the touchstone of the "Polish school" in terms of style. True, one sometimes listed such properties as "the expanded orchestral sound . . ., a technical brilliance in sound color and dynamic gradations, creations of lavish resources, with absolutely no holds barred" (Gojowy 1975: 618). Yet it was plain that, with respect to style and compositional techniques, Polish composers had highly differentiated and distinctive personalities. This individualism was particularly stressed by the Polish reviewers and musicologists, who were rather skeptical of the label of a "Polish school". For instance, Tadeusz Kaczyński wrote in 1968:

> the individuality of single members of the 'group' (the word 'group' can only be used here in quotation marks) asserted itself from the very beginning. From the beginning, each composer followed his own special path (to speak here, of course, only of those who stood at the peak of their profession), without being hindered by others, and without hindering those who took other paths. (Kaczyński 1968: 7-8)

Characteristically enough, when foreign observers concentrated on the aesthetic unity of Polish music as an integral phenomenon in musical life, Polish critics reacted by turning their own attention to the variety and wealth of its stylistic resources.

This variety was an effect of the abrupt expansion of Polish composers into the area of new music. Thirsting for knowledge and experiences from which they were so long detached, Polish composers went through an "accelerated course" of contemporary compositional techniques, and very quickly adopted styles which in their original development had grown much more slowly. The explosion of novelty and the enthusiastic attitude towards new trends coming from the West were particularly characteristic of young composers from the generation born around 1930, which was entering its mature professional life after 1956: Górecki (b. 1933), Penderecki (b. 1933), Szalonek (b. 1927), Kilar (b. 1932), Kotoński (b. 1925), and Schaeffer (b. 1929). By contrast, the older composers found it more difficult to adapt new technical resources into their music, which retained the neoclassicism of "socialist realism". The fears and hopes of that generation were suggestively expressed by Witold Lutosławski during the Congress of the Union of Polish Composers (Związek Kompozytorów Polskich) in 1957:

> Our situation is not easy. Everyone of us faces the problem of finding his place in the confusion which present-day art presents. This problem stands out in relief particularly sharply to those of us who come into contact with western-European music after several years' break. We do not all have a clear view on what is going on in this music, what it is driving at. Nonetheless, I believe that it is only a matter of time, that we will not only gain a clear view on the situation, but will also play in it a positive and not inconsiderable role. (quoted by Michalski 1984: 165)

Undoubtedly, the problem of finding one's place in the field of contemporary music was solved most splendidly by Lutosławski himself. He had already started much earlier to elaborate theoretically his own characteristic musical language, independent of any other styles or techniques. The more permissive political situation, which arose after 1956, allowed him to use it openly in works that showed only a slight influence from Western tendencies. Other composers of the older generation, such as Bolesław Szabelski (b. 1896) and Grażyna Bacewicz (b. 1909), as well as those younger artists whose names had been known before 1956, such as Tadeusz Baird (b. 1928) and Kazimierz Serocki (b. 1922), were usually inspired by Schoenbergian twelve-tone technique, a technique that had long since been abandoned by the Western avant-garde.

A truly contemporary musical technique, which attracted mainly the youngest artists, was serialism. The powerful impression serialism made on the imagination of composers certainly had much to do with their frequent visits to Darmstadt, and also with serialism's characteristic intellectual discipline and speculative magic, in which every single tone could be justified as to all its parameters. The mathematical rigor of serialism was all the more fascinating for young Poles since their own academic education had taken place in the shadow of the cult of artistic genius, which consisted of vague inspiration, and of the image of artistic creation as an irrational process, one guided by intuition rather than by intellect, both of which were aspects of the great Polish romantic tradition. Yet in spite of this fascination, total serialism in the proper sense—serialization of pitch, duration, dynamics, and timbre (articulation)—was very rare in the works of Polish composers. The unique examples of total serialism are to be found only in early works by Górecki (First Symphony, *Scontri*). As one can guess, one reason for the limited popularity of serialism was its extreme complexity, both in its pre-compositional and compositional phases, which effectively discouraged its "orthodox" application in works. Polish composers were deeply interested in the textural "effect" of serialism—its breakage of musical space into separate points. They were less interested in the technological "cause" of serialism, which demanded the arduous counting of series and their permutations. Hence, serialism was eclipsed in popularity by pointillism, which retained the sensual-auditive "phenotype" of serialism while at the same time neglecting its intellectual "genotype", which was based on the logic of series that govern the relationships of single tones (Baculewski 1987: 140). Among numerous works in pontillist style, particularly noteworthy are those by Szalonek (*Confessions*) and Penderecki (*Emanations*, *Strophes*).

The fascination with the Darmstadt style burnt itself out as quickly as it had ignited. The same traits of serialism which appeared so exciting to young Poles two or three years earlier, after 1960 were perceived as totally alien to their cultural heritage, and became the object of attacks. Serialism was charged with being overly intellectual, with prizing technology above free invention, with emptying the work of expression, and denying the role of inspiration in the creative process. In their critique of serialism, Polish artists also began to share, more or less consciously, the arguments against serialism that had previously been advanced in the West. Those same artists also took up the musical tendencies which constituted the logical outcome of such arguments.

The first well-known argument against serialism concerned performance and performers. The total serialization of musical materials demanded a level of performance precision beyond the capabilities of most performers. If all the demands of serial scores were taken seriously, the performer would have to be something like an automaton or robot, rather than an animate organism. To be consistent in this situation, one must choose between two opposing conceptions of a performer. Either one insists on total precision in the performance of a piece, including all, even the most detailed, wishes of the composer; in which case, the performer is consigned to the status of a non-entity. The other choice is to accept the human condition of performers and consequently to allow for a margin of freedom by way of possible performance deviations. "Music for tape", as a logical consequence of the former attitude, flourished in Poland together with the foundation of the Experimental Studio of Polish Radio in 1957. Nevertheless, the first Polish piece for tape—an example of *musique concrète* entitled *Etiuda na jedno uderzenie w talerz* (*Study for One Strike on a Cymbal*), by Włodzimierz Kotoński—was presented only during the fourth "Warsaw Autumn" in 1960. In turn, and as a positive answer to the second of the two alternatives above, aleatorism, musical theatre, happenings, and several other types of conceptual art, which granted the performer broad freedom, entered the area of Polish music in the early 1960s, mainly due to the activity of two ensembles of contemporary music. These ensembles were MW 2, led by Adam Kaczyński, and Warsztat Muzyczny (Musical Worshop), directed by Zygmunt Krauze. The composer who could claim the most eminent achievements in those fields was, and still is, Bogusław Schaeffer. Yet all those trends were of rather marginal significance for the general image of Polish music in the 1960s.

The mainstream of compositional interest and musical output was concentrated in a musical style that originated with the problem of musical perception. A second argument against serialism pointed out that no audience could adequately perceive its arcane technical procedures. Instead of complex serial orderings, listeners heard only the most general traits of the sounding material, such as structure, timbre, density, and movement. Paradoxically, while all the effort of serialist composers was focused on individual tones, their audiences neglected that level of musical phenomena and concentrated instead on large sets of tones. It was reasoned that, since the new music was perceived according to general traits of "sound fields" and not the complex relationships between individual elements (single tones), the compositional procedure should follow suit: composers should abandon the fruitless micro-level of tonal networks and instead deal immediately with the macrolevel of textural and formal problems, and most of all with the structure and timbre of "sound fields". This argumentation accounted for the change in composers' procedures. In the West, one noticed such changes in Ligeti's and Xenakis's styles. In Poland, there arose "sonorism", the most important conduit for the mainstream of Polish music in the 1960s. As the leading trend in contemporary Polish music, sonorism thus formed the most obvious stylistic component held in common by members of the "Polish school".

2. WHAT IS SONORISM?

Unlike exponents of the Western avant-garde, such as Boulez, Stockhausen, or Cage, who in numerous manifestos, lectures, and interviews willingly explained their theoretical assumptions, Polish sonorists eschewed any declarations of either aesthetic premises or technological procedures of their work. Therefore, in the early 1960s, musical reviewers faced the daunting task of defining the constitutive traits of the new style by relying only on their own auditive impressions and scores. This task was all the more difficult since the appearance of sonorism in contemporary musical life took place in an almost hysterical atmosphere of sensation and scandal, which was unpropitious for formulating well-considered judgments and opinions.

Such an atmosphere accompanied chiefly the beginning of Krzysztof Penderecki's brilliant career. In just two years this *enfant terrible* of twentieth-century music fought his way into concert halls of the highest prestige with a series of pieces that provoked extreme reactions in the public and in performers: from admiration to condemnation, from riotous applause to sneers and protests. In Poland his name began to gain fame in 1959, after three of his pieces—*Strophes*, *Emanations* and *Psalms of David*—were forwarded anonymously to the competition organized by the Union of Polish Composers and were awarded the three highest prizes. *Strophes* was performed the same year, during the "Warsaw Autumn", and in 1960 that festival saw the premier of a new work by the young artist, *Dimensions of Time and Silence*. Yet world-wide fame was attained by Penderecki only after the sensational triumph of his *Anaklasis*, performed at the Donaueschinger Musiktage in 1960, and the success of *Threnody*, which received an award at the International Tribune of Composers UNESCO in Paris, 1961. Succeeding pieces—particularly *Polymorphia* (1961), *Fluorescences* (1962), and *Canon* (1962)—confirmed the position of the hitherto unknown composer as the most astounding phenomenon to enter the arena of contemporary music in many years.

Penderecki's name was from the very beginning the symbol of a new current. His music was perceived not only as the earliest and most important manifestation of sonorism but also as its measure, to which any other pieces and composers classified thereafter as "sonoristic" had to be compared. Practically everything written or spoken about sonorism at that time dealt with Penderecki. Thus in the early 1960s, the reception of sonorism was identical with the reception of Penderecki's music, that reception taking place mostly in Poland and Germany. Among German reviewers, critics and musicologists, the greatest contributions to the progress of Penderecki's reception were made by Wilfried Gruhn, Wolfram Schwinger, Josef Häusler, Karl-Josef Müller, Alfred Huber, and Ulrich Dibelius. In the Polish musical milieu of that time, Józef M. Chomiński, Tadeusz Zieliński, Marian Wallek-Walewski, Tadeusz Kaczyński, and Bohdan Pociej played the most crucial role in the composer's critical reception; in the 1970s this role was taken over by Mieczysław Tomaszewski and a new generation of musicologists and music theorists such as Krzysztof Droba, Krzysztof Bilica, Andrzej Chłopecki, and Regina Chłopicka.

The shortest and most essential answer of these authors to the question "What is sonorism?" lay in the very name of that musical trend. Derived from the French verb *sonner* ('to sound'), "sonorism" indicated sound value as the paramount factor of that kind of music. The inventor of this term and one of the most eminent Polish musicologists of the early post-war period, Józef M. Chomiński, put it very clearly in his definition: "Sonoristic regulation consists in an exploration of the pure sound values of the sound material" (Chomiński 1983: 126). Such exploration led to the discovery of a wealth of new sound values, in which sonoristic pieces abounded. It was precisely those sound novelties of sonorism—sounds that had never before existed in the history of music—which attracted the attention of its commentators, and which had the strongest influence on the reception of this new style.

All music sounds, of course. But in other styles the sound value in itself was only a secondary result of compositional procedures concerning melody, rhythm, and harmony. With sonorism, by contrast, "in place of melody, harmony, meter and rhythm, the sound value became the primary tectonic factor" (Malecka 1983: 176), and it ruled over or even ousted other musical parameters. Traditional musical elements and processes, if one could still properly speak of such things, were reduced to the level of mere "by-products". This was so because traditional musical concepts referred to relations between single tones, while it was apparent from the very beginning to all commentators, that sonoristic regulations proceeded on the level of vast "sound fields", "blocks", or "masses". This latter characteristic of sonorism was aptly expressed by the German term *Klangflächenmusik*, as well as by its English counterpart, "sound-mass music".

Sonoristic compositional thinking thus required new categories that would account for sound values as properties of sound masses (rather than single tones), and that would define the relations between those masses. Timbre was commonly considered the most decisive category of any given sound value. The dependence of sound value on timbre was seen to be so close that in several articles those two notions were treated as synonyms. Timbre, though in reality a very complex parameter, was in turn perceived as a function of instrumental touch and orchestration. Plainly, the new and unusual sound values in sonoristic works were obtained first and foremost by means of new, atypical techniques of playing. As Chomiński wrote, "traditional instruments are employed in sonoristic regulation in a new way. One enriches the ways of sound production by means of various touch-effects hitherto not used nor even foreseen" (Chomiński 1983: 126). From the very beginning, the specification of those "effects" constituted an indispensable part of every critique or analysis.

Sonoristic articulation and orchestration

It was for the stringed instruments that Penderecki created the richest inventory of atypical instrumental techniques. That instrumental group was the most familiar to the composer, who had completed his secondary musical education in violin. Apart from normal playing techniques, such as arco and pizzicato, Penderecki called for several types of slow and rapid vibrati, along with previously known, but rarely employed, techniques such as *legno battuto* and *col legno*. Investigators of his early output have also listed the following innovative string-playing techniques called for by Penderecki: "highest possible tones on a given instrument obtained by pressing the string close to the bow" (Zieliński 1961: 17); "striking the sound board of violins, scraping the tailpiece" (Müller 1975: 625), "bowing, plucking, hitting one or more strings near or on the bridge or tailpiece" (Schwinger 1989: 129); striking the fingerboard with the palm of the hand, and the desk or the chair with the bow. It was mainly such "percussive effects" that most agitated Penderecki's public and that provoked the protests of performers. Scandalous mutinies were common, by orchestral musicians who refused to play Penderecki on the pretext that doing so would harm their instruments (Erhardt 1975: 36; Schwinger 1989: 132; Ćwikliński and Ziarno 1993: 10-11). Another atypical, but less "harmful", means of articulation consisted in gradually lowering the pitch by turning the tuning pins. This rare effect was called for in the scores of *Emanations* (Wallek-Walewski 1960) and *Fluorescences* (Schwinger 1989: 145). Some of the new techniques of articulation were so difficult that even the best players could not perform them. One pertinent example was the "attempt to make a string vibrate without bowing 'by stopping it with a powerful application of the finger while trilling', as the score directs at the beginning of the [First] quartet. Even the LaSalle Quartet, who gave the premiere in Cincinnati in1962, with all their skill and experience of new music, were unable to bring this off" (Schwinger 1989: 129).

New ways of sound production were also demanded of instrumental groups other than the strings. In *Dimensions of Time and Silence* the choral part contained whistling, singing *bocca chiusa*, *falsetto*, and, above all, the pronounciation of pure consonants, by which "a forty-part chorus of mixed voices entirely lost its 'vocal' character and was tranformed into a quasi-percussion instrument unfolding a broad fan of sound effects of noise consistency in front of the receiver" (Schiller 1960: 5). A similar effect was produced by the winds in *Fluorescences* by means of their playing with stops and pistons or on the mouth-pieces only. Winds and choir were obviously of lesser interest for Penderecki's inventiveness, and were used only occasionally in his early scores. In contrast, percussion instruments proved an ample source of articulatory effects.

> Many effects in the percussion group are possible, owing to the rich assortment of sticks. Penderecki also introduces several types of touch, when he calls for striking . . . (a) across another stick, (b) across the edge [or] (c) the side of the instrument, (d) with the opposite end of the stick. (Wallek-Walewski 1960: 2)

The wealth and variety of percussion sounds was also increased by the usage of several rare (usually non-orchestral) instruments, such as cowbells, congas, bongos, guiro, wood drums, metal blocks, flexatone, raganella, Javanese gong, and claves: instruments that appear in the scores of *Anaklasis*, *Dimensions of Time and Silence*, and *Fluorescences*. However, Penderecki's "most sensational innovation is the inclusion in the orchestra of noises of non-instrumental origin (in the score, the composer included them in percussion groups), such as the sawing of pieces of wood or metal with a handsaw, the patter of the typewriter, the rustle of parchment, the sounds of whistle and electric bell" (Zieliński 1964: 5). Enlarged by numerous atypical playing techniques, by new instruments, and by additional "percussive effects" in the other instrumental groups of the orchestra, the percussion section occupied a prominent position in the sonoristic sound palette. As early as in analyses of *Anaklasis*, a piece for string orchestra and percussion ensembles, it was observed that, in Penderecki's orchestra, the percussion was equal partner to the strings, and thereby took over a role traditionally reserved for wind instruments (Häusler 1969b; Müller 1974; Schwinger 1989: 136-140; Zieliński 1961).

Sonoristic texture

Even though the notions "sound value" and "timbre" were sometimes used interchangeably, the investigators of sonoristic works were usually aware that, in addition to orchestration and instrumental techniques, sound value also depends on several other factors that determine the internal structure of sound masses, such as density, mobility, homogeneity and diversity (Baculewski 1987: 203-204). The novelty of sound values was thus very often effected not by atypical ways of playing, but by phenomena of a specifically textural nature. Such phenomena were first and foremost clusters.

> A cluster causes all the chromatic notes to sound simultaneously within a prescribed compass, say a fourth. The ear accordingly cannot perceive any particular pitch (except perhaps the highest note and the lowest), since the pile of notes includes an overlay of harmonic upper partials, as well as their fundamental dissonances. (Schwinger 1989: 126)

Though used for the first time by Henry Cowell, the cluster was commonly acknowledged as the most prominent feature of Penderecki's sonorism, "the trademark of Penderecki's shaping of sound" (Müller 1975: 623).

> Penderecki goes some way further than Cowell, building clusters in quarter-tones as well as semitones, and causing them to move by varying their expanse with smaller or larger intervalls to fill out the extremes of pitch. He develops a cluster from a single pitch, thickening it, then reducing it to a single note again. (Schwinger 1989: 126)

In this way the problematic of the cluster and its special elaboration as the prominent characteristic of Penderecki's scores also involved the other characteristics of Penderecki's sonoristic style, such as quarter-tones and glissandi. If the former were of importance for the density of a cluster, the latter were considered as a factor that enriched and differentiated its internal life, endowing it with movement, and in this way transforming the originally simple if not primitive effect into a refined, subtle, and artistically elaborated sound phenomenon.

> Through incorporation of quarter-tones Penderecki enriches clusters; he gives them different widths, makes them glissando across the sound space, assigns to them several articulation techniques (tremoli of changing speed, harmonics, *col legno*, *sul ponticello*). The strange transformation which the sound of stringed instruments undergoes as a result of those instructions causes the clusters to become captivating sound landscapes: what in the verbal definition of the notion 'cluster' appears as a shapeless lump of a sound matter, becomes in Penderecki a sounding micro-vegetation, a fluctuating, mobile sound band of its own, of particular magic and poetry. (Häusler 1969a: 312)

The unusual sound values that resulted from new modes of articulation and from the internal structure of sound masses at "the border-zone between sound and noise" (Schwinger 1968: 5) strayed so far from the normal orchestral sound that they appeared to be produced by electroacoustic equipment rather than by traditional instruments. "The specific spectrum of instruments is altered, and approaches that of electronically generated music" (Huber 1971: 89). It was also in the world of electronic sounds that one sought for the origins of Penderecki's sound imagination.

> One of the more interesting influences exerted by the musical experience of electronics and engineers was the search for new, as yet unused sound possibilities of individual instruments and instrumental groups. . . . The experiment of electronic and concrete music opened a new period in the musical hearing of sound material. It made the ear of the contemporary composer sensitive to a new, often unanticipated sound palette of noises, dins, sounds of different inner organisation and structure than those to which we were accustomed. (Wallek-Walewski 1960: 1)

Those observations were confirmed by events mentioned in the composer's biography. At the end of the 1950s and in the early 1960s, Penderecki spent a lot of time in the Experimental Studio of Polish Radio in Warsaw working mostly on music for the theatre and radio broadcasts. Even though electronic music was never his main field of activity, but rather one of marginal interest, a fruit of Penderecki's studio experiences was his one "serious" piece for tape, *Psalmus 1961*.

Sonoristic notation

Atypical effects of both articulation and texture, which brought new sound values to the listening experience, were indicated in scores by means of unusual notational devices. Hence, apart from the "catalogue of effects" inherent to Penderecki's sonoristic style, the problematics of their notation came to the fore in most comments and discussions. Indeed, this usually had practical importance: one could not proceed with analysis and refer to notated examples without explaining the secrets of notation. Thus, Alfred Huber opens his analysis of *Anaklasis* by enumerating the most striking notational signs in the piece:

> Written for string and percussion instruments, the score—sensational at the time—contains apart from customary notation also graphical signs: signs of clusters of different widths, wavy lines, and the like. The ways and techniques of sound production, which stray from traditional standards, are notated by means of symbolic marks. Hence, the string parts include signs for 'very slow vibrato within a quarter-tone' (by moving a finger), for 'very rapid, non-rhythmicized tremolo', etc. The instructions for the percussion concern mainly the placement of the stroke and the type of beater. (Huber 1971: 87)

Writers commented mainly on the special signs invented by Penderecki to indicate atypical ways of instrumental articulation (Gruhn 1971; Huber 1971). A complete table of signs explaining the symbols in *Fluorescences*—the piece most abounding in atypical notational signs—was given by Wolfram Schwinger before his analysis of the work (1989: 141-42).

Apart from signs referring to individual sound phenomena, commentators were interested in some global notational solutions that were applied to entire musical parameters such as time or pitch. The notation of pitches by means of rectangles or flexures, referring to clusters and glissandi, was of interest as approaching aleatoric "graphical notation" (Baculewski 1987: 238). But an even richer innovation of the composer was displayed in the area of temporal regulation. Sometimes rhythmic phenomena were written in approximative notation, where individual durations were only roughly indicated by the composer and left largely to the free interpretation of performers. At other times, rhythms were specified very carefully and in precise values arising from complicated divisions of the crotchet into quintuplets and sextuplets. Moreover, the exact durations of these last were fixed by their being assigned to one of several levels of speed, which were indicated by metronome marks. The changes between those levels were mirrored in a "tempo line" running below the bottom staff of the score, an original device by Penderecki, as noted by commentators, which he first used in *Strophes* (Schiller 1960: 5; Erhardt 1975: 21) and then in *Anaklasis* (Schwinger 1989: 137; Erhardt 1975: 28). Still another solution was employed in the First String Quartet and *Canon*. The temporal course of those pieces was regulated by a mutual assignment between spatial units of the score, marked by vertical dividing lines (similar to those of metrical division) and forming a sort of scale, on the one hand, and temporal units given in seconds, on the other hand. Thus distances in the score had their equivalents in temporal distances of the performance. In *Canon* the same principle of "scale" notation was expanded into the area of pitch, so that in that piece the normal staff completely disappeared. The strange shape of the score was described carefully by Schwinger:

> The score is written out on millimetre graph paper. A vertical centimetre represents an octave from C to C, so that the middle line denotes F sharp. In between, the pitches are approximately indicated by undulating and jagged lines. Horizontally, 10 centimeters represents 5 seconds. In addition an extra line indicates percussive effects. Above the whole system of the score run red and purple lines numbered 1 and 2, for the running of the tapes: red for recording, purple for playback. (Schwinger 1989: 134)

Although Penderecki's notation sometimes displayed an approximative character, without precisely indicating pitches or rhythmic values, it was nevertheless commonly acknowledged to be far from aleatorism, because it did not leave important compositional decisions to the performers, and because it determined the sound result of his music quite precisely. As Huber notes (1971: 89): "Everything here is fixed. Even if the outlines of clusters are occasionally obliterated by special instructions concerning instrumental articulation, the identification of different widths, pitches and intensities of sound as a determined substance is thoroughly possible". And Huber's comments are echoed by Häusler (1969a: 310): "It thus appears that this new score, with its peculiar graphics, with its flexures and wavy lines, with signs of clusters of various widths, with arrows and a multitude of other symbols, builds up a precise equivalent of the sound imagination of the composer, and explores the limits of the domain of sound with relish and resource".

Sonoristic expression

New sound values created a new world of musical expression. Hence, discussion of instrumental techniques and textural effects was as a rule complemented by observations on the extreme expressive power of sonoristic works. This power of expression was acknowledged as particularly characteristic of Penderecki's music since the great international success of *Threnody*. The second part of the piece's title formed a dedication—*To the Victims of Hiroshima*—and was commonly considered as aptly reflective of the intense emotionality of the music. The unusual and moving sounds induced feelings of horror and torment, and provoked, among the most naive of listeners, associations with concrete noises accompanying the devastation of Hiroshima: the wail of the siren, the whir of the airplane engine, the whizzing of the falling bomb, and the groans of dying people. The final cluster was as a rule identified with the sound of the nuclear explosion. Even though the pronouncements of professional critics contained such literal interpretations rather rarely, they were invariably rife with high emotion, as the following statements by Borris indicate (1975: 611):

> At the very beginning a sharp high band of strings *fortissimo* brings about a piercing flash in the highest register. On this background only gradually there occur indefinite taps, visions flitting by in the fastest motions. For the first time a complaint sounds; deep glissandi arouse associations with groans. The episodes alternate, breaking impetuously and wildly. The end brings all the elements together: hurrying passages, whizzes, hollow thuds, shrill clusters, and a band of sirens build up a sound background on which the rotating and spiraling figures and shouts suggest the tremor of the explosion. No development or perceivable order relieves the harshness of this commentary in sound. Its very slow cessation leads to no illusion of resolution, but rather to blank nothingness. (Borris 1975: 611)

Wolfram Schwinger wrote the following about *Threnody*:

> This music, with its sharp cutting edge, not excluding effects of ennervation from its range of expression, might easily be taken as a naturalistic representation of Chaos; but this densely woven study in sound goes further to embody lament and accusation. That may have given Penderecki the courage to dedicate it subsequently to the victims of the first atom bomb. (Schwinger 1989: 124)

Not codified definitively, however, were the relations between the sound values and the expressive qualities of Penderecki's music. After all, it was an open secret that the title—*Threnody—To the Victims of Hiroshima*—was the suggestion of Roman Jasiński, the director of Polish Radio, and was adopted before the piece was submitted to the International Tribune of Composers UNESCO. The original title, *8'37"*, indicated only the approximated duration and did not betoken the emotional impact of the music. Also, other abstract titles such as *Anaklasis*, *Polymorphia*, and *Fluorescences*, induced commentators to think of specific sound qualities or technical solutions rather than of any sort of expression (Schwinger 1989: 131, 137, 141; Erhardt 1975: 28, 50; Häusler 1969b: 343; Huber 1971: 87). Was expression the aim of such innovation in sound? Or was expression merely its perceptual, or sensible, "side-effect"? The various answers to that question determined the aesthetic judgments on Penderecki's sonorism.

Originally, in the early 1960s, the first view prevailed. The new sound values were considered as subordinate to the creation of new types of expression, types which were inaccessible by traditional musical means. In his article on *Fluorescences* Tadeusz A. Zieliński writes that "under the sounds, selected with masterly skill, a definite emotion is hidden. True, an emotion of a very special type—which can be found nowhere else—but it seems to speak well for the work and ensure it an important place in the music of our century" (1964: 6). The same conviction was shared by the prominent German advocate of Penderecki's music, Wolfram Schwinger:

> Can it really be called 'expressive' music? The answer must be in the affirmative, even if the overriding initial impression is of noise rather than sound. For very soon one notices how distinctly Penderecki articulates these new-found noises, not as the interesting experiments of a fanatical sound-engineer, but as emotionally loaded, sinister energy. (Schwinger 1989: 124)

Penderecki-as-expressionist came into being, and as such, qualified as a worthy exponent of the "Polish school". As a result of that view, a positive and even enthusiastic aesthetic judgment of Penderecki's music was established.

If the leading role in Penderecki's sonoristic pieces was to be assigned to expressive qualities, then those qualities should have governed not only the assortment of sound values but also their temporal arrangement in the framework of a given piece; hence, they should have ruled the form of his works. The compositional process would proceed thus not on the level of sound-value sensations, but on the superior level of emotional states, and this would result in a specifically emotional trajectory for each work. This way the "composition of sound values" would serve a "composition of emotions". As Zieliński observed (1962: 323): "The composer uses only such sounds which have for him a definite expression. Joining them into ingenious constructions, setting them against one another and developing them, he creates a multitude of expressive tensions". In *Threnody* "Penderecki divides his piece into several clear sections, which contrast in respect of colouristic image and which grip [the listener] by newer and newer sorts of expression. Owing to this, the listener remains in a state of highest emotional tension, which is constantly renewed" (Zieliński 1961: 17). Ascribing the leading role in formal processes to expression allowed representatives of that stream of criticism to explain why Penderecki's works, though otherwise highly avant-garde, so often took the shape of such traditional musical forms as ABA, which was discovered in *Threnody* (Gruhn 1971), *Anaklasis* (Huber 1971) or *Polymorphia* (Schwinger 1989: 131). This, as any other embodiment of the "arch form", belongs to the inventory of archetypes that rule the temporal course of human experiences and, hence, to the fundamental dramatic schemata of art. Penderecki's contribution to new music was thus construed as a translation of these schemata into new musical language:

> Already at the time of the work on *Threnody*, *Quartetto per archi* or *Polymorphia* one could notice that Penderecki was perfectly aware of the fact that one could obtain the traditional course of harmonic tensions of old music by the arrangement of sonoristic effects. For the listener it meant an unusual refreshening of the sound character—and consequently its potent attraction—and on the other hand it made the perception of the work much easier. The rise and fall of tension and relaxation gave the listener the impression of a particular 'ease' in assimilating Penderecki's works. (Wallek-Walewski 1987: 39)

In further consequence, the assumption that the sense of Penderecki's sonoristic pieces consisted in their emotional course determined one's view as to the nature of his compositional procedures. This problem was, from the very beginning, a highly embarrasing one for the "expressivist" criticism of Penderecki's music. Almost everyone agreed that Penderecki's works were composed according to a precise formal conception: "the composer marks very precisely the choice and the succession of timbres so that every sound seems to be in its proper and necessary place" (Zieliński 1961: 17). But this formal logic, which "we feel subconsciously even during the first hearing" (Zieliński 1964: 6), resisted rational explanation. If the compositional procedures concerned the level of expressive qualities, however, such a state of affairs was fully justifiable. Any rational compositional procedure must be based on relations between units, and yet no clear relations between expressive qualities could be established. Thus the formal course of Penderecki's pieces must not have been shaped by technical rules constituting his "system" or "compositional technique", but rather was governed by the composer's artistic intuition. It was the greatness of that intuition, and not the perfection of an intellectually concocted system, which constituted the basis of formal coherence in Penderecki's works. Plainly, such intuitively shaped pieces "did not require the listener to trace intellectually their construction . . . but rather to join emotionally the course of the author's fancy" (Zieliński 1964: 6). The consequence of such a conviction about the intuitive character of Penderecki's compositional procedures was the purely descriptive character of analyses. For if there are no rationally comprehensible rules governing the process of composition, the effect of this process, which is the form of a given work, can only be described and never explained. Analyses of Penderecki's sonoristic works thus confined themselves to verbal accounts, with a dash of expressive designations, of what could easily be seen in the scores themselves.

Yet among commentators on Penderecki's sonoristic output there also existed an opposite view of the relationship between sound and expressive values. The exponents of this view claimed that the sonic effects formed the proper objects of the composer's interest, whereas the impression of high emotionality arose only during perception, as an emotional response by the listener. Such a view appeared already among the earliest critics. One reviewer, present during the first performance of *Anaklasis* at Donaueschingen in 1960, labelled that piece "a handbook of noises" and added spitefully: "Happy are those who can read it" (quoted by Häusler 1969a: 310).

This group of opinions, rather marginal in the early 1960s, was reinforced after Penderecki had moved from pure sonorism to larger-scale works, beginning with his *St Luke Passion* (1963-66). Then the "creation of sonic facts stopped being an aim in itself", and "the new expression, obtained by the expansion of materials within the traditional instrumental resources, was absorbed into a universal musical language" (Gąsiorowska 1983: 11, 12). Or as another critic put it: "The ludic was turned into the dramatic, the expression called 'pure' into one swelled with real emotions, the provocative attitude into an expressive one" (Tomaszewski 1994: 98). Still another commentator, Krzysztof Meyer, added:

> it appeared that manipulation of the sound itself does not suffice. Elements of musical language from early pieces have become the *means* for creating a music that is richer both 'outwardly' and 'inwardly'. For Penderecki the musical work stopped being merely an exposition of possible sonoristic effects. From then on his output would display a new important feature: a tendency towards synthesis. (Meyer K. 1983: 87)

The above comments suggest unequivocally that the sonoristic works did create sound values as aims in themselves and that the musical work was only an exposition of possible sonoristic effects—that in the process of their composition "the prime motivation was a sound phenomenon and sound experiment" (Huber 1971: 87). In comparison with monumental works that concerned the very fundamentals of the human condition and that fairly swelled with the serious emotions of human hopes, pains, and struggles—works such as *The Devils of Loudun* (1968-69) or *Utrenia* (1969-71)—the sonoristic pieces seemed to constitute merely a preparation, a "time of attempts and experiments", as Mieczysław Tomaszewski termed it (1994: 96). Kaczyński, writing earlier (1968: 9), said: "The quest that prevailed in those compositions, a quest for new sound-timbre solutions which not long ago still seemed to be an aim in itself, is to be considered today as a transitional stage to the monumental vocal works of the last period". This assessment of Penderecki's sonoristic output was consolidated in the first monographs, issued in the 1970s: In 1973 there was *Szkice o Krzysztofie Pendereckim* (*Sketches on Krzysztof Penderecki*) by Krzysztof Lisicki, in 1975 Ludwik Erhart's *Spotkania z Krzysztofem Pendereckim* (*Meetings with Krzysztof Penderecki*), and then *Penderecki. Begegnungen, Lebensdaten, Werkkommentare* (1979) by Wolfram Schwinger. In these studies, the chapters devoted to early works constitute an introduction to the broad discussion of Penderecki's later achievements in the field of vocal music.

All this caused a more critical evaluation of the early part of Penderecki's output. If in the 1960s Penderecki's sonoristic pieces were usually received enthusiastically as all that was revelational and new in the avant-garde of the time, the general changes in aesthetic evaluation which took place in the 1970s caused "his works from the years of experiment" (Schwinger 1968: 7) to be at least disregarded or slighted, and even condemned outright. A certain scepticism was already perceptible in the comments of Rudolf Stephan (1969: 4):

> Whether it is anything more than a mere sounding backdrop—as is also plenty of serial music—will become evident only when the surprise effect spends itself, when the works enter their own history and unravel themselves in it. Only then will it turn out whether, through timbre changes of individual sounds or of sound masses, any musical sense arises here, whether the means employed in those works suffice to produce what makes the music worth listening to. (Stephan 1969: 64)

Those for whom the only value of Penderecki's sonoristic music consisted in shocking the public with unusual sound effects, had to pronounce, along with Krzysztof Meyer, that after the surprise effect was spent, "the works of that period—even including *Threnody*, which was so exceptionally popular in days gone by—have become mainly of historical value, and are not those pieces by Penderecki that have taken the most prominent place in the concert repertoires of the world" (Meyer K. 1983: 87).

If, as this group of commentators asserted, sound values were Penderecki's chief compositional interest in his sonoristic pieces, then the proper level of his compositional procedures would be that of sound masses. Therefore, one might reasonably hope that those procedures would display a certain rationality, one based on a given system of technical rules that govern the arrangement of those masses into a defined musical form. Such rules apparently did not exist, however. This belief was characteristically expressed by Bohdan Pociej in his discussion of one of Penderecki's lesser known pieces, the *Sonata* for cello and orchestra (1964):

> The main problematic of *Sonata* probably does not lie in the analytical-technical sphere; the score does not hide here the 'secrets' of a workshop in the sense of some more or less coded methods or compositional assumptions. All ideas prove correct auditively; the work is what sounds, i.e., the sound—form—expression. The way of writing itself was perhaps important for the composer; for us it is not; we need not know about it. (Pociej 1965: 12)

The critics' disappointment with (the perceived lack of) formal regulations caused them to deny the very possibility of a system in sonoristic music:

> Is it thus possible that such music, in which the criteria of patterning deteriorate to secondary manifestations or are absent entirely, can be referred to in terms of repetition and variation, and can it be listened to adequately? Thus is not Penderecki's whole conception of form not called into question? (Müller 1975: 627)

It is no wonder that the interest of analysts in Penderecki's sonoristic works rapidly decreased. On the one hand there were analysts who dealt with small parts of pieces governed by mathematical procedures of serial origin, as in analyses of *Threnody* (Gruhn 1971), *Dimensions* (Müller 1975), String Quartet (Bilica 1983), and *Anaklasis* (Huber 1971). In such cases, however, those procedures do not govern the arrangement of sound masses within the overall formal course of the works, but merely the relationships between single tones, within passages of various lengths; hence such procedures are not at all specific to sonorism. On the other hand there were analysts who believed that there was nothing more to say about the sonoristic pieces, that the early descriptive analyses had said all there was to say. For this group of commentators on Penderecki, a much more interesting field of investigation was opened up by works endowed with literary texts, where one could achieve impressive analytical and interpretative results thanks to the rich extramusical implications (Chłopecki 1975a, 1975b; Pociej 1975; Chłopicka 1980, 1983a, 1983b; Wnuk-Nazarowa 1983).

The common view of sonorism

Such a reception of Penderecki's early output established the common view of Penderecki's sonorism, which was subsequently and mechanically reiterated in general histories of Polish contemporary music (Baculewski 1987; Michalski 1984), and which remains the common view among musicologists of the present day. On this view, sonorism appears as a style devoid of any interest in intellectually organized form, and is rather concerned only with the exploration of formless sound matter. Accordingly, in sonoristic compositions the raw sound material is of primary importance, whereas the form called "extensive" (*ekstensywna*) or "assembly" (*montażowa*) (Tomaszewski 1984: 9, 40) is merely a secondary result of the free fluctuation of sounds. Sonoristic works thus form "catalogues of effects" or "handbooks of noises" (Häusler 1969a: 310) rather than proper works of art. Sonoristic composers—first and foremost Penderecki himself—came to be seen, at best, as children reveling in the egoistic play of invention and, at worst, as young savages finding pleasure in the most primitive objects and emotions.

The view of sonorism, as anti-intellectual in its attitude towards the problem of artistic creation, is also of significance for the location of that style in the history of twentieth-century music. As a rule, sonorism is considered to be a reaction to the hyperformalist orientation of serialism, with its rigorous technical regulations and predomination of formal processes over the resulting sound effect (Meyer K. 1983: 87; Erhardt 1975: 39). On the other hand, Polish sonorism's purported anti-intellectualism has also separated it from the music of Ligeti and Xenakis, which, though auditively similar, is based on subtle relationships among tones: "micropolyphony" in the case of the former composer and mathematical stochastic procedures in the case of the latter. Thus, in the history of music, sonorism has been relegated to the stream of sound explorations, as a continuation of experiments begun by the Italian Futurists, continued by Varèse, and expanded further in the areas of electronic and concrete music (see Müller 1974: 227).

3. BORDERS OF SONORISM

In the absence of any technical rules governing the form of sonoristic pieces, the only distinguishing mark of sonorism appeared to be a novelty of sound effects in the field of musical texture and instrumental techniques. Such a material criterion was deceptive, however, and could not constitute a dependable tool for discriminating between sonoristic and non-sonoristic pieces, because the inventory of new effects—once they had been used for the first time—inevitably lost its newness and in time became the common property of several composers. These composers started to employ the new effects as they would any other musical resources for realization of their own artistic purposes. Whether or not those purposes still had anything to do with sonorism was beyond the reach of criticism.

It was just this uncertainty of criterion that lay at the root of problems that arose in classifying given works as inside or outside sonorism, and that caused the set of sonoristic composers never to be stated unequivocally in Polish musicology. The position of Krzysztof Penderecki, Witold Szalonek, Włodzimierz Kotoński, and Henryk Mikołaj Górecki as sonorists and inventors of new sound effects was never called into question, even if the sonoristic output of the latter was represented by only one piece, *Genesis* (1962-63). Yet one applied the label of sonorism, with larger or lesser justification, to several other composers: not only those who were starting their careers in the 1960s—such as Zbigniew Penherski, Wojciech Kilar, Andrzej Dobrowolski, and Zbigniew Bujarski—but also to older artists such as Grażyna Bacewicz, Witold Lutosławski, Tadeusz Baird, Kazimierz Serocki, as well as some representatives of the next generation, whose music did not enter the concert halls until the 1970s; for example, Krzysztof Knittel and Krystyna Moszumańska-Nazar (see Kostrzewska 1991). Material resources instead of individual properties of compositional technique also determined stylistic differentiation between individual composers. From this standpoint, Penderecki and Górecki, as pioneers of new string techniques, were set on the one side along Szalonek, who was interested mainly in new wind-instrument sounds, on the other side, next to Kotoński, who was exploring the possibilities of percussion and electronic equipment.

But except for Szalonek, who remains faithful to sonoristic ideas till the present day, sonorism constituted at most only one of several stages in the artistic development of the above-listed composers. This stage took place in the 1960s and was subsequently superseded by new tendencies arising in opposition to the "avant-garde terror" of that decade. Such a temporally limited character was displayed by Penderecki's sonoristic style as well. Therefore the vague criterion of sonorism had repercussions in the unclearness of efforts to periodize his musical output.

The new inventory of Penderecki's atypical sound effects did not occur simultaneously in one piece but, as usually happens in art, was elaborated gradually, although in a comparatively short time. Therefore, even if the starting date of his sonorism was fixed around 1960, musicologists could not agree as to which particular piece launched the sonoristic period. Mentioned were *Threnody* (Zieliński 1975; Pociej 1980) and *Anaklasis* (Zieliński 1962). Yet sometimes the beginnings of sonorism were pushed back to as early as *Strophes* and the first version of *Dimensions of Time and Silence* (Schiller 1960). Tomaszewski (1994: 39-40, 94-97) dates sonorism from *Anaklasis* and *Threnody* but excludes from this period *Dimensions*, which—together with the *Psalms of David*, *Emanations*, and *Strophes*—in his periodisation form an earlier, pointillist phase of Penderecki's output.

Discrepancies of opinion occur even in remarks by the same author. Tadeusz A. Zieliński (1961) at first linked *Emanations* and *Strophes* together with *Fonogrammi* to "a neoimpressionistic current" in Penderecki's music, as opposed to the "expressive" current of *Anaklasis*, *Threnody* and *Psalmus*. Yet he subsequently called *Anaklasis* the "first piece of the 'new' style" in which Penderecki "carved out his own path and became independent of earlier compositional techniques" (1962: 318-319). Thirteen years later, Zieliński indicated *Threnody* as the beginning of the mature period, in which the composer "had shaped his original sound-world and discovered in it hitherto unknown sound and expressive values" (1975: 5). Still another and even more complex periodization is given by Bohdan Pociej in his article on Krzysztof Penderecki in *The New Grove*. For Pociej, the beginnings of "a period of intensive search and experiment for new sound" in Penderecki's early output are already manifest in the *Psalms of David* as well as *Strophes*, *Emanations* and *Dimensions*. Particularly those two latter pieces "illustrate the richness of Penderecki's imagination with regard to variety of timbre, while the *Threnody* for 52 strings (1960) shows a new tendency towards formal unification. The evolution and crystallization of his concept of form can be followed in other works of 1960-62, of which *Polymorphia* is the most fully and perfectly achieved example" (1980: 350). German authors were much more consistent in their opinions, locating the initial border of Penderecki's sonorism in *Anaklasis* (Huber 1971; Borris 1975). Yet this definitiveness sprang not from a better scientific criterion for defining sonoristic style, but rather from extramusical reasons: it was closely connected with the fact that *Anaklasis* was the first of Penderecki's works that had been performed—and with great success—in Germany.

Defining the end point of Penderecki's sonorism constituted no less a problem for investigators and commentators. Clearly, *Stabat Mater* for unaccompanied choir (1963) and even more the *St Luke Passion* (1963-66), in which the former was finally included, started a new period of great vocal works that referred back to traditional musical language and took up archetypal themes of Western culture. (This new period found its continuation in *The Devils of Loudun*, *Dies irae*, *Utrenia*, and *Cosmogony*.) Therefore the early phase of sonorism in Penderecki's output was usually seen as ending with the two pieces immediately preceding his "turn to tradition": *Fluorescences* and *Canon* (Borris 1975; Schwinger 1989; Zieliński 1962). The former work was called "the end-point of his sound-color technique" (Borris 1975: 611) or "the balance-sheet of his experimental years", the latter phrase referring to the composer's own words in the program notes for the premiere of the piece at the 1962 Donaueschingen Music Days (Schwinger 1989: 140). In later monumental works, however, whose overall idea seemed to move far away from the previous fascination with pure sound, the effects elaborated in earlier pieces were still preserved. Moreover, Penderecki wrote, at the same time, numerous pieces that obviously continued the sonoristic style: *Capriccio* for oboe and strings (1964), *De natura sonoris no. 1* (1966), *Capriccio* for violin and orchestra (1967), *De natura sonoris no. 2* (1971) and *Partita* for harpsichord and chamber orchestra (1971). The coexistence of earlier traits of his musical language and new extramusical ideas caused Penderecki's output from those years usually to be considered not as homogenous or making up any uniform period of his artistic development, but rather as one of several, simultaneously proceeding threads of the composer's evolution. Consequently, it was usually further subdivided; yet these divisions varied again from author to author. In Zieliński's view (1975), the milestones of Penderecki's output in that period, and at the same time the most representative works of its consecutive phases, were the *Passion* (1963-66), *Utrenia* (1969-71), and *Magnificat* (1973-74). In turn, Mieczysław Tomaszewski, in his most comprehensive periodisation of Penderecki's output, divides those years into two phases: a "phase of *Passion*" in the years 1965-70, embracing also *Dies irae*, *Utrenia* and *The Devils of Loudun*, then a "phase of *Magnificat*", as well as *Ecloga* and *Canticum canticorum* composed in the years 1970-75 (Tomaszewski 1994: 40).

The clear decrease in atypical sound effects began with *The Awakening of Jacob* (1973). Thus, this piece is commonly acknowledged as the most remarkable turning point in the whole of Penderecki's output to that time, the one which first reflected the composer's fascination with post-romantic aesthetics and in which his musical language entirely changed (Droba 1978). Therefore it also marks the ultimate border of sonorism. Obviously, works written after 1975—such as the First Violin Concerto (1976-77), *Paradise Lost* (1976-78), *Christmas Symphony* (1979-80), *Te Deum* (1979-80) and the *Polish Requiem* (1980-84)—no longer have anything to do with the sonoristic style of the early 1960s.

4. IN SEARCH OF A SYSTEM

The common view of sonorism obviously stood at variance with what one knew about Penderecki's compositional procedures. During a discussion summarizing the first seminar devoted to Penderecki—held in 1975 at his home Music Academy in Cracow—the composer himself described those procedures as follows:

> At the initial stage of writing a piece, when I have not yet found the language with which I will operate, I ponder the schema—the architecture—to such an extent that actually I *draw* the piece. I put it together from graphical elements which are for me provable in music. . . . The graphic logic proves true in musical logic. It constitutes a kind of abbreviation which allows me to 'see' the piece. My first contact with a piece is thus drawing its form, then searching and finding a language, and at last— giving a work its final shape. ([Discussion] 1976: 30)

A style in which the point of departure was constituted by a well-considered architectonic schema of a work could hardly be called anti-intellectual, and a musical form lying at the beginning of a compositional process was definitely not secondary to the sound material that occurred only at its end.

It is not surprising that studies of Penderecki's compositional technique which mirrored the common view of his music were found highly unsatisfactory by some music theorists and musicologists, who persisted in searching for the "philosophers' stone" of Penderecki's sonorism—an underlying system of rules that governed the choice and arrangement of sound effects in individual pieces. The keynote of all those persistent inquiries—undertaken quite independently and with varying success— involved the common question, which later on, and in reference to Penderecki's entire (not only sonoristic) output, was raised by Mieczysław Tomaszewski:

> How does it happen? What does it consist in?—that in spite of the almost programmatically assumed heterogeneity of material and resources, in spite the use of a method in their arrangement and stratification which almost deliberately purposes them to 'be astonished at one another', along with the experience of the piece there occurs in us the feeling of musical coherence in the work's text, its wholeness and fullness? . . . What is the principle that in Penderecki creates what the theorists of literature call the 'coherence of the text'? (Tomaszewski 1983: 7)

The point of Penderecki's technical regulations had long seemed to consist in contrasts between several types of sound material. Such contrasts, which otherwise concerned different aspects of sound as well as processes of sound generation, were indicated mainly in descriptive analyses of sonoristic works, where they enabled a segmentation into a limited number of clearly delineated sections. As the most universal contrast occurring in almost all sonoristic pieces, one remarked on the contrast between a "sound" in the sense of a harmonic tone characterized by a definite pitch, on the one hand, and a "noise" on the other (Borris 1975: 611; Schwinger 1989: 124, 129). In the course of the same discussion that ended the Cracow seminar, which had brought forth Penderecki's significant revelation of his compositional habits (quoted above), the crucial importance of this opposition was insisted on by Mieczysław Tomaszewski and Krzysztof Droba. However, the opinion of the composer himself was negative. In reply to such suggestions, he expressed it quite clearly: "For me the distinction between noise and sound has never existed" ([Discussion] 1976: 46). Still, the attention of investigators was also attracted by several other oppositions, such as "softness" and "hardness" (Schwinger 1989: 132), "the level" and "the punctuated" (Schwinger 1989: 138; Huber 1971: 87), or just by oppositions of instrumental groups, such as the strings and percussion in *Anaklasis* (Huber 1971; Schwinger 1989: 137). Zieliński (1961), in his remarks on *Threnody*, divided its sound material into three groups—"the highest possible notes on a given instrument", "sound clusters", and "new ways of articulation"—and indicated contrast as the main principle of their coexistence within the work (17). Discussing *Psalmus*, he wrote: ". . . the form of the piece is constituted by a series of contrasting sections of two types: (a) long sounds or clusters of different timbre and register, (b) rapid, rhythmical passages of changing timbres" (18).

The very concept of contrast, which constituted the essence of the above, *ad hoc* hypotheses, valid merely in individual pieces, also lay (either tacitly or explicitly) at the bases of the few theoretical attempts to elucidate the general premises of Penderecki's compositional thinking and thus to provide analytical tools applicable to a larger set of his sonoristic pieces.

Tadeusz A. Zieliński: theory of "sound shapes"

Already in 1962, in the article "Der einsame Weg des Krzysztof Penderecki" (The Solitary Way of Krzysztof Penderecki) published in the German *Melos*, Zieliński dared to call Penderecki's sonoristic style "a revolutionary yet logical and consistent musical language, a special sound-world, which develops according to its own natural laws, similar to the case of the classical style" (318). This opinion followed from the conviction that "Penderecki's striving for new sounds is no goal in itself; it would be unfair for one to see in his work only an interesting catalogue of new sounds. The value of his work lies in the manner in which those means (new sounds) are put to appropriate compositional use and in how they shape his music. . . . Penderecki's compositional ability reveals itself, first, in the filling and shaping of a vertical space, that is to say, in the choice of sounds of various shapes (*Gestalt*) and widths, as well as in the superimposition of various levels of sound (a peculiar kind of 'polyphony'); second, his compositional ability shows itself in the shaping of the temporal trajectory (its order and form)" (322).

The notion of a "sound shape" (*Klanggestalt*, *Gestalt des Klanges*), introduced here and subsequently appearing in the 1966 text, "Neue Klangästhetik" (New aesthetics of sound) by the same author, is systematically elaborated in his article of 1968, "Technika operowania instrumentami smyczkowymi w utworach Krzysztofa Pendereckiego" (The technique of employing stringed instruments in pieces by Krzysztof Penderecki). This last article deals with six works from the years 1960-1962 either assigned to stringed instruments only (*Threnody—To the Victims of Hiroshima*, String Quartet, *Polymorphia*, *Canon*) or in which strings play the leading role (*Anaklasis*, *Fluorescences*). Sound shape is defined here as an elementary unit of Penderecki's sonoristic pieces defined by the distribution of the sound material in musical time and space.

> On account of these two dimensions we introduce the notion of *sound shape*, which is determined by its length and width as well as (in the case of single sound lines) by the periodic character of the course of the line. In reality these two parameters—the length of a sound (cluster or line) and the width of a cluster or the course of a line—have a purely musical sense: the former is delimited by time, the latter by pitch. (79)

The individual sound shapes placed in such a two-dimensional space are thus considered analogous to geometrical objects:

> The geometrical terminology which is used here by contract is not accidental, since it is connected with the way [Penderecki's sonoristic] music is perceived and with the essential significance of its elements. When the twelve-tone scale and the intervallic order fall down, what comes into prominence is perception of a plastic type, e.g., perceiving acoustical phenomena somewhat similarly to the way visual phenomena are perceived. (79)

Zieliński specifies three basic types of sound shapes: lines, bands, and points. For the first of these types, represented by long-lasting tones, the crucial question is whether they keep a constant pitch or move within the musical space. If the latter takes place, glissando arises as "one of most fundamental means of determining the sound shape" (80). In turn, different sorts of glissandi are distinguished according to their direction, speed, and whether they take a regular or irregular course. The significance of this sound effect and its multifariousness in Penderecki's sonoristic style, observed by several critiques, thus finds in Zieliński's article a theoretical background.

Band, as the second basic sound shape, is identified by Zieliński with the cluster, a phenomenon also widely discussed by earlier commentators and here assimilated to a theory. Of course, like single tones, clusters can change their positions within musical space by means of glissando. Of no lesser importance for the diversification of clusters, is their width and density. The width can be altered either by adding or subtracting instruments when "an instrument playing one tone (and forming a horizontal line) is joined consecutively by several others which enter in quarter-tone distances" or again by glissando movement leading outwards "from a unison . . . towards such a width, in which every musician must play a different pitch" (87). The latter method obviously implies a parallel change of density, that is, of a distance separating adjacent component pitches. A special type is that of the "intra-glissando cluster" (*klaster wewnątrzglissandowy*), though the name should instead be "intra-cluster glissando", because it consists of activity within a given registral band: "in the given width of a cluster, all the musicians perform glissando upwards and downwards, of course not simultaneously, but every one on his own account and at any speed, and this way they fill the cluster with a dense, mobile sound mass" (87).

The third and last type of sound shape is represented by points. In the case of strings, points are produced mainly by means of several, more or less atypical instrumental techniques—such as striking *legno battuto*, plucking *pizzicato*, tapping with the fingertips or with the nut of the bow—that produce momentary impulses.

In his article, which outlines a worthy theory of Penderecki's sound shapes, Zieliński does not confine himself to simply enumerating them. Rather, his interest also extends to the way the composer manipulates them in his sonoristic pieces. Thus, several different sound shapes can be stratified within the same section of a piece, whereby the characteristic "layered texture" of Penderecki's sonorism arises.

> The notion of 'sound layer' is here a counterpart of the notion of a 'voice' in polyphonic texture. Layer is a course of one line, one cluster, or one series of short tones. Beside it, there occur simultaneously other layers, which poses the problem of their arrangement according to rules of counterpoint proper for this material. Mostly, the layers juxtaposed vertically are of similar timbre and shape, which contributes to the clear segmentation of the form evolving according to rules of different sound transformations of the piece, but there also occur places in which layers of entirely different structures, and contrasting with each other, proceed in tandem. (89)

In this way, the concept of contrast is arrived at. As a matter of fact, contrasts are implied already by the very discrimination between several types of sound shapes, but only in the end of the article do they occur explicitly in Zieliński's theory, as an important factor of formal thinking in Penderecki's sonoristic style, a factor that concerns both the vertical arrangement of sound shapes within one section and the succession of several consecutive sections. According to Zieliński, "the principle of contrast actualized by contrasting sections of extremely different timbre and sound shape" plays the crucial role in building the overall form of sonoristic pieces, on a level with "evolutionary passages consisting in gradual changes of articulation, namely—in the more and more frequent occurrence of means which have not occurred previously, and which in the end seize the entire course. . . . These two principles—those of contrast and of evolution, obtained by the very diversity of sound values—serve to shape the form of Penderecki's pieces" (91-92).

Krzysztof Droba: hierarchy of formal factors

The next attempt to grasp the technical rules of Penderecki's sonorism was undertaken, independently of Zieliński's theoretical proposal, by Krzysztof Droba. Droba, at that time a representative of the youngest generation of Polish music theorists, advanced his views in a 1976 paper entitled "Hierarchia czynników formalnych w twórczości Krzysztofa Pendereckiego" (The hierarchy of formal factors in Krzysztof Penderecki's output), presented during the eventful seminar in Cracow. Though very brief, this text shows already a quite systematic and highly interesting theory of sonoristic form as built in four levels.

In Droba's opinion, the basic formal factor, that marks the most detailed level of sonoristic pieces by Krzysztof Penderecki, is a "*model*, or a defined sound structure that builds up a texture by means of operations such as multiplication and transformation. One can discern: (1) basic models, (2) variants of basic models, (3) families of models (basic models and their variants)" (22-23). What the author means by "model" is a sequence of sound events assigned to a single instrumental part and forming a pattern intended to be repeated several times in the course of a given musical section. Every model is thus defined by its component sounds or sound effects, as well as by their succession within a pattern. The simplest operation to be done upon such a model is permutation, which leads to a change in succession, while the set of sounds involved in it is preserved.

> Basic models are those which become a pattern of transformations mostly of a permutative character. Structures which arise as a result of such transformations are variants of basic models. (23)

As one can see, labeling one sequence a basic model and other sequences its variants is always a matter of convention, since one can obtain the latter by way of permutative transformations of the former, or the former by way of permuting of one of the latter which are derived from it.

Changing the set of sound effects proper for a given sequence, one goes beyond the reach of one model. However, if this change is rather slight, the new basic model remains akin to the original one, and hence both of them belong to the same family of models.

> Several basic models (together with their variants) displaying a structural affinity (several basic models which are not in model-variant relation) form families of models. (23)

Models occurring together with their variants and assigned to different instrumental parts within the same temporal section build up its texture. Hence, "the formal factor superior to the model is *texture*—a musical structure arising as a result of operations made on the textural model. One can discern homogeneous and heterogeneous textures. Homogeneous textures can be further subdivided into simple and complex ones. Simple homogeneous textures are effects of permutation made on one basic model together with its variants. Complex homogeneous textures arise as results of transformations concerning a family of several basic models. In turn, heterogeneous textures emerge from models belonging to different families" (23).

The formal level of Penderecki's sonoristic pieces superior to a texture is that of *formal sections*, which constitute separated formal parts, each of them arising through a succession of textures, be they of homogeneous (simple or complex) or of heterogeneous type. According to the character of changes brought about by consecutive textures and thus to the sort of kinship relating their basic models, "one can discern three types of formal sections: (1) progressive, (2) static, (3) regressive. Progressive formal sections will be called such sections in which the textures are submitted to addition, multiplication, structural complication. Formally static sections are sound structures in which the textures are not submitted to qualitative changes. Regressive sections are those in which textures are reduced, simplified, declining. In this view, the *form* is the sum of formal sections" (23).

The relations between formal levels forming the hierarchy of an individual piece are summed up by Droba in the following figure:

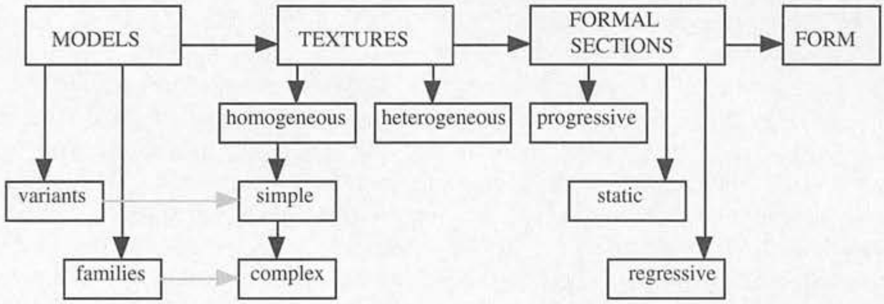


Figure 1

At the end of his article, Droba makes some interesting remarks on the direction which a possible, future theory of Penderecki's sonoristic style might take:

> The hierarchy of formal factors enables to create a theory of textural models. Such a theory would be based on formulation of rules governing the functioning of models, and its point of departure would constitute the detailed typology of models. This typology could be shown, for instance, in a table in which the ordered set of all theoretically possible models would be presented. On the basis of the typology of models one could, in turn, deal with investigation of their functions as well as functions of families of models, and hence formulate some conclusions of a general stylistic nature. (28)

Such an investigation was never undertaken, however, by Droba himself, or by any other Polish musicologist or music theorist.

Krzysztof Bilica: contrasts liberated (1)

In the theoretical approaches by Zieliński and Droba, contrasts are only tacitly acknowledged as relating different sound shapes, in the case of the former, as well as different textures and textural models, in the case of the latter author. They do come into prominence in the 1974 article, "*Ofiarom Hiroszimy—Tren*. Próba analizy jednego z aspektów utworu" (*Threnody—To the Victims of Hiroshima*: An Attempt at the Analysis of a Single Aspect of the Piece). This article was excerpted from the master's thesis by another young Polish musicologist, Krzysztof Bilica. The theory elaborated here, although applied to one piece, is highly systematic and clearly intended to elucidate the peculiarities of Penderecki's sonoristic style in general. Thus it decidedly strays from the loose observations mentioned at the beginning of this chapter and formulated by several authors merely for the sake of individual analyses.

Investigating parameters of the sound material in *Threnody*, Bilica introduces new terms, of which the most important are: "hipsophonics" (*hipsofonika*) as the entirety of problems concerning pitch; "dynamophonics" (*dynamofonika*) concerning dynamics; "chromaphonics" (*chromafonika*) referring to the sound colour; and "chronophonics" (*chronofonika*) dealing with duration of sounds. Apart from those terms, the author distinguishes also "chronoaphonics" (*chronoafonika*), which concerns duration of rests treated here as "non-sound or inter-sound phenomena"; "chronics" (*chronika*), defined as the temporal arrangement of sounds; as well as "topics" (*topika*), i.e., their arrangement in the physical space of the concert hall. Analysis carried out according to these parameters reveals that some of them are organized by means of oppositions whose terms, alternating in the course of the piece, result in contrasts between adjacent sections. This is the case of hipsophonics based on the alternation of two techniques by which the sound material is manipulated by the composer: "the technique of the simultaneous arrangement of pitches bringing about clusters" and "the technique of successive arrangement of pitches resulting in pointillist effects" (54). In turn, dynamophonics is ruled by the opposition between loud and soft sound phenomena, and chronophonics by the opposition of "relatively long" and "relatively short" sounds (65).

The significance of this theoretical proposal lies in the fact that the concept of contrast is here transposed from the level of musical units onto that of their underlying parameters. From Bilica's perspective, both sound shapes and textures are to be seen as formations of the hipsophonic and chronophonic material, possibly completed also by the chronoaphonics and chronics.

Henri Chiarucci: contrasts liberated (2)

At first glance, Bilica's analysis of *Threnody* bears a resemblance to the slightly earlier analysis of *Fluorescences* elaborated by Henri Chiarucci in his "Essai d'analyse structurale d'oeuvres musicales" (Essay on the Structural Analysis of Musical Works, 1973). Here also, the course of the piece is investigated according to its several "profiles", each of them being fixed by a single opposition. Among the full list of 23 oppositions distinguished by the author, such as "low/high" (*grave/aigu*), "ordered/unordered" (*ordonée/desordonée*), "rough/smooth" (*grain/lisse*), "stabile/ changeable" (*fixe/varié*), "mechanic/natural" (*mecanique/naturel*), "sustained/momentary" (*tenu/ ponctuel*) or "thick/thin" (*epais/mince*), one also finds "discontinuous/continuous" (*discontinu/ continu*), *forte/piano*, and "long/short" (*longue/court*), analogous to those observed in *Threnody* as characteristic of its hipsophonic, dynamophonic, and chronophonic material (38).

Despite this seeming similarity, Chiarucci's approach, which arose in the circle of the Paris Groupe de Recherches Musicales de l'ORTF, results from thoroughly different assumptions. As the title of his article says, it does not claim to discover any regularities of the compositional technique proper for Penderecki's sonorism and employed consciously by the composer, as Bilica does, who at this point follows Zieliński and Droba. Instead, Chiarucci attempts to construct an analytical method which he intends to be applicable to several pieces by different artists, with the aim of disclosing regularities that persist behind the varied compositional procedures. This is exactly why, apart from Penderecki's *Fluorescences*, Chiarucci demonstrates this method also on *Carré* by Karlheinz Stockhausen.

Particularity of the present approach

This last point separates Chiarucci's project not only from the three theoretical attempts discussed earlier, but also from the one presented in this book. It must be emphatically stressed that the sonoristic system discussed in the following chapters is claimed to constitute not a universal method of analysis, but rather the compositional method by means of which Penderecki consciously shaped his sonoristic pieces. Of course, the reconstruction of that method also furnishes one with analytical tools. Yet those tools are proper exclusively for investigating the *poietics* of Penderecki's sonoristic pieces, in the sense attached to this concept by Jean-Jacques Nattiez (1990). These tools do not preserve their validity in application either to the remaining output by the same composer nor to any other musical styles. Consequently, the present approach continues in the direction of the earlier theoretical approaches by Zieliński, Droba, and Bilica.

Also preserved is the central position of contrasts, which really lie at the basis of Penderecki's sonorism, though here taking the strictly logical shape of binary oppositions. Even so, the scope of the investigation below considerably surpasses that of the attempts made by the three Polish authors (discussed above) to discover and describe the technical rules of Penderecki's sonorism. That those attempts failed to change the common view on that style was chiefly because of their incompleteness. Those studies were carried out only in short articles that indicated some individual traits of Penderecki's compositional thinking in chosen aspects of works, without linking them together into a coherent system, one which would be able to account for the whole richness of sound phenomena in Penderecki's music of the early 1960s. Nor were they supported by analyses of any significant number of pieces. In fact, all of those studies are to be treated much more as theoretical proposals or intuitions demanding further elaboration, rather than complete theories properly speaking.

By contrast, the present book aims to reveal that the technique in question is not a loose assembly of compositional devices, occurring here and there, and organizing individual parts or sections of a few works. Rather, it will be shown that Penderecki's compositional method constitutes a rigorous system of interrelated rules that display high logical precision and rigidity, and that govern thoroughly the entirety of the composer's sonoristic output. Part One describes that system as an atemporal, synchronic set of abstract invariants comparable to "language" (*langue*), in the terminology of the great Swiss linguist and semiologist, Ferdinand de Saussure. The overall system consists of two component subsystems of relative independence: basic system and timbre system. The generative grammars of these two subsystems are presented, respectively, in Chapters 5.1 and 5.2, which contain a discussion of their elementary structures, morphology, and syntax. Chapter 6 investigates the articulation of individual categories by means of the orchestral resources used by Penderecki in his sonoristic pieces.

Part Two is devoted to the way in which concrete pieces—commensurate with the Saussurean level of "speech" (*parole*)—as utterances (or musical texts) of Penderecki's sonorism are generated by the system. There, the analyses of sonoristic works by Krzysztof Penderecki follow the previously defined categories as relevant and constitutive for this style (Chapter 8); in so doing, and unlike hitherto existing analyses, they have not merely a descriptive, but also an explanatory character. Comparison between states of the system in individual pieces will, in turn, allow one to investigate its evolution and trace back its origins in Chapter 10, which in Saussure's terminology constitutes the equivalent of a diachronic survey (as opposed to the synchronic investigation in Part One).

Because the commonly held view of Penderecki's sonorism is founded on the conviction that it is devoid of any specific technical regulations, the detection of sonorism's underlying compositional system should have important consequences, and require a new formulation of the specific traits of this musical style, one that accounts for its historical position. Therefore, in the Conclusion the opinions of previous commentators and investigators of this style, discussed earlier in this book, will be revisited, as regards sonorism's aesthetics (Chapter 14), its position in relation to some other contemporary styles and currents of twentieth-century music (Chapter 15), as well as the precise delineation and standing of sonorism in the Krzysztof Penderecki's entire musical output (Chapter 16). Finally, Penderecki's sonoristic style will also be considered in the context of structuralism—the most influential intellectual trend of the time (Chapter 17). It is precisely there where the title of this book will find its justification.

PART ONE

SYSTEM *(Langue)*

5.1. BASIC SYSTEM

5.1.1. ELEMENTARY STRUCTURES

The basic system of Krzysztof Penderecki's sonoristic style concerns three of the four parameters of auditory perception: pitch, loudness, and time. On those parameters the following binary oppositions are founded, as elementary structures of the system :

perceptual parameters	perceptual categories		
	+		-
pitch	spatial continuity spatial mobility high register middle register	vs. vs. vs. vs.	spatial discontinuity spatial immobility low register extreme register
loudness	loud dynamics	vs.	soft dynamics
time	temporal continuity temporal mobility maximal time-span	vs. vs. vs.	temporal discontinuity temporal immobility minimal time-span

The above-listed oppositions constitute the basic categories of Penderecki's sonoristic style. As such, they are comparable to phemic categories of linguistic systems fixed by binary oppositions between distinctive features, their opposite terms being, in turn, equivalent to phemes (i.e., distinctive features themselves).[1]

The way that categories operate within the system in question is contingent upon their inner logical structures. To gain insight into those structures, one needs to transfer the perceptual and, as such, subjective categories into an objective realm, and to define them at the stage preceding perception in their proper channel of communication. As in the case of language, this is necessary because "in order to decode the message, its receiver extracts the distinctive features from the perceptual data. The closer we are in our investigation to the destination of the message, the more accurately we can gauge the information conveyed by the sound-chain" (Jakobson and Halle 1956: 33-34). Therefore the musical distinctive features that ground Penderecki's sonorism are to be portrayed on acoustic parameters of frequency, intensity, and objective time, as the closest physical

[1] Both "pheme" and "phemic category" are terms established by Greimas and Courtes in their analytical dictionary *Semiotics and Language*. As is said there, "B. Pottier has suggested the use of the term 'pheme' to designate the distinctive feature of the expression plane, in contrast to the seme, a feature of the content plane. . . . A pheme is nevertheless only the end term of the relation which constitutes a 'phemic category'" (Greimas and Courtes 1982: 232).

correlates of pitch, loudness, and subjective duration.[2] This task will be accomplished by means of mathematical set theory, more precisely the theory of so called "fuzzy sets". To do so, however, is not to claim that in elaborating his compositional method Penderecki had recourse to mathematics. Rather, it seems that he took for granted the natural logical properties of individual categories. Instead, the claim here is only that the description of those properties, which is indispensable in the attempt to reconstruct his system theoretically, can be made most adequately by means of those mathematical tools.

As will be shown, the binary oppositions listed above take shape as either contradiction or contrariety, which in turn makes them again similar to binary oppositions between linguistic distinctive features. Therefore, prior to their definitions, a short discussion of those two types of opposition will be given. Individual categories will then appear as particular cases of a given type of opposition, and sharing its general characteristics.

Contradiction

Contradiction is an opposition between a sentence s and its negation ~s:

$$s \quad \text{vs.} \quad \sim s$$

In classical two-valued logic, contradictory sentences cannot be both true or both false. If the sentence s is true, its negation ~s must be false; if the sentence s is false, its negation ~s must be true:

$$v(s)=1 \Leftrightarrow v(\sim s)=0$$

Contradiction can thus be modelled as a relation between a set S and its complement X\S in space X. If X is an interval [y, z], it can be represented graphically as follows:

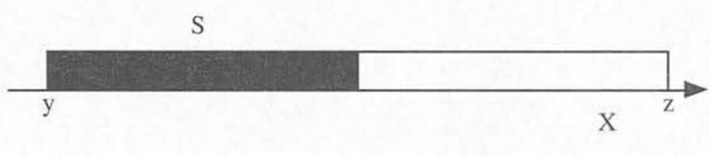
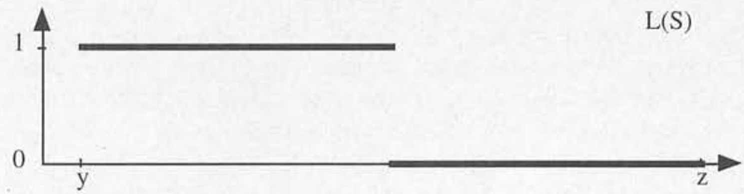


Figure 2

The logical value of sentence s can be interpreted as a "characteristic function" of set S. In other words, as a function $L(S)$: $X \rightarrow L$ of the set X into a set $L=\{0,1\}$ such that for every element x belonging to S its characteristic function $L(S)(x)$ takes value 1, and for every element x not belonging to S its characteristic function $L(S)(x)$ takes value 0. The function $L(S)$ skips between values 0 and 1, which means that one can accurately discern between elements of the set S and its non-elements. Set S and its complement X\S are thus ordinary sets.

[2] As is known, every perceptual parameter as an attribute of sound sensation is contingent on several acoustical parameters. E.g., loudness is dependent not only on intensity but also on frequency; pitch depends to some extent on intensity; and in both, duration is also involved. However, those interdependencies do not call into question the fundamental and essential link which exists between frequency and pitch, intensity and loudness, as well as subjective and physical time (see Spender 1980: 397).



$L=\{0,1\}$
$x \in S: L(S)(x)=1$
$x \notin S: L(S)(x)=0$

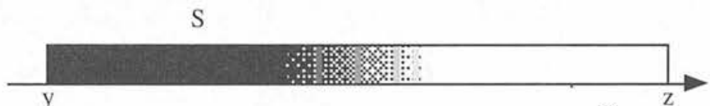
Figure 3

In the structural linguistics of Jakobson, contradiction is a type of opposition that characterizes the so-called inherent distinctive features: voiced vs. voiceless, nasal vs. oral, vocalic vs. non-vocalic, consonantal vs. non-consonantal, compact vs. diffuse, tense vs. lax, discontinuous vs. continuant, strident vs. mellow, checked vs. unchecked, grave vs. acute, flat vs. plain, sharp vs. plain. The common property of this group of features is that they are absolute and do not demand contrast—i.e., the occurrence of opposite terms in adjacent phonemes—to be discerned as such.

> The recognition and definition of an inherent feature is based only on the choice between two alternatives admissible in the same position within a sequence. No comparison of the two polar terms co-occurring within one context is involved. Hence, both alternatives of an inherent feature co-exist in the code as two terms of an opposition, but do not require a contrasting juxtaposition within one message. (Jakobson and Halle 1956: 26)

However, the absolute character of inherent features is only a theoretical idealization. Jakobson acknowledges that in reality—and because of contextual variations—they are relational and discernible only in mutual contrast (see Jakobson 1989, 1: 235). This is so because distinctive features are not physical acoustic categories, but perceptual ones; as such they are subject to the rules of human auditory perception. One of those rules is that the recognition of a difference between any values of a given acoustic parameter is possible only if this difference exceeds some liminal value (i.e., a value of so-called "just noticeable difference"; henceforth abbreviated as "j.n.d"). Subliminal differences are not perceived by the receiver, and hence sound phenomena differing less than the j.n.d are treated in perception as identical. In turn, the liminal value as a rule cannot be precisely determined, because it is always an individual property varying from one listener to another and, moreover, is conditioned by several circumstances of the act of auditory perception as well as by remaining sound parameters (see Spender 1980: 397-401).

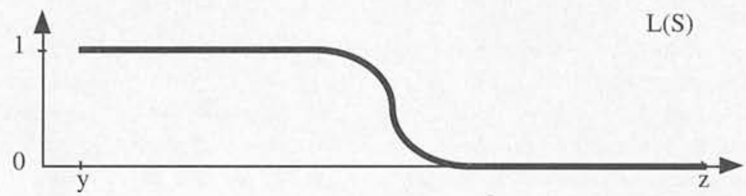
Applied to the relation of contradiction discussed above, this rule means that, for a sound phenomenon whose value x in respect of a given acoustic parameter is sufficiently close to the border value between sets S and X\S, it might be impossible for the listener to decide unequivocally whether or not it belongs to set S. Consequently, different decisions will be made, contingent upon different circumstances of a given act of auditive perception. As the classification of such a value x to set S is doubtful, set S is a so-called "fuzzy set", characterized by the property that its elements are not unequivocally discernible from non-elements.



$X=[y, z]$

Figure 4

In this way, the concept of contradiction between properties of auditive perception goes beyond classical logic, and into the area of so-called fuzzy logic, as a case of broader field of multivalued logic (see Dubois and Prade 1980). As can be seen in Figure 4 above, the borderline between S and X\S is turned into a zone whose elements are neither unequivocally included in nor excluded from S, and for which the characteristic function of set S takes values between 0 and 1. More precisely, the fuzzy set is a function L(S): X→L, where L is nöt a two-element set L={0, 1} but an interval L=[0, 1]. L(S), changing between its liminal values 0 and 1, shows the probability with which elements of space X are recognized as belonging to set S:



L=[0,1]

Figure 5

Values taken by function L(S) enable one to define the terms of every opposition based on the relation of contradiction in fuzzy logic. Such terms are modelled by intervals staked out in space X. Among them, it is essential to discriminate between (1) opposite terms forming the proper binary opposition and (2) mediative terms, with the mediation of an opposition understood as the situation of an equal presence or absence of opposite terms.

Opposite terms:

- positive term (+): an interval containing values x undoubtedly classified as elements of S, i.e., for which L(S)(x)=1;
- negative term (-): an interval containing values x undoubtedly classified as non-elements of set S, i.e., for which L(S)(x)=0.

Mediative terms:

- simple atemporal mediative term, i.e., a border-zone term (*): an interval containing elements doubtful in respect of whether they are elements or non-elements of set S, i.e., for which 0<L(S)(x)<1;
- complex atemporal mediative term (±): an interval forming the sum of both opposite terms, i.e., containing values x for which L(S)(x)=1 or L(S)(x)=0;
- total atemporal mediative term (❒): an interval forming the sum of both opposite terms and the border-zone term, i.e., containing values x for which 0≤L(S)(x)≤1. Such an interval is thus identical with the total space X.

Clearly, the three basic terms of every category based on the model of contradiction in fuzzy logic are opposite terms and the border-zone term. Since they constitute components of space X and exhaust its whole range, all of them will be called "simple terms". On the other hand, the complex mediative term and the total term arise as sums of individual simple terms. It is noteworthy that all the above-listed terms are represented by intervals which, like set S itself, are also fuzzy.[3]

Still, mediation between opposite terms of a given category can proceed processually as change, leading from one term to the other. In contrast to the above-listed atemporal terms, the processual ones involve time, and hence will be called "temporal mediative terms". There are two of them:

- simple temporal mediative term, i.e., transition ($\rightarrow$): a change of value x such that the values L(S)(x) change accordingly between 0 and 1; or vice versa:

$0=L(S)(x_0)\leq L(S)(x_1)\leq L(S)(x_2)\leq\ldots\leq L(S)(x_n)=1$

or

$1=L(S)(x_0)\geq L(S)(x_1)\geq L(S)(x_2)\geq\ldots\geq L(S)(x_n)=0$

If the parameter represented by x is not temporal, the transition can be both continuous (Fig. 6a) or discontinuous (Fig. 6b). Otherwise, for temporal parameter x there exists only a discontinuous variation of the transition process:

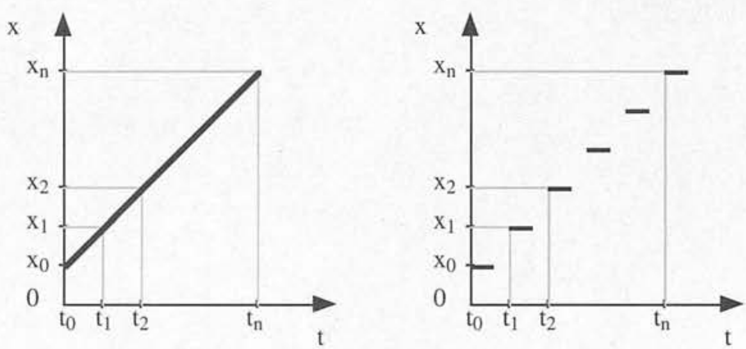


Figure 6a

Figure 6b

- complex temporal mediative term, i.e., interpenetration: this occurs when values x classified univocally as elements of set S—i.e., representing a positive term of a category (L(S)(x)=1)—and those classified as non-elements of set S—i.e., representing a negative term (L(S)(x)=0)—occur simultaneously but their ratio changes in a given interval of time. As the number of elements representing one of the terms increases, the number of those representing the other term decreases.

All of the above-mentioned terms exist in all categories of Penderecki's basic system, grounded on the relation of contradiction in fuzzy logic and discussed below. For the sake of compactness, however, only the simple terms of every given category will be indicated, for to know them also means to know all the other terms as their different configurations. As will be seen, in some categories individual terms occur in different versions. This fact does not deny affiliations of such categories to the above-discussed logical model; rather, in each case it brings subarticulations of this model which spring from the specific character of individual categories.

[3] It is an effect of so-called "secondary fuzziness". If those intervals were not fuzzy, it would be possible to delineate precisely set S, which thus would constitue not a fuzzy but an ordinary set.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY

This is an opposition between individually discernible pitches and bands, i.e., between points and sections on the perceptual axis of pitches. Two complementary definitions of this opposition on the acoustic level exist, such that spatially continuous phenomena must comply with both, whereas spatially discontinuous ones may comply with either of them.

(1) Perception of an individual pitch arises when the width (the result of the highest and lowest of simultaneously occurring frequency values) is sufficiently small, that is, when the value of that result does not exceed some liminal value above which a sound phenomenon is perceived as a band. The acoustical parameter x of the discussed category is thus a result of the highest and the lowest of simultaneous frequencies, and its space X constitutes an interval [0, z], where z is a value of maximal frequency result possible within a musical piece.[4] In this space, spatial discontinuity is modelled by a fuzzy set constituting a neighbourhood of point 0 and spatial continuity by a complement X\S:

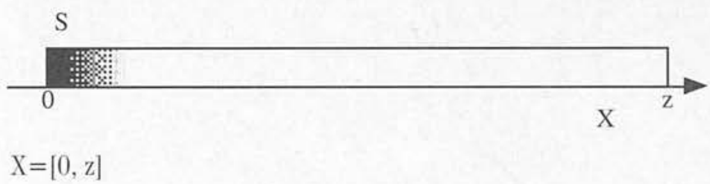


Figure 7

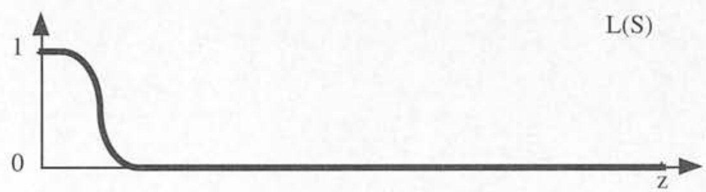


Figure 8

(2) A given sound phenomenon is perceived as a band and its individual pitches are not discernible, if its density (which is the result of neighbouring and simultaneously occurring frequencies) is close to zero, i.e., smaller than a liminal value above which a perception of individual and separate pitches arises. The second acoustical parameter y of the category under discussion is thus a result of neighbouring concurrent frequency values. Since the very notion of neighbouring values assumes that they must be different, zero must be excluded from the space Y of this parameter, which is thus an interval (0, z], z being the maximal frequency result possible within a musical piece.[5] In this space, the spatial continuity is thus a property of sound phenomena whose value y belongs to a fuzzy set P as a neighbourhood of point 0. Values of y belonging to its complement Y\P are vested in the spatially discontinuous sounds:

---

[4] Value z is contingent upon the ranges of musical sound generators, which can vary in different pieces and, of course, on the range of audible frequencies, a range which is an individual characteristic of every human being. Since it is indeterminate, the space X itself constitutes a fuzzy set.

[5] See the previous note.

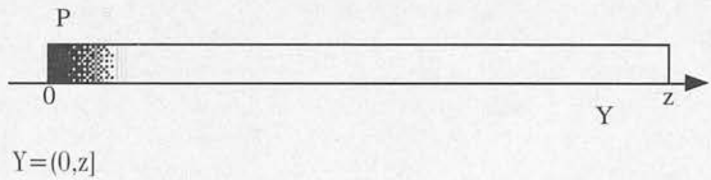


Figure 9

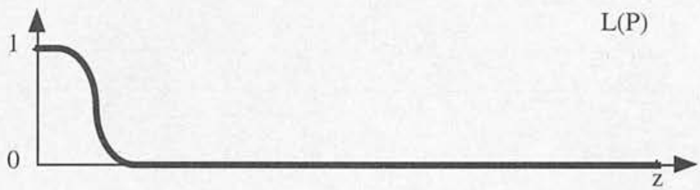


Figure 10

Terms:
- positive term (+): $L(S)(x)=0$ and $L(P)(y)=1$;
- negative term (-):
  version 1: $L(S)(x)=1$
  version 2: $L(P)(y)=0$.
- border-zone term (*):
  version 1: $0<L(S)(x)<1$
  version 2: $0<L(P)(y)<1$
- transition (→):
  version 1: $0=L(S)(x_0)\leq L(S)(x_1)\leq L(S)(x_2)\leq\ldots\leq L(S)(x_n)=1$
  or $1=L(S)(x_0)\geq L(S)(x_1)\geq L(S)(x_2)\geq\ldots\geq L(S)(x_n)=0$
  version 2: $0=L(P)(y_0)\leq L(P)(y_1)\leq L(P)(y_2)\leq\ldots\leq L(P)(y_n)=1$
  or $1=L(P)(y_0)\geq L(P)(y_1)\geq L(P)(y_2)\geq\ldots\geq L(P)(y_n)=0$

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY

Opposition between temporal continuity and temporal discontinuity is a relation between lasting sounds (sections) and momentary impulses (points) on the temporal axis in auditive perception. As with the previously discussed opposition between continuity and discontinuity in the spatial dimension of music, two complementary definitions of contradictory concepts may be given for the acoustic level:

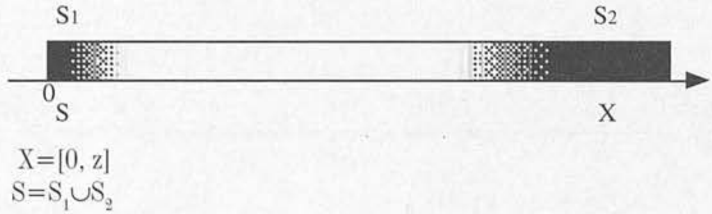


Figure 15

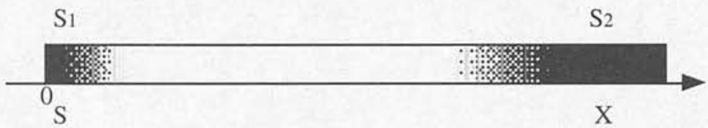
Figure 16

Terms:
- positive term (+): $L(S)(x)=0$;
- negative term (-): $L(S)(x)=1$
  version 1: $L(S_1)(x)=1$
  version 2: $L(S_2)(x)=1$.
- border-zone term (*): $0<L(S)<1$
  version 1: $0<L(S_1)(x)<1$
  version 2: $0<L(S_2)(x)<1$;
- transition (→):
  version 1: $0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq \ldots \leq L(S_1)(x_n)=1$
  or $1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq \ldots \geq L(S_1)(x_n)=0$
  version 2: $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq \ldots \leq L(S_2)(x_n)=1$
  or $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq \ldots \geq L(S_2)(x_n)=0$

TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY

Temporal mobility is a perception of a non-identity relationship between different, separate and successive sounds, i.e., of a change of their position on the axis of subjective perceptual time, in traditional terminology known as a "rhythm". It arises when the time-span between consecutive sound phenomena exceeds some liminal value below which they would be perceived as simultaneous or as phases of one lasting sound, i.e., in identity relationship. On the other hand, their time-span cannot exceed an upper liminal value above which they would not be mutually related: as events without any reference to each other, that is to say, belonging to distinct perceptional zones.

The acoustical parameter x of the opposition is thus a time-span between onsets of successive sounds. Since obviously any time-span value of successive sounds must be bigger than zero, the space X of the discussed category is an interval (0, z], where z means the maximal time-span value possible between sounds within one musical piece.[10] In this space, temporal immobility constitutes a property of those sequences of sound phenomena whose time-span takes values belonging to an unconnected fuzzy set S, consisting of neighbourhoods of zero (S_1) and of the maximal value z (S_2). Temporal mobility occurs when the time-span value belongs to the complement X\S:



$X=(0, z]$
$S=S_1 \cup S_2$

Figure.17

Figure 18

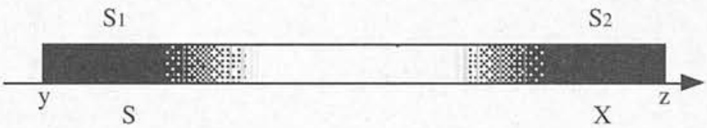
Terms:
- positive term (+): $L(S)(x)=0$;
- negative term (-): $L(S)(x)=1$
  version 1: $L(S_1)(x)=1$
  version 2: $L(S_2)(x)=1$
- border-zone term (*): $0<L(S)<1$
  version 1: $0<L(S_1)(x)<1$
  version 2: $0<L(S_2)(x)<1$;
- transition (→):
  version 1: $0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq\ldots\leq L(S_1)(x_n)=1$
  or $1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq\ldots\geq L(S_1)(x_n)=0$
  version 2: $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq\ldots\leq L(S_2)(x_n)=1$
  or $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq\ldots\geq L(S_2)(x_n)=0$

[10] Since this value is indeterminate, space X itself forms a fuzzy set.

MIDDLE REGISTER VS. EXTREME REGISTER

A given sound phenomenon is perceived as representing an extreme register when its frequency is sufficiently close to the limits of the range of audible frequencies, i.e., when it belongs to peripheral zones. On the other hand, a perception of a middle register is characteristic of sounds of frequency values that take a central position within this range.

The acoustical parameter x of the category is thus frequency. The space X representing the range of audible frequencies is modelled by an interval [y, z], where y and z are respectively the highest and the lowest frequency values accessible to human hearing.[11] In this space extreme registers are represented by an incoherent fuzzy set S consisting of a neighbourhood S_1 of the lower limit y and of a neighbourhood S_2 of the upper limit z, whereas the middle register is represented by a complement X\S:



$X=[y, z]$
$S=S_1 \cup S_2$

Figure 19

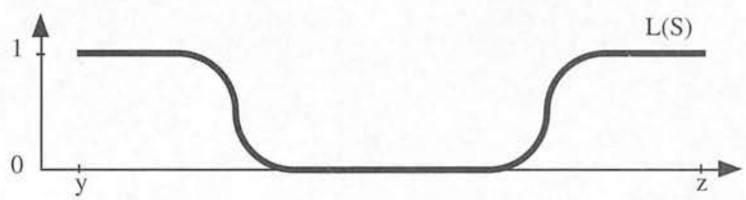


Figure 20

Terms:
- positive term (+): $L(S)(x)=0$;
- negative term (-): $L(S)(x)=1$
  version 1: $L(S_1)(x)=1$
  version 2: $L(S_2)(x)=1$.
- border-zone term: $0<L(S)<1$
  version 1: $0<L(S_1)(x)<1$
  version 2: $0<L(S_2)(x)<1$;
- transition ($\rightarrow$):
  version 1: $0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq\ldots\leq L(S_1)(x_n)=1$
  or $1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq\ldots\geq L(S_1)(x_n)=0$
  version 2: $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq\ldots\leq L(S_2)(x_n)=1$
  or $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq\ldots\geq L(S_2)(x_n)=0$

[11] As one knows, that range is not univocally delineated in itself. Though it is commonly assumed that the lowest tones accessible to the human ear are of approximately 15 Hz frequency and the highest ones

Contrariety

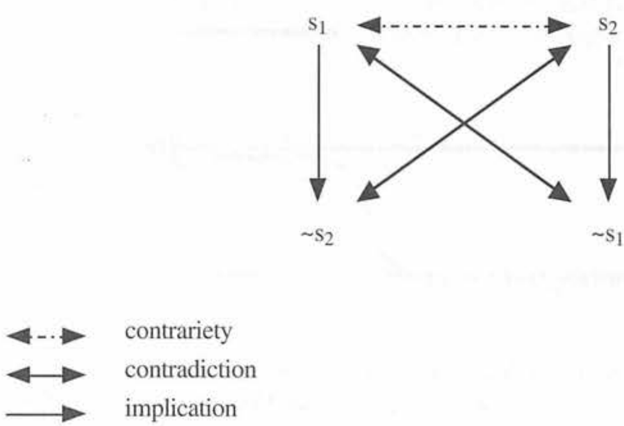
Another type of logical opposition is that of contrariety constituting a relation of two positive logical sentences:

$$s_1 \text{ vs. } s_2$$

which in classical two-valued logic meet a condition that they cannot both be true, though both can be false. This means that, if sentence s_1 is true, then sentence s_2 must be false. Conversely, if sentence s_2 is true, sentence s_1 must be false:

$$v(s_1)=1 \Rightarrow v(s_2)=0$$
$$v(s_2)=1 \Rightarrow v(s_1)=0$$

As consisting of two positive sentences, each of them possessing its negation, contrariety is a more complicated type of opposition. It presupposes relations of contradiction and of implication. The mutual connections between those logical relations are summarized in the so called "logical square":



In terms of set theory, contrary sentences s_1 and s_2 can be interpreted as sets S_1 and S_2, which constitute neighbourhoods of the polar limits of an interval $X=[y, z]$:

$S_1 \subset X \setminus S_2$
$S_2 \subset X \setminus S_1$
$S_1 \cap S_2 = 0$
$X \setminus (S_1 \cup S_2)\ \ 0$

Figure 21

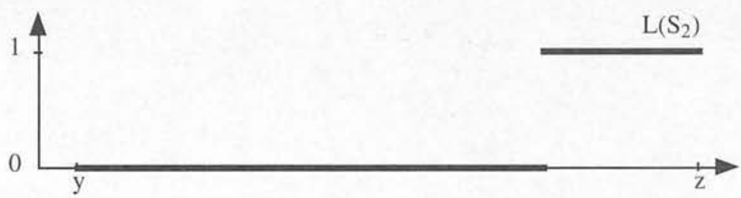
---

maximally of 16 kHz, those values vary for individual listeners. Moreover, the upper limit is age-dependent. Children can hear tones in excess of 16 kHz, but people over 60 years of age cannot normally hear tones above 10 kHz (see Beament 1980: 419). Therefore values of y and z cannot be univocally fixed and the interval X itself is a fuzzy set in the axis of frequencies. The fuzziness of interval X is aided by the fact that, in music, it also depends on the ranges of instruments.

Because both sets are ordinary, i.e., with a clear distinction between their elements and non-elements, their characteristic functions $L(S_1)$ and $L(S_2)$: $X \rightarrow L$ of set X into set $L=\{0, 1\}$ alternate between values 0 and 1:

$L=\{0,1\}$

Figure 22



$L=\{0,1\}$

$L(S_1)(x)+L(S_2)(x)=0$ or $L(S_1)(x)+L(S_2)(x)=1$

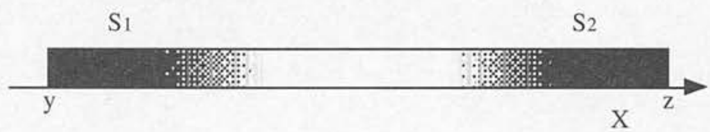
Figure 23

In phonological theory by Jacobson and Halle, contrariety characterizes binary oppositions between prosodic features: high vs. low, strong vs. weak, long vs. short. However, when describing those oppositions, both authors stress their relativeness, which sometimes causes the absolute value of parameters to differ strongly for the same term. In that case, the same value may represent different opposita in different contexts, whereby recognition of those features requires them to be embodied into two adjacent segments of speech as a contrast:

> Any prosodic feature is based primarily on the contrast between two variables within the same time sequence: the *relative* voice-pitch, voice-loudness or duration of a given fraction is determined with respect to preceding and/or succeeding fractions. . . . Tone level, or tone modulation, stress degrees or its decrescendo (*stosston*), are always purely relative and highly variable in their absolute magnitudes from speaker to speaker, and even from one utterance to another in the usage of the same speaker. Also the quantity of a vowel may be established only in relation to the quantity of the other vowels within the context or to the subsequent consonants (consonant feature), while the absolute duration of the long or short vowels in the given language presents a considerable vacillation in speed, depending upon the speech-habits of the speaker and his expressive variations of tempo. (Jakobson and Halle 1956: 25)

The reason for the relational nature of prosodic features is primarily that concepts such as "high" and "low", "long" and "short", or "strong" and "weak" are logically indistinct, so that there is no clear borderline between elements and non-elements of the sets that represent them. Within a given range of frequencies one will always discern such values, which are definitely high, definitely not high, and doubtful. Similarly, one will discern definitely low tones, definitely not low tones, and doubtful ones. In a given interval [y, z] constituting a space X, they can only be indicated as neighbourhoods, i.e., sets of values sufficiently close to its limits. Yet, it is impracticable to determine univocally the range of "sufficiently close values", whereby both neighbourhoods S_1 and S_2 form most typical examples of "fuzzy sets". Moreover, the fuzziness of the contrariety relationship, in cases of the binary oppositions under consideration, is also affected by the properties of perceptual processes discussed in the previous paragraph.[12]

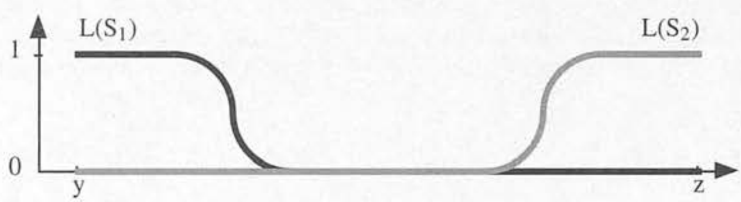
Contrariety represented by relations of "fuzzy sets" is thus a type of opposition in the area of fuzzy logic, and can be generalized graphically as follows:



$X=[y, z]$

Figure 24

Characteristic functions $L(S_1)$ and $L(S_2)$: $X \rightarrow L$ of set X into set $L=[0,1]$, and expressing the logical value of both sentences, thus change between 0 and 1, showing the disposition of probability with which individual values x are classified as belonging to S_1 or S_2 respectively:



$L=[0, 1]$
$0 \leq L(S_1)(x)+L(S_2)(x) \leq 1$

Figure 25

Again, as in the case of contradiction, on the ground of values taken by functions $L(S_1)$ and $L(S_2)$ one can delineate terms of every category based on the model of contrariety in fuzzy logic as intervals of space X. Again also, they are themselves fuzzy sets in that space.

Opposite terms:

- negative term (-): an interval containing all values x undoubtedly classified as elements of set S_1, i.e., for which $L(S_1)(x)=1$;

- positive term (+): an interval containing all values x undoubtedly classified as elements of set S_2, i.e., for which $L(S_2)(x)=1$.

---

[12] Also the range of an interval X, representing the space of a given contrariety (i.e., the values of its limits y and z), can be variously determined. E.g., the range of frequencies accessible to an adult man differs considerably from that accessible to a boy or woman. In a similar way, they can also differ for individual speakers within one group and even for one and the same speaker in different utterances (see Jakobson and Halle 1956: 25). Hence the space X itself forms a fuzzy set within the space of all possible values of a given parameter, which is sound frequency in the case given.

Mediative terms:

- simple atemporal mediative term, i.e., neutral term (0): an interval containing all values x undoubtedly classified as non-elements of S_1 and non-elements of S_2, i.e., for which $L(S_1)(x)+L(S_2)(x)=0$;

- complex atemporal mediative term (±): an interval forming a sum of both opposite terms, i.e., for which $L(S_1)(x)=1$ or $L(S_2)(x)=1$;

- total atemporal mediative term (❒): an interval identical with the whole space X, i.e., for which $0\leq L(S_1)(x)+L(S_2)(x)\leq 1$.

- single temporal mediative term, i.e. transition (→): a change of value x such that values $L(S_1)(x)$ change gradually from 0 to 1, and values $L(S_2)(x)$ change gradually from 1 to 0, or vice versa:

$0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq\ldots\leq L(S_1)(x_n)=1$
and $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq\ldots\geq L(S_2)(x_n)=0$

or:

$1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq\ldots\geq L(S_1)(x_n)=0$
and $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq\ldots\leq L(S_2)(x_n)=1$

As in the case of transition in categories based on the model of contrariety, both continuous (Fig. 26a) and discontinuous (Fig. 26b) variations of this process exist only when a parameter of a given category is not temporal. Otherwise, only a discontinuous variation of transition is accessible:

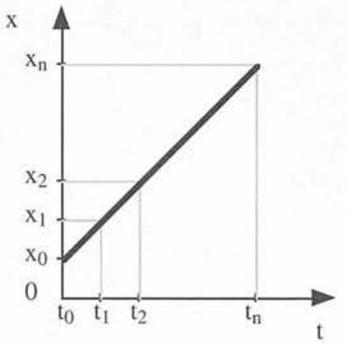


Figure 26a

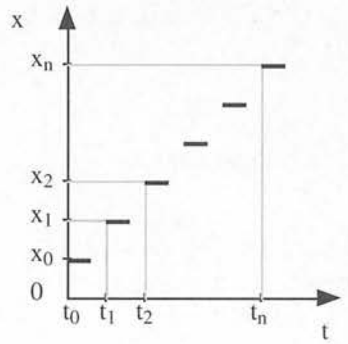


Figure 26b

- complex temporal mediative term, i.e., interpenetration: this occurs when values x classified univocally as elements of set S_1 (i.e., representing a negative term of the category ($L(S_1)(x)=1$)) and those classified univocally as elements of set S_2 (i.e., representing the positive term of a category ($L(S_2)(x)=1$)) occur simultaneously, but their ratio changes in a given interval of time. As the number of elements representing one of the terms increases, the number of those representing the other decreases.

HIGH REGISTER VS. LOW REGISTER

A sound is perceived as belonging to a high register when its frequency is sufficiently close to the highest frequency value accessible to human hearing. On the other hand, a perception of low register is a characteristic of sounds whose frequency is sufficiently close to the lowest audible frequency.

The acoustical parameter x of the discussed opposition is thus frequency, and its space X constitutes an interval [y, z] representing the range of audible frequency values.[13] In this space, low register is modelled by a fuzzy set S_1 as a neighbourhood of the lower limit y of the interval [y, z], and high register by a fuzzy set S_2 as a neighbourhood of the upper limit z:

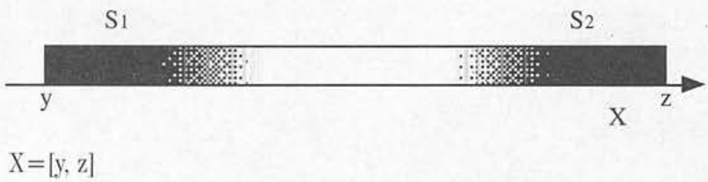


Figure 27

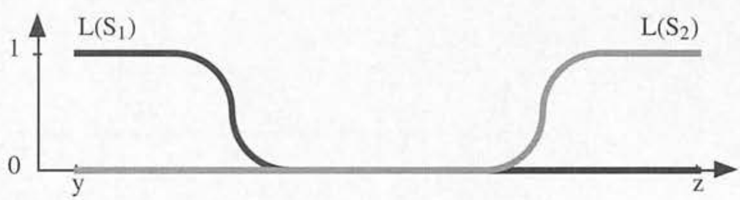


Figure 28

Terms:
- negative term (-): $L(S_1)(x)=1$
- positive term (+): $L(S_2)(x)=1$
- neutral term (0): $L(S_1)+L(S_2)=0$
- transition (→):
  $0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq\ldots\leq L(S_1)(x_n)=1$
  and $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq\ldots\geq L(S_2)(x_n)=0$

or:
  $1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq\ldots\geq L(S_1)(x_n)=0$
  and $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq\ldots\leq L(S_2)(x_n)=1$

[13] See note 11.

LOUD DYNAMICS VS. SOFT DYNAMICS

A perception of loud dynamics arises from sound phenomena whose intensity value is sufficiently close to the pain threshold, whereas quiet dynamics characterizes sounds of intensity sufficiently close to the threshold of audibility of human hearing.

The acoustical parameter x of this opposition is intensity. Its space X forms an interval [y, z], y and z representing thresholds of audibility and pain respectively.[14] A soft dynamic is to be modelled as a fuzzy set S_1 constituting a neighbourhood of the lower limit y, and loud dynamics by a fuzzy set S_2 as a neighbourhood of the upper limit z of interval X:

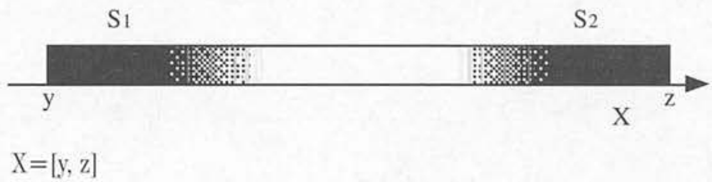


Figure 29

Figure 30

Terms:
- negative term (-): $L(S1)(x)=1$
- positive term (+): $L(S2)(x)=1$
- neutral term (0): $L(S1)+L(S2)=0$
- transition (→):
  $0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq\ldots\leq L(S_1)(x_n)=1$
  and $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq\ldots\geq L(S_2)(x_n)=0$

or:
  $1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq\ldots\geq L(S_1)(x_n)=0$
  and $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq\ldots\leq L(S_2)(x_n)=1$

[14] Like the range of frequency, also the intensity range is not univocally stated. It varies mainly with frequency and duration of sound as well as with individual capabilities of listeners (capabilities that display significant differences in respect of intensity). Therefore the interval [y, z], as the space X of the category "loud vs. soft dynamics", itself forms a fuzzy set.

MINIMAL TIME-SPAN VS. MAXIMAL TIME-SPAN

The acoustical parameter x of this category is a time-span between the onsets of two successive sound phenomena. Yet, a perception of a time-span between two different sounds arises only when the physical time-span value exceeds a liminal value, i.e., a threshold of discernibility below which two sounds would be perceived as simultaneous or fuse into one lasting sound phenomenon. Space X, containing all possible values of x within this category, forms thus an interval [y, z], where y is a liminal value of the threshold of discernibility and z is the time-span value maximal within a musical piece.[15] In this space, the minimal time-span as the negative term of the discussed category is represented by a fuzzy set S_1, which forms a neighbourhood of the lower limit y of the interval X; the maximal time-span is represented by a fuzzy set S_2 as a neighbourhood of the upper limit z of the interval X:

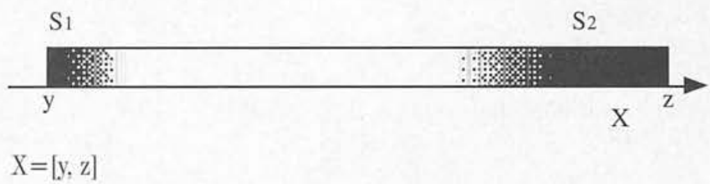


Figure 31

Figure 32

Terms:
- negative term (-): $L(S_1)(x)=1$
- positive term (+): $L(S_2)(x)=1$
- neutral term (0): $L(S_1)(x)+L(S_2)(x)=0$
- transition (→):
  $0=L(S_1)(x_0)\leq L(S_1)(x_1)\leq L(S_1)(x_2)\leq ...\leq L(S_1)(x_n)=1$
  and $1=L(S_2)(x_0)\geq L(S_2)(x_1)\geq L(S_2)(x_2)\geq ...\geq L(S_2)(x_n)=0$

or:
  $1=L(S_1)(x_0)\geq L(S_1)(x_1)\geq L(S_1)(x_2)\geq ...\geq L(S_1)(x_n)=0$
  and $0=L(S_2)(x_0)\leq L(S_2)(x_1)\leq L(S_2)(x_2)\leq ...\leq L(S_2)(x_n)=1$

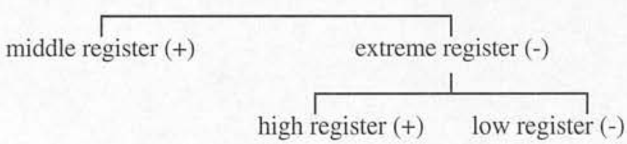
[15] See note 8.

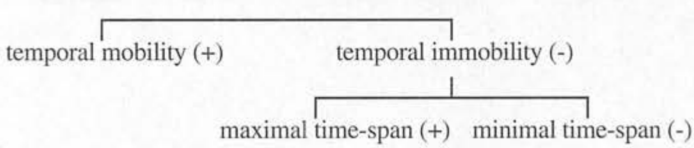
Formal incompatibilities

In principle, the categories of the basic system of Penderecki's sonorism are mutually independent, in so far as they have different acoustical parameters and, consequently, are defined in different spaces. If it is the case for a given pair of categories, then any term of one category can co-occur, i.e., is compatible with any term of the other.

Most combinable pairs of the above-discussed categories comply with this condition. However, there are exceptions. One is "extreme vs. middle register" and "high vs. low register", whose common acoustical parameter is frequency. Another exception is "temporal mobility vs. immobility" and "minimal vs. maximal time-span", which share a parameter that is an acoustical time-span value between onsets of successive sound phenomena. In either pair the former category represents the type of contradiction, and the latter the type of contrariety. What is more, fuzzy sets S_1 and S_2, modelling contrary concepts, are identical with subsets of an unconnected fuzzy set S representing one of the contradictory concepts.[16]

The just-described relationship linking categories of every pair is plainly of a hierarchical character. The superior category is constituted by contradiction, while the subordinate one is created by contrariety, the latter producing a further differentiation within the negative of the contradictory concepts:





The fact that, in every pair, the two hierarchically linked categories are defined within the same space causes their total mediative terms, identical with that space X, to be equivalent. Yet, the equivalence also connects individual intervals within that space, i.e., individual simple atemporal terms of those categories as well as their simple temporal terms, as shown in the following table:

[16] In case of the pair consisting of "temporal mobility vs. immobility" and "minimal vs. maximal time-span", set S_1, which represents a perception of minimal time-span, is slightly different from the equivalent subset of set S, which represents a perception of temporal immobility. This stems from the difference between spaces of both categories: while space X of the latter forms an interval (0, z], the former is defined in a space X as being an interval [y, z], where y signifies a time-span value that is sufficiently close to zero, and that is equal to the threshold of discernibility between successive sound phenomena. However, time-span values below y would occur only in a piece consisting of a single impulse performed by several instruments, or of one sustained sound—a situation that never happens. Normally, time-spans take always values from an interval [y, z] constituting space X of the category "minimal vs. maximal time-span". Therefore, the difference between spaces of both categories is purely theoretical and in practice, for the sake of simplicity, one can acknowledge an identity both of those two spaces and of their sets S_1.

Contradiction		Contrariety
negative term (version 1)	⇔	negative term
negative term (version 2)	⇔	positive term
positive term	⇔	neutral term
border-zone term	⇔	-
transition between versions 1 and 2 of the negative term	⇔	transition
transition (version 1)	⇔	*transition between neutral andpositive term*
transition (version 2)	⇔	*transition between neutral andnegative term*

One can see that the border-zone term of the contradiction has no equivalent in any term of its subordinated contrariety. This is why border-zone terms of categories "extreme vs. middle register" and "temporal mobility vs. immobility" do not occur in Penderecki's pieces. On the other hand, transitions between opposite terms of one of the hierarchically linked categories bring about a rise of new types of transition in the other (in italics). As regards the contradiction, such a new transition is that between two different versions of its negative term. In the category of contrariety there arise two new transitions proceeding between its neutral and one of opposite terms. Those types of transitions, not justified within their own categories as mediations of opposite terms, constitute side effects of such regular mediations in the other—superior or subordinate—category and, as such, result from the hierarchical link between them. The only exception—i.e., the only type of transition proceeding not between opposite terms but involving mediative ones, and not justified by any regular transition in the hierarchically linked opposition—is that between a middle register and the total sound space; that is, between the positive and total term of category "middle vs. extreme register" or between the neutral and total term of category "high vs. low register". This phenomenon has, however, its origins in the evolution of Penderecki's sonoristic style and, as such, will be explained only in Chapter 10.

Another case of equivalence occurs between terms of categories "minimal vs. maximal time-span" and "temporal mobility vs. immobility" on one hand, and "temporal continuity vs. discontinuity" on the other, the parameter of the latter category defined as the time-span between successive impulses. Even though it differs from the acoustical parameter of the two former hierarchically linked categories (which is the time-span between onsets of successive sound phenomena irrespective of their duration, i.e., whether they are momentary impulses or lasting sounds), this difference disappears in cases of very small time-span values. This is so because the very notion of successive phenomena implies that the preceding event must be cancelled before each consecutive event starts. Minimal time-span values thus also imply minimal duration values and hence momentary sound phenomena (impulses). Therefore, the negative term of category "maximal vs. minimal time-span" and its equivalent version 1 of the negative term of category "temporal mobility vs. immobility" (which presuppose time-spans close to the threshold of discernibility between successive sounds) are, in turn, equivalent to the border-zone term of the category "temporal continuity vs. discontinuity" in its second definition (i.e., version 2).

temporal mobility vs. immobility	maximal vs. minimal time-span	temporal continuity vs. discontinuity
negative term (version 1) ⇔	negative term ⇔	border-zone term

Apart from the interdependencies of different categories in Penderecki's basic system, which stem from their common acoustical parameter and take a logical shape of equivalence as a mutual implication between terms, there also exist a few other cases of interdependencies, in the form of ordinary, one-way implications. All of them involve transition and result from the temporal character of that mediative term. In the case of the hierarchically linked categories "high vs. low register" and "extreme vs. middle registers", transitions presuppose a change of frequency in time unit which is otherwise an acoustical parameter of "spatial mobility vs. spatial immobility" and, henceforth, imply a positive term of the latter opposition. Finally, the very notion of a continuous change of a given atemporal parameter, which is inherent to continuous variations of transitions, presupposes a long duration of a sound phenomenon, duration value constituting a parameter of the first definition of "temporal continuity vs. discontinuity". Therefore, a positive term of the category "temporal continuity vs. discontinuity" is implied by continuous transitions within oppositions "loud vs. soft dynamics", "high vs. low register", "extreme vs. middle register", "spatial continuity vs. discontinuity" and "spatial mobility vs. immobility". All those cases of implication are summarized in the tables below.

middle vs. extreme register high vs. low register	spatial mobility vs. immobility
transition ⇒	positive term

loud vs. soft dynamics middle vs. extreme register high vs. low register spatial continuity vs. discontinuity spatial mobility vs. immobility	temporal continuity vs. discontinuity
transition (continuous variation) ⇒	positive term

Obviously, the just discovered logical relations of implication and equivalence preclude some combinations of terms, thereby resulting in the phenomenon of incompatibilities. In the case of implication, an "implying" term of one category is incompatible with all terms of the other category except the "implied" one. In the case of equivalence, this incompatibility works in two ways, so that either of the equivalent terms is incompatible with all its non-equivalent terms of the other category. Such incompatibilities occurring between terms of the categories of the basic subsystem—resulting from logical dependencies between those categories and hence originating in their very nature—constitute formal incompatibilities of the system of Penderecki's sonoristic style.

5.1.2. **MORPHOLOGY**

On the paradigmatic axis, the categories established by binary oppositions discussed in the previous chapter account for the morphology of the basic system. This is so because a combinatory of their terms generates an inventory of units in Penderecki's sonoristic style. Each unit is thus a bundle of terms chosen from individual categories of Penderecki's sonorism and, as such, constitutes a musical counterpart of the linguistic phoneme as a bundle of distinctive features (phemes) chosen from phemic categories. Consequently, just as every phoneme can be completely defined by the distinctive features embodied in it, what is sufficient to define a given musical unit of Penderecki's sonorism is a specification of its component terms within individual categories. An example of such a definition is given in the following chart:

spatial continuity/discontinuity	+
temporal continuity/discontinuity	+
spatial mobility/immobility	-
temporal mobility/immobility	-
maximal/minimal time-span	+
middle/extreme register	+
high/low register	0
loud/soft dynamics	→

Figure 33

Because every category, from among eight categories of the basic system, is modelled by a one-dimensional space X (two pairs of hierarchically linked categories sharing the same spaces), the units of Penderecki's sonoristic style can be seen mathematically as objects in six-dimensional space, whose coordinates are the component terms. However, since those coordinates are not points, but intervals within spaces of their proper categories, it follows that the syntactical units of Penderecki's sonorism are not single sounds, but segments, i.e., sets of several individual sound phenomena. Even though there occasionally occur segments consisting of single sounds, they are thus to be treated as liminal cases of segments, in the same way as a set containing only one element forms a liminal set. Otherwise, not every segment is permitted to consist of only one sound phenomenon. One will return to this issue in Chapter 6, after a discussion of interdependencies between segments and their component sounds.

Since every segment is fully defined by its constitutive features expressed in terms of the basic system categories, a difference of even one category between combinations of terms defining two segments requires that such segments be considered as different. On the other hand, if two segments can be defined by the same configuration of component terms, they are identical; i.e., they form two realizations of the same unit, even if otherwise their sound contents display considerable differences. Thus, inasmuch as those differences do not threaten the constitutive terms, they are irrelevant for segments, which, like linguistic phonemes, constitute abstract invariants on the level of "language" (*langue*). Instead, they give occasion merely to several contextual variants of segments realized in concrete musical utterances on the level of "speech" (*parole*), i.e., in Penderecki's individual sonoristic works. It is noteworthy that, as the very characteristic of the syntactical units of Penderecki's basic system, so also the existence of their contextual variants originates on the acoustical level in the property of the component terms, which are represented not by points but by intervals of the acoustical parameters of individual categories. Hence they admit a number of different values as their realizations in a given musical event.

As long as syntactical units of Penderecki's sonorism are treated as primary, indivisible wholes, the only task practicable for an investigator is their sheer enumeration. Yet, because in such a case the relationships between units go undetected, such enumeration is, as a rule, far from being complete and well-ordered. This observation holds true in regards to earlier attempts made by German musicologists to inventory of *Klangflächen* in Penderecki's sonoristic pieces, and true as well of the typical "sound shapes" discussed by Tadeusz A. Zieliński and the textures enumerated in Krzysztof Droba's theoretical approach. Even though Droba wrote about families of textural models, the problem of affinities between individual textures could not be solved, since the similarities and differences between those textures were not defined. Those difficulties can be overcome by the theoretical position taken here, which defines a segment as a combinatory arrangement of terms. In contradistinction to the (obviously kindred) notions of *Klangfläche*, "sound shape" and "texture" discussed in earlier critiques, the notion of "segment" introduced in this book is conceived as a secondary construct, whereas the primary, elementary structures of Penderecki's basic system are individual categories set up by the binary oppositions. Such an organization of the basic system endows the compositional procedures in Penderecki's sonoristic style with economy, in that a small number of categories generates a high number of syntactical units, and is at the same time crucial for the analytical task undertaken in this book. Founding the definitions of segments upon the categories underlying the basic system of Penderecki's sonoristic style, one is able to make up a full list of segments and to exhibit their reciprocal logical relations. Both of those procedures result in a taxonomy of segments as syntactical units of Penderecki's sonorism.

If a segment is a combination of terms chosen from individual categories set up by binary oppositions, then the full list of segments must exhaust the possibilities of such combinations. As in the case of multi-element channels in every communication system, the number of segments as units possible in the framework of Penderecki's basic system depends on the number of elements and the quantity of their repertoire. In terms of information theory, this property of a given communication channel is called its "power" (Porębski 1986: 19):

$$N = r^m$$

m=elements
r=repertoire
N=number of units (segments)

In the terminology used in this book, the elements are to be redefined as perceptual categories constitutive of Penderecki's sonoristic style, whereas the repertoire is the inventory of terms accessible within every category. Thus if there were only two opposite terms available in each of the eight categories, and the individual categories were mutually independent, then the number of segments possible in Penderecki's sonoristic system would amount to 256:

$$N=2^8=256$$

The system in question could be graphically illustrated by a "rosette" showing opposite terms of all eight binary oppositions. Linkages indicating available combinations of terms would join together every two vertices of the rosette, except those symbolizing opposite terms of the same category, and the power of such a system would be equal to the number of octagons found in the rosette:

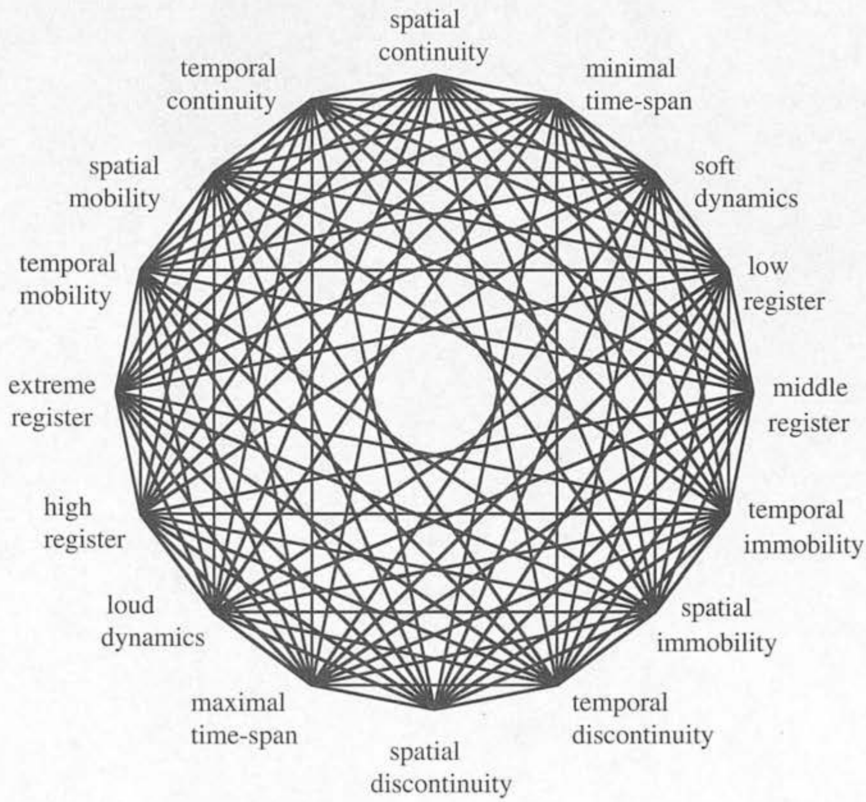


Figure 34

Yet, the number of possible segments must be lessened because of formal incompatibilities between terms of different categories. Such incompatibilities preclude combinations of "middle register" with either of the opposite terms of category "high vs. low register", "temporal mobility" with either of the opposite terms "minimal vs. maximal time-span" and, finally, "minimal time-span" with either of the opposite terms "temporal continuity vs. discontinuity". After elimination of the prohibited linkages, the segments available in the framework of the system would be represented in the rosette by all octagons containing the terms "maximal time-span", "extreme register" and "temporal immobility", all heptagons containing two of these terms, all hexagons containing one of them, and all pentagons containing none:

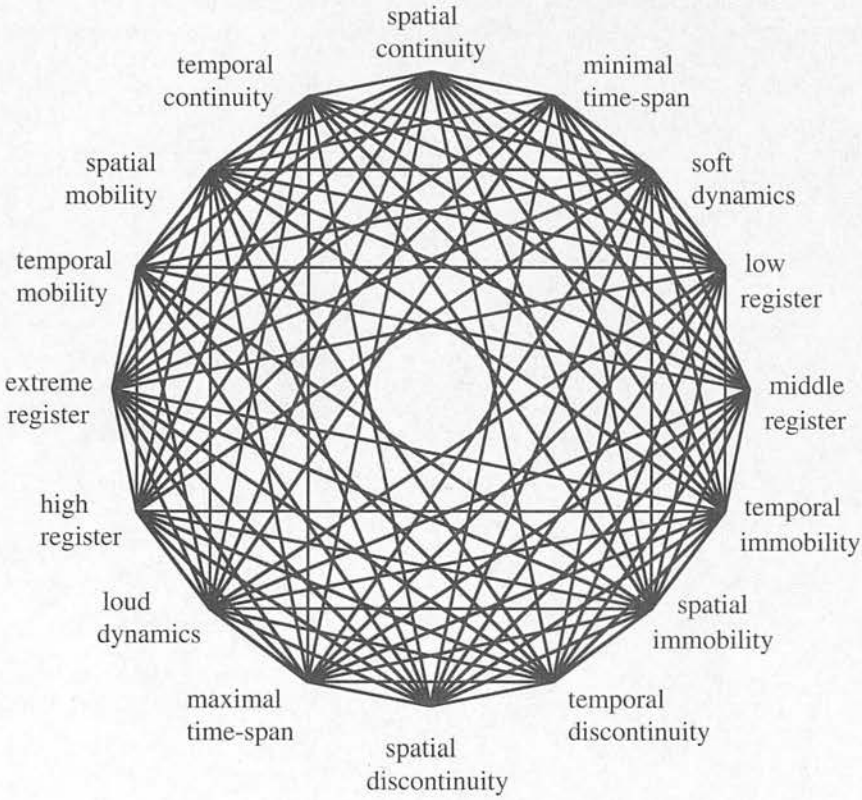


Figure 35

The definition of segments by means of terms chosen from individual categories of Penderecki's basic system also allows precise description of the paradigmatic relationships between segments. If a segment is a sum of terms, consequently the relation between any two segments constitutes a sum of relations between their component terms within their proper categories. Therefore, the similarity between given segments is higher, the more terms they have in common. The relationship between segments may also be read from the above rosette. Since every opposite term of any category forms its own vertex, the higher the number of common vertices between polygons, the closer the relationship of segments represented by them.

The rosette would constitute a full graphical representation of Penderecki's basic system if the only available terms within every category were, as in the phonological system, the opposite terms analogous to distinctive features of language. However, the analogy between the organization of the basic system of Penderecki's sonoristic style on the one hand, and phonological systems of natural languages on the other, ends here. As demonstrated in the previous chapter, in the framework of every category of the basic system there occur not only opposite, but also several mediative terms. From among the latter, any single segment can contain simple and total mediatives: a border-zone term of the categories based upon the model of contradiction, neutral terms of contrarieties, as well as a total mediative term and a transition in both logical types of binary oppositions. Not to be embodied into a single segment are thus only complex—atemporal and temporal—terms. In this way, the number of terms available within every category increases from two to five. Such an increase in repertoire results in the fact that, although the number of elements (i.e., categories) is constant, the number of possible segments constituting units of Penderecki's basic system exponentially increases, up to 390625:

$$N=5^8=390625$$

Even if the formal incompatibilities, including those between mediative terms, result in some reduction in the number of accessible segments, the remaining amount is still enormous.

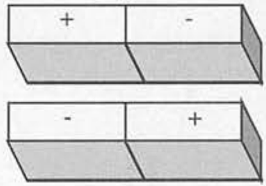
The inclusion of mediative terms not only increases the number of syntactical units, but also produces a significant complication of their paradigmatic relationships. This is so because the logical relations between terms in frameworks of individual categories can now take several, logically varied shapes: not only that between two opposita, but also between one of the opposite and one of the mediative terms, as well as between two different mediatives. In each case, the relationship between segments containing a given pair of terms is also different. Thus, the model of logical relations between segments of Penderecki's basic system is much more complex than in the case of phonemes in linguistic systems. As a result, an equal number of common terms shared by two segments does not predetermine an equal degree of similarity or difference between them. This situation can be easily apprehended on the basis of the definitions of individual categories (see previous chapter), but could hardly be shown by any graphical representation. As a matter of fact, the representation of a full taxonomy of segments in the basic system of Penderecki's sonoristic style is not crucial, since, out of the great number of all possible syntactical units, only some occur in pieces of his sonoristic period. As in other systems of communication, this is caused by so-called material incompatibilities—practical obstacles that preclude some logically permissible combinations of terms—and by redundancies, which compensate for the "noise" of a channel and which must occur if the communication is to be decoded by the receiver.

5.1.3. **SYNTAX**

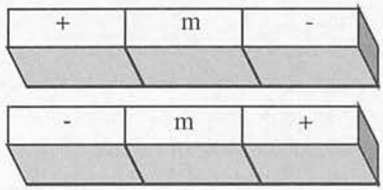
The same set of categories that on the paradigmatic axis underlies the morphology of the basic system, on the syntagmatic axis determines its syntax, i.e., the temporal order of segments in the course of a musical narration.

Terms of the same category embodied into segments form the trajectory of that category. In the framework of every trajectory, the succession of terms incorporated into its consecutive sections is allowed to assume a shape of sequences serving as either a presentation or a mediation of the binary opposition characteristic of a given category. Presentation of the opposition consists in a directly contrasting juxtaposition of its opposite terms in adjacent sections, while in the case of mediation, one or more mediative terms (m) is inserted between the opposita:

presentation:

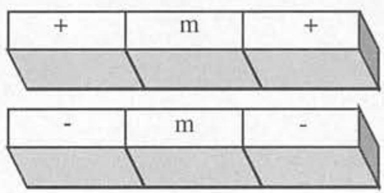


mediation:



Consequently, a prohibited type of succession in a trajectory is a return to an initial opposite term, be it positive or negative, after a mediative term or a chain of such terms has occurred.[17]

prohibited sequences:



Because terms of every category are embodied into segments, every occurrence of a new term in any category causes a change of segment. And, because the succession of terms within every trajectory is ruled by two of the above types of sequence, those types also govern the succession of Penderecki's syntactical units. Permissible successions of segments in the syntax of Penderecki's sonoristic pieces are only those whose component phemic sequences in sections of every particular categorial trajectory follow the two sequences given above, thereby constituting presentations and mediations of binary oppositions. On the other hand, prohibited are all those successions which in any single trajectory contain the last-mentioned, prohibited type of sequence.

The syntactical rules of Penderecki's sonoristic style thus eliminate some successions of segments. In this way, as do any rules whatsoever, they constrain the field of choices and decisions made by the composer. Yet, the restrictions imposed by those rules do not result in mechanistic compositional procedures, but leave ample room for artistic freedom. This is due to the fact that changes within trajectories need not be simultaneous. As one categorial difference enables a discrimination between two segments, a single change bringing about the slightest difference between neighbouring

[17] As regards the simple temporal mediative term (transition), its very definition derives from the fact that it proceeds between opposite terms of a given category. Therefore, even if inserted between two occurrences of the same term, be it positive or negative, the transition does not occasion the prohibited type of sequence. Generally, in the analyses of individual sonoristic pieces by Penderecki (Chapter 8), when a term preceding or following a given transition differs from the term constituting, respectively, its point of departure or of destination, the usual symbol for the simple temporal mediative term, which is an arrow (→), will be complemented, so as to show the direction of the transitional process in a given section of the trajectory; e.g., (+→-).

segments suffices to change any given segment. Of course, one can also move to a following segment by changing more trajectories. This means that the succession of syntactical units in the chain of a given sonoristic piece may involve segments of different degrees of kinship. The lower the number of trajectories in which change occurs at a given moment, the higher the affinity between adjacent segments on the paradigmatic axis and the smoothness of musical narration on the syntagmatic axis. By contrast, the higher number of changing trajectories, the less similar the segments and less fluent the course of the narration. Those two general types of strategies permitted by the syntax of Penderecki's basic system were aptly described by Tadeusz A. Zieliński (1968) as rules of "contrast" and "evolution". The latter might be considered as a sort of mediation: one which proceeds not on the elementary level between opposite terms of some category, but on the level of syntactical units between two contrasting segments mediated by several others, such that their sets of constitutive terms mark intermediary stages between the point of departure and the destination of such a mediating process.

Changes of terms in individual trajectories are touchstones of segmentation in a given piece. Since the number of changes taking place at the same moment between two adjacent segments can differ, the segmentation of Penderecki's sonoristic pieces displays a hierarchical organization. The higher the number of changing trajectories, the higher and hence more general the level of segmentation. Conversely, the lower number of changes, the lower and more detailed is the segmentational level in the hierarchy of a given work. It follows that the most detailed, lowest level of segmentation is that of single changes between segments. Of course, changes marking a particular level of segmentation can happen each time within a different trajectory or set of trajectories. However, a strong connection sometimes occurs between hierarchic levels of segmentation on the one hand, and trajectories on the other, so that some categories act mostly on lower and others on higher hierarchic levels. In such cases, one can speak of higher or lower level trajectories and of a hierarchy of categories in a piece or a given passage of music. As with the rules of contrast and evolution, the mutual assignments between the levels of segmentation and the categories, assumed for an entire piece or section thereof, are not determined by the syntax, but left as a space of free compositional choices. They are thus a matter of strategies elaborated by the composer on the basis of his system, and brought to bear in individual works.

In Penderecki's sonoristic style, every segment as a syntactical unit has some temporal size (duration); in other words, it has some range on the temporal axis of a work of which it constitutes a part. Thus, besides the kinship between adjacent segments, it is also the mutual relation of their ranges that exerts significant influence on the character of a musical narration in Penderecki's sonoristic pieces. This relation can take shape as succession, overlapping, or imposition.

(1) *Succession*, as the most common temporal relationship between segments, has received much discussion above. Since, according to the definition assumed in the previous chapter, segments are sets of terms chosen from individual categories of Penderecki's basic system, and because every change of segment necessarily entails the change of a term within one or more trajectories, succession as a temporal relation of ranges between segments implies that the same type of relation must also occur between two sections of at least one trajectory. Temporal ranges of those two sections exclude one another, so that the category is represented at any moment by one and only one term:

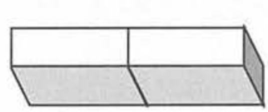


Figure 36

(2) *Overlapping* of segments presupposes that, within at least one trajectory, the temporal ranges of sections intersect. Consequently, two different terms of the same category occur simultaneously during some interval of time:

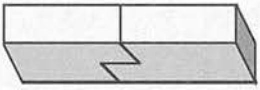


Figure 37

Provided the different overlapping terms are opposite ones, their simultaneous occurrence will bring about the complex atemporal mediative term of a given category (±), which is not accessible to single segments (discussed in the previous chapter), but can only be embodied into two different segments:

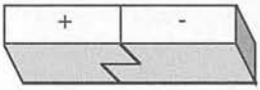


Figure 38

In the temporal course of any given segment, its sound content can undergo several changes. Yet, from the definition of a segment, it follows that as long as those changes do not affect its constitutive features (which are terms chosen from categories of a basic system), i.e., they do not cause a change within at least one trajectory, they cannot result in a change of segment and, consequently, have no bearing on the segmentation of a piece. Still, those changes can influence the character of musical narration when they concern the intensity of a given segment towards its beginning or end, and in this way affect its gradual emergence or decay. This can be caused either by means of orchestration (as an increase or decrease of the number of instruments) or by textural changes (as an increase or decrease of sound phenomena produced by the same set of instruments). Of course, such "softening" of a segment can occur in successive segments, yet without any conceptually interesting results. Nevertheless, if applied to overlapping segments containing opposite terms of some category or categories, such a procedure brings about a complex temporal mediative term—interpenetration—in at least one trajectory. This is so because the "soft", gradual emergence or decay of a segment has as its consequence a change of intensity with which its component terms appear.[18] While the intensity of one of the opposite terms in the previous segment gradually decreases, the intensity of the other gradually increases:

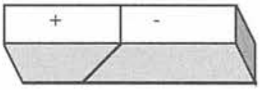


Figure 39

[18] Basically, changes in the number of sound phenomena during a segment do not affect its constitutive terms. However, such changes can have some impact on the categories "loud vs. soft dynamics" and "temporal mobility vs. immobility". When the sound phenomena are fewer, the dynamic level of a segment decreases. Similarly, a gradual increase in the number of sound phenomena in closer temporal distances can cause the impression of transition from temporal immobility to mobility (see Chapter 6). Yet, insofar as those changes are obviously caused by "softening" segments, they will not be interpreted as changes within trajectories.

(3) *Imposition* of segments can be total or partial. The former type of temporal relationship occurs between segments of equal ranges, such that their initial and final borders coincide. In turn, partial imposition implies that the ranges of superimposed segments are different, whence at least one of their borders is not in line. It is also possible for both beginning and end of the shorter segment to take place during the imposed, longer one. Transposition of these relations on the level of categories shows that, as with overlapping, the imposition of segments causes a simultaneous occurrence of different terms within at least one trajectory:

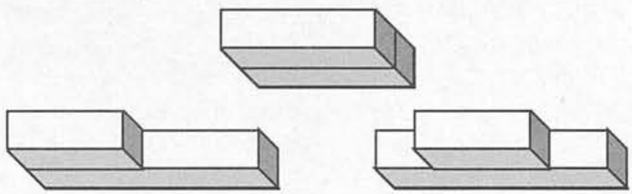


Figure 40

Of course, the simultaneously occurring terms of a given category can also be its opposite ones. Moreover, in each of the above situations of total or partial impositions, segments containing opposite terms of a given category can also be "softened" in their superimposed parts, in such a way that a decline of one is accompanied by a rise of the other. In those cases the intensity of one of the opposite terms decreases while that of the other increases. Yet, the simultaneous occurrence of both opposite terms within a trajectory, occasioned by segmental imposition, need not necessarily bring about a complex mediative term (±), be it atemporal or temporal. This is so because such a mediative term could cause a prohibited sequence of terms and, consequently, affect the course of a given trajectory. In the case of overlapping segments, a prohibited sequence could not arise, because both terms adjacent to the complex mediative one—the preceding and the following term—were univocally determined: the imposition of the positive and the negative term of a given category was preceded by one of them and followed by the other. Therefore the whole succession represents the type of sequence constituting a mediation of a binary opposition and, as such, is always permissible. And, because differentiating terms of both overlapping segments fuse into the same layer of their trajectory, those segments themselves belong to the same thread of the musical narration.

However, the simultaneous occurrence of opposite terms, which results from a total or partial imposition of segments, does happen in another context. In the case of total imposition, which presupposes an equality of temporal ranges of segments, the simultaneous occurrence of the positive and negative terms of an opposition can be preceded and followed by any of the opposite or mediative terms of a given category. Consequently, neither of its adjacent terms is determined here. As to partially imposed segments which coincide at one of their borders, one of the adjacent terms is free, the other always being determined as the positive or the negative term of a category. In both those cases, the coinciding opposite terms will fuse into a complex mediative term, be it temporal or atemporal, and both superimposed segments will be included in one thread of the narration only if the undetermined adjacent terms within a given trajectory are chosen so that a permissible succession of terms arises. Otherwise the terms remain divided between two layers of a trajectory and, consequently, the narration in a given passage of a piece splits into two parallel threads: a main thread and a subordinate thread, each of them represented by one of the superimposed segments.

The latter situation, possible in the above-described cases, is inevitable in the case of a partial imposition in which neither of the segmental changes happens simultaneously in both segments so that the shorter segment is preceded and followed by parts of the longer one. Provided one of the segments contains the positive and the other the negative term of a given category, the co-occurrence of those opposite terms in their differentiating trajectory must happen between two occurrences of the same (positive or negative) term, which is embedded in the longer, superior segment. If this co-occurrence were interpreted as a complex mediative term, such a succession would thus, by necessity, form a prohibited sequence of terms. The attachment of superimposed sections to one layer of a trajectory and the fusion of the co-occurring terms carried by those sections into one complex mediative term is thus excluded, whereby segments of such a partial imposition always belong to two different threads of narration.

Of course, superimposed segments may differ in respect of more than one category. Consequently, in different trajectories the relations of co-occurring terms can be different. If in every trajectory two simultaneously occurring terms belong to the same layer, the segments in question belong to the same thread of narration. However, it can also happen that different, simultaneously occurring terms of one category belong to the same layer of its trajectory, while different terms of another category do not. At first glance, the segments containing such terms should be subsumed by one main thread of narration in respect of some category and, at the same time, divided between two parallel narrative threads as regards some other category. Yet, if any two segments do not belong to the same thread of the musical narration at least in respect of one category, they do not belong to it at all.

The subordinate, or secondary, threads of narration need not be confined to one segment only. On the contrary, they can form longer chains that move in parallel with the main stream of segments. Though such a phenomenon rarely occurs in Penderecki's works, it is theoretically important and becomes crucial in some pieces. The problems of temporal relations between segments and that of parallel threads of narration are not precisely ruled by the system of Penderecki's sonoristic style. They therefore constitute an area of compositional strategies in individual works.

5.2. TIMBRE SYSTEM

5.2.1. ELEMENTARY STRUCTURES

In contrast to pitch, loudness and duration, each of which possesses a single equivalent among the acoustic parameters of sound, timbre depends on several physical aspects of sound phenomena. These aspects include overtones, wave forms, sound pressure, transients, as well as the number and frequency of formants. Thus, the main difference in comparison to those three remaining perceptual attributes of sound sensation is that, on the acoustic level, timbre cannot be modeled within one-dimensional space but only by means of multi-dimensional scaling techniques (see Spender 1980: 401). However, any set that cannot be projected onto a one-dimensional line of real numbers does not constitute an ordered set, and its elements are not comparable in the mathematical sense. As a consequence of this fact, no clear relationships between particular timbres can be established, and hence no rational organization of the perceptual parameter of timbre by means of any rigid system is possible on the acoustic level.[1] Therefore in the generative grammar of Penderecki's sonoristic style timbre is set apart from the other perceptual parameters. Further, it is ruled by a separate timbre system whose main particularity, in comparison to the basic system, is that its categories are defined not on the acoustic level, but on the preceding, motor level of sound generation.[2]

For Penderecki, timbre is primarily a function of materials that play a part in any individual sound generation process. Therefore the perceptual categories of timbre in Penderecki's sonorism, which underlie the system under consideration, are five types of materials: metal, wood, leather, felt, and hair. It is noteworthy that those materials are the ones most commonly used in the construction of traditional musical instruments. In this way the timbre system of Penderecki's sonoristic style is adjusted to the possibilities of a traditional orchestral ensemble.

Any single sound phenomenon results from the collision of two bodies. In the terminology of a Polish acoustician and organologist Mieczysław Drobner (1960), such a pair of interactive bodies is called a sound generator. Its components are, respectively, a vibrator (or vibrating body, i.e., the sound source) and an inciter, by means of which the former is made to vibrate. Both vibrator and inciter represent material categories. Yet, while the part of inciter can be played by any of the above-listed materials, the vibrator can be only a metal, wooden, or leather body.[3] Therefore, in

---

[1] The above-described property accounts for the fact that no patterning of timbre comparable to that of time (rhythm) or pitches (melody) is possible (see Meyer L.B. 1967). This is why timbre is the most problematical parameter. Thus in the course of music history it has usually been set aside as a secondary factor of musical form. And, even where it achieved a dominant position in the styles of individual composers (e.g., in Debussy), timbre was as a rule organized intuitively.

[2] A similar idea occurs in serialism, where the timbres are identified with different instruments or with different kinds of articulation on the same instrument. Also, in the case of serialism such a "change of levels" allows for the rational organization of timbre, although this way of organization differs greatly from that used by Penderecki.

[3] In fact, almost anything can be made to vibrate; thus, it is theoretically possible for felt and hair to act as sound sources. But in cases of those materials the vibration is so heavily dampened that it does not persist long enough to be heard (see Taylor 1980: 551).

every pair of bodies interacting to generate a sound, at least one of them must be made of one of those three materials. Metal, wood, and leather can thus interact with any materials, including themselves. On the other hand, the two remaining materials—hair and felt—never collide with one another, but must always interact with one of the materials that constitute a potential sound source. A simple combinatory depicts the possible pairs of interacting materials:

vibrators / inciters	m	w	l
m	mm	wm	lm
w	mw	ww	lw
l	ml	wl	ll
h	mh	wh	lh
f	mf	wf	lf

In Penderecki's timbre system it is of no importance whether a given material is represented by a vibrator or by an inciter, both colliding bodies being of equal weight as vehicles of material categories. Thus, the material pairs "mw" and "wm", "ml" and "lm" as well as "wl" and "lw", repeated in the above combination, can be reduced. As a result of such a reduction, there remain 12 pairs of materials as types of material combinations available in Penderecki's timbre system. Obviously, in view of that system, every such pair thus indicates one type of sound generator:

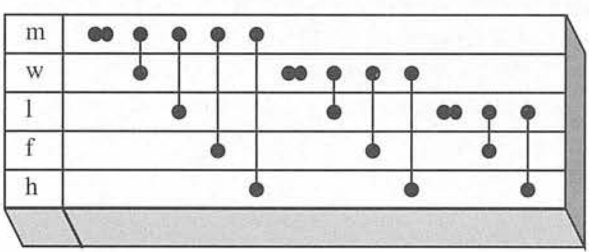
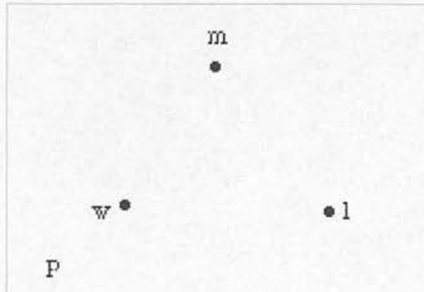


Figure 41

Plainly, the timbre of a given sound phenomenon depends primarily on the material of the vibrator. Therefore metal, wood, and leather, constituting potential sound sources, take a privileged position as the primary materials and hence as the basic categories of Penderecki's timbre system; their mutual logical relations are of first-rank importance for the system's morphology and syntax. Those relations can be elaborated when one considers metal, wood, and leather from the point of view of the set theory: as individual elements, or points, of a set P, which contains the primary materials of the timbre system. The logical dependencies between them as one-element subsets {m}, {w} and {l} of the set P are listed below the following figure:



$P=\{m, w, l\}$

Figure 42

$P\setminus\{m\}=\{w, l\}$	$\{m\}\subset P\setminus\{w\}$; $\{w\}\subset P\setminus\{m\}$; $P\setminus\{m, w\}=\{l\}$
$P\setminus\{w\}=\{m, l\}$	$\{w\}\subset P\setminus\{l\}$; $\{l\}\subset P\setminus\{w\}$; $P\setminus\{w, l\}=\{m\}$
$P\setminus\{l\}=\{m, w\}$	$\{l\}\subset P\setminus\{m\}$; $\{m\}\subset P\setminus\{l\}$; $P\setminus\{l, m\}=\{w\}$

As shown in the discussion of basic system, a relation between a set and its complement is a model of a logical relation of contradiction. From the equations in the left column it is apparent that such a relation occurs between each primary material, as an element of set P, and the two remaining ones. There are thus three oppositions of that type: metal vs. non-metal, wood vs. non-wood and leather vs. non-leather:

$$m \text{ vs. } {\sim}m$$
$$w \text{ vs. } {\sim}w$$
$$l \text{ vs. } {\sim}l$$

In turn, the relation between two sets that belong mutually to their complements is a model of contrariety. Such a relation links every two from among the three sound-source materials, as one can read out of the right column of equations. As in the case of contradiction, there are three relations of contrariety: metal vs. wood, metal vs. leather, and wood vs. leather:

$$m \text{ vs. } w$$
$$m \text{ vs. } l$$
$$w \text{ vs. } l$$

All the above-listed relations of contradiction and contrariety can be summed up as a "ternary opposition" between metal, wood, and leather, shown in the following triangle. Continuous lines linking the vertices of the triangle represent contrarieties. Discontinuous lines show contradictions between single material categories, modeled by vertices and couples of materials joined by their opposite sides:

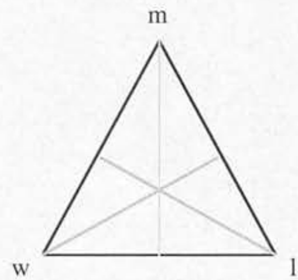


Figure 43

As is apparent, both the set P of primary materials and its component one-element sets {m}, {w} and {l} (representing, respectively, metal, wood and leather) are ordinary sets; i.e., they are characterized by a clear discrimination between elements and non-elements. Hence, unlike the types of logical opposition in the basic-system categories, the contrarieties and contradictions between primary materials as categories of Penderecki's timbre system involve relations of classical logic. This fact is of consequence for the ways of their possible mediations. Since each element of P clearly belongs or does not belong to its individual subsets, which form terms of individual oppositions, the characteristic functions of those subsets take exclusively values of either 0 or 1. Hence, the mediative terms, which in fuzzy logic are based upon intermediary values of the characteristic functions—higher than zero, but lower than one—are not available here. This situation concerns the border-zone term of contradiction as well as the transitions of both contradiction and contrariety.

Consequently, in the case of contradiction, the only possible atemporal mediative term is a sum of sets representing the opposite terms. Since this sum always includes all three primary materials, it is a total term (❐); e.g., $\{w\} \cup P \setminus \{w\} = P$.

In turn, each relation of contrariety between primary materials possesses three possible atemporal mediative terms:

- complex term (±) arising as the sum of sets representing both opposita, e.g., $\{m\} \cup \{w\} = \{m, w\}$;
- neutral mediative term (0) is the complement of the sum of both opposite terms (i.e., of the above complex term) in set P. It is always a simple term consisting of only one element, e.g., $P \setminus \{m, w\} = \{l\}$;
- total term (❐), as the sum of two earlier mediatives, both complex and neutral. As in the case of contradiction, it is always tantamount to the all-set P of the three primary materials, e.g., $\{m, w\} \cup \{l\} = \{m, w, l\} = P$.

A special type of mediation possible both for contradiction and contrariety is interpenetration, i.e., a gradual increase of material(s) forming one of opposite terms, accompanied by a decrease of the material(s) of the other. Because such a way of mediation presupposes a change of intensity, with which both of the given terms occur in an interval of time, interpenetration is a temporal mediative term.

As one can see from the above remarks, every subset available within the set P of all primary materials can have several different functions in the framework of Penderecki's timbre system. For example, leather may form an opposite contradictory term to the pair of metal and wood, but it may also constitute a neutral term of a contradiction established by the latter materials. Metal and leather can form a complex term of the relation of contrariety between them, but at the same time constitute a contradictory term to wood. The juncture of metal, leather, and wood can be a total mediative term of any opposition. Which of these possible functions is really performed by a given set of materials in a given musical context, is always dependent on which of the six binary oppositions is activated, within the framework of the "ternary opposition" represented in the triangle above. However, the choice of opposition(s) active in a given musical piece or section is not governed by the system, but is made by the composer as part of the compositional strategy for that piece.

5.2.2. **MORPHOLOGY**

As one has learned from previous chapters, the elementary unit of Penderecki's sonoristic style, in light of the basic system, is not a single sound phenomenon, but a segment consisting of several sounds. This also holds true for the timbre system, the syntactic unit of which is here called a "timbre segment" and defined as a set of sounds resulting from several sound-generating processes. Clearly, sound phenomena contained in one timbre segment can be identical or different, in the sense that they are generated by collisions of bodies representing identical or different pairs of materials. In order to describe fully a timbre of any given segment, it is thus indispensable to enumerate all pairs of materials interacting so as to produce the sounds belonging to it. If all sounds are produced in the same way, i.e., through interactions of the same two materials, then the timbre of a segment will be covered by only one material pair. Otherwise, the description of a segment will consist of several pairs. The type of segment determined by one pair of materials only can be represented by one sound phenomenon. Therefore, as in the case of the basic system, a single sound can constitute a liminal case of a timbre segment.

In the description of a single segment, a given material can thus occur several times as a component of different pairs. This is so because bodies representing one material category can interact with bodies made of either the same or different materials, in this way producing sound phenomena that differ in timbre. From this it follows that different materials may vary as to the number of occurrences in a segment description, some of them occurring more and others less frequently. Consequently, the participation of different materials in determining the sound colour of a given segment varies with the number of material pairs characteristic of that segment in which the materials occur: the more pairs, the more significant the influence of a given material to the timbre of a segment. To turn this statement around, the timbre depends mostly on the materials that occur most frequently. As exerting the decisive influence on the timbre of a given segment, they will be marked as its main materials.

However, not every material can be main. This is so because there exists a difference in the degree to which materials can determine the timbre of a single sound. Because, as stated before, segments are sets of such single sounds, that difference, discussed in the previous chapter, also has consequences for the timbre of the total segment. Felt and hair cannot constitute a proper sound source (vibrator). Thus those two materials never dominate the timbre of a whole segment—just as they cannot dominate the timbre of any of its component sound phenomena—even if they occur in all pairs of materials characteristic of such a timbre. The main timbral roles can be played only and exclusively by primary materials—metal, wood, and leather.

In the case of timbre segments consisting of several pairs, the main material(s) can be discerned by way of a "common denominator search". This search is easiest and most obvious when all pairs belonging to a given segment form different junctures of one primary material. The latter, which occurs in all pairs and in this way forms their "common denominator", is the main material for the segment. Such a segment has thus only one main material:

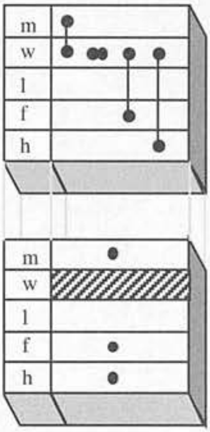


Figure 44

If no single primary material constitutes a common denominator of all the pairs within a segment, one has to search for the common denominator of the greatest number of pairs within this segment, and then for the common denominator of the remaining pairs. If such a denominator as a primary material does exist, the segment has two main materials, and the search procedure ends. However, if such a common denominator still cannot be found within the group of remaining pairs, one has to repeat the procedure: first find the common denominator of the greatest number of pairs, and then the common denominator of the last remaining group. In such a case, the segment has three main materials (metal, wood and leather), the set of which thus being identical to that of all primary materials of Penderecki's timbre system:[4]

[4] At any stage of the above-described procedure, two or even all three primary materials may be represented in the same number of pairs. In that case, one has to choose one of them arbitrarily and follow the procedure as described further. The arbitrary choice does not affect the resulting set of main materials, which will always be the same irrespective of which material was chosen as the first one.

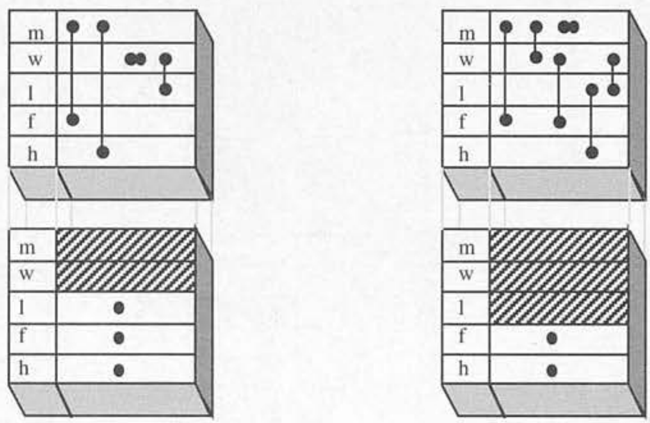


Figure 45

It is however possible for the remaining group to contain only one pair of materials. If this is the case, one treats that group as a segment consisting of only one pair. With regard to such a segment, the search procedure for main material must be slightly modified. The most evident situation happens when the only pair characteristic of the segment is a reduplication of the same primary material (metal, wood, or leather) or its juncture with hair or felt. Since in either case there occurs only one primary material, it must be the main one for the segment in question. A more complicated situation arises when the only pair of a segment consists of two different primary materials. Because either of those materials can constitute a sound source, they are of equal value in determining the timbre of a segment, irrespective of which one excites (inciter) and which one is excited (vibrator) in a given process of sound generation.[5] Hence, if a segment containing such a pair is considered as an isolated unit, or if in the given musical context it is separated by a general pause from the preceding and following segments, both primary materials of the only pair are its main materials.

Yet, within a given piece every segment usually constitutes a link in a chain whose perception is subject to the gestalt law of "good continuation" (see Meyer L. B. 1956). As applied to syntactical units of Penderecki's timbre system, this law means that, in terms of future-orientation, the listener tends to perceive, or "continue", the main material of a preceding segment in the following segments as long as it is possible to do so. On the other hand, the mind's orientation to the past allows reinterpretation of the preceding segment, such that the listener discerns in it the origins of the timbre quality that is established clearly as main material only in the following segment. Thus in a doubtful situation, such as that which arises in the case of one-pair segments, there is a tendency to perceive its timbre under the influence of adjacent segments and, consequently, to prefer as main material the one that predominates in the preceding and/or following segment:

[5] This follows Newton's second rule of dynamics, which says that if body A acts with a given force on body B, then body B acts with the same force on body A.

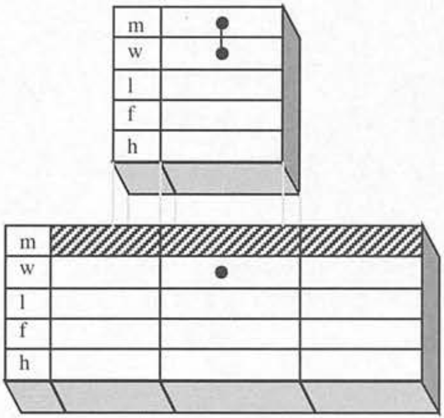


Figure 46

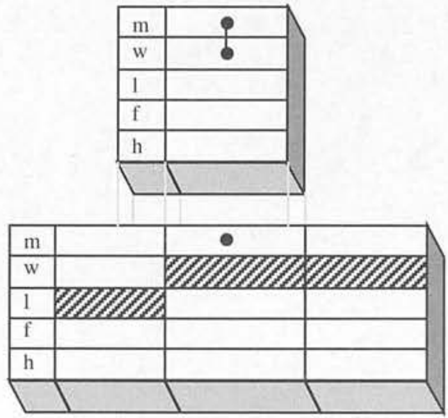


Figure 47

Thus both primary materials of a single pair appear to be evenly balanced as main materials only if they are equally marked as main in the adjacent segments, or if neither of them occurs among main materials of either the preceding or the following segment:

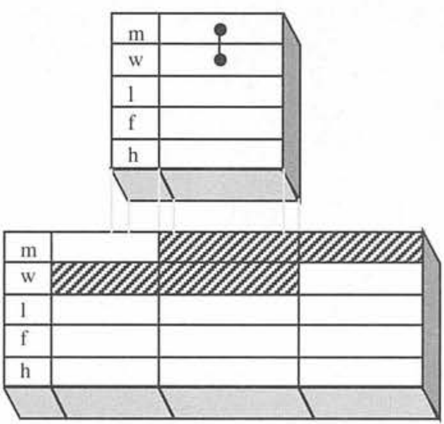


Figure 48

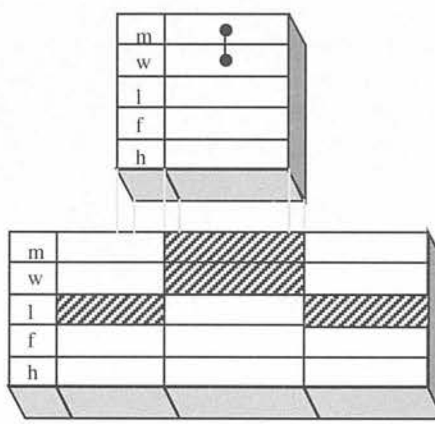


Figure 49

In light of the above remarks it seems clear that complete definition of a timbre segment, as an elementary syntactical unit of Penderecki's timbre system, requires both the specification of all materials involved in the generation of its component sounds, and the identification of those which function as main materials. According to these stipulations, any two timbre segments are different if they vary in either or both of those two constitutive aspects of their definitions. Conversely, if no difference in either respect occurs, then they form the same segment in two different realizations. It is noteworthy that, as with the above-discussed examples, segments consisting of the same set of pairs, and hence identical as to their preliminary material description, can appear to be different in the sense just stated when put into different musical contexts, because of differences in their main materials. On the other hand, segments consisting of different sets of material pairs may appear to be two realizations of the same timbre segment, i.e., its two different contextual variants on the level of "speech" (*parole*). This is so since, for the timbre segment as an abstract invariant of "language" (*langue*), any features concerning the set of material pairs, as well as (at a later stage) concrete sound generators forming embodiments of those pairs, are irrelevant inasmuch as they do not affect constitutive features of the definition inferred from them.

The character of its definition results in the fact that every timbre segment joins traits of a segment of the basic system with those of a single term within one of its individual categories. The analogy to a single term occurs on the level of main materials. The sets of main materials characteristic of given timbre segments—whether consisting of one, two, or three materials—always take the parts of opposite or mediative terms as prescribed to them by the logic of the "ternary opposition", in frameworks of its component contradictions and contrarieties. In this sense, the set P of primary materials from which come the main materials of individual segments, is analogous to the space of a single category of the basic system, and its "ternary opposition" performs a function similar to that of the "binary opposition" that establishes the category. At the same time, as regards all its materials, the timbre segment resembles a segment of the basic system in that it constitutes a combinatory arrangement of terms chosen from particular material categories.

This double nature of timbre segments has an effect on their taxonomy. This is so because the full list of timbre segments is not exhausted by possible combinations of materials, but multiplied by all sets of main materials accessible for each combination. Accordingly, the paradigmatic relationships of elementary syntactical units of Penderecki's timbre system arise both between the main materials and between all the materials of which they are comprised.

On the level of the main materials, as in the case of individual categories of the basic system, relations among segments take shape as logical relationships between opposite and mediative terms of the "ternary opposition" represented in two given timbre segments. Yet because the ternary opposition consists of three relations of contradictions and three relations of contrarieties, a given set of main materials characteristic for a single segment simultaneously performs several different functions in the frameworks of those different oppositions, as was stated before. Hence, the relations between any two given timbre segments are always manifold and coexistent on the paradigmatic axis. The choice and actualization of any one of them can be made only on the syntagmatic axis, owing to the context of further segments that disclose the one of six oppositions which is active at a given moment.

In turn, as regards sets of all materials occurring in two given segments, the relations between them should be construed not in terms of oppositions (contrariety or contradiction) and their mediations, but in terms of several degrees of kinship determined by the number of materials they have in common. Such relations are thus similar to those between individual segments of the basic system. Yet, this similarity is weakened by the fact that, in the latter case, an additional complication arises as a result of mediative terms occurring within individual categories. In the case of the timbre system, since a given material can merely occur or not occur, no mediative terms of material categories can arise. Consequently, the two types of relationships—determined by the number of common terms and by their logical interconnections—which were intermingled in the basic system, in the timbre system appear as carefully separated. Because the mediative terms concern only main materials, only on that level do they participate in logical relations between terms of the ternary opposition. Conversely, the level of all materials involved in sound generation processes of a given segment is devoid of logical relations of that sort.

However, this very property, which on one hand makes the relations between sets of all materials simpler as compared with the syntactical units of the basic system, on the other hand introduces a new complication. Since a given material need not occur in every syntactical unit, the number of materials defining timbre segments of Penderecki's sonorism fluctuates from one to five. Consequently, the number of common materials of two compared timbre segments does not predestine the number of different ones between them. Therefore, the same degree of kinship may be submitted to further differentiation of timbre relation, according to the overall number of materials in compared segments. Obviously, the relationship determined by two common materials will be much closer for segments containing only three materials than for those which contain all five material categories. Moreover, the overall number of materials can also differ between two compared timbre segments.

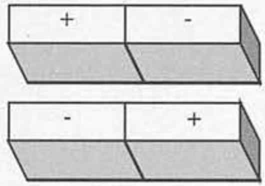
Because every given timbre depends, to various extents, on both the sets of its all and main materials, relationships between timbre segments are always resultants of the relations on those two component levels. Consequently, there are three general types of paradigmatic relationship that can occur between different timbre segments in Penderecki's sonoristic works. The first of these relationships arises when timbre segments differ on the level of all their material categories, but are identical as regards their main material(s). Secondly, they can differ in respect of main materials, but share the same set of all materials. Finally, the different timbre segments can vary both in respect of their total and their main material categories. If one also considers that the differences on both levels are submitted to further differentiation and are hence open to gradations, an extremely extensive and complicated web of possible relations generated by the timbre system arises as a field of possible compositional choices in Penderecki's sonorism.

5.2.3. **SYNTAX**

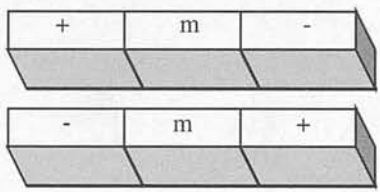
The double nature of the morphology of timbre segments is of further consequence as regards their syntactical organization. The just-discussed types of paradigmatic relationships projected onto a syntagmatic axis imply that the neighbouring sections of a piece form two distinct consecutive timbre segments if they display a change in respect of either all materials, of main materials, or of both. If no change occurs in either respect, the sections in question are parts of one integral segment.

Changes in main materials are the touchstones of macro-level segmentations of the timbre trajectory. On this level, as in trajectories of basic system categories, the succession of terms must follow two types of sequences. These last constitute processes of presentation and mediation of an opposition functioning as the active one within a whole piece or section thereof. Presentation of such an opposition presupposes a contrast between its opposite terms, which are embodied in adjacent timbre segments. Mediation arises when one or more mediative terms appropriate for a given opposition is inserted between its opposite terms.

presentation:

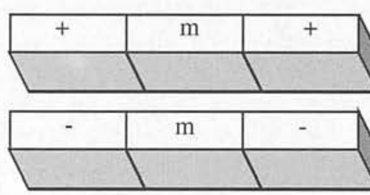


mediation:



Thus, prohibited by the logic of the main-materials level is a sequence consisting in a return to the initial opposite term after an occurrence of one or more mediative terms.

prohibited sequences:



As one can see from these remarks, the parallelism between the level of main materials in timbre segments and a single category of the basic system has its continuation in syntax. The syntactical order of timbres established by main materials forms a trajectory similar to those of the categories of pitch, loudness, and duration.

On the other hand, the succession of timbre segments as regards all their constitutive materials resembles that of segments in the basic system. It is thus not governed by a strict logic. Rather, since a change of segment can result from a change of a different number of individual materials, it can be described in terms of different degrees of kinship between adjacent segments according to their paradigmatic relations. Changes of segments characterized by different degrees of kinship thus bring about different levels of segmentation: the closer the kinship, the lower the level of segmentation. Conversely, the weaker the kinship between adjacent timbre segments, the more striking the contrast between them and, in effect, the higher the level of segmentation to which a given change belongs. As to the overall set of materials, the segmentation of the timbral course of a piece is thus hierarchical.

The segmentational levels concerning changes of the all-material categories involved in processes of sound generation are independent of the macro-level of segmentation marked by changes of main materials. Thus, changes on the macro-level of main materials need not necessarily coincide with changes on any segmentational level. The latter observation is of importance for the problem of timbre mediation. If one considers this phenomenon exclusively on the macro-level, the only possibilities for the mediation of timbre oppositions are determined by the logic of ternary opposition, as terms consisting of single primary materials or their juxtapositions, and incorporated into the trajectory of main materials. Yet, the sound colour of each segment is determined not exclusively by main materials, but bears the stamp of all its constitutive material categories. Hence, the mediation of an opposition between two segments which contain as their main materials the opposite terms of a given contradiction or contrariety, can also be achieved outside the macro-level: on the level of all materials occurring in them. A particularly striking case of such a mediation occurs between neighbouring segments that represent the second type of paradigmatic relation, i.e., when their different main materials are chosen from the same set of all constitutive materials. Then, paradoxically enough, the latter set acts as a common denominator of these segments, and thereby mediates their timbres. To a lesser extent, a similar situation occurs when the change of main material is accompanied by the continued presence of only some categories on the level of all materials. Seen from this angle, any succession of segments different as to main materials but akin in their overall set of constitutive material categories could be considered as a mediation; consequently, the degrees of kinship of adjacent timbre segments would be identical to the concept of a timbre mediation between them. Theoretically, this is the right conclusion. Practically, however, it is reasonable to speak of such a mediation only if the number of materials shared by neighbouring segments is rather high.

On the syntagmatic axis, the inter-level relations between the sets of all materials defining timbre segments and the sets of those materials which are marked as main ones can also produce several other nuances of timbral trajectory in cases where the main material is preserved. Those nuances may concern the force with which a given main material occurs. Obviously, it will appear with the greatest force if it constitutes the only material of a given timbre segment. On the other hand, the introduction of other materials, which modulate and thereby enrich the main material category, will result at the same time in a dimming of the latter's characteristic timbre. Of course, the "dimming" and "brightening" of the main timbre can proceed either gradually as a succession of slight changes (i.e., changes between segments having the highest degree of kinship) or abruptly by juxtaposition of contrasting segments. A given material can also be preserved in later timbre segments after it has been deleted from the set of main materials. Conversely, a given material can appear even before being marked as "main", which results, respectively, in continuation or anticipation of a main material, and which holds importance for the smoothness of a narration in terms of the law of good continuation. All such phenomena are not rigorously governed by the timbre system, but rather belong to the space of artistic freedom. There they are subject to free compositional choices, or the strategies followed by the composer for a given work.

The temporal relations of timbre segments—succession, overlapping, and imposition—are analogous to those between segments of the basic system, and hence all the remarks made in this connection (in 5.1.3) hold true here. However, it is noteworthy that the overlapping or imposition of "soft" segments can produce temporal mediative terms of any opposition foreseen within the logic of the main materials trajectory on the syntactical macro-level. This situation arises when a timbre segment containing an opposite term of a given contradiction or contrariety increases in intensity, while a segment containing the other opposing term decreases. As in the case of basic system segments, any two overlapping or superimposed timbre segments belong to the same thread of the musical narration, when their co-occurring main materials fuse into a term permissible within the trajectory of the macro-level, i.e., when those segments obey the rules of presentation and mediation of an opposition active in their proper context.

To conclude, there follow some remarks concerning the interrelations of the timbre system and the basic system. Obviously, although discussed separately, these two systems are designed by the composer to cooperate in individual sonoristic pieces, both in respect of segment-generation (morphology) and of syntagmatic order. The final elementary units of any piece are thus intersections of timbre segments with segments of the basic system, and their full definition must allow for features that are relevant to both subsystems of Penderecki's sonorism. Also, the succession of segments is ruled by logic of timbre determined by the main materials as well as by logic of all the categories of pitch, loudness, and duration. Finally, a segmentation is complete only if takes into account the borders of segments as syntactical units within both the basic system and the timbre system. These two aspects of generative grammar are thus complementary in the framework of the compositional technique that governs Penderecki's sonoristic style.

6. ARTICULATION

In order for any system of communication to generate its texts, it must articulate syntactical units by means of resources appropriate for a given communication channel. This is why in the case of a linguistic system the distinctive features of phonemes are defined not only on the acoustical but also on the so-called articulatory or motor level. In fact, articulatory definitions are intended as instructions on how to obtain phenomena indicated in the acoustical definitions of individual features.

The reciprocal relationship between acoustical and motor phenomena is not one-to-one, however. As Jakobson and Halle aptly observe,

> in the process of communication there is no single-valued inference from a succeeding to a preceding stage. With each successive stage, the selectivity increases; some data of an antecedent stage are irrelevant for any subsequent stage, and each item of the latter stage may be a function of several variables from the former stage. The measurement of the vocal tract permits an exact prediction of the sound wave, but one and the same acoustical effect may be attained by altogether different means. . . . Since articulation is to acoustic phenomenon as means to effect, the classification of motor data must be made with reference to the acoustic patterns. (Jakobson and Halle 1956: 34-35)

The latter statement means not only that the articulatory level is subordinate to the acoustical one but, what is more, that the relationship between them always forms an assignment between individual acoustical effects on the one hand and a variety of motoric means of their production on the other. The articulatory domain is thus by necessity broader and more complex than the acoustical one. Even so, the authors' definitions of distinctive features on the motor level are almost as compact and simple as the acoustical definitions. This simplicity is even mirrored in their terminology, sometimes relating to articulatory traits, other times to acoustical ones; e.g., nasal/oral, tense/lax, voiced/ voiceless, stressed/unstressed, and so on (see Jakobson and Halle 1956: 36).

Articulatory definitions of features characterizing musical units, i.e., definitions of how individual terms of categories can be articulated, are equally indispensable in reference to Krzysztof Penderecki's sonoristic system. In the first place, such definitions were necessary for the composer inasmuch as his system was to be practically used as a compositional method. Secondly, their reconstruction is indispensable also for analyzing individual texts (i.e., Penderecki's sonoristic pieces) in terms of the system by which they were generated. After all, the scores of those pieces are not spectrograms but notated records of articulatory acts.[1]

The elaboration of articulatory definitions of musical distinctive features is more complicated than defining those of natural languages, since the relation between the motor and acoustical stages in Penderecki's musical system displays two important differences in comparison to language. Firstly, in language all distinctive features, and their combinations into phonemes, are produced by the same generator—the human vocal apparatus—whose properties are constant and thus taken for granted. By contrast, musical sounds and their features are produced by several different generators whose number, in the case of Penderecki's sonorism, is particularly high because of the composer's usage of rare musical instruments as well as of bodies originally not designed for

---

[1] As regards the particularity of musical notation in Krzysztof Penderecki's sonoristic scores, this problem is discussed at greater lenght in Chapter 13.

musical purposes. Secondly, whereas phonemes are already syntactical units of the linguistic system, in Penderecki's sonoristic style single sounds articulated in individual sound generation processes are merely components of units, the latter being segments which usually consist of a number of sounds.

As a result of those differences, to elaborate articulatory definitions for Penderecki's sonorism requires prior formulation of what could be called "translatory rules", which embrace (1) dependencies between features of segments expressed in terms of individual categories of either the timbre or the basic system and features of individual sounds contained in such segments, (2) dependencies between features of individual sounds and aspects of sound generation, and (3) the accessibility of those latter aspects for individual sound generators in Krzysztof Penderecki's sonoristic pieces, analyzed in Part Two of this book.

6.1. ARTICULATION OF TIMBRE SYSTEM

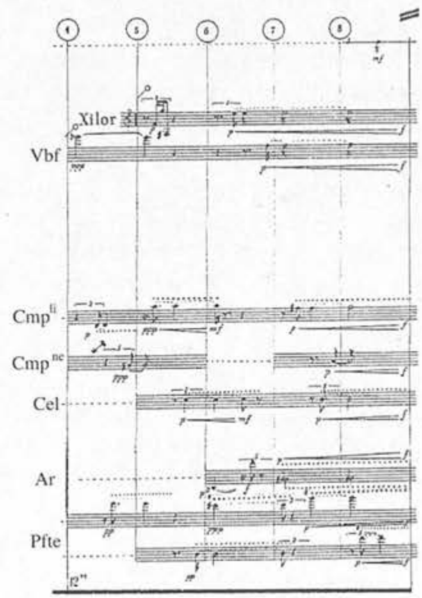
The main difference between the timbre system and the basic system of Penderecki's sonorism and, consequently, linguistic systems, appears to be that its categories are defined immediately on the articulatory level, the acoustical stage being omitted. Therefore two of the three links contained in the set of "translatory rules" have already been discussed in the previous chapter. As stated there, timbre qualities of individual sounds depend on materials of the bodies interacting in a given sound generation process (2). The way of discovering main materials of an individual segment elucidates, in turn, the dependency between the timbre of a single sound and that of the segment in which it is included (1). This leaves for discussion only the third link: the accessibility of individual material categories for bodies belonging to individual sound generators. In other words, one now needs to determine which of the categories of metal, wood, leather, felt, and hair is represented by individual vibrators and inciters used in Penderecki's sonoristic pieces.

In principle, this question poses no serious problem, since the sound generators used by Penderecki, be they musical or extramusical instruments, are well known as to their construction; this includes also the specification of materials of which individual parts of instrument bodies are traditionally made. This matter would thus normally not require detailed comment. Yet, the traditional natural materials of instruments have been more and more replaced by synthetic substances, especially with regard to percussion instruments and their accessories. The skins of membranophones are no longer made of leather, as they were originally, but of different plastics. Also, percussion accessories, such as sticks and hammers, are no longer made of wood or felt, but of synthetic substitutes for those materials. To be sure, this process of technological progress and of the resulting material substitutions was not so advanced in the early 1960s, when the pieces under consideration were written. Still, it would cause a serious theoretical problem and would spoil the timbre system if the material categories were construed in terms of their real physical make-up. However, as emphasized previously, the material categories of the timbre system are not physical, but perceptual; more precisely, they are categories of auditive perception. Therefore "metal", "wood", "leather", "hair", and "felt" are not represented solely by bodies made of equivalent materials but by those which sound as if they were made of metal, wood, leather, hair or felt. As far as the new materials preserve the acoustical properties of the older ones—as is obviously the case with synthetic substances—they are thus classified as the original materials which they replaced. In the classification of bodies in terms of material properties given in Table 1, the material composition of instruments, musical accessories, and non-musical objects is thus treated according to the natural materials of which they were—and usually still are—made, before the introduction of plastics.

However, as a survey of the table reveals, the problem of material substitutions is not confined to synthetic materials (which occur in a sense "behind" the composer), but also involves the use of natural materials as substitutes introduced consciously (and arbitrarily) by the composer mainly for practical reasons. Most often these take the place of real metal. Owing to the naturally metallic sound qualities of glass, the class of metal bodies includes suspended glass lamellae and a bar of glass. Since the former occur only in *Dimensions of Time and Silence* and the latter exclusively in *Fluorescences*, both are labeled in scores with the same abbreviation of their Italian names (vtr: *vetri* and *vetro*, respectively), without risk of confusing those plainly different kinds of vibrators. Fingernail substitutes for metal only in one piece—*Dimensions of Time and Silence*—where the players are required to draw their fingernails across the skin of the tom toms as well as the cymbal and gong. Obviously, the reason for this substitution is of a very practical nature: using a real metal body for those means of sound generation could injure the striking surfaces of the instruments, whereas using the fingernail presents lesser risk of damage.

In both of the aforementioned cases, the natural materials employed as substitutes come from outside the five material categories of the timbre system. Yet, substitutes may also be made of materials that otherwise have their own classes, such as wooden bars of the xilorimba. Take the following musical example, for instance. There, when occurring together with vibraphone, glockenspiel, tubular bells, celesta, harp, and piano, xilorimba is treated as another collection of metal vibrators and its sounds are used not to create any separate timbre but, on the contrary, fuse into the metallic sound quality produced by the co-ocurring instruments:

Example 1: *Dimensions of Time and Silence*, 4-8

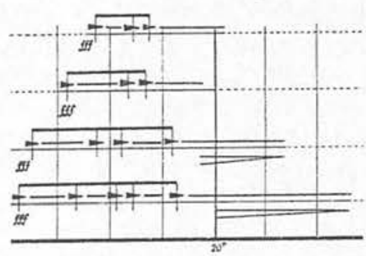


However, the use of xilorimba bars as a substitute for the class of metal does not automatically cancel their original affiliation. Therefore, at other times the bars of the xilorimba are interpreted as wooden bodies according to their physical material, and they cooperate with other representatives of this class. This happens, for instance, in bars 25-31 of *Anaklasis* (Ex. 14), where the xilorimba accompanies claves and wood drums as representatives of wooden vibrators; there this latter group joins the previously introduced leather and metal bodies (striking surfaces of tom toms and timpani, plus cymbals, tam tam and gong). Consequently, the "cross-categorial" substitution of xilorimba for metal leads to a double classification of xilorimba bars as either wooden or metal bodies, actualized in different material contexts. The "polyvalent" usage of this instrument well illustrates the arbitrariness of the composer. Since the material qualification also has some impact on the interpretation of constructional properties of the instrument—which, in turn, influence categories of the basic system—further evidence of the double function of xilorimba, in respect of material categories, will be adduced in the next chapter.

There is another case where the "cross-categorial" material substitution for metal by wood results in a double classification of the same body: the bridges and tailpieces of stringed instruments. Joint discussion of both those kinds of bodies is justified by the fact that they are treated interchangeably in Penderecki's sonoristic pieces. An interesting confirmation of this observation occurs in the score of *Fluorescences*, in a remark by the composer concerning paragraph 96. Although in that place the cellos are supposed to bow their tailpieces and the contrabasses their bridges, "it is possible to change this arrangement, supposed that for the one or the other of the players it is easier to play on the tailpiece than on the bridge, or vice versa".

If qualified in compliance with their actual physical material, bridge and tailpiece are included in the class of wooden bodies. This is the case in the following excerpt from the String Quartet No. 1, where the composer uses the tailpieces of all four instruments (two violins, viola, and cello):

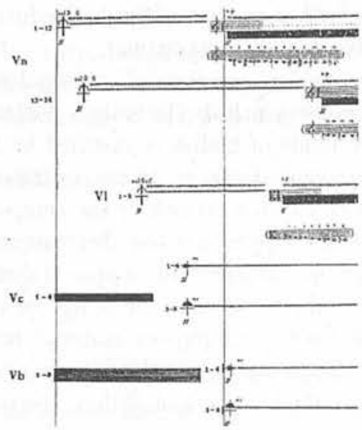
Example 2: String Quartet No. 1, 4.17-23



Even more numerous, however, are cases where bridge and tailpiece occur as substitutes for a metal body. The reason for this substitution is the need for a low-register counterpart of strings between bridge and tailpiece, which can only produce extremely high sounds. Plainly, from the viewpoint of the composer, strings in the low register do not constitute counterparts of strings played between bridge and tailpiece, but only of their traditionally bowed areas stopped in a high register. Thus on the bodies of stringed instruments no metal vibrator was to be found that could produce a low, "deformed" sound analogous to the harsh, jarring sounds articulated behind the bridge. To this end, the composer was thus forced to use other—i.e., wooden—elements. The choice of bridge and tailpiece was probably influenced by the fact that they delimit the parts of "strings between bridge and tailpiece" for which were to substitute. Moreover, the shape of the tailpiece forms a visual extension of the strings, which might explain why the composer considers it superior to the bridge. This superiority is evidenced by the fact that, though the tailpiece is sometimes played without being accompanied by the bridge (as in the above example from the Quartet), the bridge never occurs independently, but always accompanies the tailpiece.

The grounds of the discussed material substitution cause that only the bridges and tailpieces of low-register stringed instruments (cellos and basses) act as substitutes for metal bodies, and as such, they always occur simultaneously with violins and violas bowing the strings between bridge and tailpiece. Proof of this division of labour can be found in several pieces: *Dimensions of Time and Silence* (16 and 19, 65 and 68), *Canon* (46-49), *Fluorescences* (96). Yet perhaps the most striking and univocal instance takes place in the following excerpt from *Polymorphia*:

Example 3: *Polymorphia*, 63-64



Although metal is the material category most often substituted for by natural materials, individual cases occur of substitutions in the classes of felt and wood. They result from a particular classification of the beaters of percussion instruments. Even apart from the problem of plastic materials, the heads of those accessories differ widely in shape and texture, and also in their material make-up. Beaters are most commonly made of wood and felt, but there are also porcelain, rubber-tipped, and yarn-wound rubber mallets (for vibraphone) and beaters having surfaces covered with leather, such as those for tubular bells. Moreover, the felt and wood can be of different textures, and hence harder or softer. As a rule, the collection of beaters is used freely by the performer, depending on the sound effect he wants to obtain.

To bring order to this flexible situation, Penderecki divides the beaters into hard-headed and soft-headed ones. This division is mirrored in the notation: the soft-headed beaters are symbolized by white-headed, iconic signs ( ), which are designated by the composer as a kettledrum stick or a soft-headed stick for xilorimba and vibraphone. The hard-headed beaters are notated as black-headed icons of a drumstick ( ) (see the explanation of symbols in the scores of *Dimensions*, *Anaklasis*, and *Fluorescences*). In the classification of materials, all soft-headed sticks are treated as representing felt, and all hard-headed beaters as representing wood. If beaters are made of material other than the material category in which they are included, a substitution arises; this is the case with the hard-headed sticks used on xilorimba and vibraphone, which, according to the composer's explanation, are supposed to have porcelain heads (*Dimensions*, *Anaklasis*). The same notational rule for reflecting the division of beaters is also applied to the mallet of tubular bells, whose sign is always notated as black-headed ( ) and explained as "a wooden hammer" (*Fluorescences*).[1]

[1] In the scores under consideration there is one exception to this rule: namely, where the mallet of tubular bells is denoted with a white-headed sign ( ), in *Dimensions of Time and Silence* (2). This is obviously a printing error, since it is denoted with a black-headed sign in the strict retrogradation of the same section in rehearsal number 81, in other occurrences in this piece, as well as in *Fluorescences*.

Finally, there is one more substitution for a wooden body. In relation to the hitherto discussed substitutes, however, it forms a separate case, for it was "extorted" from the composer by performers of his sonoristic pieces. This substitution concerns a new instrumental technique on strings, which was originally conceived as "tapping the sound board with the nut [of the bow]" and, hence, as an interaction of two wooden bodies. Yet, during the first performances, the players protested that such a technique would damage their instruments (see Erhardt 1975: 36-37; Ćwiklinski and Ziarno 1993: 10-11). Their protests caused the composer to relent, and allow fingertips to substitute for the nut of the bow. Thus in the scores of early published pieces (*Threnody* first published in 1961, *Dimensions* and *Fluorescences* printed in 1962 as well as String Quartet No. 1 printed in 1963) this effect is indicated as "tapping the sound boards with the nut or fingertips". Naturally, the players preferred the latter option. Therefore, in *Polymorphia* (first published in 1963) and *Canon* (printed as late as 1974) the alternative way of performing this effect—"tapping the upper part of the sound board with fingertips"—became the only one indicated by the composer. Since this latter technique is obviously the result of compromise in relation to the original compositional intent, this substitution will not be taken into further consideration, and the effect to which it refers will be interpreted always according to its first conception—as interaction between the nut of the bow and the sound board of stringed instruments.

Below is a table of bodies used for sound generation in Penderecki's sonoristic pieces, classified according to their material composition (Table 1). Material categories chosen for the timbre system are exclusively solid bodies. Thus air does not appear in the table, even though it functions as inciter and vibrator of the human vocal organ, and in traditionally played winds. Consequently, from the point of view of the timbre system in Penderecki's sonoristic style, both singing and blowing are considered as neutral, "transparent" sounds, without any impact on the timbre of individual segments. Therefore they will not figure into analysis of the timbral courses of individual pieces. Wind instruments are represented in the table only by mechanisms of stops and pistons, employed for tapping in *Fluorescences* and included in the class of metal bodies, as well as by whistles, the latter constituting an extremely curious case of sound generator. The sort of whistle required by the composer has a metal body with a metal ball inside it. During the act of blowing, the sound arises from air vibrations, as in aerophones. Yet the sound also arises from the interaction of a metal ball, propelled by the air stream, and the body of the instrument, such interaction being proper to idiophones. Thus whistles are classified here according to the latter means of sound generation.

As one can see, in addition to bodies of traditional vibrators and inciters, the table also contains other elements of musical instruments, as well as parts of non-musical objects, both equally not originally designed to interact in sound generation. Yet, in Penderecki's sonorism all of those bodies, be they "old" or "new", have equal weight as representatives of a given material category, irrespective of their original appropriation. The earlier discussion of the difference between primary and secondary materials, in Chapter 5.2, has shown that only bodies made of the former can constitute sound sources. Accordingly, the categories of hair and felt are represented exclusively by inciters; whereas the classes of metal, leather and wood include both inciters and vibrators. The discrimination between those functions, and the combination of vibrators with inciters assigned to them in individual processes of sound generation, allows one to obtain a list of sound generators that appear in the sonoristic pieces considered in this book. The result of such a procedure is shown in Diagram 1.

Interestingly, some of the bodies occur there both as inciters and vibrators. Such a double function in different sound generation processes is assigned to cymbals, strings of stringed instruments, claves, and the handle-ends of beaters. The original function of the cymbal as a vibrator is replaced by that of inciter when it is supposed to rub the piano string in *Fluorescences* (15). The strings of stringed instruments become inciters when they are struck with the palm of the hand *sul tasto*, which not only excites the strings, for the strings in turn excite the fingerboard. This atypical instrumental technique forms the unique case of interaction between three (instead of two) bodies: palm of the hand, strings, and fingerboard. This threefold interaction can be understood, however, as the juncture of two regular interactions. One can see it either as the excitation of strings with palm joined with excitation of the fingerboard with strings. Alternatively, it can be viewed as a simultaneous excitation of the fingerboard by both the palm of the hand and the strings. In the former case, the strings act as both vibrator and inciter; in the latter, they fulfill only their new, atypical function.

The handle-ends of beaters act mainly as inciters, yet they also serve as vibrators when they are laid on the striking surfaces of membranophones and struck with other sticks. In contradistinction to cymbals and strings, neither of the two functions fulfilled by handle-ends is their original one. This is because they have never before been used as elements of sound generators. As such, they thus constitute one of the new bodies used in Penderecki's sonoristic pieces. An opposite case is that of the claves: two identical and interchangeable bodies collide with each other and, hence, are designed to fulfill a double function as both vibrator and inciter. This traditional technique of playing the claves is retained by the composer. In the diagram, there are a few remaining cases when the same name occurs among both vibrators and inciters: electric bell, whistles, raganella, stops and pistons mechanisms of wind instruments and the typewriter. These, however, do not represent further cases of a double function performed by one and the same body, but refer to sound generators whose inciters are immovable from and, as such, interact exclusively with their vibrators.

Like the bodies serving as vibrators or inciters and listed in individual material categories, so also the sound generators shown in the diagram are "old" and "new". Plainly, "new" generators are by necessity all those which contain bodies not employed traditionally as vibrators or inciters. Moreover, they arise also as new combinations of traditional vibrators and inciters. Such new pairs of bodies are, for instance, those consisting of triangle rod plus gong and bow hair plus tam tam, both of which occur in *Dimensions of Time and Silence*. From the point of view of the timbre system, however, all of them have equal weight as representatives of the individual material pairs enumerated in Chapter 5.2: "metal-metal", "metal-wood", "metal-leather", "metal-felt", "metal-hair", "wood-leather", "wood-hair", "wood-wood", "wood-felt", "leather-leather", "leather-felt", and "leather-hair". Still, mainly for practical reasons, the composer does not make use of all the theoretical possibilities of combinations between inciters and vibrators. This is why, as can be inferred from the diagram, not all material pairs are represented in practice. Pairs "wood-felt" and "leather-hair" indicate empty sets of sound generators.

Table 1. Classification of vibrators and inciters according to the material categories of Penderecki's timbre system

METAL	WOOD	LEATHER	FELT	HAIR
strings of stringed instruments in front and behind the bridge strings of the piano (*pianoforte*) and harp (*arpa*) snare of a snare-drum (*tamburo con corda*) bars of the vibraphone (*vibrafono*), glockenspiel (*campanelli*), and celesta tubes of the tubular bells (*campane*) bars of the xilorimba edges of membranophones: timpani, snare drums (*tamburi*), tom toms, and bongos triangle rod wire brushes gong, cymbals (*piatti*), tam tam, Javanese gong (*gong giavanese*) triangle (*triangolo*) mechanism of stops and pistons of wind instruments saws files suspended glass lamellae (*vetri*) glass bar (*vetro*) sheet metal (*lastra*) piece of iron (*ferro*) metal lamellae (*blocchi di metallo*) cowbells (*campanacci*) key mechanism of the typewriter (*macchina da scrivere*) fingernails whistles (*fischietti*) electric bell (*campanello elettrico*) bridges and tailpieces of violoncellos and contrabasses	bars of the xilorimba wood drums (*casse di legno*) wood blocks (*blocchi di legno*) claves parts of stringed instruments: sound board fingerboard bridge and tailpiece bow stick (including the nut) handle ends of beaters heads of hard sticks head of the mallet of tubular bells pencils or pieces of wood desk or chair piece of wood (*legno*) guiro and its stick rattle (*raganella*) hammers of celesta and glockenspiel (*campanelli*)	hand surfaces: palm and fingers skins of membranophones: timpani, snare drums (*tamburi*), tom toms, bongos, and conga drums	hammers of the piano heads of soft sticks	bow hair

Diagram 1. Sound generators in Penderecki's sonoristic pieces

	INCITERS \ VIBRATORS	METAL																															LEATHER					WOOD											
		strings of stringed instruments in front of the bridge	strings of the piano	strings of the harp	bars of the vibraphone	bars of the glockenspiel	bars of celesta	bars of the xilorimba	tubes of the tubular bells	triangle	cymbals	suspended glass lamellae	metal lamellae	cowbells	gong	tam tam	Javanese gong	sheet metal	edges of timpani	edges of bongos	edges of tom-toms	edges of snare-drums	mechanism of stops and pistons of wind instruments	key mechanism of the typewriter	electric bell	whistles	piece of iron	glass bar	metal lamellae	cowbells	strings of stringed instruments between bridge and tailpiece	bridges and tailpieces of violoncellos and contrabasses	skins of timpani	skins of bongos	skins of tom-toms	skins of conga drums	skins of snare-drums	wood blocks	wood drums	bars of the xilorimba	claves	desk or chair	handle end of a beater	guiro	rattle	piece of wood	fingerboards of stringed instruments	sound boards of stringed instruments	bridges and tailpieces of stringed instruments
METAL	triangle rod		X						X	X	X				X	X																																	
	mechanism of stops and pistons of wind instruments																						X																										
	key mechanism of the typewriter																							X																									
	electric bell																								X																								
	whistles																									X																							
	snare of a snare drum																																				X												
	saw																										X																			X			
	file																	X										X																					
	fingernail										X				X																				X														
	cymbal		X																																														
	strings of stringed instruments in front of the bridge																																														X		
	wire brush		X	X					X		X				X	X																	X	X	X														
WOOD	claves																																								X								
	head of a hard stick		X		X			X	X		X	X	X	X	X					X	X	X							X	X			X	X	X		X	X	X	X									
	handle end of a beater							X	X		X				X				X	X	X	X													X								X						
	head of the mallet of tubular bells								X																																								
	pencil or a piece of wood		X																																														
	hammers of celesta						X																																										
	hammers of the glockenspiel					X																																											
	bow stick (including the nut)	X																													X											X						X	
	stick of the guiro																																											X					
	rattle																																												X				
L.	hand surface (palm, fingers)	X	X	X							X				X																X		X	X	X	X											X	X	
FELT	head of a soft stick		X		X			X		X	X				X	X	X	X															X		X														
	hammers of the piano		X																																														
H.	bow hair	X									X					X															X	X																X	X

6.2. ARTICULATION OF BASIC SYSTEM

Like distinctive features of language, the categories of Penderecki's basic system are also defined beginning at the acoustical level. Therefore all three dependencies contained in translatory rules, which lead to elaboration of the articulatory definitions of individual categories, must be examined in the course of this chapter. The first step towards formulation of the translatory rules is an investigation of the dependencies between features of segments, expressed in terms of the categories, as defined acoustically earlier, and the acoustical features of their component sounds (1). In view of the mathematical models of categories elaborated in Chapter 5.1, the required dependencies are equivalent to relationships between intervals representing individual terms of categories in spaces of their acoustical parameters, and the values of those parameters taken by sound phenomena that comprise a segment determined by such terms.

The closest dependency between features of segments and their component sounds occurs in cases of categories whose acoustical parameters are frequency, intensity, and duration as the three basic physical attributes of sound. In order for a segment to be characterized by a given term, all its component sounds must take values that belong to an interval modeling that term within the space of a proper category. Such a situation happens in the case of categories "high vs. low register" and "extreme vs. middle register", both of which are founded on sound frequency, "loud vs. soft dynamics" based on intensity, and "temporal continuity vs. discontinuity", which in its first definition is based on a parameter of sound duration. Obviously, for a segment to represent high register, loud dynamics, or temporal continuity, each of its component sounds must also be high, loud, and temporally continuous, respectively. Conversely, low register, soft dynamics, and temporal discontinuity of a segment requires its sounds to be at a low frequency, quiet, and temporally discontinuous. The dependency under consideration thus has a direct character and takes the shape of identity.

Indirect dependency between segments and their sounds arises when the acoustical parameter of a given category, though concerning one of the three basic sound parameters, still is not identical with, but only derived from it. This is a case of the two remaining categories concerned with sound frequency: "spatial continuity vs. discontinuity" and "spatial mobility vs. immobility", their acoustical parameters being results of frequency values. Plainly, every such result can be achieved from a subtraction of values embodied in either one or two different sound phenomena. When the values are embodied in one and the same sound, then a feature of a segment is vested also in its individual sound components, as in the previously discussed type of category. Values of an acoustical parameter taken by every single sound belong to an interval proper for a term represented by the segment. On the other hand, when the frequency values, from which the result of frequencies is calculated, are embodied in two different sounds, then the values of component sounds can be elements of an interval modelling a term of a given category other than the one actualized by the segment to which they belong. Thus, the change of frequency value characteristic of "spatial continuity" can happen either continuously within the same sound phenomenon (glissando) which is spatially mobile in itself, or also as a skip between two different sounds even though each of them is immobile as such. Similarly, in the case of "spatial continuity" the difference in frequency values can be measured either within a band constituting a spectrum of a single sound phenomenon or between different, separately produced sounds, which, taken individually, are spatially discontinuous.

Characteristically, however, in both those cases the values of an acoustical parameter taken by individual sounds, if not belonging to an interval proper for its given term, are always lower than the values of that interval. This is so since the cooperation of different sound phenomena can only enlarge, and never reduce the frequency results inherent for each of them. Therefore the non-identity relationship between features of segments and of their component sounds happens only in the case of terms represented by intervals in relation to which there exist still lower values. If a term is represented by an interval containing the lowest values of a parameter within a space of a given category, such a case cannot happen. Hence the terms opposite to the two last-mentioned ones within their proper categories—"spatial immobility" and "spatial discontinuity"—require identity with features of component sounds: all sounds belonging to segments that represent "spatial discontinuity" and "spatial immobility" must also necessarily be spatially discontinuous and immobile, respectively.

In Penderecki's basic system, however, there exist two categories whose parameters are not derivatives of any acoustical parameters of single sounds: "maximal vs. minimal time-span" and "temporal mobility vs. immobility". Significantly, both of them are temporal categories. This is so since, in contrast to frequency and intensity, which are inseparable from concrete sound phenomena, time as a constant determinant of musical reality can occur independently, its values not necessarily embodied as durations of any individual sounds. Instead, in the two given cases, they are measured between the onsets of successive sounds. From the above remarks it follows that, as regards those two categories, any dependency between their terms as features of segments on the one hand, and features of individual sounds on the other, does not exist.

Now that the problem of relationships between segments and their component sounds have been elucidated, one can return to the question of single-sound segments as liminal cases of sonoristic syntactical units. Obviously, a given segment can consist of one sound only inasmuch as that single sound represents all features of that segment, i.e., its constitutive terms chosen from individual categories. As follows from the former discussion, this is always the case with simple atemporal terms of categories dependent (directly or indirectly) on features of their component sounds, i.e., those categories whose acoustical parameters are identical with or derived from one of the three basic physical attributes of sound: intensity, frequency, and duration. Also, continuous versions of transitions between opposite terms of those categories can be embodied in one long-lasting sound. However, by definition any single sound can never represent terms of the two, last-mentioned categories ("maximal vs. minimal time-span" and "temporal mobility vs. immobility"), because their common parameter is a time-span between the onsets of successive sounds, and thus it assumes the occurrence of at least two sound phenomena. Since every segment is determined by a set of terms chosen from all categories, this would preclude the possibility of one-sound segments in general. Yet, in practice, if the time-span is large enough, the following of two consecutive sounds can belong already to the next segment. Consequently, also the positive term of "maximal vs. minimal time-span" as well as version 2 of the negative term of "temporal mobility vs. immobility" may be represented by a single sound.

With regard to the basic system, the next step in the "translatory rules" consists in settling the dependencies between values of the acoustical parameters of individual categories taken by single sounds on one hand, and the parameters of the processes of sound generation on the other (2). For the elaboration of articulatory definitions this is of practical importance only inasmuch as it leads each time to the discovery of a motoric parameter by means of which the acoustical parameter of a given category can be regulated. Such a motoric parameter is that from among several pertinent aspects of a sound generation process which, provided all the others are equal, keeps a proportional link with the acoustical parameter.

The closest motoric correlates of the three basic physical attributes of sound covered by the basic system—frequency, duration, and intensity—are, respectively, the size of a vibrating body, the duration and the force of the excitation event. Thus the motoric parameters of all categories concern exclusively a vibrator and an excitation. At this point the articulation of the basic system appears to differ from that of the timbre system, for which the only relevant factors of sound generation processes are interacting bodies (vibrators and inciters), the way of exciting the former by the latter being left aside. Consequently, as applied to the basic system, the last link in the translatory rules (3) consists in determining the available values of each motoric parameter for either vibrators or for excitation events involved in individual sound generation processes of Penderecki's sonoristic pieces. As will be demonstrated, in cases of some motoric parameters the range of values available for a given sound source or excitation event is contingent upon further properties of those two component factors of sound generation processes. Such properties thus become bases for classification of vibrators and excitations according to the basic system.

With regard to vibrators, their classes will be divided in consideration of constructional properties. Now, the very notion of construction reasonably applies only to solid substances. Thus, as with the timbre system, air as an originally designed sound source of wind instruments and the human voice will be omitted here in classifications of sound sources on the grounds of the basic system categories. Those classifications will thus be confined to bodies listed as vibrators in Diagram 1. Yet, in contradistinction to the material categories of the timbre system, individual terms of basic system categories can also be articulated by singing or blowing. Therefore, these two latter kinds of sound generation had to be taken into account by the composer in his elaboration of articulatory definitions. Accordingly, singing and blowing will in the following discussion be considered as the equivalents of particular classes of vibrating bodies. Still, it is essential to bear in mind that their affiliation will always be indirect. This is so because they will be classified not in consideration of the construction of an air vibrator, but merely in virtue of their sharing a range of values of an acoustical parameter of a given category equivalent to a range of the motoric parameter conditioned by the constructional property constitutive of a given class of sound sources and, as such, available for solid bodies forming the set of its proper representatives.

After the translatory rules are elaborated, the articulatory definitions of individual categories of Penderecki's basic system will be formulated, which is the ultimate goal of this chapter. Each definition will specify all the ways in which every term of a category (i.e., every interval of its proper acoustical parameter) can be obtained in a segment. Plainly, for individual sound generation processes this specification is possible only in so far as values belonging to an equivalent interval of the motoric parameter of a given category occur. If this category leads to classification of vibrators or excitation events, all ways of accomplishing such values for each class will be given. However, as stated previously, in the case of categories whose acoustical parameters are derivatives of frequency—"spatial continuity vs. discontinuity" and "spatial mobility vs. immobility"—some terms characterizing segments need not be represented by all the component sounds but, on the contrary, can also be accomplished by the co-occurrence of several sounds which, if taken individually, would represent some other terms. In consequence, intervals of the motoric parameters equivalent to such terms can thus be articulated by the cooperation of several sound generation processes. Note, however, that an interval of values of a motoric parameter ensures the occurrence of an equivalent interval of an acoustical parameter and, in further consequence, brings about a given term only in so far as the sound generation processes that take place cooperatively do not display differences concerning any other aspect pertinent for a given category. If such additional differences happen, the proportional link between the motoric and the acoustical parameters of a category is broken, whereby, for articulation of its terms, the occurrence of equivalent values of the motoric parameter is no longer either sufficient or necessary.

Individual ways of articulating terms of basic system categories will be illustrated with musical examples chosen from the scores of Penderecki's sonoristic pieces. Yet even if in the context of a given category every such example is discussed in consideration of the single term it represents, it is in fact always a bundle of several terms chosen from all the categories, i.e., the realization of a segment. In this way, one musical example can be used to illustrate terms of different categories. The categories themselves will in turn be discussed in order of the basic physical attributes of sound to which they refer: frequency, intensity, and duration. The latter, temporal parameter will have its continuation in the categories "temporal mobility vs. immobility" and "maximal vs. minimal time-span". As independent of sounding acoustical properties, those two categories are not connected with any aspects of individual sound generation processes and, consequently, do not call for classification of either sound sources or excitation events.

As with the case of acoustical definitions, the following discussion will concern only the simple terms of individual categories. Still, not all of them will be separately defined on the articulatory level. This is so since, as regards equivalent terms of different categories, their articulatory definitions would have to contain redundant specifications of the same articulatory phenomena. As pointed out in the paragraph on "Formal incompatibilities" (see 5.1.1), this problem of equivalencies between terms concerns mostly the following, hierarchically linked binary oppositions: "high vs. low register" and "extreme vs. middle register", "minimal vs. maximal time-span" and "temporal mobility vs. immobility". Therefore, in this chapter only one of the interrelated categories forming such a hierarchical pair will be defined in its entirety; the articulatory definition of the other will be confined to those of its terms which do not have their regular equivalents among simple terms of the former.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY

Since sound frequency remains in a proportional link to the distance travelled by the pulse within the body of a vibrator, the result of frequencies, which constitutes the parameter of the category "spatial continuity vs. discontinuity" in both its acoustical definitions, is directly proportional to the result of such distances; in turn, the latter is identical with the result of the sizes of a vibrating body measured along the direction of the pulse's travel. In order to make practical use of this motoric parameter, however, one must know the direction of the pulse as it travels within a vibrating body. In other words, one needs a theory of sound-source acoustics. Analysis of the way in which sound sources are operated in Penderecki's sonoristic pieces suggests that the theory assumed by the composer constitutes an idealization of real acoustical processes. This idealization is simplified in that it does not account for different modes of vibration happening simultaneously within a vibrating body. In this way Penderecki omits the problem of particles—an extremely vague one in the case of percussion instruments as well as new sound sources—yet still gaining an approximation of sound phenomena sufficient to operate effectively his highly differentiated set of vibrators, even if—as will turn out—the cost he had to pay for this simplification were arbitrary classifications of some vibrators.

According to this idealization, the pulse as a transverse disturbance or wave radiates uniformly in all directions in the space set up by pertinent dimensions of a vibrator. Every distance traveled by the pulse thus equals a section that cuts across the point of excitation and that is confined by the edges of the vibrating body. Since every direction fixes one distance, it therefore follows that, for a single vibrating body, the result of such distances can be greater than zero only if the pulse travels simultaneously in several different directions. The number of directions varies, in turn, with the number of pertinent dimensions of the vibrating body. Obviously, every vibrator is three-dimensional, but the sizes of those dimensions need not be comparable. If a size of some dimension is negligibly small in comparison with one of the others, such a dimension is to be considered as non-pertinent. Therefore the classification of vibrators according to the category "spatial continuity vs. discontinuity" is made with respect to their shape as one-, two-, or three-dimensional bodies.

One-dimensional bodies are those whose width and thickness are negligibly small in comparison with their lenght. The latter thus fixes the only direction along which the pulse is supposed to travel. Consequently, the length of a given body equals the single distance to be run by the pulse. In contrast, the pulse itself forms a sideways movement of the vibrator in its two non-pertinent dimensions of width and thickness (see Taylor 1980: 552).

Characteristically, this class of sound sources contains only metal bodies. Here belong the strings of stringed instruments, piano and harp, the tubes of tubular bells, as well as the bars of vibraphone, glockenspiel, celesta, and xilorimba, the latter inasmuch as considered substitutes for metal (see previous chapter). Also, the triangle, being comprised of a single rod, is ranked among the one-dimensional bodies, though it is of curved and not straight shape. The classification of the triangle is supported by numerous cases in which it is used together with other one-dimensional vibrators as an integral component of their class; for instance, as in Example 1 from *Dimensions of Time and Silence*.

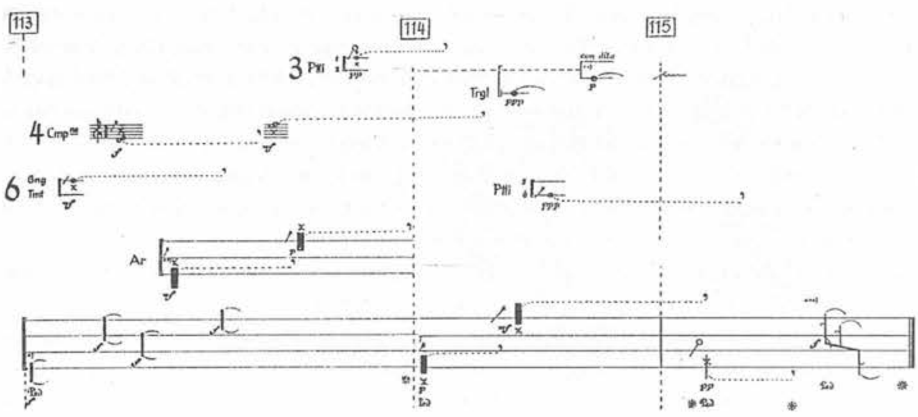
According to Penderecki's idealization of vibration processes, a single distance traveled by the pulse in one-dimensional bodies brings about a single frequency value; this means that their sounds are always to be considered as spatially discontinuous. And, since in perception a single frequency is assigned to a single pitch, this class of vibrators should produce sounds of definite pitches. Indeed, the idealization is effective, in that the above-listed sound sources are almost identical with the originally designed vibrators of tuned instruments, i.e., those instruments whose sounds produce definite pitches. Because pitch is an attribute of sound sensation, in the case of tuned vibrators the elaboration of articulatory definitions of this and the two following categories, which are founded upon the acoustical parameter of frequency, is transferred from the motoric back to the perceptual level. Thus, in order to determine which terms of these categories are accessible to one-dimensional vibrators, one need not consider the size of the vibrators, but only the pitches assigned to them. Definite pitches are also vested in singing and traditional play on wind instruments, whereby both those ways of sound generation constitute equivalents of the class of one-dimensional vibrating bodies. In turn, among proper solid representatives of that class, one exception to the rule of definite pitches is to be found, which is a triangle as the only untuned one from among one-dimensional vibrators. Otherwise, as one will see, the problematic position of that sound source is further reflected in its double classification.

Characteristic of the class of *two-dimensional* vibrating bodies is that their thickness is negligibly small in comparison with their length and width. In a plane fixed by those last two dimensions, there exists an infinite number of different directions and, consequently, an infinite number of distances available to the pulse construed as a transverse disturbance in the non-pertinent dimension of thickness. Provided a vibrator be round and excited at its periphery—as is the case with most two-dimensional sound sources used by Penderecki, such as the plates of gongs, cymbals, and tam tam, and the skins of membranophones— the distances traveled by the pulse in different directions will form unequal chords of a circle. While in such a situation the maximal result between chords sizes is significant, the infinite number of chords means that the minimal result of their sizes leads toward zero. Therefore, according to Penderecki's idealization of vibration processes, the sound of a two-dimensional body is considered as a noise, i.e., as a spatially continuous phenomenon, in both the perceptual and the strictly acoustical sense. Even if this is not in compliance with the factual acoustical complexity of sounds produced by vibrating bodies that are reckoned to the two-dimensional class,[1] such an approximation accounts quite well for the spatially continuous character of their perception.

[1] Vibrators belonging to the class of two-dimensional bodies usually produce sounds of mixed acoustical characteristics, joining features of noise and non-harmonic overtones.

In addition to the aforementioned plates and striking surfaces of membranophones, to the same class of two-dimensional sound sources there belong other metal and leather bodies: suspended lamellae of metal and plates of glass, sheet metal, as well as several vibrators whose two-dimensionality is far less obvious. One of these last is cowbells considered as small plates of a specific form. Furthermore, as virtual metal plates the composer includes here the surfaces of harp and piano strings. The tubes of the tubular bells, previously counted among one-dimensional bodies, are now viewed differently—as rolled up plates—and hence are classified alternatively as two-dimensional. Slightly similar is the case of vibraphone bars: sometimes their width is considered by the composer as negligibly small in relation to their length, which allows them to be ranked among one-dimensional vibrators. Other times those two dimensions are seen as comparable and pertinent in contrast to the non-pertinent dimension of thickness.[2] In the latter case, vibraphone bars are qualified as two-dimensional vibrating bodies. The triangle represents an extreme example of the arbitrary classification of vibrators. If numbering that vibrator among one-dimensional bodies was based on the interpretation of its shape as a curved rod, when included in the two-dimensional class it is reinterpreted as the (otherwise non-existent) virtual surface of a triangle, fixed by its three sides which form the actual body of the instrument. This claim—that the composer considers the triangle occasionally as a two-dimensional vibrator—is proved by musical passages where it cooperates with other two-dimensional bodies as an integral item of their class, as in the following section of *Anaklasis*:

Example 4: *Anaklasis*, 113-115



The above example also shows the other substitutes of two-dimensional bodies, as mentioned earlier: harp, piano, and tubular bells. Note that, in the cases of harp and piano, their alternative classification as two-dimensional vibrators influences the notation: their sounds are construed as unpitched, pitch being a property vested only in one-dimensional bodies. True, the pitch is notated for the tubular bells, yet that is only in order to indicate the two neighboring tubes and ultimately constitutes a tool for obliterating the pitch. Otherwise, when used as two-dimensional bodies together with other representatives of this class (cymbals, gong, tam tam, timpani, bongos, tom toms) in an earlier section of the same piece (25-37; see Ex. 14), the bell tubes are notated as having indefinite pitch.

[2] This stems plainly from the logical indistinctiveness of the notion of "sufficiently small size", which by necessity denotes a fuzzy set of values.

Also, vibraphone sounds are used so as to obliterate their pitch, in cases when the bars of this instrument are treated as two-dimensional bodies. As with the bells, this is achieved by the choice of neighbouring bars, which reflects in the notation as definite pitches being preserved (*Fluorescences*, 31; Ex. 33). Finally, the obliteration of definite pitch can take place not only by neighboring pitches performed by the same kind of vibrator, but also by two different tuned vibrators, which are alternatively classified as substitutes for two-dimensional bodies. Such a rare case is found in *Anaklasis*, where vibraphone and tubular bells play the pitches c^{1}♯ and c^{1} respectively. In the following example, the perception of these pitches individually is hindered both by their closeness to each other and by the simultaneous occurrence of sounds produced by metal plates (cymbals, gong and tam tam):

Example 5: *Anaklasis*, 107-110

At first glance, one would think that in *three-dimensional* bodies, as in two-dimensional ones, the number of directions traveled by the pulse should also be infinite. Yet, in such bodies there exists no "free", non-pertinent dimension, transverse to pertinent ones, in which sideways motion of the body (i.e., the pulse itself) could arise. A conclusion drawn from this fact by the composer is that, in consequence, the pulse is stopped at the point of excitation so that it runs no distance at all. With respect to the composer's idealization of acoustical processes, in three-dimensional sound sources the real vibrating body is thus the point of excitation itself, i.e., a zero-dimensional object.[3] For this reason, the motoric parameter of the discussed category, based on the size of a vibrating body, i.e., the distance traveled by the pulse, does not apply here. Instead, in his sonoristic pieces Penderecki interprets sounds produced by three-dimensional sound sources according to a very particular principle, as a sort of projection from the physical surface of a vibrator into a space of frequency values. As a result of such a projection, the equivalent of a single vibrating point is a single frequency value, whence the "clicks" of three-dimensional vibrators are considered by the composer as spatially discontinuous phenomena.[4]

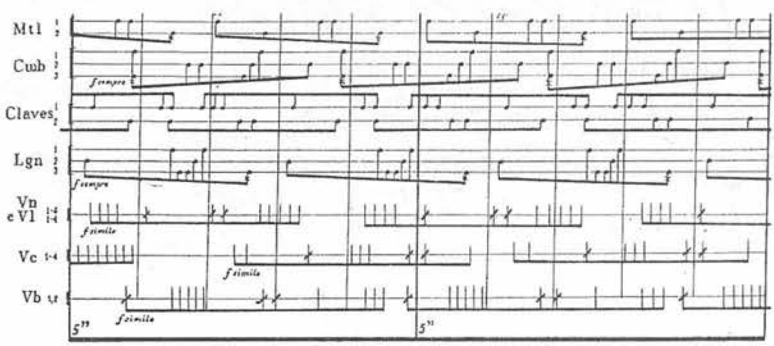
The following belong to the class of three-dimensional vibrators: the bodies of wind instruments, the edges of membranophones, the electric bell, typewriter, a piece of iron (which occurs in *Fluorescences*, where it is scraped with a hand-saw), and whistles, in so far as they are treated as a generator consisting of metal vibrator and inciter. In stringed instruments, the strings between bridge and tailpiece substitute for metal three-dimensional bodies. Though each individual string

[3] Of course, if such a description of vibration processes in three-dimensional bodies were true, no sound would arise at all. In reality, the vibration emanates from the point of excitation to other points of the body, but—and here the composer's idealization holds true again—it is soon dampened.

[4] Interestingly, new acoustical experiments show that even sounds of definite pitches, which are spatially discontinuous from the point of view of Penderecki's system, are perceived as "clicks" devoid of any determined frequency value if exposed very briefly (Spender 1980: 399). This finding might support Penderecki's classification of such clicks as spatially discontinuous sounds.

is obviously only a one-dimensional body, when taken as an integral set they are classified by Penderecki as three-dimensional. This classification is also supported by the fact that they produce sounds of indefinite pitch. Also, bridge and tailpiece may be substitutes for metal and the equivalent of strings between bridge and tailpiece in a low register (see previous chapter), whereby they are included in the discussed class. The last metallic three-dimensional vibrating bodies are metal lamellae and cowbell. Though considered two-dimensional when suspended, these instruments are counted as three-dimensional when they are laid on something that supports them. In such a position they are immediately dampened, which makes them akin to other three-dimensional bodies (see also the section on "temporal continuity vs. discontinuity", below). An example of such usage appears in *Dimensions*:

Example 6: *Dimensions of Time and Silence*, 175-183



In the above example, metal lamellae and cowbells as substitutes for three-dimensional bodies sound together in one layer of the narration along with other representatives of this class: claves, wood drums as well as the sound boards and fingerboards of the strings. Indeed, apart from the above-listed metal vibrators, the class of three-dimensional bodies includes all wooden bodies, irrespective of their actual shape. This inclusion is an effect of the assumed idealization, which appears to cover this last class of vibrating bodies in the least adequate way. If Penderecki's acoustical theory complied with the real physical image of vibration, the wooden plates, such as sound boards of stringed instruments or desks, would be reckoned among the two-dimensional vibrators and would share all the acoustical properties of that class. Yet the features of their sounds, as momentary, immediately dampened "clicks", make them fit better with three-dimensional than with two-dimensional vibrators. Paradoxically, it is thus not their shape (the number of pertinent dimensions) that conditions their sound properties, but rather the sound properties which form the basis of their classification as substitutes of bodies of three-dimensional shape.

Wooden vibrators provide us with the last example, and a very unusual one, of the arbitrary double classification of a single vibrator. This example is the xilorimba. When treated as substitutes of metal bodies, its bars belong to the class of tuned instruments and its notes are written as determinate pitches, as one can see in Example 1 (*Dimensions*, 4-8). Yet, when used as conforming to its actual material and together with other wooden bodies such as claves and wood drums, the xilorimba part is notated as indefinite pitches (see *Anaklasis*, 25-31; Ex. 14). Because at the base of the double classification of this instrument as either a one- or three-dimensional vibrator lies its twofold material classification, this variability of notation brings further evidence of the polyvalence of the xilorimba as a representative of either metal or wooden bodies (discussed above, in the previous chapter).

The classification of vibrators according to the number of their pertinent dimensions into classes of one-, two-, and three-dimensional bodies relevant to the category "spatial continuity vs. spatial discontinuity" is summarized below in the table. Moreover, as vocal equivalents of three-dimensional vibrators are to be considered consonants pronounced in *Dimensions of Time and Silence* by choral voices. This is so since—seen from the acoustical angle—they form "clicks" devoid of definite pitches and, as such, comparable with those produced by sound sources belonging to the last discussed class.

Table 2.

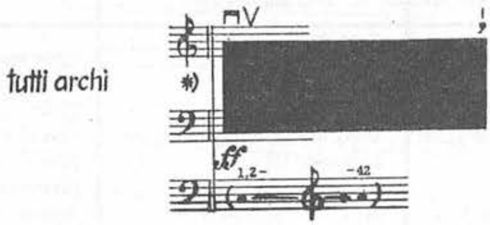
ONE-DIMENSIONAL VIBRATORS	TWO-DIMENSIONAL VIBRATORS	THREE-DIMENSIONAL VIBRATORS
strings of stringed instruments in front of the bridge bars of the vibraphone, glockenspiel (*campanelli*), and celesta bars of the xilorimba strings of the piano (*pianoforte*) and harp (*arpa*) tubes of the tubular bells (*campane*) triangle	gong tam tam cymbals (*piatti*) Javanese gong (*gong giavanese*) sheet metal (*lastra*) bars of the vibraphone tubes of the tubular bells (*campane*) strings of the piano (*pianoforte*) and harp (*arpa*) triangle metal lamellae (*blocchi di metallo*) glass lamellae (*vetri*) cowbells (*campanacci*) skins of membranophones: timpani, snare drums (*tamburi*), tom-toms, bongos, and conga drums	wood blocks (*blocchi di legno*) wood drums (*casse di legno*) claves desk or chair piece of wood (*legno*) bars of the xilorimba wooden parts of stringed instruments: fingerboard, sound board, bridge and tailpiece handle ends of beaters strings of stringed instruments between bridge and tailpiece guiro rattle (*raganella*) stops and pistons of wind instruments key mechanism of the typewriter edges of membranophones: timpani, snare drums (*tamburi*), tom toms, and bongos electric bell (*campanello elettrico*) whistles (*fischietti*) piece of iron (*ferro*) glass bar (*vetro*)

Positive term (+)

As one has seen, the values of motoric parameters characteristic of the positive term of the category "spatial continuity vs. discontinuity" are unavailable to any single one-dimensional vibrator. Yet spatial continuity can be accomplished in that class of vibrating bodies as a consequence of cooperation between several vibrators of the same kind, i.e., vibrators that share the same material and constructional properties. (Since these properties are of relevance for sound frequency, their identity is a necessary condition if the proportional link between the motoric and the acoustical parameter of the category is to be kept). This continuity arises from the simultaneous vibration of a group of such bodies, in which the results of closest-size values (length) are sufficiently small, while the maximal difference in size is quite large. For tuned vibrators—which are almost all one-dimensional sound sources—their differences in size have equivalents in differences of pitch. The above-described cooperation of vibrators of the same kind but different sizes results thus in a cumulation of minimally different pitches covering a considerably broad range. Such a phenomenon, called a "cluster", numbers among the most characteristic sound effects of Penderecki's sonorism.

Relying on the common scale of pitches, and abrogating the rule of identity as to material and constructional properties between simultaneously vibrating bodies, clusters can be built up by tuned vibrators of different kinds. Even so, in Penderecki's scores there prevail clusters produced by a single kind of vibrator. A perfect example is a cluster from *Anaklasis* played on the strings of all 42 stringed instruments used in that piece:

Example 7: *Anaklasis*, 3



As several commentators on Penderecki's music have observed, the internal structure of clusters (i.e., the distances between their component pitches) varies considerably from case to case. The smallest distance between pitches in Penderecki's scores is the quarter-tone. Theoretically, quarter-tones are accessible on all one-dimensional vibrators of changeable sizes (see below, on "spatial mobility vs. immobility"). In practice, however, intonational difficulties of human voices and wind instruments produce quarter-tone clusters serviceable only in the strings. Traditionally played stringed instruments also perform the unique 3/4-tone cluster in *Polymorphia* (5; Ex. 22). The tunings of most instruments as well as traditional instrumental techniques predetermine the most popular minimal interval to be a semitone. Semitone clusters are practicable on any tuned vibrators. However, the intervals between neighbouring tones of a cluster need not be the smallest accessible ones. Very typical is the whole-tone cluster, comparable in number of occurrences to those using semitones.

Since in the space of results of neighbouring simultaneously occurring frequencies, which underlies the second acoustical definition of the discussed category, spatial continuity is represented by a fuzzy set being a neighbourhood of zero, i.e., by an interval whose upper limit cannot be univocally stated, also the maximal interval between neighbouring pitches of clusters as spatially continuous phenomena is flexible. Its choice depends usually on the number of vibrators at the composer's disposal for a given cluster and on the registral, or frequency, field the composer intends to cover. In Penderecki's sonoristic works, the largest interval between individual pitches is the fourth. As Zieliński aptly observes, "enlarging the distances between pitches does not annihilate the essence of a cluster, but merely changes its internal structure and at the same time widens its range" (Zieliński 1968: 83). It seems that crucial point in forming clusters is not so much the size of intervals between adjacent pitches in itself, but rather that the identity and equality of that size thoroughly dominate the cluster. This situation produces the impression of an evenly covered sound field, whose individual, simultaneously occurring pitches are (at least according to composer's intention) not to be perceived as such by the listener because of their very high number, which reaches up to eight or even twelve.

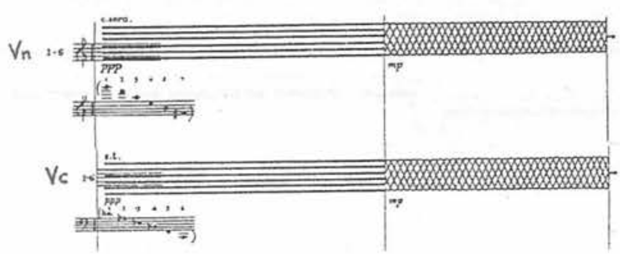
> Of course, in case of such a number of superimposed pitches one loses a feeling of a regular quartal chord. . . . In the case of eight or twelve fourths we hear simply a very broad and saturated sound and recognize only its internal structure, i.e., the fact that there is some rather large distance kept between its individual pitches. It is thus a cluster-like type of perception. (Zieliński 1968: 84)

Zieliński makes these comments with regard to a rare instance of a fourth cluster in *Polymorphia*:

Example 8: *Polymorphia*, 27-28

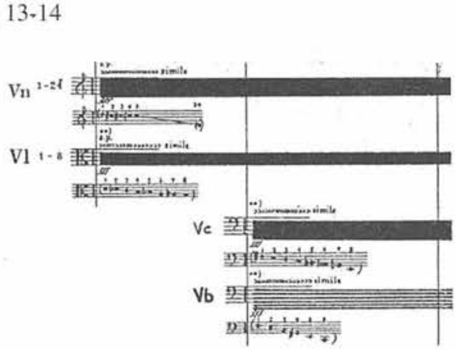
Another example of quartal structures in Penderecki's sonorism is the one played by six violins and six cellos in *Fluorescences* (37-39; see Ex. 9, below), which brings additional evidence in support of the above statements. That the composer treats this as a cluster—i.e., as a spatially continuous phenomenon—is testified to by the sinusoidal glissandi of its single component tones within its whole range, which emphasizes the integral nature of the covered sound field. Otherwise such "internally mobile clusters" occur only in dense, univocally continuous structures (see, for instance, *Polymorphia*, 8-15, cellos and basses; *Fluorescences*, 29-30, violins 1-14).

Example 9: *Fluorescences*, 37-38



A rare exception to the "rule of equidistance" happens in clusters where the distances between component pitches are gradually enlarged downwards. Such "graded" clusters are thereby adjusted to the peculiarity of human hearing in that the discernment of individual sounds becomes more difficult, the lower their frequencies:

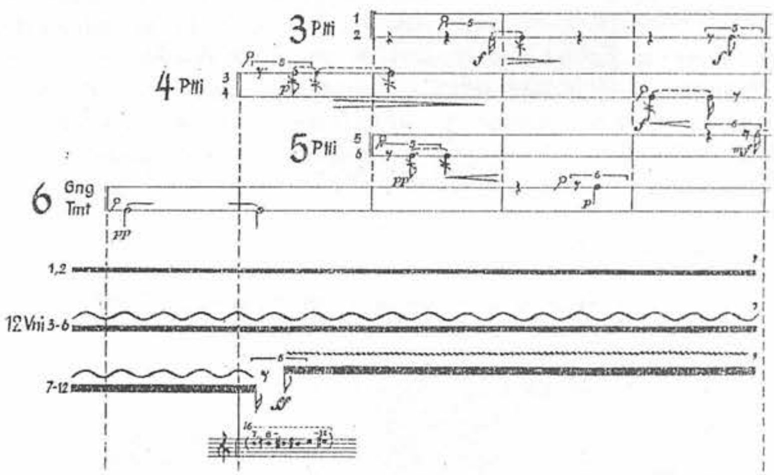
Example 10: *Fluorescences*, 13-14



Finally, an indeterminate internal organization is manifest in clusters arising as bands of highest or lowest possible sounds, produced by vibrators of changeable pitch such as the strings of stringed instruments, human voices, and winds (see below, "high vs. low register"). A similar result also arises from playing on double reeds and mouthpieces of woodwinds and brass.

Because, on the basis of the composer's idealization, all two-dimensional bodies display such values of motoric parameters of the discussed category, that are representative for "spatial continuity", this class of vibrators is particularly apt for the positive term in question. Interesting evidence that sounds produced by two-dimensional vibrators are treated as spatially continuous phenomena can be seen when they occur as counterparts of clusters, as in the following example from *Anaklasis*:

Example 11: *Anaklasis*, 17-21



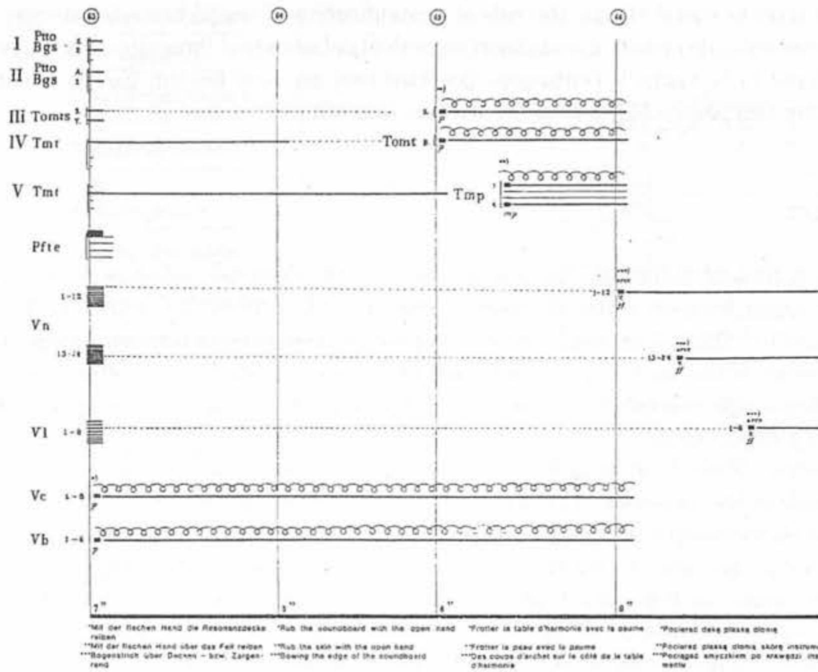
Three-dimensional bodies were acknowledged previously to produce spatially discontinuous sounds because their pulse stopped at a single point of excitation understood as the equivalent of a single frequency value in the projection made by the composer from the surface of a vibrator onto the axis of frequencies. The excitation area need not be limited to a single point, however.[5] If it constitutes a broader integral area of a vibrator's surface, consisting of an infinite number of points, its equivalent in the space of frequencies will be a section. In this way, and in keeping with his idealized criterion, the composer was able to conceive of a way to generate spatially continuous sounds on three-dimensional vibrating bodies.

The way to excite broader areas of three-dimensional vibrators is to rub them.[6] This means of excitation is represented by rubbing the sound boards of stringed instruments with the palm of the hand, as Penderecki requires the performers to do in *Fluorescences*:

[5] In fact, it never is, since a point as a zero-dimensional object of no size is only a mathematical idealization, while obviously every concrete excitation of a vibrating body concerns always an area of some—even though very limited—size.

[6] In other classes of instruments a broader area might be also excited by striking, as in the case of wire brushes or of pieces of wood thrown onto piano strings.

Example 12: *Fluorescences*, 63-66



Because rubbing is a way of producing temporally continuous sounds (see below, on "temporal continuity vs. discontinuity"), the composer's interpretation of sounds produced by three-dimensional vibrators follows the rule of "predomination of temporal continuity over spatial continuity". This means that every sound generated by bodies in the three-dimensional class is always spatially continuous if it is also temporally continuous. This rule holds true also for the substitute for three-dimensional vibrator, whichsaid substitute is the strings of stringed instruments played between bridge and tailpiece. Even if strings do not actually constitute a three-dimensional body, and though to rub (bow) them means always only to excite single points of one or, at most, two strings simultaneously, the effect on several instruments is a band of frequencies similar to a cluster. Such compliance with sound properties of the other three-dimensional bodies explains why strings between bridge and tailpiece are ranked by the composer among this class of vibrators in spite of the obvious fact that they differ from them as to construction.

The excitation of broader areas also allows for the enhancement of the spatial continuity of sounds produced by two-dimensional instruments. In the above example, not only are the sound board surfaces of cellos and contrabasses rubbed with the palm of the hand, but also the skin surfaces of tom toms and timpani. The similarity between sounds generated by those vibrators of two different classes proves up perfectly what was said above as regards the accessibility of spatial continuity for three-dimensional bodies. Moreover, techniques of exciting broader surfaces, such as playing with wire brushes or with the fingers (*con dita*), help to emphasize the two-dimensionality of vibrators that are classified in parallel to the one-dimensional class, such as piano, harp, vibraphone, or tubular bells. Most likely, at the base of those techniques—which otherwise, in the case of two-dimensional bodies, are not indispensable in the production of spatial continuity—there lies the composer's experience with three-dimensional vibrators.

In application to choral effects, the rule of predomination of temporal continuity over spatial continuity causes that consonants—as vocal equivalents of sounds of three-dimensional bodies—are considered to be spatially continuous provided they are long lasting, like /sz/ required by Penderecki in paragraphs 149-157 of *Dimensions* (Ex. 49).

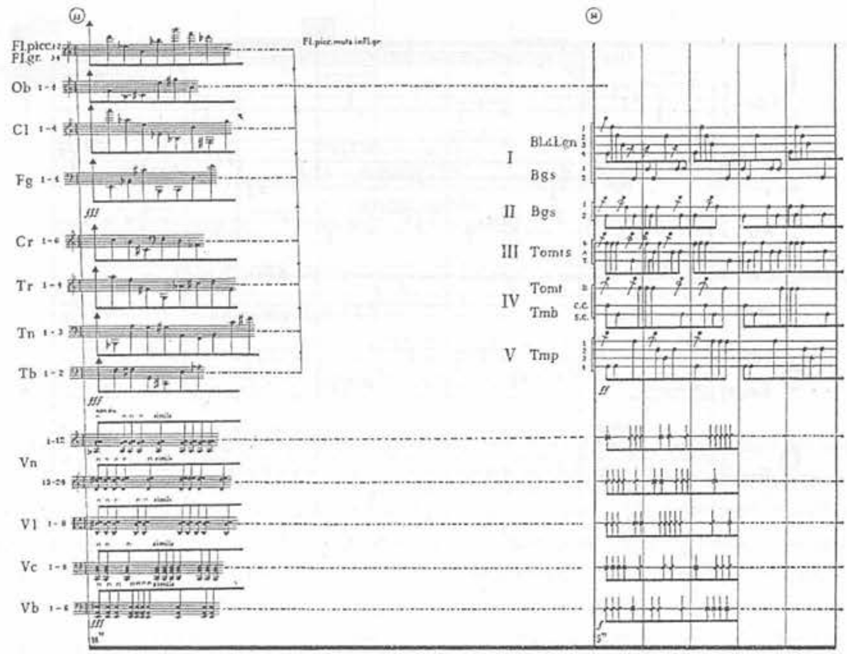
Negative term (-)

According to its first definition, the negative term of the discussed category arises when the maximal result of distances run by the pulse(s) amounts or is sufficiently close to zero (version 1). This happens in the case of any single one-dimensional vibrator, as well as of several simultaneously vibrating bodies of the same kind and size, and brings about a single pitch. Otherwise, a single pitch constitutes the touchstone of spatial discontinuity, even if it is performed by several tuned vibrators of different kinds.[7]

In the second version, the negative term of "spatial continuity vs. discontinuity" arises from several remote pitches dispersed in the musical space. In contradistinction to large-interval clusters, the intervals between such pitches are unequal, and the pitches themselves occur, as a rule, non-simultaneously. The same version of the negative term occurs also by the cooperation of several three-dimensional vibrators, which produce an array of "clicks" extending across the musical space. The similarity of these clicks to the several remote pitches of tuned instruments is evidenced strikingly in the example below. There the field of several distant pitches in the winds is superseded by a field of individual clicks on three-dimensional bodies. The change concerns only the timbre, while the spatial discontinuity is preserved in both cases:

[7] In the case of several simultaneously vibrating bodies the frequency value will never be identical, yet this fact does not disturb the negative term as it is represented on the acoustical level by an interval of frequency values whose upper limit is not stated univocally.

Example 13: *Fluorescences*, 55-56



Two-dimensional instruments that produce vibrations of several frequency values maximally close to each other are basically unable to produce spatially discontinuous sounds. Yet, using the same reasoning by which he arrived at a way to produce spatially continuous sounds on three-dimensional instruments, the composer also conceived of a situation in which two-dimensional vibrators may bring about point-like discontinuity. As stated above, three-dimensional vibrating bodies were made to produce spatially continuous sound phenomena by way of rubbing them, whereby their vibrating surfaces become expanded from one-dimensional points of excitation upon two-dimensional areas. Conversely, a two-dimensional vibrator would produce a spatially discontinuous sound if its vibrating area is reduced to a single point. In the acoustical idealization assumed by Penderecki, this can be accomplished if a vibrator is damped immediately after its excitation, whereby the disturbance cannot travel. The resulting "click" thus resembles the sounds of three-dimensional bodies, in being perceived as a point rather than as a band of sound in musical space.

Since such a momentary, immediately dampened vibration results always in a temporally discontinuous sound, one can formulate a rule of "predomination of temporal discontinuity over spatial discontinuity", which means that even in two-dimensional sound sources the sound product is treated as discontinuous spatially if it is also discontinuous temporally. That rule manifests itself in sections consisting of a medley of momentary sound phenomena produced on both two- and three-dimensional bodies. The obvious intent in such cases is to create an integral sound field characterized by spatial discontinuity:

Example 14: *Anaklasis*, 27-31

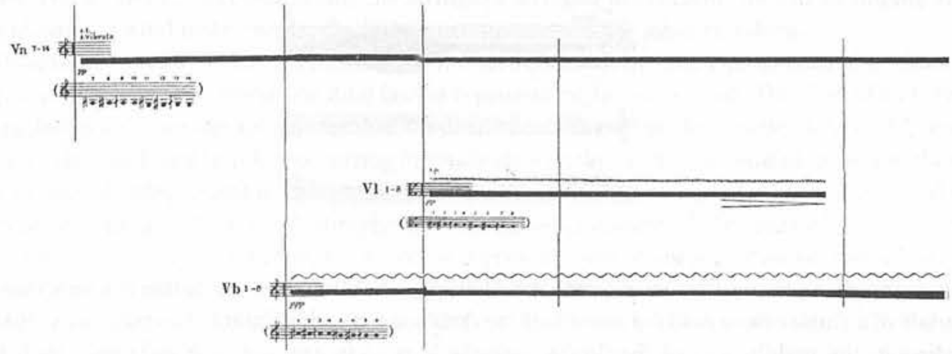
Note that in the above example there occur strikes at the center of the cymbal (ptti 1, 2). In view of the composer's idealization of acoustical processes, striking at the center is conducive to spatial discontinuity, since distances traveled by the pulse in a round body excited at its central point—such distances being equivalent to imaginary chords running across the center of a circle—are equal and constitute its diameters, which should theoretically result in a single frequency of vibration.[8]

Border-zone term (*)

Its version based on the first definition of the category can be represented by a very narrow range of pitches. Such minimal bands are thus, like clusters, accessible only for tuned, one-dimensional vibrators and are produced usually by vibrators of the same kind:

[8]Although this is not true acoustically, striking at the center of the cymbal or gong actually reduces the number of overtones, thereby making sounds of these instruments more like tones of definite pitch, and the (untuned) instruments themselves more like tuned ones.

Example 15: *Polymorphia*, 52-55



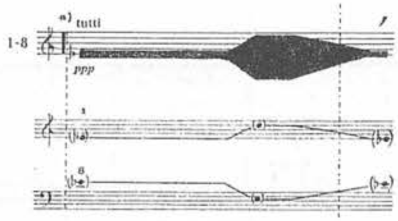
Substitutes for minimal sound-bands are trills and vibrati. In the former, pitches are separated by a gap; in the latter, they are linked by a minimal glissando acting as a continuous transition. In both cases, pitches do not occur simultaneously but in alternation. Still, trills and vibrati oscillate so rapidly that for the listener they fuse into one narrow band of simultaneously sounding pitches. In contrast, trills and vibrati turn into a real band of sound when performed at the same time by several instruments.

The second version of border-zone term would have to be articulated as a set of pitches performed by one-dimensional bodies, the distances between them being larger than in a cluster but smaller than in the case of spatially discontinuous phenomena. Yet, this term is not employed by the composer. Most likely the reason is that the largest distance (i.e., the perfect fourth) between neighbouring pitches of clusters interpreted as spatially continuous phenomena is already quite large, thus leaving no room for further intermediary sizes.

Transition (→)

The most obvious realization of its first version is a transition between a cluster and a single pitch. Since both its point of departure and point of destination are practicable only on tuned one-dimensional vibrators, such a transition is confined exclusively to that class. In its continuous variation it consists in the gradual widening of one pitch into a cluster or, conversely, in the gradual contraction of a cluster into a single pitch. Such a process is accomplished by glissando and is therefore accessible only to vibrating bodies of changeable length (see below, on "spatial mobility vs. immobility"). In practice, as in the following example from the *Threnody*, this process occurs only in the strings. Tones taking part in a continuous transition usually come together or apart in concentric glissandos. The result is that the largest change of pitch happens at the extreme (highest and lowest) tones, and the slightest change in the tones at the middle of the cluster. If an odd number of instruments is involved, the central tone does not move, and forms the axis of symmetry.

Example 16: *Threnody*, 11



The above example supplies more proof that the upper limit of intervals between neighbouring sounds of a cluster need not be a second. If the distance e-d², which marks the range of a cluster arising in the middle part of the double transition, is to be covered by 8 celli only, then the interval between adjacent pitches must be a third, which is otherwise confirmed by the notation of individual instrumental parts. Yet, the spatially continuous character of that sound phenomenon is designated unequivocally by the notation in the score, as shown in the musical example.

In its discontinuous variation, the transition between spatial continuity and discontinuity can be obtained by the gradual addition or subtraction of tones in several different instruments, as a process leading from a single pitch to a cluster, or vice versa (see Ex. 40).

The rule of the predomination of temporal discontinuity over spatial discontinuity results in that the same version of a transitional term is practicable also for two-dimensional vibrating bodies, by way of progressive shortening or lengthening of durations of their sounds produced, proceeding from long sustained sounds to momentary impulses, or vice versa. Yet, such a change of time-values may be realized only as a discontinuous process (see Ex. 28, from *Dimensions*). Also, three-dimensional vibrators can perform an analogous type of transition, due to the rule of predomination of temporal continuity over spatial continuity; however, the composer does not make practical use of this theoretical possibility.

The second version of the simple temporal mediative term would consist in the gradual filling of gaps between several distant pitches. This may be accomplished by glissandi or by the addition of tones introduced by different instruments until a cluster is achieved. Or conversely, the gaps between pitches of a cluster may be gradually enlarged, either by glissandi or by the removal of tones until individual pitches become discernible. However, in the pieces under consideration such transitional processes do not occur.

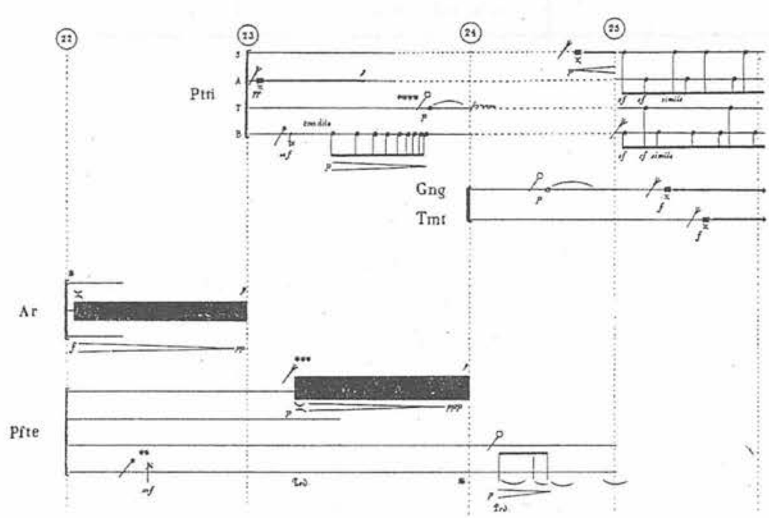
SPATIAL MOBILITY VS. SPATIAL IMMOBILITY

If all remaining properties of a vibrating body are retained, the change of sound frequency, as an acoustical parameter of this category, is directly proportional to a change of the size. Yet, because the latter concept has no application to three-dimensional vibrators, the motoric parameter of this category embraces one- and two-dimensional sound sources only. And, since its value can be positive only for vibrators whose size is changeable, the classification made according to "spatial mobility vs. immobility" divides those sound sources into bodies of *changeable* and *unchangeable* sizes. The former class contains only the strings of stringed instruments as well as singing and the blowing of wind instruments; the latter encompasses all the other vibrators.

However, a change of size, combined with the identity of all the other properties of a vibrator, happens also between several vibrating bodies representing the same kind. The class of vibrators of unchangeable size can thus be further subdivided into those that form collections of *different sizes* on one hand, and vibrators occurring in *single sizes* on the other.[9] The most obvious collections of vibrators of different and unchangeable sizes are the individual strings of piano and harp, tubes of tubular bells, and the bars of vibraphone, celesta, and glockenspiel. The bars of the xilorimba are included here, too, when they occur as the representatives of one-dimensional metal bodies. These just-mentioned collections all belong to the body of a single instrument. Yet this need not be the case. Thus in this subclass of vibrators are also included plates of cymbals (occurring mainly in four sizes—soprano, alto, tenor, and bass), two metal lamellae, sets of four glass lamellae, and three cowbells, as well as skins of membranophones represented by tom toms, timpani, snare drums, congas, and bongos.

Very interesting is the case of piano and harp. They are treated as collections of one-dimensional vibrators, but also when interpreted as virtual metal plates and classified as two-dimensional bodies. In the latter case, however, the vibrators of different sizes but of the same kind are considered not to be the individual strings, but rather several areas of the strings, i.e., various registers specified in the score by three or four lines. Such a way of notation, which is identical to that used for several sizes of cymbals, tom toms, timpani and other representatives of the discussed class, can be found in *Dimensions of Time and Silence*:

Example 17: *Dimensions of Time and Silence*, 22-25



[9] Usually the latter occur also as a single item within the orchestral make-up. Yet, this is not an indispensable condition of their subclass, for there conceivably a given kind of a vibrating body may occur as represented by several items of identical size.

As one can see, most vibrators of unchangeable size form sets of items that display size differences. The few exceptions are the triangle, gong, tam tam, Javanese gong, and the plate of sheet metal. These instruments thus constitute the second subclass of vibrators of unchangeable sizes—those occurring in one size only. The full classification of sound sources, made on the basis of the discussed category, is given in the following table:

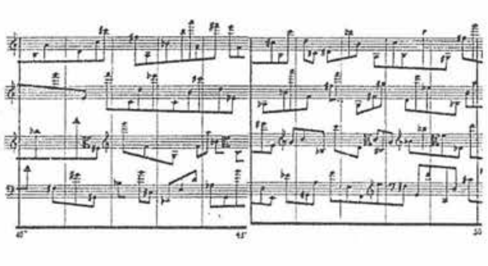
Table 3.

VIBRATORS OF CHANGEABLE SIZE	VIBRATORS OF UNCHANGEABLE SIZE	
	SEVERAL SIZES	SINGLE SIZE
strings of stringed instruments in front of the bridge	strings of the piano (*pianoforte*) and harp (*arpa*) bars of the vibraphone, glockenspiel (*campanelli*) and celesta tubes of the tubular bells (*campane*) bars of the xilorimba cymbals (*piatti*) metal lamellae (*blocchi di metallo*) glass lamellae (*vetri*) cowbells (*campanacci*) skins of membranophones: timpani, snare drums (*tamburi*), tom-toms, bongos, and conga drums	triangle gong tam tam Javanese gong (*gong giavanese*) sheet metal (*lastra*)

Positive term (+)

A value of size change proper for this term and accompanied by a retention of all other properties of a vibrating body is accessible only for vibrators of either changeable or several unchangeable sizes. The case of those representatives of both classes which in addition are tuned (i.e., those that belong to the class of one-dimensional vibrators divided according to the previously discussed category) finds its direct reflection in a change of pitch:

Example 18: String Quartet No. 1, 1.40-50



On the other hand, pitch changes attest to spatial movement in the class of one-dimensional vibrating bodies, even if such movement takes place across vibrator kinds. This may happen, for instance, between xilorimba, vibraphone, glockenspiel, celesta, harp, and piano, as occurs in Example 50 from *Dimensions of Time and Silence* (9). Otherwise, most cases of spatial mobility between tuned vibrators in Penderecki's scores are produced at the same time as a result of pitch relationships between vibrators representing the same kind, as well as between different kinds of sound sources. In other words, those relationships arise both between pitches within parts of individual instruments, and also between pitches of several such instrumental parts.

As regards untuned bodies, their variations in size, though not manifested in pitch changes, can result in no less suggestive cases of spatial movement. Characteristically, however, such cases are never produced by collections of metal two-dimensional vibrators. This theoretical possibility—which stems from the existence of several different sizes of cymbals, metal and glass lamellae, cowbells as well as virtual plates of piano and harp—is thus, in practice, not actualized. Instead, spatial mobility arises due to size changes in collections of membranophones, as in the following example, where performers are instructed to play *con dita* on the striking surfaces of congas and bongos:

Example 19: *Anaklasis*, 67-71

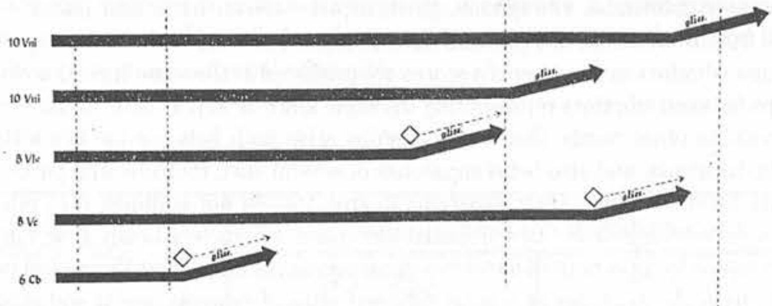
In all the former examples, the positive term of the category under discussion arises as a result of relationships between separate, successive impulses produced by numerous instances of sound-source excitation. The size changes of vibrating bodies, and the possibly resultant pitch changes, were accomplished by stepwise motion. A change of size in the vibrating body during the same long-lasting sound produced by a single excitation is available only in sound sources of changeable size, i.e., in strings of stringed instruments, in traditional wind playing, and in singing human voices. True, this type of change can also be discontinuous, as in the case of playing or singing some intervals legato on one bow or breath. No use is made of this possibility in Penderecki's sonoristic pieces, however. Penderecki's only manner of changing the size of a single vibrator during a single excitation is a continuous one, that of a glissando as a combination of spatial mobility with temporal immobility. Vibrating bodies of continuously changeable sizes, and hence capable of producing this sound effect, are strings of stringed instruments and human voices.[10] Yet choral glissando occurs only once, in *Dimensions of Time and Silence* (112), and not sung but whistled. As to other occurrences of glissandi—which apart from the clusters are the most typical of Penderecki's sound effects—they are performed exclusively by strings.

The great variety of glissandi and their uses in Penderecki's sonoristic pieces is an effect of the terms of other categories that combine with glissando in a given segment. If its constitutive terms, spatial mobility and temporal immobility, occur superposed with spatial discontinuity, the result is a glissando of a single tone. When, on the other hand, they are combined with spatial continuity, there arises a cluster glissando, i.e., the synchronized motion of numerous tones played by several instruments, as occurs in this example from *Anaklasis*:

---

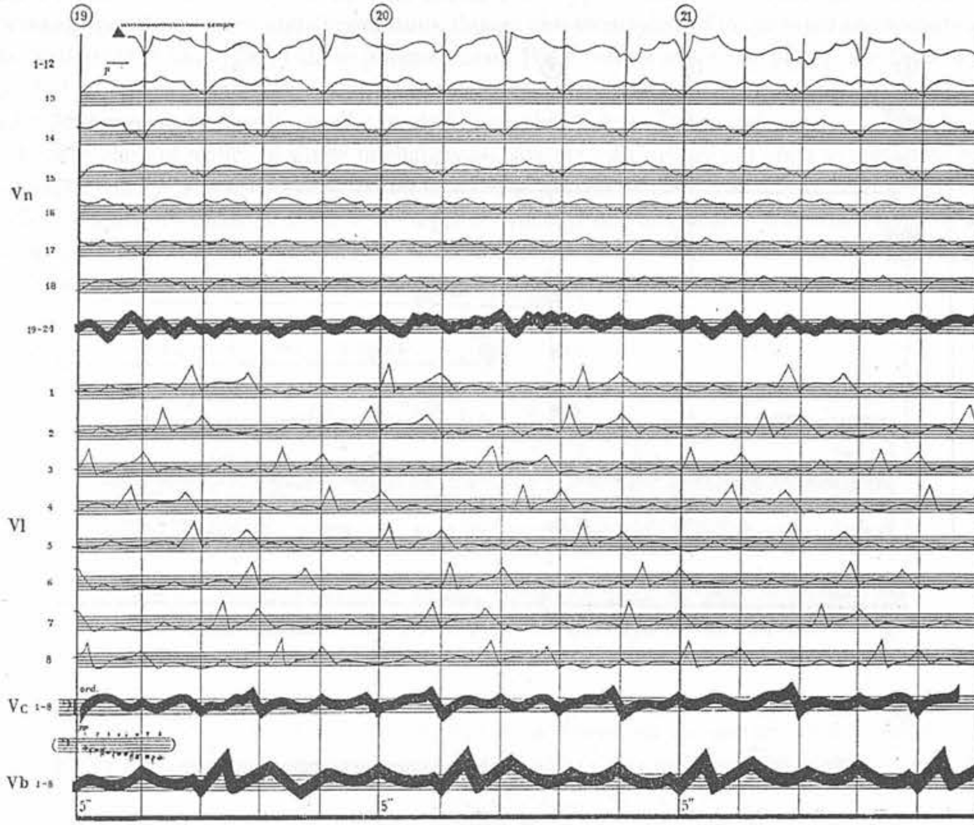
[10] Glissandi are also possible on some wind instruments, such as clarinet, but such rare effects require great virtuosity on the performer's part. This seems to be the reason that they do not occur in Penderecki's sonoristic scores.

Example 20: *Anaklasis*, 113-115



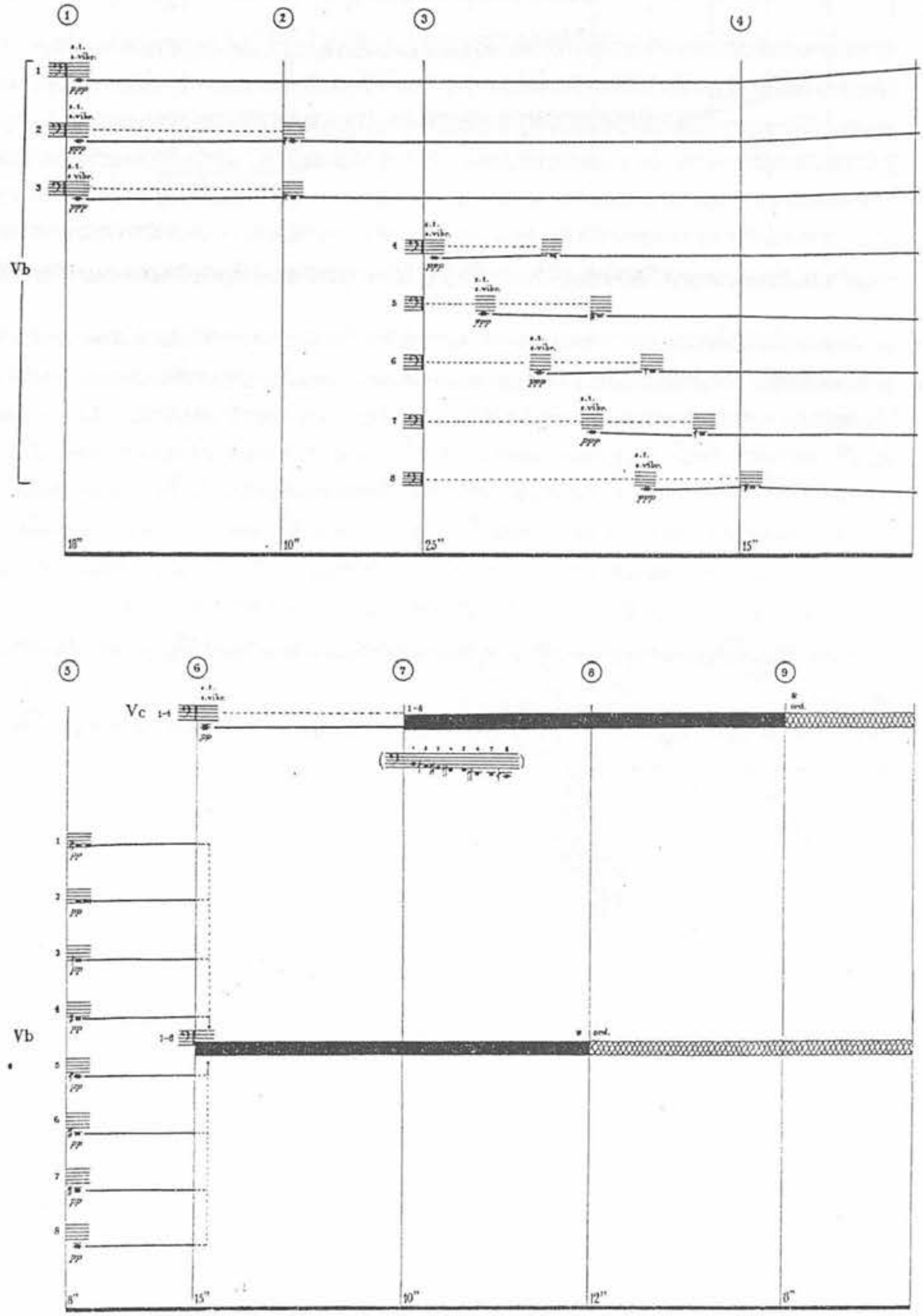
The course of a glissando depends, in turn, on the hierarchically linked categories "high vs. low register" and "middle vs. extreme register". Glissandi that directly cross a range of pitches usually serve as simple temporal mediative terms of those categories, i.e., as transitions between their opposite terms (see Ex. 38). Within a range of pitches representing the atemporal terms of those categories (i.e., a single register or totality of registers), glissandi usually take a more or less regular periodic shape. Such a shape resembles that of electrocardiograms, to which periodic glissandi have often been compared by earlier investigators of Penderecki's sonoristic music.

Example 21: *Polymorphia*, 19-21



Not every glissando need be a representative of spatial mobility, however. Because the positive term of the discussed category requires a value of size change in a given vibrator and, as a consequence, of pitch change in a time unit to exceed a liminal value, the glissandi of sub-liminal (i.e., very slight or slow) pitch changes do not bring about the perception of spatial mobility but rather that of immobility. A perfect example of such a glissando is the beginning of *Polymorphia*:

Example 22: *Polymorphia*, 1-9



* Glissando od najniższego do najwyższego z podanych dźwięków. Każdy instrumentalista rozpoczyna grę od swojego dźwięku. Tempo dowolne

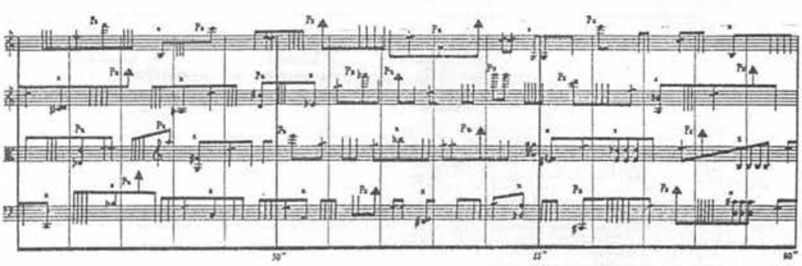
Glissando von dem jedem Instrument zugeordneten Ton aus aufwärts und abwärts innerhalb des vom ersten und achten Ton der angegebenen Skala begrenzten Tonraumes (Tempo beliebig)

Glissando upwards and downwards between the first and the eighth note of the indicated range. Each instrumentalist begins with the note allotted to his instrument (tempo free).

In this example, the contrabasses' glissandi do not aim at producing spatial mobility, but arise as a transition from spatial discontinuity, represented by the initial pitch E, to spatial continuity of a cluster established after 68 seconds in paragraph 5. The continuous variations of transitions between spatial continuity and discontinuity, though also accomplished by glissandi and accounting for still another mutation of those phenomena in Penderecki's sonoristic pieces, are thus to be treated as spatially immobile—and all the more so since their axis of symmetry, i.e., a central pitch, does not move (see the earlier quoted Example 16, from *Threnody*).

For the class of bodies of single unchangeable size, which thus are not open to mutation, and for all three-dimensional bodies, spatial mobility is possible only by way of cooperation between different kinds of vibrators. If those vibrators are parts of one instrument body, such cooperation happens within the same instrument or instrumental group. This is the case with stringed instruments played on strings, on sound boards, and on finger boards:

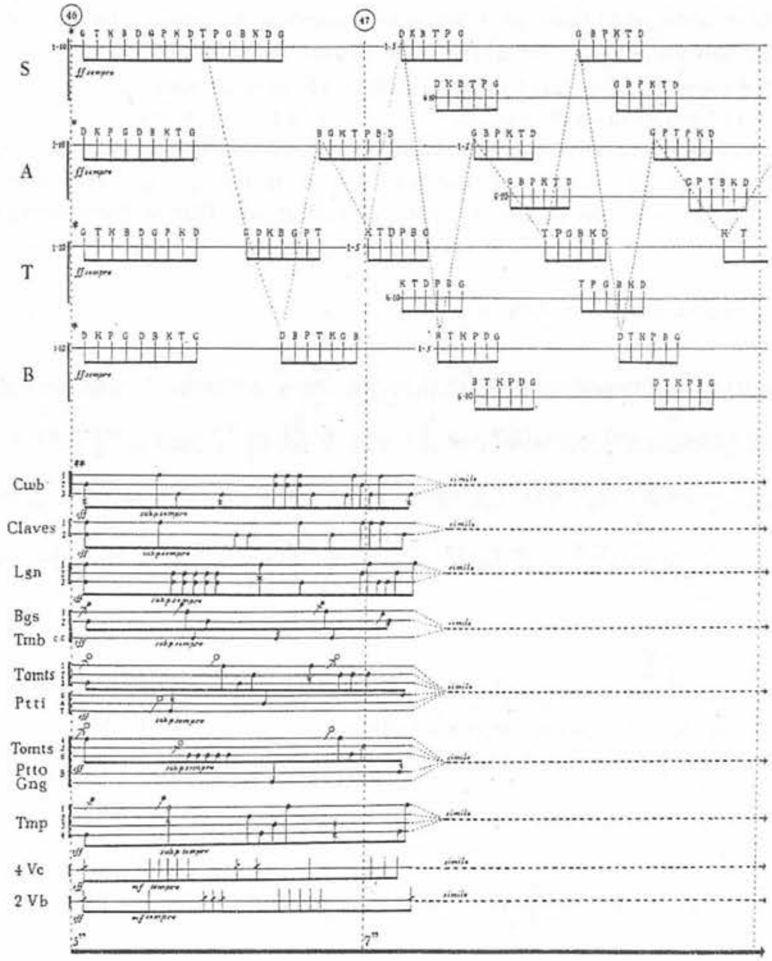
Example 23: String Quartet No. 1, 0.46-60



As in the case of tuned vibrators of different kinds, discussed earlier, spatial mobility results here not only from relationships within parts of individual instruments, but also from relationships across instrumental parts. To an even greater extent this holds true for membranophones played on the skins, on the edges, as well as on the sticks laid on striking surfaces (see Ex. 13, 14). Plainly, such cooperation—not merely of different vibrators, but of different instruments—is the only way of participation in a spatial movement for those vibrating bodies of single unchangeable sizes which constitute the only element of an instrument (claves, triangle, gong or tam tam) as well as for individual items among collections of metal two-dimensional bodies (metal and glass lamellae, cymbals, cowbells). In the latter four instruments, it is probably the physical detachment of individual vibrators that causes them not to set up spatially mobile segments independently, but always to merge with them as one of several kinds of sound sources. In Example 14 (*Anaklasis*, 25-31), except for claves, gong and tam tam, co-occurring vibrators belong either to the body of one instrument (skins, edges, and sticks laid on surfaces of timpani, bongos, and tom tom; sound boards and fingerboards of strings), or they have several unchangeable sizes (cymbals). Thus, that example illustrates a very typical "mixed" means of accomplishing spatial mobility.

A similar effect is produced when choral voices pronounce several different short consonants. This is why in paragraphs 46-48 of *Dimensions* both choral and instrumental parts fuse into a unified sound field that is characterized by the positive term of the category "spatial mobility vs. immobility":

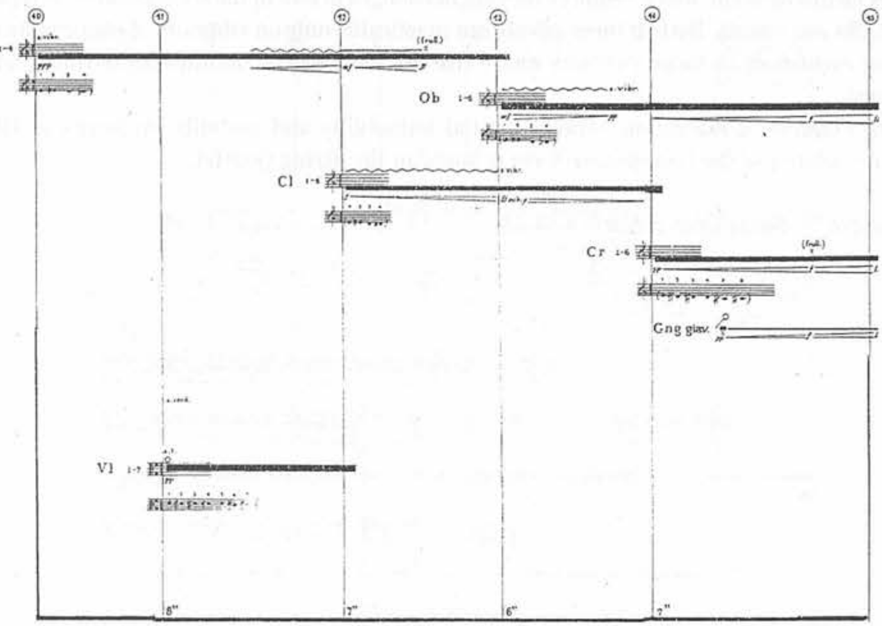
Example 24: *Dimensions of Time and Silence*, 46-47



Negative term (-)

Any vibrating body may retain the same size either during one excitation event resulting in a sustained sound, or as a repetitive series of impulses. In tuned vibrators this amounts to retaining the same pitch or pitch collection; this effect is practicable not only for sound sources that represent the same kind, but that also have different material and constructional properties. When, as is often the case, individual kinds of vibrators occur successively and, so to speak, "pass along" or hand around the same pitch or collection of pitches, then the effect is a sort of timbral opalescence not unlike Schoenbergian *Klangfarbenmelodie*:

Example 25: *Fluorescences*, 40-44



Yet, a negative term of the discussed opposition arises not only when the size of a vibrator, and possibly also a pitch, remains absolutely unchanged. As mentioned earlier, sub-liminal changes, such as that represented by the glissando in the first 68 seconds of *Polymorphia* (Ex. 22), are also perceived as spatially immobile. On the other hand, spatial immobility is also instantiated by extremely quick and big changes, which break down a relationship between sounds (version 2 of the negative term). Perceived as such unrelated, disjunct sound phenomena are the impulses in the following example:

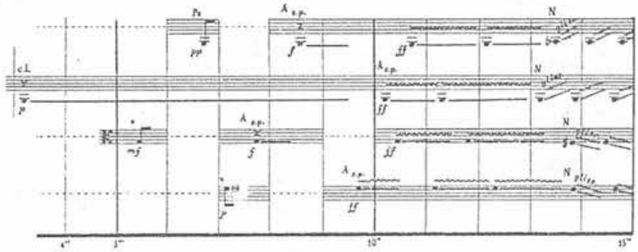
Example 26: *Dimensions of Time and Silence*, 18

Border-zone term (*)

This mediative term, which requires very slight changes of size in the sound source, is represented by trills and vibrati. Both of these effects are practicable only on vibrators of changeable size, the latter exclusively on those vibrators whose size can be changed continuously (strings and human voices).

An example of mediation between spatial immobility and mobility by means of vibrato as representative of the border-zone term is found in the String Quartet:

Example 27: String Quartet No. 1, 4.04-15



Transition (→)

From among the two theoretical versions of this term, defined acoustically, only the first version finds practical usage in Penderecki's sonoristic pieces. For it to occur, there needs to be a gradual acceleration or deceleration of size change, accompanied by the retention of the other properties of a vibrating body. This process is theoretically practicable on all sound sources belonging both to the class of vibrators of changeable size and to that of several unchangeable sizes. Yet in the pieces considered here it occurs only as a gradual acceleration of glissando in traditionally played stringed instruments, thus being reflected in a most natural way in an acceleration of pitch changes. The unique example of such a continuous type of transition in *Polymorphia* is shown in Example 52.

In untuned vibrating bodies, the same version of transition between opposite terms of this category takes place by way of a gradual reduction or enlargement of the time-spans between successive sounds produced by different vibrators of the same or different kinds; this results, respectively, in the progressive establishment or dissolution of the spatial relationships between the sounds. A striking example of the former case is found in paragraphs from 28 to 45 of *Dimensions of Time and Silence* (see Ex. 28, below). In the same piece, the opposite process, that of dissolution, occurs in paragraphs 83-101, as a retrogradation of 28-45. As involving a temporal progression, both of these cases represent the discontinuous variation of the transitional term under consideration.

Example 28: *Dimensions of Time and Silence*, 31-45

HIGH REGISTER VS. LOW REGISTER

Frequency constituting the common acoustical parameter of both hierarchically linked categories "high vs. low register" and "middle vs. extreme register" is inversely proportional to the size of a sound source. Thus the smaller the body, the higher the frequency. And conversely, the larger the size, the lower the frequency of vibration. On the articulatory level, one could thus define high and low registers as properties of sounds produced by small and large vibrators, respectively, of a given kind.

The import of this motoric parameter is, however, quite limited. For again, as in the case of the two categories discussed earlier, it does not apply to three-dimensional sound sources. Also, its application to one- and two-dimensional vibrators involves serious difficulties. These difficulties stem from the fact that "large" and "small" are relational descriptions; that is to say, one can determine only whether one vibrator is larger or smaller than another vibrator, the latter constituting a point of comparison for the former. Yet because the proportional link between size and frequency exists only inasmuch as all remaining properties of the vibrator are preserved, vibrators of single unchangeable sizes (see above "spatial mobility vs. immobility")—which cannot be reasonably compared to any other size—are by this very fact beyond the reach of this parameter, too. It thus appears that the size of a vibrator, as a motoric parameter of the discussed category, applies only to those vibrating bodies that, on the basis of the category of "spatial mobility vs. immobility", were classified as having either changeable or several unchangeable sizes. Still, such a comparison brings about only relative conclusions: it is possible to decide that the sound of a smaller vibrator will be higher than the sound of a larger one within a given kind of sound source, but not among several different kinds. A common observation is that even the smallest vibrator of a given kind may occasionally produce a frequency value lower than that of the biggest vibrator of another kind. The identification of register on the basis of size, across different kinds of sound sources, could thus result in considerable discrepancies of frequency values between the sounds that those sources produce.

This difficulty is overcome by a scale of pitches, which levels material and constructional differences between kinds of vibrators, and provides them with a common datum-plane that insures the comparability of their sounds. At the same time, however, the comparison of sizes becomes superfluous and, because pitch is an attribute of sound sensation, the articulatory definition in the case of tuned vibrating bodies turns once again—as otherwise was the case with "spatial continuity vs. discontinuity" and "spatial mobility vs. immobility"—from the motor to the perceptual level. On the other hand, to know a pitch is not equivalent to knowing a register, i.e., a term of the discussed category, represented by pitch. Since one cannot precisely determine a range of pitches equivalent to a given register, there will always be pitches whose registral affiliation remains doubtful and, as such, context-dependent.

In the case of untuned vibrating bodies, the difficulty springing from the relational character of the motoric parameter remains insurmountable. Hence, although in the absence of the common scale of pitches the size of vibrator is retained here as the (however imperfect) criterion for elaborating articulatory definitions of individual terms, it nevertheless requires aural—and, as such, again perceptual—verification. In the end, aural verification remains the only tool for qualifying the sounds of three-dimensional bodies. Even so, as among individual pitches, so also among sounds of indefinite pitch produced by untuned sound sources: sounds occur whose affiliation, in respect of the registers that they represent, appears to be vague. Therefore, the following definitions, apart from vibrators whose sounds are qualified univocally, will also specify those that are mostly representatives of a given term, but which occasionally may represent a neighbouring register. The final indication of the term to which a given untuned vibrator is assigned is, in any given case, made possible only by analysis that considers the context in a given piece—mainly owing to the co-occurrence of pitches that form a uniform sound field in conjunction with sounds of indefinite pitch.

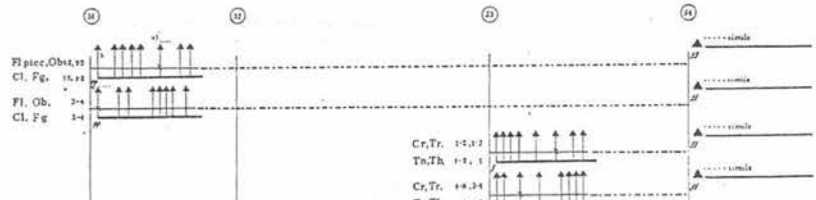
There are, however, cases in which even the empirical verification made by the composer fails to assign them to a definite register. The sounds of such vibrators are either assigned to individual registers on the basis of an accessory criterion, or they never occur as representatives of simple terms; in the latter case, they are included only in the total mediative term, which embraces the entirety of musical space. This is why, in the case of this category only, the total term is discussed below, and its definition on the articulation level is elaborated.

Positive term (+)

It is represented first and foremost by high-pitched sounds produced by tuned vibrating bodies. For most such bodies, the high register constitutes only a part of the range of all accessible pitches. In this respect, exceptional are the cases of celesta and glockenspiel used exclusively to represent the positive term of the discussed category.

Usually the pitches of tuned sound sources are determined concretely by the composer and notated traditionally on the staff. Sometimes, however, specific pitch is left undetermined in the notation and is actualized only during a given performance. This happens when the "highest possible notes of indefinite pitch" are required by the composer. They occur only in the parts of instruments having vibrators whose upper pitch-limit is not fixed but depends either on the construction of an individual item of such an instrument (e.g., piano) or, more often, on the skill of the performer, which is the case with strings, winds, and human voices. The "highest possible tones" are usually indicated with a triangle directed upwards: ▲, △. Only in *Canon* are they written on an extra line; this line, in contrast to other staff lines, is not assigned to a concrete pitch, but is instead designated with an arrow pointing upwards. Since obviously the ranges of instruments differ, the highest possible tones may vary considerably across different kinds of tuned vibrators. Yet as a rule the highest possible pitches are identified by the composer, as in the following example from *Fluorescences*, where tubas, trombones and bassoons are assigned to high register on a level with all the other winds, including oboes, flutes and piccolos:

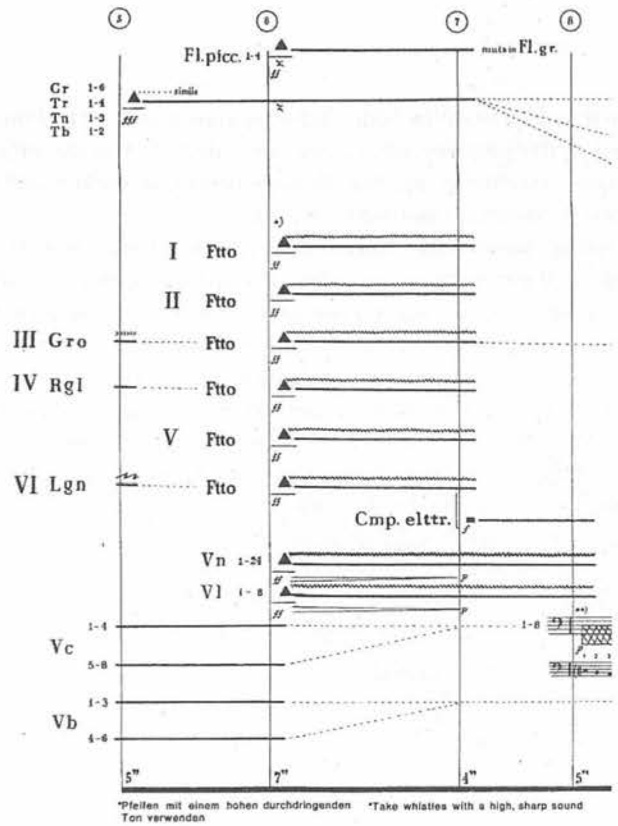
Example 29: *Fluorescences*, 51-54



Among untuned vibrators, the high register is represented firstly by metal plates of unquestionably small sizes, and their substitutes, such as metal lamellae, glass lamellae, cowbells, triangle, soprano and alto cymbals. In the opening section of *Dimensions of Time and Silence*, the high register emerges from the cooperation of these instruments along with glockenspiel and bells (Ex. 41).

Three-dimensional sources of high sounds are the electric bell, whistles, typewriter, and the stops and pistons of winds. In *Fluorescences*, the electric bell is used always together with the highest possible pitches of tuned instruments. The classification of whistles as belonging to the high register is additionally supported by the written score indication of "highest possible tone", which otherwise is the only possible tone of any individual whistle. In a footnote the composer stresses that one must use "whistles with a high, sharp sound":

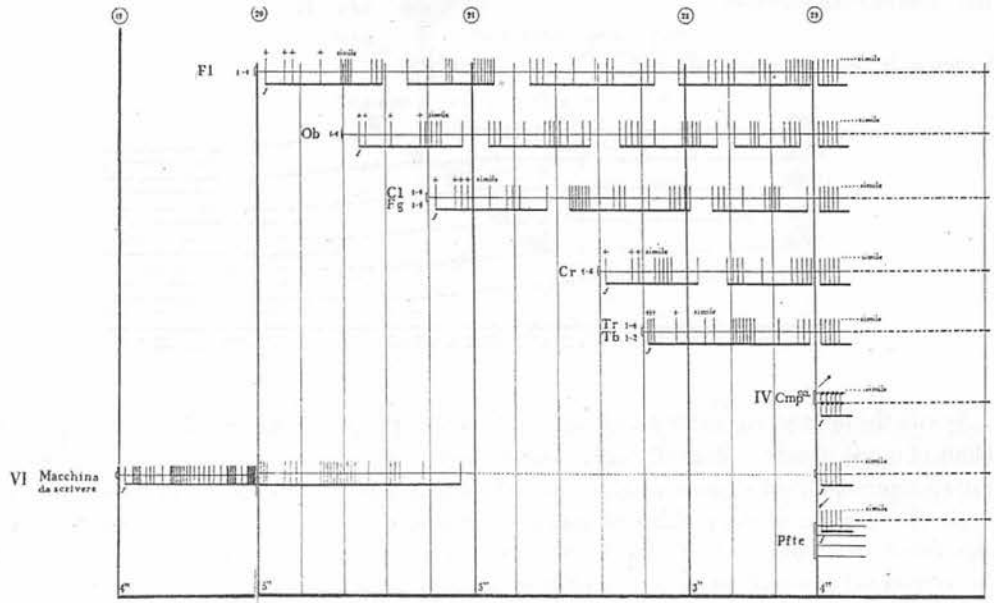
Example 30: *Fluorescences*, 5-7



In turn, the typewriter and the stops and pistons of wind instruments occur together in *Fluorescences* in paragraphs 19-25. There the high register initiated by those instruments is subsequently joined by cowbells, piano (23), two triangles, vibraphone and bells (24).[11] The notation provides an interesting clue as to instrumental assignment to the positive term of the discussed category: the cross-bars linking individual, repeated impulses in the parts of both typewriter and winds are situated underneath the staff, as is usually the case with high pitches, and with all the remaining instruments from the same example:

[11] The indicated tam tam V at number 24 of the score is an error; it should be triangle V.

Example 31: *Fluorescences*, 19-23



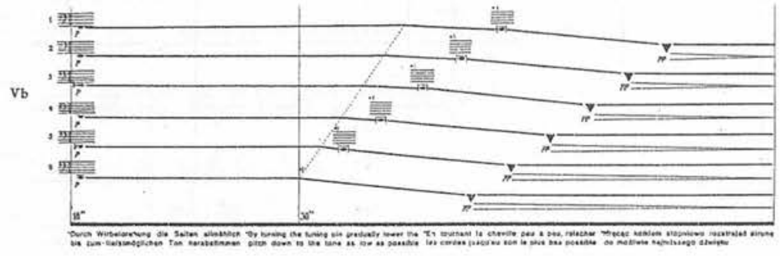
Vibrators classified previously as three-dimensional and characterized by a very high sound are also the strings of stringed instruments between bridge and tailpiece. Their attribution to the high register is proved by the notation in *Canon*, where they are always notated on the extra line of highest possible notes. Sounds played between bridge and tailpiece of different stringed instruments (violin, viola, violoncello, contrabass)—and even on different strings of the same group of stringed instruments—will vary in frequency values. Nevertheless they, like the highest possible notes of vibrators of different ranges, are usually construed by the composer as equally-valid representatives of the high register. The only exception occurs in *Polymorphia* (26-30, see the analysis in Chapter 8), where a distinction is made between instrumental groups and also between individual strings behind the bridge.

In wind instruments and choral voices, effects of indefinite pitch equivalent to playing between bridge and tailpiece are produced, respectively, by playing mouthpieces and double reeds, and by whistling. The former means of playing are indicated with a special symbol (▼). Whistling produces definite pitches, which are either notated traditionally or indicated as the "highest possible notes".

Negative term (-)

The negative term characterizes the low pitches of tuned vibrators, whether they are designated as such by the composer, or not. The latter is the case with "the lowest possible tones of indeterminate pitch" (by analogy to "highest possible tones"). These lowest tones are symbolized by a triangle pointing downwards (▼), and they occur only in instruments whose low-range limit is contingent upon the construction of a given item of an instrument (piano) or on the performer's skill (brass). The lowest pitches of stringed instruments are normally the pitches of their lowest open strings, and are therefore notated in the traditional way. But the low range can be expanded by turning the tuning pins, and then the sign of the "lowest possible tone" is used by the composer. The famous and unique example of lowering strings in such a way occurs in the contrabass line at the close of *Fluorescences*:

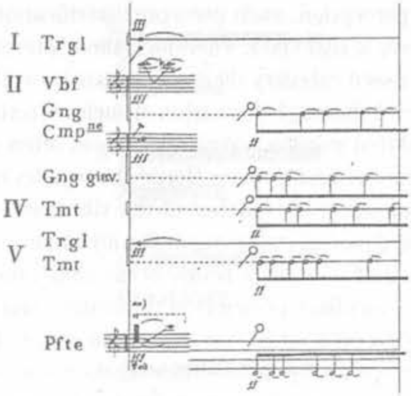
Example 32: *Fluorescences*, 101-102



As with the highest, so too the lowest accessible pitches may vary considerably across individual kinds of tuned vibrators. Basically, instruments whose range is not expanded enough downwards cannot represent the discussed term. Yet, as in the case of high register, the composer occasionally treats the lowest registers of different instruments as identical. In such cases, even if there is a significant discrepancy between the lowest possible tones of individual instruments, they are to be interpreted as equally valid representatives of the negative term. This is the case irrespective of whether the sounds are written as traditional notes, in which case they are concrete pitches, or whether they are symbolized by the triangle, in which case they are of indeterminate pitch. The example is to be found in *Canon* (4-7), where the sounds of the lowest open strings of all stringed instruments, which comprise the entire instrumental forces of that piece, are clearly used to create a low-register segment, though their pitches reach from C̲ in the basses up to g in the violins, the latter thus already being situated at the border of the middle register. However, such cases as the one described above are exceptional in Penderecki's sonoristic scores. Usually, the ranges of individual sound sources are clearly distinguished by the composer. For instance, since whistling generally produces high sounds, even the "lowest possible notes" whistled by the choir in *Dimensions* (112-113: altos, tenors) are still included in the high register, together with all the other sounds that comprise this segment.

Untuned two-dimensional bodies used to produce low-register sounds are large membranes and metal plates. These include timpani, tam tam, gong, Javanese gong, sheet metal; and, when played in the low register, the piano and harp act as substitutes of the latter. A very striking example of registral contrast accomplished by two different groups of metal, two-dimensional untuned bodies is found in *Fluorescences* (31). After a high register generated by the triangle, vibraphone, tubular bells, and piano, there follows a series of low sounds played by gong, tam tams, low register of piano, and Javanese gong:

Example 33: *Fluorescences*, 31



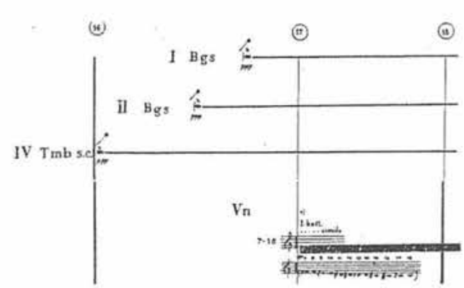
The following are three-dimensional vibrators employed by the composer for low-register sounds: sawed pieces of metal and wood, a piece of glass rubbed with a file, the guiro, and the raganella. All these instruments sound in *Fluorescences*. In that work, they are always combined with the lowest possible sounds of piano and brass, as well as with playing on the bridges and tailpieces of cellos and basses, which, as noted earlier, form a low-register area (see *Fluorescences*, 1-4; Ex. 47).

Neutral term (0)

The middle register is accessible on every tuned instrument except glockenspiel and celesta. If combined with spatial discontinuity, it is usually represented by a single pitch: either by c1 (as in *Fluorescences*, 68-85) or by the note a, which is the case in *Dimensions of Time and Silence* (17-18, 66-67) and in *Polymorphia* (46-52).

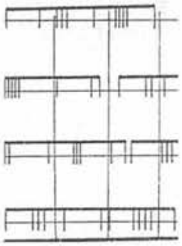
Among untuned sound sources, medium-sized leather membranes of bongos and drums are considered as producing sounds of middle register. This is evidenced by an excerpt from *Fluorescences*, where a middle register is established first by the roll on the snare drum (tmb s.c.) and two bongos, then joined by a cluster c^1-f^{1+} in the violins:

Example 34: *Fluorescences*, 16-17



For the composer, wooden vibrators were obviously the most problematic group in respect of sound register. While sounds of metal three-dimensional bodies were easily categorized on the basis of empirical, auditive perception, such perceptual verification failed almost completely as concerns the wooden members of that class. Therefore, their interpretation as representatives of individual terms of the discussed category depends primarily on the context in which they are employed in individual pieces. A thorough discussion of such contexts takes place in the upcoming analyses. There one will find that wooden bodies occur most often when fused into sound fields produced by other, mainly tuned sound sources. Hence the register intentionally ascribed to them by the composer can be read out of the pitches of the vibrators cooperating with them. (This applies to the above-mentioned case of guiro, raganella, and a piece of wood as representatives of low register.) In the rare cases when wooden bodies occur alone, their sounds are interpreted by the composer according to an auxiliary principle of unification and differentiation. Long-lasting sounds or series of repetitions on a single wooden vibrator are classified as belonging to the middle register, while a differentiated field of such sounds is considered as filling in the whole space, i.e., as a total term of the discussed category. The most common way of forming a repetitive series on a wooden vibrator is to strike the strings *sul tasto* with the palm of the hand, i.e., a kind of tapping on the fingerboard of stringed instruments:

Example 35: String Quartet No.1, 0.21-24

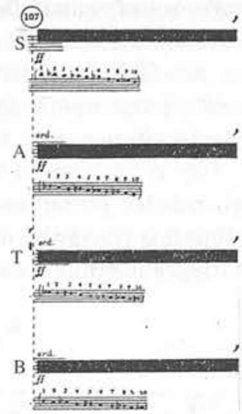


Sustained sounds can be produced on another wooden part of stringed instruments: the sound board. Rubbing sound boards with the palm of the hand and bowing their edges are two atypical instrumental techniques that occur in *Fluorescences* (63-69; see Ex. 12). There those techniques follow each other and are in turn followed by the pitch c1, which clearly constitutes a continuation of the middle register established by them. Note that sounds produced by rubbing the sound boards of cellos and basses fuse into one register with the tam tam played with wire brushes and tom toms and timpani rubbed with the palm of hand. In reference to the three latter instruments, mentioned earlier as producing sounds of low register, this is just one of several cases of the contextual variability of this category. One can see here an expansion of the principle of unification and differentiation, from wood alone onto metal and leather untuned sound sources.

Total term (❐)

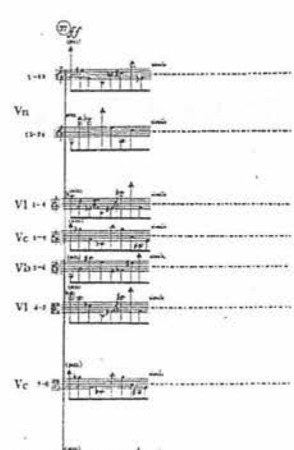
The most striking examples of this term are extended clusters that embrace the totality of musical space. As any other type of clusters, they can occur by the cooperation of tuned vibrators included previously in classes of changeable or several different unchangeable sizes. But the vast range required to cover the total musical space demands that such clusters be produced only by strings or by choir:

Example 36: *Dimensions of Time and Silence*, 107



In the above example the total term of the category "high vs. low register" is embodied into one segment with a positive term of "spatial continuity vs. discontinuity". When combined with "spatial discontinuity", it arises by the dispersion of single pitches, remote from each other, throughout the whole musical space:

Example 37: *Polymorphia*, 37

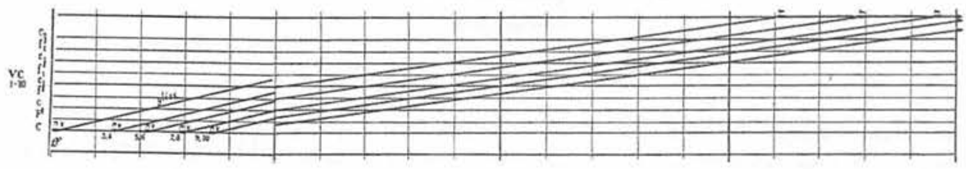


The equivalent of such a combination constitutes a sound field covered by maximally differentiated sound phenomena produced on untuned vibrators. Into such a medley of clicks can merge all the two- and three-dimensional vibrators mentioned above as representatives of simple terms, as well as vibrating bodies that otherwise are too doubtful, in terms of sound frequency, to be used for producing a definite register (e.g., piece of wood, claves, cymbals, tom toms). As an earlier example from *Dimensions* reveals (Ex. 24), a conglomerate of different short consonants is a choral equivalent of such a maximally diverse set of sound effects on two- and three-dimensional instruments.

Transition (→)

The transition between low and high register, presupposed by this term, occurs only in the continuous variation as a glissando. Thus it is practicable only on sound sources of continuously changeable sizes, i.e., the strings of stringed instruments and the choir:

Example 38: *Canon*, 42-45



A discontinuous version of that term is conceivable, as passages of separate and definite pitches moving upwards or downwards. It is not employed by the composer, however, in the sonoristic pieces considered in this book.

MIDDLE REGISTER VS. EXTREME REGISTER

Transition (→)

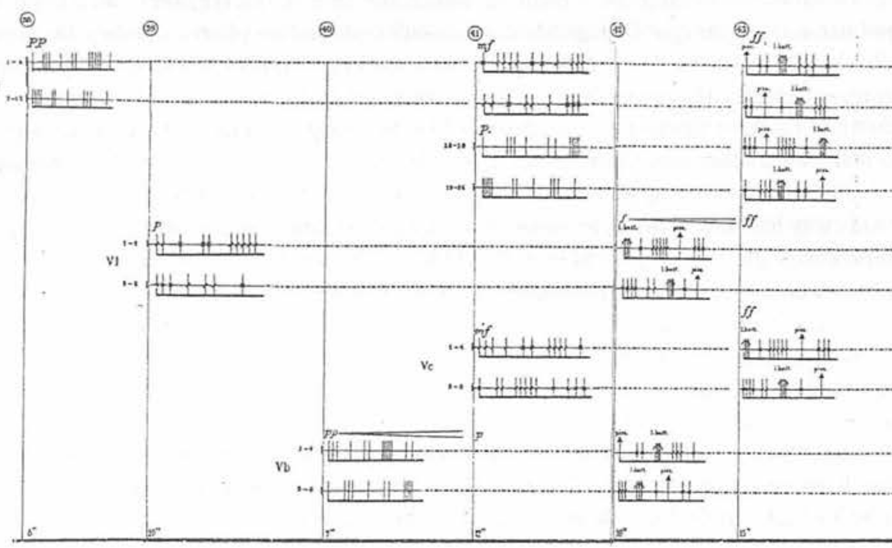
The single temporal mediative term is not used since it has no counterpart in the category "high vs. low register". It is used in later pieces, however, based on the system in question (see Chapter 16).

Transition between the positive and the total term (+→❐)

This unique transition forms a temporal case of "mediation to mediation" and occurs always as a gradual expansion of the middle register until it covers the whole musical space (this is possible because the borders of any and all registers are not fixed but variable). Most often such a transition is accomplished by a gradual expansion of the range of a cluster produced by tuned vibrators, as in *Fluorescences* (85-93), where one passes progressively from a single note a to a vast cluster C-b$^{3/4}$.

However, the principle of unification-differentiation, assumed in reference to wooden bodies, permits the same course of transition to take place also as a progressive differentiation of sound phenomena produced by such sources. This happens mostly in stringed instruments by the gradual introduction of more and more parts of the instruments' bodies employed as new, atypical vibrators; such is the case in the String Quartet No. 1 (0.21-50), and *Polymorphia* (38-43; see Ex. 39, below). In both those cases, the point of departure for the transition is striking the fingerboard *sul tasto* with the palm of the hand, subsequently joined by tapping sound boards as well as impulses *legno battuto* and *pizzicato* in front and in back of the bridge.

Example 39: *Polymorphia*, 38-43



LOUD DYNAMICS VS. SOFT DYNAMICS

The dependency of sound intensity on the force of excitation is such that, other aspects of the sound generation being equal, the stronger the force, the greater the intensity of the sound. The force of excitation involved in sound generation is regulated indirectly by means of dynamic markings which indicate the desired level of loudness or volume (as a perceptual parameter of the produced sound). Yet the very existence of a scale of dynamic markings makes consideration of the force of excitation—the motoric parameter of the discussed category—superfluous for articulatory definitions of its terms. And, like the scale of pitches in categories discussed above, the scale of dynamic markings takes us from the articulatory back to the perceptual level. Moreover, the dynamics scale has an advantage over the pitch scale, in that it indicates not only individual dynamic levels, but also assigns them to individual terms of the category. This is because the names of dynamic levels are derived from the contrary concepts of "loud" (*forte*) and "soft" (*piano*), and thus set up the binary opposition which underlies the category in question. Hence, *forte*, along with its intensifications, indicates the positive term of the category, while dynamic levels qualified by *piano* and its gradations represent the negative term.

It has been noted that the scale of absolute pitches constitutes a common datum-plane for all tuned vibrators irrespective of their kind. In contradistinction to the pitch scale, the scale of dynamic levels—governing only the force of excitation as one of several aspects of a sound generation that are pertinent for the discussed category—is relational, in the sense that the same dynamic mark brings about different values of intensity in different vibrators, and even in different means of excitation applied to the same vibrator. Therefore dynamic markings are valid only within the range of intensity values accessible to a given process of sound generation. The latter, in turn, can display considerable differences.[12] Even so, unlike the case of the registers, delineated on the basis of size and in principle distinguished across different kinds of vibrating bodies, the composer usually identifies dynamic levels between different sound generation processes. Only rarely does the composer make a distinction between those levels, and that is when extremely limited dynamic capabilities of a given vibrator are compensated for by means of a higher dynamic marking.

Intensity has another significant property: it is the only acoustical parameter that sums up from several different co-occurring sounds. This property makes intensity dependent not only on intensity values of every individual sound, but also on the number of simultaneous sounds within the same segment. Hence, the category "loud vs. soft dynamics" also involves texture: the number of sound sources in a given segment and the number of sounds that they produce.[13]

Positive term (+)

This term comprises definitely loud sound phenomena, which are indicated by dynamic markings ranging from *forte* upwards (*f*, *ff*, *fff*, *sf* and *zf*). A large set of instruments in a given segment, along with a high number of sounds produced by them, are conducive to loud dynamics.

Negative term (-)

The negative term usually arises with low dynamic markings, such as *p*, *pp*, *ppp*. Also, a low dynamic level is often obtained, in a given segment, by the use of few instruments producing few sounds.

Some sound sources, however, are inherently weak in dynamic capabilities, owing to their material and design. For such instruments, even a high force of excitation results merely in their becoming audible. This is the case with the electric bell, typewriter, and the stops and pistons of winds. Thus when applied to inherently quiet sound sources, dynamic markings higher than *p* do not necessarily disturb the soft dynamics, but only compensate for those instruments' relative weakness. Such

---

[12] Even applied to the same process of sound generation, dynamic markings can result in different intensity values, because their interpretation by a performer is never exactly the same. This is a further problem of precision which also distinguishes dynamic markings from pitches.

[13] Differences of intensity values between different sound phenomena, because of corrections imposed on them by properties of sound production processes and texture, were also noticed by Krzysztof Bilica. Bilica made a distinction between "real" (*realny*) and "nominal" (*nominalny*) loudness when discussing the so called "dynamophonic" aspect of *Threnody* (Bilica 1974: 56).

cases are easily discernible, owing to the context of dynamic markings in other instruments. For instance, in Example 30 (*Fluorescences*, 5-7), a *forte* marking is assigned only to the electric bell, while the remaining instruments play softly (*p*). Since obviously the electric bell does not constitute a separate thread of musical narration, the loud dynamic marking is intended to compensate for the naturally low dynamic level of that instrument. Indeed, this instrument can produce only one dynamic level, since the force of excitation is constant in it—that force cannot be changed by the performer.

Neutral term (0)

The medium level of dynamics is, as a rule, indicated by *mp* and *mf*. Again, however, in the case of weak sound sources or sound generation processes, the upper limit of *mf* can be exceeded without a disturbance of the neutral term.

Transition (→)

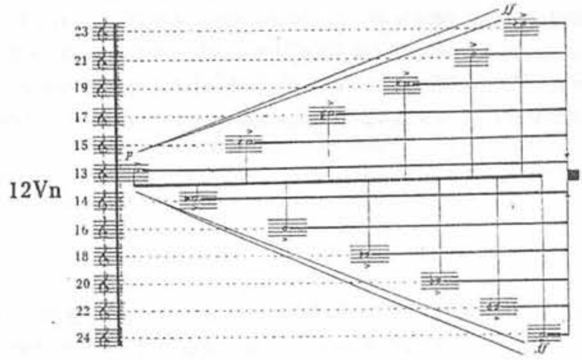
A gradual increase or decrease of volume, or amplitude, constitutes the essence of this term, as a transition between definitely loud and definitely soft dynamics. Such means of transition can be obtained by dynamics alone or by both dynamics and texture. In the former case, the gradual increase/decrease is mirrored in the dynamic markings; in the latter case, the change also involves an increasing or decreasing number of instruments as well as of the sounds made by them.

The continuous variation of transition can be obtained only as a crescendo or diminuendo during the same long-lasting sound; it therefore involves exclusively dynamic means. One of the most impressive examples of continuous transition from positive to negative term of the discussed opposition, is the final cluster of *Threnody*, which is performed by all the strings (see Ex. 64a). An almost identical result can be obtained as a crescendo or diminuendo during maximally dense series of several successive excitation events such as tremolo or frullato. Even if they theoretically result in discontinuous gradations of distinct dynamic levels, the differences between levels of individual successive sounds within series are so minimal as to be imperceptible.

Discontinuous transitions in the proper sense are those made by several sounds that are clearly discrete in respect of dynamics. Discontinuous transitions thus appear when crescendo or diminuendo markings are applied to relations between consecutive sounds of medium time-span values.[14] Such transitions may be made up of sounds produced by the same vibrators (as occurs in *Dimensions*, 3; Ex. 53) or by different vibrators (*Dimensions*, 9; Ex. 50). In the following example from *Threnody*, there occurs a very rare crossing of continuous and discontinuous variations of transition, indicated by a crescendo mark applied at the same time to long-lasting sounds in individual instrumental parts, and to the dynamic gradation between the parts of successively introduced instruments. At the same time, the example also illustrates the cooperation between dynamics and texture:

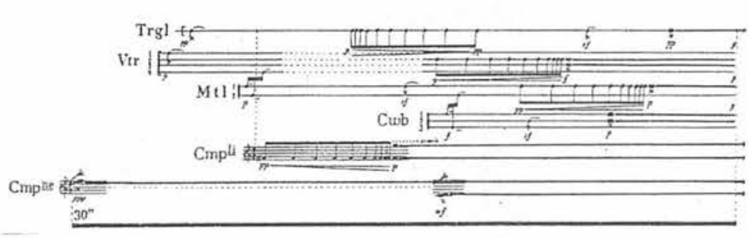
[14] Obviously, maximal time-spans break down the very relations of successive sounds. This makes impossible a dynamic gradation which by definition is based on such relations.

Example 40: *Threnody*, 18



The latter case, of one crescendo or diminuendo mark assigned to parts of several instruments, is quite rare. Mostly, when dynamic gradation is accomplished between sounds of several instruments, it is mirrored in a succession of individual, progressively increasing or decreasing dynamic markings such as *p*, *mp*, *mf*, *f*, *ff*. Yet, if the individual vibrators producing successive sounds of such a discontinuous transition differ considerably as to their dynamic capabilities, dynamic markings can be used to compensate for those differences. In that case, the succession of dynamic markings takes a more meandering course, which nevertheless results in a clear global effect of amplitude increase or decrease. Such an effect may be assisted by textural means, i.e., by an increase or decrease of the number of vibrators involved or of the sounds produced by them:

Example 41: *Dimensions of Time and Silence*, 1



TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY

The duration of sound is directly proportional to the duration of a sound generation process itself, i.e., of an excitation event happening betwen inciter and vibrator. However, the closeness of both those duration values—as respectively acoustical and motoric parameters of "temporal continuity vs. discontinuity" in its first definition—depends on the construction of a given vibrating body and hence forms a basis for dividing vibrators into two classes: dampened and undampened.

Undampened sound sources are all those whose construction allows for their free vibration, which is notated by an open-ended slur. The natural vibration-time of such bodies is considerably longer than the duration of the excitation event and hence always takes values characteristic of temporal continuity. This class contains all vibrators of natural resilience except three-dimensional ones. These last are excluded because they are considered by the composer as those in which the vibration is immediately damped, i.e., stopped at the point of excitation (see "spatial continuity vs. discontinuity"). Therefore, among undampened bodies the composer ranks only plates and bars, i.e., metal two- and one-dimensional vibrators. The classification of vibrators made on the basis of the discussed category is thus contingent upon the earlier classifications concerning the material and number of pertinent dimensions of vibrating bodies. Hence, the sound sources considered undampened are not only real plates or bars, such as gong, Javanese gong, tam tam, sheet metal, cymbals, metal and glass lamellae, vibraphone, glockenspiel, celesta, but also their substitutes mentioned earlier in the course of this chapter (tubes of bells, cowbells, triangle, and bars of xilorimba, the latter when interpreted as metal bodies). A unique case is that of piano and harp strings. Although in reality those strings are tightened and hence possess an artificial resilience resulting from tension, they are reckoned among the class of undampened vibrators by virtue of their earlier, alternative classification among two-dimensional sound sources as virtual metal plates. Moreover, even when interpreted as one-dimensional bodies, they are treated not as strings (i.e., dampened vibrators), but as undampened bars of natural resilience, together with those of vibraphone, celesta, and glockenspiel. This last observation is supported by the notation: the harp and piano sounds receive open-ended slurs not only when occurring with the sounds of two-dimensional bodies, as in *Anaklasis*, 113-115 (Ex. 4), but also when piano and harp strings represent one-dimensional vibrating bodies, and occur with other vibrators of this class, as in *Dimensions of Time and Silence*, 9 (Ex. 50). In both cases, the pianist is instructed to play *con pedale*, which emphasizes the construal of piano strings as belonging to the class of undampened sound sources.

The class of *dampened* bodies contains the remaining vibrators of artificial resilience obtained by tension: the skins of membranophones and the strings of stringed instruments. This is so since the same force of tension that tightens them and enables them to vibrate is also considered to cause rapid dampening. Moreover, all sound sources classified previously as three-dimensional are dampened, as well. Hence, suspended metal lamellae and cowbells are undampened and, consequently, interpreted as two-dimensional vibrators; yet they become dampened in their alternative version, when laid on a solid foundation and thereby treated as the equivalent of three-dimensional vibrating bodies.

Again, this twofold classification reflects in the notation of metal lamellae and cowbells. Combined with undampened vibrators (in Example 41: bells, glockenspiel, triangle, and glass) and treated as suspended metal plates, they receive open-ended slurs as a notational device indicating free vibration. On the other hand, slurs do not occur when metal lamellae and cowbells—laid on a solid surface—co-occur with dampened vibrators such as claves and wooden drums, as well as finger boards and sound boards of stringed instruments (*Dimensions*, 175-187; Ex. 6). It is thus not the classification as two- and three-dimensional vibrators which forms the basis of the double classification of metal lamellae and cowbells as dampened and undampened bodies. Rather, the converse is true: the inclusion of their suspended version in the class of undampened vibrators, and their prone version in that of dampened vibrators, has further consequence in their double classification on the basis of "spatial continuity vs. discontinuity". As pointed out above (see "spatial continuity vs. discontinuity"), the constructional or material properties of sound sources, resulting in immediate dampening of their vibration, influence the classification of several bodies as three-dimensional, even if in reality their three-dimensionality is very questionable. This was the case with strings between the bridge and tailpiece of stringed instruments, which are dampened vibrators because of an artificial resilience resulting from tension. This is the case with all wooden vibrators included in the class of three-dimensional bodies, regardless of their real geometrical shape. In all those cases, classification as three-dimensional bodies thus depends on their classification as dampened bodies. Sound sources are classified as three-dimensional on the basis of the composer's idealization, which assumes that dampening is an inherent property of three-dimensionality.

Yet, there exists also an inverse dependency between classifications of vibrators made in consideration of categories "spatial continuity vs. discontinuity" and "temporal continuity vs. discontinuity". This occurs in the case of the xilorimba. The previous classification of that instrument in the group of one- and three-dimensional sound sources causes its double classification as an undampened and dampened body, even if in both cases the sound generation processes on that vibrator are precisely the same. And, since at the base of the former classification itself lies the interpretation of xilorimba in terms of its material as a representative of either metal or wood, the occurrence (Ex. 50) or lack of slurs (Ex. 14) attached to sounds of that instrument constitutes one more notational manifestation of its double classification on the basis of the timbre system.

An equivalent of dampened vibrators is vibrating air as a sound source proper for human voices and wind instruments, in either of them the time of vibration being under control of a singer or player. In the case of consonants pronounced by singers in *Dimensions of Time and Silence*, the indirect affiliation to the class of dampened bodies is in line with their earlier classification as vocal equivalents of sounds produced by three-dimensional vibrators. The full list of dampened and undampened vibrators is shown in the following table:

Table 4.

DAMPENED VIBRATORS	UNDAMPENED VIBRATORS
wood blocks (*blocchi di legno*)	bars of the vibraphone (*vibrafono*), glockenspiel (*campanelli*), and celesta
wood drums (*casse di legno*)	bars of the xilorimba
claves	tubes of the tubular bells (*campane*)
desk or chair	strings of the piano (*pianoforte*) and harp (*arpa*)
piece of wood (*legno*)	triangle
bars of the xilorimba	gong
wooden parts of stringed instruments: fingerboard, sound board, bridge and tailpiece	tam tam
strings of stringed instruments in front of and behind the bridge	Javanese gong (*gong giavanese*)
guiro	cymbals (*piatti*)
rattle (*raganella*)	sheet metal (*lastra*)
stops and pistons of wind instruments	metal lamellae (*blocchi di metallo*)
handle ends of beaters	suspended glass lamellae (*vetri*)
key mechanism of the typewriter	cowbells (*campanacci*)
edges of membranophones: timpani, snare drums (*tamburi*), tom toms, and bongos	
electric bell (*campanello elettrico*)	
whistles (*fischietti*)	
piece of iron (*ferro*)	
glass bar (*vetro*)	
skins of membranophones: timpani, snare drums (*tamburi*), tom-toms, bongos, and conga drums	

In the case of dampened vibrators, the fact that their vibration is immediately suppressed means that in practice the duration of their vibration is almost identical with that of their excitation. In turn, values of the latter depend on the direction of excitation (i.e., of the movement performed by an inciter in relation to a vibrator) and hence allow one to classify excitation events as horizontal or vertical. Long-lasting excitation events can only be horizontal ones—those in which the inciter moves parallel to the vibrator—as in the cases of bowing, rubbing, or even sawing, all of which occur in Penderecki's scores. On the other hand, only momentary is the duration of vertical excitation events—i.e., in which the movement of inciter is perpendicular to the vibrator, as in the cases of striking, tapping or plucking.

The time-span between successive impulses constituting the acoustical parameter of "temporal continuity vs. discontinuity", in the second definition of this category, is identical with the time-span between individual, momentary events of excitation. Nevertheless, its sub-liminal values, characteristic of temporal continuity (positive term), are those between clicks that comprise a single sound phenomenon and determine its frequency value.

Positive term (+)

Long duration values and sub-liminal time-spans between successive impulses are the two conditions that insure the univocal perception of a temporally continuous sound. These conditions are met only by long-lasting vibrations. In the group of dampened instruments, long-lasting vibrations are accomplished exclusively by long excitation events of the horizontal type. The most common long-lasting excitation event—and the only representative of this type in string-playing technique—is the bowing which occurs not only as the most typical arco play on strings before the bridge, but also applied to string sections between bridge and tailpiece as well as to bridges and tailpieces themselves.

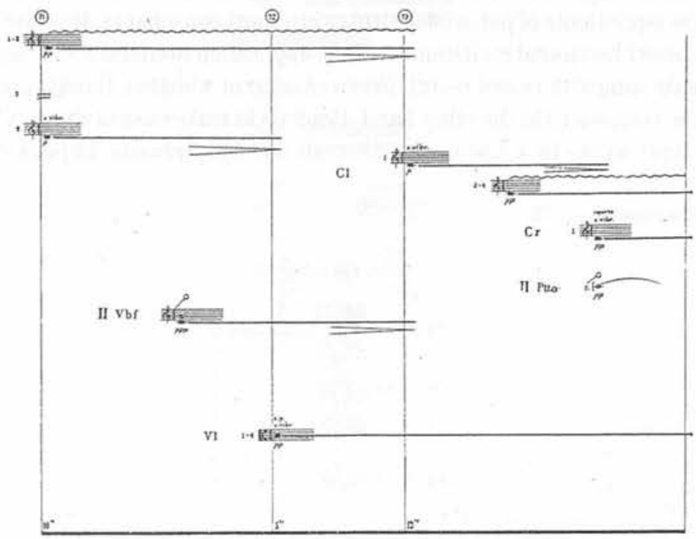
In application to two-dimensional vibrators long events of rubbing are unique. They occur only once in Penderecki's sonoristic works by scraping the skins of tom toms with a finger nail, an effect employed in *Dimensions of Time and Silence* (126). As regards wind instruments, equivalent sound phenomena are those arising through traditional playing in long breaths; in choral voices, by singing, whistling, and pronouncing long-lasting consonants like /sz/ (see Ex. 49).

In the group of freely vibrating sound sources, the positive term of the discussed category can be obtained by any excitation event that produces a free vibration of the sound source, one that is allowed to die away naturally. In traditional techniques of playing undampened percussion instruments, the predominant type of excitation is vertical, accomplished by striking the vibrators with a beater. Vertical excitation also occurs in the piano and harp. In the former, the strings are usually struck with piano hammers and occasionally with other types of beaters. In the latter, the basic instrumental technique is that of plucking the strings pizzicato. All such momentary excitation events are notated as "white-headed" whole notes followed by an open-ended slur indicating the free cessation of the vibrator. In the following example this way of notation is to be seen in the parts of the vibraphone, glass and metal lamellae, triangle, cymbals and tubular bells. The blackened signs assigned to piano, celesta and glockenspiel result, instead, from the category "spatial continuity vs. discontinuity" and signify clusters:

Example 42: *Dimensions of Time and Silence*, 2

It is the nature of free vibrations that they cannot be controlled from the outside by the performer, either as to duration or intensity, the latter of which gradually decreases. To lengthen the sounds of undampened sources or to keep them on the same dynamic level, the composer often uses tremolo. Soft-bodied inciters are employed in such cases, e.g., sticks made of felt, wire brushes, and others. Though in tremolo the excitation consists of several successive events, the latter are not intended to produce new vibrations but only to maintain the initial one. Consequently, individual strikes are not heard separately but fuse into one long-lasting sound. As such, tremoli are thus very similar to rubbing, bowing, or blowing, and quite often occur together with those means of excitation, as in the below example. There, sustained, temporally continuous sounds of flutes and violas are accompanied by tremolo in the vibraphone played with soft sticks:

Example 43: *Fluorescences*, 71-72



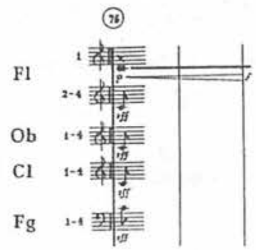
Among the pieces considered in this book, the sole examples of continuous, long-lasting excitation events applied to freely vibrating, undampened sound sources are found in *Dimensions of Time and Silence*. There, first the edges of cymbal and tam tam are bowed (118-122), and subsequently the striking surfaces of cymbals and gong are scraped with fingernails (126-127).

Negative term (-)

Momentary vibration of a sound source, constituting a necessary condition for both versions of the negative term, can arise on dampened sound sources by a momentary excitation event consisting in either horizontal or vertical interaction between inciter and vibrator. If horizontality is represented in the strings by *arco* playing, verticality is obtained by plucking the strings (*pizzicato*) and by striking them with the wood of the bow (*legno battuto*). All these techniques also have their application to strings between bridge and tailpiece, as a substitute for three-dimensional metal body, with the following difference: in that region of the instrument, *pizzicato* is, as a rule, replaced by playing *con dita*, i.e., tapping (instead of plucking) the strings with the fingers. On the wooden parts of stringed instruments, vertical excitation occurs as follows: striking the strings *sul tasto* with the palm of the hand (which excites also the fingerboard), tapping the sound board with the nut of the bow or with fingertips, and also striking the music stand with the bow or the chair with the nut (the latter is called for in string parts, even though both chair and music stand are detached from the body of the instrument).

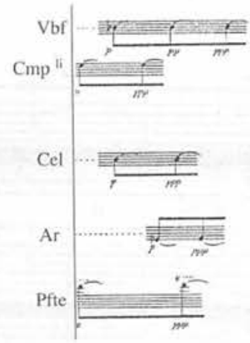
The remaining three-dimensional dampened bodies are also mainly stroked. This holds true for typewriter, for stops and pistons of wind instruments, as well as for wooden bodies that do not constitute parts of stringed instruments, such as claves, wood blocks, wood drums, and xilorimba. In the choir, the equivalents of percussive strokes are short consonants. However, there occurs no counterpart of short horizontal excitation events in application to choral voices, since short vowels, as well as sounds sung with closed mouth (*bocca chiusa*) or whistled, though practicable, are not employed by the composer. On the other hand, Penderecki makes use of short excitations on wind instruments, represented by single *staccato* sounds and by *sforzando* impulses:

Example 44: *Fluorescences*, 76



The short vibration of an undampened sound source is possible only when the free vibration following the excitation is attenuated by artificial dampening of the vibrator by the performer. This technique is indicated by notes without a slur. If the excitation itself is momentary—usually a (vertical) strike—a temporally discontinuous sound phenomenon arises. Yet, even if not muted artificially by players, the vibrations of undampened sound sources excited by a comparatively hard inciter (such as a wooden stick, a hammer, triangle rod, even the palm of the hand) display a sound envelope consisting of two different phases: a short, crisp onset and a long, soft decay. The former results from the click of a beater, which is a dampened body itself and as such produces momentary vibrations that generate a temporally discontinuous sound. If the composer treats the onset as the sound phenomenon proper and the decay phase as an irrelevant aspect of instrumental timbre, such means of playing freely sounding instruments is also acknowledged by him as a temporally discontinuous effect. Although both acoustically and performance-wise this effect is identical to that described above as representative of temporally continuous phenomena, the composer's view of that effect changes, and this change is manifested in a change of notation: if such effects are to be treated as temporally discontinuous, they are written in black notes of definite rhythmical values (mainly quavers and semiquavers), or as "black-headed" notes of indeterminate value and displaying a crossed-out flag. The slur indicates that the sound should be allowed to decay freely and without being dampened, as in the case of temporally continuous phenomena:

Example 45: *Dimensions of Time and Silence*, 11



Border-zone term (*)

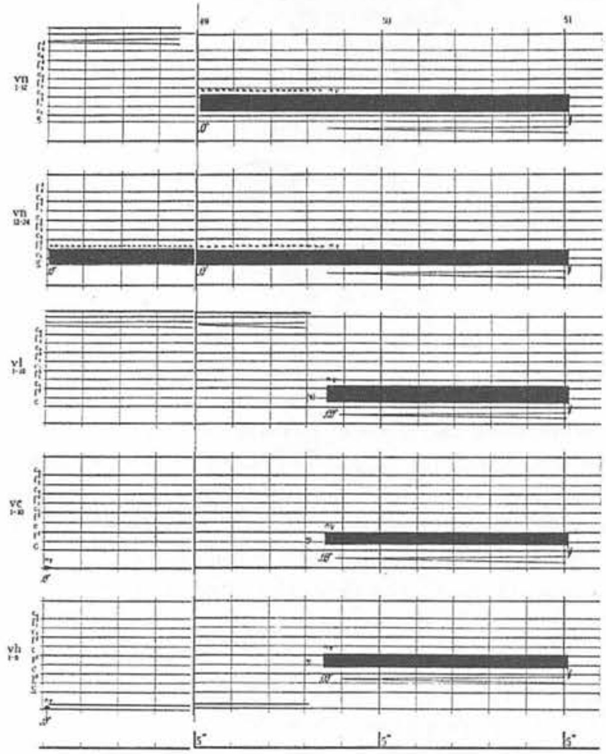
According to the first definition of the category, the border-zone term would embrace tones whose durational values are intermediate between those of momentary impulses and long-lasting sounds. Yet this possibility is not employed, since, given a specific musical context, one would tend to interpret such sounds as either continuous (positive term) or discontinuous (negative term), and the feeling of doubt essential for the mediative term would not arise.

Version 2 of this term requires minimal time-span values between the onsets of individually discernible impulses. This implies minimal time-spans between successive, momentary excitation events, i.e., quickest possible repetitions of the same sound generation process. Since momentary excitations are possible both vertically and horizontally, this means that, in practice, the border-zone term is available to all sound sources by any means of excitation, i.e., to all sound generation processes provided they proceed in maximal temporal condensation.

The most common examples of maximally dense repetitions are the string tremolo and the percussion roll. The former constitutes a series of horizontal excitations, the latter a series of vertical ones. In spite of this difference in direction, each of these effects presupposes an alternation between successive excitation events. Tremolo requires a change of direction between successive bowings (downwards and upwards); the drum roll consists in an exchange between two beaters (inciters). This common trait—the alternation of repeated excitations enabling higher speed—allows both those repetitive series to be notated with the same marking (≍).

Tremolo on stringed instruments is not restricted to the traditional playing on strings in front of the bridge. Rather, string tremolo may refer to any series of alternating, horizontal excitations involving a bow (including the wood of the bow), irrespective of where it is applied on the instrument. Hence, in Penderecki's sonoristic scores one finds tremolo played both *arco* and *col legno* on strings before and behind the bridge, and even *arco* tremoli on the edges of the sound board (*Fluorescences*, 66-69; see Ex. 12). A similar auditive effect results from irregular changes of bow (⊓∨) in a large group of stringed instruments. Even though the parts of each individual instrument may consist of successive bowings, each of considerable duration, the unsynchronized superposition of several such parts results in the impression of a maximally dense series of repetitions. While in tremolo only a small part of the bow is used, this effect utilizes the whole length of the bow hair, which affects the intensity of the resulting sounds. Irregular changes of bow are thus employed mostly to substitute for tremoli in very loud dynamics. Apart from strings before the bridge, they may also be performed on the bridges and tailpieces of cellos and contrabasses:

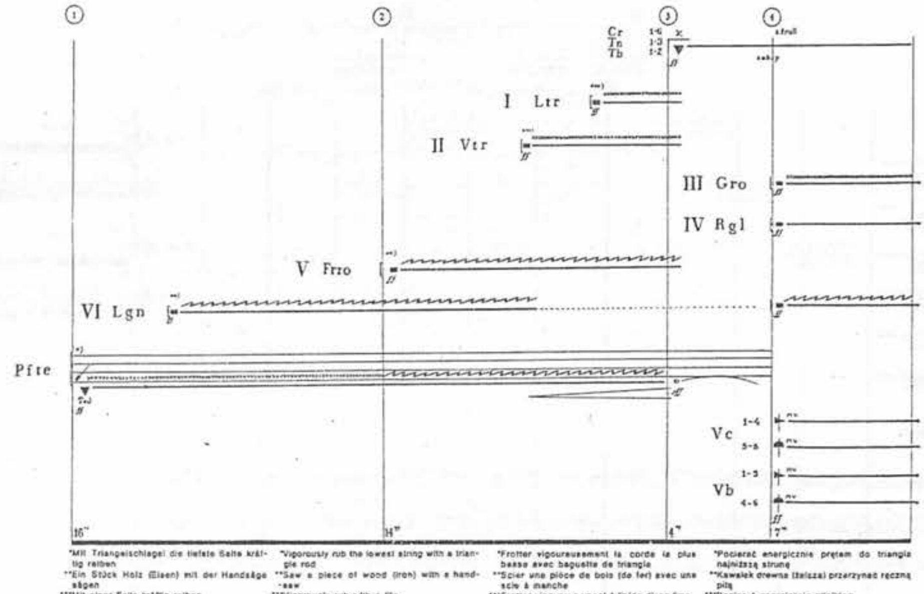
Example 46: *Canon*, 48-50



Maximally dense repetitions of horizontal excitation events of alternating direction can be performed not only with a bow, but also with several other inciters, such as saws (see Ex. 47, below) and the palm of the hand (Ex. 12). However, if such is the case, they are not indicated as tremoli and, consequently, their way of notation changes.

Quickest possible repetitions of horizontal excitations performed in the same direction (i.e., without alternation characteristic of the above-discussed phenomena), are written as series of accents (>>>>>>>>>). They occur first of all as bowing stringed instruments (either in front of or behind the bridge) at the heel of the bow with high pressure. To do so results in a "jarring, "grinding sound" or a "violent creaking", as is clearly demanded by the composer in *Canon*, *Fluorescences*, and *Polymorphia*. An even more violent sound is achieved by rubbing wood and glass with files, a means of sound generation employed in the following example:

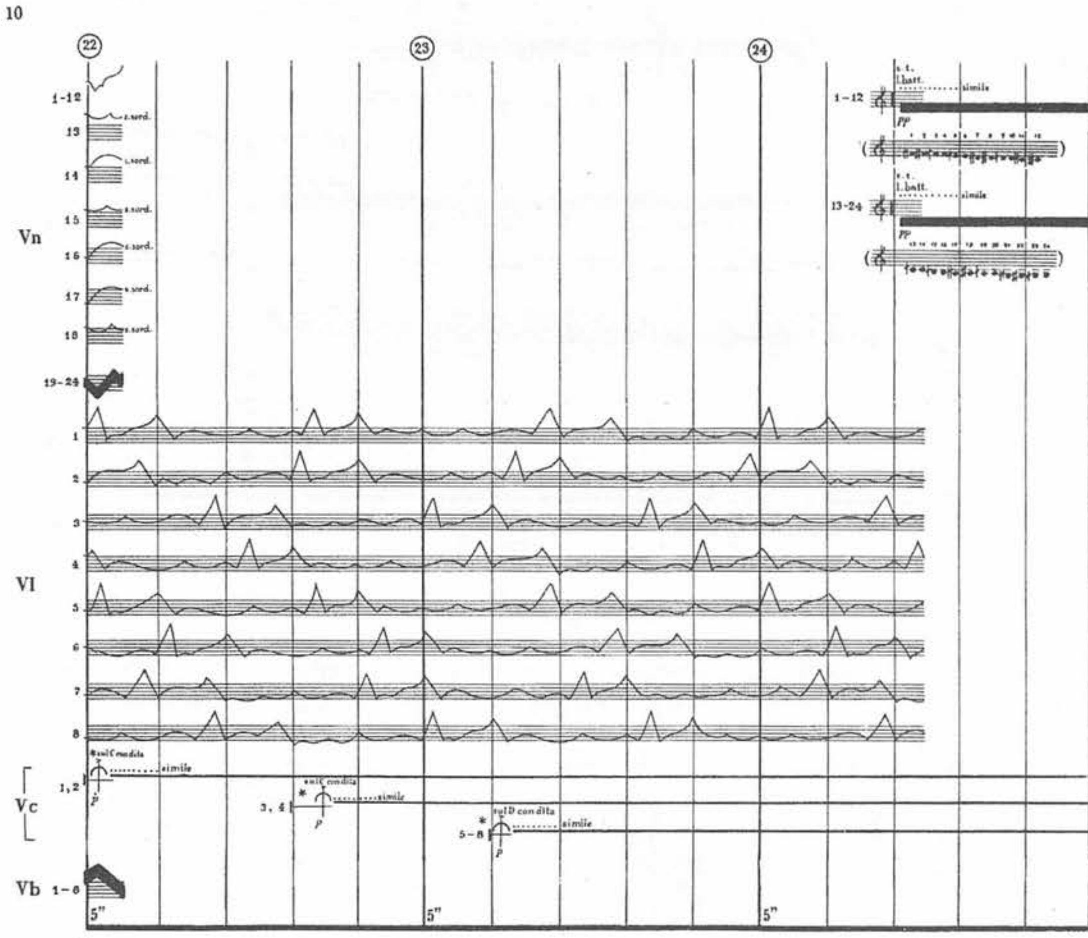
Example 47: *Fluorescences*, 1-4



In this example the notation of maximally dense repetitions of horizontal excitations performed in the same direction is applied also to a piano rubbed with a triangle rod as well as to a guiro. The notched surface of the latter instrument suggests that maximally dense repetitions constitute its proper sound phenomenon; this makes the guiro particularly suitable for the border-zone term, being not used for any other term of the category in question. The same holds true in two other cases: the rattle (raganella) emits a series of sounds that emanate from the horizontal notches on its surfaces; and the electric bell always involves a maximally rapid series of strokes (i.e., vertical excitations). Because no other way of using those generators exists, their parts receive no special notation indicating quickest repetitions. In contrast, whistle sounds do receive special notation, even though they too are always produced by repeated strikes, made by a metal ball which not only interrupts a stream of air but also periodically excites the instrument's body from the inside. In loud dynamics, whistle sounds are notated as trills (*Fluorescences*, 6; Ex. 30) or tremoli (*Fluorescences*, 98).

A repetitive series of vertical excitations made by one inciter is marked as a series of dots (.......). Such a notational device occurs in the parts of piano and harp, and in percussion instruments if only one beater is involved, as with the glockenspiel and celesta. This device is also applied to *con dita* playing between bridge and tailpiece as well as to series of string pizzicati, both cases being illustrated by the following example:

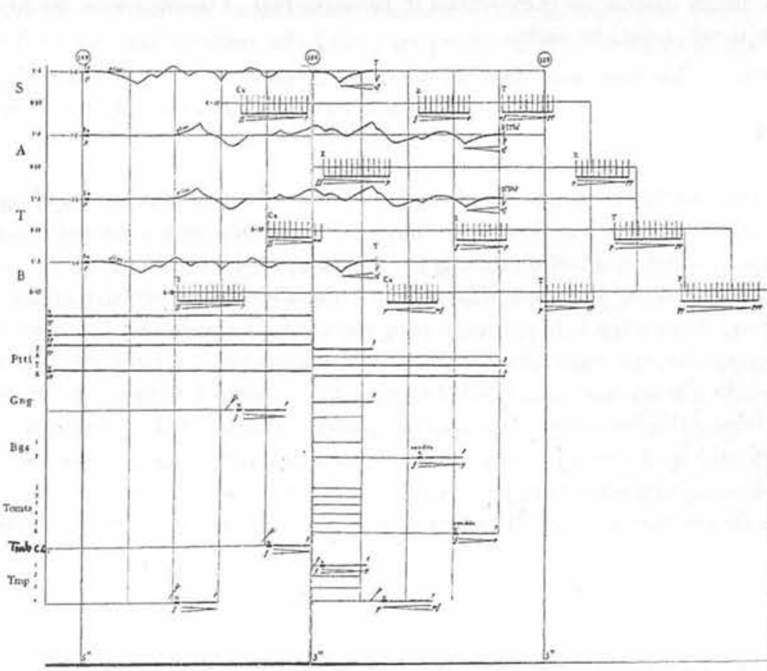
Example 48: *Polymorphia*, 22-24



* Uderzać w strunę końcami palców (za podstawkiem). Hinter dem Steg mit den Fingerspitzen auf die Saite klopfen. Tap the string with the finger-tips between bridge and tailpiece.

Series of dots are sometimes initiated by the individual notation of component vertical excitation events (in equal distances) grouped under a common beam, as in *Fluorescences*, 23 (Ex. 31). If a given repetitive series is relatively short, all of its component impulses can be indicated by such individualized, "initial" notation, and are not subsequently symbolized by an arrangement of dots. This happens in *Dimensions of Time and Silence* (151-175), where repeated consonants occur in the choral parts, and where strings are struck *sul tasto* with the palm of the hand. These repetitions are intended as maximally dense, thus representing the border-zone term of "temporal continuity vs. discontinuity" and not the negative term of this category. This is evidenced by the exact correspondence between the choral series in 151-157 of *Dimensions*, and the tremoli played with wire brushes on bongos, tom tom, snare drum, and timpani—the choir and percussion here are construed as counterparts of each other:

Example 49: *Dimensions of Time and Silence*, 149-163



It is noteworthy that, when their series are intended as maximally dense, the individually notated, repetitive impulses are always equidistant. This is so because the minimal time-span between excitation events of such a series is intentionally only one, even if in practice its value is indeterminate and varies from performer to performer. This rule of equal time-spans (i.e., temporal distances) between sounds that are maximally condensed in time is significantly similar to the previously discussed rule of equal intervals, i.e., the rule that determined the distances between component pitches of clusters as maximally condensed phenomena in sound space. At the same time, it helps to distinguish between quickest possible repetitions and repetitions of impulses in longer time-spans, which are always notated in unequal distances.

From the above example it follows that the consonants pronounced by choral voices are treated as equivalents of vertical excitation events. *Staccato* repetitions in wind instruments are interpreted in the same way, as evidenced by their notation as a series of dots (*Fluorescences*, 5). On the other hand, *frullato* in the winds is indicated by means of a tremolo mark (*Fluorescences*, 3; Ex. 47), which suggests that the composer views that technique as a counterpart to the alternating strokes of percussion rolls. Finally, trills and vibrati may substitute for maximally dense series of impulses.

Though resulting from a single, long-lasting excitation, they produce the sensation of quickest possible repetitions of their neighbouring component pitches. Their function as representatives of the term under discussion is evidenced in passages (e.g., *Fluorescences*, 83-84) where they cooperate with real repetitive series.

Transition (')

The first version of this term is accomplished as a series of sound phenomena whose durational values are either gradually lengthened or shortened, and which form a discontinuous transition between impulses and long-lasting sounds (*Dimensions*, 28-45; see Ex. 28).

According to the second definition of the category, transition would consist in gradually enlarging or diminishing time-spans between individual, successive impulses. Yet this does not occur in practice. Because the time-span values characteristic of temporal continuity are only those between individual clicks of one sound (i.e., a sound produced by a single excitation), and time-span values proper for temporally discontinuous sounds are measured between different excitations, such a transition would by necessity contain a skip between long-lasting sounds and momentary impulses—a skip which would deny its very nature as a smooth progression that leads unnoticeably from one of the opposite terms to the other, and which in this way mediates between them.

TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY

The time-span values between onsets of successive sounds are dependent exclusively on—and as such are identical to—the time-spans between onsets of successive processes of sound generation, i.e., between successive excitations of a vibrator by an inciter. This identity allows the acoustical and the motoric parameters to be used interchangeably in the following articulatory definition of "temporal mobility vs. immobility" as well as of the hierarchically linked category "maximal vs. minimal time-span".

Negative term (-)

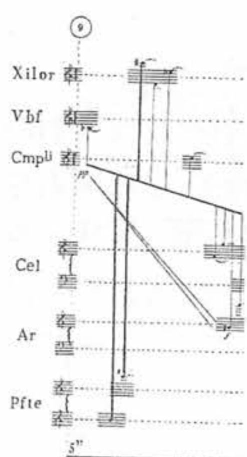
This term arises between successive sounds produced by excitations whose time-spans take either maximal or minimal values. (The duration of individual sounds is irrelevant: they can be either sustained or momentary.) Because, as pointed out earlier (in Chapter 5.1), for a given sound its successor is that which starts after the former stops, the time-spans between long-lasting sounds are always necessarily maximal and, in consequence, constitute the first version of temporal immobility. Of course, a maximal time-span can also separate impulses generated by momentary events of excitation. The lack of a definitive temporal relationship between such separated impulses finds its reflection in the notation. Even if belonging to one instrumental part, they are as a rule written as notes without a common beam (*Dimensions of Time and Silence*, 18; Ex. 26).

Temporally immobile sounds of minimal time-spans, representing the second version of this term, are all those enumerated as representatives of a border-zone term of the above-discussed category "temporal continuity vs. discontinuity". Because a minimal time-span of successive sounds also implies their minimal duration, all of them are produced by series of momentary excitation events, even though the direction of those events can be both horizontal and vertical (see above discussion of "temporal continuity vs. discontinuity").

Positive term (+)

Theoretically, the medium time-span value characteristic of temporal mobility admits both long (temporally continuous) or momentary (temporally discontinuous) sounds. Yet only the latter possibility is employed by the composer in pieces considered in this book. Therefore the positive term of this opposition results only from several momentary excitations, or impulses. Temporal interrelations between such impulses are signaled by a common beam uniting individual notes played by the same instrument or instrumental group (see Ex. 18, 24). Occasionally, a common beam also joins together notes of different instruments, if they enter mutual temporal relations characteristic of the term in question. A unique example of such a "cross-instrumental" beaming occurs in the score of *Dimensions*:

Example 50: *Dimensions of Time and Silence*, 9



It is noteworthy that, in the case of undampened vibrators left to cease vibrating naturally, as in this case, sound phenomena acknowledged as successive and establishing the medium time-span characteristic of temporal movement occur long before the attenuation of their predecessors. This is explained by the fact that, as demonstrated earlier, the phase of sound decay is irrelevant for such sounds, inasmuch as they are intended by the composer as temporally discontinuous.

If temporally interrelated impulses constitute repetitions of the same sound, their time-spans are always notated as unequal (Ex. 35). This is so since the very notion of medium time-span embraces several different time-span values. Such inequality of time-spans between successive excitations results in a rhythm that, as stated before, constitutes the very essence of the concept of temporal mobility.

Transition (→)

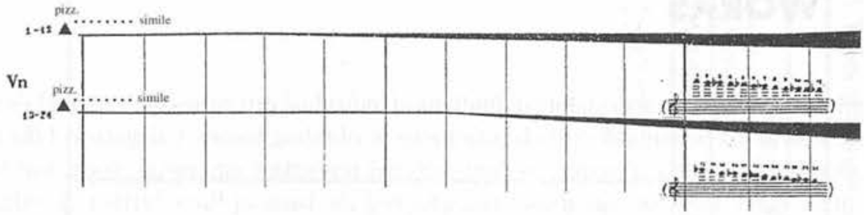
Because the parameter of this category is temporal, only the discontinuous variation of the transitional term can be accomplished. It consists in a gradual change of time-span values between excitations producing individual successive tones, such that they increase or decrease between the values representative of two opposite terms. Yet, since the negative term is represented by an incoherent (unconnected) set consisting of two subsets embracing maximal and minimal values, there also exist two versions of transition: either between minimal and medium (version 1) or between maximal and medium time-spans (version 2).

The second version occurs in the String Quartet as a repeated series of impulses of progressively diminishing time-spans:

Example 51: String Quartet No. 1, 3.53-57

The first version occurs only once in Penderecki's sonoristic pieces, in *Polymorphia*, and gives interesting proof of the composer's intuitions about processes of perception. It makes use of the fact that successive sounds become more discernible as the interval between them increases (thus repeated sounds are the hardest to hear individually). Therefore, in the following unique case of this version of transition, the impression of a gradual increase of time-spans between individual *pizzicato* sounds arises not owing to the progressive enlargement of physical time-span values, which in fact remain equal, but through a gradual acceleration of glissando:

Example 52: *Polymorphia*, 34-36



MAXIMAL TIME-SPAN VS. MINIMAL TIME-SPAN

Transition (→)

As with the simple temporal mediative term of "temporal mobility vs. immobility", the only available variation of this transition is the discontinuous one, which consists in a progressive increase or decrease in time-span between minimal and maximal values:

Example 53: *Dimensions of Time and Silence*, 3

While minimal time-span implies only minimal durations of successive sounds, maximal time-span can occur between either momentary or long-lasting sounds. In the case of the latter performed by undampened sound sources, the composer foresaw a notational problem. Because, as pointed out before (see "temporal continuity vs. discontinuity"), in this class of vibrating bodies temporally continuous sounds are written with white note-heads, and discontinuous sounds with black note-heads, he would be forced to skip from black to white notation at some arbitrarily chosen moment in the transition. This, in turn, would create the false impression of a clear border between durational values of temporally continuous and discontinuous sounds. To avoid such a situation in reference to the discussed temporal term, Penderecki breaks his own notational rule, and uses only black note-heads to symbolize onsets, regardless of whether the maximal time-span between them is actualized by long-lasting (temporally continuous) sounds or momentary (temporally discontinuous) impulses. In the framework of a transition, to determine the length of sounds in time-spans longer than minimal, one thus needs to check an adjacent segment that contains the positive term of this category (i.e., maximal time-span) as the point of departure or of destination of the simple temporal mediative term.

6.3. ORCHESTRATION AND INSTRUMENTAL TECHNIQUES IN PENDERECKI'S SONORISTIC WORKS

In the preceding chapters, articulatory definitions of individual categories of Penderecki's timbre and basic system led to four different classifications of vibrating bodies. Categories of the timbre system classified vibrators according to their material properties into metal, wood, and leather. On the other hand, basic-system articulations formed the basis of three further classifications made according to constructional properties.

Yet, the inclusion of a vibrating body in a given class was sometimes made by the composer in a highly arbitrary way. Even if it does not really possess a constitutive property of some class, a vibrator can be ranked among its representatives as a substitute, i.e., as a material or constructional substitute for a given class of sound sources. In extreme cases such arbitrariness results in a double classification of the same vibrator treated as a representative of two different classes, divided on the basis of the same category according to the same property. This situation applies to piano, harp, vibraphone, xilorimba, triangle, bridges and tailpieces of cellos and contrabasses, cowbells, and metal lamellae. If the different double classification of the two latter sound sources is justified by a real difference in property, depending on whether they are played in their suspended or prone position, in all the remaining cases the polyvalence in classification occurs even though no change of properties takes place. In spite of this, those vibrators are interpreted as having mutually exclusive properties and, according to those interpretations, are operated differently in different musical contexts. Obviously, from the point of view of the composer, two different interpretations of the same vibrator are acknowledged as two intentionally different sound sources though incidentally residing in only one physical body.

Therefore, only after the classifications have elucidated all the cases of double interpretations of vibrating bodies can one make a full list of sound sources in Penderecki's sonoristic style. This list arises from a combination of all four classifications, as shown in the following table (Table 5). Because for this task only classifications by properties of a single vibrator are pertinent, the subdivision of bodies of unchangeable size into individual single-sized items and into collections of different sizes is not included here.

The superposition of classifications reveals six types of sound sources (vibrators), each qualified by a set of material and constructional properties relevant for categories of the timbre and basic systems. Strikingly, most of those types have their counterparts in groups of contemporary Western instruments, as classified by Polish acoustician and organologist, Mieczysław Drobner (1960). The type defined as "metal one-dimensional dampened vibrators of changeable size" and represented exclusively by strings of stringed instruments clearly constitutes an equivalent of chordophones. "Leather two-dimensional dampened vibrators of unchangeable sizes" are equivalent to membranophones, and "wooden three-dimensional dampened vibrators" to wooden idiophones. Two further types—"one- and two-dimensional undampened vibrators of unchangeable sizes"—form subdivisions of metal idiophones, being represented respectively by metal bars and plates together with their material and constructional substitutes. Only the type qualified as "metal three-dimensional dampened vibrators of unchangeable size" has no equivalent among instruments in Drobner's classification; to find its place there, it would have to be classified as a third subclass of metal idiophones on a level with bars and plates.[1]

[1] The reason for this analogy between types of Penderecki's vibrators and Drobner's classification is, plainly, that the latter, as any systematic classification of instruments, refers primarily to vibrating bodies. Otherwise, it is not unlikely that the classifications of vibrators made by Penderecki as well as his idealization of acoustical processes were inspired by Drobner's book *Instrumentoznawstwo i akustyka*, first published in 1960.

Table 5. Types of vibrators employed in sonoristic pieces by Krzysztof Penderecki and their representatives

METAL				LEATHER	WOOD
ONE-DIMENSIONAL		TWO-DIMENSIONAL	THREE-DIMENSIONAL	TWO-DIMENSIONAL	THREE-DIMENSIONAL
DAMPENED	UNDAMPENED	UNDAMPENED	DAMPENED	DAMPENED	DAMPENED
CHANGEABLE	UNCHANGEABLE	UNCHANGEABLE		UNCHANGEABLE	
strings of stringed instruments in front of the bridge	strings of the piano	cymbals	edges of timpani	skins of timpani	wood blocks
	strings of the harp	suspended glass lamellae	edges of bongos	skins of bongos	wood drums
	bars of the vibraphone	metal lamellae	edges of tom-toms	skins of tom-toms	bars of the xilorimba
	bars of the glockenspiel	cowbells	edges of snare-drums	skins of conga drums	claves
	bars of celesta	bars of the vibraphone	mechanism of stops and pistons of wind instruments	skins of snare-drums	desk or chair
	bars of the xilorimba	strings of the harp	key mechanism of the typewriter		handle end of a beater
	tubes of the tubular bells	strings of the piano	electric bell		guiro
	triangle	tubes of the tubular bells	whistles		rattle
		gong	piece of iron		piece of wood
		tam tam	glass bar		fingerboards of stringed instruments
		Javanese gong	metal lamellae		sound boards of stringed instruments
		sheet metal	cowbells		bridges and tailpieces of stringed instruments
		triangle	strings of stringed instruments between bridge and tailpiece		
			bridges and tailpieces of violoncellos and contrabasses		

Vibrators constituting tokens of the same type most often cooperate with each other. Hence, the above-listed six types of sound sources constitute a fundamental determinant of orchestration in Penderecki's sonoristic pieces, and account for its peculiarities—so striking in comparison with traditional orchestration: not only for those idiosyncrasies pointed out numerous times by critics and music analysts, but also for traits unnoticed by them. Obviously, Penderecki's sonoristic orchestration deviates from traditional orchestration to the same extent that the above types diverge from the division of traditional symphonic orchestra into string, wind, and percussion instruments.

A cursory survey reveals already that, among the six types of vibrating bodies, aerophones are missing. This fact sheds light on the inferior position of wind instruments in Penderecki's early sonoristic pieces, in comparison with the pride of place given strings and percussion. Still, while the former instrumental group has its counterpart in one type of vibrator only (that of chordophones), the latter embraces as many as five remaining types. The resulting emancipation of individual groups within the set of percussion instruments (membranophones, wooden idiophones, three groups of metal idiophones) seems to have escaped the attention of earlier commentators on Penderecki's sonoristic period. Nevertheless, that emancipation accounts significantly for the privileged position of percussion in the works considered in the present study.

The elevation of strings and percussion finds its further justification in the leading roles of these two orchestral groups, as resources of vibrators representing individual types of vibrating bodies. In the case of stringed instruments, this springs from their complexity: each item contains several elements, different as to material and constructional properties which are relevant for the categories of the timbre and basic systems and, as such, form the bases of individual classifications of vibrators. On the other hand, the richness of percussion results mainly from the fact that, in contrast to the uniformity of stringed instruments, this orchestral group is highly differentiated internally, as an assembly of instruments radically diverse in their material make-up and means of construction. Furthermore, the percussion section in Penderecki's sonoristic pieces is much larger and diverse than that of the traditional symphonic orchestra, made so by the inclusion of instruments (such as suspended cymbals, bongos, conga drums, and the like) which are usually employed in popular music and jazz rather than in art music, as well as by the addition of non-musical sound tools—all of which are subsumed under the percussion parts.[2] Hence, though some of the percussion instruments are of a rudimentary construction consisting only of one element (such as the wooden claves), the diversity of this group as a whole and its contribution to the set of sound sources employed by the composer surpasses even that of stringed instruments. That, in spite of this apparent fact, percussion never occurs independently as the only staff of a sonoristic piece, being in this respect less discriminated in the composer's favour than strings, it has two important reasons. First, while the string orchestra already exists in traditional musical practice as a "ready-made" ensemble, vast percussion orchestras are unique, and were even more so in the 1960s. To gather such an ensemble of players, as well as such a variety of instruments, would prove so difficult as to minimize considerably the number of performances of a piece scored for percussion only.[3] Secondly, in the group of percussion instruments there occur no vibrators characterized by changeability of size. As can be ascertained from the above table, the latter

---

[2] At the turn of 1950s, along with other Western currents of contemporary music, jazz also began to flow into Poland and very quickly gained great popularity. This high interest in jazz, shared from the very beginning by Penderecki, found its manifestation in *Actions*, a piece for free jazz orchestra, composed in 1971.

[3] Such a misfortune befell, for instance, Edgar Varèse's pieces for percussion orchestra, which, because of organizational difficulties attached to their performance, remained forgotten for decades and were re-discovered as late as the 1950s.

constructional property is vested exclusively in the strings of stringed instruments, which (apart from the human voice) are the only sound sources capable of articulating a combination of "temporal immobility" with "spatial mobility" resulting in a glissando: an effect impracticable for percussion in spite of all its richness. Undoubtedly, the privileged position of strings over percussion may be partially explained by the musical education of the composer. Yet, in the context of the two above-mentioned reasons, of practical and theoretical nature respectively, Penderecki's hands-on familiarity with stringed instruments and string-playing techniques seems to be of much less importance than some biographers claim.

Thorough study of Table 5 shows that some instruments occur as tokens of the several different types listed. This results from the fact that, while orchestral groups are classified by instruments, the typology of Penderecki's sonoristic orchestration refers to vibrating bodies. Traditionally, the notion of an instrument admits of only one kind of vibrator, represented either by a single element of an instrumental corpus or by a collection of elements identical as to material and construction. Meanwhile, as pointed out in Chapter 6.1, in Penderecki's sonorism the function of vibrators is fulfilled also by elements not originally designed as such. Thus, as usually happens, if a new vibrator of some instrument differs from the traditional one as regards material or constructional properties relevant for the classifications of sound sources on the basis of timbre and basic systems, such a vibrator is by necessity the token of a different type than the originally designed sound source. Consequently, one instrument belongs to several types of vibrators, being represented there by its different elements. An extreme example of such a phenomenon is stringed instruments, whose elements occur in three different types: (1) strings in front of the bridge are included among the chordophones; (2) strings between bridge and tailpiece as well as bridges and tailpieces of cellos and contrabasses belong to three-dimensional metal idiophones; (3) sound boards, fingerboards, bridges and tailpieces are ranked among wooden idiophones. As another example: tom toms, timpani, snare drums, and bongos belong to membranophones as regards their striking surfaces, but to three-dimensional metal idiophones as regards their edges. Even more curious is the case of wind instruments in the table above. There they are represented by mechanisms of stops and pistons and numbered again among three-dimensional metal idiophones, even though their original sound source (air) is not included among the classification at all. As one can see, in Penderecki's sonorism the employment of untraditional parts of instrument bodies as sound sources destabilizes the very notion of an "instrument". Unlike in traditional orchestration, here the use of one and the same instrument can be manifold, in the sense that such an instrument cooperates with different sets of other instruments in different contexts, depending upon which of its elements is employed as a sound source in a given sound-generation process.

One more remark must be made in this connection. All the newly found vibrators of traditional musical instruments represent idiophones—either wooden or three-dimensional metal ones—which in the symphonic orchestra constitute a part of the percussion staff. This is why sound generation processes involving atypical sound sources of originally non-percussion instruments (strings and winds) were labeled by earlier commentators as "percussive effects", an insufficient if not inaccurate expression. Since the affiliation of an instrument with a given orchestral group is made primarily according to its vibrator, a change of vibrating body also causes a change of affiliation. Thus, striking the sound board of stringed instruments does not result merely in a "percussive effect"—it actually turns them into percussion instruments. Similarly, tapping on the stops and pistons of brass or woodwinds causes them to become percussion instruments; in such cases, those instruments should no longer be treated as winds.

---

[1] Cases of adulteration (i.e., occurrences of different kinds of vibrating bodies as immovable parts of the same instrument) are always exceptional and do not occur on the staff of the symphonic orchestra.

In Penderecki's sonoristic pieces, there occur however two traditional, non-percussion instruments that are always treated as percussion, even though they are played on the originally designed vibrators. These instruments are piano and harp. In both cases, the percussive character attributed to them by the composer results from arbitrary classification of their strings not as chordophones but as metal idiophones, i.e., as substitutes for either bars or plates. It is noteworthy that this phenomenon concerns exactly those two instruments which are usually considered apart from the orchestral groups. The reason is obviously that the division into bowed strings, winds, and percussion is based on a non-uniform principle involving both the vibrating substance and the mode of sound-excitation (see Wachsmann 1980: 242). While the former aspect joins piano and harp to stringed instruments, the latter one distinguishes them from that group. In particular, striking as a way of making the strings vibrate turns the piano into a quasi-percussion instrument, which explains its percussive treatment by such earlier composers as Bartók, Stravinsky and Prokofiev. Inclusion of the piano among percussion instruments in the table thus continues this twentieth-century tradition, rather than merely being a novelty of Penderecki's sonoristic style.

The full list of sound sources, shown in the table above, constitutes a basis for elaborating a complete list of sound generators, i.e., pairs of vibrators and inciters that interact to produce a sound phenomenon. This task is to be accomplished through a combination of vibrating bodies with their particular inciters in sound generation processes of Penderecki's sonoristic pieces. In comparison with Diagram 1, such a list is ameliorated in consequence of allowances made for vibrators doubly classified on the grounds of basic system categories. Pairs consisting of the same type of vibrator (defined by material and constructional properties) as well as the same type of inciter (qualified by its material properties only) are tokens of the same type of sound generator. The extent of individual types is represented by rectangles in the diagram below (Diagram 2). Each individual sound generator is shown there as a square arising at the intersection of a column representing its vibrator with the row of a proper inciter.

In turn, a full list of generators enables us to make a complete list of sound generation processes. Because each of those processes is the excitation of a vibrator by an inciter, such a list arises by further combination of individual generators with means of excitation, divided into two classes, according to their direction (horizontal or vertical). Every concrete process of sound generation thus forms one of two triangles available in every square of Diagram 2. Sound generation processes forming a combination of the same types of vibrator, inciter, and excitation are to be treated as tokens of the same type. Yet, as the following diagram shows, just as not all of the theoretically possible combinations of existing inciters and vibrators are actually employed as sound generators, so also, in really existing generators, both directions of interaction need not necessarily exist between their component bodies. Hence, not all possible sound generation processes are actualized. The sound generation processes actually occurring in pieces discussed in this study are only those whose equivalent triangle blanks in the diagram are filled with successive numbers. There are 117 such processes, a very high number, though still much lower than the total number of all possible combinations (i.e., all triangles encompassed in the diagram). The main reasons for narrowing the potential field of sound generation processes are again of a practical nature.

Most of the processes of sound generation shown in the diagram correspond to individual instrumental techniques or ways of playing non-musical tools. In such cases, both sound generation process and instrumental technique are to be treated as synonymous. Still, some sound generation processes enter into fixed unions of two or even three interactions caused by one act of excitation, thereby constituting compound instrumental techniques. Bodies involved in such techniques can occur as vibrators or inciters in only one of two or three interactive pairs (generators) or in several pairs simultaneously. The unique latter case is represented by the performer's striking the strings *sul tasto* with the palm of the hand. This makes the strings interact with both the fingerboard and the palm, while the fingerboard also forms two different sound generators, with strings and with

Diagram 2. Processes of sound generation in Penderecki's sonoristic pieces

	VERTICAL EXCITATION / VIBRATORS	METAL																					
		ONE-DIMENSIONAL									TWO-DIMENSIONAL												
		D.	UNDAMPENED								UNDAMPENED												
		CH.	UNCHANGEABLE								UNCHANGEABLE												
	HORIZONTAL EXCITATION / INCITERS	strings of stringed instruments in front of the bridge	strings of the piano	strings of the harp	bars of the vibraphone	bars of the glockenspiel	bars of celesta	bars of the xilorimba	tubes of the tubular bells	triangle	cymbals	suspended glass lamellae	metal lamellae	cowbells	bars of the vibraphone	strings of the harp	strings of the piano	tubes of the tubular bells	gong	tam tam	Javanese gong	sheet metal	triangle
METAL	triangle rod									17	18 19						35	42	47	54			61
METAL	mechanism of stops and pistons of wind instruments																						
METAL	key mechanism of the typewriter																						
METAL	electric bell																						
METAL	whistles																						
METAL	snare of a snare drum																						
METAL	saw																						
METAL	file																					59	
METAL	fingernail										20								48				
METAL	cymbal																36						
METAL	strings of stringed instruments in front of the bridge																						
METAL	wire brush										21					33	37	43	49	55			
WOOD	claves																						
WOOD	head of a hard stick				9			13			22	27	28	29	30		38	44	50				
WOOD	handle end of a beater							14	16		23				31			45	51				
WOOD	head of the mallet of tubular bells																	46					
WOOD	pencil or a piece of wood																39						
WOOD	hammers of celesta						12																
WOOD	hammers of the glockenspiel					11																	
WOOD	bow stick (including the nut)	1 2																					
WOOD	stick of the guiro																						
WOOD	rattle																						
L.	hand surface (palm, fingers)	3	6	8							24					34			52				
FELT	head of a soft stick				10			15			25				32		40		53	56	58	60	62
FELT	hammers of the piano		7														41						
H.	bow hair	4 5									26									57			

	VERTICAL EXCITATION / VIBRATORS	METAL													
		THREE-DIMENSIONAL													
		DAMPENED													
	HORIZONTAL EXCITATION / INCITERS	edges of timpani	edges of bongos	edges of tom-toms	edges of snare-drums	mechanism of stops and pistons of wind instruments	key mechanism of the typewriter	electric bell	whistles	piece of iron	glass bar	metal lamellae	cowbells	strings of stringed instruments between bridge and tailpiece	bridges and tailpieces of violoncellos and contrabasses
METAL	triangle rod														
METAL	mechanism of stops and pistons of wind instruments					70									
METAL	key mechanism of the typewriter						71								
METAL	electric bell							72							
METAL	whistles								73						
METAL	snare of a snare drum														
METAL	saw									74					
METAL	file										75				
METAL	fingernail														
METAL	cymbal														
METAL	strings of stringed instruments in front of the bridge														
METAL	wire brush														
WOOD	claves														
WOOD	head of a hard stick		64	66	68							76	77		
WOOD	handle end of a beater	63	65	67	69										
WOOD	head of the mallet of tubular bells														
WOOD	pencil or a piece of wood														
WOOD	hammers of celesta														
WOOD	hammers of the glockenspiel														
WOOD	bow stick (including the nut)													78 79	
WOOD	stick of the guiro														
WOOD	rattle														
L.	hand surface (palm, fingers)													80	
FELT	head of a soft stick														
FELT	hammers of the piano														
H.	bow hair													81 82	83

	VERTICAL EXCITATION / VIBRATORS	LEATHER					WOOD											
		TWO-DIMENSIONAL					THREE-DIMENSIONAL											
		DAMPENED					DAMPENED											
		UNCHANGEABLE																
	HORIZONTAL EXCITATION / INCITERS	skins of timpani	skins of bongos	skins of tom-toms	skins of conga drums	skins of snare-drums	wood blocks	wood drums	bars of the xilorimba	claves	desk or chair	handle end of a beater	guiro	rattle	piece of wood	fingerboards of stringed instruments	sound boards of stringed instruments	bridges and tailpieces of stringed instruments
METAL	triangle rod																	
METAL	mechanism of stops and pistons of wind instruments																	
METAL	key mechanism of the typewriter																	
METAL	electric bell																	
METAL	whistles																	
METAL	snare of a snare drum					100												
METAL	saw														110			
METAL	file																	
METAL	fingernail			92														
METAL	cymbal																	
METAL	strings of stringed instruments in front of the bridge															111 112		
METAL	wire brush	84	89	93														
WOOD	claves									105								
WOOD	head of a hard stick	85	90	94		101	102	103	104									
WOOD	handle end of a beater			95								107						
WOOD	head of the mallet of tubular bells																	
WOOD	pencil or a piece of wood																	
WOOD	hammers of celesta																	
WOOD	hammers of the glockenspiel																	
WOOD	bow stick (including the nut)										106						114	
WOOD	stick of the guiro												108					
WOOD	rattle													109				
L.	hand surface (palm, fingers)	86 87	91	96 97	99											113	115	
FELT	head of a soft stick	88		98														
FELT	hammers of the piano																	
H.	bow hair																116	117

the palm of the hand. Because it leads to a double function of inciter and vibrator performed simultaneously by the strings, this instrumental technique was discussed above in Chapter 6.1. Even more numerous are techniques of the former sort—those without bodies constituting common denominators of several sound-generating pairs.

The above diagram cannot adequately exhibit compound instrumental techniques. Those techniques are always split here into their component sound generation processes even though some of the latter never occur independently: for example, the interaction between the snare and skin of a snare-drum, which is produced by a sympathetic vibration caused by excitation of the opposite membrane. Another example is the interactions between the handle-ends of sticks and the edges of membranophones, which always involve the performer's striking the skin surfaces with the stick heads. Therefore a full specification of instrumental techniques is listed separately (Table 6). Individual techniques are defined there in terms of their equivalent sound generation processes, which are indicated with numbers previously assigned to them in the diagram above. If a given technique already has a traditional musical designation, such as *pizzicato* or *col legno*, that designation is also given. The techniques are specified in order of instruments as well as non-musical objects in parts of which they occur, even if occassionally do not involve any of their elements, like in the case of "tapping the desk with the bow or the chair with the nut" counted among the instrumental techniques of strings. In comparison with the diagram, instrumental techniques are thus rearranged in Table 6 such that all the ways of playing a given instrument, distributed formerly between several types of sound generation processes, are now subsumed under their proper instrumental part. In this way, for every given instrument the full extent of its technique required in Krzysztof Penderecki's sonoristic works is delineated. As one can see, the list contains almost exclusively techniques of stringed instruments and percussion, the latter also embracing all tools traditionally not acknowledged as musical objects. This springs from the predominance of those orchestral groups as resources of vibrators, discussed earlier. The predominance rises exponentially through the combination of vibrators with inciters—bringing about sound generators employed in Penderecki's sonorism—and, finally, with ways of excitation, all of which result in a multitude of sound generation processes.

Careful scrutiny of the list makes it clear that—as in reference to individual interactive bodies used by Penderecki as vibrators or inciters, as well as to pairs of bodies comprising individual sound generators—in reference to instrumental techniques one can distinguish between "old" and "new" ones. The "old" are all traditional ways of playing instruments, established as normative over the centuries in the evolution of music history. In earlier comments made on Penderecki's sonorism these were called "typical instrumental techniques" or "typical articulations" of some instrument. Regarding all those at variance with originally-designed ways of using instruments, one used to speak of "new" or "atypical" articulations, and label them as so-called "sound effects". In Diagram 2 the equivalent sound generation processes of these new techniques are enclosed in thickened frames.

The terminological distinction between "typical" and "atypical" instrumental techniques prompted several analysts to put those groups of sound generation processes against each other in a sort of opposition which ostensibly underlaid individual works.[5] Yet, as expressed emphatically by Penderecki in an interview with Tadeusz A. Zieliński "Współczesny kompozytor a tradycja" (Contemporary composer and a tradition), this opposition was of no importance for the composer himself. Asked about his innovative ways of treating traditional musical instruments, he reproached:

> Thus you also yield to illusion. . . ; you pay attention only to new elements, although in my pieces—besides new articulatory means—there are also several older ones. (Zieliński 1963: 8)

[5] Usually, the opposition of typical and atypical articulation was connected with that between "sound" and "noise" (see Chapter 4).

Table 6. List of instrumental techniques in Penderecki's sonoristic pieces

STRINGS	
1	*legno battuto*
2	*col legno*
3	*pizzicato*
4	*arco spiccato*
5	*arco*
78	*legno battuto* on strings between bridge and tailpiece
79	*col legno* on strings between bridge and tailpiece
80	*Threnody*, String Quartet No.1: *pizzicato* on strings between bridge and tailpiece; *Polymorphia*: tapping the strings between bridge and tailpiece with the fingers (*con dita*)
81	*arco spiccato* between bridge and tailpiece
82	*arco* play behind the bridge
83	bowing on bridges and tailpieces of violoncellos and contrabasses
106	tapping the desk with the bow or the chair with the nut
111+3	striking the strings with the palm of the hand *sul tasto*
111+113	striking the strings with the palm of the hand *sul tasto*
112+113	*senza arco* articulation: setting the string into vibration by pressing it strongly with a finger and simultaneous trilling
114	tapping the sound board with the nut or fingertips
115	rubbing the sound board with the open hand
116	bowing the edge of the sound board
117	bowing on bridges and tailpieces
PERCUSSION	
	PIANO
6	plucking the strings with fingers *pizzicato*
7, 41	ordinary playing on strings with felt hammers operated from the keyboard
35	rubbing the lowest string with a triangle rod
36	rubbing the lowest string with one of the cymbals
37	striking the strings with wire brushes
38	striking the strings with hard drumsticks
40	striking the strings with soft kettledrum sticks

	HARP
8	plucking the strings with fingers *pizzicato*
33	striking the strings with wire brushes
34	striking the strings with palms of hands
	VIBRAPHONE
9, 30	playing with hard sticks (with porcelain heads)
10, 32	playing with soft-headed sticks
31	striking the bars with handle ends of soft sticks
	XILORIMBA
13, 104	playing with hard sticks (with porcelain heads)
14	striking the bars with handle ends of soft sticks
15	playing with soft-headed sticks
11	GLOCKENSPIEL
12	CELESTA
	TUBULAR BELLS
16, 45	striking the tubes with handle ends of the mallets
42	playing with the triangle rod
43	playing with wire brushes
44	playing with drumsticks
46	ordinary playing with the mallet of tubular bells
	TRIANGLE
17, 61	ordinary playing with the triangle rod
62	striking with a soft stick
	CYMBALS
18	striking with a triangle rod
19	touching a previously struck cymbal with a triangle rod (perpendicularly to the edge of the cymbal)
20	drawing the edge of a fingernail across the cymbal
21	playing with wire brushes

22	striking with a drumstick
23	striking with handle ends of soft sticks
24	playing with fingers (*con dita*)
25	striking with a kettledrum stick
26	bowing the edge of a cymbal (*arco*)
	SUSPENDED GLASS LAMELLAE
27	striking with drumsticks
	METAL LAMELLAE
28, 76	striking with drumsticks
	COWBELLS
29, 77	striking with drumsticks
	GONG
47	striking with a triangle rod
48	drawing the edge of a fingernail across the striking surface
49	playing with wire brushes
50	striking with a drumstick
51	striking with the handle end of a kettledrum stick
52	playing with fingers (*con dita*)
53	striking with a kettledrum stick
	TAM TAM
54	striking with a triangle rod
55	playing with wire brushes
56	striking with a kettledrum stick
57	bowing the edge of the striking surface (*arco*)
	JAVANESE GONG
58	striking with a kettledrum stick
	SHEET METAL
59	rubbing with a file

60	striking with a kettledrum stick
	TIMPANI
84	playing with wire brushes
85	striking with drumsticks
86	playing with fingers (*con dita*)
87	rubbing with open hands
88	striking with kettledrum sticks
63+85	striking with drumsticks simultaneously on skins and edges
85+107	striking with a drumstick on another stick laid on the striking surface
	BONGOS
89	playing with wire brushes
90	striking with drumsticks
91	playing with fingers (*con dita*)
64	striking on the edge with the head of a drumstick
65+90	striking with drumsticks simultaneously on skins and edges
90+107	striking with a drumstick on another stick laid on the striking surface
	CONGA DRUMS
99	playing with fingers (*con dita*)
	TOM-TOMS
92	drawing the edge of a fingernail across the striking surface
93	playing with wire brushes
94	striking with drumsticks
95	striking with handle ends of soft sticks
96	playing with fingers (*con dita*)
97	rubbing with open hands
98	striking with kettledrum sticks
67+98	striking with kettledrum sticks simultaneously on skins and edges
67+94	striking with drumsticks simultaneously on skins and edges
94+107	striking with a drumstick on another stick laid on the striking surface

98+107	striking with a kettledrum stick on another stick laid on the striking surface
	SNARE DRUMS
100+101	striking with drumsticks
101	striking with drumsticks (snares off)
100+101+69	striking with drumsticks simultaneously on skins and edges
101+69	striking with drumsticks simultaneously on skins and edges (snares off)
100+101+107	striking with a drumstick on another stick laid on the striking surface
71	TYPEWRITER
72	ELECTRIC BELL
73	WHISTLES
	PIECE OF IRON
74	sawing with a hand-saw
	GLASS BAR
75	rubbing with a file
	WOOD BLOCKS
102	striking with hard-headed sticks
	WOOD DRUMS
103	striking with hard-headed sticks
105	CLAVES
108	GUIRO
109	RATTLE
	PIECE OF WOOD
110	sawing with a hand-saw
WINDS	
70	MECHANISM OF STOPS AND PISTONS

Obviously, the "history" behind individual sound generation processes that he employed—whether or not they had previously occurred in musical practice as traditional instrumental techniques—did not carry any weight with Penderecki. Besides, the composer was aware that the very notion of traditional techniques was relative from a historical point of view: several ways of articulation now considered typical for some instrument or musical style were at one time considered "new".

> Resources introduced by me constitute only an extension of the sound of the instrument [i.e., violin] in the same way as playing *pizzicato*, *tremolando*, flageolet, glissando or *col legno* did in the past. (Zieliński 1963: 6)

From the statements quoted above, one can infer unequivocally that any distinction made between typical and atypical instrumental techniques is only the (inter)subjective illusion of listeners, which arises from their prior musical experience. For the composer, the opposition between "old" and "new" had no relevance and, consequently, had no impact on the organization of his sonoristic works. In these last, old and new sound generation processes are not opposed to, but rather cooperate with each other, as Penderecki notes later in the same interview, with reference to his *Fluorescences*:

> Occasional non-instrumental noises only supplement the orchestral timbre as colouristic retouching and are adjusted to that orchestral timbre. The jar of sawed iron merges with the jar of rubbed low strings of the piano, and the tapping of the typewriter corresponds both with the percussion and with the clattering of the stops and pistons of wind instruments. (Zieliński 1963: 7)

The irrelevance of the old/new opposition for Krzysztof Penderecki's sonoristic compositional system is also exhibited in Diagram 2. There, all ways of sound generation—traditional and non-traditional—are given equal weight as tokens of individual types of sound generation processes.

Yet, if novelty is irrelevant to Penderecki's sonoristic style, one must ask, What, then, was the reason for the composer's inventiveness? Why in his sonoristic pieces did he introduce so many new bodies to be used as inciters and vibrators, so many new sound generators and, in the end, so many new sound generation processes? Were Penderecki's practices driven by some vague artistic intuition? the need for excessive expression? Or were they the result of sheer caprice, as some commentators have claimed? If it was caprice it was certainly a strange one, which made the practical application of the compositional system much more complicated. Indeed, it was precisely the new sound sources that forced the composer to undertake the difficult task of elaborating articulatory definitions of individual categories of the basic system, categories which with regard to traditional ways of playing most musical instruments are self-explanatory.

In order to answer the questions just raised, one must recall that, as already pointed out in the course of this chapter, in Penderecki's sonoristic pieces every material body, sound generator, and sound generation process is a token of some type. Each body, according to the function it performs, is thus the token of a type of vibrator or an inciter. Each sound generator is the token of a type arising as a combination of types represented by its component vibrator and inciter. Finally, each sound generation process is the token of some type, forming a combination of types represented by vibrator, inciter, and excitation event that takes place between them. If the representation of a given type was insufficient or simply did not exist among traditional instrumental resources, then new bodies, generators, or sound generation processes had to be discovered by the composer in order to fill this lack. Thus "novelties" have their theoretical explanation in the types they represent. In turn, hierarchical relations between types imply that, if a body is new, then also each sound generator in which it participates as a vibrator or inciter must be new. And if a generator is new, every sound generation process, as interaction between vibrator and inciter, will be new, too. In this way, novelty of higher level phenomena justifies novelty of lower level ones in which the former are involved. This is represented in the diagram of sound generation processes (Diagram

2), where thick frames marking new inciters and vibrators are lengthened respectively into all rows and columns fixed by them. In turn, thick squares marking new sound generators, regardless of whether they arise through prolongation of rows and columns or independently of them, embrace both triangle fields of possible sound generation processes. It is noteworthy that no single triangle of thickened frame occurs in the diagram: this means that no new instrumental techniques arise in Penderecki's sonoristic pieces as interactions between bodies of traditional sound generators. In order to explain fully the richness of Penderecki's new instrumental techniques in his sonoristic pieces, it thus suffices to limit oneself to explaining the reasons for occurrences of new bodies and their combinations into new sound generators. Such explanation will be made below, as a commentary on the foregoing diagram.

It will become evident, however, in the course of further discussion, that not every novelty occurs as a token of a non-existent or insufficiently represented type. Sometimes new bodies or new sound generators occur in spite of the fact that their types are represented satisfactorily. Yet, one has to bear in mind that those higher level phenomena never occur in isolation. Instead, they are always involved in phenomena of lower levels: bodies, be they vibrators or inciters, participate in generators, and both bodies and generators take part in individual sound generation processes. In the cases of new phenomena unjustified in types on their proper hierarchical levels, the explanation is thus of a practical nature, and springs from phenomena of lower levels in which the former participate. In turn, those lower level phenomena have their own theoretical justification in types represented by them. In this way a sort of a dialectic between phenomena of higher and lower levels arises: it is not only that the former explain the novelty of the latter, but also, and conversely, that the latter elucidate the novelty of the former. Finally, as concerns the invention of new bodies, sound generators, and sound generation processes as related to the instrumental techniques of stringed instruments: such inventions were additionally stimulated by the composer's intent to employ that group independently, in sonoristic pieces for string orchestra and string quartet.

Bodies

Many new bodies were introduced in Penderecki's sonoristic pieces for their material properties. Though in the "timbre system" metal, wood, and leather were conceived as equiponderant terms of the ternary opposition, metal obviously dominated the two remaining primary materials among the originally designed sound sources of traditional instruments. In comparison with the large number of metal vibrators in stringed instruments and percussion, leather and wooden vibrating bodies were represented very modestly, not only as to kind, but also as to the sheer number of items jammed onto the staff of the symphonic orchestra score.

As regards the representation of wooden bodies, this explains why—in addition to claves, guiro, raganella, xilorimba, as well as wood blocks and wood drums—the composer's interests also included other wooden things which were available as parts of instruments or of instrumental accessories. In that respect, Penderecki's most significant discovery was that of the wooden elements found in the string section: sound boards, fingerboards, bridges and tailpieces, as well as chairs and desks used as vibrators, which, though detached from the actual body of the instruments, were still subsumed under their instrumental parts. The weight of their inclusion in the set of vibrators consisted not only in that the high number of stringed instruments automatically increased the representation of the material category of wood, but also that in this way a material differentiation was introduced to this very group and, in consequence, offered a possibility of its independent use in the sonoristic pieces.

Another resource of wooden bodies was percussion accessories: the heads of hard sticks (a previously used resource) and also the handle-ends of soft beaters, which earlier had never directly participated in sound generation processes, either as vibrators or as inciters. Characteristically, Penderecki never uses the handle-ends of hard sticks—a perspicuous choice on the composer's part, because such a procedure would not contribute to the inventory of new wooden bodies. Since normally one can use either the head or the handle-end of a stick, the usage of handle-ends of hard sticks would eliminate the possibility of using their heads. The only exception is the case of the previously mentioned, compound instrumental technique, in which a stick simultaneously strikes the skin of a membranophone with its head, and the edge of a membranophone with its handle-end. This explains why in such situations the handle-ends of hard-headed sticks are also employed.

Certainly, some contribution is made to the set of wooden bodies by a wood bar (*legno*) used as a vibrator as well as by pieces of wood, used interchangeably with pencils, which appear as inciters. Yet, in the context of the previously discussed enlargement of the class of wood, their introduction was not really crucial to balancing the disproportion between the material categories of wood and metal. Instead, the justification of these two bodies in Penderecki's sonoristic pieces seems to come from lower hierarchical levels, those of generators and sound generation processes. The occurrence of the wood bar is justified by the sound generation process in which it is involved, and which consists in a horizontal excitation of a wooden vibrator by means of a metal inciter. Obviously, such a means of excitation could harm the wood of instruments. Therefore the only way to actualize the procedure as a token was to use a piece of wood from outside the musical accessories. In order to make the sound of such a vibrator sufficiently audible, even a hand-saw may be used as an inciter. (The sawing of a piece of wood with a hand-saw is the only token of the horizontal excitation of a wooden vibrator with a metal inciter that occurs in the pieces considered in this book.) On the other hand, pencils or other small pieces of wood used as inciters of piano strings compensate for the alternative, arbitrary classification of piano strings as virtual metal plates. Obviously, a real metal plate made to vibrate by any sort of existing traditional wooden beater would produce spatially continuous sound phenomena. Yet, striking strings with the head of a wooden stick would result in a single pitch only. Pencils or some other oblong wooden pieces thrown onto the string area produce clusters, thereby avoiding this difficulty.

Interestingly, in Penderecki's sonoristic pieces no new leather bodies appear. As regards vibrators, it was simply impossible to find any sort of membranes (i.e., two-dimensional bodies of skin) apart from those of musical instruments. Still, not all such instruments in Penderecki's sonorism were previously employed in the symphonic orchestra. Tom-toms were introduced here from jazz bands, and bongos and congas previously occurred mainly in South-American popular music. The two latter kinds of membranophones, usually played with bare palms or fingers, also caused the performers' hands to be seen as representatives of leather inciters, which in the symphonic orchestra were employed exclusively for *pizzicato* effects in stringed instruments.

From the discussion thus far, it is obvious that, even though the organization of the composer's timbre system was adjusted to accommodate traditional orchestral instruments (as noted in Chapter 5.2), this very inventory of instruments and ways of playing them was equally adjusted to the requirements of the timbre system. The enlarged set of leather and wooden bodies in Penderecki's sonoristic works gives evidence that the mutual dependency between the timbre system and orchestral resources forms yet another dialectical relationship.

By contrast, the material category of metal is richly represented by the vibrators of traditional orchestral instruments, as pointed out earlier. Therefore, Penderecki's introduction of new metal bodies is justified not by their material, but by their constructional properties. The largest group of new metal sound sources is that of three-dimensional metal idiophones. In fact, no traditional vibrator is represented in that group, which explains why it has no counterpart in Drobner's classification of instruments. That entire instrumental "tree" had to be created from the bottom up by Penderecki. Its trunk is constituted by the edges of membranophones, stops and pistons of winds, the typewriter, as well as the electric bell, whistles, a piece of iron, and a glass bar. Since this group has no items among stringed instruments, strings between bridge and tailpiece are used as substitutes of its tokens. In turn, their low-register substitutes are established by the bridges and tailpieces of low stringed instruments treated as metal bodies (as noted in Chapter 6.1).

The group of two-dimensional metal sound sources originally consisted of gong and tam tam, and sometimes included pairs of cymbals. To enrich this group, the composer introduced into it an exotic Javanese gong, suspended cymbals (used in jazz bands), and an entirely new object, a piece of sheet metal (called a *lastra*). Glass and metal lamellae, as well as constructional substitutes for metal plates (a triangle, cowbells), were to supplement the small bodies in this group in order to help produce sounds in high registers. Their justification thus lies in the size of the vibrator—a category relevant for the basic system, though not forming a distinct classification.

Although partly justified as tokens of their proper, weakly represented, types of vibrators, the piece of iron, glass bar, and sheet metal occur in Penderecki's sonoristic works mainly for the sake of sound generation processes involving the horizontal excitation of metal vibrators by metal inciters. As in the case of wood, rubbing metal surfaces of instruments with another metal body would risk scratching or other damage to the instrument. Hence, sound generation processes representing such types are instead made by non-musical objects, on which, without harm, one can use saws and files as inciters. The only way that iron (*ferro*) and glass (*vetro*) participate in Penderecki's sonoristic works, is through excitation by a hand-saw and rubbing with a file, respectively. In turn, sheet metal can be excited not only with a file, but also with felt sticks, as can the gong, tam tam, and Javanese gong.

Because classification of bodies according to basic system categories concerns only vibrators, the occurrence of the few remaining metal inciters is again justified by material properties. This is the case, because although metal is richly represented among sound sources, it has only one token among inciters in the traditional orchestra, that token being the triangle rod. Therefore—and apart from inciters that are undetachable from their vibrators (e.g., stops and pistons of winds, the metal ball inside a whistle, typewriter mechanisms)—this type of inciter has to be supplemented with wire brushes (taken over from jazz drumming) and with files and saws, whose function in sound generation was just elucidated. Finally, the use of a fingernail to substitute for a metal body has its reason in the practical conditions of its interaction with the striking surface of tom toms, gong and cymbals, as pointed out in Chapter 6.1.

Generators

New generators comprised of bodies already used as vibrators or inciters within the symphonic orchestra usually arise by the transfer of inciters traditionally bound to one of the vibrators of a given type onto all other vibrators of the same type, in so far as such a transfer is practical.

Traditionally, the type of sound generator consisting of a metal plate excited by a metal inciter is represented exclusively by the triangle, played with triangle rod, and by cymbals, played with wire brushes. The new tokens of this type are obtained by application of wire brushes to other metal plates and their substitutes (gong, tam tam, bells, piano, and harp), and triangle rod applied to gong, tam tam, bells, piano, and cymbals. The remaining sound generator consists of piano strings as vibrator, with cymbal employed as inciter. The usage of cymbal as an inciter compensates here for the composer's arbitrary classification of piano among metal plates. A plate should produce a spatially continuous sound when rubbed on its edge, but the "edge" of the virtual plate construed as the surface of piano strings is a single—highest or lowest—string, which gives a single pitch only. Thus, in actual fact, the desired, spatially continuous sound arises not from the vibrating piano string, but from the cymbal (inciter) which here serves double duty as a vibrator. Interestingly, the sound generator in question occurs exclusively in Penderecki's *Fluorescences*, where rubbing the lowest string of piano with a cymbal produces the only sound phenomenon in paragraph 15. Otherwise, when occurring with some other vibrators producing similar bands of noises, the lowest string of the piano is always rubbed with a triangle rod (*Fluorescences* 1-2, 94, 96).

Traditional sound generators, consisting of wooden inciters and vibrators classified as metal plates, are represented only by bells played with mallet and by cowbells and vibraphone bars struck with hard-tipped sticks. From jazz practice comes the playing on suspended cymbals with wooden sticks. Enrichment of this type of generator is thus achieved by application of hard sticks to other representatives of this group (piano, gong, tam tam). In the case of instruments that, like gong or bells, do not normally use that equipment, the heads of hard sticks are occasionally replaced by the handle ends of soft sticks or mallets, respectively.

A type of sound generator not found among traditional orchestral resources is that consisting of metal plates and leather inciters. Its tokens, invented by Penderecki expressly for his sonoristic pieces, occur as playing the gong, cymbals, and harp with bare hands or with fingers (*con dita*). It is noteworthy that, in the case of the harp, playing it with an open hand (instead of the usual *pizzicato* technique) produces note clusters; this technique is demanded by the composer only when he treats the harp as a substitute for two-dimensional vibrators. Thus, as in the aforementioned case of the piano, the arbitrary classification of a chordophone as a virtual plate is again compensated for by a device on a hierarchically lower level of sound generator.

From the discussion thus far of new sound generators, one can see that the arbitrary classification of a vibrating body according to properties that it does not in fact possess has the immediate result of attributing new inciters to them. And, consequently, new ways of exciting that body as a substitute of a given type take over from the proper representatives of that type. The same happens with generators consisting of metal plates excited by felt bodies. Since soft-headed felt sticks are the normal accessories of some real metal plates (such as gongs and tam tams, vibraphone), the cymbals, piano, and triangle are also played with this kind of beater, and in this way supplement the representation of this type of generator.

As with leather bodies, hair never occurs as an inciter attached to a metal two-dimensional vibrator. Therefore bowing the edges of tam tams and cymbals is included among "atypical instrumental techniques"—as otherwise is *pizzicato* playing on piano strings that, together with the ordinary harp technique forms the unique token of a generator type consisting of one-dimensional metal vibrator and a leather inciter. For practical reasons, plucking is not applicable to the proper representatives of metal bars.

There are two remaining types of sound generators that possess atypical new tokens in Penderecki's sonoristic pieces: leather vibrators excited by metal bodies, and leather vibrators and inciters. The former is traditionally represented by interaction between the snare and membrane of a snare drum (in orchestras), and between wire brushes and striking surfaces of tom toms (in jazz bands). This method is enriched by the playing of bongos and timpani with wire brushes, which does not harm the skins of membranophones. As to leather vibrators and inciters, the technique of playing congas and bongos with bare hands is also used on tom toms and timpani.

The discussion in this chapter has demonstrated that all the peculiarities of Penderecki's sonorism, as regards orchestration and instrumental techniques, are rooted in the classifications of three factors of every sound generation process: vibrator, inciter, and means of excitation. Those classifications explain why some new instrumental techniques occur among Penderecki's articulatory devices. Conversely, they also explain why other techniques were not included here, even though admissible on the basis of instruments and extra-musical tools which were at the composer's disposal in his sonoristic pieces. In the light of earlier remarks, it becomes clear that new articulatory inventions would be superfluous if they brought about tokens of types already sufficiently represented by traditional orchestral resources. The limitation in the number of sound generators and sound generation processes observed in Penderecki's scores, in comparison with the whole field of possible combinations between vibrators, inciters, and excitation events delineated in Diagram 2, thus results not only from practical obstacles, but also finds theoretical justification in an economy of compositional procedures. Although luxuriant in new articulatory phenomena, Penderecki's sonorism appears, paradoxically, to be stamped by an extreme thrift of articulatory means.

Because the present classifications of vibrators, inciters, and excitations have been made in consideration of properties relevant to categories of the timbre and the basic systems, the ultimate justification of novelties in orchestration and sound generation processes turns out to reside in the compositional method employed by Penderecki in his sonoristic pieces of the period under discussion. The same can be said about his new choral technique, which consists in the pronunciation of consonants that result in vocal equivalents of sounds produced by bodies belonging to the class of three-dimensional vibrators. However, the significance of both component subsystems of Penderecki's sonoristic style for explanation of the above-discussed articulatory phenomena is not equal. The inequality in this respect springs from different relations linking categories of the timbre and basic systems, on the one side, with classes of vibrators, inciters and excitations divided on the basis of those categories, on the other side.

In the case of the basic system, defined originally on the acoustical level, this relation is only of an indirect character. Thus, properties that form the basis of individual classifications of vibrators and excitation events are relevant here for equivalent categories of the basic system, in the sense that, in different classes, the availability of individual terms of a given category varies. Still, each term is usually available (though in different ways) for several classes. At this point, things stand otherwise with the timbre system, because its categories, defined on the motor level, directly determine classes of vibrators and inciters. The material properties are thus not merely relevant for, but literally identical with the material categories of the timbre system. As a consequence, every category is accessible for one class of bodies only, and a lack in representation of this class means automatically that a given category cannot be actualized. This is why the orchestration and instrumental techniques in Penderecki's sonoristic pieces, though both conditioned by the sonoristic system as a whole, are influenced much more decisively by the timbre than by the basic system.

In the end, the so-called "sound effects", which constitute new sound generation processes, must be clearly distinguished from effects of a textural nature, such as several types of cluster and glissando, as well as the highest and lowest possible tones. Though mixed with the former in earlier investigations of Penderecki's sonoristic output, the latter depend exclusively on the basic system; and, as demonstrated in the previous chapter, they arise by way of combinations of terms of that system's different categories concerning perceptual categories of time and pitch.

It becomes clear that the totality of atypical articulatory phenomena—orchestral, instrumental, and textural—in Krzysztof Penderecki's sonoristic style forms a manifestation of the system governing that period of Penderecki's output. It follows that the commonly held view, formulated by earlier critics of Penderecki's music, as to the significance and purpose of those articulatory resources becomes invalid. Evidently, the new kinds of articulation do not spring from the free improvisation of the composer and are not aimed at producing vaguely expressive effects. Even less do they result from some humbug intent to shock the audience. Instead, these new articulations result from the very logic of the sonoristic system, and from the requirements of its practical realization as a compositional method. Without that rich inventory of articulatory devices, the system just described would stand as the sophisticated conceptual construct of a hyper-rationalistic mind. With that richness of articulatory means, however, comes the possibility of generating works of art, understood as communications addressed to receivers and reaching them through an acoustical channel.

PART TWO

SYSTEM AT WORK (*Parole*)

7. EXPRESSIVE AND REDUNDANT FEATURES

In contradistinction to *langue*, which constitutes the level of abstract invariants—phonemes—as units completely qualified by sets of distinctive features chosen from binary oppositions proper for a given linguistic system, *parole* is the level of concrete variants of those units as they occur in individual utterances generated by the system, i.e., in texts of a given language. The very existence of variants is due to the fact that definitions of distinctive features stake out an area of possible realizations both in acoustical and articulatory stages. Hence, the level of *parole* can be said to exploit this area of free choices foreseen by distinctive features on the level of *langue*.

However, free choices can be made not only in the domain of distinctive features that set up the system, but can also manifest themselves in those properties of a given phonemic variant, which are not governed by the system at all. Such "extrasystemic" phenomena of language are called its configurative, expressive, and redundant features, differentiation between them being based on functions performed within a speech event:

> Configurative features signal the division of the utterance into grammatical units of different degrees of complexity, particularly into sentences and words. . . . Expressive features (or emphatics) put the relative emphasis on different parts of the utterance or on different utterances and suggest the emotional attitudes of the utterer. . . . Redundant features help to identify a concurrent or adjoining feature, either distinctive or configurative, and either a single one or a combination. (Jacobson and Halle 1956: 9)

All those features have first of all an articulatory character. For instance, redundant features in most cases form minute differences at the points of articulation, their acoustical effect being sometimes audibly hardly recognizable by itself (Jakobson and Halle 1956: 46). The configurative, expressive, and redundant features can be thus said to constitute articulatory phenomena devoid of justification in the system of distinctive features. The difference between them as extrasystemic features on the one hand, and distinctive features comprising a system on the other, is reflected in the fact that the former lack the binary divisions characteristic of the latter. In the internal organization of features of linguistic units there exists thus "the difference between the markedly discrete, oppositional character of distinctive features and the more continuous 'grading gamut' characterizing most of the expressive features" (Jacobson and Halle 1956: 18).

In spite of a clear theoretical discrimination between systemic (distinctive) features of linguistic units and their configurative, expressive, and redundant features of extrasystemic character, the latter can occasionally influence the former, and bring about their masking or even elimination from a phonemic variant on the level of *parole*. Conversely, sometimes such "missing" distinctive features can also be substituted for by redundant ones. It is in this sense that *parole* is said to overcome *langue*: paradoxically, in extreme cases the exploitation of free choice available in the framework of the system may occasion the break-down of some of its rules.

The characterization of *parole* as the level of free choice in an otherwise rigorous system holds true also as regards Penderecki's sonoristic style. As in language individual utterances form not only manifestations of grammatical rules but also of the freedom of their users, so also in Krzysztof Penderecki's sonorism individual musical works result from systemic regulations as well as from the composer's artistic freedom. In fact, the freedom is here even broader than in language, for the composer is not only the user of his system, but at the same time its creator. This point marks another important distinction between systems of natural languages and that of Penderecki's sonoristic style. Whereas the ordinary user of a language finds its rules already existing and takes them for granted, usually without even being aware of them, the composer consciously constructs his *langue* in a pre-compositional stage of his artistic process. Therefore he has the ability (and is authorized) to break arbitrarily some of his own laws, during compositional processes aimed at the generation of individual musical texts (i.e., particular works). Such cases of overthrowing systemic rules usually seek to achieve some specific artistic effects. As a consequence, the areas of compositional free choice in Penderecki's sonorism are even more numerous than in linguistic systems.

Still, the basic manifestation of the composer's freedom in every individual work remains the shaping variants of segments as syntactical units of his particular musical language. Like its analogous linguistic procedures, this splits into two areas of free choice, those of systemic and extrasystemic phenomena. With regard to the former, it was noted earlier that the existence of contextual variants is assumed by the very definition of a segment, in that its constitutive terms are represented by intervals of values delineated in spaces of acoustical parameters proper for individual categories of Penderecki's basic system. Each such value subsequently appears to be available in several different ways during processes of sound generation. The resulting greater complexity of the domain of articulation, compared with that of acoustical phenomena, insures that, accordingly, the range of compositional freedom in realizing segments on the articulatory level also widens. The choice of a possible realization of a given term, enumerated in its articulatory definition, is thus made freely by the composer, and each time brings with it the choice of some value of an appropriate motoric parameter. Moreover, it is only the articulatory level, where the timbre characteristics of a given segment can be realized through concrete sound generators as tokens of individual material pairs, from which the definition of a given timbre segment stems. This area of free choice is thus parallel to the possibilities left open by distinctive features of language.

If regulation of parameters affecting categories of the sonoristic system is free only within limits marked by boundaries of an individual term, compositional freedom in all the other aspects of sound generation—i.e., those on which no category depends—is by definition unlimited. This area of free choice, which concerns extrasystemic phenomena, thus constitutes a musical counterpart to expressive, redundant, and configurative features of language. Characteristically, those aspects of sound articulation that are irrelevant from the point of view of Penderecki's system concern mainly points of contact between the vibrating body and the inciter, and, in this respect, mostly resemble redundant features. The most numerous effects of this sort occur in stringed instruments. In this group, deviations from the normal point of string excitation take place as playing *sul tasto*, *sul ponticello*, and *flautando*.[1] As for deviations concerning the inciter, there occurs bowing at the heel (*al tallone*) and with only half a bow (*metá*). Other string-playing techniques irrelevant to Penderecki's sonoristic system are harmonics and playing with mutes (*con sordini*). Harmonics and playing *sul ponticello* are to be found in the following example as attributed to individual sounds in parts of strings:

[1] Playing between bridge and tailpiece does not belong here, since it results not from a change of place at which the same vibrator (i.e., string) is excited, but from a change of vibrator itself. This is so because if one plays on strings before bridge, the string between bridge and tailpiece does not vibrate and hence does not constitute part of a vibrating body.

Example 54: *Anaklasis*, 92-96

All aspects of instrumental techniques that deviate from the standard way of playing a given instrument, yet are not connected with categories of Penderecki's sonoristic style, will be called "expressive features". This term thus denotes articulatory phenomena which, because they are not regulated by motoric parameters of either the basic or the timbre system, are devoid of both influence on and justification in the system of categories underlying Penderecki's sonorism. For that reason, they were not listed in Diagram 2 of sound generation processes. Characteristically, all these expressive features are commonplaces in traditional instrumental techniques. As such, they occur in Penderecki's music that preceded his sonoristic period, and were taken for granted by the composer in his sonoristic works. Therefore, their presence in the latter does not invalidate the thesis formulated at the end of Part One, which states that all new articulatory phenomena in Penderecki's sonorism are manifestations of the compositional system lying at its base. In his choral writing, expressive features analogous to string articulations mentioned above, are whistling, singing *falsetto* and *bocca chiusa*. It is noteworthy that the articulatory phenomena constituting expressive features affect those parameters of sound—such as formants, number and choice of harmonics—that do not underlie any from among Penderecki's categories. Normally, these acoustical parameters influence timbre as an attribute of sound sensation. Thus, it was precisely for timbral shading that Penderecki used the just-listed string-playing techniques in his pre-sonoristic works, mainly in Emanations for two string orchestras (1958), *Strophes* for soprano, speaker and ten instruments, (1959) and in *Miniatures* for violin and piano (1959). Yet, because in the timbre system of sonoristic pieces the acoustical components of sound colour are left aside, the expressive features can function freely as extrasystemic phenomena. Plainly, as specific additional aspects of sound generation they always co-occur with several of those aspects of an interaction between two bodies, which are relevant for categories of the system—such as force or time of excitation.

Unlike extrasystemic features of language, however, the expressive phenomena of Penderecki's sonorism are not restricted to the aspects of articulation discussed above. This situation results from the much-referenced, significant difference concerning the character of units in linguistic systems and in Penderecki's sonoristic style: whereas in language those units are individual sounds (i.e., phonemes), in sonoristic pieces they are segments construed as sound sets or fields. Therefore in Penderecki's sonorism the expressive, or extrasystemic, phenomena can occur in frameworks of individual units both as additional articulatory devices involved in the generation of their component sounds, and as individual sounds or groups of sounds occurring simultaneously with those of a given segment, and yet not belonging to it. In contradistinction to the expressive features, such phenomena will be called "expressive sound events".

Individual sound phenomena are to be excluded from a given segment inasmuch as they do not correspond with it in respect of at least one of its constitutive terms and, at the same time, are disproportionately minute and few in comparison with segmental sounds to set up their own separate segment. However, expressive sound events are qualified not only by features that mark them as different from the sounds of a segment, but also by several others. In respect of those latter, they can thus be analyzed like segmental sounds. The status of expressive sound events is thus similar to that of segments that form secondary threads of a musical narration (discussed in 5.1.3): expressive sound events can be seen as belonging to the segment in respect of some of their parameters, and at the same time not belonging to it in respect of some other(s). Yet, as with superimposed segments, a rule is assumed here, that the nonconformity in respect of one category is sufficient to exclude sound events from among segmental sounds and to treat them as expressive phenomena. Otherwise, expressive sound events rarely appear in Penderecki's pieces and never obscure either the logic of his sonoristic system or the univocality and integrity of segments as units of that system. Hence, they can be viewed as embellishments or decorations of the architectonic construction governed by the rules of Penderecki's sonoristic style. (Of course, as with any segmental sounds, expressive sound events can be additionally qualified by expressive features, i.e., articulatory devices which constitute non-standard aspects of sound generation processes, and which have no impact on categories of Penderecki's sonoristic system.)

Clearly, the identification of expressive phenomena with all the extrasystemic components of Penderecki's sonoristic works, assumed in this book, differs from their position in language, where expressive features form only one of three types of extrasystemic phenomena, the other two being redundant and configurative features. Yet, such identification is justified by the fact that both expressive features and expressive sound events are designed mainly to modulate the emotional quality of a musical utterance, i.e., its expressivity, in the sense common to both linguistics and musical aesthetics. The definition of expressive phenomena in Penderecki's sonoristic style is thus founded on their function and, as such, corresponds to the definition of linguistic expressive features.

Nevertheless, in Penderecki's works redundancy does occur, as well. This happens when one feature co-occurs with another one in order to reinforce it and thereby help it to perform its function. Yet since the field of articulation in Penderecki's sonoristic style is already completely covered by systemic and extrasystemic (expressive) features, redundancy does not delineate any separate type of phenomena, but joins the two above-mentioned types as the additional function of a given feature, previously classified as either systemic or extrasystemic. Also, the reinforced phenomenon may belong to either of those groups, such that a function assisted by the redundant feature can be either systemic, as are the distinctive features of language, or expressive.[2] Consequently, there exist three types of redundancy in Penderecki's sonoristic style: (1) that between two extrasystemic (expressive) features; (2) redundancy between one extrasystemic and one systemic feature; (3) or between two systemic ones. Each of these will be discussed in turn.

[2] This point distinguishes the redundancy of Penderecki's sonoristic style from linguistic redundant features.

Redundancy, as the co-occurrence of two expressive features, forms a combination of articulatory devices that deviate from ordinary instrumental technique, but are irrelevant to categories of Penderecki's system (e.g., *sul tasto*, *sul ponticello*, flageolet, *con sordino*). An example of such a redundancy can be observed in the passage from *Anaklasis*, quoted earlier in this chapter (Ex. 54), where in violins 1-4 there occurs a harmonic played *sul ponticello*. Since the expressive features carry equal weight, as phenomena performing the same extrasystemic function, one cannot indicate the single redundant feature within a co-occuring pair, since both of them are at the same time reinforcing and being reinforced. This mutual reinforcement is possible because all expressive features on the acoustical level belong to phenomena that influence the same perceptual parameter of timbre. Each of them aims at "making strange" the normal timbre of an instrumental sound, so as to modulate that sound's expressiveness. Their combination thus intensifies this effect, since the expressive features combined as redundant are as a rule comprised of similar acoustical and expressive qualities. For instance, both the *sul ponticello* and flageolet in Example 54 result in a peculiar fragility and suavity of timbre. The function assisted by the redundancy between two expressive features is thus always expressive.

In the second type of redundancy, which consists in a co-occurrence relating an extrasystemic feature with a systemic one, the former is subordinated to the latter, in the sense that it is designed to reinforce it. In such a case, what is assisted by the redundancy is the systemic function residing in the motoric parameter relevant to a given category of Penderecki's sonoristic system, while the assisting, or redundant, function is performed by the expressive feature. (Obviously, this case is closest to linguistic redundancies that aid in the identification of distinctive features.)

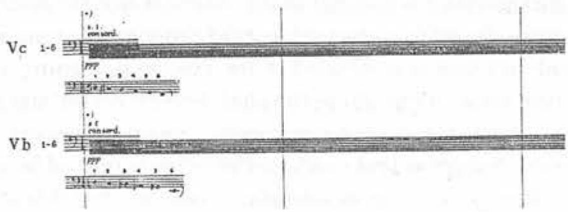
From among all the systemic aspects of a given sound generation process, the one reinforced by a co-occurring expressive feature is that to which the latter is related by virtue of some natural bond. In other words, if redundancy is to take place, systemic and extrasystemic aspects must both influence the same perceptual parameter of sound. As stated above, all the articulatory devices reckoned among expressive features have primarily an effect on timbre. Furthermore, they also influence the loudness of a given sound sensation. This is so not only because loudness is strongly influenced by timbre (as psychophysiology teaches), but also because all expressive features have an impact on sound intensity, which is the closest acoustical equivalent to loudness. As regards *sul ponticello*, *sul tasto*, and *flautando*, this impact stems from the fact that a change in point of string excitation from the optimal point of standard string-playing technique results always in a reduction of resonance and, consequently, a decrease of intensity. Lessening of intensity is also brought about by harmonics (flageolets), playing with mute, and by playing the strings with only half the bow (*metá*). In contrast, playing the string at the heel of the bow (*al tallone*) allows one to obtain a much higher pressure, which increases the intensity of the sound. All those string techniques thus appear as involving aspects of sound generation relevant to the intensity on a level with its closest motoric equivalent, which is the force of excitation. This holds true also for the choral effects of *falsetto*, *bocca chiusa* (closed mouth), and whistling. From this it follows that it is the force of excitation assisted by extrasystemic components of a given sound generation process. Without losing their expressive function, all of the latter thus form redundant features concerning the category "loud vs. soft dynamics", whose motoric parameter is constituted by the force of excitation.

---

which help in the identification of distinctive and configurative features only, but never reinforce expressive ones.

If the expressive features are assigned only to individual sounds of a segment, as happens in Example 54, their redundant function is performed on the subsegmental level. In turn, if expressive features are assigned to all the sounds of a given segment, the redundancy moves from the subsegmental level of individual sounds onto that of segments. Of course, the same redundant function is also performed by combinations of several expressive features. Thus such combinations as discussed above need not be limited to individual sound phenomena, but may also occur on the level of whole segments. Such is the case in the musical example below (Ex. 55). In this context, it is noteworthy that combinations of expressive features in Penderecki's sonoristic pieces always couple together only those articulatory devices that exert the same influence on dynamics. Thus one finds in those pieces several combined expressive features that are conducive of silent dynamics—as far as their junctures are practically possible. In contrast, the only expressive feature producing loud dynamics—playing at the heel of the bow—always occurs singly, even though there exists no practical obstacle to combining it with other extrasystemic aspects of articulation. Exceptions are only its combinations with playing *sul ponticello* that enable the composer to obtain an effect of "violent creaking".

Example 55: *Fluorescences*, 32-34



As emphasized above, the redundancies containing expressive features are founded on a natural bond between reinforcing and reinforced aspects of a sound generation process. Therefore redundancy arises even though the co-occurrences of aspects involved in its two, hitherto discussed types are optional within a piece: expressive features need not occur constantly, neither with each another, nor with the terms they reinforce of the category "loud vs. soft dynamics". On the other hand, no such natural bond occurs between any two systemic features of sound generation processes: even though the basic system of Penderecki's sonoristic style contains interdependencies between parameters of different categories, those interdependencies do not produce redundancies, but rather logical implications or equivalencies between terms. Hence the third type of redundancy is possible only on the strength of a conventional bond, which is established between different categories through assignments between their individual terms, i.e., through artificial implications and equivalencies. To be efficient, they—like the natural logical relations of implication and equivalence—must be constant within an entire piece. Redundancies as mutual reinforcements between terms of different categories thus occur not on the subsegmental level of individual sounds, but always on the level of segments. As in the case of the second type of redundancy, the assisted function here is the systemic one of a term that is constitutive of a given segment and that distinguishes it from other predictable segments of Penderecki's sonorism. Yet, since this function is performed by both related terms, the latter are equiponderant and mutually redundant, each of them being at the same time reinforcing and reinforced—as in the first type of redundancy.

Assignments between categories can concern either their individual terms only or all of their terms, i.e., two categories as wholes. In the former case, a partial redundancies may arise between categories, as logical implications between their opposite terms. As shown in the following figure, those implications work in opposite directions, so that, while one of the opposite terms of the first category implies an opposite term of the second category, the remaining opposite term of the second category presupposes the remaining opposite term of the first one:

category	positive term (+)	⇒	negative term (-)	category
	negative term (-)	⇐	positive term (+)	

Figure 50

In contrast, total redundancy arises by equivalencies of all terms between two categories, such that any term of one category both presupposes and is presupposed by its parallel term of the other category.[3] It follows that this type of redundancy can occur only between categories set up by oppositions of the same logical type— either two contrarieties or two contradictions—and fuses two different categories based on elementary binary oppositions into a more general, compound category.

more general category		
elementary category		elementary category
positive term (+)	⇔	positive term (+)
negative term (-)	⇔	negative term (-)
border-zone term (*)	⇔	border-zone term (*)
total mediative term (❐)	⇔	total mediative term (❐)
transition (→)	⇔	transition (→)

Figure 51

Intercategorial redundancies established arbitrarily for individual works form another manifestation of compositional freedom on the level of *parole*. However, they do not belong to the variant-shaping procedures, but constitute one of two methods of shaping the system in a given sonoristic work. The other method is the selection of categories constitutive of the system from among those that set up the *langue* of Penderecki's sonoristic style. Plainly, these two areas of compositional free choice have no counterpart in linguistic phenomena, and their very possibility stems from the special position of the composer as both user and creator of his musical *langue*, as pointed out before.

[3] This parallelism concerns mediative terms. As to the opposite terms of any given category, determination of one of them as positive and the other as negative is always a matter of convention. Thus, an artificial equivalence between the positive term of one category and the negative term of another category—like that between spatial mobility and temporal discontinuity, revealed in the analysis of *Threnody* (see below, Chapter 8.3)—does not nullify the principle formulated here.

In this light, one has to reinterpret the role of *langue* described in Part One of this book. It appears that, as a consequence of system-shaping procedures, *langue* need not be identical with systems of individual sonoristic works construed as musical texts generated on the level of *parole*. This is so because not all of the categories must occur in every piece; and those which do occur need not be independent, but may fuse into more general categories by means of intercategorial redundancies. This concerns mainly the basic system, since both intercategorial redundancies and the non-usage of some categories happen in its framework. Hence, though the fully developed system embraces eight categories, individual pieces may use less. In Penderecki's sonorism, compositional freedom in the area of shaping-systems of individual pieces causes the systemic states to vary from one piece to another. This, in turn, affects the status of Penderecki's sonoristic works. As governed by different subsystems of the fully elaborated *langue*, they resemble not particular "texts" of the same language, but rather texts of different languages in the framework of a universal linguistic system.

In turn, the fact that there may exist differences in state of the system underlying individual sonoristic works by Penderecki has significant impact on the problem of expressive features. If in the area of articulation the field of expressive (extrasystemic) phenomena is complementary to, and hence dependent on, the field of systemic ones, then changes in the range of the latter also effect appropriate changes in the range of the former. Consequently, because a system of a given piece may appear to be narrower than the superior system, described previously as *langue*, the field of expressive features may embrace not only those discussed earlier in this chapter, and henceforth called "regular expressive features", but may also include features irrelevant to its particular subsystem. This is true even if the latter have been previously construed as systemic within the totality of the *langue*. This optional type of expressive features thus contains articulatory phenomena defined as follows: (1) they deviate from the norm in an aspect regulated by a motoric parameter of some basic-system category operative in a given sonoristic work; (2) nevertheless, on the grounds of the systemic state constitutive of a given work, such articulatory phenomena are eliminated from the set of possible realizations of the term to which they have been ascribed by the articulatory definition of that category. The optional expressive features come to light only during analyses of individual pieces, and thus are discussed in more detail in Chapter 9.

From the above remarks, it follows that reconstruction of the state of system constitutes the most fundamental analytic task, and that only the completion of this task can enable the proper analysis of all Krzysztof Penderecki's sonoristic works. Any procedure aimed at accomplishing this task must follow the rule of "the maximum elimination of redundancies and the minimum amount of distinctive alternatives" (Jacobson and Halle 1956: 47); according to Jakobson and Halle's linguistics, adherence to this rule ensures the optimal, most economical description of a natural language. In reference to Penderecki's sonorism, and in light of the differences, discussed earlier, between description of music and that of natural language, Jakobson and Halle's rule can be reconstrued, as "the maximum elimination of expressive phenomena and the minimum amount of categories".

Yet, as already observed, those two sets of phenomena—systemic (ruled by categories) and extrasystemic (expressive)—are always interdependent. The expressive features can be determined only on the basis of a system. In order to reconstruct the state of system in a given piece, however, one must choose the phenomena relevant to its categories from among the all phenomena of the piece, and then discern them from expressive ones. The same situation also holds true as regards the investigation of systems of natural languages: "When analyzing a given language into its ultimate constituents, we seek the smallest set of distinctive oppositions which allow the identification of each phoneme in the messages framed in this language. This task requires an isolation of distinctive features from concurrent or adjoining redundant features" (Jakobson and Halle 1956: 45). This leads to a serious methodological problem—a "vicious circle" that impedes the analyses of Penderecki's sonoristic works to the same degree as it does the linguistic analyses referred to by Jakobson and Halle. Still, this danger can be avoided here, as in linguistics, by the addition of rules designed to protect the validity of the analysis.

The first of these rules originates in linguistic procedures, and is inspired by this instruction by Jakobson:

> If two or more allegedly different features never co-occur in a language and if they, furthermore, yield a common property distinguishing them from all other features, then they are to be interpreted as different implementations of one and the same feature, each occurring to the exclusion of the other and, consequently, presenting a particular case of complementary distribution. (Jakobson and Halle 1956: 27-28)

Mechanical transposition of this instruction to music and applying it to Penderecki's sonoristic style are impossible because of differences between units of language and those of Penderecki's sonorism: because segments as musical units embrace several sounds, different implementations, or means of production, of one and the same categorial term, as the musical equivalent of a distinctive feature, can and often do co-occur within the same segment. Hence, to be helpful for our purposes, the above instruction must be reformulated. It must be adapted to the realm of the object of investigation, so that the crucial point is not complementary distribution as a property of linguistic distinctive features, but contrast as an inevitable effect of their juxtaposition. This leads to the following reformulation of Jakobson's "rule": If two different realizations of the same aspect of sound production are juxtaposed, either in simultaneous or adjacent sounds, without the clear intention of bringing about a contrast between them, but instead are fused into one sound field of a uniform character, then those realizations are to be treated as different ways of realizing the same term within a given category.

The other instruction useful in reconstructing subsystems of individual pieces does not originate in linguistics. Rather, it concerns an aspect peculiar to Penderecki's sonorism, and stems from the logic of trajectories: if a given feature of sound, as systemic, does not follow this logic, it most likely constitutes an expressive feature. The intentional violation of the logic of trajectories is also possible in sonoristic pieces as the last area of compositional freedom. Penderecki uses it very sparingly, however, and only for particular artistic purposes.

8. ANALYSES OF MUSICAL TEXTS

The sonoristic system elaborated in earlier chapters governs the following pieces by Krzysztof Penderecki, composed in years 1960-1962: *Anaklasis* for 42 strings and percussion (1959-60), *Dimensions of Time and Silence* for mixed choir, strings and percussion (1960-61), *Threnody* for 52 strings (1960), String Quartet No. 1 (1960), *Fonogrammi* for flute and chamber orchestra (1961), *Psalmus 1961* for tape, *Polymorphia* for 48 strings (1961), *Fluorescences* for orchestra (1962), and *Canon* for string orchestra and tape (1962). All these works thus constitute texts generated by the musical language discussed in Part One of this book or, more properly, by its several sub-languages, the latter being equivalent to states of system in each work.

Of the nine pieces listed above, two of them—*Psalmus* and *Fonogrammi*—will be not considered in the following analyses, each for a different reason. The analysis of *Psalmus*, as the only example of "music for tape" in Penderecki's sonoristic output, would demand formulating articulatory definitions of terms in every category that would apply to electronic sound-resources, instead of the traditional orchestral instruments discussed here. Besides, even provided such definitions were elaborated, the very possibility of analysis is put into question, because a score of this piece, in the proper sense of a word, does not exist.[1] As is the case with most electronic pieces, *Psalmus* was composed immediately as a tape recording, hence its analysis would have to be purely auditive.[2] The second of the omitted pieces—*Fonogrammi* for flute and chamber orchestra—is the lone concerto piece in this set. As such, it involves a problematics of the interrelations between solo flute and accompanying ensemble of instruments, which makes it akin to slightly later works of a similar character, such as *Capriccio per oboe e 11 archi* (1963), *Capriccio per violino e orchestra* (1967), or *Sonata per violoncello e orchestra* (1966). Because discussion of those latter works goes beyond the scope of this book (for reasons that can be made clear only later), the essential issues of *Fonogrammi* can not be investigated here. An even more serious obstacle concerns the original score of *Fonogrammi*: it was lost, and a reconstruction of it was made by the composer ten years later, with the aid of some preserved instrumental parts (Erhardt 1975: 31). This reconstruction, however, deviates in several ways from both the notation and the inventory of sound effects characteristic of the works from the years 1960-62, instead making the reconstructed score similar to pieces belonging to Penderecki's output from the early 1970s—such as *De natura sonoris no. 2* (1970) or *Partita* (1971-72)—and thus composed at the time of the reconstruction. Again, these points of resemblance can be discussed only in comparison with the later pieces, a procedure which would exceed the scope of the present study.

---

[1] There exists only a sketch of *Psalmus*, made by the composer. It is in the possession of the engineer of that piece, Eugeniusz Rudnik, at the experimental studio of Polish Radio in Warsaw. It was not accessible to the author of this book.

[2] Such an analysis was carried out by Józef Rychlik (1983), who also elaborated his own chart of the piece as a record of its auditive perception. Characteristically, the author concludes that *Psalmus* is based on several oppositions, among which the one between impulsive and continuous sound phenomena is considered the most crucial. The description of these two types of musical material indicates that their opposition is equivalent to the binary opposition "temporal continuity vs. discontinuity" within the basic system of Penderecki's sonorism as reconstructed in this book. Another opposition pointed out by Rychlik—between autonomous and non-autonomous rhythm—is, in turn, parallel to "temporal mobility vs. immobility". Finally, the textural opposition observed between bands (*model pasmowo-współbrzmieniowy*) and points (*model punktualistyczny*) obviously corresponds to the binary opposition "spatial continuity vs. discontinuity". The Polish author also mentions two oppositions concerning the character of sound material electronically processed in *Psalmus*. As such, these oppositions have no equivalent within the systems of the remaining sonoristic works: "natural voice vs. artificial voice" (*głos naturalny/głos sztuczny*) and "singing voice vs. pronouncing voice" (*głos śpiewający/głos mówiący*).

As far as possible, the presentation of analyses in this chapter follows the chronology of Penderecki's sonoristic works. However, that chronology is not always clear-cut, especially as concerns the earlier pieces. According to Ludwik Erhardt (1975: 23-25), the composer began work on *Anaklasis* and *Threnody* almost simultaneously, during his stay in Italy in December 1959 and January 1960. Yet, in spring of 1960 he also commenced work on *Dimensions of Time and Silence*, which was first performed in September of the same year at the Fourth International Festival of Contemporary Music "Warsaw Autumn". The first performance of *Anaklasis* took place in Donaueschingen in October, and *Threnody*—though it had been submitted to the International Tribune of Composers UNESCO in May 1961—premiered only at the next "Warsaw Autumn" in September 1961. Earlier, in the spring of 1961, while writing his String Quartet, Penderecki also elaborated yet a second version of *Dimensions* (Erhardt 1975: 33). The original version had not satisfied the composer and was thus withdrawn, so that today neither its score nor a recording exist. We know something of how the work was subsequently changed thanks only to the memories of some who attended the first performance, and to the composer's commentary, which was inserted in the festival program notes. The most important change seems to have concerned the conclusion of the piece, which in the original choral part contained a text: "a twelve-syllable, Latin, five-verse stanza composed as a magic square:

S A T O R
A R E P O
T E N E T
O P E R A
R O T A S"

In the second version of *Dimensions* the text[3] has disappeared, leaving only the phonetic material of the choral part. This material consists of "rotationally permuted groups of consonants" mixed with sung vowels and "noise effects obtained by the proper juxtaposition of sibilants and a whistle" (Program, quoted by Erhardt 1975: 25-26). The first performance of *Dimensions of Time and Silence* in its second version—the only version existing today and the one analysed below—took place in June 1961; it thus premiered before the String Quartet, which was first performed on 11 May 1962, by the LaSalle Quartet in Cincinnati. In sum: *Anaklasis*, *Dimensions of Time and Silence*, *Threnody*, and the String Quartet were composed almost in tandem, during 1960 and the first months of 1961, and the only objective criteria by which to order analyses of these pieces chronologically are the dates of their first performances.

The chronological order is much clearer as regards the three remaining pieces. True, the composer had begun working on *Polymorphia* and *Fluorescences* simultaneously, during the summer holidays of 1961 (Erhardt 1975: 34). The former was performed, however, for the first time in April 1962, whereas the latter occupied the composer's attention until autumn of that year. *Fluorescences*, which had been commissioned for "Donaueschinger Musiktage", had its premier at that festival on 21 October, and thus after the first performance of *Canon*. Though the last-composed of the seven pieces analyzed below, *Canon* had already in June been awarded first prize in the Malawski Competition for Composers, held in Cracow, and in September1962 it was played during the Sixth "Warsaw Autumn". As one can see, the order of first performances belies the relatively clear chronology of composition—*Polymorphia*, *Fluorescences*, and *Canon*—and hence is not counted as a criterion by which to order their analyses.

[3]The same magic square was employed by Anton Webern to demonstrate the rules of twelve-tone composition during his famous lectures given in 1932-33 at a private home in Vienna. However, according to Schwinger (1989: 194), the text to those lectures, first published by Willi Reich in 1960, was not known to Penderecki at the time of his work on the original version of *Dimensions*. The Polish translation of those lectures was not published until 1972 (*Res Facta* 6).

Every of the following analyses concerns both articulation and system. The articulations of each piece will be displayed by reference to Diagram 2; more precisely, this last diagram will serve as a stencil on which the sound generation processes in a given piece will be marked. From such a diagram, one will also be able to read the detailed set of instruments designed for each piece, as well as peculiarities of orchestration consisting in types of sound sources distinguished within this set. A full diagram will be used for *Anaklasis*, *Dimensions*, and *Fluorescences*, whereas the articulation of pieces written for strings only—*Threnody*, String Quartet No. 1, *Polymorphia*, and *Canon*—will be shown on a partial diagram that displays the sound generation processes involved in string techniques.

The discussion of the basic system will start with a description of its state in a given piece. After a specification of categories operative in a given work, intercategorial redundancies will be indicated as artificial logical implications or equivalencies of their terms. The subsystem of a piece will be summarized in a rosette similar to those given in 5.1.2. Though each rosette is incomplete, in the sense that it visualizes only the opposite terms of categories and their possible combinations, it still effectively exhibits the complexity of the basic system as it is reformulated in each sonoristic piece.

After the state of the basic system is determined, the analysis of a piece according to its individual categories will be carried out. It will thus consist in a description, section by section, of each trajectory.[4] The temporal range of each section will be given in numbers, assigned by the composer to spans of music—which shall here be called "paragraphs"—and more rarely to bars. Musical paragraphs will sometimes be further subdivided according to needs of the analysis. Only in analysis of the String Quartet will the numbers indicate timing of the piece in minutes and seconds. Analysis of individual trajectories will account for possible expressive sound events as well as for optional expressive features. The logical and temporal relations of sections within every trajectory are visualized in a chart preceding the verbal description. Such a chart is of particular importance for trajectories split into several layers, since it enables one to follow their arrangement and their changing interdependencies in the course of the piece.

Finally, each piece will be analyzed from the point of view of the timbre system. After discussion of individual sections of the timbre trajectory, identified by pairs of materials, these will be subsequently interpreted as timbre segments defined by sets of material categories, from among which the main ones will be chosen. The course of the segmentational macrolevel will allow one to identify the contradictions or contrarieties of the "ternary opposition" active in a given piece or musical passage and, in light of that identification, to interpret the sets of main materials contained in successive segments as their opposite or mediative terms.

A summary chart of each piece will show the full segmentation resulting from intersections of timbre and basic system segments, as well as its hierarchical organization and the possible assignment between categories and individual hierarchical levels in a complete piece or in a section thereof. The juxtaposition of all trajectories will also exhibit the threads into which the musical narration is stratified, and the interdependencies between those threads in the course of a piece.

[4] In the course of analysis, references to individual instruments or instrumental groups occurring in a given section will be made not by means of their full English names, but of abbreviations of their Italian names, as found in the scores.

8.1. ***ANAKLASIS* (1959-60)**

Articulation

The piece was written for string orchestra and percussion. The latter also includes piano and harp, which confirms the conclusions drawn in Chapter 6.3 as to the classification of these two instruments in Penderecki's sonoristic style. The remaining percussion instruments are divided into six groups, with each group delegated to one performer. The following division of the orchestral ensemble is specified at the beginning of the score:

20 violins (vni)
8 violas (vle)
8 cellos (vc)
6 contrabasses (cb)
harp (ar)
piano (pfte)
claves

1: xilorimba (xilor)
2 congas (cgs)
3 wood drums (lgn)

2: vibraphone (vbf)
2 bongos (bgs)
3 tubular bells (cmpne)

3: 2 suspended cymbals (ptti 1, 2)
glockenspiel (cmpli)

4: 2 suspended cymbals (ptti 3,4)
3 tom-toms (tomts)
tubular bells (cmpne)
triangle (trgl)

5: 2 suspended cymbals (ptti 5,6)
3 tom-toms (tomts)

6: gong (gng)
tam tam (tmt)
4 timpani (tmp)

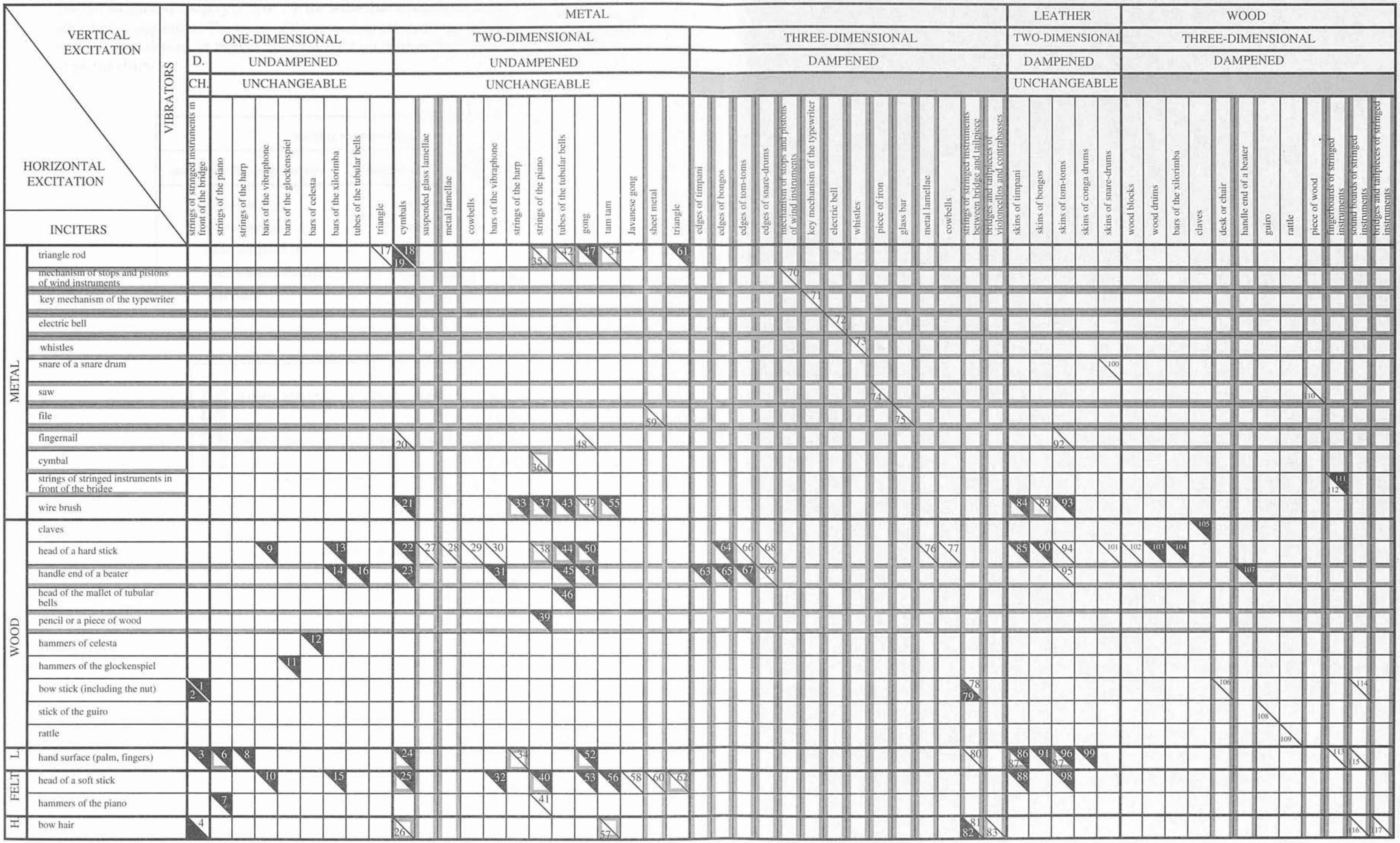
The rich inventory of sound generation processes arising from this expanded set of instruments is exhibited in Diagram 3.

Basic system

The subsystem of *Anaklasis* contains five from among eight categories of the basic system. They are as follows:

temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
temporal mobility vs. temporal immobility

Diagram 3. Processes of sound generation in *Anaklasis*



spatial mobility vs. spatial immobility
loud dynamics vs. quiet dynamics

The last mentioned category is "free", in the sense that its terms are independent of terms of any other binary opposition. The terms of the remaining categories are mutually related by means of artificial equivalencies or implications, which set up intercategorial redundancies of either total or partial character:

mobility vs. immobility		
spatial mobility vs. immobility		temporal mobility vs. immobility
positive term (+)	⇔	positive term (+)
negative term (-)	⇔	negative term (-)
border-zone term (*)	⇔	border-zone term (*)
total mediative term (❐)	⇔	total mediative term (❐)
transition (→)	⇔	transition (→)

temporal continuity vs. discontinuity		mobility vs. immobility
positive term (+)	⇒	negative term (-)
negative term (-)	⇐	positive term (+)

spatial continuity vs. discontinuity		mobility vs. immobility
positive term (+)	⇒	negative term (-)
negative term (-)	⇐	positive term (+)

Moreover, "temporal continuity vs. discontinuity" is modified in that the quickest possible repetitions, acknowledged previously as representing its border-zone term, are treated here as temporally continuous and thus as representatives of the positive term of this category on a level with long-lasting sounds. This treatment is evidenced by several passages of the piece, where maximally dense temporal phenomena and sustained sounds occur side by side, yet without eliciting any clear textural contrast, instead being fused into an integrated sound field. The modification thus concerns the articulatory definition of the category, but its very possibility originates in the acoustical definition. Because the interval modeling temporal continuity as a neighbourhood of point zero in the space of possible time-span values between consecutive impulses is fuzzy (in the mathematical sense elaborated earlier), its upper limit, which is identical with the threshold of discernibility of successive sounds, cannot be stated unequivocally. Raising that limit is tantamount to interpreting time-span values between quickest possible repetitions of sound generation processes to be subliminal on a level with time-spans between component clicks determining the frequency of a sound generated through a single excitation event. As a consequence, the border-zone term of "temporal continuity vs. discontinuity" is eliminated from the category. Being devoid of any separate set of representatives, it cannot be articulated, and thus it does not occur in *Anaklasis*.

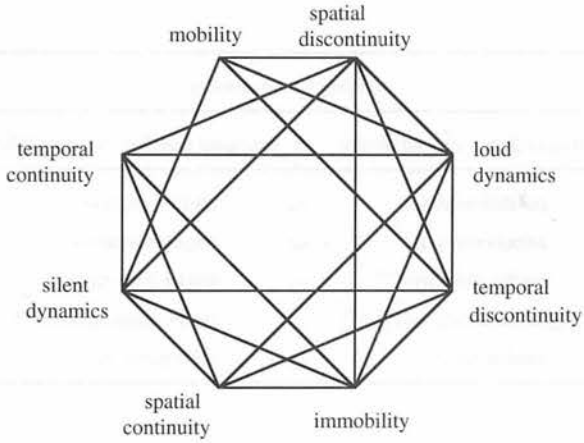
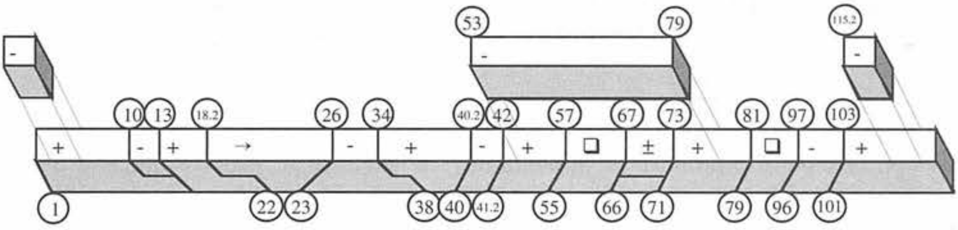


Figure 52. Rosette of the system in *Anaklasis*

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY



1 (-): at the beginning of the piece this trajectory is split between two contrasting layers. One of them includes sharp impulses *sff* (vni I 2-10, vni II 2-10, vc 2-8, cb 2-6);

1-12 (+): sustained notes of solo stringed instruments in the background of the impulses (vno I 1, vno II 1, vla 1, vc 1, cb 1) open the other layer, which subsequently appears to be the main one. Its initial section under discussion is continued by several tremoli and long-lasting notes played with or without vibrato;

10-12 (-): momentary sound phenomena played *pizzicato* (vno 1: 10; vno 2: 11; vc 2: 12) and *legno battuto* (cb 1: 10; vc 1: 12; cb 1: 12);

13-21 (+): tremoli and long-lasting sounds in strings, from 14 on assisted also by percussion (ptti: 14-16; tmt: 17-18);

18.2-25 (→): the succeeding sound phenomena in the percussion parts initiate a transition from temporal continuity to discontinuity, accomplished by the gradual shortening of rhythmical values in the tremoli and single sustained sounds;

23-37 (-): semiquaver impulses, as a goal of the transitional process, attained successively by individual groups into which the set of percussion instruments is divided. They are introduced at first in groups 2, 4, 5 (23), then in groups 3, 6 (25), and finally in group 1 (27);

34-40.1 (+): tremoli on tomts (1-3: 34-40; 4-6: 35-40) and timp (37-39) overlap with the momentary sound phenomena of the previous section;

40-41 (-): short, separate beats;

41.2-56 (+): long-lasting tremoli;

55-66 (❐): among tremoli retained from the previous section in parts of tomts, tmp, ptti as well as newly introduced gng and tmt, there occur junctures of short initial impulses *sf*, notated as semiquavers, and their prolongations *p* (ptti: 56, 63-64; tomts: 57-58, 59-60, 64-65). While the latter represent temporal continuity, the former are temporally discontinuous phenomena; hence the resulting mix brings about the total mediative term of the category. The lack of slurs between impulses and tremoli is noteworthy since it indicates the intentional separation of those two kinds of sounds, even if in performance they fuse into one tremolo of sharp onset;

66-72 (+)(-): a total imposition of contrasting sections represented respectively by impulses *sf* and long lasting tremoli *p*. Together they constitute the effects of *sfp* in the membranophones (tomts, tmp);

53-78 (-): along the main layer of the trajectory, there proceeds an expanded section of temporally discontinuous impulses played *con dita* on cgs (53-77) and bgs (54-75) and, beginning at 75, also on tomts and timp. Although forming a side-layer, it is logically related to the two previously discussed sections in that it brings the missing negative term;

71-80 (+): return to dynamically steady tremoli in ptti, tmt, and tomt 4, from 74 on gradually replaced by quickest possible repetitions in pfte, cel, ar, and cmpli parts. Single sustained sounds appear in vbf (75-76) and ptto 3 (80);

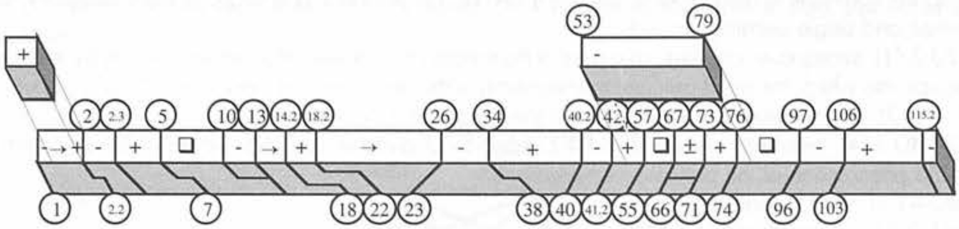
79-96 (❐): several different rhythmic values performed as both simple durations and maximally dense repetitions, mixed into a unified sound field of ar, pfte, and idiophones (xilor, vbf, cmpli, ptti, trgl, gng, tmt, cel), and after 87 joined by strings;

96-102 (-): series of semiquaver impulses in percussion parts (xilor: 97-101, cmpli: 98-102, vbf: 96-101, cel: 96-102), ar (97-102), pfte (97-101), and strings played *pizzicato* (vni: 96-100, vle 1-2: 98-101), *legno battuto* (vc 1-2: 96-101, cb 1-2: 97-101) and struck *sul tasto* with palm of the hand (vc 3-4: 95-101; cb 3-4: 96-100). Tremoli *arco* played by vni 5-8 (99) and vle 3-4 (99-100) are expressive sound events within this section;

101-115 (+): long-lasting sounds and maximally dense repetitions initiated at first in pfte (101) and vbf (102), then spreading over the whole instrumental ensemble, which consists here of xilor, vbf, cmpli, cmpne, ptti, gng, tmt, cel, ar and pfte. In 110-115, temporal continuity is represented by very long clusters of stringed instruments, from 113 on joined again by percussion playing tremoli and sustained sounds (cmpne, gng, tmt, pfte, ar, ptti, trgl);

115.2 (-): three final impulses *pizzicato* (pfte) correspond with the beginning of the trajectory in that they cause its bifurcation into two layers. Their onsets form a side layer whose temporal discontinuity is suggested in the notation by rhythmical values of quavers with crossed-out flags, while fading sounds prolonged *con pedale* belong to the above-discussed section characterized by temporal continuity.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



1 (+): four successive quarter-tone clusters played by vni II (a♯-d^{1}♯), cb (f^{+}-g♯), vni I (g-b^{+}) and vc (g♯-c^{1}) in the side-layer[1];

1-2.1 (-→+): the main layer of the trajectory starts from a process of building up a quarter-tone cluster g-a^{+} by adding to the initial tone a (vla 1) its consecutive neighbouring pitches a^{+} (vno II 1), g (cb 1), g^{+} (vno I 1) and g♯ (vc 1). Interconnection between the layers consists in the fact that the successive tones of solo instruments are always introduced together with momentary clusters of the entire instrumental group as their integral components, and are then retained after a given cluster disappears;

2.1-2.2 (-): return to spatial discontinuity in glissandi of single tones upwards and downwards (vle 2-8);

2.3-6 (+): band of highest possible tones in vni 11-20 (2.3), then quarter-tone clusters of cb (2-3), tutti archi (3), vle and vni 11-20 (3), vni 1-10 (3-4) and finally of vc and cb (4-6);

5-12 (❐): the total mediative term here embraces several processes that build up and disintegrate clusters through asynchronic introduction and cancellation of their component tones (vle 1-3: 5-6; vle 1-2, vni 5-7: 5-8; vc 1-4, vno 2, vla 1: 8-10; vle 1-2: 11-12); also a very narrow-range cluster of vni 1-4 (5-8) and an octave separation F♯-G of a minor second as a minimal cluster (cb 1-2: 7-9). Together these form a unified sound field containing both spatially continuous and discontinuous phenomena;

10-12(-): point-like single pitches *pizzicato* and *legno battuto* occurring simultaneously with the last sounds of the previous section in vni 1 (10) and 2 (11), cb 1 (10, 12), vc 1 and 2 (12);

13-17 (→): progressive introduction of neighbouring pitches building up quarter-tone clusters in vni 7-12 (13-14), then in vc 1-4 and cb 1-2 (15-17);

14.2-21 (+): in vni 7-12 a cluster is established already in 14.2, then expanded by joining vni 3-6 (15), 1-2 (16) and vle (18). To this section belong also the long-lasting sounds of ptti (14-16) and tmt (17-18);

18.2-25 (→): subsequent sound phenomena played on two-dimensional sound sources—metal plates (ptti, gng, tmt) and skins of membranophones (tomts, timp)—are gradually shortened. Hence they form a transition from the positive to the negative term of the discussed category. Interestingly, this transition starts immediately after the opposite transitional process in vc and cb ends, and before the above-discussed, spatially continuous section is canceled;

23-37 (-): spatially discontinuous, point-like effects, attained consecutively by percussion groups 2, 5, 4 (23), 3, 6 (25) and 1 (27), are momentary semiquaver beats on xilor, lgn, cmpne, claves, tmp, gng, ptti as well as skins, edges, and sticks laid on the striking surfaces of bgs and tomts;

34-40.1 (+): tremoli on tomts and tmp overlapping with the preceding section;

40-41 (-): impulsive beats;

41.2-56 (+): long-lasting tremoli on two-dimensional striking surfaces of tomts, tmp, and ptti;

55-66 (❐): spatially continuous tremoli on tomts, tmp, ptti, gng and tmt mixed with point-like impulses *sf* in ptti (56, 63) and tomts (57-58, 59, 64);

---

[1] Atypical chromatic signs occurring in scores of Krzysztof Penderecki refer to quarter-tones. New sharps, $^{+}$ and ♯, indicate that a pitch is raised one and three quarter-tones, respectively. Black flat ♭ means lowering a quarter tone, and left-sided (reversed) flat —lowering three quarter-tones.

66-72 (+)(-): contrasting, superimposed sections of sharp impulses *sf* and delicate tremoli *p* are absorbed into the same instrumental parts as *sfp* (tomts, tmp);

53-78 (-): secondary layer of bgs and cgs, subsequently undertaken by tomts (75-78) and tmp (75-77), contains series of individually discernible, point-like impulses *con dita*. It thus brings the negative term missing in the succession of sections occurring in tandem within the main layer of the trajectory;

71-75 (+): long-lasting tremoli in the main layer, which includes here tomts (72-73), ptti (71-75), and tmt (73-74);

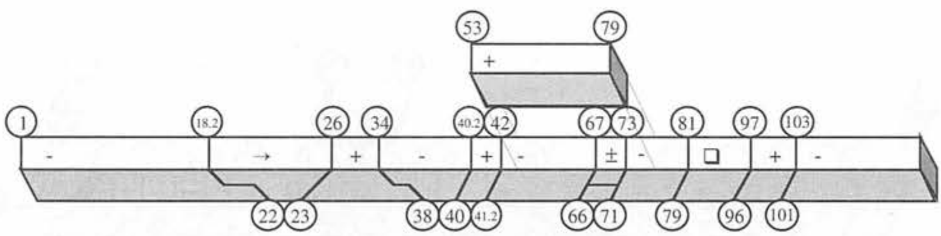
74-96 (❐): spatially continuous, lasting sounds and tremoli on ptti, gng, and tmt are mixed in this section with discontinuous impulses on those instruments, and with sounds produced by one-dimensional sources, including tones of the trgl and single distant pitches of pfte, vbf, xilor, cel, ar, and cmpli. Beginning at 87, spatially discontinuous phenomena are also represented in parts of stringed instruments by discrete pitches, highest possible notes, and single sounds of indefinite pitch played between bridge and tailpiece;

96-105 (-): distant, definite pitches throughout the strings and percussion (cel, vbf, cmpli, xilor), the latter including pfte and ar. In the former instrumental group there also occur spatially discontinuous sound phenomena of indefinite pitches, produced by striking the finger-board with the palm of the hand (vc 1-2: 95-101, cb 3-4: 96-100), highest possible notes, and playing between bridge and tailpiece;

103-115.1 (+): band of long-lasting sounds and tremoli on ptti (102-105) and gng (103-104), after 106 joined by tmt, with which the pitches of vbf and cmpne are fused. The intent to generate a spatially continuous sound field is apparent in the parts of the two latter instruments, through the choice of maximally close pitches c^1 (cmpne) and $c^1\sharp$ (vbf) forming a minimal cluster. In paragraphs 110-115 there occur quarter- and semitone clusters of strings, finally (113-115.1) accompanied by long-lasting sounds on metal plates (gng, tmt, ptti) and by clusters of pfte, ar, and cmpne (d^1-e^1, e^2-f^2) treated as substitutes of the class of two-dimensional vibrators. Also, trgl occurs here as a virtual metal plate; in addition, its single sound fuses into the cluster played with wire brushes on piano strings, with which it occurs simultaneously (114);

115.2 (-): pizzicati on individual strings of pfte.

MOBILITY VS. IMMOBILITY



1-21 (-): the initial section is filled in with static, long-lasting sounds and tremoli, along with intermittent, isolated impulses played *arco* (1), *pizzicato*, and *legno battuto* (10-12) by stringed instruments. The combination of spatial mobility and temporal immobility characteristic of glissandi is irrelevant on the grounds of the discussed category, therefore glissandi occurring in paragraphs 2 (vle 2-8) and 3 (cb) form optional expressive features. At the same time, they also perform redundant functions as each of them enhances a process of diminuendo. In 14-18 the strings are assisted by sustained tremoli of ptti (14-16) and the long sound of tmt (17-18);

18.2-25 (→): a gradual shortening of the originally sustained sounds in percussion, along with a reduction of time-spans between those sounds, results in the progressive setting up of temporal and spatial relations between individual sounds and hence in a transition from immobility to mobility;

23-37 (+): interrelated semiquaver impulses are produced by many percussion instruments (xilor, lgn, cmpne, bgs, ptti, tomts, gng, tmt, tmp) and introduced successively in their individual groups;

34-40.1(-): long-lasting tremoli emerge from among sounds of the previous section, in tomts and in 37 joined by tmp;

40-41 (+): mutually related beats on tmp and tomts;

41.2-66 (-): long-lasting, immobile tremoli of tomts, tmp, ptti, gng, and tmt, with occasional, single impulses *sf* at their onsets (ptti: 56, 63-64; tomts: 57-58, 59-60, 64-65);

66-72 (+)(-): static tremoli *p* and a movement between individual interrelated beats *sf* as two contrasting sections superimposed in the tomts and tmp parts (*sfp*);

53-78 (+): series of rhythmic impulses in the subordinate layer of cgs and bgs, then going to timp and tomts, result in movement as a positive term, logically demanded by the sequence of sections proceeding in tandem within the main layer of the trajectory;

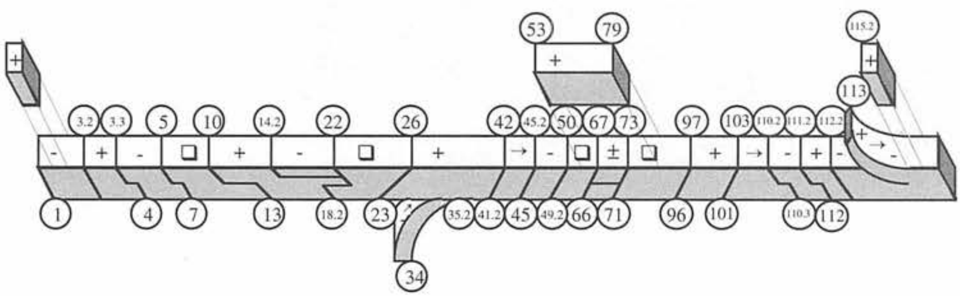
71-80 (-): sustained tremoli (ptti, tmt, tomt 4), quickest possible repetitions in cel, cmpli, pfte and ar (74-78) parts, and a single sustained sound in the vbf (76-77);

79-96 (□): a mix of static, sustained sounds, vibrati, and repetitions combined with short impulses that enter into spatial-temporal relations;

96-102 (+): series of individually discernible semiquaver impulses of different pitches in vbf (96-101), xilor (97-101), cmpli (99-102), cel (96-101), ar (97-102), pfte (97-101), and strings (vni: 97-100; vle 1-2: 98-101; vc 1-2: 96-101; cb 1-2: 97-101). The movement established by these instruments is not disturbed by repetitions of strikes with the palm of the hand (vc 3-4: 95-101; cb 3-4: 96-100). Since the latter constitute the only percussive effect on stringed instruments in the piece, they cannot be spatially differentiated. On the other hand, sustained tremoli in vni 5-8 (99) and vle 3-4 (99-100) are to be acknowledged as expressive sound events;

101-115 (-): the static character of the extended final section springs at first from the immobility of long-lasting sounds, tremoli, fastest possible repetitions, and separate impulses performed by pfte (101-105), vbf (102-110), xilor (103-105), cmpli (104-105), cmpne (103-110), cel (104-106), ptti (102-110), gng (103-104, 108-110), and tmt (107-108). In 110-115 there occur clusters in the strings, from 113 on joined by tremoli and sustained sounds in percussion instruments (ptti, gng, tmt, trgl, cmpne, ar, and pfte). The last events of this section are three isolated tones, played *pizzicato* on pfte (115.2). Expressive glissandi of strings in 113-115 are conducive to the decay of dynamics in the conclusion of the piece.

LOUD DYNAMICS VS. SOFT DYNAMICS



1 (+): short sharp clusters *sff* (vni I 2-10, vni II 2-10, vc 2-8, cb 2-6);

1-3.1 (-): *ppp* and *pp* dynamics of sustained notes in solo strings (vno I 1, vno II 1, vla 1, vc 1, cb 1) provide delicate background for the clusters of the superimposed section in paragraph 1. This quiet dynamic is not disturbed by *mf* (2), which merely compensates for the natural weakness of solo instruments played with mutes (vle), and is immediately followed by a diminuendo to *pp*. The two following clusters are kept *ppp* (vn 11-20) and *p* (cb);

3.2-3.3 (+): *ff* in all stringed instruments (*tutti archi*), then *f* in vni and vle;

3.3-6 (-): clusters *pp* (vni 1-10: 3-4) and *ppp* (vc, cb: 4-6);

5-12 (❐): changing, varied dynamics of long-lasting sounds and tremoli provided with markings ranging from *pp* through *p*, *mp*, *mf* to *f* and *ff*, also including short decrescendi and crescendi;

10-21 (+): strong impulses *ff*, *sf*, *sff* played *pizzicato* and *legno battuto* (10: vno 1, cb 1; 11: vno 2; 12: vc 1, 2, cb 1), followed by *f* in vni (13-14), vc and cb (15-17). After cancellation of the latter two instrumental groups the loud dynamic level is taken over by vle (17-21) and vni 7-12 (18-21);

14.2-21 (-): cluster of vni between *pp* and *p* (vni 1-6: 15-21; vni 7-12: 15-17) originally accompanied by delicate tremoli played with felt sticks *mf diminuendo* on ptto 1 (14.2-16), *p diminuendo* on ptto 5 (15-16) and *pp* on tmt (17-18);

18.2-25 (❐): several short crescendi and decrescendi on tremoli played by percussion instruments whose points of departure range from *pp* to *f*. Occasional single beats, which preclude crescendo or diminuendo, receive the dynamic mark *p* (gng: 20; tmp: 24) and *f* (ptto 2: 21);[2]

23-41 (+): *f* dynamic is introduced first by percussion groups 5, 2, 4 (23), then by groups 3 and 6 at rehearsal number 25, and finally by group 1 (27). Such a soft emergence—resulting in the interpenetration with the previous section—as well as the process of gradual enlargement of the set of percussion instruments cause the initial stage of this section (23-27) to be equiponderant with the transition from a mix of different dynamic levels to consistently loud dynamics, the latter being ultimately established only in 28, together with the introduction of xilor and claves;

34-35.1 (→): *p* crescendo (tomt 1) opens a new layer of the dynamic trajectory;

35.2-41 (+): in its further course, the originally separate, subordinate layer fuses together with the parallel section of the main layer. Several crescendi and diminuendi between *ff* and *f* (tomts, timp: 35-39) occur here as a fluctuation in the framework of loud dynamics, which is subsequently restored by semiquaver beats *ff* provided with accents;

41.2-45.1 (→): diminuendo from *ff* down to *p* (tomts 3, 5) and *pp* (timp 3);

45-49 (-): soft dynamics within the range *ppp-p*;

49.2-66 (p): several different dynamic levels between *p* and *f*, including sforzati, crescendi and diminuendi, all of them intermingled in the layer of ptti, tmp, tomts, gng, and tmt;

66-72 (+)(-): *sfp* as an imposition of sections characterized by opposite terms of the category in individual instrumental parts of tomts and tmp;

71-96 (❐): mix of different dynamic levels from *pp* to *ff*, as well as sforzati, crescendi and diminuendi spread at first among tomts, timp, ptti, gng, and tmt (71-74), then only in metal idiophones, pfte, and ar, and joined finally (87) by stringed instruments;

53-78 (+): parallel to the main layer, the permanent high dynamic level *f* is maintained in the subordinate layer of the trajectory established originally by cgs and bgs, but from 75 on passing to tmp and tomts;

96-102(+): series of impulses *ff sempre* in expanded set of instruments containing xilor (97-101), vbf (96-102), cmpli (99-102), cel (96-101), ar (96-102), pfte (97-101), and strings (96-101);

101-110.2 (→): overall gradual decrease of loudness is effected by the transition, from *forte* dynamics prevailing at the beginning of this section, to *pianissimo* at its end, as well as by several diminuendi (ptti: 103, 108; cmpne, gng: 103-104; xilor: 104). This softening of dynamics is supported by progressive reduction of the large instrumental ensemble of the previous section down to vbf, ptti, cmpne, gng, and tmt in 106-110. The last mentioned instruments participate in the global, final diminuendo (110);

110.2-111 (-): *pppp* in strings;

111.2-112.1 (+): high dynamic level *ff* occurring successively in particular groups of strings (vni II, vc: 111; vle, vni I, cb: 112);

112.2-115 (-): *pp* introduced unexpectedly (*subito*) and lasting till the end of the piece in the strings;

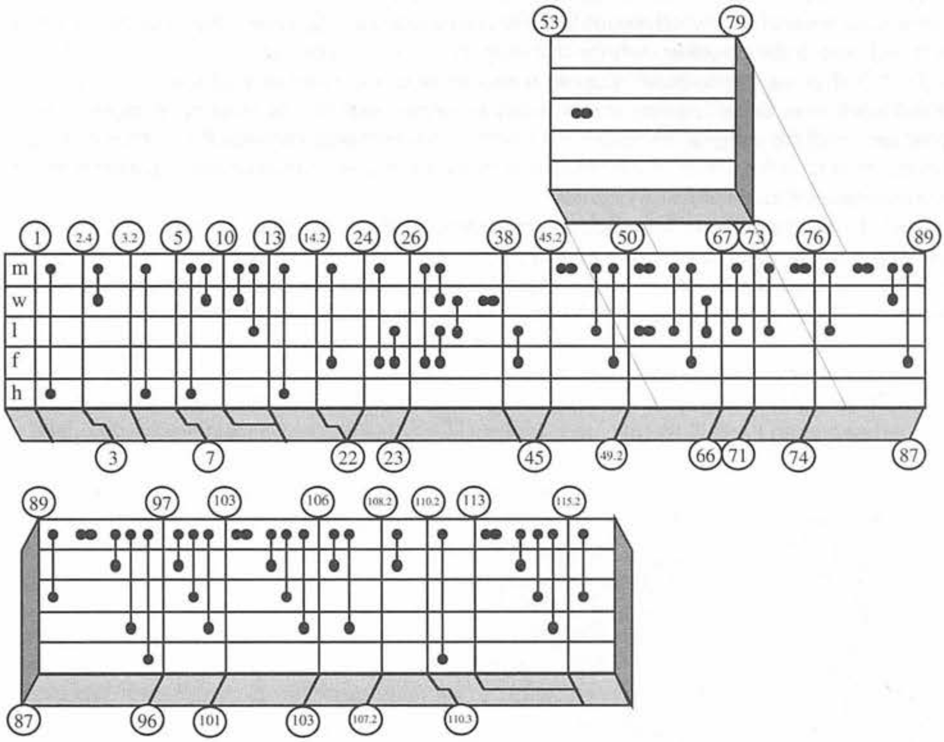
113-115.1 (+→-): gradual progression from *f* to *pp* in the percussion layer (gng, tmt, cmpne, trgl, ptti, pfte, and ar). Seeming irregularities take place, consisting in occasional louder dynamic markings after quieter ones (*mf* of gng before *f* of cmpne in 113; *pp* in ptti before *p* and *mf* of pfte in 113-114, etc.); yet these do not mask the global direction of the dynamic process in this section, which causes it to fuse gradually with the main layer of the trajectory, but rather compensate for the natural differences between dynamic possibilities of individual instruments or instrumental techniques;

---

[2] Lack of a dynamic mark at the onset of tomt 3 (22) is an omission.

115.2 (+): imposition of loud impulses *f*, played *pizzicato* on piano strings *con pedale*, and of their free resonance suggested by slurs, that ceases in the lowest dynamics. While the resonance continues the negative term established earlier by strings, the sharp onsets of individual pizzicati form a new side-layer section at the end of the trajectory.

Timbre system



1-2 (mh): traditional *arco* articulation on strings;

2.4-3.1 (mw): cb *col legno*;

3.2-6 (mh): clusters played *arco* by changing sets of stringed instruments (tutti archi: 3; vni 11-20, vle: 3; vni 1-10: 3-4; vc, vb: 4-6);

5-12 (mh, mw): sustained sounds and tremoli *arco* and *col legno*;

10-12 (mw, ml): *pizzicato* (vno 1: 10; vno 2: 11; vc 2: 12) and *legno battuto* impulses (cb 1: 10; vc 1, cb 1: 12);

13-21 (mh): strings *arco*;

14.2-23 (mf): play with soft felt sticks on gng, ptti, and tmt overlaps with the traditional string technique of the previous section;

22-25 (mf, lf): metal plates (gng, ptti, tmt) and skins (tomts, tmp) played with felt sticks;

23-37 (mf, lf, mw, wl, ww): sound generation processes involving soft felt sticks, which occurred gradually in the course of two previous sections, are complemented here by playing simultaneously on skins and edges, as well as on other sticks laid on the skins of tomts and timp. The newly introduced bgs are struck on their skins, edges, or on both simultaneously with hard drumsticks; this type of beater is subsequently used also for lgn (27) and bars of the xilor (28), the latter being treated here in compliance with their real physical material as wooden bodies. In 28, claves enter;

38-45 (lf): membranes of tomts and timp played with heads of soft felt kettledrum sticks;

45-49 (mm, ml, fm): tremoli with wire brushes on ptto 4 (mm) and tomt 2 (ml), and with felt sticks on ptto 6 (fm);

49.2-66 (ll, lm, mm, mf, lw): play with wire brushes, hard wooden sticks, and *con dita* on skins of membranophones (tomts, timp) and on metal plates (gng, tmt, ptti);

53-78 (ll): a large subordinate-layer segment features *con dita* playing on skins of bgs and cgs, and from 75 also on timp and tomts skins; this segment brings leather as the single main material, which is missing in the parallel segments of the main layer, and which constitutes a term of the active opposition "m vs. l";

66-72 (ml): tomts and timp played with wire brushes;

71-75 (mm, ml): play with wire brushes on tomts, tmp, tmt, and ptti;

74-88 (mm, mw, ml, mf): traditional instrumental techniques on cel, pfte, ar, and cmpli; playing with wire brushes, triangle rod, hard drumsticks, and soft kettledrum sticks, as well as *con dita* on metal idiophones (gng, ptti, tmt, trgl, vbf) and on xilor treated as a representative of metal;

87-96 (mm, mw, ml, mf, mh): except for *con dita* technique, all sound generation processes of the preceding section continue here and are joined by strings played *arco*, *pizzicato*, and *col legno*;

96-102 (mw, ml, mf): traditional ways of playing ar, pfte, cmpli, and cel, together with vbf and xilor struck with hard sticks, and stringed instruments played *pizzicato* (vni: 97-101; vl 1-2: 98-101), *legno battuto* (vc 1-2: 96-101; cb 1-2: 97-101) as well as with the palm of the hand *sul tasto* (vc 3-4: 95-101; cb 3-4: 96-100). The latter, compound instrumental technique is considered in this piece to be a simultaneous interaction of strings with skin (of the hand) and wood (of the fingerboard);

101-105 (mf, mw, ml, mm): vbf played with hard (102-103) then with soft stick (103-105); bars of xilor excited with head and handle of a hard stick (103, 104) and with head of a felt stick (105); ptti struck with felt kettledrum sticks (102-103) and wire brushes (104-105); gng played with wooden stick; plus traditional instrumental techniques on cmpne, cmpli, pfte, ar, and cel;

103-108.1 (mw, mf): out of the myriad sound generation processes of the preceding section there emerges the playing with soft sticks on vbf, ptti and, tmt, with hammer on cmpne, and with wooden sticks on ptto 5;

107.2-110.2 (mw): vbf, ptti, cmpne, and gng excited with handle ends of soft sticks;

110.2-115.1 (mh): stringed instruments *arco*;

113-115.1 (mm, mw, mf, ml): *arco* strings joined by play with wire brushes on cmpne, ptto 6, ar, and pfte, with felt stick on ptto 1 and strings of pfte, and triangle rod on trgl and gng. Rare effects in this section are the throwing of pieces of wood or pencils onto piano strings (113) and the touching of the edge of a previously struck ptto[3] with a triangle rod (115);

115.2 (ml): piano strings played *pizzicato*.

[3] The *con dita* marking assigned to ptto 2 (114) conflicts with an explanation added by the composer, which says that the cymbal is to be struck with a kettledrum stick. The error here is obviously in the score.

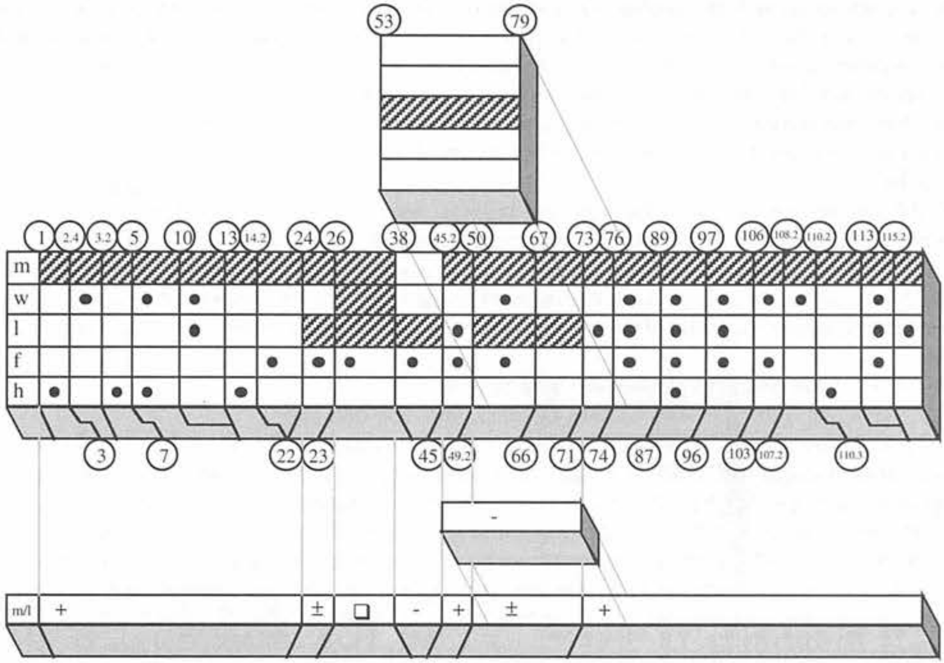


Figure 53. Timbre trajectory of *Anaklasis* and its active material opposition

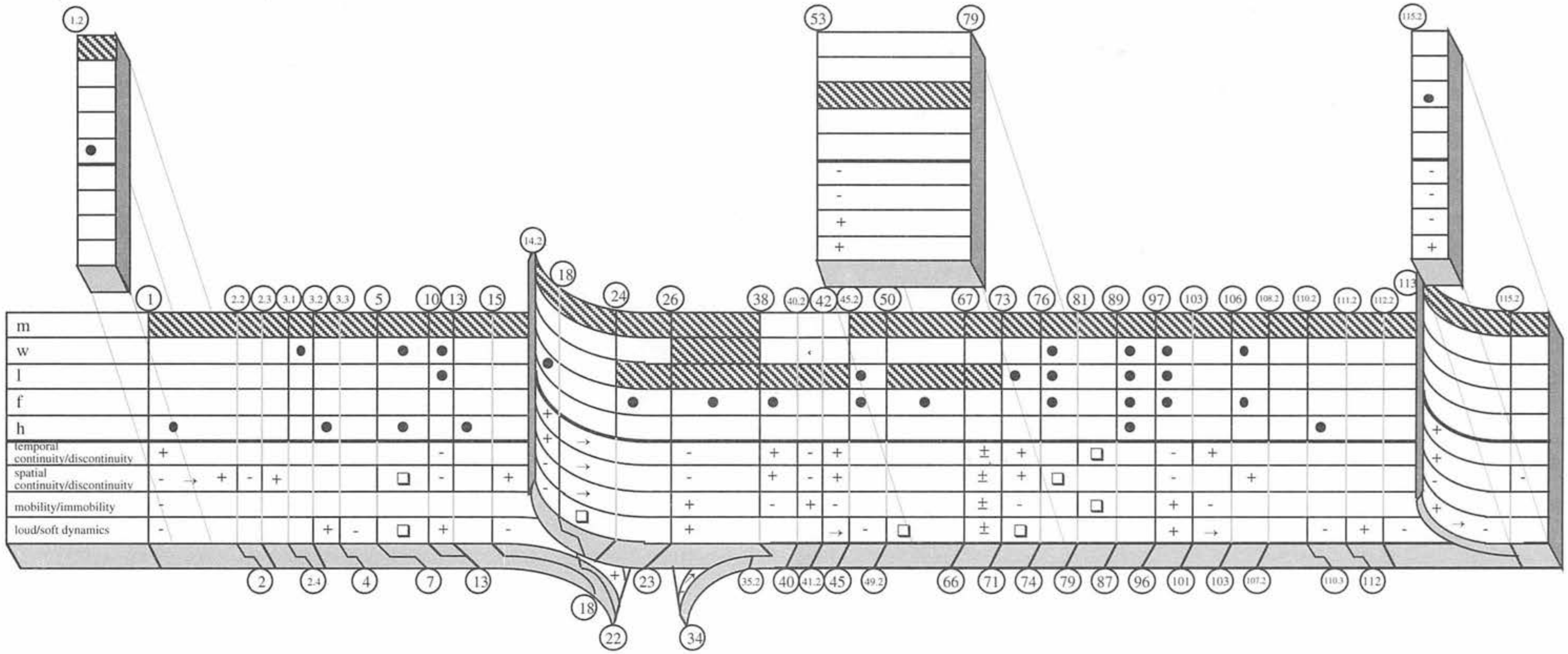


Figure 54. Summary chart of *Anaklasis*

8.2. ***DIMENSIONS OF TIME AND SILENCE (1960-61)***

Articulation

Dimensions is the only sonoristic piece investigated in this book in which the composer makes use of choir. The performing forces, announced on the title page, include a "forty-part chorus of mixed voices, percussion groups and strings". As in *Anaklasis*, each percussion group is assigned to one performer, yet this assignment is not mirrored here in the order of instruments as listed in the score. Instead, the list follows the types of vibrators proper to individual instruments. The few exceptions in this respect are the piano, harp, and celesta, which, as keyboard instruments, are scored separately, located between the remaining percussion and strings. In the cases of piano and harp, such a separation is otherwise justified by their twofold classification among Penderecki's sound sources, which was pointed out earlier.

CHORUS

10 sopranos (S)
10 altos (A)
10 tenors (T)
10 basses (B)

ORCHESTRA
triangle (trgl)
4 suspended cymbals (ptti s, a, t, b)
gong (gng)
tam tam (tmt)

2 claves
3 wood drums (lgn)
xilorimba (xilor)
vibraphone (vbf)

4 glass lamellae (vtr)
2 metal lamellae (mtl)
3 cowbells (cwb)
glockenspiel (cmpli)
tubular bells (cmpne)

2 bongos (bgs)
6 tom-toms (tomts)
drum and snare drum (tmb c.c. e s.c.)
4 timpani (tmp)

celesta (cel)
harp (ar)
piano (pfte)

6 violins (vn)
4 violas (vl)
4 cellos (vc)
2 contrabassi (vb)

Diagram 4 shows for this piece the full resources of sound generation processes, in which the above-listed instruments participate.

Basic system

The basic system categories constitutive for *Dimensions of Time and Silence* are as follows:

high register vs. low register
temporal mobility vs. temporal immobility
spatial mobility vs. spatial immobility
temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
maximal time-span vs. minimal time-span
loud dynamics vs. silent dynamics

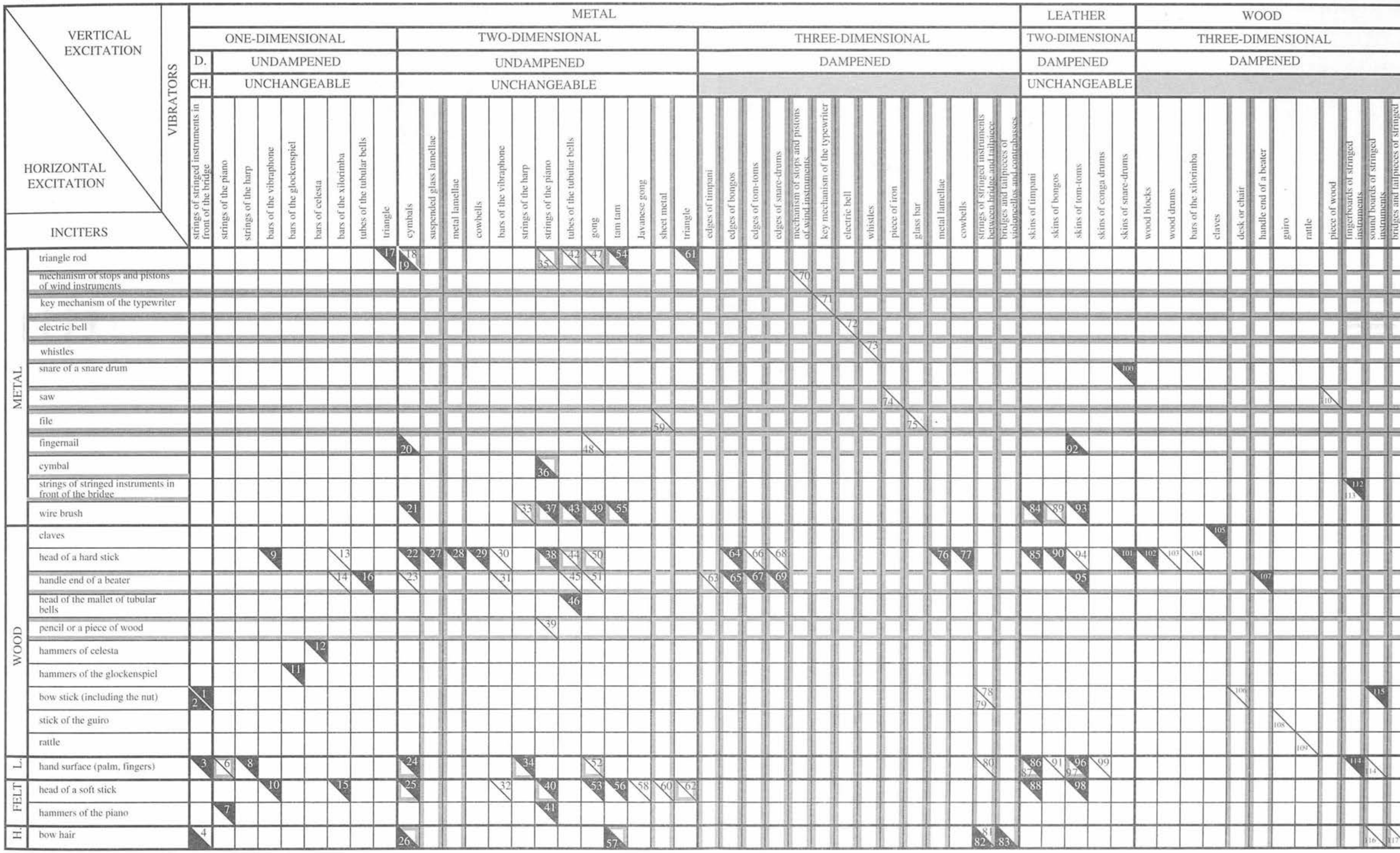
The first and last categories are independent, but several intercategorial redundancies occur between the remaining ones. As in *Anaklasis*, total redundancy ties "temporal mobility vs. immobility" with "spatial mobility vs. immobility" and results in their fusion into the general category of "mobility vs. immobility". On the other hand, the categories "spatial continuity vs. discontinuity" and "temporal continuity vs. discontinuity" are connected both to each other and to "mobility vs. immobility" on the strength of partial intercategorial redundancies:

mobility vs. immobility		
spatial mobility vs. immobility		temporal mobility vs. immobility
positive term (+)	⇔	positive term (+)
negative term (-)	⇔	negative term (-)
border-zone term (*)	⇔	border-zone term (*)
total mediative term (❐)	⇔	total mediative term (❐)
transition (→)	⇔	transition (→)

temporal continuity vs. discontinuity	positive term (+)	⇒	negative term (-)	mobility vs. immobility
	negative term (-)	⇐	positive term (+)	

spatial continuity vs. discontinuity	positive term (+)	⇒	negative term (-)	mobility vs. immobility
	negative term (-)	⇐	positive term (+)	

Diagram 4. Processes of sound generation in *Dimensions of Time and Silence*



spatial continuity vs. discontinuity	positive term (+)	⇒	negative term (-)	temporal continuity vs. discontinuity
	negative term (-)	⇐	positive term (+)	

Regarding "temporal continuity vs. discontinuity", the modified articulatory definition, which occurred already in *Anaklasis*, holds true here as well. Hence the phenomena listed in Part One as representatives of the border-zone term will be interpreted in the following analysis as temporally continuous. Finally, the category "maximal vs. minimal time-span", which belongs to the subsystem of *Dimensions of Time and Silence*, is activated in this piece only occasionally. As will be shown below, its trajectory consists of only a few passages coinciding each time with the negative term of "mobility vs. immobility", which is an effect of the hierarchical relation linking "maximal vs. minimal time-span" with "temporal mobility vs. immobility" as an elementary binary opposition comprised in the latter-mentioned, general category.

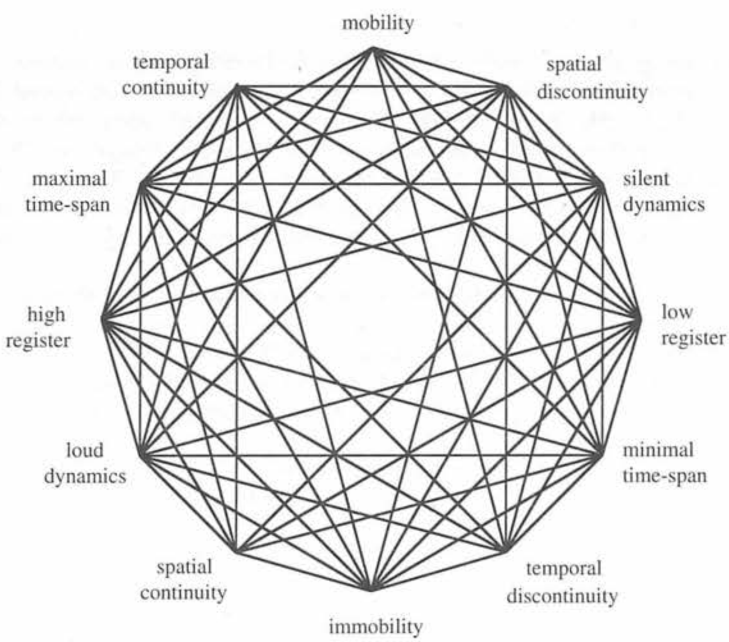
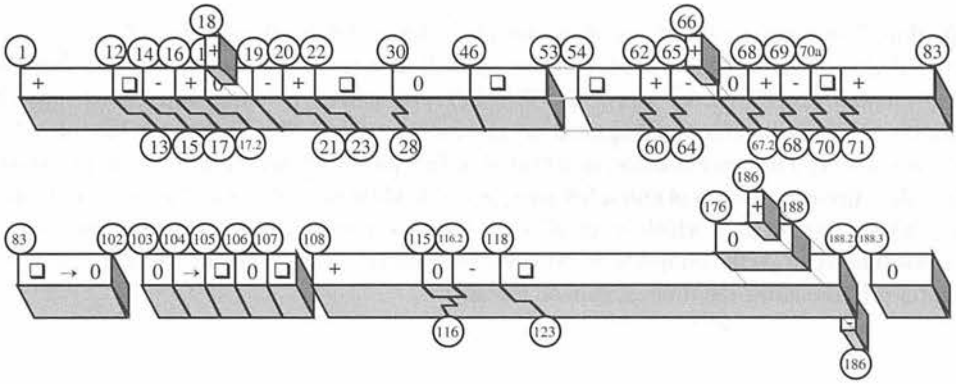


Figure 55. Rosette of the system in *Dimensions of Time and Silence*

In the formal design of *Dimensions* two passages are subsequently reiterated as retrogrades: the initial passage, embracing musical paragraphs 1-27, proceeds backwards in paragraphs 54-82; the passage of paragraphs 28-45 is reversed in 83-101. The result is a retrogradation of equivalent sections within individual trajectories.

HIGH REGISTER VS. LOW REGISTER



1-11 (+): the opening exhibits a bright, lustrous sound quality of trgl, mtl, vtr, cwb as well as cmpli (f^2♯, g^3) and cmpne played with wire brushes (e^2-f^2 and e^1-f^1). Subsequently, in paragraph 2 there occur sonorous clusters of pfte (c^1-b^1, b^3♭-a^3), cel (d^3♭-c^3, f^1-e^2) and cmpli (f^2♯-g^3) along with the striking of vbf (b^1♭-a^3♭, f^1-b^1), cmpne (f^1♯-c^2) and indefinite pitches of ptti (s, a), followed by single pitch f^3♭ of ar (3).[1] The resulting high register is continued by pitches ranging from b♭ up to g^4♭ in all the previously introduced tuned instruments (vbf, cmpli, cmpne, pfte, ar, cel), joined by xilor (5-10), and occasionally by trgl (8);

12-14 (❒): several pitches dispersed evenly throughout the musical space (G̲-a^3), played by stringed instruments;

14-16 (-): repetitions of C♯ (vc 3-4) and C̲ (vb), the latter subsequently turning into an effect produced by striking the unstopped strings with the palm of the hand *sul tasto* (16);

16-17.1 (+): playing between bridge and tailpiece in vn (1-4) and vl (1-2);

17-18 (0): single pitch a (vn 5-6, vl 3-4, vc 1-2) chosen from a middle register;

18 (+): pizzicati b^3♭ (vn 1-2), a♭ (vl 1-2) and g^3 (vn 3-4) occurring in a subordinate layer of the trajectory;

19-20 (-): bowing on bridges and tailpieces of vc and vb;

20-22 (+): clusters of harmonics, played with mutes and at the bridge in vn (g^4♭-a^4) and vl (b^3♭-b^3♮),
split into individual tones *glissando*;

22-29 (❒): a zone of sounds produced by metal plates of all sizes (ptti s, a, t, b; gng; tmt) as well as by pfte and ar in all their registers;

28-45 (0→): progressive differentiation of sounds of indefinite pitch, beginning with sustained tremoli on medium-sized tomt 3 and tmp 2, which represent the middle register, till the totality of musical space is filled by many strokes on 6 tomts, 4 tmp, tmb c. c. e s. c., 2 bgs, 3 lgn, 2 claves and 3 cwb;

46-52 (❒): the point of destination of the previous section constitutes a total mediative term represented by sounds of a maximally differentiated set of percussion instruments embracing membranophones and wooden idiophones, as well as cwb, ptti (s, a, t, b) and gng, accompanied by percussive effects on stringed instruments (vc, vb). These last include tapping on sound boards with the nut or fingertips and striking the strings with the palm of the hand *sul tasto*. The resulting broad field of instrumental

---

[1] The bass clef assigned to ar in paragraphs 3-8 instead of a treble clef is an error, as can be ascertained from a comparison with a retrograde of the discussed section in 71-82.

sounds is complemented by consonants /g, t, k, b, d, p/ enunciated by the choir (46-49), then gradually superseded by pitches within the range B♭-a^2 (48-51). In the conclusion of this section (50-52) the musical space is filled with sounds made by wire brushes on all sizes of metal plates (ptti s, a, t, b; gng; tmt) as well as on cmpne (g^1-a^1), and in different registers of pfte, which correspond to the choir's hummed, unvoiced vowels /s, sz/ of indefinite pitches (S 7-9: 51-52; T 1-3: 51-52; T 8-10: 51; B 1-3: 52);

54-61 (❐): retrogradation of section 22-29;

60-64 (+): retrogradation of section 20-22;

64-65 (-): retrogradation of section 19-20;

66 (+): retrogradation of section 18;

66-67 (0): retrogradation of section 17-18;

67.2-68 (+): retrogradation of section 16-17.1;

68-70 (-): retrogradation of section 14-16;

70-70b (→): retrogradation of section 12-14;

71-82 (+): retrogradation of section 1-11;

83-101 (❐→): retrogradation of section 28-45;

103 (0): a single mid-range pitch, d^1 (A 1-5: 103);

104 (→): gradual expansion of d^1 to clusters c^1-f^1 and g-b^1♭ by introduction of tenors 1-5, then the altos with tenors 6-10;

105 (❐): wide-range cluster A-a^2♭ in the whole choir, after introduction of the sopranos and the basses along with ptti (t, b), gng and tmt;

106 (0): ranges of f-a (B 1-5 *fischio*), b-e^1♭ (A 1-5 *bocca chiusa*), and g^1♭-b^1♭ (T 1-5 *falsetto*);

107 (❐): cluster A♭-b^2;

108-114 (+): high pitches of vbf (a^2♭, d^2), cmpli (a^3, e^3), pfte (g^4, b^3♭), xilor (e^4♭, f^3), ar (c^3♯, b^1) and cel (c^4, f^3♯), highest possible whistles (*fischio*) of the choir as well as tones of vn occurring together with trgl. The glissando descending from highest to lowest register of the altos and the tenors (112) forms an expressive feature and does not threaten the positive term of the category "high vs. low register" represented in this section, since the lowest possible whistled sound still belongs to the high register of the available sound space. The return to the positive term after several mediative ones disturbs here the logic of the trajectory. Note, however, that this disturbance stems from the order of retrogradation assumed by the composer for two broad passages in the central part of the piece;

115-116.1 (0): cluster f-a^1♯ (vn, vl) joined by e♭ played *pizzicato* by vc (115);

115-122 (-): single pitch D (vb: 115), then cluster C-E, which contracts to the range of C♯-D♯ (vc, vb: 116-122);

118-188.1 (❐): totality of the musical space covered by various sounds of indefinite pitch, produced by membranophones and metal plates of all sizes (tmt; ptti s, a, t, b; gng; 2 bgs; 6 tomts; 4 timp; tmb c.c.), and by choral voices pronouncing consonants /cz, s, sz, z, t, p/. In 164-165 the whole sound space is filled evenly by the sustained consonant /s/ (S 1-5, A 1-5, T 1-5, B 1-5), by long diminuendi in ptti (a, t, b) and tmt, then by sound effects played on 6 tomts (165-173), the tenor cymbal (168), gng (170), 2 mtl, 3 cwb, 2 claves and 3 lgn; these effects include also taps with nuts or fingertips on the sound boards of stringed instruments, striking strings *sul tasto* with the palm of the hand, and diverse consonants in the choral parts /k, g, t, d, b, s, d, ds, cz, h, r/. At the end (188) there occurs a huge cluster in the choir, G-b^2♭;

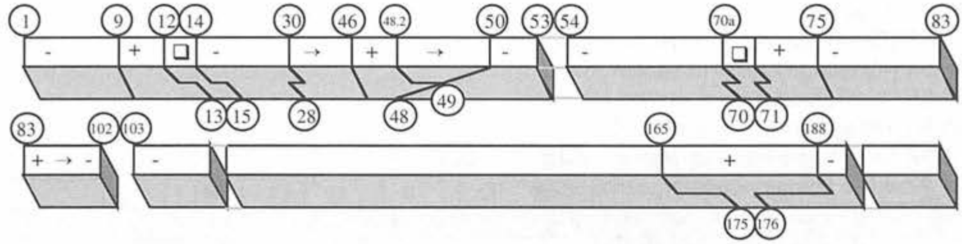
176-187 (0): in the background, a cluster c^1-e^1 is built up by the successive introduction of individual choral voices (A 9, T 9, B and S 9, A and T 10), supported by vbf, gng and ptti;

186-187 (+): pitch g^2♯ (S 10) forms another subordinate layer of the trajectory;

186-187 (-): pitch G in bass 10 assisted by tmt as the third section superimposed in a subordinate layer;

188.3-190 (0): the closure of the piece takes place exclusively in the main layer of the trajectory, containing clusters e-b (B *fischio*), g^1-c^2 (T *falsetto*) and d^1-a^1♭ (A *bocca chiusa*).

MOBILITY VS. IMMOBILITY



1-8 (-): static sound phenomena at the beginning of the trajectory are single, separated impulses in the trgl, vtr, mtl, cwb, along with tremoli (cmpne) and fastest possible repetitions (trgl, vtr, mtl, cwb). The repetitive series of gradually faster or slower impulses, which proceed in 1 (trgl, vtr, mtl, cmpli) and turn back in 3 (ar), occur here as side-effects of transitions within the trajectory "minimal vs. maximal time-span". In musical paragraph 2 there occur long-lasting sounds played by all the aforementioned percussion instruments, joined also by ptti, pfte and cel. In 4-8, except for a sustained sound in the vbf (4-5) and two arpa strokes (6), only maximally dense repetitions are to be found. Three interrelated pitches in the xilor (8), standing out in relief against this static background, form expressive sound events in the discussed section;

9-11 (+): point-like pitches, entering into both spatial and temporal relations, first occur successively (9), then simultaneously, in the xilor, vbf, cmpli, cel, ar and pfte;

12-14 (❐): mutually interrelated impulses (vc, vn, vl 3-4: 12; vb, vl 3-4: 13) mixed with sustained tremoli and long-lasting sounds (vl 1-2: 12-14; vb 2: 12-13; vn, vl 1-2: 13-14);

14-29 (-): this vast static section begins with repetitions of gradually shortened time-spans played *legno battuto* by vb and vc (14-15). On the basis of the discussed category, as a fusion of "temporal mobility vs. immobility" with "spatial mobility vs. immobility", they are irrelevant, functioning merely as optional expressive features. The same is true of the analogous—accelerated or decelerated—repetitive series, occurring later in16 (vb), 23 and 27 (ptti), as well as of glissandi performed by individual vn and vl in 21-22. It is noteworthy that all of these effects are redundant towards processes of diminuendo. Instead, the sound phenomena that properly establish immobility here are the tremoli played *col legno* by vc and vb (15-16), then tremoli between bridge and tailpiece in vn 1-4 and vl 1-2 (16-17); these last are superseded by the sustained pitch a (vn 5-6, vl 3-4, vc 1-2: 17-18), which forms the background for isolated pizzicati *con due dita* (18). Beginning in paragraph 19, there occur bowings on bridges and tailpieces of vc and vb (19-20) and long-lasting clusters played *tremolo* (vn, vl: 20-21). Subsequently, the static sound phenomena are taken over from the strings by percussion instruments performing tremoli (ar: 22; pfte: 23, 27; ptto A: 23; ptto S: 24; gng: 25-26; tmt: 25-27), sustained sounds played with soft kettledrum sticks (ptto t: 23; ptti s, b: 28; gng: 24, 27; tmt : 29; pfte: 24), as well as short impulses on pfte (22, 26) and the bass cymbal (ptto b: 23) struck with hard sticks. Impulses *sf* played on different ptti in paragraph 25 stray from the hitherto listed sound phenomena, and thus form expressive sound events within this section. This is so because they enter into temporal-spatial relations and in this way are to be treated as mobile, which is also emphasized by their notation under the same cross-beam. The exceptional position these series of impulses take in all of Penderecki's sonoristic output springs from the fact that they form a unique example of single beats performed with wire brushes, which otherwise are always designed for the purpose of tremoli. Moreover, they constitute the single case of spatial mobility produced by a collection of metal two-dimensional vibrators;

28-45 (→): the transition from mobility to immobility, as a progressive process of setting up temporal and spatial relations between sounds, is accomplished here by the shortening of sound phenomena, from sustained tremoli on tomts, timp, bgs and tmb down to momentary impulses, which occur gradually first in the membranophones (37: tomt 1; 38: tomt 5), then in newly-introduced idiophones (cwb: 38; lgn, claves: 39);

46-48.1 (+): a multitude of individually discernible and highly differentiated impulses in the percussion (cwb, claves, lgn, bgs, tmb, tomts, ptti, gng), in stringed instruments being tapped on sound boards with the nut or fingertips, and struck *sul tasto* with the palm of the hand (vb, vc), and in choral voices pronouncing several short consonants /d, k, p, g, b, t/;

48.2-49 (→): the gradual dissolution of the groups of consonants in the choir, initiated already in the course of paragraph 48, leads to single separate impulses in the individual vocal parts (S 10, A 10, T 10, B 10);

48-52 (-): long-lasting vowels and consonants in the choir bring about the immobility in parallel to the above-discussed transition, whose goal it constitutes, and cause the section to overlap with the two preceding ones. In 50 they are joined by sustained clusters tremolo in the orchestra (ptti, gng, tmt, pfte, cmpne);

54-70 (-): retrogradation of section 14-29;

70-70b (❐): retrogradation of section 12-14;

71-74 (+): retrogradation of section 9-11;

75-82 (-): retrogradation of section 1-8;

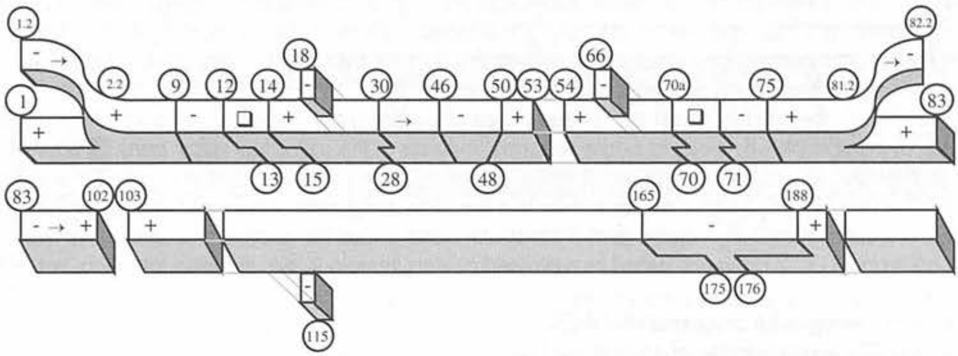
83-101 (+→-): retrogradation of section 28-45;

103-174 (-): static pitch d^1 and long-lasting clusters in the choir (103-107), single sustained sound of ptti, gng and tmt (105), then repetitions of the same pitches in vbf, cmpli, xilor, pfte, ar and cel (108-114) joined by bands of highest possible notes in vn parts (111-112) and choral voices (S, B: 110-112; A, T: 110-111). The irregular glissando in 112 (A, T) is an expressive feature irrelevant to the "mobility vs. immobility", but instead heightening the abrupt diminuendo from *f* to *p*. Beginning in 115, the static character of this section is prolonged by a single impulse *pizzicato* (vc, vb: 115) and by long-held clusters of stringed instruments (vn, vl: 115-116; vc, vb: 116-122), then in percussion by long-lasting sound phenomena (tmt 118-120; ptto t: 120-121; tomts: 122-126; ptti, gng: 126-127) mixed with numerous tremoli of membranophones and metal idiophones (121-157: bgs, tmp, tomts, tmb c.c., ptti, gng, tmt). Long-lasting consonants (137-158) and maximally dense series of repeated short consonants (151-163) represent immobile sound phenomena in the choral part. Interestingly, in 149-157 the sustained consonants are set into a glissando obtained by dynamic changes in pronunciation of the consonant /sz/. This glissando forms again an expressive feature on the basis of the discussed category. From 164 on, there occurs a long-lasting consonant /s/ accompanied by sounds of ptti and tmt (164-165) as well as pursuant tremoli of tomts, single strikes on the tenor cymbal (ptto t: 168) and gng (170), and series of quickest possible repetitions in strings (vb: 167-173; vc: 169-174; vn, vl: 170-172);

165-187 (+): the latter-mentioned sounds of the previous section are gradually crowded out by interrelated, diverse consonants performed by the choir /t, k, g, d, b, ds, z, r, s, h, cz/, by impulses in the percussion (mtl, claves, lgn, cwb: 169-187), and by the percussive effects in the strings: tapping the sound board with the nut or fingertips and striking the strings with the palm of the hand (vn, vl, vb: 174-187; vc: 176-187);

176-190 (-): the final section of the trajectory overlaps with the foregoing by means of long-lasting tones in the choir (S 9-10, A 9-10, T 9-10, B 9-10), vbf, ptti, gng and tmt (176-187). The conclusion of the piece is filled in by static vocal tone-clusters in the choir.

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY



1-8 (+): the main layer of this trajectory starts with a tremolo on cmpne (1-2.1) replaced by long-lasting sounds of undampened percussion instruments (2: trgl, ptti, vbf, vtr, mtl, cwb, cmpli, cmpne, cel, pfte *con pedale*). The temporal continuity of those latter effects is indicated by white-headed notes in all instrumental parts except cmpli, cel and pfte. The black notation of these last refers however not to momentary temporal character of sound phenomena, but to spatial density of clusters filled in with the intervals of semitone and whole tone. Nor do the black-headed notes which occur subsequently in the ar (3) signify temporal discontinuity of the sounds that they represent. Instead, they merely indicate the onset of sounds comprising a transition from the positive to the negative term within the trajectory "maximal vs. minimal time-span". Because the "maximal time-span" constituting the point of departure of the transition concerns long-lasting sounds of paragraph 2, the initial sounds of the repetitive series are to be acknowledged as long-lasting and hence temporally continuous, as well. Also the "minimal time-span" of destination predetermines temporal continuity on the strength of the articulatory definition of the latter, as valid in the discussed piece. Its representatives in paragraphs 4-8, after a sustained tone in the vbf (4-5), are maximally dense repetitions and tremoli, serving as background for expressive sound events in the xilor (5) and ar (6);

1.2-2.1 (→+): the subordinate layer of trgl, vtr, mtl, cwb and cmpli begins with single impulses written as black-headed notes (trgl, vtr, mtl, cwb), subsequently condensed in series of gradually shortened time-spans (vtr, mtl, cmpli) up to maximally fast repetitions (cmpli) and tremoli (trgl, vtr, mtl, cwb) that fuse into the main layer of cmpne. A unique reversed rhythmic series in the trgl part makes the transition less than straightforward, yet does not obliterate its main course;

9-11 (-): momentary sounds written in black-headed notation (xilor, vbf, cmpli, cel, ar, pfte);

12-14 (□): semiquaver impulses (12: vc, vl 3-4, vn 1-4; 13: vl 3-4, vb 1) mixed with long-lasting sounds (vb 2) and tremoli (vl 1-2: 12-14; vc 1-2, vn: 13-14);

14-29 (+): tremoli of vb and vc 3-4 (15-16) inaugurate an expansive section of a temporally continuous character. As stated before, repetitions of beats preceding and following the tremoli as well as analogous repetitive series occurring later in ptti (23, 27) are optional expressive features, which are not to be taken into account in this examination. In paragraph 16 there occur several superimposed tremoli *arco* between bridge and tailpiece in vn 1-4 and vl 1-2. There follows a sustained pitch a performed *vibrato*, *molto vibrato*, or *senza vibrato* (17-18: vn 5-6, vl 3-4, vc 1-2), then play on the bridges and tailpieces of vc and cb (19-20). Long-lasting tremoli in vn and vl (20-22) are subsequently taken over by ar played with palms of the hands (22), pfte with wire brushes (23, 27), and metal idiophones (ptto a: 23, ptto s: 24; gng: 25-26; tmt: 25-27). Temporal continuity is achieved also by long-lasting sounds made by beating with soft felt kettledrum sticks on ptti (23, 28-29), pfte (24: *con pedale*), gng

(24, 27) and tmt (29), and by maximally dense repetitions obtained by touching a previously struck cymbal with a triangle rod (ptto t: 24). In contrast, short, sharp impulses played with hard sticks on the bass cymbal (23) and on piano strings (22, 26), as well as *sf* strokes with wire brushes on ptti (25) constitute expressive sound events;

18 (-): a short section superimposed on the just-discussed larger section includes three *pizzicato* impulses *con due dita* (vn 1-2, 3-4, vl 1-2);

28-45 (→): in the further course of the main layer, long-lasting tremoli of membranophones (tomts, tmp, bgs, tmb s.c. e c.c.) are gradually shortened and then progressively superseded by impulses occurring at first in the tomts (tomt 1: 37; tomt 5: 38) and the wooden idiophones (cwb: 38; claves, lgn: 39) to saturate the texture at the end of this section;

46-49 (-): beats on percussion instruments, taps on the sound boards of vc and vb, strikes on their strings *sul tasto* (46-48), and short consonants /g, t, k, b, d, p/ pronounced by the choir (46-49);

48-52 (+): long-lasting vowels and consonants in the choral parts beginning in 48 cause an interpenetration with the preceding section. In paragraphs 50-52 these consonants are joined by tremoli with wire brushes on ptti, gng, tmt, cmpne and pfte;

54-70 (+): retrogradation of section 14-29;

66 (-): retrogradation of section 18;

70-70b (❐): retrogradation of section 12-14;

71-74 (-): retrogradation of section 9-11;

75-82 (+): retrogradation of section 1-8;

81.2-82.1 (+→-): retrogradation of section 1.2-2.1;

83-101 (→+): retrogradation of section 28-45;

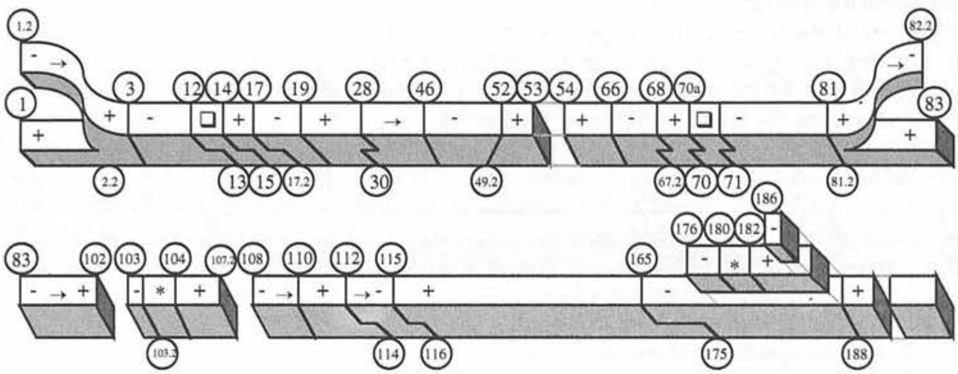
103-174 (+): temporal continuity is set up here by long-lasting tones and tone-clusters in the choir (103-107.1), accompanied by delicate sounds, indicated with white note heads, in ptti, gng and tmt, all of them struck with soft kettledrum sticks (105). In 109-111, in undampened cmpli, cel, ar, pfte, xilor and vbf, there occur maximally dense repetitions and tremoli preceded by series of gradually accelerated (108) and followed by gradually decelerated sound phenomena (112-114) which form transitions within the trajectory of "maximal vs. minimal time-span"; though written in black notes, these do not affect the positive term of this section, as being framed by temporally continuous sounds. Parallel to those processes, long-lasting sounds appear in vn (111-112) and choir (110-113). Beginning from 115, there follow long clusters of strings (vn, vl: 115-116.1; vc, vb: 116-122), then several sustained sounds in percussion instruments, including *arco* play on edges of tmt (118-120) and ptti (120-121), drawing the edge of a finger-nail over the skin of tomts (123-126) and the striking surfaces of gng and ptti (126-127), and numerous tremoli both on membranophones (bgs, tomts, timp, tmb c.c.) and metal idiophones (ptti, gng, tmt). From 137 on, sustained phenomena occur again in the choir as long consonants /s, sz, cz, z/ and maximally dense repetitions of short consonants /z, cz, t, p/. After a sustained /s/, supported by ptti and gng (164), the temporal continuity is prolonged by tremoli of tomts (165-173) and maximally dense repetitions of strikes *sul tasto* in the vb (167-173), vc (169-174), vl and vn (170-172); in background sound two beats of the tenor cymbal (ptto t: 168) and gng (169), notated in whole notes;

115.1 (-): a miniature secondary layer includes pizzicato in vc and vb and the impulse *sff* at the onset of the cluster in the vn and vl parts;

165-187 (-): in the main layer of the trajectory, temporal discontinuity is initiated as early as in 165 by short consonants in the choir /k, g, t, d, b, h, r, ds, s, cz, h/ joined by strokes on mtl and cwb laid on a solid surface, on claves and lgn, as well as by taps on sound boards with nuts or fingertips and strikes *sul tasto* with the palm of the hand on stringed instruments (vn, vl, vb: 174-187; vc: 176-187);

176-190 (+): the final section starts before the former one ends. Temporally continuous, very long sounds of individual choral singers (S 9-10, A 9-10, T 9-10, B 9-10) supported by sustained tremoli of vbf, ptti, gng and tmt (176-187) occur already as background to short beats and consonants. At the close of the piece (188-190), temporal continuity comes into prominence, represented by long-lasting clusters in the choir.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



1-2 (+): long-lasting tremolo in a layer of cmpne treated as a metal plate that is rolled into a tubular shape and played with wire-brushes. The resulting spatially-continuous sound is enhanced by the choice of adjacent tubes, which produce minimal clusters, each consisting of two pitches, e^2-f^2 and e^1-f^1. In 2 there occur clusters of pfte, cel and cmpli, and long-lasting tones of metal plates (ptti, vtr, mtl, cwb). Into these are fused sounds of trgl and vbf, which substitute for two-dimensional sound sources;

1.2-2.1 (-→+): at the same time, there occur point-like impulses on trgl, cmpli, and two-dimensional metal idiophones (mtl, vtr, cwb). These impulses are gradually condensed into fastest possible repetitions and in this way become spatially continuous phenomena, which causes them to fuse with the tremolo of cmpne and, consequently, causes their layer of the trajectory to fuse with the main layer. The intent to produce the just-described process is reflected in the use of the two closest sizes of vtr (2, 3) and cwb (1, 2) as well as the choice of pitches f2♯ and g^3 in the cmpli (the only tuned instrument in this layer): f^2♯ joins the upper cluster e^2-f^2 of cmpne, and g^3 forms its further extension in a higher octave;

3-11 (-): the single pitch f^3♭ (ar) followed by several distant pitches spread across the musical space (4-11);

12-14 (❐): a medley of remote single pitches G (vb 2), c (vb 1), a♭ (vc: 12), a (vl 1-2), d^1 (vc 1-2: 14), b^1♭ and e^3♭ (vl 3-4), b^2 and f^3 (vn: 12) and a quarter-tone cluster e^3-f^3♯ (vn: 13-14);

14-17.1 (+): minimal semitone cluster dispersed between two octaves in vc and vb (14-16: C-C♯) and prolonged by a series of repeated strikes on strings of vb with the palm of the hand *sul tasto* (16), then several superimposed sounds of vn and vl played behind the bridge (16-17: vn 1-4, vl 1-2);

17-18 (-): the single pitch a (17-18: vn 5-6, vl 3-4, vc 1-2) serves as a background for pizzicati b^3♭ (vn 1-2), a♭ (vl 1-2) and g^3 (vn 3-4);

19-29 (+): the section of spatially continuous sounds starts with bowing on the bridges and tailpieces of vc and vb (19-20) followed by quarter-tone clusters (vn, vl: 20-21) whose dissolution into independent glissandi on individual instruments constitutes an expressive feature that enhances the simultaneous dynamic decline from *f* down to *pp* and beyond. Beginning in 22 there occur clusters played tremolo with the palms of hands on ar (22) and with wire brushes on pfte (23, 27), tremoli on ptti, gng and tmt performed mainly with wire brushes (ptto a: 23; ptto s: 24, gng, tmt: 25-26), but also with a triangle rod (tmt: 26-27); in addition, there occur long-lasting sounds of metal plates excited by soft kettledrum sticks (ptto t: 23; pfte: 24; gng: 24, 27; ptti a, b: 28; tmt: 29). Touching the edge of a vibrating cymbal with a triangle rod (ptto t: 24) causes a spatially continuous sound effect close to a long-lasting tremolo on this two-dimensional sound source. Also, spatial continuity is achieved by series of accelerating (ptto b: 23) and decelerating repetitions (ptti: 27) which were previously acknowledged as temporally continuous. On the other hand, the single, immediately muffled strikes with hard sticks on pfte (22, 26) and the bass cymbal (ptto b: 23), along with impulses *sf* with wire brushes on ptti (25), are to be excluded from this section as expressive sound events characterized by spatial discontinuity;

28-45 (→): progressive reduction of sustained tremoli on two-dimensional striking surfaces of membranophones (tomts, bgs, tmp, tmb) and their gradual replacement by separate semiquaver beats played also on three-dimensional sound sources (cwb, claves, lgn) result in a transition from spatial continuity to discontinuity;

46-51 (-): point-like impulses on previously introduced percussion instruments complemented here (46-48) by ptti and gng, and supported by percussive effects in string section (tapping sound boards with the nut or fingertips, striking strings with the palm of the hand). These spatially discontinuous effects are mixed with short consonants /g, t, k, b, d, p/ in the choral parts (46-49), which subsequently give way to distant pitches of vowels and of long-lasting voiced consonants /r, ż, ź, s, sz/[2] prolonged till 51 in parts of altos 8-10 (b^1), basses 7-9 ($B^{\flat}$) and sopranos 4-6 (c^2);

49.2-52 (+): the noise component of voiced long consonants included in the preceding section already brought spatial continuity, which is maintained here by long-lasting unvoiced consonants /s, sz/ of indefinite pitches (51-52: S 7-9, T 1-3, 8-10, B 1-3). These are accompanied by similar-sounding effects obtained by wire brushes playing on metal plates (ptti, gng, tmt, pfte and cmpne). The virtual two-dimensional character, ascribed here to the latter two instruments, arises from the indefinite clusters on pfte (51-52) and the major second g1-a^1 occurring as a minimal cluster in the cmpne (52);

54-65 (+): retrogradation of section 19-29;
66-67 (-): retrogradation of section 17-18;
67.2-70 (+): retrogradation of section 14-17.1;
70-70b (❐): retrogradation of section 12-14;
71-80 (-): retrogradation of section 3-11;
81-82 (+): retrogradation of section 1-2;
81.2-82.1 (+→-): retrogradation of section 1-2.1;
83-101 (→+): retrogradation of section 28-45;
103.1 (-): single pitch d^1 *senza vibrato* (A 3);
103.2 (*): slow vibrati causing minimal spatial expansion of pitch d^1 (A 1-2, 4-5);

104-107.1 (+): semitone clusters in the choir, in 105 supported by long-lasting sounds of metal plates (ptti, gng, tmt);

108-109 (→): after a rest, the musical narration starts anew with a single pitch $a^{3\flat}$ (vbf), joined by pitches in the cmpli, pfte, xilor, ar and cel. Their successive introduction builds up an irregular, spatially dense structure of a cluster-like character: b^1-d^2-f^2-$a^{3\flat}$-$e^{3\flat}$-e^3-$f^{3\sharp}$-a^3-$b^{3\flat}$-c^4-g^4;

110-113 (+): prolongation of the irregular cluster from the former section, to which are added bands of highest possible tones in the vn and choral parts. The glissando of altos and basses (112) leads to the band of lowest tones possible for whistling, where they are retained in 113 after the remaining voices drop out;

112-114 (→-): a transitional process, opposite to that of section 108-109, consists here in breaking up the cluster-like structure by a consecutive cancellation of sounds in ar, pfte, cmpli, vbf, xilor and cel, until reaching single, asynchronic pitches, which are joined by a *pizzicato* impulse in vc and vb (115: D, $e^{\flat}$);

115-174 (+): spatial continuity is immediately restored by whole-tone (vn, vl: 115-116), semitone (vc, vb: 116.1) and quarter-tone (vc, vb: 116.2-122) clusters in the stringed instruments, then by sustained sounds and tremoli on two-dimensional vibrators, including both metal plates (tmt, ptti, gng) and skins of membranophones (timp, tomts, bgs, tmb c.c.). In 137 the choral part is reintroduced with long-lasting unvoiced consonants /s, sz, cz, z/ (137-148) followed by the juxtaposition of long hummed consonant /sz/ (S 1-5, A 1-5, T 1-5, B 1-5) with a maximally dense series of repeated short

---

[2] /S/ and /sz/ are unvoiced consonants in the Polish language. Voiced /s/ and /sz/, ordered by Penderecki in parts of basses 7-9, sopranos 4-6 and altos 8-10 (50), are equivalent to /z/ and /ż/.

consonants /cz, ż, t, p/ (S 6-10, A 6-10, T 6-10, B 6-10). Also spatially continuous are the sounds of ptti and tmt struck with felt sticks and accompanying the long consonant /s/ (164-165), followed by tremoli in the tomts (165-173) and maximally dense series of strikes with the palm of the hand on strings *sul tasto* (vb: 167-173, vc: 169-174; vn, vl: 170-172);

165-187 (-): the end of the preceding section overlaps with spatially discontinuous short consonants /k, t, d, b, g, ds, h, r, s, cz/ performed asynchronically by choral voices (165-187), and with single impulses on percussion (mtl: 169-187; claves: 170-187; lgn: 171-187; cwb: 172-187). Beginning in 174 there occur also percussive effects—taps on the sound boards with nuts or fingertips and strikes on strings *sul tasto* with the palm of the hand—on the stringed instruments (vn, vl, vb: 174-187; vc: 176-187);

176-179 (-): the pitch d^1 in alto 9 and vbf, then also in tenor 9 assisted by gng, initiates a subordinate layer of the trajectory;

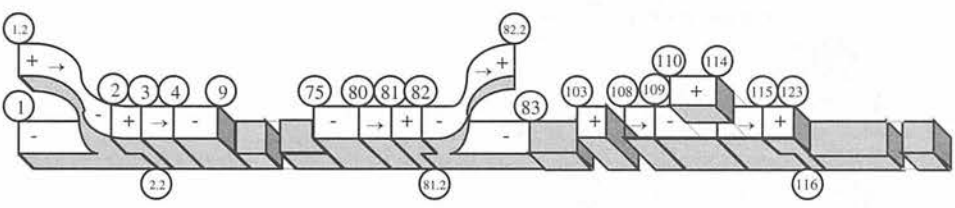
180-181 (*): within the subordinate layer, a narrow seam arises by the addition of $c^1\sharp$ (B 9, vbf) and $e^1\flat$ (S 9, vbf) as pitches that neighbor the d^1 prolonged from the previous section. These pitches appear simultaneously with a long-lasting tremolo on the tenor cymbal;

182-187 (+): the introduction of c^1 and e^1 in solo voices (A 10, T 10), along with tremolo on the soprano cymbal, builds up a semitone cluster c^1-e^1;

186-187 (-): single pitches G (B 10) and $g^2\sharp$ (S 10), which enter together with tmt, form another secondary layer;

188-190 (+): the conclusion of the piece belongs to the main layer of the trajectory. It contains semitone clusters in the whole choir (188.1), then in basses (188.3-189.1), tenors (189-190.1), and finally in altos (190).

MAXIMAL TIME-SPAN VS. MINIMAL TIME-SPAN



1-2.1 (-): cmpne tremolo initiates the main layer of the trajectory;

1.2-2.1 (+→-): in the subordinate layer, single impulses played by trgl, vtr, mtl and cwb are followed by a repetitive series of gradually decreasing time-spans (cmpli, vtr, mtl) leading to tremoli (trgl, vtr, mtl, cwb) and to quickest possible repetitions (cmpli). The increase of time-span in a series of impulses played by trgl does not obliterate the direction of the overall process, which in this section passes from positive to negative term of the opposition. After attaining the minimal time-span, the discussed layer fuses with the layer described above, represented by cmpne;

2 (+): separate beats on the previously introduced percussion instruments, complemented by ptti (s, a), cel and pfte. The first of these beats (in vbf, vtr, mtl, pfte) occurs against the background of quickest possible repetitions prolonged in the trgl, cmpli and cmpne parts;

3 (→): progressive reduction of time-span values between consecutive repetitions of pitch $f^2\flat$ (ar);

4-8 (-): maximally dense repetitions (cmpli: 4-8; cel: 5-8; ar: 7-8; pfte: 4-8) and tremoli (xilor: 6-8; vbf: 6-8; cmpne: 4-5, 7-8; trgl: 8). Individual impulses of ar (6), sustained sound of vbf (4), and a group of three individually discernible sounds in xilor (5) are expressive sound events within this section;

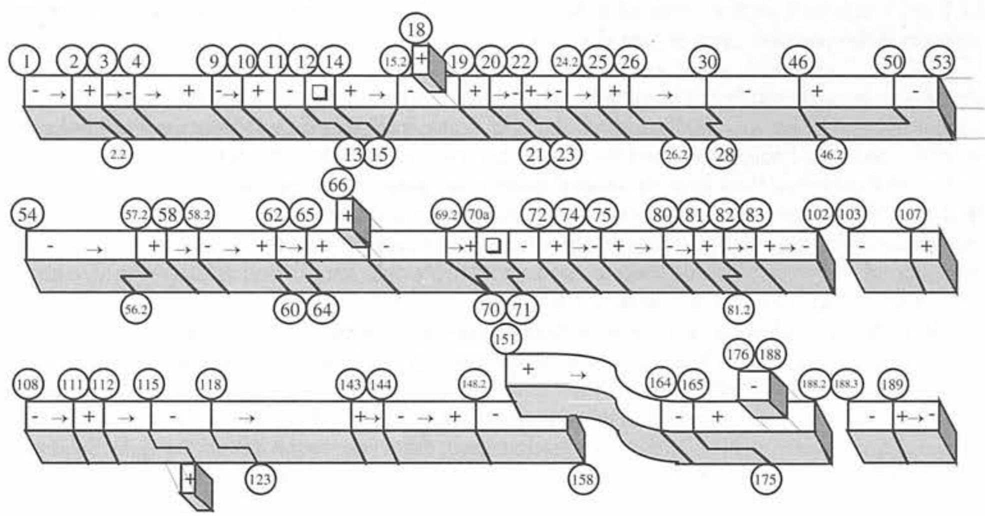
***

75-79 (-): retrogradation of section 4-8;
80 (→): retrogradation of section 3;
81 (+): retrogradation of section 2;
81.2-82.1 (-→+): retrogradation of section 1-2.1 in trgl, vtr, mtl, cwb and cmpli;
81.2-82 (-): retrogradation of section 1-2.1 (cmpne);

***

103-107.1 (+): long-held tones and clusters in the choir along with sustained sounds of ptti, gng, and tmt (105);
108 (→): gradual temporal condensation of repetitions in vbf, cmpli, pfte, xilor, ar, and cel part reaches its goal in the next section;
109-111 (-): tremoli (xilor, vbf: 109-111; trgl: 111) and maximally dense repetitions (pfte, cmpli, cel, ar) as sound phenomena of minimal time-span;
110-113 (+): in the contrasting subordinate layer of choir and vn there occur very long-lasting sounds. Vibrati do not substitute here for fastest possible repetitions, but form redundant features to dynamic processes, which is testified to by a transition to *non vibrato* sounds at the end of 112 along with a decrescendo (*p* down to *ppp*);
112-114 (→): the process of slowing down repetitions through increase of time-span between individual impulses forms a re-transition in the main layer of the trajectory (pfte, ar, cel, xilor, vbf, and cmpli);
115-122 (+): single *pizzicato* impulse in vc and vb (115), then sustained clusters (vn, vl: 115-116; vc, vb: 116-122).

LOUD DYNAMICS VS. SOFT DYNAMICS



1-2.1 (→): the initial transition is accomplished chiefly by textural means, through introduction of vtr, trgl, mtl and cmpli consecutively joining cmpne, as well as by progressive temporal condensation of their sounds, which relates to the trajectory "maximal vs. minimal time-span". The resulting growth of loudness finds its partial reflection also in dynamic markings: in an increase from *ppp* (cmpne) through *p* and *pp* up to *mf*, *f* and sforzati occurring towards the end of this section, as well as in crescendi of cmpli, vtr and mtl. On the other hand, *forte* and *sforzando* marks appear occasionally in individual instrument parts before reiteration of *p* or *pp* (trgl, cwb), and one diminuendo takes place in the trgl part. Thus, the dynamic gradation is not entirely straightforward and has a somewhat wavering character. Nevertheless, the progressive intensification of the global loudness in this section is not masked by these incidental dynamic changes;

2 (+): strong beats played *ff* (vbf, vtr, mtl, cmpli, cmpne, cel, pfte), *f* (trgl, ptto a) and *mf* (ptto s);

3 (→): diminuendo from *f* to *pp*;

4-8 (→+): textural and dynamic crescendo from a single sound *ppp* in vbf up to quickest possible repetitions of beats *f* in xilor, vbf, cmpli, cmpne, cel, ar and pfte;

9 (→): a new transition from *pp* to *f*, this time by means of a crescendo linking separate, consecutive sounds divided among the xilor, vbf, cmpli, cel, ar, and pfte;

10 (+): *ff*;

11 (-): various shades of quiet dynamics *p-pp-ppp*;

12-14 (p): a medley of different dynamic levels (*ff*, *sfz*, *f*, *mf*, *p*, *pp*) spread among individual instruments and instrumental groups of strings;

14-15.1 (+→): decrescendo from *f* to *p* (vc 3-4, vb);

15-18 (-): *p* (vc, vb: 15-16), *ppp* (vn 1-4, vl 1-2: 16-17) and *pp* (vn 5-6, vl 3-4, vc 1-2: 17-18);

18 (+): impulses *pizzicato con due dita ff* form a short superimposed section (vn 1-4, vl 1-2);

19-20 (+): bowing bridges and tailpieces of vc and vb in *f* dynamic level;

20-22 (→-): diminuendo from *f* to *pp* (vn, vl). The progressive cessation of sounds is enhanced by asynchronic glissandi upwards and downwards in individual instruments, thus here constituting redundant features;

22-24.1 (+→-): reiteration of a dynamic decrease, now in the percussion instruments. This is apparent from the succession of dynamic marks (*f*, *mf*, *p*, *ppp*) and several diminuendi in the ar (22), bass cymbal (ptto b: 23) and pfte (23, 24);

24.2 (→): opposite transition, from soft to loud dynamics, accomplished by a short, but very intensive crescendo of the soprano cymbal (ptto s);

25-26.1 (+): *f* (gng, tmt) and *sf* (ptti);

26-29 (→-): diminuendo from *f* to *pp* reflected in several partial diminuendi of individual instruments (gng, tmt: 26; pfte, ptti: 27), by the succession of dynamic marks, and by the decreasing number of instruments, reduced finally to ptti and tmt. The single impulse *sf* in pfte (26) constitutes an expressive sound event that does not threaten the overall direction of the dynamic process of this section;

28-45 (→): the dynamic wavering, observed previously, also continues in this section. It occurs as a crescendo accomplished by dynamic markings (gradual increase from *ppp* to *ff*) as well as by progressive introduction of instruments into the texture, starting from a single tomt 3 and ending with 3 cwb, 2 claves, 3 lgn, 2 bgs, 6 tomts, 2 tmb and 4 timp;

46-49 (+): the goal of the above dynamic growth is a loud dynamic reached together with an initial impulse *sff* of paragraph 46 in the large instrumental ensemble, then prolonged *ff sempre* by consonants articulated by the choir (46-49);

46.2-52 (-): *subito* dynamic reduction to *p sempre* in percussion and *mf sempre* in vc and vb; the end of the section extends this effect by a decrescendo to *ppp*. From paragraph 48 on, the quiet dynamics between *pp* and *mf* are taken over by the choir: at first they are assigned to sustained vowels, which gradually replace the sharply articulated consonants; they then go to sustained consonants joined in 50 by delicate noises caused by wire brushes playing on ptti, gng, tmt, cmpne, and pfte in dynamics ranging from *mp* to *pppp*. Initial impulses *mf* and *f* that appear at the onsets of vowels in 48 (A 4-6, 7-9; T 4-6; B 4-6, 7-9) enhance the intonation of the vowels by making them more audible, yet without disturbing the negative term of the category established in this section. The interpenetration with the preceding section, which represents an opposite dynamic level, results in the equivalent of a transition from loud to soft dynamics; this effect is heightened in the orchestral part by the decrescendo (48) pointed out above. From this point of view, this decrescendo is thus explainable as an example of cooperation between overlapping sections;

54-57.1 (→): retrogradation of section 26-29;

56.2-57 (+): a retrogradation of the section 25-26.1;

58.1 (-): retrogradation of section 24.2;

58.2-61 (→+): retrogradation of section 22-24.1;

60-64 (→): retrogradation of section 20-22;

64-65 (+): retrogradation of section 19-20;

66 (+): retrogradation of section 18;

66-69 (-): retrogradation of section 15-18;

69.2-70 (→+): retrogradation of section 14-16;[3]

70-70b (□): retrogradation of section 12-14;

71(-): retrogradation of section 11;

72 (+): retrogradation of section 10;

74 (→-): retrogradation of section 9;

75-79 (+→-): retrogradation of section 4-8;

80 (→+): retrogradation of section 3;

81 (+): retrogradation of section 2;

81.2-82 (+→-): retrogradation of section 1-2.1;

83-101 (+→-): retrogradation of section 28-45;

103-106 (-): after a rest, the musical narration resumes in quiet dynamics ranging from *ppp* to *p*. The dynamic mark *mf* assigned to tenors 1-5 (104-105) aims to compensate for the comparatively weaker *bocca chiusa* singing;

107 (+): *ff*;

108-110 (→): the abrupt fall to *pianissimo* provides a point of departure for dynamic growth. This growth is accomplished through the progressive introduction of instruments (vbf, cmpli, pfte, xilor, ar, cel in 108; second beaters of the same instruments accordingly in 109; choir in 110), an increase in dynamic marks (instruments: *pp*, *p*, *mp*, *mf*, *f*, *ff*; choir: *p* cresc. *ff*), and the gradual temporal condensation of impulses (108) arising from the transition from the positive to the negative term of the category "maximal vs. minimal time-span";

111 (+): *ff* as the peak of the dynamic build-up, established together with the introduction of trgl and vn;

112-114 (→): an expanded diminuendo from *f* to *ppp*, aided by the progressive cancellation of groups within the orchestra and choir (S, B, vn: 113; A, T: 114) and by gradually thinning the texture;

115.1 (+): *sff* in strings;

115-122 (-): vn and vl wavering between *pp* and *mf*, then vc and vb between *ppp* and *p*;

118-142 (→+): a global dynamic increase is accomplished mainly by textural means through the introduction of more and more percussion instruments beginning with tmt solo, then the addition of choral voices (A: 137; T: 138; S, B: 140). In the percussion, the parts of individual instruments contain several crescendi and diminuendi between *p* and *pp* on one hand and *mf* and *f* on the other; the frequency of those partial transitions and the ratio of louder dynamic marks increase during the course of this section. A more decisive and unequivocal crescendo, from *pp* through *p*, *mf* and *f* up to *ff* in the choir (137-142), sharpens the overall dynamic process near its end;

143 (+→-): sudden diminuendo in both choral and instrumental parts;

144-148.1 (→): crescendo from *pp* in the choir and *p* in percussion instruments up to *sff*;

148.2-157 (-): return to a low dynamic level, indicated by *pp* assigned to ptti and gng played with wire brushes, as well as by *p* of sustained consonants /sz/ (S 1-5, A 1-5, T 1-5, B 1-5). The final short crescendi, up to *sf* on the short consonant /t/ in individual choral parts (S, B: 155; A, T: 158), serve only to make more audible the moments when voice parts drop out, and does not threaten the low dynamic level of this layer;

[3] Dynamic marks *ff* and *mf*, which occur here in the vb parts (68) instead of *pp* appearing in paragraph 16, are most likely printing errors since their occurrence affects the faithfulness of the retrogradation.

151-163 (+→): against the above soft background, a secondary layer of the trajectory occurs as a decrease from *ff* to *ppp*, by way of several short diminuendi in series of repeated consonants (S 6-10, A 6-10, T 6-10 and B 6-10) accompanied by tremoli on membranophones (timp, bgs, tmb c.c., tomts). A slight disturbance of this otherwise clear process is caused by a single case of crescendo from *p* to *mf* in 155-156 (B 6-10, tmp 4). At the end, the dynamic decline characteristic of this section leads to its absorption into the main layer, where it replaces the already canceled, previously discussed section 148-157;

164-174 (-): quiet dynamic in a stroke (*piano*) on metal idiophones (ptti, tmt) and in consonant /s/ in half of the choir (S 1-5, A 1-5, T 1-5, B 1-5). The surprisingly high dynamic mark *ff* assigned to choral parts ensures the audibility of this consonant, and compensates for its weakness without affecting the overall low dynamic level. This last is subsequently prolonged in ptti (*pp*: 168), gng (*p*: 171), tomts played with felt sticks (*pp-mf*: 165-170), and stringed instruments (*p* in vb: 167-173; vc: 169-174; vn, vl: 170-172);

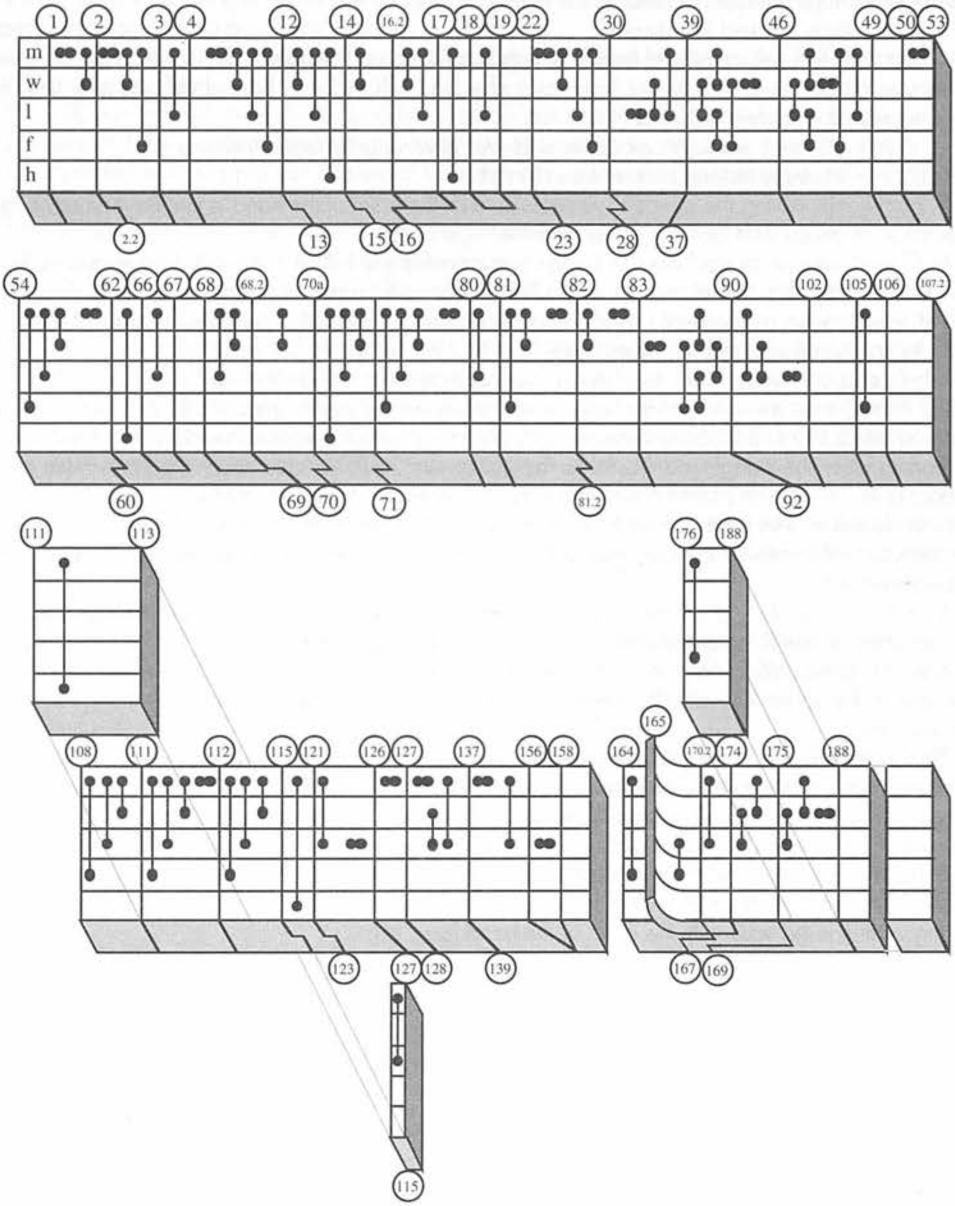
165-188.1 (+): *f sempre* initiated by short sharp consonants in the choir (165-187), then joined consecutively by percussion instruments (mtl: 169; claves: 170; lgn: 171; cwb: 172) and strings (vn, vl, vb: 174; vc: 176). The section ends *fortissimo*, with a dense homogenous cluster in the choir (188.1);

176-187 (-): superimposed in a subordinate layer, there occurs a quiet section *pp-p-mp* of long lasting sounds sung *quasi aperto* by soloists (S: 9, 10; A: 9, 10; T: 9, 10; B: 9, 10); in the same dynamic range are kept the tremoli of vbf, gng and ptti;

188.3 (-): quiet dynamics *ppp* are established in the basses (*fischio*), after a rest separating this section from the preceding one 165-188.1 in the main layer of the trajectory;

189-190 (+→-): diminuendo starting from *f* (basses) and *mf* (tenors), down to *pp*, *ppp*, and beyond (altos: 190). This process is supported by a reduction of choral voices from all of the basses and tenors down to altos alone, and by the use of inherently weaker female voices and *bocca chiusa* articulation near the end of the piece.

Timbre system



1-2.1 (mm, mw): cmpli (mw), cmpne played with wire brushes and trgl struck with its rod (mm). Cwb, vtr, and mtl are excited here with hard-headed wooden sticks, which, as the most common sort of beater, are not indicated in the score (mw);

2 (mw, mm, mf): vtr, mtl, cwb, and vbf played with hard sticks, cmpne struck with its proper wooden mallet, as well as traditional instrumental techniques of cmpli and cel represent the material pair "wm". In contrast, the pair "mf" is actualized by ptti struck with felt kettledrum sticks and ordinary playing on pfte strings with the hammers operated by the keyboard, while the trgl excited, as before, with a triangle rod brings a material combination "mm";

3 (ml): ar strings plucked with fingers;

4-11(mf, mw, mm, ml): cmpli and cmpne hit with handle ends of hammers (mw), traditional instrumental techniques on cel (mw), ar (ml), trgl (mm), and pfte, and soft sticks on bars of vbf and xilor (mf), the latter treated as a representative of metal;

12-14 (mh, ml, mw): *pizzicato*, *col legno*, and *arco* playing on stringed instruments;

14-16.1 (mw): *legno battuto* and *col legno* (vc, vb);

16.2 (mw, ml): striking the strings of vb *sul tasto* with the palm of the hand is interpreted here as the interaction of strings with both the finger and the fingerboard;

16-22 (mh): *arco* on strings between bridge and tailpiece (vn 1-4, vl 1-2: 16-17), then ordinarily, in front of the bridge (vn 5-6, vl 3-4, vc 1-2: 17-18), followed by bowing bridges and tailpieces of vc and vb which serve as substitutes of strings between bridge and tailpiece in low register (19-20). A return to traditional *arco* playing takes place in 20-22 (vn, vl);

18 (ml): pizzicati played with two fingers (*con due dita*) in vn 1-4 and vl 1-2;

22-29 (mm, mw, ml, mf): playing with wire brushes on the piano strings (23, 27) and on metal plates of ptti (23, 24, 25-26), gng and tmt (25-26) brings about a material combination "mm" which also arises when the triangle rod is used for tremolo on tmt (26-27) and for touching a previously struck cymbal (24). Tremolo on ar with palms of hands (22) and *con dita* play on ptti (23, 27) results in a pair "ml", while strikes with hard drumsticks and with soft kettledrum sticks on strings of pfte (22, 24, 26), ptti (ptto b, t: 23; ptto a, b: 28), gng (24, 27) and tmt (29) elicit material pairs "mf" and "mw", respectively;

28-38 (ll, lm, lw): skins of membranophones (tomts, timp, bgs, tmb c.c. e s.c.) played *con dita*, with wire brushes, and with hard drumsticks and handle ends of soft kettledrum sticks. Play with a drumstick on tmb. c.c. brings about not only an interaction between a skin and the wooden head of the beater (wl), but at the same time also between the snare and the opposite membrane set in sympathetic vibration (ml);

37-45 (wm, ww, wl, fl, fw): after the *con dita* playing drops out, membranophones are played with soft (tomts, timp) or hard sticks (bgs, tmb c.c. e s.c.) on their skins, edges, simultaneously on skins and edges, as well as on other sticks laid on the striking surfaces. Hard wooden sticks are also employed for exciting lgn and cwb, while claves strike each other in their usual manner;

46-48 (ww, wm, lm, fl, wl, mf): instrumental techniques of the previous section are joined here by felt sticks on gng and ptti (mf), taps on the sound boards of vc and vb with nuts or fingertips (ww), and the striking of strings *sul tasto* with the palm of the hand (mw, lm);

50-52 (mm): ptti, gng, tmt, cmpne, and strings of pfte excited with wire brushes;

54-61 (mm, mw, ml, mf): retrogradation of section 22-29;

60-68 (mh): retrogradation of section 16-22;

66 (ml): retrogradation of section 18;

68.1 (ml, mw): retrogradation of section 16.2;

68.2-70 (mw): retrogradation of section 14-16.1;

70-70b (mh, ml, mw): retrogradation of section 12-14;

71-79 (mf, mw, mm, ml): retrogradation of section 4-11;

80 (ml): retrogradation of section 3;

81 (mm, mw, mf): retrogradation of section 2;

81.2-82 (mm, mw): retrogradation of section 1-2.1;

83-91 (wm, ww, wl, fl, fw): retrogradation of section 37-45;

90-101 (ll, lm, lw): retrogradation of section 28-38;

105 (mf): a stroke on ptti, gng and tmt with kettledrum sticks;

108-110 (fm, ml, mw): xilor and vbf played with soft sticks, as well as traditional playing techniques of pfte, ar, cmpli and cel;

111 (mf, ml, mw, mm): sound generation processes of the previous section joined by trgl (mm);

112-114 (mf, ml, mw): after cancellation of trgl the remaining instrumental techniques are prolonged;

111-112 (mh): vn *arco* build up a superimposed, subordinate-layer section;

115.1 (ml): single *pizzicato* impulse (vc, vb);

115-122 (mh): *arco* on strings (vn, vl: 115-116; vc, vb: 116-122) and on the edges of tmt (118-120) and ptto (120-121);

121.2-126 (ml, ll): *con dita* technique on bgs and timp (ll), wire brushes on timp, and the edge of a fingernail scraping the skin of tomts (ml);

126-127 (mm): drawing the edges of fingernails across gng and ptti interpenetrates both the preceding and following segment;

127-138 (mm, ml, wl): tremoli with wooden sticks on bgs and tmb c.c. as well as with wire brushes and fingers on both membranophones and metal idiophones (tomts, tmp, bgs, ptti, gng, tmt);

137-157 (mm, lm): wire brushes on skins of timp, tmb c.c., tomts and bgs, as well as on metal plates of gng, tmt and ptti;

156-157 (ll): tremoli *con dita* on skins of bgs and tomts;

164-170 (mf): ptti, gng and tmt struck with felt sticks;

165-170 (lf): tremoli with felt sticks on tomts occur originally as a superimposed timbre segment in a subordinate layer. However, it subsequently fuses into the main layer of the trajectory because it brings leather as its main material which, together with metal of the parallel, above-discussed segment, sets up the complex mediative term of the contrariety "m vs. l" active in this passage of the piece;

170.2-173 (ml): immediately after ptti, gng and tmt drop out, wire brushes replace soft sticks in the tomts, whereby the complex mediative term occurs in one and the same timbre segment as a juxtaposition of two main materials—metal and leather—interacting with each other;

167-174 (wm, wl): strikes on strings *sul tasto* with the palm of the hand (vb: 167-173; vc: 169-174; vn, vl: 170-172) form a timbre segment overlapping with the three segments discussed above. This percussive effect on stringed instruments is now reinterpreted in comparison to its earlier occurrences in this piece, as a compound technique in which the fingerboard interacts at the same time with two different bodies: hand and strings;

169-187 (mw, ww, wl): the complex stratification of timbre segments in the conclusion of the trajectory culminates together with the introduction of mtl, cwb, claves and lgn (169), which subsequently are supported by taps on the sound boards of stringed instruments with nuts or fingertips, and by strikes on their strings with the palm of the hand *sul tasto* (vn, vl, vb: 174-187; vc: 176-187);

176-187 (mf): in the background of the above-mentioned effects, there occur tremoli with soft sticks on vbf, ptti, gng and tmt as a superimposed, subordinate-layer section of the timbre trajectory.

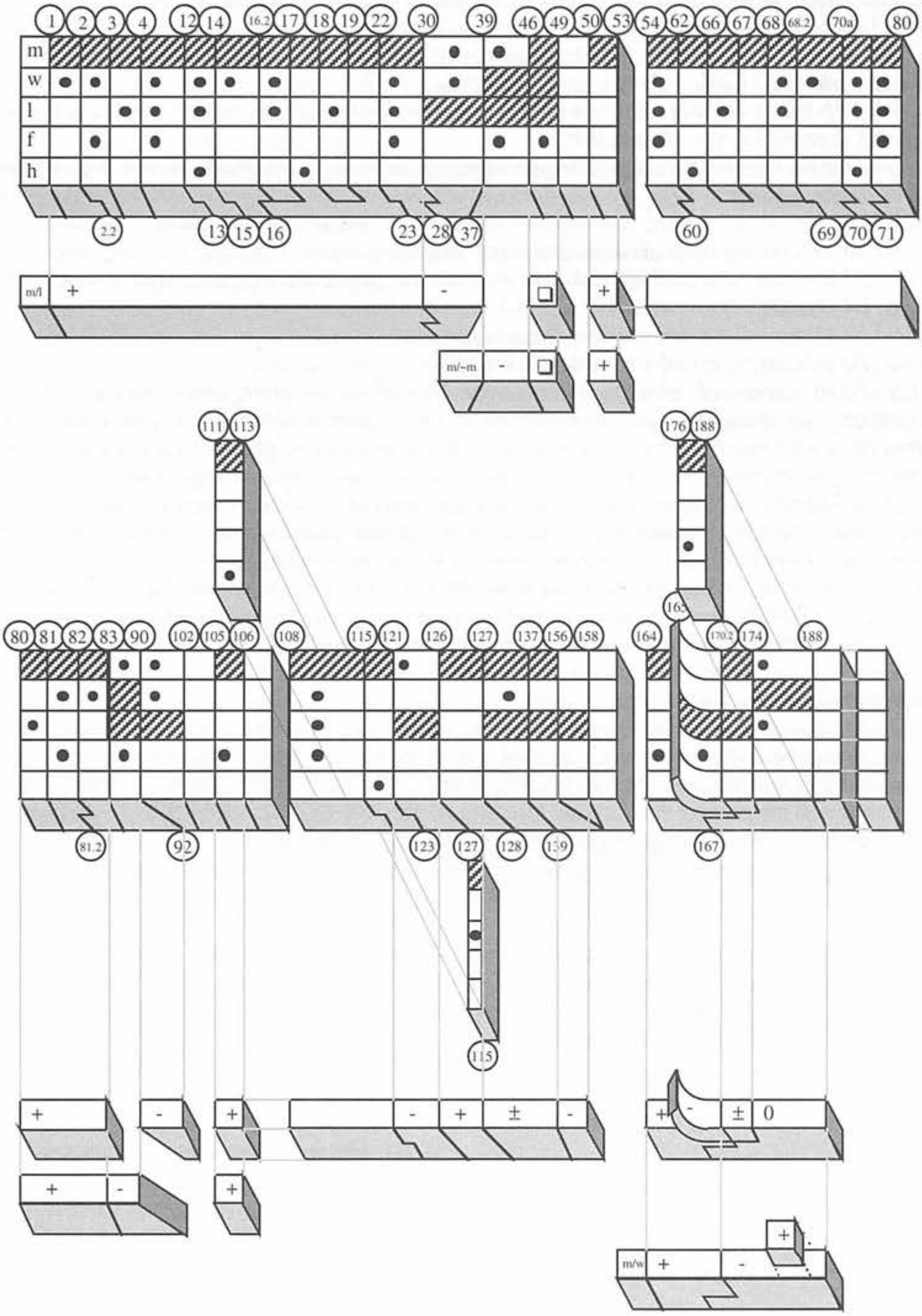


Figure 56. Timbre trajectory of *Dimensions of Time and Silence* and its active material oppositions

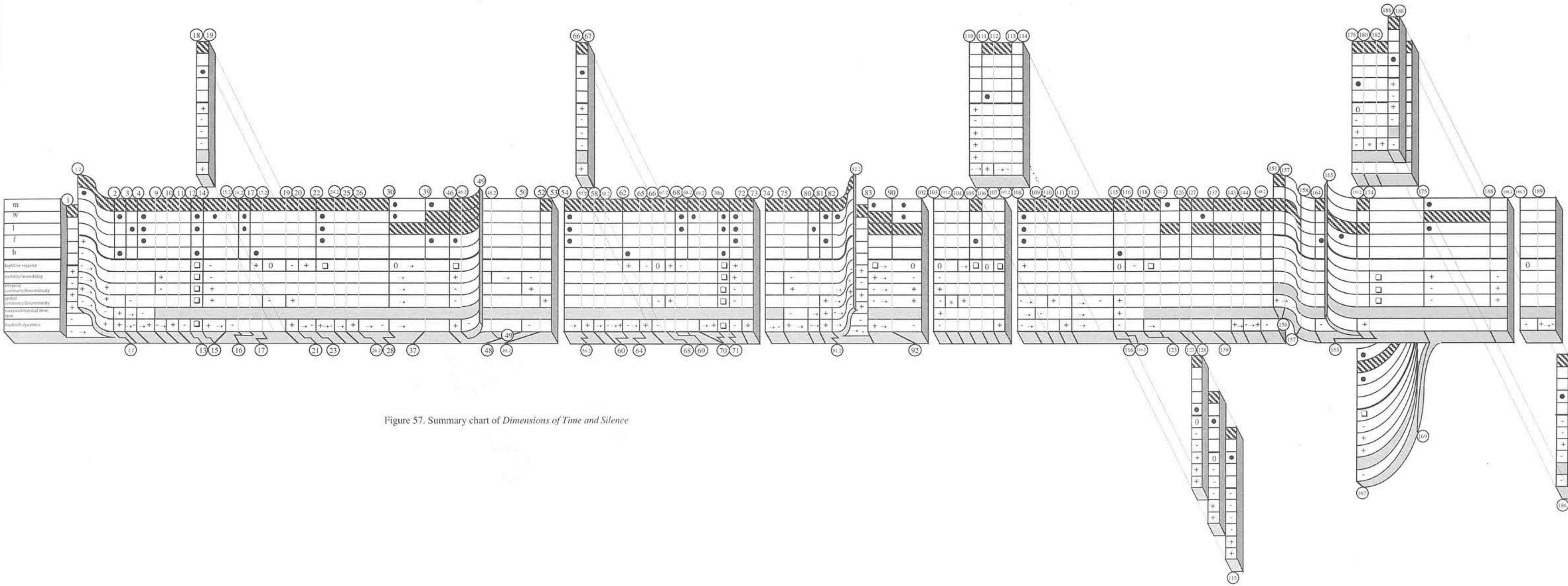


Figure 57. Summary chart of *Dimensions of Time and Silence*

8.3. *THRENODY-TO THE VICTIMS OF HIROSHIMA (1960)*

Articulation

The orchestra of 52 stringed instruments required for *Threnody* consists of 24 violins (vn), 10 violas (vl), 10 cellos (vc), and 8 contrabasses (cb). All sound generation processes in this piece are exhibited in the following diagram:

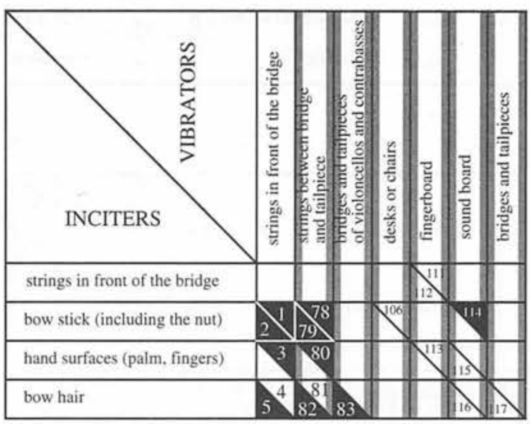


Diagram 5.Processes of sound generation in *Threnody*

Basic system

The binary oppositions operative here are identical with those previously listed as forming the basis of *Anaklasis*:

spatial mobility vs. spatial immobility
temporal mobility vs. temporal immobility
temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
loud dynamics vs. soft dynamics

Differences between these two pieces become apparent, however, when one examines the interdependencies of individual categories. The general category "mobility vs. immobility" arises here as a fusion of not two, but as many as three binary oppositions: "temporal mobility vs. immobility", "spatial mobility vs. immobility", and "temporal continuity vs. discontinuity". Hence the consequence of the partial redundancy between "spatial continuity vs. discontinuity" and "temporal continuity vs. discontinuity" is an analogous redundancy between the former elementary category and "mobility vs. immobility":

mobility vs. immobility				
spatial mobility vs. immobility		temporal mobility vs. immobility		temporal continuity vs. discontinuity
positive term (+)	⇔	positive term (+)	⇔	negative term (-)
negative term (-)	⇔	negative term (-)	⇔	positive term (+)
border-zone term (*)	⇔	border-zone term (*)	⇔	border-zone term (*)
total mediative term (❐)	⇔	total mediative term (❐)	⇔	total mediative term (❐)
transition (→)	⇔	transition (→)	⇔	transition (→)

spatial continuity vs. discontinuity		temporal continuity vs. discontinuity
positive term (+)	⇒	negative term (-)
negative term (-)	⇐	positive term (+)

spatial continuity vs. discontinuity		mobility vs. immobility
positive term (+)	⇒	negative term (-)
negative term (-)	⇐	positive term (+)

The modification of the articulatory definition of "temporal continuity vs. discontinuity", as seen in the two previously analyzed pieces, continues in *Threnody*. Hence the sounds of maximal temporal condensation listed as representatives of the border-zone term are treated here as actualizations of the positive term on a level with long-lasting sounds.

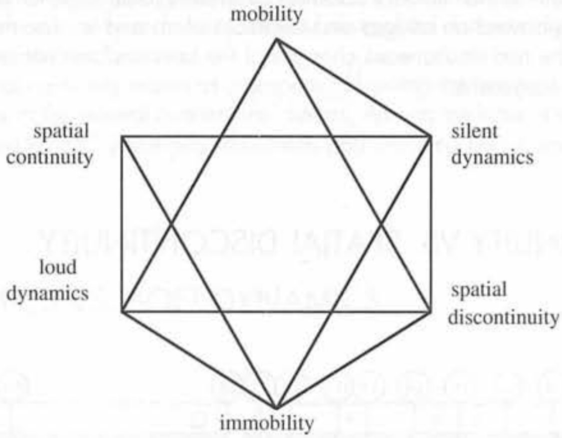
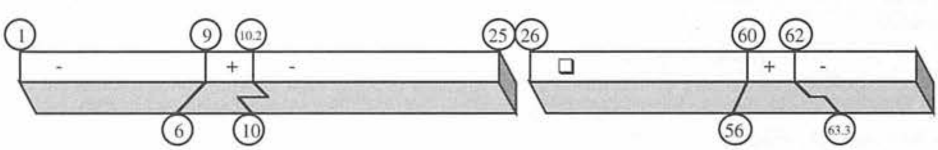


Figure 58. Rosette of the system in *Threnody*

MOBILITY VS. IMMOBILITY



1-8 (-): the piece begins with static bands of highest possible notes;

6-10.1 (+): rapidly performed series of several atypical articulatory effects occur, such as tapping the sound board with the nut or finger tips, highest possible tones (*pizzicato* and *arco*), impulses played *legno battuto* and *arco* between bridge and tailpiece. These effects gradually oust the long-lasting clusters and establish a movement in vc (6), vl (7), vn (8) and cb (9);

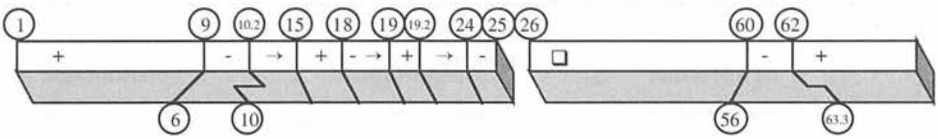
10-24 (-): return of long-lasting tones, clusters and glissandi. The latter (17), as irrelevant for the discussed category, constitute optional expressive features in this section. Characteristically, the onsets of glissandi in all groups of strings coincide each time with an introduction of dynamic level *pp*, in this way marking the collapse of loudness succeeding the former *ff*;

26-59 (❐): after a break, the trajectory resumes with a total mediative term as a medley of long-lasting tones and tremoli representing immobile sounds on the one hand and mobile short impulses (*arco*, *pizzicato*, *legno battuto*, taps on the sound-board with the nut or fingertips) entering temporal and spatial relationships on the other;

56-63.2 (+): the foregoing zone of extremely differentiated sounds spread in individual instrumental parts gives way to a movement between impulses *arco*, *legno battuto* and *pizzicato* gradually introduced by three ensembles of the same set (4 vn, 3 vl, 3 vc, 2 cb), divided off from the staff of the whole stringed orchestra;

62-70 (-): the conclusion of the trajectory contains several long-lasting sounds, vibrati and tremoli. It overlaps with the previous section in that it commences already in 62 together with a sustained cluster of vn 1-12 and sounds bowed on bridges and tailpieces of cb and vc. The rhythmic patterns of the latter indicate merely the non-simultaneous changes of the bow and are not perceived as such in a stratification of several instruments.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



1-8 (+): clusters set up by highest possible tones of all the instruments—vn (1-7), vl (1-6), vc (1-5) and cb (1-8)—establish spatial continuity. Their non-simultaneous cancellation in individual instrumental groups results in an interpenetration between this and the next section;

6-10.1 (-): vc (6), vl (7), vn (8) and cb (9) consecutively introduce series of point-like articulatory effects of indefinite pitch: highest possible tones *pizzicato* and *arco*, striking the upper sound board with the nut or the finger tips, impulses *arco* and *legno battuto* between bridge and tailpiece, all performed independently by individual instruments;

10-14 (→): a zone of several continuous transitions between clusters and their single central tones, achieved through glissandi of individual instruments outwards from or inwards toward the centre of symmetry;

15-17 (+): dense quarter-tone clusters;

18 (→): build-up of clusters in five instrumental groups, around their central initial pitches (vc: A; vn 13-24: c^2; vl: f♯; cb: A♯; vn 1-12: g^2♯), by addition of consecutive neighbouring tones introduced at quarter-tone distances;

19.1 (+): quarter-tone clusters in vn (vn 1-12: g^2-b^2; vn 13-24: a^1-d^2♭) and vl (e-g♯), built in the previous section, together with newly established semi-tone clusters in vc (C-A) and cb (b♭-f^1);

19.2-23 (→): continuous glissando transition of this section—proceeding from the two above-mentioned separated clusters (in vc and cb) through dense and slow vibrati of decreasing number of instruments (10 vc and 8 cb in 20; 10 vc in 21-22.1; 5 vc in 22.2, vc solo in 23)—drives to a single pitch d, *senza vibrato*, in the vc solo of the next section;

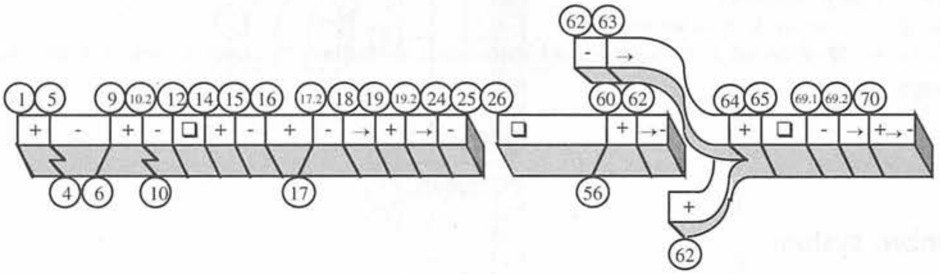
24 (-): point-like pitch d;

26-59 (□): an area of scattered, single pitches played in several different ways (*arco*, *pizzicato*, *legno battuto*, harmonics, *con* and *senza sordino*) along with highest possible tones of individual instruments and point-like effects of indefinite pitch (play between bridge and tailpiece on single strings, striking the sound board with the nut or finger tips), from among which there emerge quarter- and semitone clusters of harmonics (35-37, 47-52);

56-63.2 (-): beginning in 56 the asynchronic sounds of the previous section are ousted by effects of striking the sound board with the nut or finger tips, playing between bridge and tailpiece *arco* and *legno battuto*, as well as highest possible notes, played *arco* and *pizzicato*. All of these, previously heard in section 6-10, now return as synchronized between instruments and are introduced successively by the first (56), second (58), and third (60) of the groups into which the orchestral ensemble is divided here. Even though such a synchronization of highest possible tones as well as arpeggios between bridge and tailpiece results in spans of indefinite pitches rather than in point-like sounds, both these articulatory effects are here plainly interpreted as resulting in spatially discontinuous sounds on a par with the other, above-listed sound generation processes. One can see this interpretation as influenced by the rule of predomination of temporal discontinuity over spatial discontinuity, expanded beyond the class of two-dimensional sound sources;

62-70 (+): the spatial continuity returns as a property of bowing the bridge and tailpiece (cb: 62-64; vc: 63-65) as well as of the several quarter-tone clusters. Among the latter, the most impressive one is the final cluster played by all 52 stringed instruments and reaching from c up to $c^{2\sharp}$.

LOUD DYNAMICS VS. SOFT DYNAMICS



1-4 (+): high dynamic level *ff* (1), slightly altered together with occurrence of *subito f* in paragraph 2;

4-8 (-): *subito ppp* introduced at first by vl (4), then taken over by all the remaining instruments (5);

6-10.1 (+): though having no dynamic marking (which is most likely an error in the score), the series of impulses occurring from number 6 onward obviously do not continue the low dynamic level of the previous section but introduce a loud dynamic. This is evidenced by dynamic markings *pp* and *ppp* in 10 and 11 that restore low dynamics in the next section, which would not be necessary if the section under discussion proceeded in low dynamics. The interpenetration with the previous soft section, caused by the fact that the new dynamic appears successively in individual instrumental groups (vc: 6-9, vl: 7-10, vn: 8-10, cb: 9-10), is equivalent to a transition obtained by textural means and supported by a crescendo to *mf* in 6 (vn, vl, cb). This very crescendo forms another proof that the series of impulses are kept loud here;

10-11 (-): dynamic range between *ppp* and *pp*;

12-14 .1 (❒): different dynamic levels (*ppp*, *p*, *mf*, *f*) and continuous transitions between them (12-13: diminuendi of vl and vc; 14: crescendo of vn) make up a total mediative term;

14.2 (+): twelve violins playing *forte*;

15 (-): *ppp*;

16-17.1 (+): sudden *ff* brings about a striking dynamic contrast after the previous section;

17 (-): *pp* and *ppp* dynamics supersede *ff* consecutively in vc, vn 1-12, cb, vl and vn 13-24. The resulting interpenetration with the previous section is tantamount to a transition from loud to soft dynamics, assisted by a diminuendo in vl;

18 (→): a transition from *pp* to *ff* attained by intense crescendi in individual instrumental parts as well as by textural means, through introduction of more and more instruments and instrumental groups, from a single cello to all the orchestra;

19.1 (+): the dynamic climax *ff* (vn, vl) and *fff* (vc, cb);

19.2-23 (→): a return transition from loudest to softest possible dynamics by a cancellation of vn and vl (19), then by reduction of the instruments within the remaining groups of vc and cb (from 10 vc and 8 cb in 20 to vc solo in 23) along with gradually decreasing dynamic markings (*fff*, *f*, diminuendo, *p*, diminuendo, *pp*);

24 (-): vc solo ceases in a decrescendo to *pppp*;

26-59 (❐): a variety of dynamic levels (*ppp*, *pp*, *p*, *mp*, *mf*, *f*, *ff*, *sff*), as well as crescendi and diminuendi between them, takes place in individual instrumental parts;

56-61 (+): *ff sempre* occurs consecutively in orchestral groups I (56), II (58) and III (60);

62-63 (→-): continuation of the layer of three orchestral groups (vn 13-24, vl 1-9, vc 1-9) brings a gradual decrease of dynamics (*f*, *mf*, *p*, *pp*) and the dropping out of cb (62) and vc (63);

62 (-): *pp* in a new layer of the trajectory set up by vn 1-12;

62-64 (+): this section, characterized by a steady high dynamic level *ff* in cb (62-64) and vc (63-65), belongs to a third layer separated simultaneously with the above-discussed second one. Beginning from 64, *ff* is taken over also by vn 1-12 and vl, which leads to a reunification of the trajectory;

65-68 (❐): different dynamic levels (*pp*, *p*, *mf*, *f*, *ff*) juxtaposed in different configurations in particular groups of instruments (vn 1-12; vn 13-24, vl, vc, cb);

69.1 (-): *pp-p* dynamics;

69.2 (→): crescendo from *pp* to *fff*;

70 (+→-): *fff* of the full orchestra followed immediately by the very slow diminuendo that dies away to *pppp*.

Timbre system

A peculiarity of *Threnody* compared with the remaining pieces under consideration in this book, is that the timbre system does not operate in it. Thus, the material properties of bodies serving as vibrators or inciters in sound generation processes—previously acknowledged to be relevant for categories of the timbre system—appear irrelevant for the state of the system in *Threnody*, in which the timbre system itself is absent. This is of particularly great consequence for the position of the unusual instrumental techniques in that piece whose novelty springs from the collision of bodies traditionally not designed as vibrators or inciters, but used by the composer in consideration of their material properties. Being normally justified on the grounds of the timbre system, they turn out to be devoid of justification in *Threnody*. Such instrumental techniques are as follows: bowing the bridges of cellos and basses as well as tapping the sound board with the nut or fingertips. Still, having been elaborated in the earlier pieces, they are taken for granted here—as if they were traditional string playing techniques—and appear in *Threnody* regardless of the material pairs that they represent, for they already belong to the standard articulatory resources of Penderecki's sonorism.

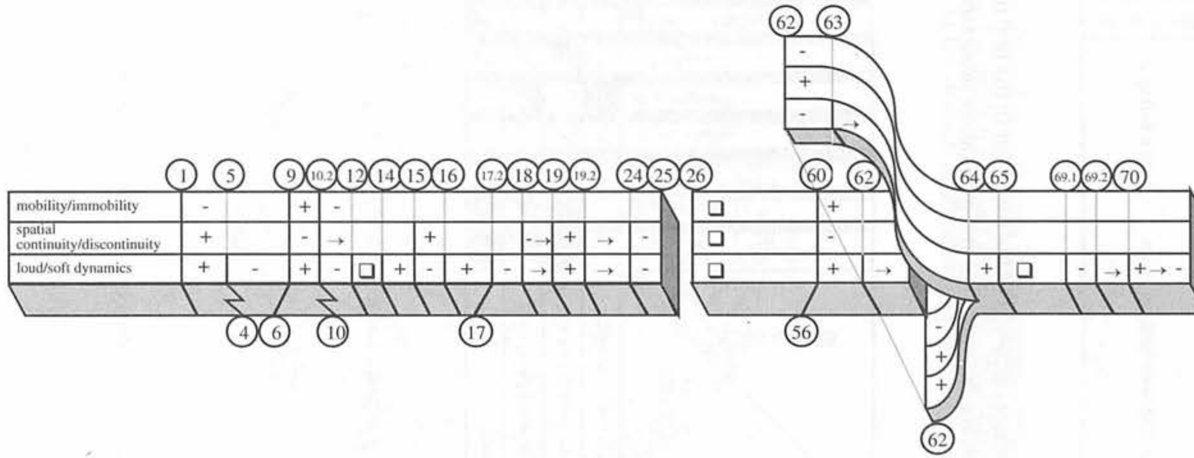


Figure 59. Summary chart of *Threnody*

8.4. STRING QUARTET NO. 1 (1960)

Articulation

Instrumental techniques of strings employed by the composer in the first of his two string quartets can be inferred from the following diagram of sound generation processes:

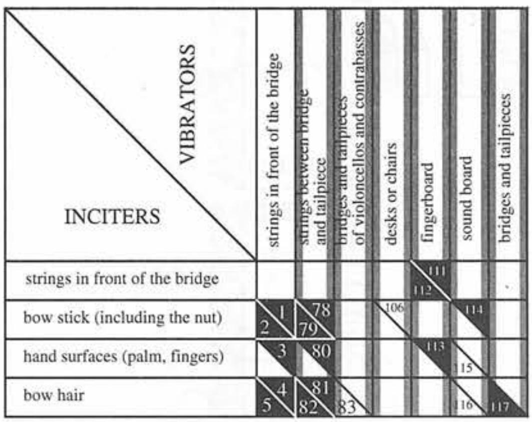


Diagram 6. Processes of sound generation in String Quartet No.1

Basic system

Underlying the piece are the following binary oppositions of the basic system:

extreme registers vs. middle register
temporal mobility vs. temporal immobility
spatial mobility vs. spatial immobility
temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
loud dynamics vs. soft dynamics

Within these six categories there occurs only one redundancy of a partial character, which arises at the instance of implications between opposite terms of "temporal mobility vs. immobility" and "temporal continuity vs. discontinuity":

temporal continuity vs. discontinuity	positive term (+)	⇒	negative term (-)	temporal mobility vs. immobility
	negative term (-)	⇐	positive term (+)	

However, temporal continuity as a positive term is again represented here not only by long-lasting sounds, but also by quickest possible repetitions and their substitutes, construed as representatives of the border-zone term in the original articulatory definition.

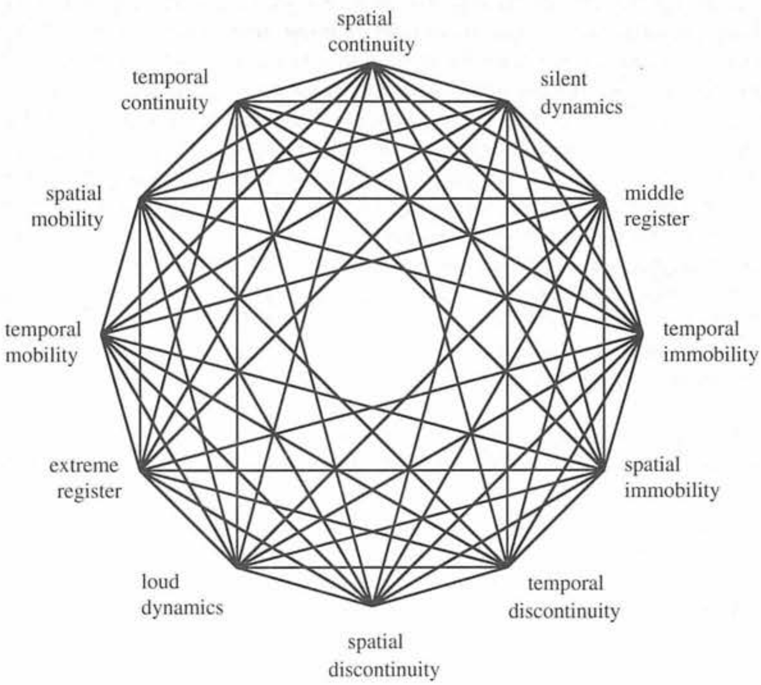
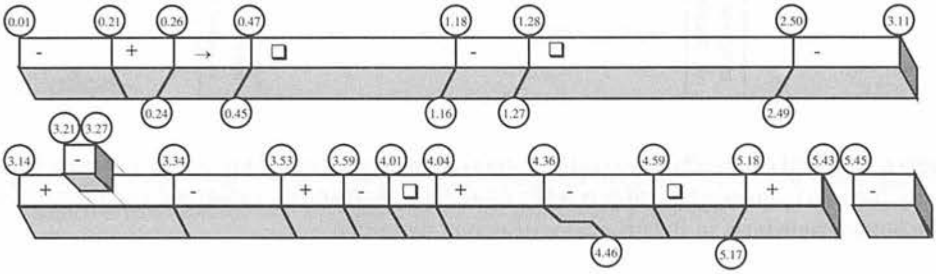


Figure 60. Rosette of the system in String Quartet No.1

MIDDLE REGISTER VS. EXTREME REGISTER



0.01-0.20 (-): the piece commences with the pitch D in vc, followed by glissandi upwards and downwards from lowest possible tones accessible to *senza arco* playing in individual instruments. Since in this type of instrumental technique the string is set into vibration with the fingers of the left hand, the lowest accessible pitches here are not those of the lowest open (unstopped) strings, but their minor or major upper seconds: D for vc, d♭ for vl and a♭ for vn. Thus, the pitch g as the point of departure for glissando in vn 1 is an obvious error in the score. In order to distinguish the ranges of glissandi in vn 2 from that of vn 1, the former uses not the first but second lowest string beginning from its lowest available pitch $e^{1}\flat$. These low-register sounds are then (0.16) joined by play *legno battuto* between bridge and tailpiece, representing the high register;[1]

0.21-0.25 (+): repetitions of a percussion effect of striking strings *sul tasto* with the palm of the hand;

0.24-0.46 (→): gradual spatial expansion accomplished by consecutive introduction of two new articulatory effects: tapping the sound board with a nut or fingertips (0.24) and *legno battuto* (0.32). The latter instrumental technique helps to widen the sound field by producing sounds more and more differentiated in respect of pitch, from g (vn 1: 0.32) downwards to C (vc: 0.39) and upwards to d^3 (vn 1: 0.41);

0.45-1.17 (❑): total sound space, ranging from the lowest pitch C of vc to the highest possible tones of vni, is established after addition of *pizzicato* articulation to the inventory of instrumental techniques from the previous section;

1.16-1.27 (-): repetitions of double-stops *legno battuto* in the expanded low register of individual instruments (vc: E♭-G; vl: f-e^1; vn 1: c^1-b^1; vn 2: $f^1\sharp$-$g^2\sharp$) followed by rapid glissandi *col legno* (1.24-26) up to triple stops repeated in high registers (vn 1: $b^1\flat$-a^2-$a^3\flat$; vn 2: f^1-c^2-$d^3\flat$; vl: d^1-$e^1\flat$-e^2; vc: g^1-b^1-$f^2\sharp$);

1.27-2.50 (❑): sounds of definite as well as indefinite pitch produced *legno battuto*, *pizzicato*, *arco*, and by tapping the sound boards with nuts or fingertips; these effects are spread throughout the whole musical space from lowest pitch of vc (C) up to highest possible tones of indefinite pitches;

2.49-3.10 (-): the highest possible tones and play between bridge and tailpiece performed first as *pizzicato* impulses (vl, vc: 2.49) and *legno battuto* strokes (vl: 2.49; vc: 2.50; vn 2: 2.51), then as sustained *arco* notes. The return to the negative term disturbs here the logic of the discussed trajectory. Yet, this disturbance is neutralized by the fact that it happens after a very long mediative section. It is thus not unlikely that the prohibited sequence of sections has arisen here by a sheer oversight of the composer;

3.14-3.34 (+): single pitch e^1 in vl (3.14-21), followed by $c^1\sharp$ (vn 2), c^1 (vc), b (vl) and b♭ (vn 1). The middle register established by those pitches is kept in 3.31-34 by the cluster b♭-$c^1\sharp$;

3.21-3.26 (-): E♭ (vc) and d^2 (vn 1) represent, respectively, the low and the high register in a subordinate section;

[1] Note that, in the score of the First Quartet, the individual numbers of timing (in seconds) refer—unusually—not to the following, but to the preceding section.

3.34-3.52 (-): high register represented by cluster of harmonics $b^{2\flat}$-$c^{3\sharp}$ (3.34-37), then low-register double stops in 3.38 consisting of pitches whose choice is constrained by the category "spatial continuity vs. discontinuity" (vn 1: g-$f^{1\sharp}$, vn 2: a-$g^{1\sharp}$, vl: d-a♯; vc: C-d♭). Glissandi upwards starting from consecutive pitches B♭ (vc: 3.48), $c^{1\sharp}$, b and c^{1} (vl, vn 2, vn 1: 3.39) form a transition to highest possible notes of vn 2 and vl (3.40-52), joined by repetitions of pitches in the lowest registers of vn 1 (a♭) and vc (G);

3.53-3.58 (+): juxtaposition of clusters f♯-a and d^{1}-f^{1}, which result from simultaneously played double-stops on all four stringed instruments;

3.59-4.01 (-): low pitch B♭ in part of vc;

4.01-4.04 (❐): *pizzicato* pitches covering registers from D (vc) up to $a^{3\flat}$ (vn 1) and to the highest possible tone of indefinite pitch (vc);

4.04-4.45 (+): the pitch g (4.04-4.14) is surrounded subsequently by neighbouring pitches at semitone distances, building up a cluster f-a♭ and moving outwards in short glissandi (3.14-16). In the remaining part of this section the middle register is represented consecutively by bowing tailpieces of all instruments (3.17-23), a repeated percussive effect of tapping sound board with the nut or fingertips (vn 2, vl, vc: 3.24-30), as well as by a trill g-a♭ (vn 1: 4.24-42) and a single pitch f♯ (vc: 4.33-45);

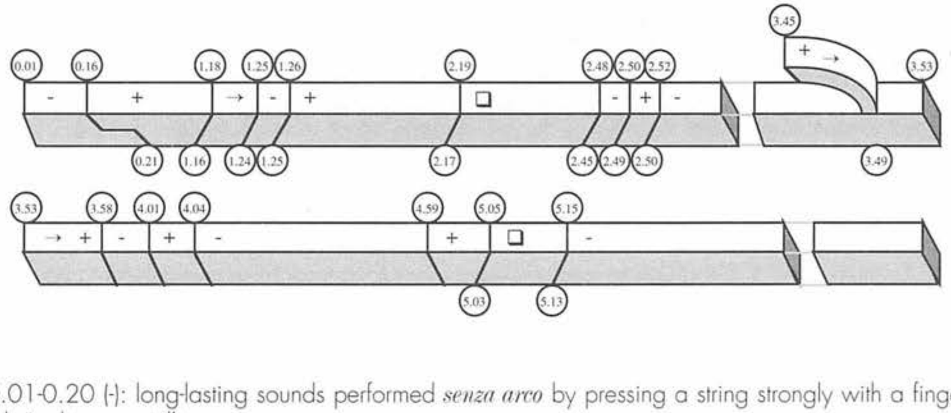
4.36-4.58 (-): before the two last-mentioned sounds stop, a high register is introduced by playing between bridge and tailpiece in vn 2 (4.37-49) and vl (4.38-49). This register continues in highest possible tones of vn 1(4.42-53), vc (4.46-52) and vl (4.48-58), and a harmonic $a^{2\flat}$ in vn 2 (4.50-56);

4.59-5.17 (❐): the whole musical space is covered by several types of percussive effects, such as tapping the sound board with the nut or fingertips, striking the strings with the palm of the hand, and *legno battuto* between bridge and tailpiece, as well as by definite pitches produced *arco* and *col legno* and reaching from C up to the highest possible tones of vni;

5.17-5.42 (+): middle-register clusters b-$f^{1\sharp}$ are reduced to d^{1}-f^{1} through cancellation of tones, a process carried out consecutively between 5.20 and 5.23;

5.45- 6.00(-): lowest register represented by D♭ in vc (5.45-52) and highest register sounds of indefinite pitch played behind (vn 1, vl) and in front of the bridge (vn 1).

TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY



0.01-0.20 (-): long-lasting sounds performed *senza arco* by pressing a string strongly with a finger and simultaneous trilling;

0.16-1.17 (+): impulses played *legno battuto* between bridge and tailpiece, imposed on *senza arco* glissandi of the previous section (0.16-20), inaugurate a temporal movement, which is subsequently continued by several instrumental techniques, including striking the strings *sul tasto* with the palm of the hand, tapping the sound boards with the nut or fingertips, *legno battuto* and *pizzicato*;

1.16-1.24 (→): progressive reduction of time-span values between repeated double stops *legno battuto* in individual instruments of the quartet;

1.24-1.26 (-): tremoli *col legno* in vn 2 (1.24), vl (1.24-25), vc and vn 1 (1.24-26);

1.25-2.18 (+): expanded section containing taps on the sound board, strikes on the strings *sul tasto*, beats *legno battuto*, pizzicati and *arco* spiccati combined into series of temporally interrelated impulses;

2.17-2.47 (❐): sustained tremoli and long-lasting sounds appear among the momentary effects *pizzicato*, *arco spiccato* and *legno battuto* retained from the previous section, thereby bringing about a total mediative term of the category;

2.45-2.49 (-): long-lasting harmonics (vc: 2.45-47; vn 2: 2.47-50; vn 1: 2.48-50), tremoli *arco* (vl: 3.46-48) and *col legno* (vc: 2.48);

2.49-2.51 (+): individual impulses *pizzicato* (vl, vc: 2.49) and *legno battuto* between bridge and tailpiece (vl: 2.49; vc: 2.50; vn 2: 2.51), linked together by temporal relations;

2.50-3.52 (-): temporal immobility is established by sustained highest possible notes of vn 1 and vl as well as tremoli between bridges and tailpieces of vn 2 and vc (2.50-3.10). After a caesura come long-lasting sounds, tremoli as well as occasional discrete beats *legno battuto* (vc: 3.21; tutti: 3.38) and pizzicati (3.39-40);

3.45-3.48 (+→-): repetitions of impulses *legno battuto* separated by increasing time-span elicit a transition from temporal mobility to immobility in the subordinate layer of vn 1 and vc;

3.53-3.57 (-→+): an opposite transition is accomplished in the main layer of the trajectory by way of a gradual reduction of time-spans that separate consecutive repetitions of double stops. This reduction is synchronized throughout the quartet;

3.58-4.01 (-): single-impulse, *pizzicato glissando* (3.58), then long tremolo in vc (3.59-4.01);

4.01-4.04 (+): pizzicati spread evenly in all instruments. Temporal relations between individual impulses are indicated by cross-bars;

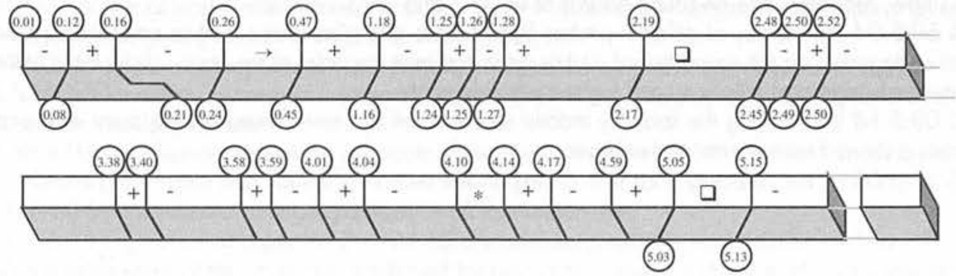
4.04-4.58 (-): long-lasting tremoli (vn 2: 4.04-10, 4.50-56; vn 1: 4.09-10; vl: 4.08-09; vc: 4.46-52), vibrati (4.10-16; vn 1: 4.43-53; vc: 4.33-45), glissandi (4.14-16), trills (vn 1: 4.25-42) and simple long-lasting sounds bowed on strings between bridge and tailpiece (vn 2: 4.37-49; vl: 4.38-46) as well as on tailpieces alone (4.16-23). In 4.24-30 there occur also single unrelated taps on sound boards of vn 2, vl and vc;

4.59-5.04 (+): temporal movement returns along with several types of impulses played *pizzicato*, *legno battuto*, tapped with fingertips on sound boards, and struck with the palm of the hand on strings *sul tasto*;

5.03-5.14 (❐): momentary articulatory effects of the previous section mixed with long-lasting tremoli *arco* and *col legno*;

5.13-6.00 (-): tremoli *sul ponticello* (vn 2, vc: 5.14-16; vl: 5.13-17; vn 1: 5.16-17) and long harmonics (vn 1: 5.13-15; vc: 5.16-17) superseded gradually by fast, then slow vibrati, and finally by long sounds *senza vibrato*. After a general pause there occurs tremolo *col legno sul ponticello* in vc (5.45-52) and simple sustained sounds in the three remaining instruments.

SPATIAL MOBILITY VS. SPATIAL IMMOBILITY



0.01-0.11 (-): sustained, spatially immobile pitches D (vc: 0.01-0.07), $d^{\flat}$ (vl: 0.05-0.10), $e^{\flat}$ (vn 2: 0.05-0.09) and g (vn 1: 0.07-0.11). Trills do not represent here a mediative border-zone term of the category, but constitute an indispensable component of *senza arco* articulation;

0.08-0.20 (+): glissandi upwards and downwards start successively in vc (0.08), vn 2 (0.09), vl (0.11) and vn 1 (0.12), eliciting an interpenetration with the initial section;

0.16-0.25 (-): repetitions of impulses played *legno battuto* between bridge and tailpiece (0.16-0.20), then struck with the palm of the hand on strings *sul tasto*;

0.24-0.46 (→): progressive differentiation of articulatory effects is accomplished by introduction of tapping the sound boards with the nut or fingertips producing sounds of indefinite pitches, then also of *legno battuto* bringing about several pitches spread across the musical space;

0.45-1.17 (+): the transitional process of the previous section reaches its goal after adding *pizzicato* to the instrumental techniques listed above, whereby a field arises of spatially interrelated sounds of indefinite as well as different definite pitches;

1.16-1.24 (-): repetitions of double stops *legno battuto*;

1.24-1.26 (+): glissandi upwards not synchronized between individual instruments (vn 2, vl: 1.24-25; vc, vn 1: 1.24-26);

1.25-1.27 (-): triple stops *legno battuto* repeated four times by every instrument (vn 2: 1.25-26; vl: 1.25-1.27; vc, vn 1: 1.26-27);

1.27-2.18 (+): several individual pitches and sounds of indefinite pitch played *pizzicato*, *legno battuto* and *arco spiccato*, tapped on the sound board with the nut or fingertips, and struck with the palm of the hand on strings *sul tasto*;

2.17-2.47 (□): spatially mobile sequences of different pitches performed *pizzicato*, *spiccato* or *legno battuto* are joined here by immobile tremoli and long-lasting sounds;

2.45-2.49 (-): static lasting harmonics in vc (2.45-47), vn 2 (2.47-50) and vn 1 (2.48-50) as well as tremoli *arco* (vc: 2.48) and *col legno sul ponticello* in vl (2.46-48);

2.49-2.51 (+): highest possible tones *pizzicato* (vc, vl: 2.49) and strikes *legno battuto* between bridge and tailpiece (vl: 2.49; vc: 2.50; vn 2: 2.51) as spatially differentiated sounds in mutual relationships;

2.50-3.38 (-): sustained highest possible tones *arco* (vn 2, vc) and tremoli between bridge and tailpiece (vn 1, vl). Beginning from 3.14 spatial immobility is represented by long-lasting tones, clusters, vibrati and tremoli along with occasional single impulses *legno battuto* (vc: 3.21; tutti archi: 3.38);

3.38-3.40 (+): glissandi upwards initiated by pizzicati in vc (3.38), vl, vn 2 and vn 1 (3.39);

3.40-3.58 (-): return to spatially immobile sounds: long tremoli on highest possible tones of vn 2 and vl and repetition of pitches in vn 1 ($a^{\flat}$) and vc (G), followed by a cluster repeated by all synchronized instruments of the quartet (3.53-3.58);

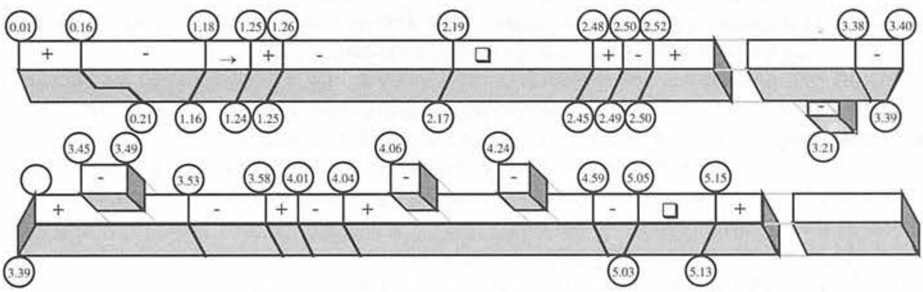
3.58-3.59 (+): glissando upwards;

3.59-4.01 (-): tremolo on $B^{\flat}$ (vc);

4.01-4.04 (+): different spatially interrelated pitches *pizzicato* dispersed in the sound space;

4.04-4.10 (-): single pitch g;
4.10-4.14 (*): intensive vibrati as representatives of the border-zone term;
4.14-4.16 (+): glissandi upwards from g and a″ (vn 1, 2) and downwards from f♯ and f (vl, vc) played independently by individual instruments;
4.17-4.58 (-): long-lasting sounds bowed on tailpieces (4.17-23) and on strings (4.25-58) as well as single, repeated taps on sound boards of vn 2, vl and vc (3.24-30);
4.59-5.04 (+): medley of different pitches *legno battuto* and *pizzicato* as well as point-like taps with nuts or fingertips on the sound board, strikes on strings with the palm of the hand, clicks *legno battuto* between bridge and tailpiece, and highest possible notes;
5.03-5.14 (❐): among the spatially mobile series of the aforementioned sounds there also occur static, sustained tremoli *arco* and *col legno*;
5.13-6.00 (-): the trajectory ends with an expanded section of tremoli and long-lasting sounds.

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY



0.01-0.20 (+): long-lasting trills *senza arco*;
0.16-1.17 (-): clearly separated impulses *legno battuto* between bridge and tailpiece occur against the background of the temporally continuous phenomena of the previous section (0.16-0.20); these impulses initiate the temporal discontinuity characteristic subsequently of the extended zone filled in by striking strings *sul tasto* with the palm of the hand, tapping the sound board with the nut or fingertips, as well as by impulses *legno battuto* and *pizzicato*;
1.16-1.24 (→): gradual temporal condensation of impulses *legno battuto* through acceleration of repetitions (vn 2: 1.16-23; vc, vl, vn 1: 1.17-24) leads to the tremolo of the next section;
1.24-1.26 (+): tremolo *col legno* (vn 2, vl: 1.24-25; vc, vn 1: 1.24-26);
1.25-2.18 (-): another temporally discontinuous zone of *pizzicato*, *legno battuto*, tapping the sound boards with nuts or fingertips, striking strings *sul tasto* with the palm of the hand, and *arco spiccato*;
2.17-2.48 (❐): the foregoing discontinuous effects mixed with tremoli and long-lasting sounds played both *arco* and *col legno* between bridge and tailpiece, both normally and as harmonics;
2.45-2.49 (+): sustained harmonics (vc: 2.45-47; vn 2: 2.47-50; vn 1: 2.48-50), tremoli *arco* (vl: 2.46-48) and *col legno* (vc: 2.48);
2.49-51 (-): single impulses *pizzicato* and *legno battuto* between bridge and tailpiece in vl, vc (2.49-50) and vn 2 (2.51);
2.50-3.37 (+): sustained highest possible notes *sul ponticello* (vn 2, vc) and tremoli between bridge and tailpiece (vn 1, vl). After a general pause come long-held tones both *vibrato* and *senza vibrato* (3.14-34), then a tremolo in all four instruments (3.34-37);

3.21(-): single beat *legno battuto* in vc as a unique, temporally discontinuous event of the subordinate section;

3.38-3.39 (-): impulse *legno battuto* synchronized in all the quartet (3.38), and consecutive pizzicati of vc (3.38), vl, vn 2 and vn 1 (3.39), bring the temporal discontinuity into the main layer of the trajectory;

3.39-3.52 (+): glissandi after *pizzicato* impulses (3.39-40) are again temporally continuous, as are the following, very long tremoli in vn 2 and vl (3.40-52);

3.45-3.48 (-): series of repetitions *legno battuto* (vn 1, vc) as a contrasting subordinate layer;

3.53-3.58 (-): clearly separated momentary clusters *arco* of the whole synchronized quartet (3.53-57) and an impulse *pizzicato*;

3.58-4.01 (+): glissando following pizzicato of the previous section (3.58), then tremolo *col legno* in vc;

4.01-4.04 (-): separated impulses *pizzicato* in all four instruments;

4.04-4.58 (+): tremoli *col legno* (vn 2: 4.04-10) and *arco sul ponticello* (vl: 4.08-09; vn 1: 4.09-10) mark the main layer of the trajectory, continued by long-lasting sounds *vibrato* in all four instruments (4.10-16) and by the bowing of tailpieces (4.17-23). The long trill of vn 1 (4.25-42) resumes the temporal continuity of this section in 4.25 and subsequently, beginning from 4.33, is joined by vibrati, tremoli, and simple durations assigned to individual remaining instruments;

4.06-4.08 (-): in a subordinate layer parallel to the course of the above-discussed section, there occur impulses *legno battuto* and *pizzicato* performed consecutively by vl (4.06), vn 1 (4.07) and vc (4.08);

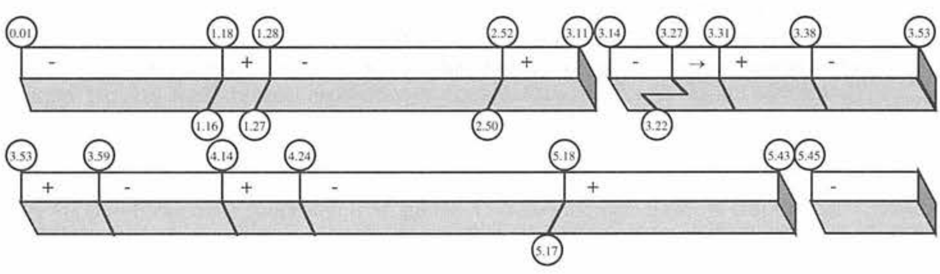
4.24-4.30 (-): another subordinate section representing temporal discontinuity contains five separate taps with nuts or fingertips on sound boards of vl (4.24, 4.30), vc (4.26, 4.28), and vn 2 (4.27);

4.59-5.04 (-): in the main layer of the trajectory the temporal discontinuity returns as late as in 4.59 together with impulses played *legno battuto*, *pizzicato*, tapped with the nut or fingertips on sound boards and struck with the palms of hands on strings *sul tasto*;

5.03-5.14 (❐): a mix of the above-listed percussive effects with long-lasting tremoli *arco* and *col legno*;

5.13-6.00 (+): tremoli oust the momentary sounds and start the final section. In its course they are superseded consecutively by long-lasting sounds *vibrato* and *senza vibrato*. In 5.45-6.00 there occurs tremolo *col legno* in vc, then very long sounds in the three remaining instruments.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



0.01-1.17 (-): separate lines of single tones, moving independently up and down in individual instruments *senza arco* (0.01-20), are joined by clicks *legno battuto* between bridge and tailpiece (0.16-20). Beginning from 0.21, an assortment starts of individually discernible, point-like sound effects produced by striking the strings with the palm of the hand *sul tasto*, tapping the sound boards with the nut or fingertips, *legno battuto* and *pizzicato*;

1.16-1.27 (+): dissonant double- and triple-stops arising by octave dispersion of minimal clusters as sets of two or three pitches at the distance of minor or major seconds (vn 1 in 1.17-1.27: c^1-b^1, b^1♭-a^2-a^3♭; vn 2 in 1.16-1.26: f^1♯-g^2♯, f^1-c^2-d^3♭; vl in 1.17-1.27: f-e^1, d^1-e^1♭-e^2; vc in 1.26-27: g^1-b^1-f^2♯); these substitute here for regular clusters, whose possibility in the low register is very limited because of differences in range between instruments of the string quartet. In vc, for a practical reason, the pitch E♭ is joined not by its upper seventh or ninth, but by G as the tone of the next-lowest unstopped string (1.17-24);

1.27-2.51 (-): strikes on strings with the palm of the hand, taps on sound board with the nut or fingertips, pizzicati, spiccati, clicks *legno battuto* and individual tones performed either *arco* or *col legno* all produce spatially discontinuous sound phenomena;

2.50-3.10 (+): band of highest possible tones played in front of (vn 2, vc) and behind the bridge (vn 1, vl);

3.14-3.26 (-): pitches e^1 (vl 9.14-20), E♭ (vc: 3.21), and d^2 (vn 1: 3.21-26);

3.22-3.30 (→): build-up of a semitone cluster, b♭-c^1♯, by addition of successive tones (c^1♯ in vn 2: 3.22; c^1 in vc: 3.24; b in vl: 3.26; b♭ in vn 1: 3.28);

3.31-3.38 (+): semitone cluster b♭-c^1♯ (3.31-34), transposed by harmonics up to b^2♭-c^3♯ (3.34-36), and double stops constituting mainly an octave displacement of minor seconds (vc: C-d♭; vn 2: a-g^1♯; vn 1: g-f^1♯) as substitutes for a low-register cluster. That function, assigned for the second time to dissonant intervals in this piece, is confirmed here by a particular mutual relationship between pitches of vn 1 and 2, which form a semitone cluster f♯-g-g♯-a divided between two octaves;

3.38-3.52 (-): single pitches B♭ (vc), c^1♯ (vl), b (vn 2) and c^1 (vn 1) introduced successively and followed by glissandi upwards (3.38-39), then highest possible tones of vn 2 and vl as well as G and a♭ in vc and vn 1 respectively;

3.53-3.58 (+): four sixths, in semitone distances, result in two semitone clusters f♯-a and d^1-f^1;

3.59-4.14 (-): B♭ in vc (3.59-4.01), then different pitches spread across the musical space (4.01-4.04), and a single pitch g (4.04-4.14);

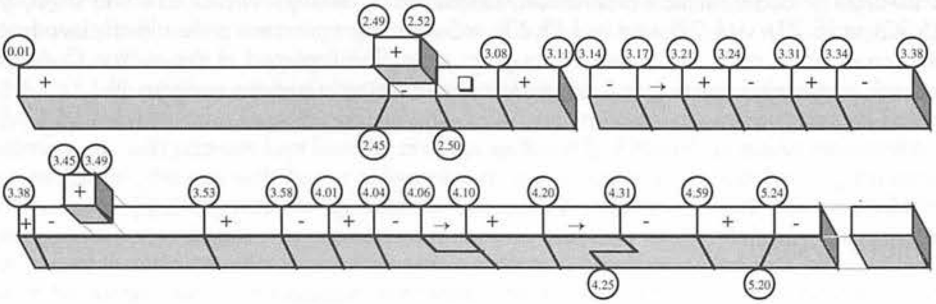
4.14-4.23 (+): pitches f (vc), f♯ (vl), g (vn 2) and a♭ (vn 1) are crowded in the middle register and move outwards in short glissandi *vibrato* (4.14-16), followed by the bowing of tailpieces of all four instruments;

4.24-5.17 (-): taps on sound boards with nuts or finger tips (vn 2, vl, vc: 4.24-30) and a single pitch g (vn 1: 4.25-42), then several other individual tones of both definite (f♯ in vc: 4.33-45; a^2♭ in vn 2: 4.50-56) and indefinite pitch, the latter being represented by highest possible tones of vn 1, vc, vl as well as by play between bridge and tailpiece of vn 2 (*sul E*: 4.37-49) and vl (*sul C*: 4.38-47). In 4.59-5.17 occur percussive clicks of sound board tapped with the nut or fingertips, striking strings with the palm of the hand, *legno battuto* between bridge and tailpiece, as well as individual definite pitches spread across the musical space;

5.17-5.42 (+): the semitone cluster b-f^1♯ is reduced to d^1-f^1;

5.45-6.00 (-): distant, long-lasting tones of both definite (D♭: vc) and indefinite pitch (vn 1, vn 2, vl).

LOUD DYNAMICS VS. SOFT DYNAMICS



0.01-2.47 (+): the initial *ff sempre* covers almost half of the entire piece. The occasional decrescendi, which lead to no definite dynamic level, enhance the long-lasting tremoli (vn 2: 2.23-24, 2.33-35; vc: 2.24-26, 2.35-36; vn 1: 2.37-38) yet do not affect the uniform dynamic character of this section;

2.45-2.50 (-): sustained sounds *pp* (vc: 2.45-47), *pp diminuendo* (vn 1: 2.48-50) and *p diminuendo* (vl: 2.46-48). The dynamic markings *mf diminuendo* and *f* do not aim at fixing a particular level of loudness, but merely indicate a stronger performance in order to ensure the audibility of a harmonic in vn 2 (2.47-50) and of the col-legno playing *sul ponticello* in a low register of the vc (2.48), respectively;

2.49-2.51 (+): impulses *pizzicato* and *legno battuto ff* (vl, vc: 2.48-49; vn 2: 2.50);[2]

2.50-3.08 (❐): juxtaposition of numerous crescendi (vn 2, vc: highest possible tone) and diminuendi (vn 1, vl: playing between bridge and tailpiece) between *pp* and *f* results in simultaneous yet different dynamic levels and hence in a total mediative term;

3.08-3.10 (+): from the dynamic wavering of the previous section a single high dynamic level *f* crescendo emerges in the whole quartet;

3.14-3.16 (-): vl sola *pppp* occurring after a rest;

3.17-3.20 (→): crescendo from *pppp* to *f*;

3.21-3.23 (+): *f* (vl) and *ff* (vn 1, vn 2, vc);

3.24-3.30 (-): sudden dynamic drop, *subito pp*, on sustained notes of vn 1 and 2, then *ppp* in vc (3.24), vl (3.25) and vn 1(3.28);

3.31-3.34 (+): *fff*;

3.34-3.37 (-): *p* diminuendo;

3.38 (+): sharp stroke, *sff, legno battuto*;

3.38-3.52 (-): soft dynamic is restored by pizzicati glissandi *p* performed successively by all instruments (3.38-40), then prolonged by *pp* tremoli of vn 2 and vl;

3.45-3.48 (+): *legno battuto* impulses *f* (vn 1, vc) in a superimposed section;

3.53-3.58 (+): in the main layer of the trajectory, the high dynamic level is fixed by all instruments of the quartet playing synchronized repetitions of double-stops *fff* and an accent *pizzicato sff*;

3.58-4.01 (-): soft dynamic returns in glissandi after an impulse *pizzicato sff* and is kept *pp* by vc;

4.01-4.04 (+): pizzicati *f* in all four stringed instruments;

4.04-4.10 (-): *p* (vn 2);

4.06-4.10 (→): dynamic gradation from *pp* (vn 1: 4.07) through *p* (vc: 4.08) to *f* (vl: 4.08-09; vn 1: 4.09-10). The comparatively loud initial impulse *mf* (vl: 4.06) enables audibility of this superimposed section at its onset and compensates for the weakness of *legno battuto* play;

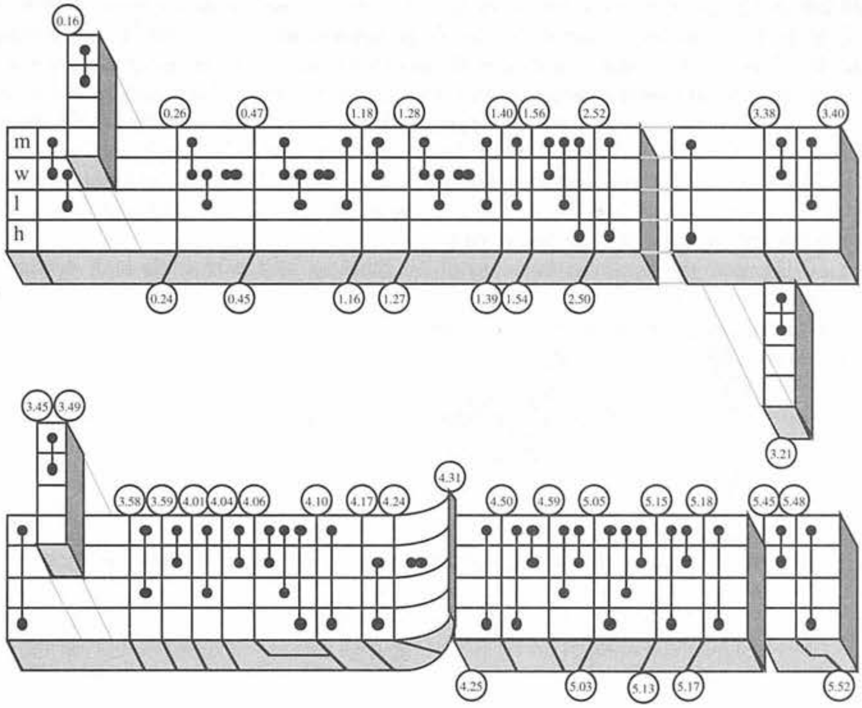
4.10-4.20 (+): the uniform dynamic *ff*, in 4.17, is superseded by *fff* assigned to the effect of bowing tailpieces;

---

[2] The lack of *ff* dynamic mark in the vc part (2.49-50) is an error in the score.

4.20-4.30 (→): dynamic decline indicated first by decrescendo (vl, vc: 4.21-23), then by gradually lower dynamic markings *mf* (vl: 4.29), *p* (vc: 4.26; vn 2: 4.27) and *pp* (vc: 4.28; vl: 4.30);
4.25-4.58 (-): even before the end of the previous section a soft dynamic zone is initiated by *pppp* in vn 1 (4.25-42) and vc (4.33-45). Subsequently there occur subtle dynamic shades, *pp* and *ppp*;
4.59-5.23 (+): *f sempre*, from 5.17 strengthened up to *ff*;
5.20-6.00 (-): loud dynamic is progressively supplanted by *subito pp* introduced consecutively by vn 2 (5.20), vc (5.21), vl (5.22), and vn 1 (5.23). In 5.42 a slight alteration of the already low dynamic level comes about by a simultaneous change to *pppp*. The final part of this section (5.45-6.00) proceeds in dynamics *ppp* (vc, vn 1, vl), then in *pppp* ceasing in a diminuendo (vn 2).

Timbre system



0.01-0.25 (wm,wl): compound instrumental technique *senza arco*, in which the string is set into vibration by pressing it strongly with the finger with simultaneous trilling, results in an interaction of both the string and the finger with the wood of the fingerboard (wm, wl). Beginning from 0.20 the same juncture of material pairs is taken over by striking the strings with the palm of the hand *sul tasto*;
0.16-0.20 (wm): *legno battuto* playing on strings between bridge and tailpiece, performed simultaneously with *senza arco* articulation, fixes a subordinate segment of the timbre trajectory;

0.24-0.46 (wm, wl, ww): striking the strings with the palm of the hand (wl, wm) is joined gradually by tapping the sound board with the nut or fingertips (ww) and by *legno battuto* (wm);

0.45-1.17 (wm, wl, ww, ml): the foregoing process of articulatory diversification is completed together with the occurrence of *pizzicato* (ml);

1.16-1.27 (wm): *legno battuto* and *col legno* (vn 2: 1.16-26; vn 1, vl, vc: 1.17-27);

1.27-1.39 (ml, wm, ww, wl): a return to the set of instrumental techniques including *legno battuto* (mw), *pizzicato* (ml), striking the strings with the palm of the hand *sul tasto* (wm, wl) and tapping the sound board with the nut or fingertips (ww);

1.39-1.55 (ml): *pizzicato* retained after cancellation of the remaining ways of playing;

1.54-2.51 (ml, mw, mh): *legno battuto*, *col legno* (mw) and *arco* (mh), as newly introduced types of articulation, mix with pizzicati kept from the previous section (ml). If treated as regular representatives of a material pair, the taps with the nut or fingertips on sound boards (ww), fused among the above-listed effects in 1.54-2.16, would bring wood as the second (in addition to metal) main material of this segment. However, a double main material as a complex mediative term of the active opposition "m vs. w" would threaten here the logic of the timbre trajectory, being preceded and followed by the same of the contrary terms. This suggests that tapping the sound board occurs here regardless of the material combination represented by it as an instrumental technique relevant exclusively for the basic, but not for the timbre system. It reverts thus to a previous use of the discussed sound generation process in *Threnody*;

2.50-3.37 (mh): *arco* play before and behind the bridge (2.50-3.10), then ordinarily only;

3.21 (mw): single beat *legno battuto* (vc) in a subordinate layer;

3.38 (mw): *legno battuto* impulse performed simultaneously by all four instruments;

3.38-40 (ml): pizzicati;

3.40-3.57 (mh): *arco* (vn 2, vl);

3.45-3.48 (mw): impulses *legno battuto* occurring in vn 1 and vc (mw) build up another secondary section;

3.58 (ml): pizzicato;

3.59-4.01 (mw): vc *col legno*;

4.01-4.04 (ml): pizzicati in all instruments;

4.04-4.10 (mw): vn 2 *col legno*;

4.06-4.10 (mw, ml, mh): against the background of the long-lasting tremolo *col legno* (vn 2), there occur impulses *legno battuto* played by vl (4.06) and vc (4.08), *pizzicato* on vn 1 (4.07) and tremoli *arco* in vl and vn 1 (4.08-10);

4.10-4.16 (mh): the whole quartet plays *arco*;

4.17-4.23 (wh): bowing on tailpieces which in the discussed piece are treated, in accordance with their real material make-up, exclusively as representatives of wood;

4.24-4.30 (ww): tapping the sound boards of vn 2, vl and vc with nuts or fingertips. In the context of the following segment, this effect appears to stray from the main course of the timbre trajectory;

4.25-4.49 (mh): *arco* playing in vn 1, then also in the remaining instruments;

4.50-4.58 (mh, mw): *col legno* (vn 2) and *arco* (vc, vl, vn 1);

4.59-5.04 (mw, ml): a variety of pizzicati (ml), beats *legno battuto* (mw) and strikes on strings with the palm of the hand (wm). As regards tapping the sound boards with the nuts or fingertips, see section 1.54-2.16;

5.03-5.14 (ml, mw, mh): the aforementioned playing techniques are joined by long-lasting tremoli *arco* (mh) and *col legno* (mw);

5.13-5.17 (mh, mw): *col legno* and *arco*;

5.17-5.42 (mh): traditional *arco* playing in all instruments;

5.45-5.51 (mw): vc *col legno*;

5.48-6.00 (mh): *arco* between bridge and tailpiece (vn 1 and vl) and ordinarily (vn 2).

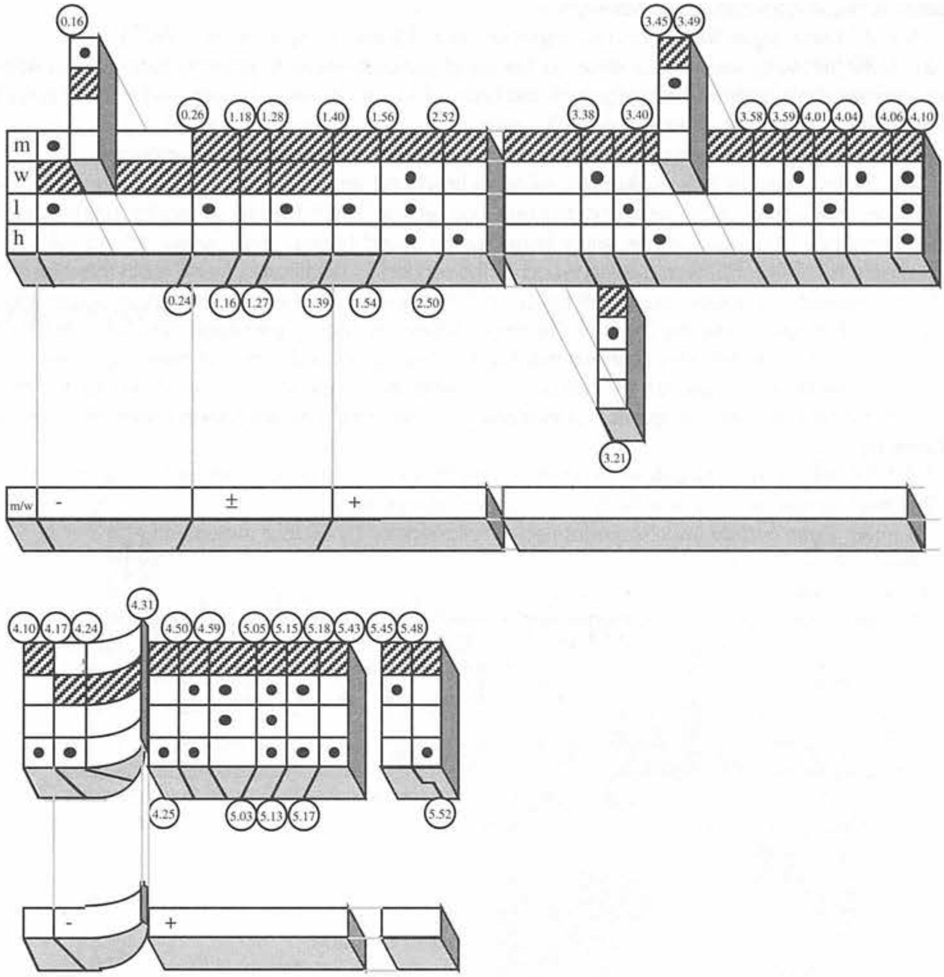


Figure 61. Timbre trajectory of String Quartet No. 1 and its active material opposition

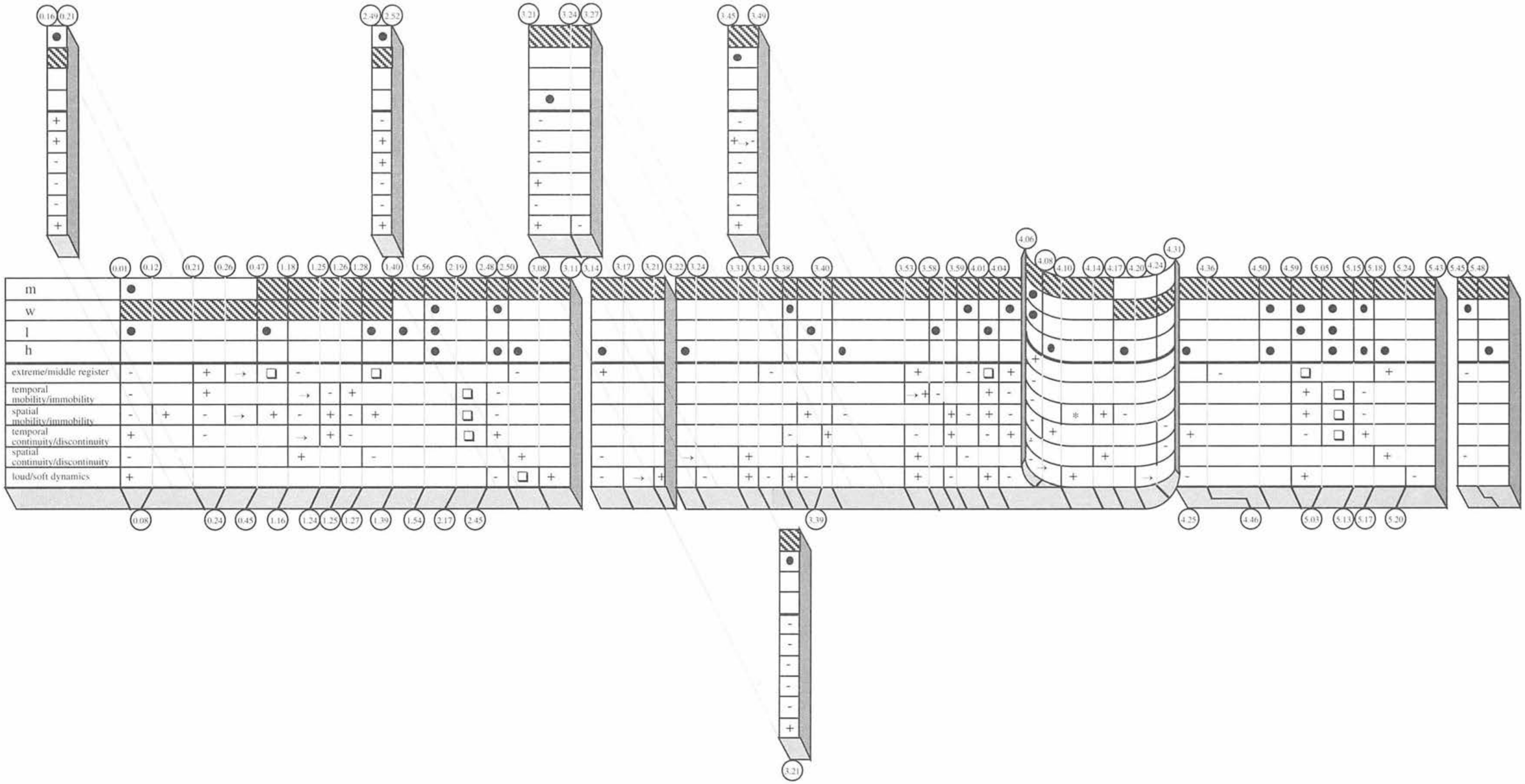


Figure 62. Summary chart of String Quartet No. 1

8.5. **POLYMORPHIA (1961)**

Articulation

The score calls for an ensemble of 48 strings, consisting of 24 violins (vn), 8 violas (vl), 8 cellos (vc), and 8 contrabassi; these last are termed here *violbassi* and hence marked with the abbreviation vb. All the strings participate in the sound generation processes shown in the following diagram:

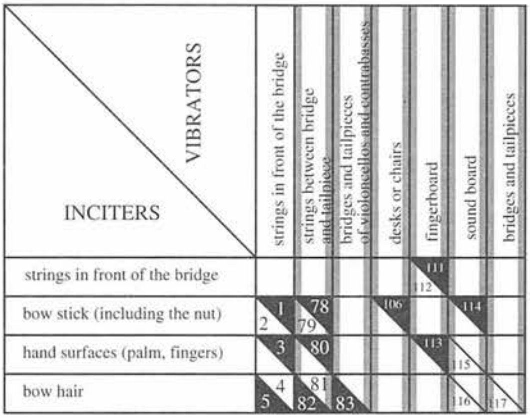


Diagram 7. Processes of sound generation in *Polymorphia*

Basic system

Polymorphia is the only one of Penderecki's sonoristic works whose subsystem embraces all eight categories of the basic system and, as such, is identical with the full state of *langue* as reconstructed above in Part One:

high register vs. low register
middle register vs. extreme registers
temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
temporal mobility vs. temporal immobility
maximal time-span vs. minimal time-span
spatial mobility vs. spatial immobility
loud dynamics vs. soft dynamics

Also, the articulatory definition of the category "temporal continuity vs. discontinuity" in this piece is for the first time in compliance with the regular definition described in Chapter 6.2. As for interdependencies between categories, there exists only one partial redundancy, between "temporal mobility vs. immobility" and "temporal continuity vs. discontinuity", which occurred earlier in the String Quartet:

temporal continuity vs. discontinuity	positive term (+)	⇒	negative term (-)	temporal mobility vs. immobility
	negative term (-)	⇐	positive term (+)	

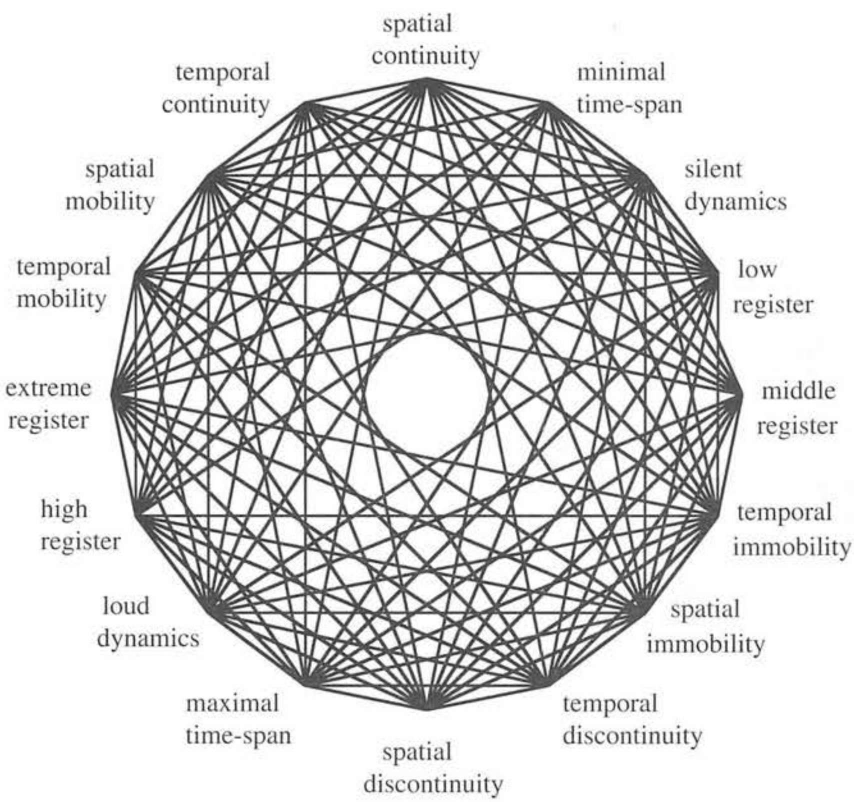
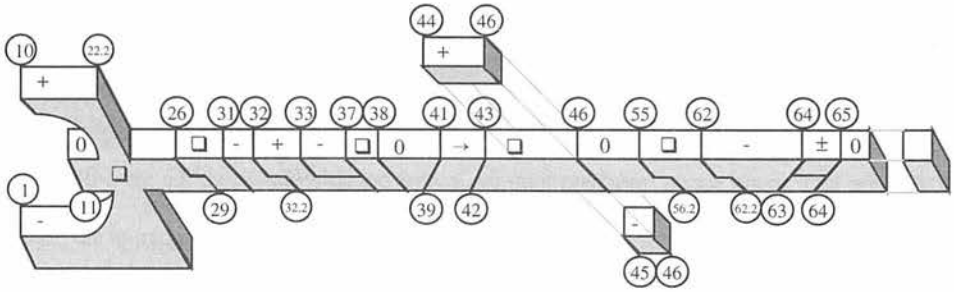


Figure 63. Rosette of the system in *Polymorphia*

HIGH REGISTER VS. LOW REGISTER



1-22.1 (-): the piece emerges from the lowest register. Its first pitch is E gradually expanded to produce the cluster C-A♯ in vb (5), then joined by C as the lowest possible tone of vc 1-4 (6) and by the cluster C♯-B in vc 1-8 (7). Further spatial expansion of this layer happens by means of (graphically notated) glissandi of an irregular course. These proceed within a range whose lower border is defined by the position of both clusters as established previously, and whose upper border reaches approximately up to clusters c-a for vb (17.5-22.1) and e-d1 for vc (19-21);

10-22.1 (+): a parallel layer occurs together with highest possible tones of vn 1-12 as a band expanded downwards by means of periodic, sinusoidal glissandi of individual instruments downwards and upwards (16.3-18), and by irregular glissando movement of the whole cluster whose upper limit is marked by highest possible tones (19-22.1). Earlier, the process of widening the spatial reach of this layer is assisted by vn 13-18, which are introduced consecutively in whole tone distances (from a^3 downwards to b^2) and perform an irregular glissando within the space of approximately one and half octaves below their initial tones (13-22.1), as well as by glissando movement of vn 19-24 (15-22.1) around their initial cluster $b^{1\flat}$-$g^{2\sharp}$;

11-28 (0): vl open up a third layer of the trajectory. They are introduced consecutively in semitone distances (downwards from d^1 to g, 11-14.1) and perform irregular though periodic glissandi, indicated by graphic notation, within ranges reaching approximately one and half octaves above their initial pitches (11-24.3). From 22 on the middle register is taken over by tapping on strings of vc between bridge and tailpiece (vc 1-4: sul C; vc 5-8: sul D) and from 24.3 on, after cancellation of vl, also by a quarter-tone cluster g-$f^{1\sharp}$ in vn (vn 1-12: $c^{1\sharp}$-$f^{1\sharp}$ in 24.3-27; vn 13-24: g-c^{1+} in 24.3-28). Spatial expansion of the layers representing the extreme registers leads to the gradual elimination of gaps between high, middle, and low registers and to a unification of the musical space. This process reaches its goal in 19, after the glissando movement of clusters in vn 1-12 and in vc is set up. From this point on, the three originally separated layers fuse into an integrated musical space, evenly filled with sounds, which constitutes a total mediative term of the opposition (❐). Still, the cancellation of the high and low registers (22.1) proves that, from among the three layers being unfolded at the same time, it is the middle register that is primary. It finds its continuation in the following course of the trajectory;

26-30 (❐): tapping the strings of vc between bridge and tailpiece, as a middle register effect retained from the previous section, is completed throughout the whole musical space by playing between bridge and tailpiece on vn 1-12 (28-29: *sul D e G*) and vn 13-24 (29: *sul E ed A*), vl (26-29: *sul G e C*) and vb (29-30: *sul A ed E*) as well as by tones of vb a fourth apart and filling the space between C and b (27-28);

31-32.1 (-): the range covered here is E-g—the lowest possible range if, as is the case, eight vl and eight vc are supposed to create a uniform semitone cluster. This is so since the 8 lowest pitches available to vl are those between c and g, while the 8 next lower pitches of vc go down to E;

32-36 (+): highest possible tones of violins *pizzicato* are expanded to the cluster g^2-c^4;

33-36 (-): in a secondary layer there occur two types of chords: one of them covers the space $\underline{C}$-g^2 (vl 1-4, vc 1-4, vb 1-4), and the other ranges from A up to g^1♯ (vl 5-8, vc 5-8, vb 5-8). The classification of both chords as representatives of the low register is predetermined mainly by the fact that the first of them begins on the lowest possible note of the vb, while the exceptionally high upper limit of this chord and the location of the other one stem here from so-called subsegmental regulations (discussed below in Chapter 12) that go beyond the basic system of Penderecki's sonorism. The spatial expansion downwards of the layer of vn aims to eliminate the gap between high and low registers, and to unify the musical space within the range $\underline{C}$-c^4 which is attained at the very end of 36 ($\underline{C}$-g^2: vb, vc, vl; g^2-c^4: vn). Therefore the widening of the cluster in the violins in 35-36 can be seen at the same time as a transition from a complex (±) to total (❐) mediative term of the opposition, and hence as a gradual fusion of two layers;

37 (❐): the total sound space, reaching from the lowest possible tone of vb ($\underline{C}$: vb 5-8) up to the highest possible tone of vn, is covered evenly by *pizzicato* impulses in all instruments;

38-40 (0): repetitions of a percussive effect, that of striking the strings with the palm of the hand (vn 1-12), bring about a neutral middle register;

39-42 (→): the middle register is widened by the gradual introduction of new instrumental groups (vl from 39, vb from 40, vc and vn 13-24 from 41) and the progressive differentiation of the sound effects they make. Apart from striking the strings with the palm of the hand, an effect appearing now in vb (40-41) and vn 13-24 (41-42), there occur also series of impulses produced by alternation of two atypical techniques of playing: tapping the desk with the bow or the chair with the nut and tapping the upper part of the sound board (vl: 39-41; vc, vn 1-12: 41-42);

42-45 (❐): series of articulatory effects introduced first in vl and vb (42-45), then also in vn and vc (43-45) display highest variety: tapping the upper part of the sound board with fingertips, tapping the desk with the bow or the chair with the nut, play *legno battuto* between bridge and tailpiece, and highest possible tones *pizzicato*. Possibly, the choice of effects is somewhat influenced by the needs of notation, since all of them can be written without need of a staff (see Chapter 13). Notably, striking the strings with the palm of the hand, the effect that began the process of articulatory diversification, does not occur here;

44-45 (+): the highest possible tones of vn 1-6 and 13-18, vl 1-4 and vc 1-4 form a superimposed, subordinate section;

45 (-): another secondary layer includes the whole-tone cluster $\underline{C}$-$\underline{F}$♯ of the lowest tones accessible to vb;

46-56.1 (0): after cancellation of the two subordinate layers of the trajectory, a new section of the main layer starts. It brings a middle register represented by the single pitch a (46-51; vc 1-4 until 52), then by a quarter-tone cluster built around a (g-a♯: vn 7-14 in 52-56, vl in 54-55, vb in 53-55) that widens gradually to e-a♯ (vb in 56.1);

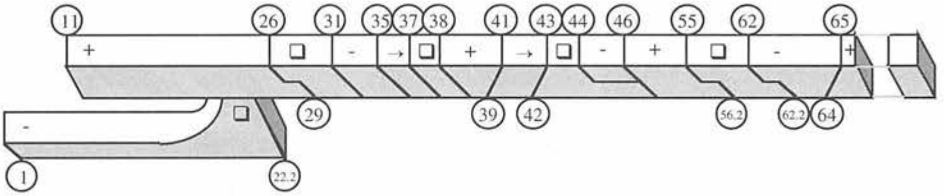
55-62.1 (❐): the introduction of vc in 55 inaugurates a zone of sound phenomena situated in different parts of the musical space;

62-63 (-): a definitively low register is established by clusters $\underline{E}$-F (vb: 62-63) and C-G (vc: 62-63.1);

63-64 (+)(-): juxtaposition of two contrasting sections: one of them is represented by the play between bridge and tailpiece in vn and vl, which produces high sounds of indefinite pitch, the other by bowing bridges and tailpieces of vc and vb, bringing about a jar in the low register;

64-67 (0): several clusters crowded in the middle register (vn 1-12: g♯-d^1 in 64-65; vn 13-24: g-c^{1+} in 64.2-65; vl: d♭-a♭ in 64.2-65; vc a+-c^1♯ in 65; vb: B-c^1 in 65) are followed by a C major triad (67: C-c-e-g-c^1).

MIDDLE REGISTER VS. EXTREME REGISTER



1-22.1 (-): lowest possible tones of vb ($\underline{E}$, then $\underline{C}$-$\underline{A}^\sharp$: 1-17.4) and vc (C in 6; then C♯-B: 7-18) combine with the highest possible tones of vn 1-12 (10-18), thereby establishing the extremes of the sound space. Their reaches are gradually widened by glissandi of individual vn 13-28, starting from pitches within the range a^3-b^2 (13-22.1) and of a cluster beginning from $b^{1}\flat$-$g^{2}\sharp$ in vn 19-24 (15-22.1), as well as by a glissando that enlivens the clusters of vb (17.4-22.1), vc (19-21), and vn 1-12 (19-22.1);

11-28 (+): irregular glissandi of vl, starting from pitches a semitone apart within the range d^1-g, inaugurate a parallel layer of the trajectory, which in its further course proves to be the main layer. Beginning in paragraph 22, this layer is prolonged by playing between bridge and tailpiece in vc (1-4: *sul C*; 5-8: *sul D*) and by the quarter-tone cluster g-$f^{1}\sharp$ in vn (vn 1-12: 24.3-27; vn 13-24: 24.3-28). Earlier, the process of gradual inward expansion of the extreme registers results in the unification of the sound field after the introduction of glissandi in vn 1-12 and vb in paragraph 19. From then on, the two layers thus fuse temporarily into a total mediative term of the category (❐);

26-30 (❐): playing between bridge and tailpiece, continued by vc and newly introduced by vl (*sul G e C*: 26-29), vn 1-12 (*sul D e G*: 28-29), vn 13-24 (*sul E ed A*: 29) and vb (*sul A ed E*: 29-30), fills in the upper part of the sound space. Its lower part is covered by definite pitches, all separated by the interval of a fourth, between $\underline{C}$ and b in vb (27-28);

31-34 (-): the cluster E-g (vl, vc: 31-32), together with the subsequent chords in the ranges $\underline{C}$-g^2 and A-$g^{1}\sharp$ (vl, vc, vb: 33-36), represents the low register combined in this section with the highest possible notes of vn (32-34);

35-36 (→): the progressive expansion of the band of highest possible tones (vn) forms a transition from a negative to the total mediative term of the category, in that it aims at gradual filling in the gap between the low ($\underline{C}$-g^2) and high (g^2-c^4) registers;

37 (❐): the whole sound field is covered evenly by pitches reaching from the lowest possible note of vb ($\underline{C}$) up to the highest possible notes of vn;

38-40 (+): repetitions of the percussive effect of striking strings with the palm of the hand (vn 1-12);

39-42 (→): a progressive diversification of instrumental techniques takes place by the addition of two new ways of playing—tapping the sound board with fingertips and tapping the desk with the bow or the chair with the nut. These string techniques form series of impulses in vl (39-41), vn 1-12 and vc (41-42) and complement the repetitive strokes on strings with the palms performed by vb (40-41) and vn 13-24 (41-42). The resulting impression of a gradually expanding sound field is additionally supported by the consecutive entry of instrumental groups: vl (39), vb (40), vn 13-24, and vc (41);

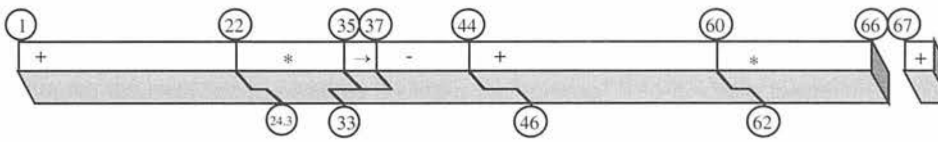
42-45 (❐): the final stage of the expansion starts together with the series of as many as four different articulatory effects—tapping the sound board with fingertips, tapping the desk with the bow or the chair with the nut, *legno battuto* between bridge and tailpiece, and highest possible tones *pizzicato*. They are introduced by vl and vb (42), then by vn and vc (43), whereby spread over the entire musical space;

44-45 (-): a superimposed section of highest possible tones, appearing consecutively in vn 1-6 and 13-18, vl 1-4, and vc 1-4 (44), and joined subsequently by lowest possible tones of vb 5-8 ($\underline{C}$-$\underline{F}\sharp$);

46-56.1 (+): the single pitch a (46-52) and its surrounding zone g-a♯ (52-56.1: vn 7-14, vl, vb), which is widened to e-a♯ in vb (56.1);

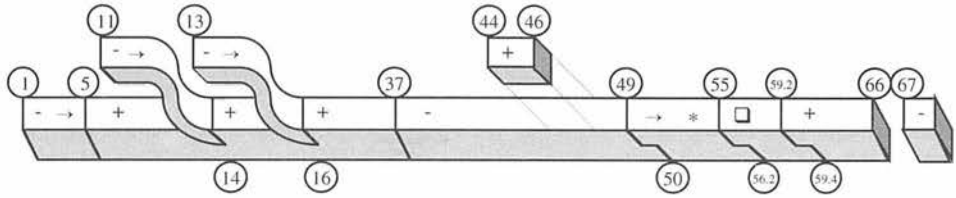
55-62.1 (❐): tones, clusters, and the transitions between them are located in different registers (55-59.3), then clusters fill in the whole sound space from E♭ in vb up to highest possible tones of vn;
62-64 (-): the low register (E-G: vc, vb) is superseded by an imposition of both extreme registers, the latter obtained by simultaneous play between bridge and tailpiece of vn and vl as well as on bridges and tailpieces of vc and vb;
64-67 (+): in the final section, the center of the sound space is marked by a gradually built-up cluster B-d^1 (vn 1-12: g♯-d^1 in 64-65; vn 13-24: g-c^{1}♯ in 64.2-65; vl: d♭-a♭ in 64.2-65; vc: a♭-c^1♯ in 65; vb: B-c^1 in 65), then by a C major triad C-c-e-g-c^1 (67).

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY



1-24.3 (+): long-lasting tones, clusters, and glissandi;
22-34 (*): before the preceding section ends, there occur maximally dense impulses *con dita* on vc, which are joined by series of quickest possible repetitions in vn (24.3) and then in the remaining instrumental groups (vl: 26, vb: 27). Further along, maximally dense repetitions, *legno battuto* played by vl and vc (31-32), make room for temporally condensed series of pizzicati (vn);
35-36 (→): the accelerated glissando in vn creates the impression of progressively enlarged time-spans between individual impulses. The resulting transition, from a border-zone term to the positive term of the category, is here the side-effect of a regular transitional process in the trajectory "temporal mobility vs. immobility";
33-45 (-): against the background of the two above-discussed sections, there occur separated, momentary sounds performed *pizzicato con due dita* by vl, vc, and vb. The resulting temporal discontinuity permeates the whole string orchestra in musical paragraph 37 and, beginning at 38, is continued by several percussive effects;
44-61 (+): long-lasting sounds appear successively in vn 1-6, vl 1-4, vn 13-18, vc 1-4 (44), and vb 5-8 (45). After cancellation of the preceding section, temporal continuity is represented by several bands, single tones, and glissandi, until internally mobile clusters arrive in vn 1-12 (59.3-61.1), vl (59.2-60), vc (59.4-61.1), and vb (60.2-61);
60-65 (*): another case of overlapping sections in this trajectory takes place by the introduction of vibrati (vn 13-18: 60-61.1; vn 1-24: 61.2-62.1; vl: 61-62.1; vc: 61.2) representing the border-zone term, which is subsequently retained by maximally dense repetitions of sounds played with strong pressure of the bow (vc, vb: 62-65; vn, vl: 63-65);
67 (+): the turn back to the positive term in the final, sustained chord intentionally disturbs the logic of the trajectory in its last section. As regards reasons of this composer's intention, see Chapter 14.2 below.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



1-4 (→): a glissando widens the initial point-like pitch E (vb 1-3: 1) to a cluster;

5-36 (+): a 3/4-tone cluster C-A♯ (vb 1-8) is established in 5, then broadened by addition of the tone C in vc 1-4 (6) and 3/4-tone cluster C♯-B in vc 1-8 (7). In 10 a separate cluster of highest possible tones of vn 1-12 appears. All three clusters are subsequently submitted to internal mobility of component tones (vb: 8-15; vc: 9-13; vn1-12: 16.4-18) and set into glissando movement (vb: 17.5-22.1; vc: 19-21; vn 1-12: 19-22.1). The latter is initiated by a whole-tone cluster b¹♭-g²♯ in a new adjoining group of vn 19-24 (15-22.1). Further on, the spatial continuity is maintained by clusters of different densities. These range from bands created by playing between bridge and tailpiece (vc: 22-29; vl: 26-29; vn 1-12: 28-29; vn 13-24: 29; vb: 29-30) and by stratification of highest possible tones (vn: 32-35), through quarter-tone (vn 1-12: 24.3-17; vn 13-24: 24.3-28), semitone (vl, vc: 31-32; vn: 36), and whole-tone clusters (vl 5-8, vc 5-8, vb 5-8: 33-36), to rare dispositions of component tones evenly spaced in fourths (vb: 27-28; vl 1-4, vc 1-4, vb 1-4: 33-36). In the case of the latter, fourth clusters, the impression of spatial continuity—in spite of the rather large distance between tones—arises due to the fact that both of them represent a low register, in which the discernibility of single pitches by a listener is significantly lower than if they were in a higher register;

11.1-13(→): the logical course of the main layer is reiterated in the subordinate layer of the trajectory, beginning with a single glissando tone of vl 1 (d¹) to which further instruments of the same group are gradually added in semitone distances (vl 2-8: d¹♭-g);[1]

14-24.3 (+): the goal of the foregoing transition is reached, together with introduction of the last, eighth viola (14). From here on, the glissandi crowded into the middle register (vl 1-8) form a spatially continuous phenomenon and fuse with the parallel, main layer;

13-15 (→): meanwhile, consecutive glissando tones in whole-tone distances (vn 13-18: a³-b²) join the initial vno 13, thereby producing another secondary layer of the trajectory, which reiterates once again the transition from spatial discontinuity to continuity;

16-22.1 (+): after arriving at spatially continuous condensation of glissandi within the limited band of frequencies (vn 13-18), this secondary layer also fuses with the main layer of the discussed trajectory;

37-49 (-): in the further course of the main layer, a contrasting section occurs. It includes spatially discontinuous sounds: at first individual pitches (37), then point-like percussion effects of indefinite pitch (striking the strings with the palm of the hand; tapping the sound board with the fingertips; tapping the desk with the bow or the chair with the nut; *legno battuto* between bridge and tailpiece; and highest possible tones *pizzicato*) spread across the entire sound space. In 46 all these atypical articulatory effects are replaced by the single pitch a;

44-45 (+): bands of highest possible tones, introduced consecutively in vn 1-6, vl 1-4, vn 13-18, vc 1-4 (44-45), and a whole-tone cluster of lowest possible tones in vb 5-8 (C-F♯ in 45) form a clearly separate, secondary-layer section;

---

[1] The note d¹, instead of d¹♭, appears in the score as the starting pitch of vl 2 (11.4). This is obviously an error, since it violates the consistent semitone order of pitches by which the violas enter in this section.

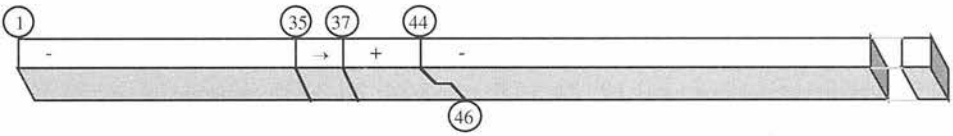
49-56.1 (→*): in the main layer occurs a gradual widening of the pitch a by means of slow and fast vibrati (vl 1-4: 49-50; vc 1-4: 51-52; vn 1-6: 50-51), thin surrounding quarter-tone cluster g-a# (vn 7-14: 52-56.1), and a combination of both (vl: 54-55; vb: 53-56.1);

55-59.3 (❐): the total mediative term embraces single pitches, clusters, and glissando transitions between them, superimposed in several configurations in different instrumental groups, beginning with vc (55), vl and vn 15-21 (56);

59.2-65 (+): internally mobile (vl: 59.2-60; vc: 59.4-61.1; vn 1-12: 59.3-61.1; vb: 60-61) and immobile clusters, the latter being performed also between bridge and tailpiece of vn and vl, and on bridges and tailpieces of vc and vb (63-64);

67 (-): a major triad consisting of the pitches C-c-e-g-c¹ in large, unequal distances in the musical space.

TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY



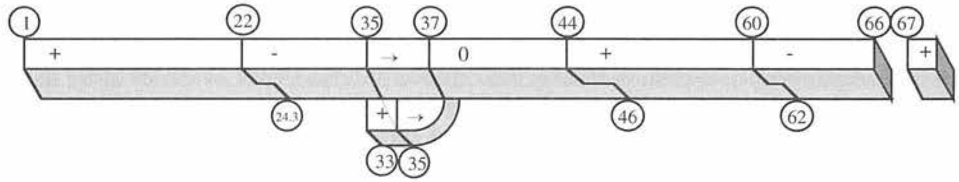
1-34 (-): long-lasting tones, clusters, and glissandi (vn, vb till 22.1; vc till 21; vl till 24) set up the temporal immobility of the initial section, which is subsequently continued by maximally dense impulses *con dita*, *legno battuto* and *pizzicato* (vc: 22-30, vn: 24.3-34; vl: 26-32; vb: 27-30) as well as by single isolated pizzicati *con due dita* (vl, vc, vb: 33-34) as different types of sounds devoid of fixed temporal relationships;

35-36 (→): a transition from temporal immobility to mobility by way of two complementary processes: gradually shortening time-spans between distant, separated chords *pizzicato* in vl, vc, and vb, and the impression of gradually lengthening time-spans between quickest possible repetitions; this last impression arises in the vn from an acceleration of glissando;

37-45 (+): numerous, temporally interrelated impulses *pizzicato* (37), then striking the strings with the palm of the hand, tapping the sound board with fingertips, tapping the desk with the bow or the chair with the nut, impulses *legno battuto* between bridge and tailpiece, and highest possible tones *pizzicato*;

44-67 (-): sustained clusters, occurring already in 44-45 (vn 1-4, vl 1-4, vn 13-18, vc 1-4, vb 5-8), initiate a return to temporal immobility. After the end of the preceding section (46), there follow at first several long-lasting tones, glissandi and vibrati, then maximally dense repetitions obtained by exerting high bow pressure on the strings (62-65.1) and by several irregular changes of the bow (65.2). Also temporally immobile is the final C major chord (67), which lasts five seconds.

MAXIMAL TIME-SPAN VS. MINIMAL TIME-SPAN



1-24.3 (+): extremely long-lasting sounds in all instrumental groups;

22-34 (-): maximally dense impulses *con dita* (vc: 22-29; vl: 26-29; vn 1-12: 28-29; vn 13-24: 29; vb: 29-30), *legno battuto* (vn 1-12: 24.3-27; vn 13-24: 24.3-28; vb: 27-28; vl, vc: 31-32.1) and *pizzicato* (vn 32-34);

35-36 (→): rapidly increasing speed of glissando gives the impression of gradually enlarging time-span values between individual impulses *pizzicato* (vn), which acts as a transition from the negative to the neutral term of the opposition;

33-34 (+): in a subordinate layer, there occur isolated, distant impulses *pizzicato con due dita* (vl, vc, vb);

35-36 (→): the gradual shortening of time-spans between pizzicati (vl, vc, vb) results in a transition from the positive to the neutral term. Both atypical transitional processes, proceeding in parallel in paragraphs 35-36, are side-effects of a regular transition within the trajectory "temporal mobility vs. immobility". They reach their common goal in the following section. There the layers represented by these processes fuse together, and the trajectory under consideration is re-united;

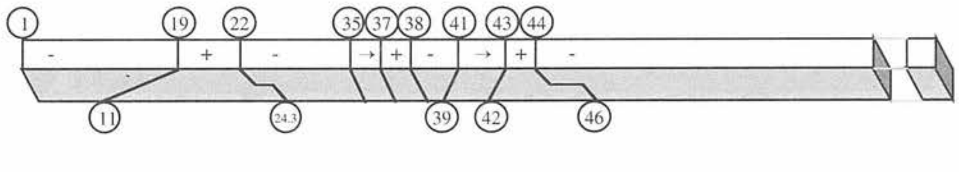
37-45 (0): intermediate temporal distances between *pizzicato* impulses (37), then between momentary sounds produced by atypical instrumental techniques such as striking the strings with the palm of the hand, tapping the sound board with the fingertips, tapping the desk with the bow or the chair with the nut, *legno battuto* play between bridge and tailpiece, and highest possible notes *pizzicato*;

44-61 (+): long-lasting sounds of maximal time-spans occur first in vn 1-6 and 12-18, vl 1-4, vc 1-4 (44) and vb 5-8 (45) alongside the sound phenomena of the previous section, then independently until reaching the internally mobile glissandi of vn 1-12 (59.4-61.1), vl (59.2-60), vc (59.4-61.1) and vb (60-61);

60-65 (-): vibrati introduced successively by individual groups of strings (vn 13-24: 60-61; vn 1-24: 61-62.1; vl: 61-62.1; vc: 61.2) substitute here for maximally rapid repetitions, the latter being subsequently represented by bowing with high pressure (vc: 62-63.1, 65.1; vb: 62-63, 65.1; vn, vl: 63-65.1) as well as by irregular bow changes (vc: 63.2-64; vb: 64; tutti: 65.2);

67 (+): the long-lasting C major chord constitutes a return to the initial section of the trajectory.

SPATIAL MOBILITY VS. SPATIAL IMMOBILITY



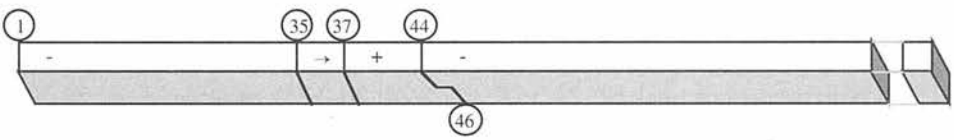
49-56.1 (→*): in the main layer occurs a gradual widening of the pitch a by means of slow and fast vibrati (vl 1-4: 49-50; vc 1-4: 51-52; vn 1-6: 50-51), thin surrounding quarter-tone cluster g-a# (vn 7-14: 52-56.1), and a combination of both (vl: 54-55; vb: 53-56.1);

55-59.3 (❐): the total mediative term embraces single pitches, clusters, and glissando transitions between them, superimposed in several configurations in different instrumental groups, beginning with vc (55), vl and vn 15-21 (56);

59.2-65 (+): internally mobile (vl: 59.2-60; vc: 59.4-61.1; vn 1-12: 59.3-61.1; vb: 60-61) and immobile clusters, the latter being performed also between bridge and tailpiece of vn and vl, and on bridges and tailpieces of vc and vb (63-64);

67 (-): a major triad consisting of the pitches C-c-e-g-c¹ in large, unequal distances in the musical space.

TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY



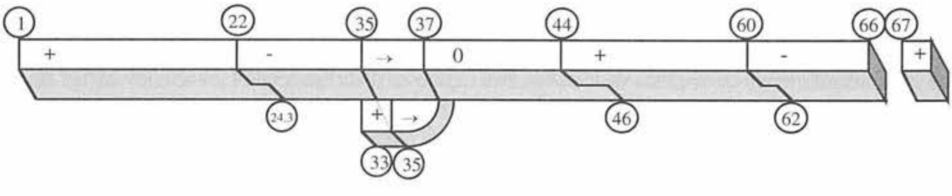
1-34 (-): long-lasting tones, clusters, and glissandi (vn, vb till 22.1; vc till 21; vl till 24) set up the temporal immobility of the initial section, which is subsequently continued by maximally dense impulses *con dita*, *legno battuto* and *pizzicato* (vc: 22-30, vn: 24.3-34; vl: 26-32; vb: 27-30) as well as by single isolated pizzicati *con due dita* (vl, vc, vb: 33-34) as different types of sounds devoid of fixed temporal relationships;

35-36 (→): a transition from temporal immobility to mobility by way of two complementary processes: gradually shortening time-spans between distant, separated chords *pizzicato* in vl, vc, and vb, and the impression of gradually lengthening time-spans between quickest possible repetitions; this last impression arises in the vn from an acceleration of glissando;

37-45 (+): numerous, temporally interrelated impulses *pizzicato* (37), then striking the strings with the palm of the hand, tapping the sound board with fingertips, tapping the desk with the bow or the chair with the nut, impulses *legno battuto* between bridge and tailpiece, and highest possible tones *pizzicato*;

44-67 (-): sustained clusters, occurring already in 44-45 (vn 1-4, vl 1-4, vn 13-18, vc 1-4, vb 5-8), initiate a return to temporal immobility. After the end of the preceding section (46), there follow at first several long-lasting tones, glissandi and vibrati, then maximally dense repetitions obtained by exerting high bow pressure on the strings (62-65.1) and by several irregular changes of the bow (65.2). Also temporally immobile is the final C major chord (67), which lasts five seconds.

MAXIMAL TIME-SPAN VS. MINIMAL TIME-SPAN



1-24.3 (+): extremely long-lasting sounds in all instrumental groups;

22-34 (-): maximally dense impulses *con dita* (vc: 22-29; vl: 26-29; vn 1-12: 28-29; vn 13-24: 29; vb: 29-30), *legno battuto* (vn 1-12: 24.3-27; vn 13-24: 24.3-28; vb: 27-28; vl, vc: 31-32.1) and *pizzicato* (vn 32-34);

35-36 (→): rapidly increasing speed of glissando gives the impression of gradually enlarging time-span values between individual impulses *pizzicato* (vn), which acts as a transition from the negative to the neutral term of the opposition;

33-34 (+): in a subordinate layer, there occur isolated, distant impulses *pizzicato con due dita* (vl, vc, vb);

35-36 (→): the gradual shortening of time-spans between pizzicati (vl, vc, vb) results in a transition from the positive to the neutral term. Both atypical transitional processes, proceeding in parallel in paragraphs 35-36, are side-effects of a regular transition within the trajectory "temporal mobility vs. immobility". They reach their common goal in the following section. There the layers represented by these processes fuse together, and the trajectory under consideration is re-united;

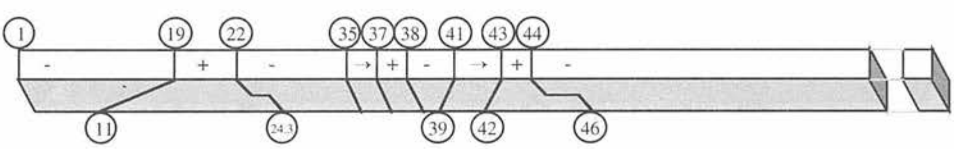
37-45 (0): intermediate temporal distances between *pizzicato* impulses (37), then between momentary sounds produced by atypical instrumental techniques such as striking the strings with the palm of the hand, tapping the sound board with the fingertips, tapping the desk with the bow or the chair with the nut, *legno battuto* play between bridge and tailpiece, and highest possible notes *pizzicato*;

44-61 (+): long-lasting sounds of maximal time-spans occur first in vn 1-6 and 12-18, vl 1-4, vc 1-4 (44) and vb 5-8 (45) alongside the sound phenomena of the previous section, then independently until reaching the internally mobile glissandi of vn 1-12 (59.4-61.1), vl (59.2-60), vc (59.4-61.1) and vb (60-61);

60-65 (-): vibrati introduced successively by individual groups of strings (vn 13-24: 60-61; vn 1-24: 61-62.1; vl: 61-62.1; vc: 61.2) substitute here for maximally rapid repetitions, the latter being subsequently represented by bowing with high pressure (vc: 62-63.1, 65.1; vb: 62-63, 65.1; vn, vl: 63-65.1) as well as by irregular bow changes (vc: 63.2-64; vb: 64; tutti: 65.2);

67 (+): the long-lasting C major chord constitutes a return to the initial section of the trajectory.

SPATIAL MOBILITY VS. SPATIAL IMMOBILITY



1-18 (-): at the outset of the piece, the spatially immobile pitch E expands to a cluster in vb (5-17.4) and vc (6-18). The glissando occasioning this expansion in 1-5 and, as such, taking the transition from negative to positive term of the category "spatial continuity vs. discontinuity", cannot be perceived as a movement because of its slowness and minimal range. In 10, vn 1-12 set up a band of highest possible tones. The constant ranges of the clusters in vb, vc and vn are not threatened by their inner, sinusoidal glissandi upwards and downwards, which take place independent of each other and are played by individual instruments (vb: 8-15; vc: 9-13; vn: 16.4-18). Hence the sinusoidal glissandi are to be interpreted merely as expressive features that do not disturb the spatial immobility of this section;

11-24.3 (+): irregular glissandi of single tones performed independent of each other and by individual vl (11) and vn 13-18 (13). These are joined by glissandi of clusters in the entire instrumental groups of vn 19-24 (15) and vb (17.5). All these glissandi initiate a spatial movement long before the initial section has ended, in this way causing the most striking case of interpenetration within this trajectory. Beginning at 19, glissandi occur also in vc and vn 1-12, whence they spread throughout the whole string orchestra. The retention of vl until 24.3 results in an overlapping with the next, spatially immobile section;

22-34 (-): an extended zone of repetitions which are performed *con dita* between bridge and tailpiece (vc: 22-29; vl: 26-29, vn 1-12: 28-29; vn 13-24: 29; vb: 29-30), *legno battuto* (vn 1-12: 24.3-27; vn 13-24: 24.3-28; vb: 27-28; vl: 31-32.1), and *pizzicato* (vn: 32-34; vl, vc, vb: 33-34);

35-36 (→): a progressive reduction of time-spans that gradually establishes relations between two different chords in vl, vc and vb, and the rapidly increasing speed of glissando that widens the registral band of highest possible tones of vn constitute two complementary ways of transition from spatial immobility to mobility;

37 (+): there occurs a total movement of *pizzicato* impulses spread across the entire musical space;

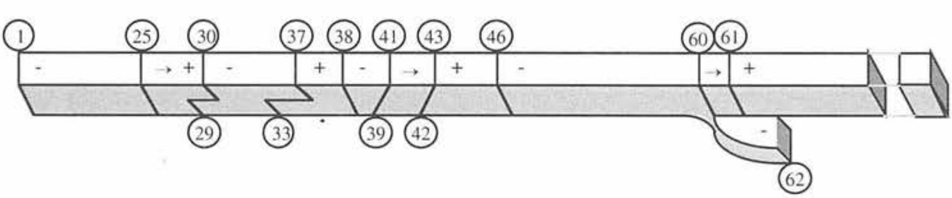
38-40 (-): percussive effect of striking the strings with the palm of the hand, repeated in vn 1-12;

39-42 (→): the increasingly diverse instrumental techniques (striking the strings with the palm of the hand; tapping the sound board with fingertips; tapping the desk with the bow or the chair with the nut) are played by a gradually enlarged set of instruments (vl: 39-41; vb: 40-41; vc, vn 13-24: 41-42) and drive to the next section;

42-45 (+): spatial movement involving sounds of indefinite pitch; these are produced by tapping the sound board with fingertips, tapping the desk with the bow or the chair with the nut, *legno battuto* between bridge and tailpiece, highest possible tones *pizzicato* (vl, vb: 42-45; vn, vc: 43-45);

44-67 (-): static clusters, set up consecutively by vn 1-6 and 13-18, vl 1-4, vc 1-4 (44) and vb 5-8 (45), already initiate the final section. In 46 they are replaced by the pitch a, then by a cluster of its neighbouring pitches g-a♯. The glissandi of instrumental groups, occurring between 55-59.3, serve as a transition between single pitches and clusters and as such are only relevant for the category "spatial continuity vs. discontinuity". The sinusoidal glissando of individual instruments within groups of vl (59.2-60), vn 1-12 (59.3-61), vc (59.4-61.1), and vb (60-61) is an expressive feature that produces internal mobility of clusters but does not threaten their overall static character, which is ensured by constant ranges.

LOUD DYNAMICS VS. SOFT DYNAMICS



1-24 (-): this vast initial section is constantly kept in soft dynamics *ppp*, *pp*, and *p*;

25-29 (→+): the increase of loudness finds its reflection in crescendi (vn: 25, 29; vl: 28-29; vc: 29) and in the succession of dynamic markings proceeding from *pp* through *p* (vn: 26) and *mf* (vl: 26; vn 1-12: 28) to *f* (vn 13-24, vc: 29). The transition, dynamically regressing in vn (*diminuendo*: vn 1-12 in 26-27; vn 13-24 in 26-28), is, however, sustained and pursued by the textural crescendo that takes place by the introduction of new instrumental groups (vl: 26, vb: 27);

29-36 (-): the former section appears to overlap with soft sounds of vb playing p and retained after cancellation of the remaining instrumental groups in 30. Beginning from 31 the already feeble dynamic level is further weakened by a reduction to *pp*, which occurs first in vl and vc (31-32) and is subsequently taken over by vn (32-36);

33-37 (+): another overlapping of sections occurs, when against the vanishing background of vn there occur pizzicati *sff* played by vl, vc, and vb (33-36). In paragraph 37 the loud dynamic *ff* embraces already the whole string orchestra;

38-40 (-): soft dynamics *pp* in vn 1-12;

39-42 (→): crescendo accomplished by a gradation of dynamic markings *p* (vl in 39, vn 13-24 and vb in 41) and *mf* (vn 1-12 and vc in 41), as well as by textural means consisting in enlarging the orchestral forces through introduction of new instrumental groups (vl: 39; vb: 40; vc, vn 13-24: 41);

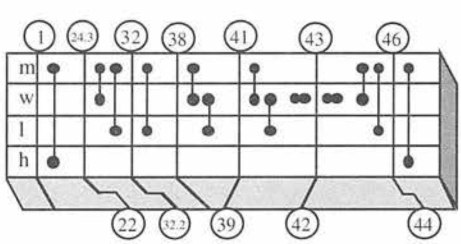
42-45 (+): *f crescendo* (vl, vb: 42) leads to climax *ff* in all instruments (43-45);

46-62 (-): soft dynamics between *pp* and *p*. Vn 1-12, vc and vb are maintained on this dynamic level until paragraph 62. Yet this excessive prolongation of the section results in its deviation from the main layer of the discussed trajectory and, consequently, in a stratification of the latter;

60 (→): within the main layer, the change of section happens already at the crescendo in vl, vn 13-18 and 19-24. The accompanying crescendi of vc, vb, and vn 1-12, which lead only to *p*, exemplify cooperation between overlapping sections;

61-67 (+): the final section sets up a loud dynamic level *ff* introduced consecutively by vl, vc, vn (61), and vb (62). In paragraph 65 there even occurs *fff*, intensified by a crescendo. The last chord (67) returns to *ff*.

Timbre system



1-24.3 (mh): traditional *arco* playing on all stringed instruments, continued by vl until 24.3;

22-32.1 (mw, ml): strikes *legno battuto* on strings before the bridge (mw) in vn 1-12 (24.3-27), vn 13-24 (24.3-28), vb (27-28), vl and vc (31-32.1) as well as taps *con dita* between bridge and tailpiece (ml) played by vc (22-29), vl (26-29), vb (29-30), vn 1-12 (28-29) and 13-24 (29);

32-37 (ml): *pizzicato* introduced by vn (32), then taken over by the remaining instrumental groups as *pizzicato con due dita* (vl, vc, vb: 33);

38-40 (wm, wl): striking the strings with the palm of the hand (vn 1-12);

39-42 (wm, wl, ww): percussive effect of the previous section in vb (40-41) and vn 13-24 (41-42), joined by taps on the sound board with fingertips and strikes on the desk with the bow or on the chair with the nut (vl: 39-41; vc, vn 1-12: 41-42);

42-45 (ml, ww, wm): tapping the sound board with fingertips (ww), tapping the desk with the bow or the chair with the nut (ww), *legno battuto* play between bridge and tailpiece (mw) and *pizzicato* (ml) (vb, vl: 42; tutti archi: 43). All these percussive effects continue till the end of this section, in vn 7-12 and 19-24, vl 5-8, vc 5-8, and vb 1-4;

44-67 (mh): return to the typical *arco* articulation is initiated before the end of the previous section by vn 1-6, vl 1-4, vn 13-18, vc 1-4 (44) and vb 5-8 (45). Bowing the strings between bridge and tailpiece (vn, vl), as well as bridges and tailpieces of vc and vb substituting for the former in the low register, both inserted in 63-64, display a combination of materials "mh" identical with that of ordinary *arco* articulation.

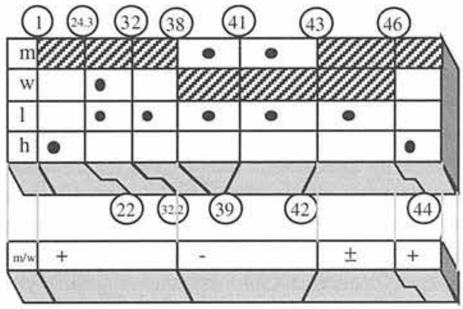


Figure 64. Timbre trajectory of *Polymorphia* and its active material opposition

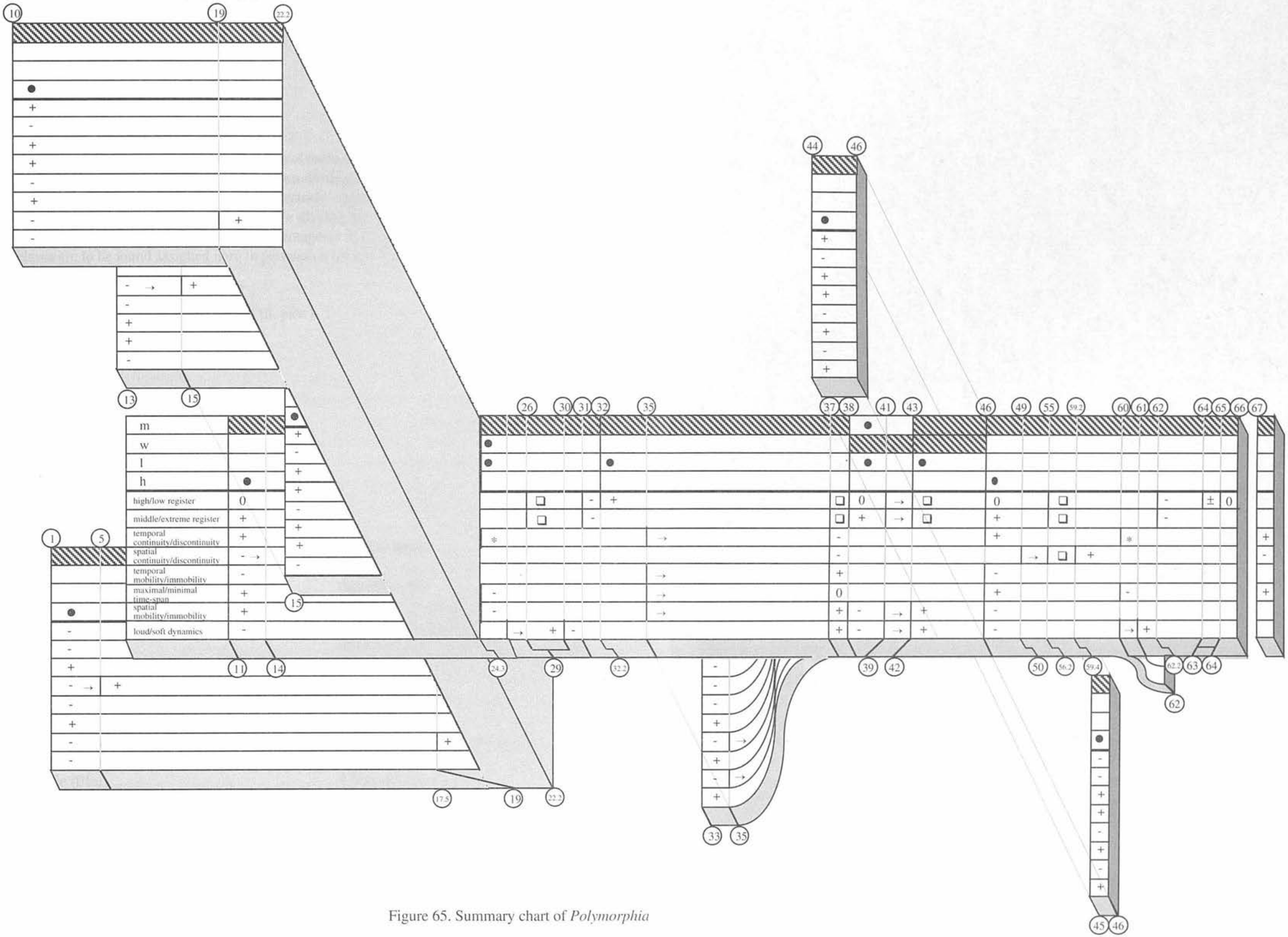


Figure 65. Summary chart of *Polymorphia*

8.6. **FLUORESCENCES (1962)**

Articulation

Fluorescences calls for the most impressive array of performing forces of all Penderecki's sonoristic works. Only in this piece are brass and woodwinds required, along with a massive percussion section. Most striking is undoubtedly the extremely expanded collection of non-musical tools used in the piece.[1] Percussion instruments are divided into six groups—each one for a single percussionist—and in this order listed by the composer at the beginning of the score. Curiously, the claves are to be found assigned here to percussion groups 4 and 5, though this instrument is not used at all during the piece.

4 flutes (fl) interchangeable with 4 piccoli (fl. picc.)
4 oboes (ob)
4 clarinets in B-flat (cl)
4 bassoons (fg)

4 French horns in F (cr)
4 trumpets in B-flat (tr)
3 trombones (tn)
2 tubas (tb)

Percussion groups:

I: suspended soprano cymbal (ptto s)
sheet metal (ltr)
triangle (trgl)
4 wood blocks
bongos (bgs)
whistle (frro)

II: suspended alto cymbal (ptto a)
gong (gng)
vibraphone (vbf)
a piece of glass (vtr)
bongos (bgs)
whistle (ftto)

IV: tam tam (tmt)
claves
raganella (rgl)
2 cowbells (cmpcci)
bass tom-tom (tomt b)
drum and snare drum (tmb. s.c. e c.c.)
whistle (frro)

V: triangle (trgl)
tam tam (tmt)
claves
a piece of iron (frro)
4 timpani (tmp)
whistle (ftto)

[1] In a remark at the beginning of the score the composer allows the jar of those atypical sound sources to be recorded on tape and only played during performance.

III: Javanese gong (gng giav.)
guiro (gro)
tubular bells (cmpne)
flexaton
3 tom-toms (tomts s, a, t)
whistle (ftto)

VI: electric bell (cmp. elttr.)
a piece of wood (lgn)
saw (sega)
typewriter (macchina da scrivere)
sirena
whistle (ftto)

piano (pfte)

24 violins (vn)
8 violas (vl)
8 cellos (vc)
6 contrabassi (vb)

The huge set of instruments forms the basis of an equally large inventory of instrumental techniques. Like the orchestra itself, so also the resources for sound generation processes in *Fluorescences* are the most impressive and differentiated. This is why the articulation of Penderecki's sonoristic pieces has usually been discussed by earlier commentators on the basis of this piece (Erhardt 1975; Schwinger 1989). Indeed, as one can see from Diagram 8, the resources for sound generation processes in *Fluorescences* exploit to the highest extent the field of instrumental techniques of Penderecki's sonorism. Yet even here this field is not employed to the fullest, for some instruments, used earlier in *Anaklasis* and *Dimensions of Time and Silence*, do not appear in the present work.

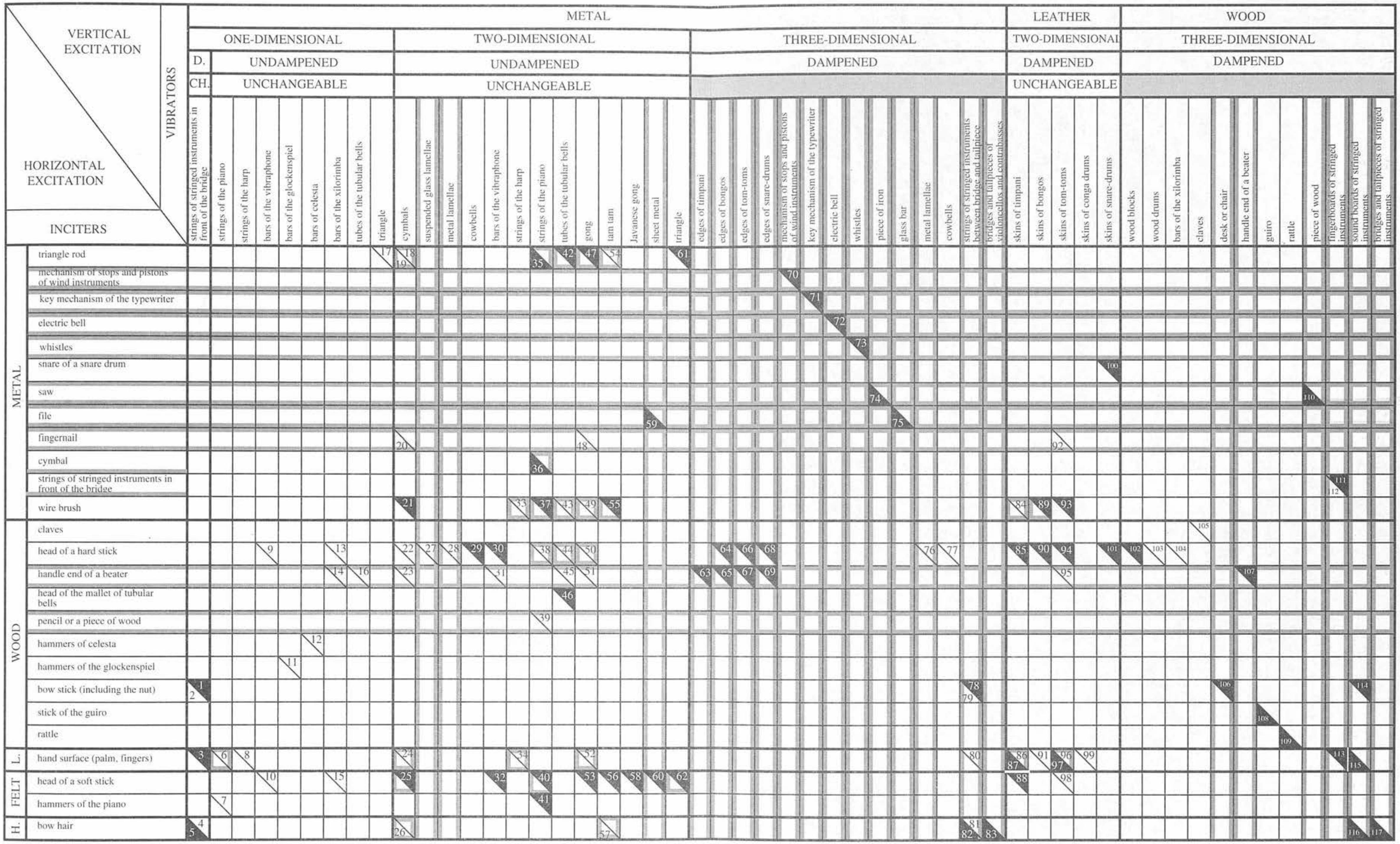
Basic system

The state of the basic system characteristic of *Fluorescences* differs from the fully elaborated *langue* of *Polymorphia* in that it contains only six constitutive categories:

high register vs. low register
temporal mobility vs. temporal immobility
spatial mobility vs. spatial immobility
temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
loud dynamics vs. soft dynamics.

The articulatory definition of "temporal continuity vs. discontinuity" is regular here, and the only intercategorial redundancy, which couples this binary opposition with "temporal mobility vs. immobility", is the one known already from the String Quartet and *Polymorphia*:

Diagram 8. Processes of sound generation in *Fluorescences*



temporal continuity vs. discontinuity				temporal mobility vs. immobility
	positive term (+)	⇒	negative term (-)	
	negative term (-)	⇐	positive term (+)	

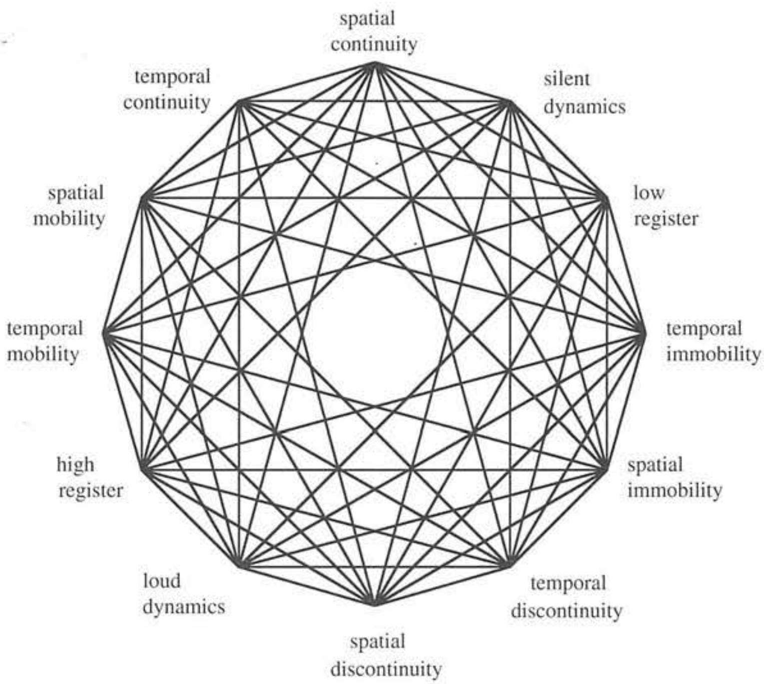
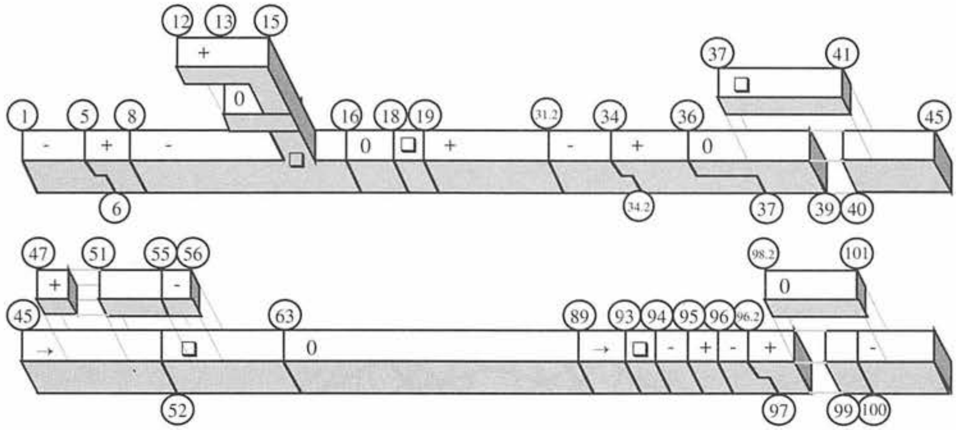


Figure 66. Rosette of the system in *Fluorescences*

HIGH REGISTER VS. LOW REGISTER



1-5 (-): the piece starts in a low register established by rubbing the lowest string of pfte with a triangle rod, sawing pieces of wood (lgn) and iron (frro) with a hand-saw, and rubbing vtr and ltr with a file (1-2). In paragraph 3 occur the lowest possible tones of cr, tn, tb, joined subsequently by bowing the bridges and tailpieces of vc and vb (4-5), to which sounds of guiro, raganella, as well as re-introduced lgn (4) are added;

5-7 (+): the effect of bowing bridges and tailpieces, continued from the previous section (5), overlaps with highest possible tones of the brass (cr, tr, tn, tb: 5-6), fl. picc., ftti (6), vn and vl (6-7) accompanied by cmp. elttr. (7);

8-15 (-): clusters occur, built on the lowest possible tones of vc (C-c♯: 8-13) and vb (C-B♭: 10-13), complemented by clusters of cr (c-b♭: 9-12), tn with tb (D♭-A: 10-12), and supported by sounds of gng giav., sirena and tmt (10-14). In 14 the low register is expanded upwards to C-f♯ in a new cluster of vc and vb, then (15) reduced back to rubbing the lowest string of pfte with one of the cymbals;

12-14 (+): in a secondary layer, the high register is represented by sounds of woodwinds (fl, ob, cl, fg: 12-14) and brass (cr, tr, tn, tb: 14) playing mouthpieces and double reeds;

13-14 (0): the cluster g-d^2 in vn and vl belongs to another subordinate section, which is characterized by a middle register. Interestingly, the just-observed stratification of the trajectory is followed by a gradual reconciliation of its three distinct layers. The spatial expansion of the low register through widening the cluster of vc and vb, as well as of the high register through introduction of brass instruments, fills in the gaps between positive, neutral, and negative terms of the category in question. This is quite apparent in the low (C-f♯) and middle (g-d^2) registers, which fuse into one cluster C-d^2. The analogous fusion of the middle and high register is equally audible, though it cannot be expressed as an integral band of the musical space because of the indeterminate pitches of wind instruments. As a consequence, in paragraph 14 the sound space is unified into a total mediative term of the opposition (❐);

16-17 (0): the middle register is represented by tmb s.c. and bgs 1-2, played with drumsticks, and by a dense quarter-tone cluster c^1-f^1‡ in vn 7-18;

18 (❐): the sound field E♭-e^3 is covered evenly by stringed instruments, its central band (c^1-f^1♯: vn 7-18) being retained from the previous section;

19-31.1 (+): the typewriter introduces the high register, taken over by atypical effects of the winds playing with stops and pistons. At 23 the pfte enters, its highest strings struck with a triangle rod, as do metal idiophones of indefinite (cmpcci, trgli I and V[2]) and definite (vbf: e^3-f^3, cmpne: c^2♯-d^2) pitch

[2] In the score of the piece, the abbreviation tmt, assigned to percussion group V, is an error. As one can

(23-25). This entire set of instruments is superseded by strings and woodwinds playing highest possible tones (vn 1-14: 25-30; vc, vb: 28) and clusters concretely situated in the musical space (vn 15-24: harmonics f^4-a^{4+} in 26-30; vl: harmonics c^3-g^3 in 27-30; fl: $g^{3\flat}$-a^3 in 26-28; ob, cl: c^3-g^3). These are joined by sega (29-30), flexaton (30) and tones whistled as high as possible by violinists 1-14 (26-30). At the beginning of 31 the high register is retained again by the return of pfte (c^4-c^5) and metal idiophones: 2 trgli, cmpne (c^2-d^2) and vbf (d^3-f^3);

31.2-34.1 (-): a sudden skip to the low register in this section is first accomplished by the introduction of large metal plates (tmt, gng giav., gng) along with pfte played with felt sticks on the lowest strings. In paragraphs 32-34 the negative term is kept by clusters $\underline{E}$-D and F-$d\sharp$ occurring respectively in vb and vc, their tones being simultaneously hummed one or two octaves higher by instrumentalists;

34-36 (+): a return to the high register by playing between bridge and tailpiece in all strings, then clusters of harmonics b^3-f^4 (vn 16-22) and b^1-f^2 (vc);

36-44 (0): two separated clusters a-c and e^1-g^1 (36) are tightened through glissando (37) into a single pitch d^1 (38) in vn 7-14. Beginning at 40, there occurs a cluster $d^{1\flat}$-e^1 (40-44: fl 1-4, vl 1-7, cl 1-4, ob 1-4, cor 1-6) supported by gng giav. played with felt sticks (44);

37-40 (❐): a vast sound space $\underline{C}$-g^3, covered evenly by tones a fourth apart (vc 1-6, vn 1-6), which in paragraph 38 are also set into sinusoidal glissandi, constitutes a subordinate-layer section imposed on the above-discussed one;

45-51 (→): the transition from the neutral middle register to the total mediative term is achieved by gradual expansion of the sound field in strings through the consecutive introduction of instrumental groups (vl: 45; vc, vb: 46; vn: 48) and the progressive diversification of their articulatory effects. As regards the latter, this section begins with striking the strings with the palm of the hand, tapping the sound board with the fingertips and the desk with the bow (vl: 45-48; vc, vb: 46-49; vn: 48-51). In paragraph 50 there occurs also *legno battuto* playing between bridge and tailpiece along with highest possible tones *pizzicato* (vc, vb);

52-62 (❐): the total musical space is first established here by all the stringed instruments performing the percussive effects introduced in the previous section (52-54), then by winds reaching from the lowest register of tb and tn up to highest possible tones of fl. picc. (55), and finally by wooden idiophones and membranophones of several sizes (4 bl. di lgn.; 4 bgs; tomts s, a, t, b; 4 tmp; tmb s.c.; tmb c.c.) accompanied by tapping the sound boards of strings with the fingertips and the desks with bows (56-58.1). The consecutive cancellation of instrumental groups performing the last-mentioned effects (archi: 58.2; bl. di lgn., bgs I 1-2: 58.5; bgs II 1-2: 59.4; tomts s, a, t: 60.2; tomt b, tmb c.c e s.c., tmp 1-4: 60.5) is compensated for by the introduction of new or the reiteration of just-cancelled instruments and instrumental groups (vc, ptto s, bgs I 1: 59; ptto a, bgs II 2: 59.4; vn, vl: 60; tomts s, a, t: 60.4; tmts, vb: 61.2; pfte: 62). The string cluster, ranging at first from $E\flat$ up to a3 (60), then from $\underline{E}$ to $f^{3}\sharp$ (61) and to highest pitches of pfte (62), forms a sound field, into which fuse evenly the noises of the remaining, simultaneously sounding percussion instruments;

47-54 (+): a separate layer of the trajectory, parallel to the above-discussed section, starts in a high register represented by playing on stops and pistons (47-49), then blowing highest possible tones (51-54) of wind instruments;

55 (-): triple stops in the lowest register of individual stringed instruments bring a sharp contrast (vb: $\underline{E}$-$\underline{A}$-$E\flat$; vc: C-B-d; vl: c-$c^1\sharp$-d; vn 1-12: $a\flat$-g^1-a^1; vn 13-24: d^1-$d^2\sharp$-e^2). The comparatively high position of vn 13-24 stems from the omission of the lowest string (g), in order to distinguish them from the group of vn 1-12;

63-88 (0): tmts played with wire brushes (tmt IV: 63; tmt V: 63-64), retained after cancellation of the other effects of the previous section, are joined here by rubbing on the sound boards of vc and vb (63-65) and skins of tomts and tmp (65). The resulting middle register is prolonged by bowing the edges of sound boards of stringed instruments (vn 1-12: 66; vn 13-24, vl: 66-67; vc: 67-68; vb: 67-69). In 68 there occurs the single pitch c^1, which lasts until 85.1, with the occasional appearance of indefinite pitches in ptti (73, 74), then an expansion into wider and wider clusters: $a\sharp$-$c^{1\sharp}$ (85-86: vc), a-d^1 (86-87: fl, cl, vbf), $b\flat$-$c^1\sharp$ (vbf: 86-87), $a+$-d^{1+} (87: cr, tn), $g\sharp$-$d^1\sharp$ (88: vn, vl);

---

ascertain from a comparison with the set of instruments whose sounds subsequently represent the high register in 31.1, it occurs here instead of trgl.

89-92 (→): further expansion by outwards glissandi (88: vn 9-24, vc, vb), then by adding new instruments (91: fl, ob, cr), causes the cluster to go beyond the middle register and gradually cover the whole sound space (89-90: $f\sharp$-g^1, 91: $d\flat$-d^2; 92: C-a^2);

93 (□): cluster C-$b\flat^2$ as the totality of musical space;

94 (-): lowest possible tones of pfte, cr, tn and tb are accompanied by harsh sounds of rgl and gro as well as by non-instrumental noises of frro, lgn, ltr and vtr;

95 (+): band of highest pitches of pfte, clusters of vbf (d^3-f^3), fl and ob (d^3-a^3), playing between bridge and tailpiece of strings, and the sounds of trgl (I, V) and flexaton;

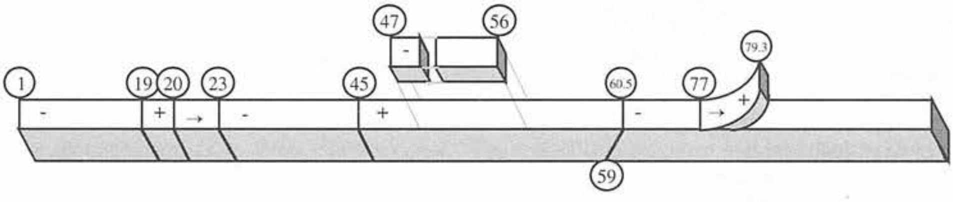
96 (-): lowest possible tones of indefinite pitch in the brass (cr, tn, tb) and pfte, lowest pitches of cl (e-g) and fg ($\underline{B\flat}$-$D\flat$), bowing on the bridge and tailpiece of vc and vb, rubbing ltr and vtr with files and gro with stick;

96.2-99 (+): the high register first occurs simultaneously with low-register effects of the previous section, as playing between bridge and tailpiece (vn, vl: 96.2). That register is then represented by trgl, cmp. elttr., vbf (d^3-f^3), fl, ob, cl ($b\flat^2$-a^3) and by highest possible tones of strings, cmpne, ftti and winds. After a break, in 99.2 this section is continued by stringed instruments played between bridges and tailpieces (vn 13-24, vl 5-8, vc 5-8, vb 4-6) and supported by winds blowing double reeds and mouthpieces;

100-102 (-): the final skip to the low register is anticipated by gng giav. and sirena (99), to which tmp, ltr, gng and pfte are subsequently added (100), the latter instrument being played in its lowest register. In paragraph 101, the lowest possible tones of indefinite pitch occur in tn and tb (101) together with a cluster $\underline{C}$-$\underline{F}$ of vb. By means of turning the tuning pegs the cluster is further lowered beyond the ordinary range of stringed instruments (102);

98.2-100 (0): in parallel to the two last sections of the main layer, a sub-layer of the trajectory proceeds. It contains clusters B-a^1 (98.2-99: vn 1-12, vl 1-4, vc 1-4, vb 1-3) and $d\sharp$-d^2 (100: tutti archi) representing an expanded middle register.

TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY



1-18 (-): rubbing a pfte string with a triangle rod (1-2), ltr and vtr with files (2), sawing lgn and frro with hand-saws (1-2, 4), frullati and fastest possible staccati in winds (3, 5-6), irregular changes of bows in vc and vb (4-5), tremoli in percussion (gng giav.: 10-13, tmt: 12-13; tmb s.c., bgs: 16-17), as well as maximally rapid repetitions in pfte, played with a cymbal (15), and in strings *arco* (vn, vl: 13-14; vc, vb: 14), *legno battuto* (vn 7-18:17-18), *pizzicato* (vni 1-6, vl, vc, vb: 18) as maximally temporally dense phenomena represented also by sounds of rgl, gro (2), cmp.elttr. (7) and ftti additionally played *vibrato* (6), which makes them akin to the vibrati occurring simultaneously in vn and vl (6-7). The same effect of temporal condensation, and hence immobility, results from the stratification of numerous wind instruments playing reeds and mouthpieces (12-14) even if their notation suggests rhythmical series of impulses. Long-lasting sounds, anticipated in 4 (cr, tn, tb), occur in 8-13 in strings (vc, vb), winds (cr, tn, tb), and sirena;

19 (+): a rhythmic series of clearly discernible clicks on the typewriter establishes temporal mobility for a little while;

20-22 (→): a progressive obliteration of temporal relations between individual clicks takes place through the introduction of consecutive instrumental groups of winds (fl: 20.1; ob: 20.3; cl, fg: 20.5; cr: 21.4; tr, tb: 21.5) and multiplication of their sounds produced by playing on stops and pistons;

23-44 (-): quickest possible repetitions of beats in percussion instruments (cmpcci: 23-25; trgli, cmpne, vbf: 24-25), also including typewriter and pfte (23-25) as well as wind instruments played on stops and pistons (23-24). Substituting for maximal temporal condensation is the vibrato of vn 1-14 (25). The following part of this section (26-44) contains long-lasting clusters of strings and winds, glissandi of sega (29-30) and flexaton (30), and freely decaying sounds of metal idiophones (trgl, vbf, gng, cmpne, gng giav., tmt, pfte: 31-32.1);

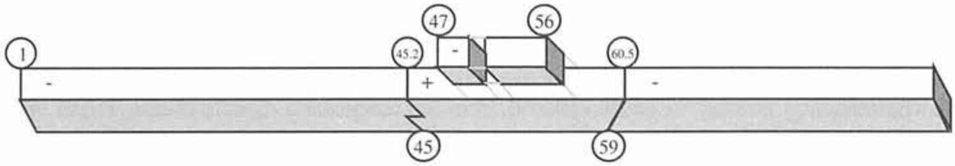
45-60.4 (+): a skip to temporal mobility happens together with the introduction of individually discernible impulses represented by atypical articulations in strings in 45-54 (striking the strings with the palm of the hand, tapping the sound board with fingertips and the desk with the bow, *legno battuto* between bridge and tailpiece, highest possible tone *pizzicato*), followed by *staccato* winds (55) and finally by percussion strokes (bl. di lgn., bgs, tomts, tmb c.c. e s.c., tmp), the latter accompanied by taps on desks and on sound boards of stringed instruments (56-57);

47-55 (-): the subordinate layer, unfolding alongside of the above-discussed section, brings a temporal condensation of clicks with stops and pistons (47-49), then of highest possible notes performed by woodwinds and brass (51-54), and finally of chords repeated by five groups of stringed instruments (55: vn 1-12, 13-24, vl, vc, vb). This maximal condensation makes it impossible to hear individual sounds in rhythmical series, which occur in parts of instruments, and consequently obliterates the temporal relationships between them. Since the condensation is achieved by stratification of instrumental parts, the introduction of fastest possible repetitions, superseding the seemingly rhythmical series in winds in 54, has no further impact on the term of discussed category established in this section, but influences the category "loud vs. soft dynamics" by the multiplication of produced sounds;

59-102 (-): in the main layer of the trajectory, tremoli on the soprano cymbal and bgs I (59.1-62), alto cymbal and bgs II (59.5-62), tomts (s, t: 60.4-62), tmt (61.2-64), pfte (62) and fastest possible *legno battuto* repetitions in strings (vc: 59-62; vn, vl: 60-62; vb: 61.2-62) gradually replace the temporal movement of the previous section. From 63 on, the maximal condensation of repetitions is continued by rubbing the sound boards of vc and vb (63-65) and skins of membranophones (tomts, tmp: 65), then by bowing the edges of strings (vn 1-12: 66; vn 13-24, vl: 66-67; vc: 67-68; vb: 67-69). In 68-81.1 there occurs the pitch c^1, both as a long-lasting tone in winds and strings accompanied by vbf (71-72) and ptto (74), as single impulses *sff* (75, 76, 80), or as tremoli (76: fl 1, cr 1, vc 1-3; 80.5-81.1: vl). Maximally rapid repetitions of c^1 in 81.2-84 are accomplished by stratification of rhythmical series in fl, cl (81.2-84), cr, tr (82-84), then by fastest possible *staccato* in ob, fg, tn, tb (84), joined by long-lasting vibrati in strings (83-84). Sustained sounds come into prominence in 85-93, where tremoli (vbf: 86-87; tmt: 87) and trills (fl, ob, cr: 91-92) appear only occasionally. Finally, paragraphs 94-102 are predominated at first by temporally dense series of sounds constituting a reprise of phenomena from section 1-18, then by slowly decaying notes played by tn, tb and vb (101-102);

77-79.2(→+): this short, superimposed section contains a transition from temporal immobility to mobility attained through progressive reduction of time-spans between *sf* accents in individual wind instruments.

SPATIAL MOBILITY VS. SPATIAL IMMOBILITY



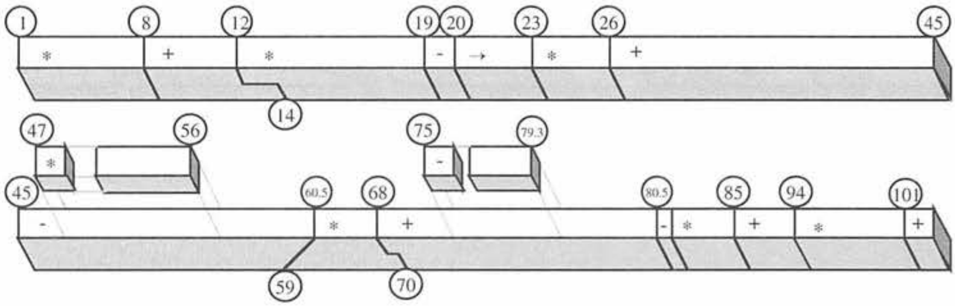
1-45.1 (-): this entire, vast section is filled by long-lasting or repetitive sounds that represent spatial immobility. Some variety arises through glissandi which, however, occur only as expressive features. This last refers to the inner glissandi of individual instruments within static clusters (vc, vb: 8-13; vn 1-12: 28-30; vn 1-6, vc 1-6: 38-39). These glissandi do not disturb the negative term of the category, nor do the outward glissandi of vn 1-6 and vc 1-6 (40), which disentangle the latter of the internally mobile clusters and highlight its diminuendo. Among the expressive features one also has to count the "levitating" glissandi in sirena (11-14), sega and flexaton (29-30). Interestingly, the glissando is inseparable from the sounds of these three instruments, and arises as a sort of spatial projection of their dynamic fluctuation. The last sound of this section is an isolated pizzicato impulse sff in vc and vb at the beginning of paragraph 45;

45-60.4 (+): spatial mobility of several point-like sounds produced in 45-54 by stringed instruments (striking the strings with the palm of the hand, tapping the sound board with fingertips and desks with the bows, *legno battuto* between bridge and tailpiece, highest possible tones *pizzicato*), then of *staccato* pitches that cover the whole sound space, played by winds (55). Beginning at 56, the percussion effects of tapping the sound boards with fingertips and the desk with the nut in strings are reiterated in order to support the strokes on wooden idiophones and membranophones of several sizes (4 bl. di lgn, 4 bgs, 4 tomts, 2 tmb, 4 tmp), which drop out consecutively between 58.5 and 60.4. To produce further spatial differentiation of the sound field in the percussion, membranophones are struck not only on their skins, but also on the edges, as well as on sticks laid upon membranes;

47-55 (-): in parallel to the above-discussed section, a contrasting subordinate layer unfolds. It includes repetitions of sounds produced by stops and pistons on wind instruments (woodwinds: 47-49; brass: 49), then of highest possible notes in winds (51-54) and chords in stringed instruments (55);

59-102 (-): the expanded final section of the main layer brings a return of long-lasting sounds and repeated effects of definite and indefinite pitches, complemented by rare, isolated impulses *sff* (75: cr 1, tr 1-4, tn 1-3, tb 1-2; 76: fl 2-4, ob, cl, fg, strings; 80.5: cr 3-6, tr 3-4, tn 3, tb 2, vn, vc, vb). The glissando accompanying the exchange of ranges between clusters of vn 1-12 and 13-24 (60-61.1) is not perceived as a spatial movement, because of its slowness and limited scope. Instead, glissandi occurring in flexaton (95) and sirena (99.2-100), inner glissandi in clusters played by stringed instruments (vn 1-8, vl: 89-91; tutti archi: 92-93) and finally, the descending glissando accomplished by turning the tuning pins of vb (102), which assists the diminuendo at the end of the piece—all these constitute expressive features of sustained sounds within this section.

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY



1-7 (*): sawing with a hand-saw (lgn, frro), rubbing with a triangle rod (pfte) and file (ltr, vtr), *frullato* (brass: 3, 6; fl. picc.: 6), irregular bow changes (vc, vb), maximally dense repetitions of a note (brass: 5), vibrati (ftti, vn, vl), as well as sounds of raganella, guiro and cmp. elttr. set up the border-zone term at the beginning of the piece. Ordinary playing, *senza frullato*, in the brass (4) does not threaten the unity of this section, being masked by simultaneously sounding phenomena of maximal temporal density (vc, vb, gro, rgl, lgn);

8-13 (+): long-lasting clusters in vc (8-13), vb (10-13), cr (9-12), tn and tb (10-12), supported by sirena, gng giav. and tmt. The tremoli of the two latter instruments serve here merely to maintain their sounds;

12-18 (*): sustained sounds of the previous section are gradually replaced by maximally dense repetitions. The latter are initiated by winds blown on mouthpieces and double reeds (12-14). Though notated as rhythmical series of impulses, the 16 woodwinds and 15 brass parts located in the same band of musical space bring about an effect of maximal temporal condensation, which is joined subsequently by strings bowed at the heel with high pressure (vn, vl: 13-14; vc, vb: 14). In the further course of the section, the quickest possible repetitions are represented by rubbing the lowest pfte string with a cymbal (15), tremoli in tmb s.c. and bgs (16-17), finally by *legno battuto*, and *pizzicato* on strings (17-18);

19 (-): discrete impulses on the typewriter;

20-22 (→): gradual temporal condensation of impulses through the consecutive addition of groups of wind instruments playing with stops and pistons (fl: 20; ob: 20.3; cl, fg: 20.5; cr: 21.4; tr, tb: 21.5);

23-25 (*): maximal density of repetitive impulses (winds, percussion, pfte, typewriter) complemented by vibrato in vn 1-14 (25);

26-44 (+): an expanded zone of long-lasting sounds in strings, winds, sega and flexaton, plus whistling (26-30) and humming (32-34) by instrumentalists. Also sustained are the sounds produced by strokes on undampened vibrators of metal idiophones (trgl, vbf, gng, cmpne, gng giav., tmt) and pfte *con pedale* in paragraphs 31-32. Their long-lasting nature is indicated by the white-headed notes and by open-ended slurs suggesting the free decay of the sound. Frullati in wind instruments (fl, cl, ob: 41-43) and vibrati in strings (vc, vb: 28; vn 7-14: 36-38) do not occur here as representatives of the mediative border-zone term, but rather as expressive features, whose task is, moreover, to enhance the crescendo and diminuendo of the sustained cluster c^1♯e^1 (40-44);

45-60.4 (-): individually discernible impulses are introduced by stringed instruments (45-54), then taken over by winds *staccato* (55), and finally by percussion (bl. di lgn., bgs, tomts, tmb c.c e s.c., tmp) accompanied again by the atypical articulatory effects in the strings (tapping the sound board with fingertips and desk with the bow);

47-55 (*): in the winds, repetitions of impulses played on stops and pistons (47-49) inaugurate a parallel section which, after a break, is continued by staccati of highest possible notes (51-53). Their maximally dense temporal effect results from the condensation of individual rhythmical series performed simultaneously by numerous instruments. Thus, the change to quickest possible repetitions in all wind instruments (54) exerts no further influence on the just-discussed subordinate layer of the trajectory, but instead serves to increase the dynamics within the trajectory "loud vs. soft dynamics". In paragraph 55 an exchange of instrumental groups takes place between the sections proceeding in parallel with each other. While the winds pass to the main-layer section (examined above), the sub-layer section is taken over by strings. In the latter, the seemingly rhythmic repetitions of triple stops, performed by numerous instruments within particular groups, produce the effect of maximal temporal condensation, similar to that in the winds in 47-53;

59-69 (*): in the further course of the main layer, an interpenetration of sections is accomplished through the progressive introduction of tremoli in percussion instruments (ptto s, bgs I: 59; ptto a, bgs II: 59.5; tomts s, t: 60.4; tmt IV: 61.2; tmt V: 61.2; pfte: 62) which supersede their previously separated impulses. The resulting border-zone term is supported by fastest possible repetitions *legno battuto* in strings (vc: 59-62; vn, vl: 60-62; vb: 61.2-62), then maintained by rubbing the sound boards of vc and vb (63-65) and skins of tomts and tmp (65), and finally by *arco* tremoli on the edges of sound boards (from 66);

68-80.4 (+): the sustained pitch c' is passed round by individual instruments and instrumental groups of strings and winds beginning with fl 1 (68-69) and ending with brass (80). The occasional vibrati, frullati and tremoli in this section do not elicit a border-zone term of the discussed category. Instead, tremoli in vbf (71-72) and ptto II (74) serve merely to maintain the sounds of those percussion instruments, and woodwind vibrati and frullati (fl: 71-72; cl:73-74; fl 1, cr 1: 76) as well as string tremoli (vc 1-3: 80) occur here as optional expressive features and bring into relief the dynamic iridescence of the single pitch. This is particularly apparent in paragraph 76, where the flute tremolo assists the crescendo from *p* to *f*, and the subsequent diminuendo is enhanced both by frullato in cr 1 and the tremolo in vc 1-3;

75.1-79.2 (-): in the background of the above section there occur two, separated and momentary accents *sff*, in 75 (cr 1-3, tr 1-4, tn 1-3, tb 1-2 and ptto) and 76.1 (fl 2-4, ob, cl, fg, vn 7-24, vl, vc, vb), followed by a series of sforzati as sharp onsets of wind sounds in 77-79.2. All those phenomena comprise a subordinate-layer section;

80.5 (-): a single impulse *sff* (cr 3-6, tr 3-4, tn 3, tb 2, vn, vc, vb) breaks the temporal continuity in the main layer of the trajectory;

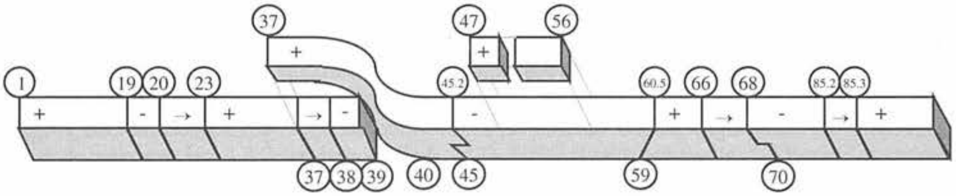
80.5-84 (*): vl tremolo brings a border-zone term, which is retained subsequently by maximally dense impulses in the winds, resulting from stratification of repetitive rhythmic series of the same pitch (c') in numerous instruments (fl, cl: 81-84; cr, tr: 82-84), then by string vibrati (83-84) and fastest possible repetitions introduced in ob, fg, tn and tb (84);

85-93 (+): the sustained c' (85.1) is followed by clusters and glissandi. Trills in fl, ob, and cr (91-92) constitute the expressive effect of enhancing dynamic fragility *ppp*;

94-100 (*): tremendous accumulation of maximally dense repetitions. Most of them are reprised here from the initial section, such as sawing lgn and frro with hand-saws (94), rubbing ltr and vtr with files and a string of pfte with a triangle rod (94, 96), wind frullati (cr, tn, tb: 94, 96; cl: 96; all winds: 98), sounds of gro, rgl (94) and ftti (97), and irregular bow changes on bridge and tailpiece in vc and vb (96). The others are tremoli in trgli (95, 97), pfte (95, 100), cmpne (97), gng giav. (99-100), ltr, gng, tmt and tmp (100), as well as temporal condensation of arpeggios between bridge and tailpiece (95), changes of the bow ordinario (100), vibrati (97), and maximally dense repetitions in stringed instruments (vn, vl: 96; tutti archi: 98-99). The few sustained sounds (fl, ob: 95, 97; fg: 96; cl: 97; flexaton: 95) are entirely lost amidst the prevailing phenomena of minimal time-span and hence play no role assigning a term of the discussed category;

101-102 (+): the return of long-lasting sounds affects the logic of the trajectory at its very end. This disturbance is deliberate, however: it serves a specific artistic purpose of the composer, as will be explained in Chapter 14.2.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



1-18 (+): spatial continuity is established originally by bands of noises produced by rubbing the lowest string of pfte with a triangle rod (1-2), vtr and ltr with files (2), sawing lgn (1-2, 4) and frro (2) with hand-saws, bowing bridges and tailpieces of vc and vb (4-5), and playing gro and rgl (4). These are gradually superseded by clusters resulting from the accumulation of lowest or highest possible tones in large instrumental groups (brass: 3-6; 6 ftti, 4 fl. picc.: 6; 24 vn, 8 vl: 6-7 joined by cmp.elttr. in 7). In 8-14 there occur regular clusters of definite pitch in whole-tone distances (cr: 9-12; tn, tb: 10-12; vc: 8-13; vb: 10-13), accompanied by tremoli on metal plates (gng giav., tmt), then bands of sounds played on reeds and mouthpieces of winds (12-14) and a graded string cluster, whose intervals pass from quarter-tones on the top (vn: 13-14) through semi-tones (vl: 13-14) and whole-tones (vc: 14) to minor and major thirds on the bottom (vb: 14). The spatially continuous character of the sound which results from rubbing the string of pfte with a cymbal (15) is suggested by notation identical with that proper for a cluster. Although the lowest piano string is interpreted here as the edge of a virtual metal plate and hence a two-dimensional sound source, the factual two-dimensional source of the cluster-like sound is here the cymbal. After tremoli on membranophones (tmb s.c., 2 bgs: 16-17), the quarter-tone and semitone clusters are reiterated in strings (vn 7-18: 17-18; vn 1-12, vl, vc, vb: 18). The sirena sound, as the glissando of a single tone (11-14), is not to be considered within this section, because of its purely expressive character (see trajectory "spatial mobility vs. immobility");

19 (-): repetitions of point-like clicks on the typewriter;

20-22 (→): the progressive condensation of clicks played with stops and pistons by more and more wind instruments (fl: 20.1; ob: 20.3; cl, fg: 20.5; cr: 21.4; tr, tb: 21.5) builds up a transition to the next section;

23-36 (+): continuity is represented here by spatially cumulated clicks of indefinite pitch in the typewriter, numerous winds introduced in the previous section (fl, ob, cl, fg, tr, tb), as well as in cmpcci and pfte, the latter played with a triangle rod and treated as the substitute for a metal plate. In 24 there also occur other substitutes for two-dimensional metal vibrators: vbf and cmpne, each of them playing definite pitches a semitone apart (vbf: e^3-f^3; cmpne: $c^2\sharp$-d^2), together with trgli I and V. A band of highest possible tones in vn 1-14, appearing simultaneously with the former sound phenomena (25), anticipates the string and wind clusters in 26-30. These last constitute a background for the expressive glissandi of sega (29-30) and flexaton (30). From 31 on, spatial continuity is continued first by clusters of pfte, vbf and cmpne, into which the sounds of trgli are fused, subsequently by freely decaying sounds of gng, gng giav., tmts IV and V and pfte, and finally again by clusters in the strings. The latter display internal organization ranging from indeterminate pitches produced by playing between bridge and tailpiece (vn 11-15, vl, vb: 34-35; vc 1-4: 34) to clusters of definite pitches in whole-tone (vc, vb: 32-34) and semitone distances (vn 16-22, vc: 35-36; vn 7-14: 36);

37 (→): gradual tightening of two semitone clusters in vn 7-14, established in the previously discussed section (vn 7-10: e^1-g^1; vn 11-14: a-c^1);

38 (-): single pitch d^1 (vn 7-14);

37-45.1 (+): in parallel to the transitional process accomplished by vn 7-14, there occurs a cluster of fourths that is set into internal motion by sinusoidal glissandi of individual tones (vn 1-6, vc 1-6: 37-40). This cluster initiates a section whose further course takes over the main layer of the trajectory, and whose spatial continuity is then represented by semitone and quarter-tone clusters of fl, ob, cl, cr, and vl. In 44, the clusters in ob and cr are accompanied by a long tremolo in the gng giav. and lead to the band of highest possible notes played as a *pizzicato* impulse by all vc and vb at the beginning of paragraph 45;

45-60.4 (-): a field of spatially discontinuous effects of indefinite pitch played by stringed instruments (45-54: striking the strings with the palm of the hand, tapping the sound board with the fingertips and the desk with the bow, *legno battuto* between bridge and tailpiece, highest possible tone *pizzicato*). These are replaced by *staccato* pitches in winds (55), then by point-like clicks of wooden idiophones (bl. di lgn.), membranophones (bgs, tomts, tmb c.c. e s.c., tmp), and strings (tapping the sound board with fingertips and the desk with the bow);

47-55 (+): spatial continuity in the sub-layer section is accomplished by the accumulation of sounds of wind instruments playing with stops and pistons (47-49), then blowing the highest possible tones (51-54). In 55, this sub-section is continued by chords in the strings, which arise as octave-displaced clusters consisting of three pitches in semitone or whole-tone intervals (vn 1-12: a♭-g^1-a^1; vn 13-24: d^1-d^2♯-e^2; vl: c-c^1♯-d^1; vc: C-B-d; vb: $\underline{E}$-$\underline{A}$-E♭). Though having large gaps between component tones, those superimposed, dissonant chords are perceived as spatially continuous sounds. Their occurrence here—as substitutes for regular clusters—and the choice of their component pitches are conditioned by the complexities of several other trajectories. The decision to assign not single pitches but chords to each instrumental part was influenced by the composer's intention to attain the highest possible dynamic level (*fff*) as the positive term of the category "loud vs. soft dynamics". In order to create the effect of maximal temporal condensation resulting from stratification of several rhythmic series in individual instruments (border-zone term of category "temporal continuity vs. temporal discontinuity"), several instruments within instrumental groups had to perform the same chord located in lowest register (negative term of "high vs. low register"). These two demands, together with significant differences between groups of stringed instruments as to their lowest available pitches, precluded the possibility of shaping a semitone or whole-tone structure that would evenly cover the space of the low register. Therefore, to compensate for the lack of regular clusters, the chords take the shape of pitches a semitone or whole-tone apart, which surround the lowest possible tone of a given instrumental group (in vn 13-24: the second lowest string d^1 for the sake of distinguishing them from vn 1-12), for practical reasons (tuning of higher strings) being transposed one octave above it. Because such a pitch structure is still impracticable on vb, the chord in that instrumental group contains only one instance of the interval of a second from the lowest tone—$\underline{E}$ and E♭, which requires the octave transposition of the latter note—along with the lowest pitch of the second lowest string ($\underline{A}$);

59-65 (+): in the main layer of the trajectory, spatial continuity comes back together with sustained tremoli played by wire brushes on two-dimensional vibrators (ptti, tmt, bgs, tomts, pfte), and with a graded cluster of strings. This last consists of pitches whose intervallic distances grow larger towards the lower registers, from whole tones (vn: 60-62), minor and major thirds (vl: 60-62; vc: 59-62), to fourths (vb: 61-62). In 63-65 tmts tremoli are joined by effects of rubbing the sound boards of vb and vc, then also membranes of tomts and tmp with open hands;

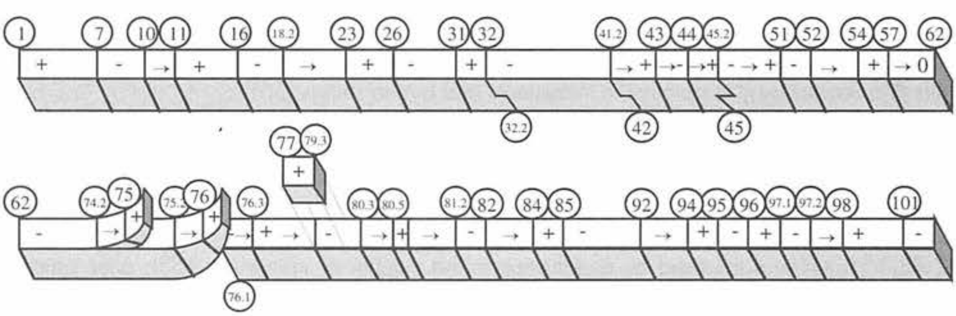
66-69 (→): a gradually narrowing band of noise arises from bowing the edges of sound boards of stringed instruments whose number is progressively reduced (vn 1-12: 66; vn 13-24: 66-67; vl 1-8: 66-67; vc 1-8: 67-68; vb 1-6: 67-69);

68-85.1 (-): single pitch c^1. The long-lasting tones of ptto II (73, 74) do not represent the category of spatial continuity here, but support the coperto sounds played by cr;

85.2 (→): continuous transition from pitch c^1 to a cluster a♯c^1♯;

85.3-102 (+): the return to spatial continuity in the final section of the trajectory happens first by quarter-tone and semitone clusters (85.3-93). Beginning at 94, there return several techniques of sound generation first heard in section 1-15: sawing lgn and frro with hand-saws (94), rubbing ltr and vtr with files and pfte with triangle rod (94, 96), lowest possible tones of brass (cr, tn, tb: 94, 96), bowing bridges and tailpieces of vc and vb (96), the sounds of gro and rgl (94). These returning sounds are juxtaposed with clusters in fl, ob, vbf (95, 97) cl and fg (96) and with continuous phenomena in strings: sounds played simultaneously between bridges and tailpieces (95: tutti archi; 96: vn, vl) or on bridges and tailpieces (96: vc, vb) of numerous instruments. Into this sound amalgam the tones of trgli and flexaton (95) are fused. In 97 and 98 there also appear bands of highest possible notes in strings, ftti, winds, and cmpne, together with the sound of cmp. elttr. These are followed (98.2-102) by clusters in strings (vn 1-12, vl 1-4, vc 1-4, vb 1-3: 98.2-99; tutti archi: 100), and by spatially condensed sounds played between bridge and tailpieces of stringed instruments (vn 13-24, vl 5-8, vc 5-8, vb 4-6: 99) and on reeds and mouthpieces of winds (98). Spatially continuous phenomena are produced also by sustained tremoli on two-dimensional instruments (gng giav.: 99-100; ltr, gng, tmp, tmt, pfte: 100). At the conclusion there occurs a band of lowest possible tones in tn and tb (101) together with a semitone cluster C-E, which drives beyond the lowest possible tones of vb (101-102).

LOUD DYNAMICS VS. SOFT DYNAMICS



1-6 (+): *ff* first occurs in pfte, then in the lgn, frro, vtr and lastra, which join with the piano. In paragraph 3 that dynamic marking passes to the brass. The same loud dynamic level is kept throughout this section, in spite of the *subito p* in the brass (4) and the decrescendo in vn and vl (6), the latter serving not as a transition, but so as to achieve more easily the soft dynamic (*p*) in the following section;

7-9 (-): the soft dynamic is established here not only by the marking (*p*), but also through a reduction in the number of instruments. The *f* marking assigned to cmp. elttr. (7) does not result in dynamic contrast between that musical tool and strings, but aims to compensate for the weak sound of the electric bell and merely enables its audibility here;

10 (→): intensification of loudness by crescendo marking and introduction of new instruments (tn, tb, vb, gng giav.);

11-15 (+): *f crescendo* to *ff* (gng giav., tmt), *ff* (vc, vb: 11-13; winds), *fff* (vn, vl: 13-14; vc, vb: 14) and *ffff* (pfte 15);

16-18.1 (-): low dynamic level between *ppp* (tmb. s.c., bgs) and *pp* (strings);

18.2-22 (→): gradual dynamic growth achieved at first by crescendo (18.2), then by adding more and more instruments (typewriter: 19; fl: 20.1; ob: 20.3; cl, fg: 20.5; cr: 21.4; tr, tb: 21.5). The dynamic marking of *f*, which appears as early as 19, does not yet establish overall loud dynamics in this section, but suggests the relative strength of performing the otherwise dynamically weak sounds of the typewriter and of winds played on stops and pistons;

23-25 (+): the *forte* dynamic is assisted by introduction of new instruments (cmpcci, pfte, reintroduction of the typewriter: 23; trgli, vbf, cmpne: 24) and the condensation of their impulses. The occurrence of vn 1-14 and the crescendo in all instruments in paragraph 25 compensates for the cancellation of the winds;

26-30 (-): soft, iridescent dynamic field ranging from *pppp* (ob, cl 27-28, fl 26-28) through *pp* (strings) to *mf* in very weak sega (29-30) and flexaton (30);

31-32.1 (+): loud strokes *fff* and *ff* on idiophones and pfte;

32-41 (-): between *ppp* and *mp*;

41.2-42 (→+): crescendo from *ppp* to *ff* (fl, cl);

43 (→): decrescendo;

44-45.1 (-→+): another crescendo from *pp* to *ff* (ob, cr, gng giav.) whose goal is marked by the *sff* in vc and vb (45.1);

45-50 (-→+): dynamic gradation accomplished mainly by textural crescendo through introduction of consecutive instrumental groups (vl: 45; vc, vb: 46; fl, ob, cl, fg: 47; vn: 48; cr, tr, tb: 49). At the beginning of the section this process is also reflected in dynamic markings increasing from *pp* (vl: 45) crescendo to *p* (vl, vc, vb: 46). However, the *ff* assigned to winds playing with stops and pistons (47-49) does not signify an abrupt change of loudness, but instead compensates for those dynamically weak effects, as was the case also in paragraphs 20-22. A sudden collapse of the achieved loudness, after cancellation of wind instruments (50), is prevented by *ff* in vc and vb;

51 (-): *subito p* (vc, vb) and *pp* (woodwinds);

52-53 (→): intensive crescendo from *p* through *f* up to *ff*, assisted by introduction of vn, vl (52), and brass (53);

54-56 (+): *ff* established along with maximal condensation of sounds in winds (54). In 55 there occurs *fff* followed by *ff* in percussion instruments and by *f* in strings (56);

57-61 (→0): diminuendo in stringed instruments (57-58.1) and progressive cancellation of percussion *ff* (bl. di lgn, 2 bgs I: 58.5; 2 bgs II: 59.3; tomts s, a, t: 60.2; tomt b, tmb c.c e s.c., tmp: 60.5), superseded by weaker *mf* effects (ptto s, bgs I: 59; ptto a, bgs II: 59.5; tomts s, t: 60.4; tmts: 61.2) and *legno battuto* on strings in dynamic *f* (vc: 59; vni, vl: 60; vb: 61.2). This process of dynamic decrease leads to an intermediate dynamic level;

62-75.1 (-): *subito p* followed by a reduction in the number of instruments (63), after which soft dynamics (*p-mp*) are prolonged by the delicate sound effects of tmt played with wire-brushes, rubbing the sound boards of vb and vc and skins of tomts and tmp, then by bowing the edges of stringed instruments (66-69). The unexpected dynamic sign *ff* in 66 (vn 1-12, vn 13-24, vl) does not threaten the soft dynamics of this section. It merely insures the audibility of the last-mentioned bowing effect, which displays an extremely weak dynamic value and after a long diminuendo ceases in *pp* (69: vc, vb). The pitch c¹ in 68-75.2 appears in dynamics between *pppp* and *p*;

74.2 (→): a crescendo (cr 2-4, ptto II), emerging against the background of *pp* in vn as a superimposed section, causes a stratification of the trajectory;

75.1 (+): *sff* of cr, tr, tn, tb in this sub-layer constitutes the point of arrival of the preceding crescendo;

75.2 (→): crescendo (vn 1-6) appears now in the main layer of the trajectory;

76.1 (+): *sff* (fl 2-4, ob, cl, fg, strings);

76.1-2 (-→): crescendo from *p* to *f* (fl 1);

76.3-5 (+→): decrescendo (cr 1, vc 1-3);

77-80.2 (-): *p* dynamic assigned to sustained tones;

77-79.2 (+): contrasting subordinate layer of *sf* accents that emphasize the onsets of sounds in wind instruments;

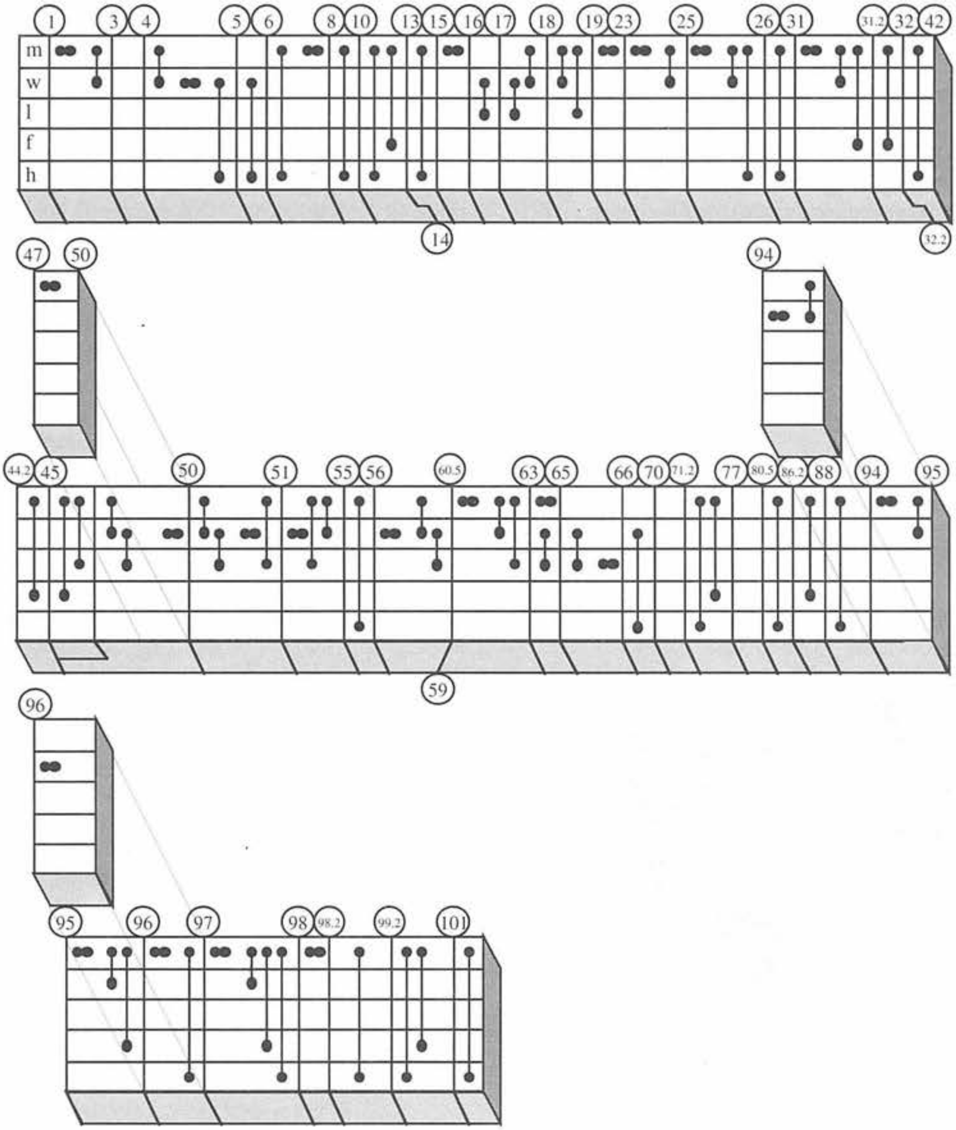
80.3-4 (→): crescendo up to *ff*;

80.5 (+): impulse *ff* (cr 1-2, tr 1-2, tn 1-2, tb 1) and *sff* (cr 3-6, tr 3-4, tn 3, tb 2, vn, vc, vb) briefly establishes a loud dynamic;

80.5-81.1 (→): immediate decrescendo in vl;

81.2 (-): soft *pp* dynamic of fl and ob;
82-83 (→): intensification of loudness by adding new instrumental groups (cr, tr: 82; vc, vn, vl, vb consecutively in 83) and general crescendo in paragraph 83;
84 (+): high dynamic level *ff* established along with introduction of ob, fg, tn and tb performing maximally condensed repetitions;
85-91 (-): after a sudden reduction of both dynamics and orchestral ensemble, soft dynamics are represented first by *pp* in vc, then by a dynamic range *ppp-p* in several wind and stringed instruments;
92-93 (→): crescendo from *p* to *ff* supported by introduction of new winds (cl, fg, tr, tn, tb: 93);
94 (+): violent creakings *ff* produced by ltr, vtr, frro, lgn, gro, rgl and pfte as well as by frullati in the brass (cr, tn, tb);
95 (-): between *pp* and *ppp*. Weak sound of flexaton is enhanced by *mf*;
96 (+): *f* in winds and *ff* in remaining instruments;
97.1 (-): low dynamic level *pp*. As regards *f* in cmp.elttr., see section 7-9;
97.2 (→): dynamic growth accomplished by introduction of ftti and general crescendo up to *f*;
98-100 (+): *ff* (winds, ftti: 98.1; strings 98.2-99; sirena) and *fff* (winds 99, strings 100). The relatively weaker dynamics *mf* in gng giav. (99), ltr, gng, tmt, tmp and pfte (100) enable an intensive crescendo of those instruments to *fff* in 101;
101-102 (-): soft dynamics *p* further weakened by decrescendo to *ppp* in tn and tb (100) and beyond *pp* in vb (102).

Timbre system



1-2 (mm, mw): rubbing the string of pfte with a triangle rod, vtr and ltr with a file as well as sawing a piece of iron with a hand-saw represent a material pair "mm", while sawing a piece of wood (lgn) gives a combination "mw";

4 (wh, ww, wm): playing on guiro and raganella (ww), sawing a piece of wood with a hand-saw (wm), and bowing bridges and tailpieces of vc and vb, which here represent wood as their factual physical material (wh);

5 (wh): bowing bridges and tailpieces of vc and vb;

6-7 (mm, mh): ftti and cmp. elttr. (mm) occur simultaneously with traditional *arco* playing on vn and vl (mh);

8-9 (mh): vc *arco*;

10-13 (mh, mf): strings of vc and vb bowed *arco* (mh); gng giav. and tmt played with heads of soft sticks (mf);

13-14 (mh): bowing *arco* at the heel with much pressure in vn and vl as early as paragraph 13, which causes an overlapping with the previous section. In 14 this way of playing is taken over by vc and vb, as well;

15 (mm): rubbing the lowest piano string with one of the cymbals;

16 (lw): skins of tmb s.c. and bgs struck with hard drumsticks;

17 (wl, mw): membranophones retained from the previous section (wl) are joined here by vn 7-18 played *legno battuto* (mw);

18 (mw, ml): after cancellation of tmb. s.c. and bgs, the *legno battuto* playing on vn 7-18 is accompanied by pizzicati in all remaining strings (ml);

19-22 (mm): typewriter (19-20), then consecutively introduced wind instruments played with stops and pistons (fl: 20; ob: 20.3; cl, fg: 20.5; cr: 21.4; tr, tb: 21.5);

23-24 (mm, mw): apart from the effects of winds and typewriter, the material pair "mm" is represented here also by playing with triangle rods on trgli, cmpne and strings of pfte, while cmpcci and bars of vbf struck with hard-headed sticks elicit a combination "mw";

25 (mm, mw, mh): immediately after the winds drop out, *arco* playing on vn 1-14 (mh) supervenes on the remaining instrumental techniques of the preceding section;

26-30 (mh): strings *arco*;

31.1 (mm, mw, mf): trgli (mm), cmpne struck with a mallet, vbf played with hard sticks (mw), and a traditional playing on pfte, i.e., with felt hammers operated from the keyboard (mf);

31.2-32.1 (mf): gng, gng giav., tmts and strings of pfte excited by felt sticks;

32-41 (mh): several groups of stringed instruments *arco*;

44.2 (mf): gng giav. struck with felt sticks;

45.1 (mf, ml): last beat on gng giav. (mf) coincides with pizzicato in vc and vb (ml);

45-49 (wm, wl, ww): striking the strings with the palm of the hand (wm, wl), tapping the sound board with fingertips and the desk with the nut (ww);

50 (wm, wl, ww, ml): the series of percussive effects introduced at the beginning of the previous section are prolonged here by vn, whereas vc and vb initiate series consisting of *pizzicato* (ml), *legno battuto* between bridge and tailpiece (wm), tapping the sound board with fingertips and the desk with the bow (ww);

51-54 (ww, ml, mw): the latter set of instrumental techniques is retained in vc and vb and subsequently taken over by vn and vl, whereby it spreads over all the stringed instruments (52);

47-49 (mm): playing with stops and pistons of winds (fl, of, cl, fg: 47-49; cr, tr, tb: 49) occurs in the subordinate layer of the timbre trajectory, in parallel to the percussive effects of strings;

55 (mh): strings *arco*;

56-60.4 (ww, wm, wl): tapping the sound boards of stringed instruments with fingertips and the desks with bows (56-58.1), playing with wooden sticks on bl. di lgn. (ww), edges of bgs and tomts (wm), simultaneously on edges and skins of bgs, tmb and tmp (wm, wl) as well as on other sticks lying on skins of membranophones used in this section (ww, wl);

59-62 (mm, ml, mw): beginning from 59, the just-listed sound generation processes are ousted by playing with wire brushes on skins (bgs, tomts), metal plates (ptti, tmt), and pfte strings as a virtual metal plate (ml, mm). All of these are assisted by *legno battuto* playing in stringed instruments (mw);

63-64 (mm, lw): tmt played with wire brushes (mm), sound boards of vc and vb rubbed with open hands (wl);

65 (lw, ll): rubbing with hands as a way of exciting sound boards of vc and vb (wl) as well as skins of tomts and tmp (ll);

66-69 (wh): bowing edges of stringed instruments (vn 1-12: 66; vn 13-24, vl: 66-67; vc: 67-68; vb: 67-69);

71.2-76 (mf, mh): vbf (71-72) and ptti (73, 74) played with soft sticks (mf) and several stringed instruments *arco* (mh);

80.5-86.1 (mh): strings *arco*;

86.2-87 (mf): vbf (86.2-87.1) and tmt (87) played with soft-headed sticks;

88-93 (mh): *arco* play comes back in more and more, consecutively introduced stringed instruments (vn 1-8, vl: 88; vni 9-24, vc, vb: 89);

94 (mm, mw) (ww, wm): unusual sound generation processes known already from the beginning of the piece: rubbing pfte string with a triangle rod and pieces of vtr and ltr with files, as well as sawing a piece of iron and wood filled in paragraphs 1-2, while the latter effect together with sounds of rgl and gro occurred in paragraph 4. The simultaneous reiteration of these effects has this result: instead of alternating—as was the case with the initial, corresponding timbre segments—both segments are now totally superimposed, which results in a stratification of the trajectory;

95 (mm, mw, mf): *legno battuto* between bridges and tailpieces of stringed instruments (mw), play with wire brushes on strings of pfte (mm), striking trgl I and vbf with soft sticks (mf) and trglo V with a rod (mm);

96 (mh, mm) (ww): another case of timbre-segment stratification. While one of the segments is established by gro and rgl (ww), the other includes sounds of ltr and vtr rubbed with files, the lowest string of pfte rubbed with triangle rod (mm), playing between bridge and tailpiece of vn and vl as well as on bridges and tailpieces of vc and vb, the latter substituting here for metal bodies (mh);

97 (mh, mm, mw, mf): strings played *arco* (mh) together with cmp. elttr., ftti, trgl V excited with a triangle rod (mm), trgl I struck with a felt stick (mf), and cmpne hit normally, with a wooden mallet (mw);

98.1 (mm): ftti;

98.2-99.1 (mh): strings of stringed instruments bowed *arco* before and behind the bridge;

99.2-100 (mh, mf): traditional *arco* playing on strings (mh) supported by metal plates—ltr, gng, gng giav. and pfte—struck with felt sticks (mf). The sound of timpani, here played with soft sticks and constituting a unique combination of leather and felt, has no impact on the timbre value of this section (lf), since the latter is dominated by a huge set of metal bodies;

101-102 (mh): vb *arco*.

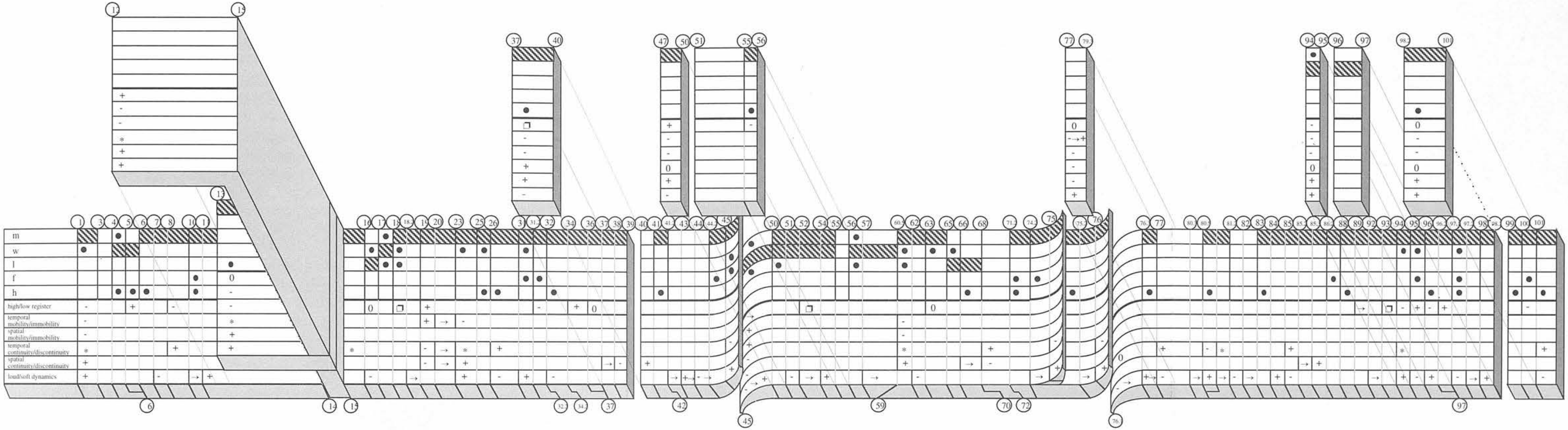


Figure 68. Summary chart of *Fluorescences*

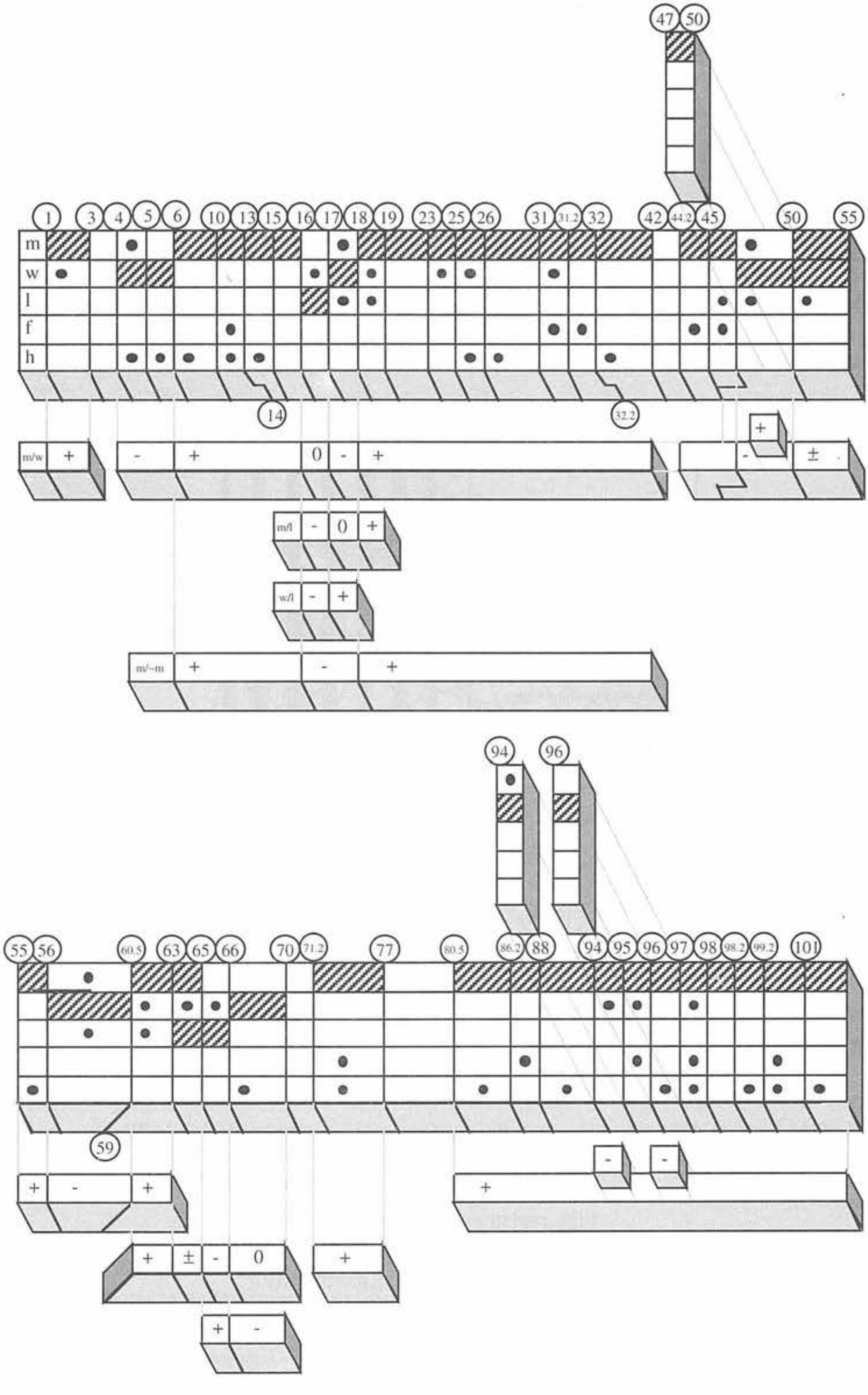


Figure 67. Timbre trajectory of *Fluorescences* and its active material oppositions

8.7. *CANON* (1962)

Articulation

The string orchestra for which the piece is designed consists of 24 violins (vn), 10 violas (vl), 10 cellos (vc) and 8 contrabassi (vb). The following diagram exhibits all sound generation processes involving this set of instruments:

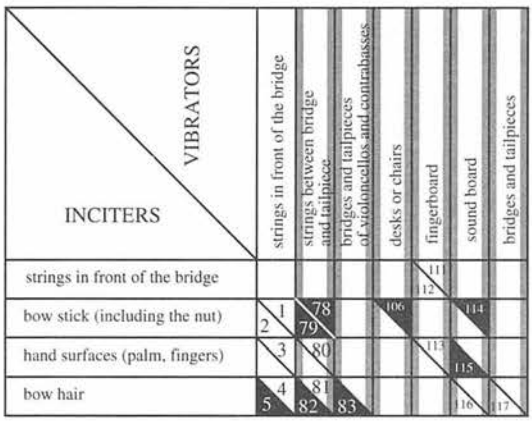


Diagram 9. Processes of sound generation in *Canon*

Basic system

The set of the basic system categories operative in *Canon* is identical with that in *Fluorescences*. It comprises six binary oppositions listed below:

high register vs. low register
temporal continuity vs. temporal discontinuity
spatial continuity vs. spatial discontinuity
temporal mobility vs. temporal immobility
spatial mobility vs. spatial immobility
loud dynamics vs. soft dynamics

As in the String Quartet, *Polymorphia*, and *Fluorescences*, here too the partial intercategorial redundancy ties "temporal mobility vs. immobility" with "temporal continuity vs. discontinuity":

<table>
<tr><td rowspan="2">temporal continuity vs. discontinuity</td><td>positive term (+)</td><td>⇒</td><td>negative term (-)</td><td rowspan="2">temporal mobility vs. immobility</td></tr>
<tr><td>negative term (-)</td><td>⇐</td><td>positive term (+)</td></tr>
</table>

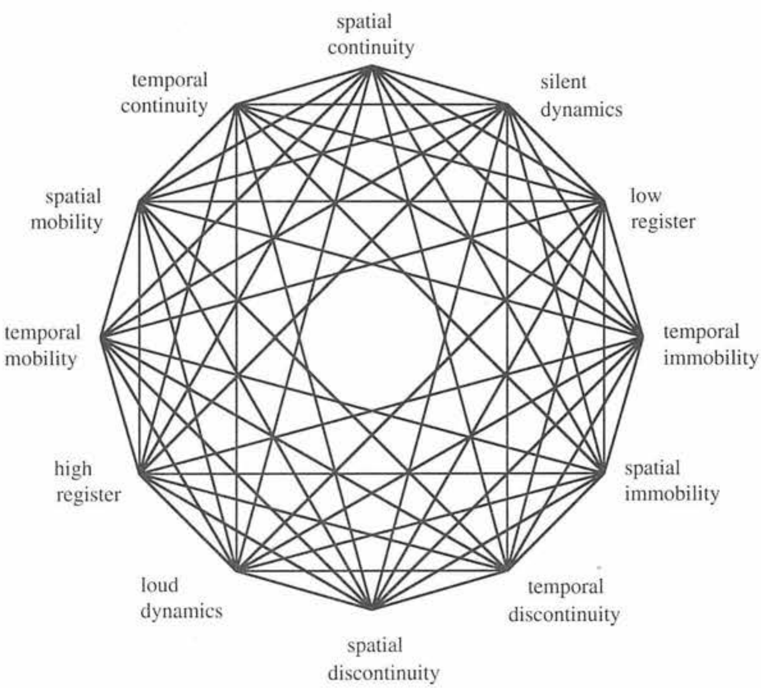
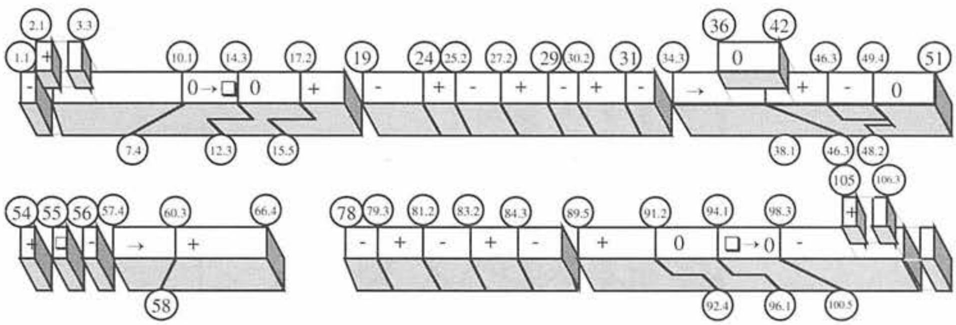


Figure 69. Rosette of the system in *Canon*

In the orchestral part of *Canon*, the vast initial passage of 1-30.1 returns in retrograde at the conclusion (78-107.2). This means that, in the course of individual trajectories, there occur retrogradations or reiterations of individual sections as well. The musical form of the piece is complicated even more by the presence of two tape recordings played simultaneously. The first tape recorder plays passage 1-33 of the orchestral part parallel with that of 52-84 performed live, and then occurs once again in 95 with passage 1-18. In turn, the orchestral passage 31-66, recorded together with the simultaneously proceeding part of the first tape, is played by the second tape recorder beginning from 71. The following analysis offers only an examination of the orchestral part.

HIGH REGISTER VS. LOW REGISTER



1.1-9.5 (-): the main layer of this trajectory begins with a section representing a low register. Here belongs the initial striking with fingertips on sound boards of low stringed instruments (vb, vc, vl: 1.1), rubbing sound boards of vb and vc (1.4-4.1), then the lowest possible notes in all instrumental groups (vl: c in 4.2-7.3; vn 1-12: g in 4.4-9.5; vn 13-24: g in 4.5-7.3; vc: C in 6.4-8.5; vb: $\underline{C}$ in 6.4-9.4);

2.1-3.2 (+): meanwhile, in a subordinate-layer, a tap on the sound board of vn and vl (2.1) is followed by a series of ricochets of vn between bridge and tailpiece (2.5-3.2);

7.4-14.2 (0→❐): in the further course of the main layer, an interpenetration occurs. The low register established in the initial section gives way gradually to a middle register of irregular periodic glissandi (vl), starting from f^1♯ (vl 1-5) and c^1 (vl 6-10) and moving within the approximate span of c-f^2♯ (7.4-12.1). This range gradually widens by successive introduction of glissandi upwards and downwards in vc (9.1-14.2: ca. C-f♯), vb (9.5-13.2: ca. $\underline{C}$-c), vn 13-24 (10.1-14.2: ca. a-c^3) and vn 1-12 (10.5-14.2: ca. a-f^3♯). The resulting registral band reaches roughly from $\underline{C}$ to f^3♯ and covers evenly the whole musical space;

12.3-17.1 (0): in the background of glissandi, there occurs a cluster c-c^2 in vl (12.3-15.4) expanded downwards to C by adding a parallel cluster C-c in vb (13.3), the tones of both clusters being also sung by instrumentalists (*cantare bocca chiusa*). The downwards glissando that enhances the diminuendo in the latter instrumental group and goes to the lowest register $\underline{C}$-C, is an expressive feature without influence on the neutral term of the discussed category as it is established here. Characteristically, the beginning of the glissando coincides with a cancellation of vl as well as with the onset of the cluster in vn 1-12, which belongs already to the next, overlapping section;

15.5-18.3 (+): clusters of harmonics within approximate ranges a^3-d^5 (vn 1-12: 15.5-18.3) and f^2♯-a^3 (vc: 16.4-18.3) supported by whistling of their tones in a freely chosen octave;

19-23 (-): after a break in the musical narration, the trajectory takes the shape of a clear-cut alternation of opposite terms, starting in this section from the lowest register of vb (19.1: ca. $\underline{C}$-$\underline{G}$), then of vc (20.4: ca. C-G), and finally of vl and vn (21.5: ca. c-f^1);

24.1-25.1 (+): the high register is represented by harmonics in the approximate range e^2-e^3 (vl, vn);

25.2-27.1 (-): reiteration of clusters from section 19-23;

27.2-28 (+): glissando movement downwards and upwards beginning from highest possible notes of particular instrumental groups;

29-30.1 (-): double stops in lowest registers of individual instrumental groups. Their notation suggests using two lowest strings;

30.2-5 (+): arpeggii between bridge and tailpiece in the full stringed orchestra;

31-33.4 (-): double stops from section 29-30.1 (reiterated in 31.1-32.4) are followed by clusters ranging from lowest possible notes of individual instrumental groups up to approximately a fifth above;

34.3-46.2 (→): glissandi from lowest to highest possible tones in vb (34.3-37.5), vl (38.1-41.2) and vc (42.1-46.1) as a transition between opposite terms;

36.1-41.5 (0): series of taps with fingertips on sound boards and with bows on desks, which occur in vn (36.1-40.4) and vc (39.2-41.5), belong to a subordinate-layer section and in this way elicit another stratification of the trajectory;

38.1-49.3 (+): both previous sections overlap with the high register established within the main layer by highest possible tones arrived at consecutively by vb (38.1-41.5) and vl (41.4-45.1), then occurring in vn (45.3-46.5). The same positive term of the category is represented here also by playing between bridge and tailpiece (vb: 42.1-45.1; vl: 45.2-49-3; vn 1-12: 43.2-45.1, 47.1-48.5; vn 13-24: 43.2-45.1, 47.1-48.1; vc: 46.3-48.1);

46.3-49.3 (-): another case of imposition, this time between sections belonging to the main layer of the trajectory, is occasioned by a cluster in vb ranging from C̲ approximately up to B̲ (46.3-48.1), replaced by bowing bridges of vb and tailpieces of vc;

48.2-50.5 (0): the neutral term occurs together with the cluster in vn 13-24 in 48 (ca. a-$f^1\sharp$) joined by vn 1-12 in 49 (ca. e^1-d^2). After the two preceding sections end, the mid-register cluster is further supported by vl, vc and vb (49.4) and expanded upon a vast, but integrated sound field that ranges approximately from E up to d^2;

54.1-54.4 (+): *spiccato* ricochets between bridge and tailpiece. The positive term that they represent disturbs the logic of this trajectory, which otherwise is interrupted by the general rest and the beginning of the first tape recorder part (52);

55.1 (❐): a single beat on the sound boards of the all instruments;

56.2 (-): a tap with fingertips on sound boards of vl, vc and vb;

57.4-60.2 (→): glissandi upwards from lowest notes of vc (57.4-60.2) and vb (58.3-60.2). The transitional term represented by these glissandi overlaps with the sounds representing the high register of the goal of the transition;

58.1-66.3 (+): bands of highest possible tones (vn 1-12: 58.1-62.2; vl: 59.4-62.2), playing between bridge and tailpiece (vb 60.5-66.3; vl: 62.3-66.3; vn 1-12: 63.5-66.3), and a cluster of harmonics in vc (63.2-64.4) establish the positive term of the category. Straying from them in this respect is only the cluster played *sul tasto* by vn 13-24 (61.5-63), whose approximate range reaches from a to a^1. This cluster should not be excluded from the discussed section as an expressive sound event nor should it be treated as a superimposed section within the orchestral part. Instead, it anticipates the cluster of vl (12.3-15.4) re-played in 63.3-66.4 and introduces a middle register within the parallel layer of the trajectory established by the first tape-recorder part;

78.1-79.2 (-): reiteration of section 29.1-30.1;

79.3-81.1 (+): reiteration of section 27.2-28.5;

81.2-83.1 (-): reiteration of section 25.2-27.1;

83.2-84.2 (+): reiteration of section 24.1-25.1;

84.3-89.2 (-): retrogradation of section 19.1-23.5;

89.5-92.3 (+): retrogradation of section 15.5-18.3;

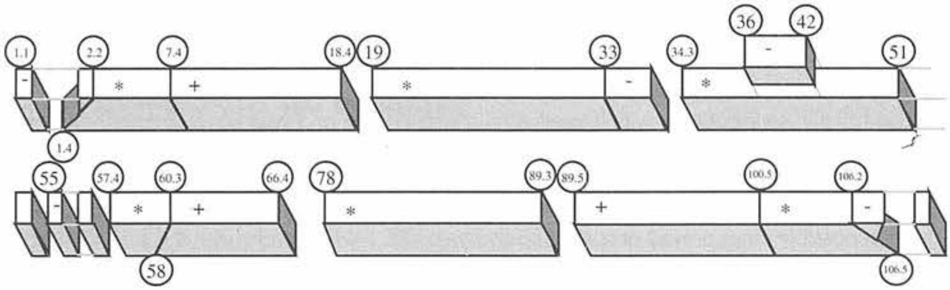
91.2-95.5 (0): retrogradation of section 12.3-17.1;

94.1-100.4 (❐→0): retrogradation of section 7.4-14.2;

98.3-107.2 (-): retrogradation of section 1.1-7.3;

105.1-106.2 (+): retrogradation of section 2.1-3.2.

TEMPORAL CONTINUITY VS. TEMPORAL DISCONTINUITY



1.1-2.1 (-): two separate taps on sound boards with fingertips. The first is played by vl, vc and vb (1.1), the other by vn and vl (2.1);

1.4-7.3 (*): rubbing sound boards of vb and vc with palms of the hand establishes the border-zone term and forms a background for ricochets *col legno spiccato* between bridge and tailpiece, in vn and vl. In 4.2-7.3 both these instrumental techniques are replaced by tremoli *arco*;

7.4-18.3 (+): long sustained tones, glissandi and clusters *senza tremolo* played, sung (vl: 12.3-15.4; vb: 13.2-17.1), and whistled (vn 1-12:15.5-18.3; vc: 16.4-18.3) by the instrumentalists. Vibrati in vn 1-12 (15.5-18.3) and vc (16.4-18.3) are not related to the discussed category, but constitute expressive features enhancing the dynamic fragility of the harmonics;

19.1-32.5 (*): asynchronic repetitions of sustained sounds are bowed *al tallone* by numerous instruments within narrow bands of lowest tones in individual instrumental groups (vb: 19.1-23.5; vc: 20.4-23.5; vl, vn: 21.5-23.5), then reiterated in 25.2-27.1 (tutti). These repetitions bring about an overall effect of maximally dense sounds characteristic also of tremoli (24.1-25.1) as well as of rhythmical series of repeated double stops (29.1-30.1; 31.1-32.4) and arpeggii *legno battuto* between bridge and tailpiece (30.2-30.5) stratified in the whole string orchestra. Irregular glissandi (27.2-28.5), performed independently within a band of highest pitches by individual instruments, produce an effect close to intense vibrato and efficiently substitute for the latter, as happens in an analogous place of *Fluorescences* (97: tutti archi);

33 (-): two separate and hence temporally discontinuous impulses tutti;

36.1-41.5 (-): a side-layer section composed of individually discernible clicks tapped with fingertips on the sound board and with the bow on the desk in vn (36.1-40.4) and vc (39.2-41.5);

34.3-54 (*): meanwhile, in the main layer, an expanded section of maximally temporally dense sounds unfolds. It starts with irregular bow changes in vb (34.2-40.4), vl (38.1-41.5) and vc (42.1-46.2). These are replaced by rapid vibrati in vb (40.5-41.5) and vl (42.1-45.1) immediately after cancellation of the subordinate-layer effects in vn and vc respectively. The resulting border-zone term is supported by arpeggii *legno battuto* between bridge and tailpiece performed independently by all vb (42.1-45.1) and vn (43.2-45.1). In spite of their rhythmical notation, the series of arpeggii produce the overall effect of maximally dense sounds. From 45.2 on there occur fastest possible repetitions of grinding sounds played with strong pressure of the bow (vl: 45.2-49.3; vb, vc: 46.3-48.1; vn: 47.1-49.4) and finally irregular bow changes (vb, vc: 48.2-50.5; vn, vl: 49.4-50.5). The impositions of slow and rapid vibrati in vn (45.3-46.5) substitute for temporally dense phenomena. After a rest, this section is continued by quickest possible repetitions *col legno spiccato*, between bridges and tailpieces (54);

55-56 (-): single taps with fingertips on the sound boards of all instruments (55.1), then of vl, vc and vb only (56.2). The break-down of the basic syntactical rule of the sonoristic system (a prohibited return to the negative term), which they bring into the course of the discussed trajectory, is justified inasmuch as it happens after a general rest and the beginning of the replay in the first tape-recorder part;

57.4-60.2 (*): *molto vibrato* imposed over slow vibrato glissando;

58.1-66.3 (+): continuous long-lasting sounds performed either before (vn 1-12: 58.1-62.2; vl: 59.4-62.2; vn 13-24: 61.5-63.4; vc: 63.2-64.4) or behind the bridge (vb: 60.5-66.3; vl: 62.3-66.3; vn 1-12: 63.5-66.3);

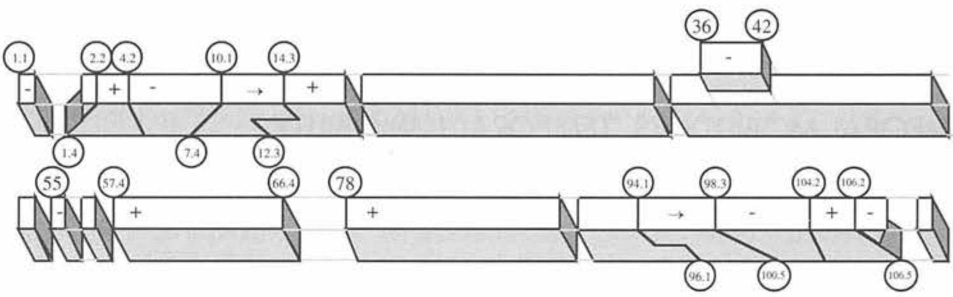
78.1-89.2 (*): retrogradation of section 19.1-30.1;

89.5-100.4 (+): retrogradation of section 7.4-18.3;[1]

100.5-106.4 (*): retrogradation of section 1.4-7.3;

106.2-107.2 (-): retrogradation of section 1.1-2.1.

SPATIAL CONTINUITY VS. SPATIAL DISCONTINUITY



1.1-2.1 (-): two taps with fingertips on sound boards of stringed instruments;

1.4-4.1 (+): spatially continuous sounds produced by rubbing the sound-boards of vc and vb with the palm of the hand (1.4-4.1) and bands of spiccati *col legno* on two strings between bridge and tailpiece of all vn and vl (2.5-3.2);

4.2-9.5 (-): lowest possible tones of individual instrumental groups as single, remote pitches c (vl: 4.2-7.3), g (vn 1-12: 4.4-9.5; vn 13-24: 4.5-7.3), C (vc: 6.4-8.5) and C̲ (Vb: 6.4-9.4). Cancellation of those pitches happens non-simultaneously, whereby interpenetration with the next section arises;

7.4-14.2 (→): transition from a single mobile tone (vl 1-5) to a sound field filled by numerous glissandi. This transition is accomplished through introduction of glissando in more and more instrumental groups (vl 6-10: 8.1; vc 6-10: 9.1; vc 1-5: 9.3; vb 5-8: 9.5; vn 18-24: 10.1; vb 1-4: 10.2; vn 13-17: 10.2; vn 1-6: 10.5; vn 7-12: 11.2) as well as by progressive desynchronization of instruments within individual groups, which is here an inevitable result of the approximative temporal notation;

12.3-54.4 (+): before the transition has been completed, clusters of vl (12.3) and vb (13.3) establish the spatial continuity of its destination. In the further course of the section initiated by these clusters, spatially continuous sounds are not only clusters, but also bands set up by asynchronic, approximately pitched tones crowded in the lowest registers of instruments (19-23, 25.2-27.1, 29-30.1, 31-33), glissandi downwards from and upwards to highest possible notes of individual instruments of various instrumental groups (27.2-28.5), as well as arpeggii between bridge and tailpiece (30.1-30.5). Beginning in 34 the following effects take place: bands of glissandi, going upwards from lowest to highest notes, are performed non-simultaneously by pairs of vb (34.3-37.5), vl (38.1-41.3) and vc (42.1-46.1); bands of highest possible notes played before or behind the bridge; arpeggii between

[1] The introduction of tremolo signs as early as 98 (vn 1-12, vb) and 99 (vc) is an error that disturbs the faithfulness of the retrogradation.

bridge and tailpiece (vb: 42.1-45.1; vn: 43.2-45.1); bowing on bridges of vb and tailpieces of vc (48.2-49.3); and finally clusters in vb (46.3-48.1), vn 13-24 (48.2-49.4), vn 1-12 (49.1-49.4) and the whole orchestra (49.4-50.5). After a break, ricochets between bridge and tailpiece in vn 13-24, vl, vc and vb (54.1-54.4) close this expanded section;

36.1-41.5 (-): spatially discontinuous effects of tapping sound boards with fingertips and desks with bows (vn: 36.1-40.4, vc: 39.2-41.5) occur in a sub-layer of the trajectory;

55.1-56.2 (-): single beats with fingertips on sound boards establish brief spatial discontinuity in the main layer;

57.4-66.3 (+): return to spatial continuity takes place in clusters that result from the desynchronization of individual vc and vb within zig-zagging glissandi (57.4-60.2) and from bands of highest possible tones played before and behind the bridge. Regular clusters occur in vn (61.5-63.4) and vc (63.2-64.4);

78.1-95.5 (+): retrogradation of section 12.3-30.1;

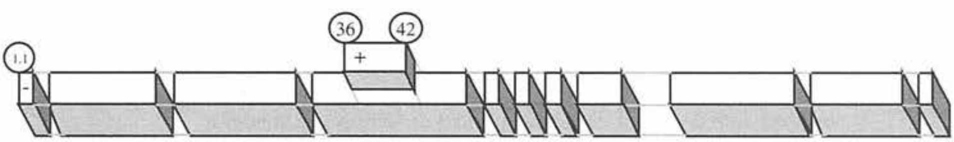
94.1-100.4 (→): retrogradation of section 7.4-14.2;

98.3-104.1 (-): retrogradation of section 4.2-9.5;

104.2-106.4 (+): retrogradation of section 1.4-4.1;

106.2-107.2 (-): retrogradation of section 1.1-2.1.

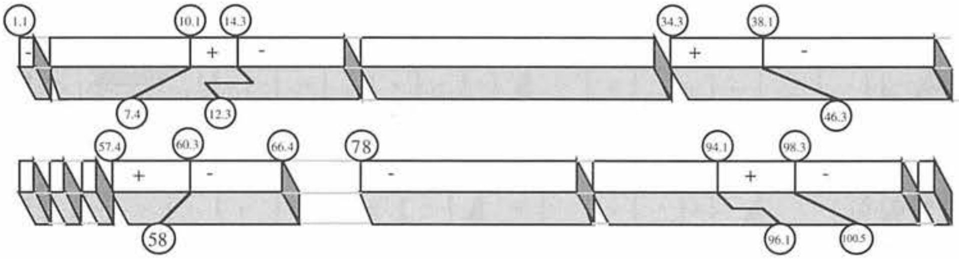
TEMPORAL MOBILITY VS. TEMPORAL IMMOBILITY



1.1-107.2 (-): the whole main layer of this trajectory constitutes one section characterized by temporal immobility. It contains single, isolated impulses (1.1, 2.1, 33, 55.1, 56.2, 106.2, 107.2), long-lasting tones or clusters, and maximally dense sounds. These last result either from quickest possible repetitions or from seemingly rhythmic passages of individual instruments stratified within instrumental groups or the whole orchestra (29.1-32.4; 42-45.1; 78-79.1);

36-41 (+): in the contrasting sub-layer, there occur series of taps played on the sound boards with fingertips and on the desks with the bows (vn: 36.1-40.4; vc: 39.2-41.5).

SPATIAL MOBILITY VS. SPATIAL IMMOBILITY



1.1-9.5 (-): single taps (1.1, 2.1) and repetitions represented by rubbing the sound boards with the palm of the hand (vc, vb: 1.4-4.1), ricochets between bridge and tailpiece (vn, vl: 2.5-3.2) and long-lasting tremoli (vl: 4.2-7.3; vn 1-12: 4.4-9.5; vn 13-24: 4.5-7.3; vc: 6.4-8.5; vb: 6.4-9.4);

7.4-14.2 (+): the spatially immobile sounds of the initial section are forced out by glissando movement which gradually spreads over the whole stringed orchestra beginning from vl (7.4-12.1), through vc (9.1-14.2) and vb (9.5-13.2) to vn 13-24 (10.1-14.2) and vn 1-12 (10.5-14.2);

12.3-33.4 (-): clusters of vl (12.3) and vb (13.3) restore spatial immobility, which is prolonged subsequently by several other static bands, and also by repetitions and single impulses. A slow, downwards glissando accompanies a diminuendo in the cluster of vb (15.5-17.1) and thus exudes the character of an expressive feature. An expressive character is also vested in periodic glissandi of all instruments (27.2-28.5), which bring about an internal movement of a static band of highest possible notes and, as such, are comparable to glissandi known already from *Polymorphia* (vn 1-12: 16.4-18.5) and *Fluorescences* (vn 1-14: 28-30), though without the regular, sinusoidal shape of the latter;

34.3-46.2 (+): glissandi cross the whole range of vb (34.3-37.5), vl (38.1-41.3) and vc (42.1-46.2), and differentiated series of taps are performed with fingertips on sound boards and with bows on desks (vn: 36.1-40.4; vc: 39.2-41.5);

38.1-56.2 (-): long-lasting bands of highest possible tones (vb: 38.1-41.5; vl: 41.4-45.1; vn: 45.3-46.5) and repetitions of arpeggii between bridge and tailpiece (vb 42-45.1; vni: 43.2-45.1) initiate a section of spatially immobile character and cause it to overlap with the foregoing one. After a break, the spatial immobility is resumed in quickest possible repetitions of ricochets (54.1-4) followed by isolated taps on the sound boards (55.1, 56.2);

57.4-60.2 (+): serpentine, upward glissandi (vc, vb);

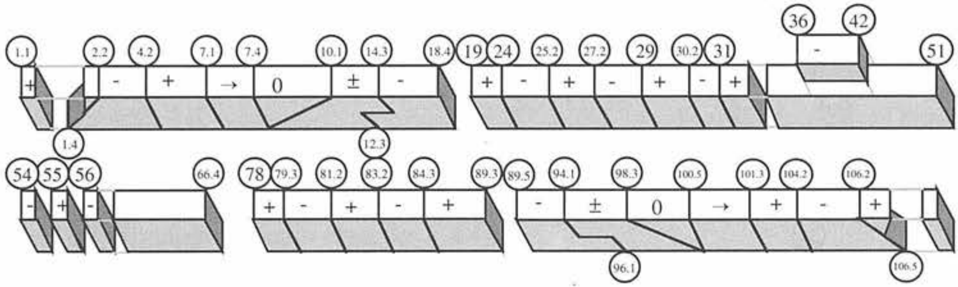
58.1-66.3 (-): long-lasting, immobile clusters played before and behind the bridge. The glissando in vc (63.2-64.4) is an expressive feature that assists the diminuendo and does not disturb the negative term established in this section;

78.1-95.5 (-): retrogradation of section 12.3-30.1;

94.1-100.4 (+): retrogradation of section 7.4-14.2;

98.3-107.2 (-): retrogradation of section 1.1-9.5.

LOUD DYNAMICS VS. SOFT DYNAMICS



1.1-2.1 (+): vigorous beats *sf* performed first by vl, vc and vb (1.1), then by vn and vl (2.1);

1.4-4.1 (-): even before the second beat, a low dynamic level is established in vb (1.4) and then taken up by vc (2.2). The dynamic mark *f* is misleading here: it does not indicate a loud dynamic, but merely compensates for the extreme dynamic weakness of rubbing the sound board with the palm of the hand, ensuring its audibility within the range of soft dynamics. A dynamic mark *pp*, adequate to the level of loudness in this section, appears in vn and vl (2.5-3.2);

4.2-6.5 (+): *f* in all instruments;

7.1-7.3 (→): decrescendo from *f* low to *mf*;

7.4-9.5 (0): *mf* fixes an intermediate dynamic level in vc (7.4-8.5), vb (7.4-9.4) and vn 1-12 (7.4-9.5);

7.4-14.2 (+)(-): this very curious juncture of two totally superimposed sections begins simultaneously with the above-discussed section, and gradually forces it out. Opposing dynamic levels, *pp* and *f*, always occur together here, within every instrumental group (vl: 7.4-12.1; vc: 9.1-14.2; vb: 9.5-13.2; vn 13-24: 10.1-14.2; vn 1-12: 10.5-14.2), being assigned to its two halves, each of which performs different types of glissando movement;

12.3-18.3 (-): soft dynamics *pp* are introduced already in 12.3 by vl and in 13.3 by vb. Dynamic marks *mf* and *p* in vn 1-12 (15.5-18.3) and vc (16.4-18.3) compensate the dynamic weakness of harmonics;

19-23 (+): *ff sempre*;

24-25.1 (-): *p*;

25.2-27.1 (+): *ff*;

27.2-28 (-): *pp*;

29-30.1 (+): *ff*;

30.2-30.5 (-): *p*;

31-50.5 (+): the high dynamic level is fixed as a *ff crescendo* ending with two impulses *sff* (33). After a rest, the narration begins anew in loud dynamics *ff* assigned to vb (34.3). In its further course, this section is kept in dynamics ranging from *f* to *fff* and includes all instrumental groups except vn and vc in 36-41. It climaxes with an impressive, violent crescendo tutti, starting from *ff* (vn) and *fff* (vl, vc, vb);

36-41 (→): dynamic gradation from *p* (36) through *mf* (37) to *f* (39.2) in the sub-layer of vn and vc. The increase of loudness causes this section, which was originally separated from the main layer of the trajectory, now to fuse with the latter when reaching the appropriately high dynamic level;

54 (-): ricochets *pp*;

55.1 (+): *sf* beat in all the instruments;

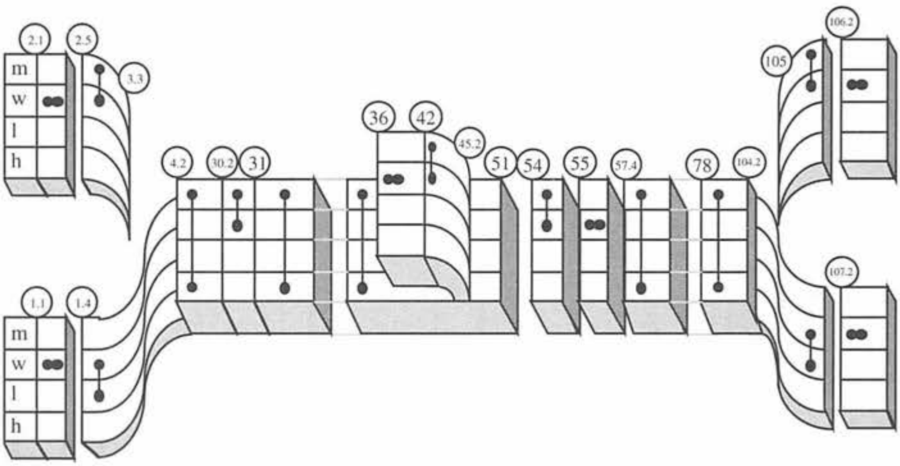
56.2-66.3 (-): a single tap *p* on sound boards of vl, vc and vb (56) followed by *arco* play in *p-pp* dynamic range;

78.1-79.2 (+): reiteration of section 29.1-30.1;

79.3-81.1 (-): reiteration of section 27.2-28.5;

81.2-83.1 (+): reiteration of section 25.2-27.1;
83.2-84.2 (-): reiteration of section 24.1-25.1;
84.3-89.2 (+): retrogradation of section 19-23;
89.5-95.5 (-): retrogradation of section 12.3-18.3;
94-100.4 (+)(-): retrogradation of sections juxtaposition from 7.4-14.2;[2]
98.3-100.4 (0): retrogradation of section 7.4-9.5;
100.5-101.2 (→): retrogradation of section 7.1-7.3;
101.3-104.1 (+): retrogradation of section 4.2-6.5;
104.2-106.4 (-): reiteration of section 1.4-4.1;
106.2-107.2 (+): reiteration of section 1.1-2.1.

Timbre system



1.1 (ww): initial tap with fingertips on the sound boards of vl, vc and vb;
1.4-4.1 (wl): continuation of the same layer, by the rubbing of sound boards with the palm of the hand (vc and vb);
2.1 (ww): tap with fingertips on sound boards of vn and vl initiates a parallel layer of the timbre trajectory;
2.5-3.2 (wm): col-legno playing on strings between bridge and tailpiece (vn, vl);
4.2-30.1 (mh): reconciliation of the two layers arrives together with traditional *arco* playing of the whole stringed orchestra;
30.2-30.5 (mw): playing *legno battuto* between bridge and tailpiece;
31.1-50.5 (mh): *arco*—beginning at 34.3 this most typical instrumental technique occurs independently in vb (34.3-41.5), vl (38.1-41.3) and vc (42.1-46.2), subsequently joined by playing between bridge and tailpiece (vl: 45.2-49.3; vc: 46.3-48.1; vn 1-12: 47.1-48.5; vn 13-24: 47.1-48.1) as well as on bridges and tailpieces of vb and vc (48.2-49.3), which substitute for metal in the low register. Finally, in 49.4-50.5 it spreads over all instrumental groups of strings;

[2] The lack of the dynamic indication f in vn 1-6, vn 13-18, vl 1-5, vc 1-5 and vb 1-4 is obviously an error in the score.

36.1-41.5 (ww): a sub-layer begins, with tapping sound boards with fingertips and desks with bows in vn (36.1-40.4) and vc (39.2-41.5);

42.1-45.1 (mw): *legno battuto* playing between bridges and tailpieces of vb (42.1-45.1) and vn (43.2-45.1) forms a consecutive sub-layer section. Because it brings a complex mediative term of the active opposition "m vs. w", this section forms a bridge between "wood", as the main material of the preceding section, and "metal", which is continued in the principal layer of the trajectory;

54.1-54.4 (mw): ricochets *col legno* between bridge and tailpiece;

55.1-56.2 (ww): taps on the sound board with fingertips;

57.4-66.3 (mh): *arco* playing before and behind the bridge;

78.1-104.1 (mh): retrogradation of section 4.2-30.1;

104.2-106.4 (wl): retrogradation of section 1.4-4.1;

107.2 (ww): reiteration of section 1.1;

105.1-105.3 (mw): retrogradation of section 2.5-3.2;

106.2 (ww): reiteration of section 2.1.

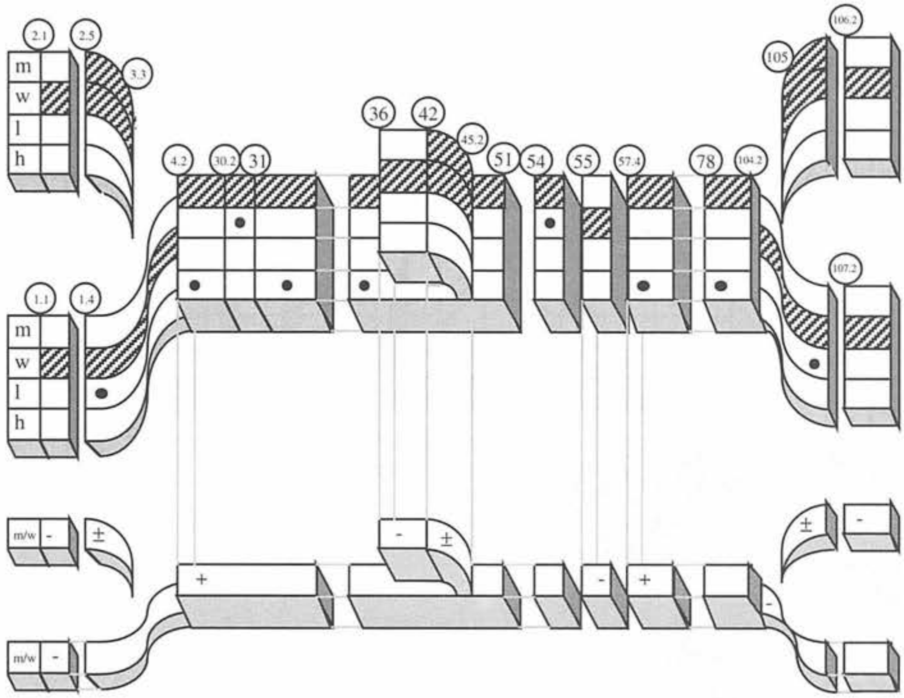


Figure 70. Timbre trajectory of *Canon* and its active material opposition

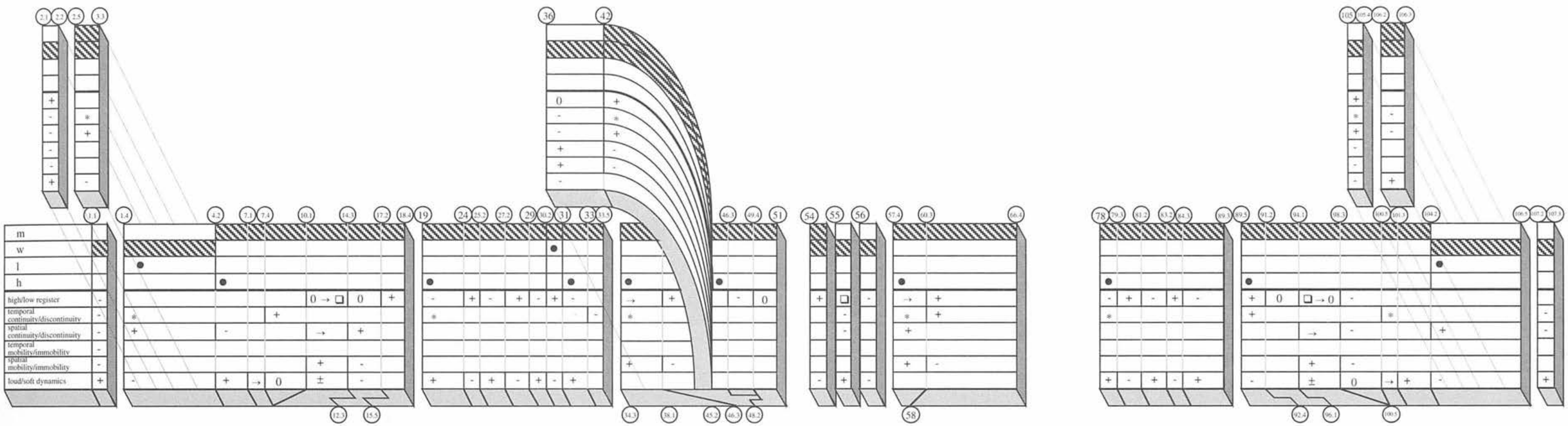


Figure 71. Summary chart of *Canon*

9. **EVOLUTION OF EXPRESSIVE FEATURES**

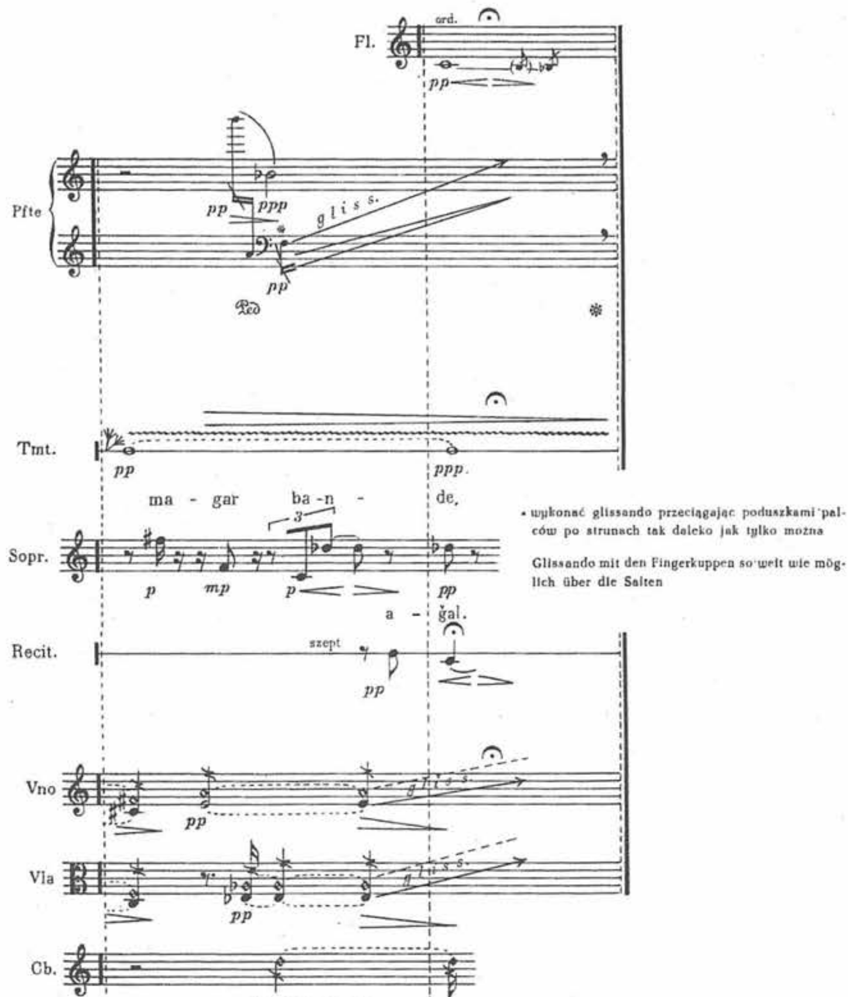
The set of regular expressive features remains more or less constant in Penderecki's sonoristic output. The articulatory phenomena of strings, reckoned here, are found in almost all the pieces analyzed in the previous chapter. The two exceptions are *metá* and *flautando*: the former occurs only in *Threnody—To the Victims of Hiroshima*, the latter exclusively in *Anaklasis*. Surprisingly, expressive features of vocal techniques—*bocca chiusa*, *falsetto* and whistling—are employed by the composer not only in *Dimensions of Time and Silence* as his only sonoristic piece whose performing ensemble includes choir, but also in *Fluorescences* and *Canon*, where they are performed by instrumentalists. Some change is noticeable merely in the application of regular expressive features. In the four earlier pieces—*Anaklasis*, *Dimensions*, *Threnody*, and the String Quartet—those features are mostly assigned to individual sounds and hence are active on the subsegmental level. In *Polymorphia*, *Fluorescences*, and *Canon* such usage is not made of regular expressive features; they occur always applied to huge sound complexes, chiefly clusters, and are thereby transported onto the level of segments. For this change, the difference pointed out formerly between Examples 54 and 55, stemming respectively from *Anaklasis* and *Fluorescences*, thus appears to be very characteristic.

Instead, evolution is to be observed as regards optional expressive features. As one remembers, the exclusion of these features from the field of systemic articulatory phenomena, and their construal as being extrasystemic, is each time caused by several reasons in the framework of the basic system constitutive for a given sonoristic piece. Among the optional expressive features brought to light by the analyses, two are regulated by the motoric parameters of categories "spatial mobility vs. immobility" and "temporal mobility vs. immobility"; these features acquire their expressive character due to the total redundancy which leads to the fusion of those oppositions into a more general opposition "mobility vs. immobility" in *Anaklasis*, *Threnody*, and *Dimensions of Time and Silence*. In Chapter 7 it was stated that the terms of a category constituting a fusion of elementary binary oppositions arise as constant combinations of parallel terms of the component categories established on the strength of artificial equivalences between them. In turn, all other combinations of their terms are irrelevant for the general category and, consequently, also for the system of a given piece. Being characterized at the same time by "spatial mobility" and "temporal immobility", a glissando forms such an irrelevant combination. Another combination of terms precluded on the grounds of intercategorial redundancy between "spatial mobility vs. immobility" and "temporal mobility vs. immobility" is occasioned by series of gradually accelerated or decelerated repetitions.[1] This is so since, while from the viewpoint of "spatial mobility vs. immobility" such series are representatives of the negative term, seen from the angle of "temporal mobility vs. immobility" they articulate transitions between two versions of the negative term. Otherwise, this sort of transition constitutes a side-effect of the simple temporal mediative term within the hierarchically-linked opposition of "minimal vs. maximal time-span". This is why in *Dimensions of Time and Silence*, whose system embraces also the latter mentioned category, the repetitive series are treated as optional expressive features only inasmuch as the opposition "maximal vs. minimal time-span" is not activated in a given part of the piece.

[1] The peculiarity of these phenomena in comparison with all the remaining expressive features, both regular and optional, is that they are not aspects of individual sound generation processes, but of their sequences. This springs from the exceptional character of the motoric parameter of the category "temporal mobility vs. immobility" (and also of its hierarchically-linked category "maximal vs. minimal time-span"), as emphasized in Chapter 6.2.

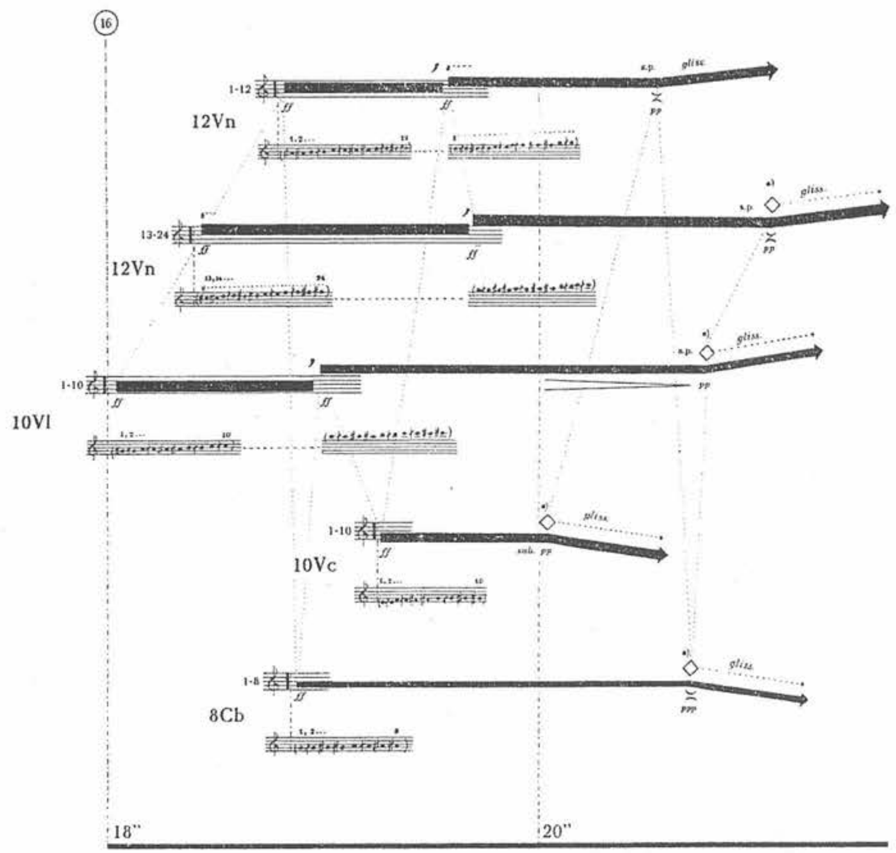
Obviously, neither glissandi nor repetitive series can be said to constitute new articulatory devices. In actuality, just like regular expressive features, so also all optional ones, though deviating from standard articulation, turn out to be commonly known among traditional instrumental or vocal techniques. This is exactly why they could be taken for granted by the composer in his sonoristic pieces, though they are neither indispensable nor justified on the basis of their subsystems. As emphasized in the analyses, optional expressive features are always intended to bring dynamic processes into relief, that is to say, to make the latter more salient. This redundant function of optional expressive features, which forms another point of resemblance between them and the regular ones, originates again (just like the latter features themselves) in pieces by Penderecki that precede those of his sonoristic period. For instance, the connection between glissandi and dynamic decline can be traced back to *Miniatures* for violin and piano, *Strophes*, and *Emanations*. Perhaps its most impressive example is to be found in the conclusion of *Strophes*, where the glissando performed simultaneously by violin, viola, piano, and flute accompanies a diminuendo:

Example 56: *Strophes*, last page (98-99)



One should not overlook the striking similarity between this suggestive closural effect and the way in which glissando, as an optional expressive feature, is employed subsequently in sonoristic pieces, for instance in *Anaklasis* (see Ex. 20), as well as in *Dimensions of Time and Silence* (20-22), or *Threnody*:

Example 57:*Threnody*, 16-17



Only rarely is an expressive glissando coupled with gradual dynamic changes of a differing character; that is, ones which embrace not only decrease, but also increase of loudness. This happens exclusively in cases when the construction of a sound generator predetermines an organic relationship between intensity and frequency. Such is the case with flexatone, musical saw (*sega*), and siren, whose glissandi have been said to form a sort of spatial projection of dynamic changes. Because none of these instruments can produce a steady pitch or registral band, they are used by the composer exclusively for expressive purposes. This explains why saw, flexatone, and siren are not listed among the articulatory resources of Penderecki's sonorism in Diagram 2. In addition, sound generation on flexatone and siren involves air; thus neither of these instruments can represent a proper sound generator, which in Penderecki's sonorism presupposes the material solidity of both vibrator and inciter. An interconnection between intensity and frequency also characterizes sustained, unvoiced consonants. Therefore, the ascending and descending glissandi on the consonant /sz/ in *Dimensions of Time and Silence* (see Ex. 49) also presuppose several alternating crescendi and decrescendi, respectively, even though these dynamic processes are not indicated in the score.

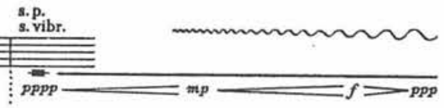
Gradually accelerated or decelerated series of repetitions also have precedents in the composer's presonoristic phase; they are employed in *Strophes*, the most sophisticated of Penderecki's early pieces. In that work, all five occurrences of such series accompany either a gradual diminuendo or crescendo. The same holds true with respect to the redundant function attached to all expressive occurrences of this effect in *Dimensions of Time and Silence*.

In contradistinction to repetitive series—which are so rare in Penderecki's sonoristic output as to be found exclusively in *Dimensions*—glissando occurs in all three sonoristic pieces whose systems are suitably modified by total intercategorial redundancy between "spatial mobility vs. immobility" and "temporal mobility vs. immobility": *Anaklasis*, *Dimensions*, and *Threnody*. What is more, glissando occasionally preserves its expressive function in *Fluorescences* and *Canon*, although in those works, these two elementary categories are independent of each other, so that a combination of the positive term of the former with the negative term of the latter is already relevant on the basis of their subsystems. In *Fluorescences* does one find the exceptional cases, mentioned above, of glissandi performed by flexatone, saw, and siren. As pointed out in the analyses, the remaining occurrences of glissandi as optional expressive features in *Fluorescences* (40, 102) and *Canon* (15.5-17.1, 91.2-92.3, 63.2-64) are typical, in the sense that they always perform their original redundant function as abetting dynamic decline (diminuendo). *Fluorescences* also contains other articulatory phenomena performing an expressive function, even though those phenomena are otherwise relevant for the system of the piece. They are tremoli, vibrati, and trills. Tremolo and vibrato enhance the dynamic consistency of a sustained cluster in paragraphs 41-44 and of the single tone c^1 in paragraphs 71-81, while trills help support the fragile dynamics (ppp) in the wind instruments in 91-92. Their unexpected occurrence as optional expressive features—side by side with trills, tremoli, and vibrati employed for their systemic functions—suggests that, like glissandi, they may have performed the expressive function even earlier in Penderecki's output, in pieces whose state of system precluded them as representatives of the border-zone term of "temporal continuity vs. discontinuity".

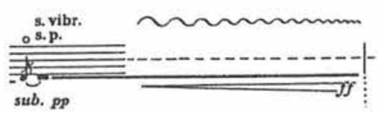
Indeed, the present analyses have indicated the expressive use of vibrati in *Dimensions of Time and Silence* (110-112), where they assist the dynamic changes in violins and voices. However, as a consequence of the modified articulatory definition of "temporal continuity vs. discontinuity" assumed by the composer, expressive trills, vibrati, and tremoli are much more numerous in *Anaklasis*, *Dimensions of Time and Silence*, *Threnody*, and String Quartet. In those pieces, raising the upper limit of the interval representing the positive term resulted in its expansion to cover all the articulatory phenomena that normally represent the border-zone term of the category. Because trills, tremoli, and vibrati have, in this way, found their place within the basic system on the ground of the opposition "temporal continuity vs. discontinuity", they are not indicated in the analyses as optional expressive features. Still, their occurrences do not occasion there the proper border-zone term, to which they were assigned in the regular articulatory definition in Part One. Furthermore, with regard to traditionally played strings and winds, tremolo, vibrato, and trill are articulatory devices that are non-standard in comparison with long-lasting sounds, among which they are included as representatives of temporal continuity. Therefore, all their occurrences in pieces where the modified articulatory definition of "temporal continuity vs. discontinuity" obtains, are to be considered as expressive and, in addition, redundant towards dynamics.

The redundant function performed by vibrato in Penderecki's presonoristic pieces is illustrated at best in *Miniatures*, where the gradual change of vibrato speed twice accompanies an equally gradual dynamic change:

Example 58a: *Miniature I*, 2



Example 58b: *Miniature I*, 5



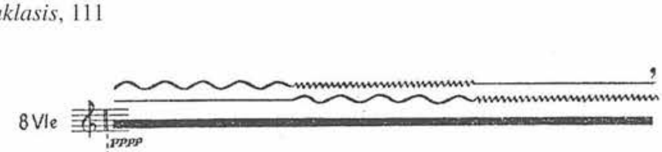
In both examples above, the lowest dynamic level is connected with *senza vibrato*, and the highest one with vibrato. Yet the speed of vibrati assigned to the loudest dynamics and, consequently, the manner in which one passes from *senza vibrato* to vibrato, differs in the two transitions. In the former, the lowest dynamic level accompanied by *senza vibrato* is followed by a *molto vibrato* leading to a slow vibrato at the dynamic peak (here, *forte*). Conversely, in the latter example it is slow vibrato that follows *senza vibrato* and leads to *molto vibrato* in *ff* dynamics. The odds are that this difference reflects two different ways in which vibrato is conceived by the composer. If vibrato is seen as a slight spatial movement, the speed of this movement is highest for *molto vibrato* and lowest for slow vibrato, whereby the latter is closer to *senza vibrato* as a lack of movement. This is the case of the vibrato employed in bar 5 (Ex. 58b). On the other hand, if one considers vibrato as a substitute for a dense series of repetitions, then the *molto vibrato*, as quicker, appears to be closer to a sound played *senza vibrato*, in which the gaps between individual clicks are subliminal. Such an interpretation is apparent in bar 2 (Ex. 58a). The polyvalence of vibrato—as the representative of a border-zone term within either "spatial mobility vs. immobility" or "temporal continuity vs. discontinuity"—was pointed out earlier, in the articulatory definitions of these categories. That polyvalence now turns out to have had its origins in the presonoristic phase of Penderecki's output.

The gradual change of vibrato speed observed in *Miniatures* for violin and piano has no counterpart in any other piece by the composer. That is why the redundant function performed by vibrati towards dynamic processes of crescendo and diminuendo is exceptional here. Instead, both in the remaining presonoristic pieces and in the later sonoristic output of Penderecki, one finds only vibrati of a constant speed, whether rapid (*molto vibrato*) or slow, and kept at a constant dynamic level. In the presonoristic pieces there occurs only slow vibrato, which always accompanies soft dynamics, as in the following example from *Emanations*. That piece starts *pianissimo*, with very slow vibrati, which, according to the composer's directive, are obtained through a "fluctuation by a third of a tone by sliding the finger". The notation of these vibrati is very curious: additional quasi-notes are introduced here and fork so that they join neighbouring notes which indicate the starting pitch of a vibrato:

Example 59: *Emanations*, beginning (1-4)

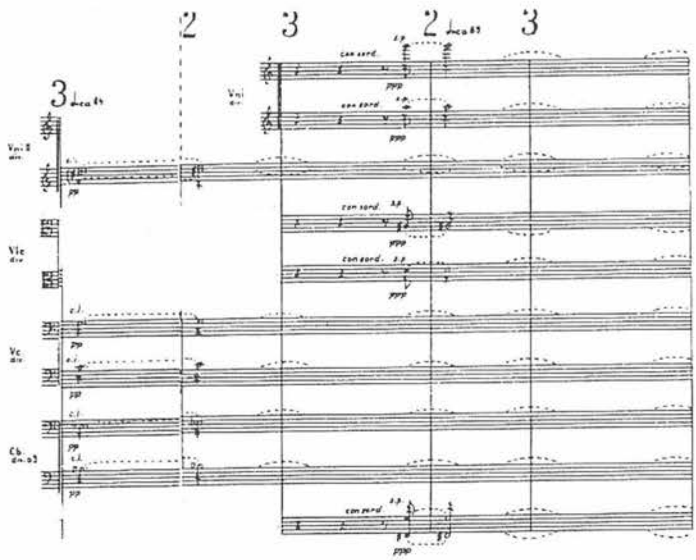
In *Strophes* (13-15, 73-75), where the slow flute vibrati are obtained by the player's drawing back the instrument in *pp* dynamics, this notational device is replaced by a wavy line, which appears subsequently in sonoristic pieces. Yet, among the latter, where (apart from slow vibrati) *molto vibrato* already occurs, the correlation between these optional expressive features and levels of loudness is much more vague. Even if slow vibrato still assists mostly soft dynamics and *molto vibrato* aids high dynamics, numerous deviations nevertheless occur, and these deviations allow the two speeds to be seen as interchangeable as regards their redundant function. An extreme case of such interchangeability happens occasionally, when both types of vibrati occur simultaneously in the same dynamics, and are assigned to the same sound or cluster in different instrumental parts, as occurs in *Dimensions* (17, 67) and *Anaklasis* (111):

Example 60: *Anaklasis*, 111



As regards trills and tremoli, both devoid of speed differentiation, they occur either in loud or in soft dynamics. A suggestive illustration of the prominent expressive role of tremoli in Penderecki's presonoristic pieces is the following example from *Emanations* for two string orchestras (see Ex. 61, below). In rehearsal numbers 57-65 those effects thoroughly fill the second orchestra part at the dynamic level of *ppp*. In other passages of the same piece (12, 86-89), in turn, trills and tremoli tend to support an extremely high dynamic level. The equivocation of assignment between vibrati, tremoli, and trills on the one hand, and levels of loudness on the other, does not negate their redundant function with respect to dynamics. Instead, this function is justified by the physical image of trembling inseparable from all those articulatory devices, which on a low dynamic level suggests fragility, while in loud dynamics it is perceived as a shaking that accompanies physical exertion.

Example 61: *Emanations*, 57-61



As already pointed out, glissandi, vibrati, tremoli, and trills as optional expressive features in *Fluorescences* and *Canon* occur side by side with similar articulatory phenomena employed in systemic functions. In the foregoing analyses, the determination of function—expressive or systemic—in individual cases was made possible each time by means of the context of a musical narration. Still, sometimes a given articulatory phenomenon, used systematically as a representative of its proper term within some category, may preserve its earlier expressive character, when it occurs as assisting a dynamic level or process towards which it was originally redundant. For instance, this is the case with gradually accelerated or decelerated repetitive series in *Dimensions of Time and Silence*, where they serve as transitions within the trajectory "maximal vs. minimal time-span"; such series, like the remaining, expressive occurrences, always accompany crescendi or diminuendi.[2] Another example is the slow and rapid vibrati in paragraphs 44-45 of *Polymorphia*, which not only represent the substitutes for the border-zone term within the trajectory "temporal continuity vs. discontinuity", but also support the dynamic climax of the piece, being assigned in common to *ff*; this also shows again the interchangeability of two speeds of vibrati as regards the dynamic level which they assist. Such situations are quite common, and all of them constitute intriguing cases of coincidence between expressive and systemic functions.

[2] The only exception is found in 108 and 112-114, where the gradual temporal condensation of repetitions and their thinning-out, respectively, proceed in a steady dynamic. Still, the increase and decrease of loudness is accomplished there by textural means, whereby transitions in the trajectory "loud vs. soft dynamics" arise.

In the three later sonoristic pieces, however, whose subsystems admit vibrato, tremolo, glissando and trills as systemic, the expressive role of those articulations, though occasionally preserved, is greatly limited. This is probably why in *Polymorphia* and *Fluorescences* a new optional expressive feature occurs: the so-called "sinusoidal" glissandi performed by individual instruments within clusters. Their exceptional position results from the fact that they are not excluded from the field of systemic articulatory phenomena because of peculiarities of the system constitutive of a given piece, but by virtue of their very nature. As stated during the analyses, the glissandi of individual instruments here take place between the lowest and the highest pitch of a cluster; thus they affect neither the range nor the spatial position of the cluster. Paradoxically enough, the movement of pitches in individual instrumental parts brings about a static overall effect in the framework of the whole instrumental group. Moreover, the sinusoidal glissandi are the only optional expressive features for which no clear counterpart can be found among articulatory phenomena in Penderecki's presonoristic pieces. Still, as all the remaining expressive features, both regular and optional, sinusoidal glissandi are redundant towards dynamics, more precisely towards a low dynamic level between *pp* and *p*, in which they mainly occur in *Polymorphia* (see Ex. 22) and *Fluorescences* (see Ex. 9). Only in the latter piece is the initially established low dynamic level, accompanied by sinusoidal glissandi, subsequently increased to *ff* (8-13 and 90-93).

To the several similarities between regular and optional expressive features which have already been pointed out in this chapter, one must add one more: as the former, so also the latter can be combined into bundles as much as is practically possible, which occasionally results in a cooperation between these two equiponderant, though different, sets of non-systemic articulatory phenomena. Because most of the regular as well as optional expressive features enhance soft dynamics, their combinations also appear to be redundant mostly towards low volume, or amplitude, levels. From among such bundles, found in Penderecki's presonoristic and sonoristic scores, one is particularly significant, since it is used several times in similar contexts. This is a combination of glissando with a varying set of other features—tremolo, harmonics, mutes, *sul ponticello*, and the like—which enhance a diminuendo. The expressive content of this bundle allows one to speak here of a "gesture of decay"—an "unraveling" of the musical thread. Accordingly, it usually occurs at the conclusion of long passages or of entire pieces.

One of the first examples of this musical gesture comes at the close of *Strophes*, shown earlier in Example 56. Surprisingly similar are also the conclusions of *Emanations* and *Miniatures*:

Example 62: *Emanations*, last page (115-118)

Tremolo na pustej strunie. Glissando uzyskujemy przez stopniowe opuszczanie kołka instrumentu. Szybkość i czas trwania glissanda są uzależnione od wykonawcy.

Tremolo on the open string. Glissando by turning the tuning peg: speed, duration and interval of glissando *ad libitum*.

Example 63: *Miniature III*, 12

Note that the descending glissando played by violin and cello in the above excerpt from *Emanations* is accomplished by turning the tuning pins, which causes the instruments, in a sense, to go beyond their proper range. One recalls that the same effect returns in the last paragraph of *Fluoresences* as a glissando of contrabasses (see Ex. 32)—one of the clearest examples of the "gesture of decay" in Penderecki's sonoristic works. The earlier-quoted example from *Strophes* (Ex. 56) contains another instance of the lower border of a normal instrumental range being exceeded, by means of drawing the flute to one side; this allows the performer to obtain b and b♭. Meanwhile, the ascending glissandi in violins, violas, and piano create the impression of surpassing the upper limit of their ranges, which is suggested by the upward-pointing arrows at the end of glissando lines. The impression of going beyond the space of musical sounds and thus also beyond the musical narration takes place also in *Threnody* (16-17, Ex. 57), *Anaklasis* (113-115, Ex. 20), *Dimensions of Time and Silence* (20-22), and *Fluorescences* (40). Undoubtedly, those musical effects emphasize the concluding function of the "decay" gesture. Consequently, when it occurs not at the end of a whole piece, but only closes one of its sections, it is as a rule followed by a rest, after which the musical narration starts "anew".

In a sense, all expressive occurrences of glissandi in Penderecki's sonoristic pieces can be seen as mutations of the "gesture of decay". This gesture, though extrasystemic, thus appears to take in Penderecki's works a position comparable to a rhetorical figure of clear and univocal significance. However, as is apparent from the above remarks, this significance concerns not only expressivity, but also a syntax of musical narration. Therefore, as marking the ends of syntactical units, the articulatory phenomenon termed the "gesture of decay" performs not only an expressive and redundant function, but at the same time appears to constitute the unique configurative feature of Penderecki's sonorism.

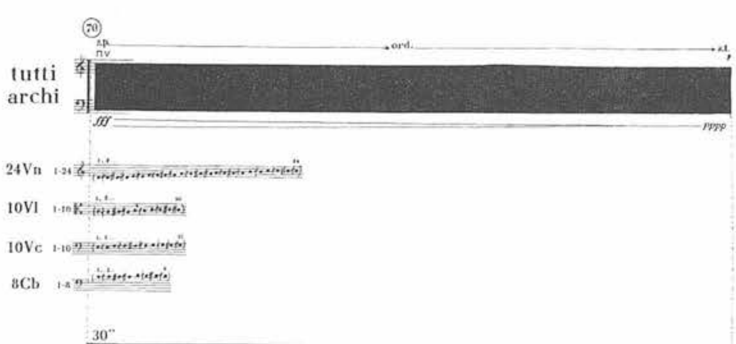
10. EVOLUTION OF THE SYSTEM

10.1. BASIC SYSTEM IN GROWTH

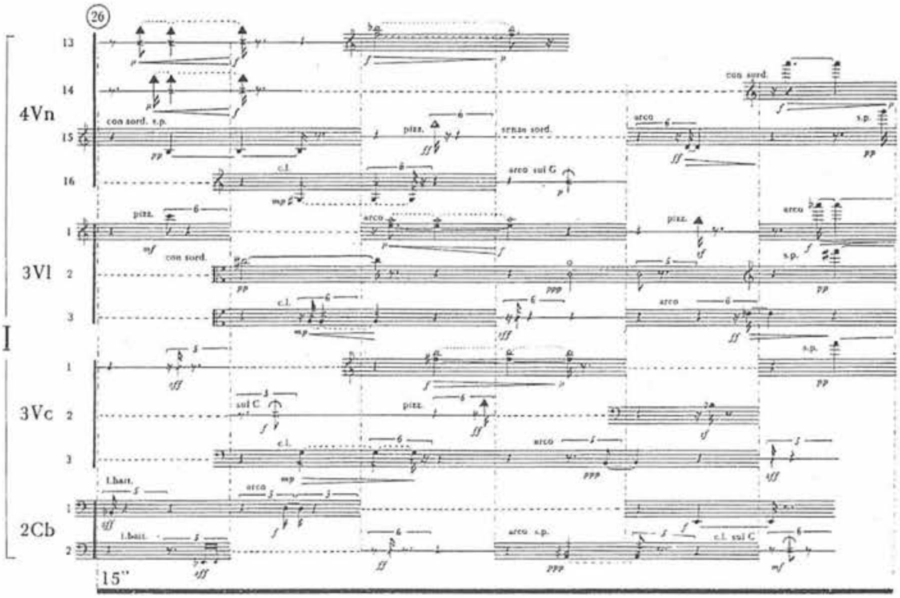
The foregoing remarks provide a valuable clue: Because the optional expressive features are excluded from among systemic articulatory phenomena due to peculiarities of the basic system categories as defined and configured within a subsystem proper for a given sonoristic piece, their evolution observed in the course of the previous chapter gives one to suppose that also transformations of the basic system itself display some ordered character. Indeed, after a comparison of the states of that system governing individual sonoristic pieces, one inevitably arrives at the conclusion that their transformations assume an evolutionary course stamped by a conspicuous logic. It is the concern of the following discussion to elucidate this logic and in this way to uncover the interconnections between consecutive stages of the evolution recorded in individual sonoristic works by Krzysztof Penderecki.

As far as one can reasonably hypothesize, at the beginning of the evolution of the basic system lies an opposition between two polar types of texture. One of them is a heterogeneous, pointillist texture resulting originally from serial operations that expose individual sounds as being maximally differentiated in respect of all their parameters. This type of texture existed already in Penderecki's pieces immediately preceding his sonoristic period, mainly in *Emanations* and *Strophes* (which were composed under the evident influence of the Darmstadt school). The other texture is characterized by maximal homogeneity, where component sounds are individually indiscernible. This texture—the cluster—arose together with sonorism, and was the most emblematic sound phenomenon of the new style. Traces of such a "nuclear opposition" between an optimal cluster and optimally pointillist sound field are to be found in early sonoristic pieces. Optimal clusters are undoubtedly those played by all the stringed instruments (*tutti archi*) in *Anaklasis* (3; Ex. 7), sung by all the choral voices in *Dimensions of Time and Silence* (107, 188; Ex. 36), and to some extent the cluster of all four instruments of Penderecki's First String Quartet (3.31-33). In all those works one also finds optimally disintegrated mixtures of sounds. In *Dimensions* they occur in paragraphs 14-17 and 70. In *Anaklasis* an extensive field of maximally differentiated sound phenomena occurs in the passage between 80 and 95, and in the Quartet in sections 2.16-2.50 as well as 4.58-5.15. Yet the most striking exposition of the contrasting textures is undoubtedly that which occurs in *Threnody*. While the central section of this piece is filled in with a sound field of a plainly pointillist character, in which each instrument is treated soloistically (Ex. 64b), the closure brings an impressive quarter-tone cluster of all 48 strings (Ex. 64a):

Example 64a: *Threnody*, 70



Example 64b: *Threnody*, 26-31



Still, the just-mentioned pieces cannot be said to correspond with the initial, most rudimentary stage of the basic system evolution represented by the "nuclear opposition". Obviously, the contrast of two textures is too flimsy a base on which to elaborate a musical narration of a length and complexity sufficient for a musical work. Therefore, the "nuclear opposition" is to be treated merely as a mental construct conceived by the composer at the outset of devising his sonoristic compositional technique, but not yet recorded in any of his concrete sonoristic pieces. In order to be of practical service as a regulative factôr in generating such pieces, it first required to be mediated. However, mediation of an opposition between textures is impossible as long as they are taken as primary, indivisible wholes. The situation here is similar to the mediation between segments, which are textures of Penderecki's sonoristic style. As demonstrated in Chapter 5.3, to mediate between two contrasting segments and in this way to create a musical narration of an evolutionary character, one needs to determine the respects in which such segments are opposite, that is, to state a set of terms as features constitutive for each of them. Only afterwards, by recombining those features, is it practicable to build several new segments and order them into a chain proceeding between the opposita as, respectively, the point of departure and of destination of a mediative process. With regard to the "nuclear opposition", in so far as its original textures are polar, all the newly arising ones will by necessity represent several intermediate stages of homogeneity and heterogeneity and, consequently, mediative terms, in the same way as several segments representing different intermediary degrees of kinship can be seen as mediations between contrasting segments in passages governed by the strategy of evolution. Such intermediate types of texture occur in *Anaklasis*, *Threnody*, *Dimensions*, and the String Quartet. Each of these four pieces, apart from being analyzed in terms of elementary categories of the basic system (as is the case in Chapter 8), can be thus considered in a complementary view, as a process of mediating the "nuclear opposition", which proceeds between the optimal cluster and the optimally pointillist sound field.

Mediation of the "nuclear opposition", bringing about a shift from a level of segments (textures) onto that of their features, must have constituted a turning point in the evolution of Penderecki's compositional thinking. If the hypothesis formulated here is right, it is exactly at this moment when a process of crystallizing elementary binary oppositions was initiated. Most likely, such elementary oppositions were originally conceived by the composer as partial contrasts embodied directly into terms of the nuclear opposition, through an application of the concepts of homogeneity and heterogeneity to individual parameters of sound. Indeed, such was the case as regards pitch. Because the heterogeneity resulting from serialization of this parameter, and causing a dispersion of pitches in the pointillist texture, appeared to be opposite to a homogeneity as a unification of pitches in a cluster, the elementary binary opposition "spatial continuity vs. spatial discontinuity" arose. The fact of its being assigned directly to terms of the "nuclear opposition" explains why in Penderecki's sonorism it occurs already in the subsystems of the earliest pieces.

Yet the very nature of homogeneity and heterogeneity kept analogous elementary oppositions between terms of the "nuclear opposition" from arising with respect to loudness and duration. This was the case because, while the uniformity of a sound field presupposed by its homogeneity was always accomplished through a choice of a single value of these parameters assigned to all component sounds of an optimal cluster, the heterogeneity of an optimally pointillist texture was due to a differentiation of sound phenomena as an effect of serial procedures on dynamics and rhythm. Thus, paradoxically enough, the search for elementary binary oppositions between terms of the nuclear opposition led to the discovery that, in respect of loudness and duration, these terms are not exactly opposite, but rather related as part to whole. Despite this, further categories of Penderecki's basic system have arisen, owing to the fact that the optimal cluster always took maximal values of both parameters. This, on the strength of a logical mechanism, automatically provoked the occurrence of minimal values of loudness and duration as the polar extremum represented among the component sounds of the optimally pointillist texture.

Such a mechanism brought about a most obvious result regarding the loudness. In all the cases mentioned earlier, the "optimal cluster" was always kept at a very loud dynamic, indicated as *ff* or *fff*, and additionally supported by an accumulation of simultaneously played sounds concentrated within a compact band. Hence the dynamic level naturally opposite to it was that of soft sounds contained in the pointillist type of texture, which otherwise, as a whole, was also much softer than a cluster because of the spatial and temporal diffusion of sound phenomena. Of course, the resulting opposition "loud vs. soft dynamics" could hardly be called Penderecki's invention. In fact, this type of dynamic relationship was the very first, once dynamics began to be treated as a tectonic element of music. The "terraced dynamics" of Baroque music were based on this opposition, beginning with Giovanni Gabrieli's *Sonata pian' e forte*, and its earliest mediation was most likely the famous Mannheim crescendo as a temporal simple mediative term. Its obviousness and a very long tradition in music history caused "loud vs. soft dynamics" not only to be (like "spatial continuity vs. discontinuity") present in all sonoristic pieces, but also to occur there always as a "free" opposition independent of any other categories of the basic system, and thus not entering into any intercategorial redundancies with them.

Characteristically, all optimal clusters are not only loud, but also very long-lasting. The 30-second cluster in *Threnody* is an extreme case in this respect. Similarly, the above-mentioned sound phenomena from *Anaklasis*, *Dimensions of Time and Silence*, and String Quartet No. 1 are characterized by considerable duration, which is not indicated in rhythmical values but given in seconds. Because the polar interval of durations is that of minimal values, the sound phenomena of a pointillist texture that appeared to stand in opposition to such sustained clusters were very short, momentary impulses, whereby the category "temporal continuity vs. discontinuity" arose as an elementary opposition between points and sections on the axis of perceptual time. It is likely that what could have been of importance for conceiving this category by the composer, was its analogy to "spatial continuity vs. discontinuity", as the earlier crystallized relation of points and sections within the axis of pitches. This analogy finds a clear reflection in the logical structures of both binary oppositions, elaborated graphically in Chapter 5. Still, it is noteworthy that these two similar categories vary as regards representations of their terms within the "nuclear opposition". In contradistinction to "spatial continuity vs. discontinuity", "temporal continuity vs. discontinuity" is not directly embodied into polarized textures because, while "temporal discontinuity" appears only in the pointillist sound fields, "temporal continuity" occurs both in their individual, long-lasting sounds and in a homogeneous cluster. As a consequence, spatial continuity of an optimal cluster implies temporal continuity, but at the same time temporal discontinuity of momentary sound phenomena presupposes spatial discontinuity of an optimally heterogeneous pontillist texture. Apparently this is the case in the relation of the discussed categories within the nuclear opposition, where the artificial logical implications originate, these last setting up the partial intercategorial redundancy between "temporal continuity vs. discontinuity" and "spatial continuity vs. discontinuity". As one recalls, this redundancy is characteristic of two of the earliest sonoristic pieces by Penderecki, *Threnody-To the Victims of Hiroshima* and *Dimensions of Time and Silence*. Moreover, the modification of the articulatory definition of "temporal continuity vs. discontinuity" (observed in *Anaklasis*, *Dimensions*, *Threnody*, and the Quartet) also springs from here. The inclusion of quickest possible repetitions among the representatives of its positive term resulted most likely from the fact that the long-lasting sounds in the pointillist texture were occasionally performed as tremoli—articulatory phenomena treated originally as expressive shadings that did not disturb the temporally continuous character of sounds. Such a treatment can be ascertained not only from the central part of *Threnody* shown in the earlier example (Ex. 64b), but also from the texturally heterogeneous passages indicated in scores of *Anaklasis*, *Dimensions* and Quartet as well as from the presonoristic pieces by Penderecki, like *Strophes* (8-12, 84-86) or *Emanations* (14-23, 66-80).

The homogeneity of a cluster was ensured, however, not only by equal durations of its component sounds, but also by their simultaneous onset. This onset appeared thus to constitute another point of differentiation in comparison with non-simultaneous occurrences of sounds in the optimally pointillist texture which—combined with pitch changes—brought about an impression of a movement as opposite to an immobility of an optimal cluster. Because this impression embraced both the spatial and the temporal aspects of auditive perception, the category "mobility vs. immobility", which occurs in the earliest pieces (*Dimensions*, *Threnody*, and *Anaklasis*), forms a fusion of two elementary categories: "spatial mobility vs. immobility" and "temporal mobility vs. immobility". What is noteworthy is the direct, one-to-one assignment between opposite terms of the category "mobility vs. immobility" and terms of the "nuclear opposition", resembling the case of "spatial continuity vs. discontinuity". One might suspect that this coincidence of representations within the nuclear opposition should have influenced the original logical relations of categories "mobility vs. immobility" and "spatial continuity vs. discontinuity" and have caused their fusion on the strength of some total intercategorial redundancy. Indeed, although not recorded in any of the sonoristic pieces, such a fusion seems to have been characteristic of the conceptual stage of the system evolution. However, the fact that it is not present in the musical texts investigated in this book, is most likely because a quite common (though not contained within the "nuclear opposition") case of an immobile phenomenon appears also to be a single, momentary sound of definite pitch representing spatial discontinuity. Therefore in *Anaklasis*, *Dimensions*, and *Threnody* the intercategorial redundancy between "mobility vs. immobility" and "spatial continuity vs. discontinuity" displays a weaker partial character.

Also the other of the intercategorial redundancies entered into by "mobility vs. immobility" within subsystems of Penderecki's sonoristic pieces—that which ties this general category to "temporal continuity vs. discontinuity"—displays the clear influence of the way in which both these oppositions have been found to be represented in terms of the nuclear opposition between an optimal cluster and an optimally pointillist texture. If in a cluster the immobility co-occurred exclusively with temporal continuity, the movement considered originally as being vested in the pointillist sound fields was a property of both temporally continuous and discontinuous phenomena. As far as one can guess, this observation might have led the composer to suppose that, if in the cluster long lasting duration results in immobility, it is only momentary sounds that give the pointillist texture the impression of movement. Accordingly, a change was made by the composer: the pointillist texture was not to be seen any longer as a representative of mobility, but as a combination of mobile, momentary, and immobile long-lasting sound phenomena. In turn, from this new point of view, the representation of the category "mobility vs. immobility", while not in line with the terms of the nuclear opposition, appeared instead to be identical with the representation of "temporal continuity vs. discontinuity". Here one can detect the origin of the fusion of these two categories in *Threnody* by virtue of their total redundancy. The intercategorial redundancy between "mobility vs. immobility" and "temporal continuity vs. discontinuity" is weakened in *Anaklasis* and *Dimensions*, however. The fact, that in the last-mentioned pieces this redundancy displays only a partial character (based on artificial implications according to which the mobility presupposes temporal discontinuity and temporal continuity presupposes immobility), is caused probably by the same consideration of a single, short, immobile sound which otherwise led to a change of the interrelation between "mobility vs. immobility" and "spatial continuity vs. discontinuity".

In consequence of the correction concerning the representation of "mobility vs. immobility" within the nuclear opposition of textures, this category appears not to be directly connected with "temporal continuity vs. discontinuity", which makes clear that it is not contingent on the sound duration. Apparently, immobility can be equally represented by temporally continuous (long) and discontinuous (short) phenomena. Still, if either of those phenomena is to be perceived as immobile, its time-span in relation to the successive sound must be large. Consequently, high time-span values turn out to be the common denominator of immobile sound phenomena, irrespective of their qualification on the ground of the category "temporal continuity vs. discontinuity". However, it has already been pointed out that, at this stage of the basic system evolution, the long-lasting, temporally continuous sounds are of two types, according to their preliminary articulatory definition, which is valid in *Anaklasis*, *Dimensions*, *Threnody*, and the String Quartet. Apart from sound phenomena generated by single excitation events, the composer includes here also their maximally dense repetitions represented mainly by tremolo. The latter, while a large time-span if taken as a whole, displays instead a minimal time-span value between component sound generation processes. The immobility is thus once again reinterpreted as a property of sounds separated either by maximal or by minimal time-spans. On the other hand, the mobility becomes attached by the composer to medium time-spans between successive sounds. In this way the proper acoustical definition of "mobility" and "immobility" is reached.

According to this definition, the set of immobile phenomena appears to be unconnected, consisting of two separated subsets of polar time-span values. The polarisation of these subsets, happening again due to natural logical mechanisms, has caused that they, in turn, come into an elementary opposition of "maximal vs. minimal time-span". Still, because both its opposite terms belong to "immobility", the trajectory of "maximal vs. minimal time-span" in *Dimensions*, where this category occurs for the first time, does not persist through the whole course of that piece. Rather, it is divided into sections, each of which coincides with the negative term of the superior, general category "mobility vs. immobility". A mediation of this new opposition was already close at hand, as series of gradually accelerated or decelerated repetitions, which occur in the presonoristic *Strophes*, and which were employed as optional expressive features in those passages of *Dimensions* where the category "minimal vs. maximal time-span" is not active. Their occurrence as a single temporal mediative term exerts a crucial influence not only upon the crystallization of the category "minimal vs. maximal time-span", but also upon the further evolution of the basic system.

This last assertion is true, because a transition between maximal and minimal values of time-span within such series presupposes one inevitably to cross medium time-span values which are characteristic of mobility, and yet, unlike mobile phenomena, separate here several repetitions of the same pitch. The described sort of transition thus brings a new sort of sound relation that meets only the temporal condition of mobility, but is devoid of pitch changes. Consequently, from the general category "mobility vs. immobility", the elementary opposition "temporal mobility vs. immobility" is divided off. Logical symmetry between musical dimensions of time and space (pointed out earlier in reference to temporal and spatial mutations of the opposition between continuity and discontinuity) has in turn caused a parallel-crystallization of "spatial mobility vs. immobility". This crystallization was made easier by the fact that a sound phenomenon characterized by spatial mobility, but not by medium time-spans between successive sounds, had already existed in Penderecki's pieces as another optional expressive feature. This phenomenon was glissando, which consists in pitch changes that take place during the same long-lasting sound. In this way, the category "mobility vs. immobility" splits into two different elementary oppositions—"spatial mobility vs. immobility" and "temporal mobility vs. immobility"—of analogous internal structures. This split happens for the first time in String Quartet No. 1. Subsequently, "spatial mobility vs. immobility" and "temporal mobility vs. immobility" occur as thoroughly independent categories in the subsystems of *Polymorphia*, *Fluorescences*, and *Canon*. Splitting the general category "mobility vs. immobility" in those pieces has an impact on the intercategorial redundancies in which it has been previously involved. The redundancy with "spatial continuity vs. discontinuity" disappears completely, and the one with "temporal continuity vs. discontinuity" henceforth concerns exclusively "temporal mobility vs. immobility". Otherwise, the partial intercategorial redundancy linking "temporal mobility vs. immobility" and "temporal continuity vs. discontinuity" is the most persistent interrelation of elementary oppositions. It, alone, remains until the very end of the sonoristic period investigated in this book.

The emergence of the opposition "maximal vs. minimal time-span", which led to the diffusion of "mobility vs. immobility" into its two elementary binary categories, contributed also to a change of the preliminary articulatory definition of "temporal continuity vs. discontinuity". Clearly, once the composer had acknowledged that tremoli, interpreted thus far as long-lasting sounds, are in fact very dense series of repetitions whose minimal time-span sets them against sound phenomena of long durations, he then had to admit that the components of such repetitive series are very short and hence, if taken separately, would display a temporally discontinuous character, as do the momentary impulses that occur independently within optimally pointillist sound fields. It was thus no longer possible to treat these components as being temporally continuous on a level with sustained sounds. Still, the peculiarity of tremolo was exactly that the successive, repeated impulses were perceived not one by one, but merged into a phenomenon whose component sounds were only barely discernible by a listener. This equivocation in auditive perception produced by tremoli—which stand at the border between temporal continuity and temporal discontinuity—eventually compelled Penderecki to exclude them from among the representatives of the positive term of the category, and to interpret them (and also all the other sorts of quickest possible repetitions) as articulations of a new border-zone term, which from now on enters the trajectory "temporal continuity vs. discontinuity".

The survey of the states of the basic system, as recorded in Penderecki's sonoristic pieces, shows that what succumbs comparatively late to elementary binary oppositions is the organization of musical space. From among the two categories concerning this aspect of musical narration, neither "middle vs. extreme register" nor "high vs. low register" is comprised in the subsystems of *Anaklasis* and *Threnody-To the Victims of Hiroshima*; in those two works, the vertical arrangement of sound phenomena is regulated rather freely by the composer. The reason is most likely that pitch, as the perceptual parameter accounting for the vertical dimension of music, has already been covered by the category "spatial continuity vs. discontinuity". However, the location of spatially continuous and discontinuous sound phenomena also soon became very important, even though not sufficiently defined in the "nuclear opposition".

The only register distinguished within the terms of the nuclear opposition was the middle one. In this register, the condensation of pitches characteristic of an optimal cluster and representing a maximally homogeneous texture was carried out; this resulted naturally, from the fact that the middle register was accessible to all tuned instruments. On the other hand, the heterogeneity of an optimally pointillist texture implied that pitches were to be dispersed evenly throughout the whole sound space. Although, taken logically, the relationship between middle register and all registers is not an opposition, but instead constitutes a relation of part to whole, it was treated as an opposition by the composer in pieces in which the nuclear opp6sition was still active—even before the crystallization of the proper elementary oppositions. The same relationship is thus regulative for the organization of musical space in passages of *Anaklasis* and *Threnody*. How influential and obstinate this relation was, can be ascertained from the fact that relics of itself can be found in all the remaining sonoristic pieces, as the transition between the middle register and the total sound space—the only transition not justified by a mediative process taking place between opposite terms of any elementary category (see 5.1.1).

The proper oppositions of registers arose due to a logical mechanism similar to that which led to the crystallization of categories concerning loudness and duration. Because the central or middle register represented by the optimal cluster was singled out in the "nuclear opposition", it was naturally set against those sounds of the optimally pointillist texture which occur in peripheral parts of the sound space; thereby, the category "middle vs. extreme register" arose. Though this category occurs for the first time in the String Quartet, one can detect its beginnings earlier, in Threnody and *Anaklasis*; in those pieces, however, it does not rule over the entire musical narration. It is thus most likely that, in those two pieces, the category "middle vs. extreme register" was not yet considered by the composer as an elementary opposition on a par with the other categories comprised in their subsystems. Nevertheless, the contrast between the middle and the extreme registers is quite striking in certain passages; for instance, in paragraphs 1-4 of *Anaklasis*, and at the conclusion of *Threnody*, where the centrally located cluster (70) brings an antithesis to the earlier, curious configuration of sound phenomena in violins 1-12, cellos and contrabasses (62-65). It is thus here, in passages of pieces which are not yet submitted by Penderecki to any conscious organization of musical space, where the independent strength of logical mechanisms inherent to the basic system manifests itself to the fullest. Under the further influence of those mechanisms, the hierarchically linked opposition of registers crystallizes as well. Since the extreme register forms an unconnected set, consisting of high and low sound phenomena as its two subsets, the polarisation of those latter leads to the occurrence of the category "high vs. low register"; this polarisation first takes place in *Dimensions of Time and Silence*, then later in *Polymorphia*, *Fluorescences*, and *Canon*. In this new opposition that organizes the sound space of Penderecki's sonoristic pieces, the middle register performs the function of the neutral mediative term.

The above discussion suggests that the evolution of the basic system of Penderecki's sonoristic style can be aptly called its "growth". This last term is appropriate, because the system proceeds from the minimal number of segments and maximal number of redundancies—a state characteristic of the "nuclear opposition"—towards the multiplication of syntactical units by way of progressive liquidation of redundancies between individual elementary categories. This process progresses along three "branches" which concern, respectively, dynamics, registers, and all the remaining aspects of musical narration. The individual branches are independent of each other. Yet in turn, there occur several interdependencies between elementary categories within the same branch, whereby the occurrence of a given opposition is quite often conditioned by several intermingled circumstances, these last involving (an)other opposition(s). Intercategorial redundancies thus take place exclusively between elementary oppositions belonging to one branch. One can ascertain this fact from the "tree" chart below, which summarizes the earlier discussion and shows the course of the system's evolution:

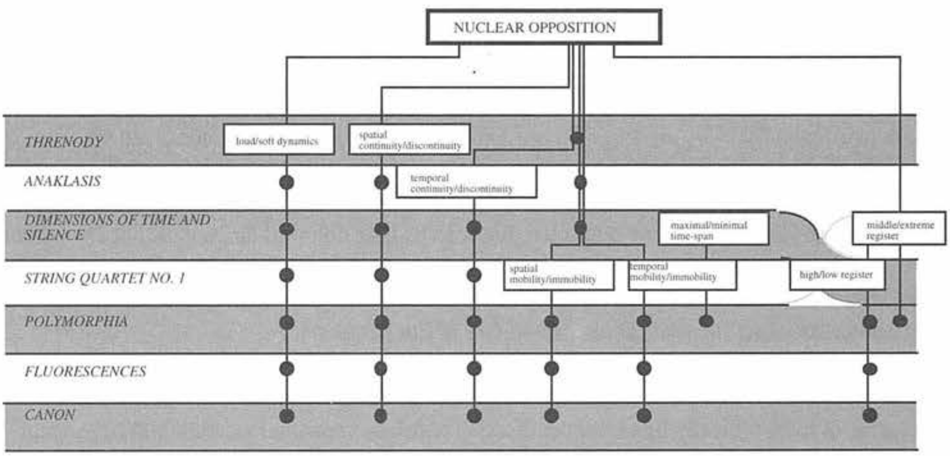


Figure 72

As with any organic growth, the evolution of the basic system appears to be a self-regulating process. Initiated by the tension between the optimal cluster and the optimally pointillist texture—an opposition whose energy is liberated through the mediation of the "nuclear opposition"—the growth process subsequently follows the implicative laws characteristic of the logic immanent to the basic system itself. While first categories of this system arise under the influence of an automatic logical mechanism, which consists in the mutual attraction and polarization of contrarieties, the emergence of consecutive elementary oppositions is stimulated by natural implications and equivalencies of their terms (described in Chapter 5.1, in the paragraph on formal incompatibilities). A particularly important role in this process is played by hierarchically linked oppositions whose terms are correlated by logical equivalencies, such that an occurrence of one of those oppositions is immediately followed by an occurrence of the other. Interestingly, the succession in which the hierarchically linked categories are crystallized in Penderecki's sonoristic pieces is in line with their logical relations: the superior opposition always occurs first, while the subordinate opposition arises only later, through polarization of the unconnected set representing the negative term of the former (superior opposition). This order of appearance is clear in the case of the categories "middle vs. extreme register" and "high vs. low register". As regards "temporal mobility vs. immobility" and "maximal vs. minimal time-span", the superior category first occurs as fused into the general opposition "mobility vs. immobility"; thus, although "mobility vs. immobility" implies "maximal vs. minimal time-span", the latter category in turn causes the crystallization of "temporal mobility vs. immobility" as an elementary opposition independent of "spatial mobility vs. immobility". In fact, the whole system is thus "deducible" from the "nuclear opposition", and its progressively growing complexity can be read out of the rosettes of subsystems that underlie individual sonoristic pieces.

If this last statement is true, one needs to emend what was said earlier about the position of the composer in relation to the sonoristic system as his own, original compositional method. Although at the beginning of Part Two Penderecki was acknowledged as the creator of this system, now he instead appears to be the discoverer (as well as the only user) of it. In light of the above remarks, it is apparent that Penderecki's decisions as to the shaping of subsystems of individual works were not arbitrary. Rather, those decisions reflected the consecutive stages of a growth that was governed by the inner, logical mechanism of basic system categories. This statement concerns the omission of categories not yet existing on a given stage of the evolution, as well as redundancies between categories that already existed but were still mutually interdependent. In turn, redundancies themselves are thus not to be seen as artificial implications or equivalencies between terms of fully-crystallized oppositions that were set up deliberately and consciously by the composer. Rather, those redundancies should be viewed as states preceding the emergence of elementary categories in the course of their crystallization, a course that led slowly, but constantly, to the dissolution of the "nuclear opposition". Consequently, the individual sonoristic pieces constitute recordings, an "archaeology" if you will, of the consecutive stages of the basic system growth, as exhibited in the chart above. In the long run, it thus appears that those sonoristic works are comparable neither with texts of one language, as first suspected, nor with texts in different languages that are subsumed under one linguistic system, as claimed later, in Chapter 7. Rather, the sonoristic pieces are comparable with texts of the same language in different historical moments of its evolution, this evolution constituting the diachronic dimension of the language.

The fully unfolded basic system occurs only once—in *Polymorphia*. However, the presence of all eight categories in this piece imposes considerable limitations upon the possibilities of shaping trajectories of hierarchically linked oppositions. Therefore "minimal vs. maximal time-span" and "middle vs. extreme register"—which the composer acknowledged as probably weaker binary oppositions in comparison to "temporal mobility vs. immobility" and "high vs. low register", respectively—are eliminated from the subsystems of *Fluorescences* and *Canon*. Thus the reduction in the number of categories from eight to six, which happened in the two latest sonoristic pieces investigated in this book, did not signal any "atrophy" of the system. Rather, the economy of Penderecki's compositional thinking comes to the fore: in those two pieces, no two categories govern the same aspect of the musical narration, thanks to the reduction in the number of categories.

In a sense, the growth of the basic system can be seen as tantamount to the composer's discovering or learning this system. And it is not by chance that the word "learning" is used in this context, since the evolution of Penderecki's basic system displays a striking similarity to the way in which a child learns the phonological system of a given language. According to the description by Jakobson and Halle (1956), this process starts from a "nuclear syllable", transcribed usually as /pa/:

> From the articulatory point of view the two constituents of this utterance represent polar configurations of the vocal tract: in /p/ the tract is closed at its very end while in /a/ it is opened as widely as possible at the front and narrowed toward the back, thus assuming a horn-shape of a megaphone. This combination of two extremes is also apparent on the acoustic level: the labial stop presents a momentary burst of sound without any great concentration of energy in a particular frequency band, whereas in the vowel /a/ there is no strict limitation of time, and the energy is concentrated in a relatively narrow region of maximum aural sensitivity. In the first constituent there is an extreme limitation in the time domain but no ostensible limitation in the frequency domain, whereas the second constituent shows no ostensible limitation in the time domain but a maximum limitation in the frequency domain. Consequently, the diffuse stop with its maximal reduction in the energy output offers the closest approach to silence, while the open vowel represents the highest energy output of which the human vocal apparatus is capable. This polarity between the minimum and the maximum of energy appears primarily as a *contrast* between two successive units—the optimal consonant and the optimal vowel. (Jacobson and Halle 1956: 37)

The initial stage of phonemic system evolution, described above, is clearly analogous to that of the "nuclear opposition" between the optimal cluster and the optimally pointillist texture at the outset of the evolution of the basic system. As there, also here the opposition does not yet relate distinctive features, but only syntactical units composed of them (i.e., phonemes, in this case).

Only later, from the nuclear syllable as an opposition of phonemes, do the individual elementary oppositions between distinctive features start to emerge. In the course of this process, the oppositions embodied directly into the optimal consonant and optimal vowel are gradually matched by new distinctive features, obtained by a transferal of the differentiation between the consonantal and the vocalic axes. This situation leads first to the rise of the so-called "primary triangle" /p-t-a/, and then to its further splitting into two triangles—consonantal /p-t-k/ and vocalic /u-a-i/:

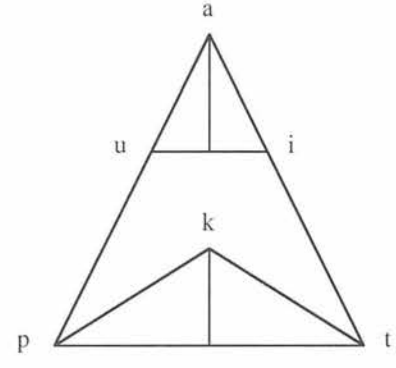


Figure 73

Of course, this process and the further evolution of the phonemic system differ in details from those of the basic system. Yet what is held in common, is that both the basic system of Penderecki's sonoristic style and the phonemic systems of natural languages follow in their growth an inherent logic. In reference to language, Jakobson and Halle put it this way: "The development of the oral resonance features in child language presents a whole chain of successive acquisitions interlinked by laws of implication" (1956: 41).

Curiously, the emergence and crystallization of elementary binary oppositions in language results in a reinterpretation of the contrast between the earliest syntactical units comprised in the nuclear syllable.

> On the one hand, the oppositions bearing upon the *sonority axis* display various fissions and attenuations of the primary contrast between optimal consonant and optimal vowel, and thus give rise to more minute and specific distinctions. On the other hand, those oppositions that involve the *tonality axis*, perpendicular to the sonority axis, emerge originally as the counterpart and corollary of the contrast, 'optimal vowel vs. optimal consonant' and, subsequently, as the corollary of the opposition, 'optimal, compact vowel vs. attenuated, diffuse vowel' or 'optimal, diffuse consonant vs. attenuated, compact consonant'. (Jacobson and Halle 1956: 44)

From the viewpoint of the distinctive features emerging from the nuclear syllable, its original constituents are thus not always opposite. The same is the case with the nuclear opposition that lies at the beginning of the basic-system evolution. As has been seen, the mediation of this opposition, by way of applying the concepts of "heterogeneity" and "homogeneity" to individual sound parameters discloses that, with respect to loudness, duration, and registers, the optimal cluster and the optimally pointillist sound field are not opposite but, instead, related as part to whole. Interpreted according to elementary oppositions in the course of analyses, the pointillist texture of the "nuclear opposition" thus appears to constitute most often the total mediative term; in this way, the occurrences of pointillist sound fields in the sonoristic pieces play the role of multi-mediative combinations. To expand this mediative function to the category "spatial continuity vs. discontinuity" (the only category embodied directly in its pure state into the terms of the "nuclear opposition"), the pointillist passages of Penderecki's sonorism also contain narrow bands that merge into fields of individually discernible pitches. Even so, segments that constitute combinations of total mediative terms, chosen from all categories of the basic system, occur only in the four earliest sonoristic pieces which still display the influence of the "nuclear opposition": *Anaklasis, Threnody, Dimensions*, and the String Quartet. In *Polymorphia, Fluorescences*, and *Canon* the pointillist type of texture is no longer to be found.

10.2. **EVOLUTION OF THE TIMBRE SYSTEM**

In contradistinction to the basic system, the timbre system of Penderecki's sonorism does not evolve as such. From the very first sonoristic pieces all its material categories are fully crystallized, and the ternary opposition between primary materials exists. Evolutionary changes in the timbre system concern, instead, the choice and number of component binary oppositions which are activated in individual works and which govern their timbre trajectories.

In order to interpret correctly the direction of the evolution, one needs to make a distinction between pieces designed only for strings, and those that also include percussion. This distinction is necessary because, in the group of stringed instruments, no leather vibrators are available. From this fact it follows that, from among three component primary materials of the ternary opposition, only two can be actualized as main material categories of individual timbre segments. Consequently, the sole material opposition possible here—and which occurs in String Quartet No. 1, *Polymorphia*, and *Canon*—is the contrariety "metal vs. wood". When this contrariety is not active in *Threnody*, this earliest of the sonoristic pieces for strings appears devoid of any timbre regulation whatsoever.

In turn, all three primary materials possess their representations among vibrators when a string orchestra is complemented by percussion, as is the case with *Anaklasis*, *Dimensions of Time and Silence*, and *Fluorescences*. Yet even in those pieces only a few are activated, from among the six contrarieties and contradictions embraced in the ternary opposition as the elementary structure of the timbre system. In *Anaklasis* the only active material opposition ruling over the total timbre trajectory is the contrariety "metal vs. leather". As regards wood, it forms no independent term of material opposition here; nor does it ever occur as a single main material. Hence the neutral term of the active contrariety is not articulated in this piece. The material category of wood comes into prominence in *Dimensions of Time and Silence*, owing to the contrariety "metal vs. wood", in which it is involved as an independent opposite term. However, "metal vs. wood" is not the only material opposition in *Dimensions*. The peculiarity of this piece is that its timbre trajectory shifts between three different oppositions that are activated in its individual passages, the two remaining being "metal vs. non-metal" and "metal vs. leather". Finally, in *Fluorescences* there occur already all three possible contrarieties—"metal vs. wood", "metal vs. leather" and "wood vs. leather"—as well as one contradiction, "metal vs. non-metal", which is retained from *Dimensions*.

Clearly, while the positions of metal and leather do not undergo any changes, what bears the stamp of an evolution in Penderecki's sonoristic pieces, analyzed from the viewpoint of the timbre system, is the rise of wood. Whereas originally in *Anaklasis* and *Threnody*, wood is thoroughly absent as a single main material and does not enter into any binary opposition, beginning with *Dimensions* and the Quartet it starts to be treated as a material category contrary to metal—a position preserved by wood also in *Polymorphia* and *Canon*. The ultimate consolidation of this position happens in *Fluorescences* where, as with any other of primary materials, it is involved in two contrarieties. However, the latter fact does not put metal, leather, and wood on an equal footing, as one might assume at first glance, because neither leather nor wood ever become positive terms of contradictions. This privilege goes exclusively to metal, as the best represented primary material of Penderecki's sonorism.

11. EVOLUTION OF ARTICULATION

If, as claimed in the conclusion of Part One, new articulatory phenomena characteristic of Penderecki's sonorism are manifestations of the sonoristic system, then the introduction of the latter should have marked a conspicuous change in orchestration, sound generation processes, and texture. Indeed, a comparison of the articulatory resources employed in the sonoristic pieces with those of the earlier period of Penderecki's output reveals that such a change took place. This is emphatically not to say that atypical articulatory devices are found only in the scores of sonoristic pieces. On the contrary, new articulations occur as early as in the presonoristic phase, particularly as regards instrumental techniques. Like harmonics, tremoli, and playing with mutes—which deviate from standard articulation, but belong to traditional musical practice and hence are subsequently preserved as expressive features in the sonoristic pieces—so also new techniques of sound generation aim in the presonoristic pieces to vary the shades of tone-colour between individual sounds within a heterogeneous, serial-pointillist texture. In this respect, *Strophes* and *Miniatures* are of particular interest, as *Emanations* is with regard to string technique.

The introduction of a new compositional method thus did not exactly initiate a process of inventing new articulatory phenomena. Rather, it brought about a reorganization of the articulatory domain through the selection of pre-existing, unusual devices, with an eye to their possible usefulness for the sonoristic system. In consequence of this selection, eliminated were articulatory novelties that appeared irrelevant for the system (i.e., not concerned with motoric parameters of the system categories). In this way, the composer cast off and never again used the effects of the resonance of piano strings. Earlier these were accomplished by depressing the sustain pedal (as required in *Miniature II*, the one for unaccompanied violin, while "the violinist should lean as far forward as possible towards the inside of the piano") or, in a more subtle way, by the voiceless pressing down of either individual keys or broader ranges of the keyboard—a method exploited in *Strophes*. Other ingenious piano techniques, abandoned by Penderecki, were harmonics accomplished by lightly pressing the string with a fingertip, and preparation of the piano with a sheet of paper inserted between strings and dampers. Also not finding a place in sonoristic pieces, was a spatial effect from *Emanations*, which consisted in a division of all the stringed instruments into two ensembles and the proper configuration of those ensembles on stage, as well as scordatura specified for the whole second string orchestra. It is interesting to note that, if preserved in the sonoristic period, all these devices, as asystemic, would have performed an expressive function. Yet the composer obviously took for granted in his sonoristic pieces only those articulatory phenomena that existed in traditional instrumental playing. He thus did not create any new expressive features—which is but a reverse formulation of the earlier statement, that all new articulatory phenomena of Penderecki's sonorism are systemic as manifestations of either the timbre or the basic system or both.

On the other hand, Penderecki's choices resulted in the preservation of the uncommon phenomena relevant and, what is more, indispensable for the articulation of basic or timbre system categories; such phenomena included plucking the piano strings with the fingers (*Miniatures*), playing with soft-headed sticks on tom toms and cymbals or with wire brushes and triangle rod on gong and tam tam (found as early as in the *Psalms of David*). In *Strophes*, the most sophisticated of Penderecki's presonoristic works, apart from the just mentioned instrumental techniques, there also occurs playing *con dita*, as well as touching perpendicularly the edge of an already excited cymbal with a triangle rod, an effect employed later in *Anaklasis* and *Dimensions of Time and Silence*. Interestingly, the novelty of all these articulatory devices consists in a new configuration of traditional vibrators and inciters. Only in *Miniatures* is a new body employed: strings between bridge and tailpiece, which are either bowed or struck with the bow stick. Still, the inventory of new articulations found in the presonoristic pieces was drastically insufficient for the demands of the sonoristic system. Thus the just-mentioned devices were supplemented by several other novelties. For instance, it is only in the sonoristic period that non-musical tools are introduced into the performing ensemble of individual pieces. Consequently, the change of articulation brought about by the sonoristic system was twofold: both qualitative, as manifested in the selection of devices, and quantitative, which was evident in their quick rise in number.

The dependency between articulation and the sonoristic system is, however, not testified to exclusively by the change that accompanied the emergence of the new compositional technique on the threshold of sonorism. As the system evolved, this dependency is apparent also during the sonoristic period, in the parallel evolution of the articulatory phenomena. Still, it would be naive to think that the dependency in question works in only one direction. Rather, those two domains—the system and its articulation—are locked into mutual dependence of a dialectical character: True, the evolution of the system stimulated the evolution of articulatory phenomena. But on the other hand, the stages of the system evolution, as recorded in consecutive musical texts, were vitally contingent upon the articulatory resources at the composer's disposal when he was writing individual pieces.

11.1. EVOLUTION OF TEXTURAL EFFECTS

This dialectic is evident in articulatory phenomena of a textural nature. Older textural effects, such as glissandi, tremoli, and repetitive series of accelerated or decelerated impulses—used before Penderecki's sonoristic period, and then incorporated into his sonoristic pieces as optional expressive features—exerted a significant influence on the growth of the basic system, as was pointed out in the previous chapter. By contrast, in the sonoristic pieces, new textural phenomena occur only when their constitutive combinations of terms are permitted at a given stage of the basic system evolution. Thus, more sophisticated types of glissando are introduced by the composer, once the category "mobility vs. immobility" has split into its temporal and spatial aspects. Because this happens for the first time in the String Quartet, it is not until that piece where one can find, apart from ordinary glissando, alternating, ascending and descending glissandi, which combine into a sort of oscillation in individual instrumental parts (0.08-20). Characteristically, this textural phenomenon can be found earlier, in *Emanations* (86-91). However, alternating glissando, as any glissando whatsoever, was irrelevant for the category "mobility vs. immobility", established on the basis of the subsystems of *Anaklasis*, *Dimensions*, and *Threnody*. Therefore it was at first suppressed from the scores of sonoristic pieces. Even more complicated examples of glissandi, not found in the pre-sonoristic output, are the famous "electrocardiograms" employed in *Polymorphia*, *Canon*, and *Fluorescences*.

The mutual independence of the elementary binary oppositions "spatial mobility vs. immobility" and "temporal mobility vs. immobility" admits also—as systemic—the rhythmical repetitions of irregular time-spans. Thus it is again in the Quartet (0.16-0.24) where those repetitions, which in fact are not new effects at all, enter for the first time into Penderecki's sonoristic scores. On the other hand, clusters occur in all pieces of the sonoristic output, beginning with the earliest ones, because the category "spatial continuity vs. discontinuity" was already crystallized as an elementary binary opposition of the basic system, right from the start of its evolution.

It might seem that exceptional cases are represented by the effects relevant to the hierarchically linked categories "middle vs. extreme register" and "high vs. low register". True, these categories appear for the first time in *Dimensions of Time and Silence* and the Quartet, whereas the highest and lowest possible notes are required by Penderecki even earlier, in *Threnody* and *Anaklasis*. Still, it is precisely in the two last-mentioned pieces where the opposition between the middle and the extreme registers starts to crystallize. Occurrences of the articulatory phenomena in question are thus manifestations of this preliminary process of crystallization, even if that process is not yet completed, and the categories concerning the organization of the sound space do not yet unfold their trajectories along the entire course of pieces. This is why, in the former discussion, those articulatory phenomena were not treated as optional expressive features. On the other hand, the lowest possible notes occur only in *Fluorescences*, at a stage in the system's evolution where the opposition "high vs. low register" has been present for a long time. This is because the lowest notes of indefinite pitch can be reasonably required only when the lower limit of a given instrumental range is not univocally stated. Apart from the piano, whose individual items can differ in this respect, such instruments are only the brass. Like wind instruments generally, the brass are employed exclusively in *Fluorescences*, and it is in their parts where the lowest possible tones are called for. The only exception is the last paragraph of the piece. There, lowest possible tones are also demanded from the contrabassi, whose strings are slackened by the bassists' turning the pins while playing.

11.2. EVOLUTION OF SOUND GENERATION PROCESSES AND ORCHESTRATION

The evolution of orchestration and sound generation processes in the sonoristic period is most apparent on the level of bodies as regards wooden and metal sound sources. Since wooden sound sources are employed by the composer for the sake of material properties, changes concerning their class as represented in individual sonoristic pieces are parallel to the evolution of the timbre system. However, in contradistinction to new articulatory phenomena concerning texture—which depend on the state of basic system in a given piece—here, quite the reverse, it is the articulation which conditions the evolution of the timbre system of Penderecki's sonorism, all the more so since the link between its material categories and classes of vibrators is a direct one. Thus the gradual rise of the category of "wood" observed in the previous chapter is contingent on inventions of more and more wooden bodies serving as vibrators in individual pieces, a process which chiefly concerns string technique.

In *Anaklasis* the advancement of this process is still minimal. Even if the fingerboard as a new wooden body is used here, the only instrumental technique in which it is involved—striking strings *sul tasto*—is interpreted by the composer as a combination of two sound generation processes, which happen, respectively, between strings and the fingerboard (wm) as well as between strings and the hand (ml). Because the common denominator of this pair is "metal" (strings), the compound technique in question contributes to the metal effects rather than to wood; thus the latter does not occur in that piece as a self-dependent main material. In *Threnody* the technique of striking strings with the palm is not employed; instead, tapping the sound board with nuts or fingertips is introduced. Still, the sound board as the only wooden sound source does not constitute here a counterbalance for metal. Although in this piece the composer makes use of bridges and tailpieces, they are intended as substitutes of metal bodies; this intention is proven by the fact that only bridges and tailpieces of violoncellos and contrabasses are bowed here. As shown during the analysis, the underestimation of wood in *Threnody* has even more important consequences than it has for *Anaklasis*: Such underestimation results in the fact that the only material opposition accessible to strings—"metal vs. wood"—cannot be actualized, whereby *Threnody* is the only sonoristic piece in which the timbre system is not yet operative.

Both instrumental techniques involving fingerboard and sound board of stringed instruments—techniques employed separately in *Anaklasis* and *Threnody*—occur together only in *Dimensions of Time and Silence*. Moreover, striking the strings *sul tasto* is now reinterpreted by the composer as two simultaneous excitations of the fingerboard, with strings as well as with fingers (wm, wl), thereby contributing to the elevation of wood and not metal bodies. In *Dimensions*, this allows activation of the contrariety "wood vs. metal". The representation of wood is further enlarged by the treatment of bridges and tailpieces as wooden accessories; this innovation takes place in the String Quartet, where otherwise both sound board and fingerboard are preserved. Yet the confirmation of the position of wood among primary materials on a level with leather and metal happens only because of the use of desks and chairs, which occur as sound sources in three later sonoristic pieces: *Polymorphia, Fluorescences*, and *Canon*. Whereas in *Polymorphia* and *Canon* it has no additional manifestation regarding active oppositions (because "metal vs. wood" has occurred already in the Quartet), in *Fluorescences* the ultimate elevation of wood is reflected in the appearance of a new contrariety, "leather vs. wood", which shows the equiponderance of these two material categories. Otherwise, the employment of desks and chairs as wooden sound sources has further impact on earlier devised articulatory effects, in that it allows the omission of formerly introduced wooden bodies. This is why the fingerboard involved in striking strings *sul tasto* does not appear in *Canon*. Also, bridges and tailpieces, in *Polymorphia* and *Canon*, are interpreted again as substitutes for strings between bridge and tailpiece in a low register. The only exception is found in *Fluorescences*, where the dual affiliations of bridges and tailpieces (as both wooden and metal bodies) are employed.

A significant change can be observed also as regards the set of new metal sound sources employed by Penderecki in his sonoristic pieces. With the exception of strings between bridge and tailpiece, which were used as vibrators already in the pre-sonoristic period (*Miniatures*), all new metal bodies are included among percussion. Therefore the change under consideration concerns only three pieces in which the latter instrumental group occurs: *Anaklasis, Dimensions of Time and Silence*, and *Fluorescences*. Comparison of those pieces shows that the most radical difference between their sets of metal sound sources concerns bars, that is, representatives of the type of two-dimensional bodies of unchangeable sizes: These last, which occur in two earlier sonoristic pieces, disappear completely in *Fluorescences*. Thus in the latter piece, preserved are only the triangle, the tubes of the tubular bells, vibraphone bars, and piano strings, all of which vibrators are classified alternatively as substitutes for metal plates, while the remaining representatives of bars are excluded totally from the performing ensemble.

The reason for eliminating the metal bars in the later phase of the sonoristic period lies in one of their constructional properties. As noted earlier, bars, together with metal plates, form two unique types of sound sources characterized by an undampened-ness, which causes the time of their vibration to surpass greatly the time of excitation and, what is more, not to be controlled by the performer other than by an artificial muffling. This property allowed the composer to interpret sound phenomena generated by single, momentary excitations of metal bars either as long-lasting (due to the acoustical state of affairs) and hence temporally continuous, or (intentionally) as momentary, temporally discontinuous, in which case the decay phase of the sound envelope is neglected. Yet, the latter interpretation turned out to have a disturbing impact on medium time-span phenomena that represent temporal movement. In the discussion of the articulatory definition of "temporal mobility vs. immobility" (Chapter 6.2) it was observed that, in the case of undampened vibrators, sound phenomena acknowledged as successive and establishing the medium time-span characteristic for temporal movement occur exceptionally prior to the termination of their predecessors. This is probably why the composer eventually decided to relinquish their intentional interpretation. Indeed, the way in which the undampened sound sources are used in *Fluorescences* suggests that their sounds in that piece are always treated as long-lasting, that is to say, in accordance with the acoustical reality. Yet in this very piece metal bars are abandoned. These two facts are obviously interconnected. For the intent to perform a temporal movement on metal bars would mean now that the performer would have to dampen artificially the sound sources after every strike, which is plainly impractical on vibrators such as vibraphone, xilorimba, glockenspiel, or celesta. Consequently, these instruments could not participate in passages characterized by temporal mobility. Meanwhile, it was precisely for the sake of the mobility that the discussed type of vibrator was originally intended by Penderecki. More exactly, it was for a combination of spatial and temporal movement as characteristic of the state of the basic system in *Anaklasis* and *Dimensions*. Unable to perform this function, metal bars were thus eliminated. This explanation is confirmed by the fact that the strict physical interpretation of sound durations does not cause any changes as regards metal plates, the other type of undampened sound sources. Since they were never independently involved in either temporal or spatial movement, they are retained by the composer in *Fluorescences*, where they generate exclusively sequences of temporally immobile sound phenomena of maximal or minimal time-spans.

For the return of metal bars, in *Fluorescences* the composer introduces three-dimensional metal vibrators which are dampened and hence do not cause any trouble as regards the sound duration. This explains another difference between the sets of metal vibrators used in *Anaklasis* and *Dimensions* on the one hand, and in *Fluorescences* on the other. In the two earlier pieces, three-dimensional metal sound sources are represented only by the edges of membranophones and by strings between bridge and tailpiece; thus they never occur as a group. In *Fluorescences*, those metals are joined by the typewriter and by the stops and pistons of wind instruments. Yet since three-dimensional bodies are not concerned with the motoric parameter of size changes, they are not able to produce independently any positive term of "spatial mobility vs. immobility". The temporal movement they produce is obtained always by series of repetitions and thus by spatially immobile phenomena. Otherwise, it seems that the inclusion of the stops and pistons of winds—the most easily found three-dimensional metal vibrators of the symphonic orchestra—was the main reason for also traditional playing on wind instruments, which normally is precluded from the articulatory resources relevant to the sonoristic system. If he had employed a huge set of woodwinds and brass merely to click with their stops and pistons, the composer would have been accused by critiques of, at best, having an absurd sense of humor.[1]

The hitherto discussed changes concerning the set of metal bodies, although they display the most autonomy, are still connected with the evolution of subsystems underlying individual sonoristic pieces. This is understandable if one bears in mind that the new metal bodies were introduced by the composer for their constructional properties relevant for basic system categories. In contrast, the introduction of the remaining three-dimensional metal bodies (whistles, electric bell, piece of iron, and a glass bar), which occur in *Fluorescences* and no earlier, is conditioned not by the system, but by a compositional strategy taken by Penderecki. This strategy elevates the effects of vigorous, maximally dense repetitions exposed in the initial and final parts of the piece. The same reason explains the emergence of wooden bodies not employed in *Anaklasis* and *Dimensions*: guiro, raganella, and a piece of wood sawed with a hand-saw (*legno*). Compositional strategies adopted in individual sonoristic pieces also underlie other, slighter changes, which can be observed

[1] Another circumstance which might have been of importance for the employment of brass and woodwinds in *Fluorescences* is that this piece was commissioned by the South-West German Radio Orchestra, and thus by a traditional symphonic orchestra containing the wind section.

from the comparison of diagrams summarizing sound generation processes of individual sonoristic pieces. Even if some of those changes can be explained as side-effects of the evolution of the basic system, they are as a rule under the influence of some particular artistic purposes realized through this system in individual texts and, as such, are beyond the reach of this investigation.

12. SUBSEGMENTAL REGULATIONS

The foregoing discussion emphasized, several times, that the syntactical unit of Penderecki's sonorism is a segment defined as a set of sounds. Thus the level of segments constitutes the proper plane of compositional operations in the sonoristic pieces investigated in this book. Categories of the timbre and basic systems govern the choice of segments as well as their succession within a given piece, in this way ruling over both the paradigmatic and syntagmatic relations between them. However, the system does not provide a means of regulating the dependencies between the sound phenomena of a given segment. Relationships between individual sounds on the subsegmental level of a piece are thus beyond its reach.

Nevertheless, it does not follow that in Penderecki's sonoristic pieces such intersonic relations are totally unregulated, and at the whim of random compositional choice. Even if they are not ruled by the sonoristic system, the composer sometimes orders those relations rationally, by additional procedures not connected to the specific and original compositional method, as reconstructed in Part One of this study. It was precisely those subsegmental regulations that attracted the attention of the early investigators of Penderecki's sonorism, and that constituted the objects of their explanatory analyses in the 1960s and 70s. That those analyses were always fragmentary, resulted from the fact that the subsegmental regulations themselves never applied to the global structure of a piece, but merely to certain (shorter or longer) passages.

One of the most expansive examples of such regulations is the central part of *Threnody–To the Victims of Hiroshima* (26-59). This passage was referred to in Chapter 10 as a relic of optimally heterogeneous, pointillist texture and hence of the nuclear opposition underlying the growth of Penderecki's basic system (see Ex. 64b). It was Wilfried Gruhn (1971) who noticed for the first time that this type of texture results from highly complicated intersonic procedures. The composer used those procedures to construct this entire section in the form of a serial canon that embraces pitches, durations, dynamic marks, and ways of articulation. The section proceeds in three layers assigned to the parts of three string orchestras, each of them consisting equally of 4 violins, 3 violas, 3 celli, and 2 contrabassi.

> The entire second-orchestra part answers to the first orchestra, as a literal canon at the distance of twelve bars, yet in reversed instrumental distribution (almost as an inversion), so that the part of the four violins now goes to the two contrabasses and two cellos, and so on. Between measures 42 and 43 in the first orchestra lies the axis of symmetry, round which all the parts are mirrored; yet even here the inverted distribution of instruments still holds between the first and second orchestras (like a crab inversion). However, the first four measures (16-19) do not take part in this mirroring. Thus, in the first orchestra, the correspondence exists between bars 42 and 43, 41 and 44, and so on until 30 and 55. In the second orchestra the corresponding axis of symmetry lies twelve bars later, between bars 54 and 55. Finally, the third orchestra enters into a canon with the second orchestra, at the distance of two bars, without the four initial bars, which also are exempt from the mirroring, but this time have the same distribution of instruments. (Gruhn 1971: 410)

Gruhn overlooks the fact that the canonic relation between the third and second orchestras is a secondary result of the relationship that ties the part of the third orchestra, as a retrograde, to the original part of the first orchestra, whereby bar 44 of the former corresponds to bar 55 of the latter, bar 45 to bar 54, and so on. This is also why the four initial bars of the third orchestra are missing: they correspond to the four initial bars of the original, which are missing in the retrograded course of the first orchestra itself.

The canonic section of *Threnody* is undoubtedly a *tour de force* that showcases the composer's ability to shape rigorous relations between individual sounds on the subsegmental level. Yet it is not the only example, in kind and scope, to be found in Penderecki's sonoristic pieces. A vast and no-less complex web of intersonic connections is hidden in the String Quartet No. 1. Remarks on the mathematical character of compositional procedures used in this piece have been made (probably on the basis of some general information furnished by the composer), by authors of two pioneering Polish books on Penderecki: Krzysztof Lisicki (1973) and Ludwik Erhardt (1975). According to Erhardt, "the Quartet was composed as a strict construction based on arithmetical series which determined a place for every sound" (1975: 42). This was further elucidated in Wolfram Schwinger's monograph. There the author indicates a section (ca. 0.30-2.45) whose "sequence of changing instructions for [ways of] playing, the pitches, and the rhythmic layout keep strictly to given arithmetical series", though otherwise that section has "nothing in common with post-Webern serial technique" (Schwinger 1989: 129-130).

The regulative procedures governing relationships between sounds in that section were completely revealed only by Krzysztof Bilica, and explained in a paper he presented at the second seminar on Penderecki's music, held in Cracow in 1980 (Bilica 1983a). The pitch regulation is based here on a specific modification of the twelve-tone technique, which "consists in operating not an entire row, but so-called pitch cells. Components of such a cell, reduced to within the octave, usually form a trichord segment of the semitonal row. The number of trichord cells is limited to twelve" (73). All these cells are summarized by the author in the following chart:

	1	2	3	4
A	c c♯ d	e♭ e f	f♯ g a♭	a b♭ b
	5	6	7	8
B	c♯ d e♭	e f f♯	g a♭ a	b♭ b c
	9	10	11	12
C	d e♭ e	f f♯ g	a♭ a b♭	b c c♯

Figure 74

The technique of manipulating small pitch cells is found by Bilica to be characteristic not only of the String Quartet, but for several pieces of Penderecki's early output and (though Bilica does not say so) occurs also in most of the composer's later works. On the other hand, "what is specific exclusively for the Quartet, are structures based on arithmetical series. In the score such an order embraces so-called ligatures, i.e., the ties linking several notes with a common cross-bar . . . The number of sounds (notes) within one ligature is determined by the composer with particular care. Penderecki operates here with four sequences of ligatures which, together with individually occurring sounds, take the shape of finished arithmetical sequences of (a) odd numbers: 1-3-5-7-9-11, (b) natural numbers 1-2-3-4-5-6-7-8-9, (c) couples of alternating even and odd numbers: 1-3-2-4-5-7-6-8, (d) Fibonacci numbers: 2-3-5-8-13, or numbers of increasing differences between following and preceding ones: 2-3-5-8-12. Each of those sequences of ligatures is employed in two variants: as an increasing or decreasing series. In sum, in the initial part of the Quartet, for almost one and half minutes, they form skillful higher-level structures" (Bilica 1983a: 75). The ordering of one of the structures discovered by Bilica is determined by a number matrix, or "magic square", whose individual rows correspond with individual columns.

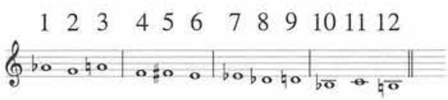
A mathematical order also governs the rhythmic course of Anak*lasis*. Alfred Huber, in his article "Pendereckis *Anaklasis* für Streicher und Schlagzeuggruppen" (1971), observes that in section 22-37, three different divisions of the crochet are assigned to six groups of percussion instruments. While the parts of groups 4 and 6 display an ordinary division into four semiquavers, in groups 1 and 3 there occur quintuplets, and in groups 2 and 5, sextuplets. What is more, in each group the organization of the single bar is founded on a retrogradation principle: the relation between the first and second halves of every bar is that between an original and retrograded form of a model consisting each time of only one rhythmic value, the semiquaver, yet properly situated within a half-bar (i.e., properly configured with rests).

> Penderecki employs two shaping principles for the succession of the basic rhythm and crab canon. Either the basic rhythm is notated on the first half of the bar and the canon on the second half, or the basic rhythm is written on the second half of the bar and the canon on the first half of the following bar. . . . Only the fifth percussion group is exempt from this rule, by which the temporal completion of structural repetitions is identified. (Huber 1971: 90)

In fact, group 5 is also subjected to a strict rhythmical structuration, even if its principle varies slightly from that which underlies the parts of the other groups. In group 5, the retrogradation is applied not to half-bars, but to the whole rhythmical course of this section, whose axis of symmetry coincides with the bar-line between bars 30 and 31. Subsequently, the same sort of rhythmic principle occurs again, and rules bongos part in section 54-75. The axis of symmetry there is the bar-line between bars 70 and 71.

Subsegmental regulations in *Dimensions of Time and Silence* were investigated by Karl-Josef Müller in an article entitled "Pendereckis Musik in 'mobilen Netz trigonometrischer Punkte'" (1975). In contradistinction to mathematical procedures concerning rhythm patterns in the Quartet and *Anaklasis*, those that govern relationships between individual sounds in this piece appear to apply mostly to pitch organization, and hence display the influence of twelve-tone thought. In question here is the succession of pitches sung by the choir in 48-50. As pointed out by Müller (1975: 625-26) and echoed by Wolfram Schwinger (1989: 196-97), the vowels from paragraph 48 are assigned to 12 different pitches, whose series displays a refined internal structure of four trichord cells; those cells form four possible permutations of a succession that consists of a semitone downwards and a whole tone upwards: original, inverted, retrograde, and inverted retrograde:

Example 65



1–3	1↓	2↑
4–6	1↑	2↓
7–9	2↓	1↑
10–12	2↑	1↓

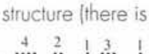
Neither of the authors noticed that the same series, though with slight changes consisting mainly in the omission of some pitches, also rules the order of voiced consonants in the following paragraphs, 49-50. Apparently, each of the trichords in that passage forms a segment of a semitonal row. This fact accords with an observation made by Krzysztof Bilica, on the specific traits of Penderecki's twelve-tone technique. The cells chosen for the discussed part of *Dimensions* are those marked in Bilica's chart as 7, 6, 5, and 8, respectively, which together form the whole B series starting on c♯ (or d♭). There is another manifestation of twelve-tone thought contributing to relations between individual sounds in *Dimensions*. Undiscovered by Müller, this is found in paragraph 10, and in retrograde in 72, where four instrumental parts (of xilorimba, vibraphone, glockenspiel, celesta, piano and harp) contain the same complete twelve-tone row in six different transpositions. Also bar 9 (and 73 as its correlate) comes close to twelve-tone organization, even though it contains only eleven, not twelve, different pitches.

The influence of twelve-tone thought on *Dimensions of Time and Silence* is apparent also in sequences of consonants pronounced by the choir. In the same analytical survey, Müller points out a row of consonants /g, t, k, b, d, g, p, k, d/, which occurs in paragraph 46 in its original shape, where it is given to sopranos and tenors; at the same time, its retrograde occurs in altos and basses. By removal of the repeated consonants, in paragraph 47 the number of consonants is reduced to six, which "are presented in the following structural order:

	1 2 3 4 5 6
Soprano	D K B T P G
	6 3 5 2 4 1
Alto	G B P K T D
	4 5 6 3 2 1
Tenor	T P G B K D
	1 4 2 5 3 6
Bass	D T K P B G

If the soprano's row of consonants is considered the original, the alto then gives a retrograde in which the sounds of the first half are closed up in the second. The tenor voice is equally closely related to the original, since the second half of the original and the first half of the original are exchanged in retrograde form. The bass gives the retrograde of the alto voice" (Müller 1975: 625; quoted by Schwinger 1989: 275).

This example demonstrates that permutations characteristic of twelve-tone technique can constitute a tool of subsegmental regulations that govern not only pitch relationships between individual sounds, but also sequences of sound phenomena that do not form pitch rows. In Penderecki's sonoristic pieces, such permutations occur chiefly in application to the so-called "textural models" which are repeated several times in the parts of individual instruments or their groups. Krzysztof Droba, the first to attend to the role of textural models in Penderecki's sonorism, described them exactly as "patterns for transformation—mostly of a permutative character. Structures which arise in the course of those transformations are variants of the basic model" (Droba 1976: 23). As an example of a basic textural model, Droba takes the rhythmic sequence in paragraph 38 of *Polymorphia* in the part of violins 1-6:

This model lacks an articulatory structure (only one kind of articulation occurs here) as well as dynamic structure (there is only one dynamic level, *pp*). This is thus a model that is structurally determined by a rhythm. 

The first variant occurs simultaneously with the model, in violins 7-12. It is a permutative-reductive transformation (retrogradation of the pattern without two last rhythmical values). (Droba 1976: 24)

Still, it seems that the permutation in the above example is fortuitous; that is, it does not result from a conscious and purposeful compositional manipulation. In the case of such limited material and, consequently, such constrained possibilities for shaping a sequence, any two sequences cannot avoid being reciprocal permutations of each other. In turn, clearly intentional permutations of sequences take place in those textural models which, in Droba's terminology, do possess articulatory structure, that is to say, which consist of sounds performed in two or more different ways. The earliest example of such permutative sequences, organized by the composer with great ingenuity, was observed independently by Wilfried Gruhn (1971) and Krzysztof Bilica (1974) in *Threnody* (6-10). Four models, occurring first in the cello parts (6), are put into subtle relationships, which are shown very clearly in this graphical representation by Bilica (1974: 60):

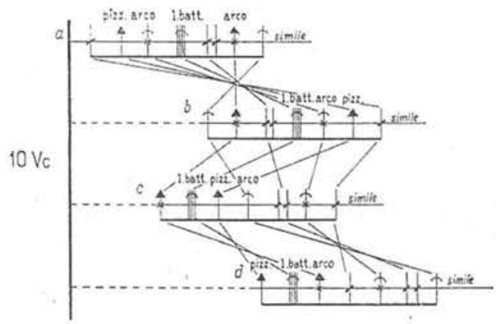


Figure 75

Also, the order in which individual models occur subsequently, in the parts of violas (7), violins (8) and contrabasses (9), is related to the original succession of their introduction by cellos, as can be deduced from the following figure (Bilica 1974: 61):

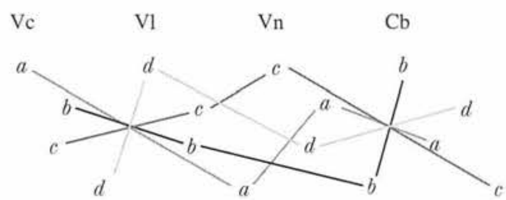
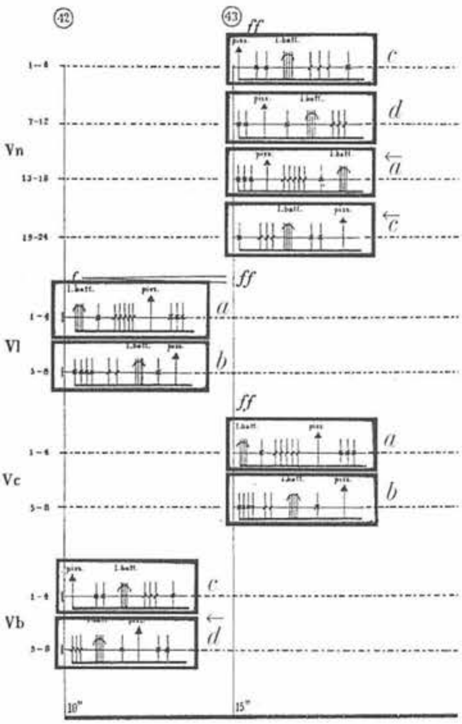


Figure 76

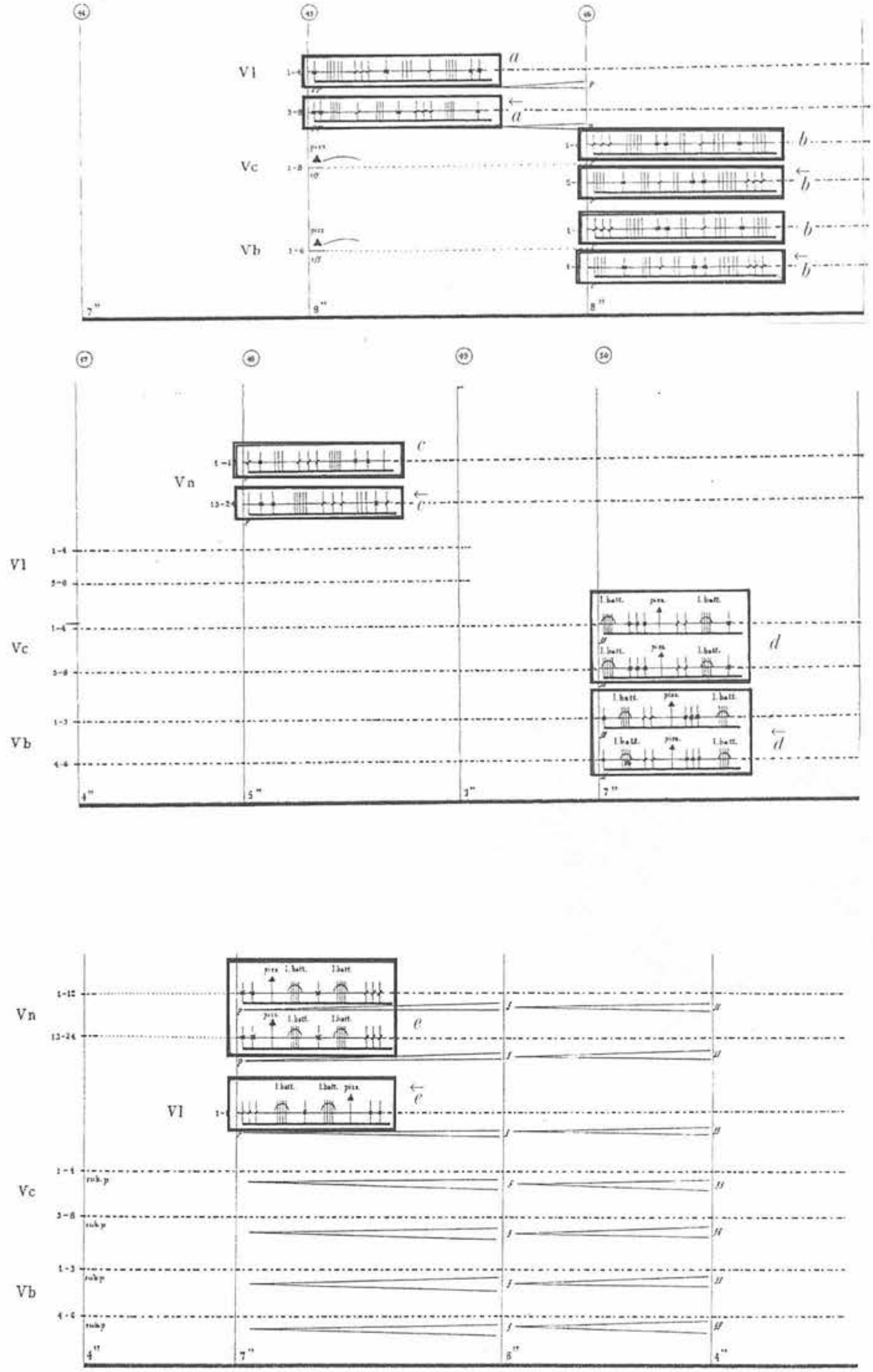
Textural models, which do not occur at all in Anaklasis and the Quartet and which are only occasionally present in *Threnody* and *Dimensions of Time and Silence*, come into prominence in *Polymorphia, Fluorescences*, and *Canon*. In those later sonoristic pieces, one finds two more striking examples of conscious permutative operations made by Penderecki on articulatory sequences as textural models. In *Polymorphia*, paragraphs 42-43, the sounds tapped on the sound board and desk or chair, plucked *pizzicato*, and struck *legno battuto* between bridge and tailpiece are ordered into four sequences and their retrogrades, as shown in the following example:

Example 66: *Polymorphia*, 42-43



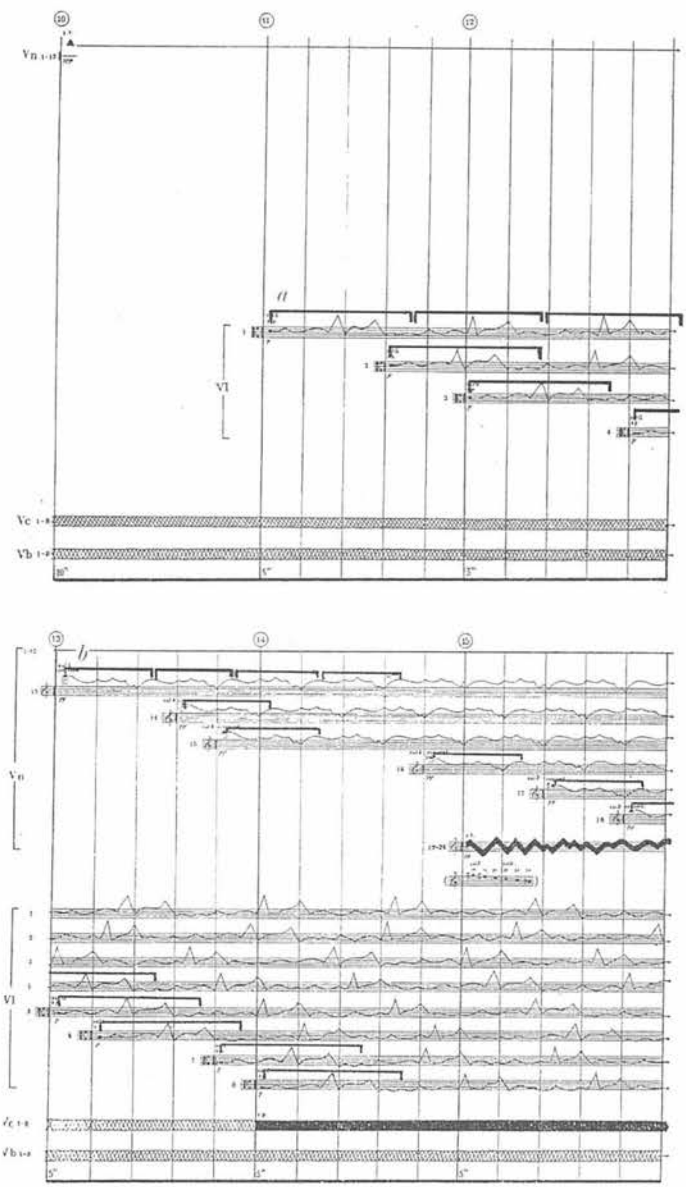
In paragraphs 45-54 of *Fluorescences* (Ex. 67, below), every model occurring in the parts of stringed instruments is always introduced simultaneously with its retrograde. The sequence of violas 5-8 in 45 is a retrogradation of that played parallelly by violas 1-4. In 46, celli 1-4 and contrabassi 1-3 perform the same sequence, whose retrograde occurs both in celli 5-8 and contrabassi 4-6. In addition, two sequences introduced by violins 1-12 and 13-24 (48) are the original and retrograde of each other, as is also the case of the sequences played by celli and contrabassi in 50, and by violins and violas in 52. Finally, the textural models occurring in the strings in paragraph 56 form two pairs in the relation original-retrograde: while the model given in violins 1-12 is retrograded in violins 13-24, another one assigned to celli is set into a retrogradation in violas and contrabassi. Otherwise, a kind of quasi-twelve-tone thought also governs the organization of pitch models in *Polymorphia* (37) and *Fluorescences* (55). These do not contain 12, but only between 7 and 10 pitches, among which is also the highest possible indefinite pitch. Still, the fact that no pitch is repeated within a given model is obviously influenced by the basic rule of non-repetition in "classical" (Schoenbergian) twelve-tone theory. Because in both cases the sounds contained in the model are articulated in the same way, no permutative procedures similar to those described earlier can be employed here by the composer.

Example 67: *Fluorescences*, 45-54



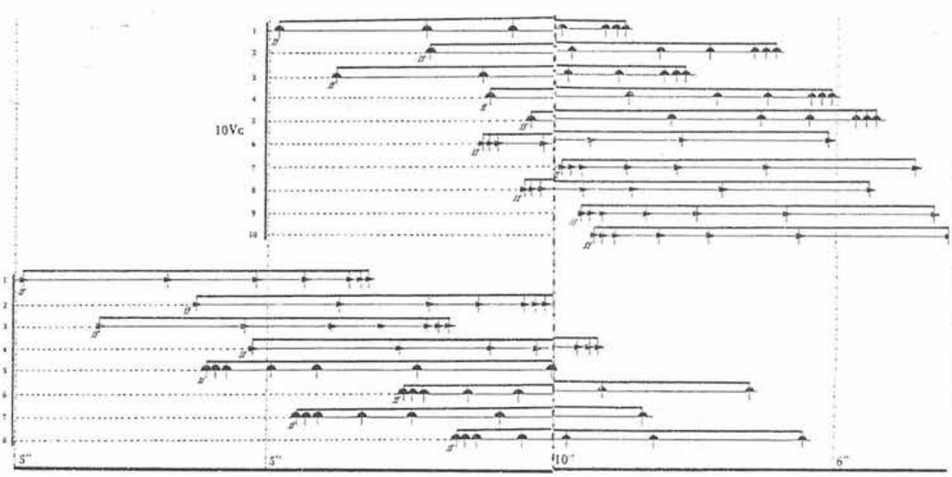
As curious examples of models founded on indefinite pitches, one can adduce the glissandi in *Polymorphia* and *Canon*. Owing to their graphic shapes, these glissandi are usually compared to electrocardiograms. As the example below shows, in each of them it is possible to delineate a section that is later repeated periodically, thus forming a subsegmental pitch regulation within a given instrumental part. What is more, in the parts of violas and violins 13-18 in Polymorphia, the same model is taken over by successively introduced instruments, thereby establishing an interdependence between those parts, as a very special case of canonic voicing:

Example 68: *Polymorphia*, 10-15



To conclude, one should come back to the score of *Threnody* in order to observe one more canon, which this time concerns rhythm and relates the instrumental groups of contrabasses (62-64) and cellos (63-65). The rhythmic complexity of this passage involves interrelations between individual instrumental parts based on the same rhythmic model; these interrelations are as follows: while half of each group introduces the original rhythmic pattern (cb 1-4 and vc 1-5), the other half of the group plays its retrograde (vc 6-10, cb 5-8). The slight difference in number between 10 cellos and 8 contrabasses causes a small difference that threatens the strict canonic interrelation, in the parts of cellos, where two more rhythmical patterns occur that do not have an equivalent in the contrabasses. Another, but this time deliberate, difference concerns articulatory devices assigned to both variants of the rhythmic pattern. If in the contrabasses the original is bowed on tailpieces and the retrograde on bridges, in celli the former is played on bridges and the latter on tailpieces. This exchange could be seen as a curious equivalent of pitch inversion, though applied to sound phenomena of indefinite pitches:

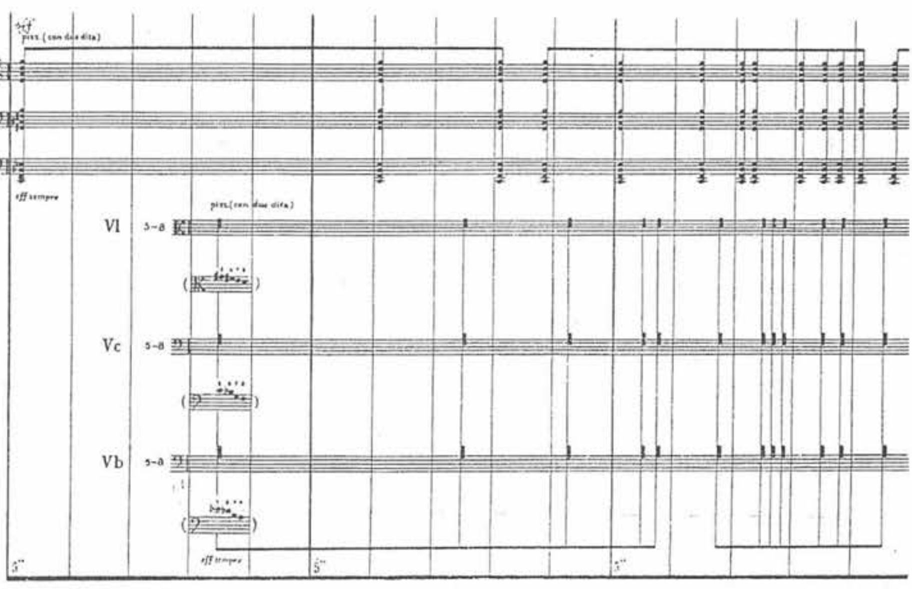
Example 69: *Threnody*, 62-65



The relationships between individual sounds on the subsegmental level, which have been mentioned thus far, concern sound phenomena that appear successively. In later pieces, mainly in *Polymorphia* and *Fluorescences*, one can also observe subsegmental regulations between simultaneous sounds. Of course, to treat every semitone-cluster consisting of twelve pitches as a manifestation of twelve-tone thinking would be not only scientifically untenable, but quite naive. Nevertheless, there occur also such clusters of twelve different pitches which, in their internal organization, are based on a relatively large interval and, as a rule, display some significant irregularity—the trace of a conscious compositional manipulation. For instance, the cluster of contrabasses and cellos, in paragraph 8 of *Fluorescences* and embracing two octaves, is basically comprised of whole-tones. Nevertheless, it contains one semitone in the middle (D♭-C: vc 7-8); this produces a situation where the pitches in the lower octave (vc 8 and vb 1-6) are not merely transposed to the upper one, but displaced so that the entire cluster includes all twelve pitches, two of which are repeated (c♯-C♯ and C-C̲).

An even more sophisticated case of vertical twelve-tone organization is found in *Polymorphia*, in the parts of violas, cellos and contrabasses (33-36; Ex. 70 below). Those instruments are divided into two groups, twelve instruments in each (I: vl 1-4, vc 1-4, vb 1-4; II: vl 5-8, vc 5-8, vb 5-8), and assigned to two different clusters. Group I performs a fourth cluster that is built on the lowest accessible pitch of the contrabasses (C-$\underline{F}$-$\underline{B}\flat$-$E\flat$-$G\sharp$-$c\sharp$-$f\sharp$-b-e^1-a^1-d^2-g^2) and that exhausts all twelve tones. The other group, in turn, performs a whole-tone cluster containing one minor third, a shift which makes it constitute a superposition of two whole-tone clusters of six different notes each, thus also using all twelve tones. Interestingly, the position of the latter cluster is such that its axis of symmetry is identical with that of the fourth cluster, falling between g♯/a. This interconnection explains the exceptionally high position of the whole-tone cluster as a sound phenomenon representing the low register, a fact pointed out during the analysis of this piece earlier.

Example 70: *Polymorphia*, 33-35



The regulations discussed in the course of this chapter are as a rule imperceptible to the listener. This was emphasized already by such authors as Erhardt, Schwinger, and Bilica, the latter even comparing them to "an inaudible musica mundana which, like Pythagorean Harmony of the Spheres, is governed by the most general laws of the cosmos: the laws of mathematics" (Bilica 1983a: 72). This imperceptibility has different reasons. The just-demonstrated interrelations of simultaneous sounds are obliterated due to the very nature of the cluster, which is the indiscernibility of its component pitches. In the first of the described cases, from *Fluorescences* (8-13), pitches are additionally put into glissando, which completely cancels any relations between them, that is, relations stemming from twelve-tone thought. As regards textural models: when a common beat is missing, their realization by several instrumentalists assigned to one instrumental part leads inevitably to temporal stratification, which blurs the strict logical order of permutations. In *Threnody*, the complicated interrelations observed in paragraphs 6-10 of the score are, in practice, canceled by the composer when he admits that "each instrumentalist chooses one of the

4 given groups". The serial canon of the same piece, as well as the rhythmic regulations in *Anaklasis*, elicit interrelations of sounds far too subtle and complex to be perceived by ear, and thus they are discernible only during analysis with the aid of a score. What is more, the complicated rhythmic passages of *Anaklasis* are additionally obliterated by several changes of the beat, as indicated by the time-line under the bottom staff. Finally, in the Quartet the so-called "ligatures" manifest themselves exclusively in the notation as beams of several notes, without any impact on temporal relationships between the sounds they represent, since each sound occurs as a separate impulse. In addition, in his analysis of mathematical sequences of ligatures, Bilica met with slight deviations, which he supposed were meant to "cover the composer's tracks" even under the eye of an analyst (Bilica 1983a: 77). From the foregoing remarks, it follows that the subsegmental regulations are manifestations of the same need for discipline, characteristic of Penderecki's compositional turn of mind, which also gave rise to his sonoristic system for ruling the segmental level. Nevertheless, those regulations make no allowances for the perceptual capabilities of the listener—in contradistinction to categories of the sonoristic system, whose fuzzy logical structures mirror the realities of auditive perception.

The relation between categories of the timbre and basic systems on the one hand, and subsegmental regulations on the other, as between two orders forming the groundwork for the organization of sonoristic pieces by Krzysztof Penderecki, is that of complementarity. While the timbre and basic systems determine segments in their global features, the subsegmental regulations may be added, as an extra determinant, to govern the sound content of a given segment. Still, the subsegmental regulations, influenced mainly by serialism of the Darmstadt school, are subordinate to the sonoristic system. For it is the type of segment—that is, the set of its constitutive terms chosen from individual categories—which delimits possible subsegmental regulations on the strength of the dependencies (discussed at the beginning of Chapter 6) between features of segments and of their component sounds. For example, temporal regulations apply only to segments characterized by temporal mobility. This explains why subsegmental relationships between individual sounds are to be found only in certain passages of pieces. Accordingly, the two complementary analytical descriptions of segments—in terms of subsegmental regulations made by the earlier investigators of Penderecki's sonoristic output, and in terms of categories of the sonoristic system given in this book—are also of different importance. If the analyses of subsegmental procedures always give only a partial view of a given segment—one taken in a way "from below"—the description from the standpoint of the reconstructed sonoristic system offers a global view "from above". The latter view elucidates kinships between segments, their succession within a piece, and, consequently, the role which they play in the entire course of the musical narration.

13. APPENDIX: THE NOTATION OF PENDERECKI'S SONORISTIC SCORES

In linguistic study, notation constitutes a secondary issue. This is because "letters never, or only partially, reproduce the different distinctive features on which the phonemic pattern is based and unfailingly disregard the structural relationship of these features" (Jakobson and Halle 1956: 17). A graphic sign, which is a letter, thus refers neither to the acoustical characteristics of a given feature itself, nor to any aspect of motoric acts leading to its articulation. A letter is a symbol denoting a phoneme, as if the latter constituted an irreducible unit. This is why graphic code is inferior to speech: Even if it occurs, it does so merely as a phenomenon that assists speech acts, yet never replaces the latter in processes of linguistic communication. As Jakobson and Halle pointed out,

> in contradistinction to the universal phenomenon of speech, phonetic or phonemic writing is an occasional, accessory code that normally implies the ability of its users to translate it into its underlying sound code, while the reverse ability, to transpose speech into letters, is a secondary and much less common faculty. Only after having mastered speech does one graduate to reading and writing. . . . There is no such thing in human society as the supplantation of the speech code by its visual replicas, but only a supplementation of this code by parasitic auxiliaries, while the speech code constantly and unalterably remains in effect. One could neither state that musical form is manifested in two variables—notes and sounds—nor that linguistic form is manifested in two equipollent substances—graphic and phonic. (Jacobson and Halle 1956: 16-17)

Consequently, notation does not form a stage of the "speech event" in the process of linguistic communication, which leads from the intention of a sender (speaker) to the perception of a listener.

It is exactly at this point where the comparison with music made by Jakobson and Halle, in the just quoted passage of their book, fails. As is commonly acknowledged, in Western music the notation (score) plays a very important role in that it constitutes an intermediate stage between the sender (here, the composer) and the performer of motoric acts, which acts result in the generation of the musical utterance. If, as is the usual case, this utterance is not known to the performer in advance—in contradistinction to a phoneme known to a speaker even before he reads it out of a letter—then the notation can play its role only because notes reproduce features of sounds and, consequently, also their structural relations with respect to those features.[1] Moreover, instructions concerning motoric acts are also conveyed through the musical notation. It is precisely this trait which tacitly informs those critics who claim that the reason for the unorthodox notation characteristic of Penderecki's sonoristic scores lies in his new articulatory "sound effects". One would have to add now that, just as those "effects", identified in this book with either sound generation processes or textural effects, in turn form a manifestation of the sonoristic system, so also new notational devices are indirectly undergirded by this system, and form second-degree manifestations of it.

Yet, a thorough study of the sonoristic scores reveals that new articulation does not always result in new notational devices. And conversely, new devices apply also in reference to some traditional articulatory phenomena. This points out a gap in the reasoning of earlier investigators. In fact, new articulatory effects need not bring about new notation, in so far as the reference of the latter to the former has a conventional character. Such purely conventional, symbolic signs, devoid

[1] Characteristically, so-called group notation as well as early neumatic notation (cheironomic neumes), which failed to record sound features and their structural interconnections, constituted also, like letters, an auxiliary device: the assistance of memory, and not a stage of the communication processes. Every communicate—and every musical event symbolized by them—had to be known by heart; only then could the notation perform its task.

of inner relations to their objects, predominate in traditional musical notation. By contrast, in the sonoristic scores of Krzysztof Penderecki, in addition to symbols one finds numerous iconic signs whose relation to objects is based upon similarity or resemblance. As will be shown in the discussion below, it is precisely icons, applied both to traditional and atypical articulatory phenomena, which constitute most of the new notational devices. Hence, without denying the crucial role of articulatory novelties, one has to acknowledge that the transformation of notation characteristic of Penderecki's sonorism is influenced also by a tendency concerning the character of signs: eliminating symbols and introducing icons, as far as it is practical to do so. Most likely, this tendency was to find its systematic elaboration in the book *Partytura współczesna* (*A Contemporary Score*) having been prepared by the composer together with his close friend, Marian Wallek-Walewski, at the end of the 1950s and intended as a continuation of the study *Partytura na tle współczesnej techniki orkiestracyjnej* (*A Score in the Light of the Contemporary Orchestration*, 1954) by Feliks Wrobel. The former book never got beyond the stage of sketches, however, one of which was published as an article by Wallek-Walewski (1960).

In the following discussion, the new notational devices are divided into those that refer to sound generation processes, and those that refer to textural effects. This division is justified by the fact that the notation of both those groups of articulatory phenomena has an iconic point of reference in two different stages of musical communication.

13.1. NOTATION OF SOUND GENERATION PROCESSES

Processes of sound generation are notated by means of signs that have their denotation directly on the motor stage; that is, signs that refer directly to vibrators, inciters, and excitation events as three component factors of every sound generation process. In traditional musical notation, all of these factors were always indicated by means of symbols, and mainly verbal ones, such as the names of instruments or their abbreviations, given on the score before a staff assigned to a given instrumental part. Such information was quite enough in situations where only one element of an instrument—its "original" vibrator—served as the sound source. When this sound source was usually excited in the same way, with one and the same inciter, the two further factors of the sound generation process were as a rule not indicated at all. Thus, in such cases the name of the instrument gave information not only about the standard vibrator, but also about the standard inciter and the typical excitation event. Only rare cases of deviation from the standard way of playing demanded some separate cues (e.g., *legno battuto*, *spiccato*, *flautando*). Most of these cues were verbal symbols, as well. Exceptions in this respect are symbolic, yet non-verbal signs, such as those for harmonics or for left-hand pizzicato in string technique.

From this it follows that all verbal symbols or footnotes referring to factors of sound generation processes in Penderecki's sonoristic scores are also to be considered as traditional notational devices, even if they denote new excitation events, inciters, or vibrators, such as a piece of iron (*ferro*), sheet metal (*lastra*), and a typewriter (*macchina da scrivere*). On the other hand, new notation uses mainly iconic signs. To create an icon (i.e., a sign based on a resemblance to its object) was easiest in reference to bodies, that is, vibrators and inciters. Most icons in the scores of Penderecki's sonoristic pieces refer to inciters that already numbered among the standard

---

[2] Even though recognition of such a similarity itself involves an element of convention (see Eco 1976: 191-217), the distinction between symbols and icons as two types of signs characterized by different relations to their objects remains classical in the field of semiotic research.

percussion equipment: wire brushes ( ), hard sticks ( ), soft sticks ( ), mallet of tubular bells ( ), and a triangle rod ( ), ( ). When the element of a soft-headed stick, indicated as that which collides with a vibrator, is its handle-end, then a combination of iconic and symbolic sign arises ( ).

Icons for the vibrators in Penderecki's sonoristic pieces refer exclusively to elements of stringed instruments: bridges ( ), tailpieces ( ), strings between bridge and tailpiece. As regards the latter, the iconic representation even shows the number of strings to be excited: one ( ), two ( ), or all four ( ). Sometimes an iconic relation ties a sign to a sound generator as a whole, that is, to a combination of inciter and vibrator; this happens in the case of signs indicating the sort of beater and the part of a membranophone which is supposed to be struck by it: an edge ( ), edge and skin ( ), or another stick laid on the membrane ( ). In turn, symbols constitute new notational devices only as signs of those new bodies that preclude iconic representation, such as sound boards ( ), fingerboards ( ), as well as desks or chairs ( ). All of them, which occur exclusively in the parts of stringed instruments, are non-verbal symbols.

As regards those vibrators, which in Penderecki's sonoristic pieces are excited always in the same way, by one inciter only, their non-traditional signs, mentioned above, convey information about the whole sound generation process. This is the case with bridges, tailpieces, sound boards, fingerboards, and desks or chairs. Otherwise, additional information about the two remaining factors, inciter and excitation event, is given either by means of traditional or non-traditional notation. In contrast, icons of inciters occur only if applied to several different vibrators and never provide information about the whole sound generation process. This holds true also with regard to those signs, listed above, which refer to combinations of vibrators and inciters: even if one knows which part of a membranophone is supposed to be excited with a clearly determined beater, still the concrete instrument must be indicated in a traditional way, by means of an abbreviation that signifies tom-toms (tomts), bongos (bgs), drums (tmb), or kettle drums (timp).

While iconic representation of objects is comparatively easy, it is much more difficult to invent icons of acts that are excitation events. This is why, in Penderecki's sonoristic scores, one finds only a few examples of such signs. Those signs are conceived as the projection of a movement performed by an inciter in relation to a vibrator's surface, so that the physical space of this movement is represented by the vertical dimension of the score, and time by the horizontal dimension. The most suggestive effects are obtained in application to horizontal excitations, such as rubbing sound boards with the palm of the hand ( ), sawing ( ), and vigorous rubbing with file or bowing (>>>>>>). In the case of the latter notational device, however, one can treat it as a series of repeated accents, and so in a symbolic rather than iconic way. Also tremolo ( ) might be seen as a projection of the two-way movement of the bow, though this time given in an abbreviation without the temporal projection. Vertical excitation in which the inciter moves perpendicularly towards the vibrator gives only points on the surface of the vibrating body; hence the possibilities of its iconic representation are much more constrained. Still, the icon of such a movement is a series of dots (............), which can also be explained in a complementary way, as the multiplication of traditional symbols for staccato.

Notational devices concerning sound generation processes are obviously contingent upon the occurrences of a proper vibrator, inciter, or excitation. Since wire brushes, sticks, and triangle rod occur in the presonoristic period of Penderecki's output, their icons are found as early as in the scores of *Strophes* and the *Psalms of David*. In *Miniatures*, where strings between bridge and tailpiece are used for the first time as sound sources, their icons, too, occur in different versions, depending upon the number of excited strings (,). Interestingly, in some presonoristic pieces there occur also new signs, which refer to articulatory devices that were subsequently abandoned by the composer after the introduction of the sonoristic system. They were graphic symbols for striking piano strings with fingertips (), or for plucking them with fingernails () in the score of *Strophes*. These novelties suggest that, in reference to sound generation processes, Penderecki's predilection for non-verbal and iconic representation is basically independent of his sonoristic system. Still, it is unquestionable that the considerable intensification of this tendency happens only in the sonoristic pieces, and that the evolution of notation for vibrators, inciters, and excitation events is parallel to the evolution of sound generation processes and hence, indirectly, parallel to that of the system itself. The only changes which occur in this field, but are not caused by new articulatory phenomena, result merely from attempts to find the best graphic representation of the signs. This concerns the alternative form of the sign that represents strings between bridge and tailpiece in the Quartet (), and the two versions of the icon of the triangle rod (/, /). The former (and simpler) sign is found in *Anaklasis* and *Dimensions of Time and Silence*, the latter in *Fluorescences*. In the Quartet, the composer introduces a cross-mark (×), instead of the traditional abbreviation *legno battuto*, which is most likely dictated by rapid changes of articulation characteristic of long passages of the piece, in the course of which it is thus much easier to operate a non-verbal than a verbal symbol.

13.2. **NOTATION OF TEXTURAL EFFECTS**

The graphic recording of textural effects takes its denotation not from the motor stage of their production, but from the perceptual stage, as the destination of the acoustical enunciate. This situation came to light earlier, during the articulatory definitions of basic system categories, combinations of whose terms set up textural effects. In all those cases where a given articulatory definition was transferred from the motor to the perceptual stage, that transference resulted always from the notation: either notation of pitches as regards tuned instruments in categories "spatial continuity vs. discontinuity", "spatial mobility vs. immobility", "high vs. low register", and "middle vs. extreme register"; or notation of dynamic marks concerning "loud vs. soft dynamics". The same observation is also to be expanded to the categories "temporal continuity vs. discontinuity", "temporal mobility vs. immobility" and "maximal vs. minimal time-span" owing to the time notation, which can be interpreted equally as referring to the time of motoric acts, of acoustical phenomena, or of auditive perception.

Traditional notation of time and pitch combines symbolic and iconic features. As regards time: even if the exact rhythmic value of a note, as well as its time-span between other notes, is indicated symbolically by values within a meter marked by bars and bar-lines, the succession and time-spans between their onsets are also always represented iconically, as distances between individual notes in the horizontal dimension of the score. Similarly, the precise pitches and intervals between them are indicated symbolically on the staff, though their mutual position—higher or lower—as well as their approximate distances are reflected in an iconic way in the score's vertical dimension. Because a third dimension of the score does not exist, loudness (or volume) cannot have an iconic representation, thus it is indicated symbolically by means of dynamic marks. Yet, dynamics constitutes precisely the perceptual parameter that has no impact on texture.

It is noteworthy that the role of the symbolic component in the musical notation of time and pitch is always to make precise the pitches and rhythmical values of individual sounds, as well as the relations between sounds in respect of these two perceptual parameters, whose approximation is given already by the iconic component. Thus, the importance of the symbolic aspect of notation springs from the fact that it enables procedures on the level of sounds—a level which is equally proper for compositional operations both in traditional and in most twentieth-century music. Yet as already stated, in Penderecki's pieces based on the sonoristic system, the proper level of compositional operations is not that of individual sounds, but of sound fields, or segments. In turn, features of segments are modeled not by individual values of acoustical parameters, but by intervals of such values which, in addition, form fuzzy sets; these last are characterized by the property that their borders cannot be univocally stated. Precision regarding individual values of component sounds of such segments is thus superfluous. Hence, in application to textural effects, it is the sonoristic system that weakens the symbolic aspect in Penderecki's scores. Instead, iconicism comes to the fore, as a projection of the musical axes of pitch and time onto the two-dimensional space of the score. This has been noted by Tadeusz Zieliński:

> The manifestation of such a 'plastic' conception of music is also the notation used by the composer, in which a sound shape is reproduced not by means of conventional symbols, but by a direct reflection accomplished through its transposition onto correlates of the two-dimensional space of the score. There exists thus the similarity of a sound shape received auditively to an analogous visual shape. A single short sound—e.g., *pizzicato*—has in our auditive imagination the meaning of a point. Long-lasting sound takes the shape of a line. The simplest example of such a line is a straight horizontal line, obtained by a longer duration of a sound that does not change its pitch, i.e., its place in the vertical space. . . . Apart from sounds taking the shape of different lines, there occur also broad sound phenomena, which form sound bands, i.e., clusters. (Zieliński 1968: 79, 82)

In this way, the three basic sound shapes distinguished by Zieliński—points, lines, and bands (see Chapter 4)—find their direct notational reflection. Otherwise, their interpretation by the Polish author is clearly conditioned by the notation, which is mirrored in the very names. Hence Zieliński's article, quoted above, can be seen as constituting at the same time a study both of sound shapes and of Penderecki's notational devices.

Without questioning the apt and very interesting observations made by Tadeusz A. Zieliński, one has to emphasize that, from the point of view of the sonoristic system reconstructed here, every sound shape is a textural effect qualified by basic system categories concerning the perceptual parameters of pitch and time and, as such, reducible to its component terms. Accordingly, its graphical representation, too, can be dissolved each time, into component features related to these categories. Such is the case for this reason: just as pitch and time are mirrored in the two-dimensional space of the score, for each one of the perceptual categories concerning pitch and time there also exists a relevant aspect of notation in Penderecki's sonorism. "Temporal continuity vs. discontinuity" as a perception of points and lines (sections) on the time axis is reflected in points and lines within the horizontal dimension of a score. "Minimal vs. maximal time-span" as well as its hierarchically linked category, "temporal mobility vs. immobility", have their graphical counterparts in distances between signs referring to individual sounds (more precisely, between left ends of such signs, since the score is read from left to right); these distances are to be measured along the horizontal dimension. The temporal relationship arising between medium time-span sounds is indicated symbolically by a common cross-bar. As noted earlier in the articulatory definitions, however, this cross-bar occurs almost exclusively between notes belonging to the same instrumental part. In turn, minimal time-span series of sounds constitute the mediative border-zone term of "temporal continuity vs. discontinuity". The doubtful classification of such series, from the point of view of the latter opposition, is very aptly reflected in the notation, which notation combines a series of dots or accents, suggesting temporal discontinuity, with a line representing otherwise temporally continuous sounds (<u>..........</u>, <u><<<<<<<<<</u>). Interestingly, both these notational devices can thus be considered as either icons of the excitation event (as done in the previous paragraph), or as iconic signs of perceptual phenomena. This equivocation springs from the characteristics of time, pointed out earlier, which is a parameter common to motoric acts, to acoustical phenomena, and to the perception of the latter.

On the other hand, all categories concerning pitch rule the vertical dimension of signs and their arrangement on a score. "Spatial continuity vs. discontinuity", as a perception of points or sections on the axis of pitches, is transposed onto points or sections in the vertical dimension. "Spatial mobility vs. immobility", which accounts for the perception of changes concerning the position of a given sound phenomenon on the pitch axis, governs the changes of vertical location of the graphical signs on the score space. Finally, both the hierarchically linked categories of "high vs. low register" and "middle vs. extreme register" account for the location of individual signs in the vertical dimension of the score. Otherwise, this latter aspect raises some difficulty, because the vertical arrangement of signs is made each time in relation to some point of reference, which in the case of the vertical dimension is different for individual instrumental parts written on separate staves. This situation results in the fact that vertical relations across staves need not account properly for the spatial relations of sounds. In other words, a given note can be assigned to a pitch lower than that of another note, even if in the space of the score the former is located higher than the latter. In such cases, the iconic representation fails. This difficulty can be avoided if the parts of all instruments are notated on a common staff-system, as in *Anaklasis* (tutti archi: 3; see Ex. 7). For practical reasons, however, such cases are very rare. Still, iconic representation remains at least partially valid, when the order of staves reflects the registers of the individual instruments or instrumental groups which are assigned to them, as occurs in scores for strings. Even so, it is still possible that a graphic sign in the contrabassi part may indicate a pitch that is higher than pitches in the parts of some other instruments placed above it. That the iconic representation of pitch relationships is limited basically to one instrumental part, has its further impact on notation, with regard to the categories "spatial mobility vs. immobility" and "spatial continuity vs. discontinuity". An example of this situation arises when one integral cluster is, on the score, divided into several clusters (see *Dimensions*, 107; Ex. 36) or even into several individual pitches (see the Quartet, 3.31-36). Also, a change in the graphic location of a sign need not necessarily denote a pitch change; for instance, see Example 25, where the same cluster passes through several instrumental parts.

From the foregoing discussion it follows that the notational devices discussed in Zieliński's article, which record three basic sound shapes, can easily be interpreted as combinations of several graphical aspects ruled by individual categories of the basic system. Since Zieliński considers only single signs, and not their location or interrelations in the space of the score, he leaves aside aspects of notation ruled by "high vs. low register", "middle vs. extreme register" (vertical locations of sings and relations between them), as well as "minimal vs. maximal time-span" and "temporal mobility vs. immobility" (horizontal interrelations of signs). His sound shapes are thus combinations of opposite terms that have been chosen mainly from the categories "temporal continuity vs. discontinuity" and "spatial continuity vs. discontinuity". The negative terms of both categories produce a point in the graphic representation. The positive term of the former and negative term of the latter category brings about a line; and the positive terms of both categories, a band. Note that there exists also a fourth possible combination of opposite terms. This combination consists of the negative term of "temporal continuity vs. discontinuity" and the positive term of "spatial continuity vs. discontinuity". The graphic equivalents of this combination are vertical sections that symbolize momentary clusters, such as those at the beginning of *Anaklasis* (1), and those in *Canon* (33).

Further differentiation of the three basic shapes stems either from the introduction of mediative terms or from the contribution of the category "spatial mobility vs. immobility". Zieliński writes further on:

> If one employs here a trill or vibrato by sliding the finger a quarter-tone, the line will take a slightly wavy shape. . . . Apart from horizontal lines, there are lines changing their location in two-dimensional space, i.e., rising and sinking in several ways. They are realized by glissando. . . . If the glissando goes evenly, i.e., if its rise and fall is directly proportional to the stream of time, then it still forms a straight line. The gradient of this line depends on the speed of the glissando. . . . When this proportion is broken, i.e., when in the course of the glissando there occur some accelerations and decelerations, then the line becomes an irregular curve. If one employs in one line different straight and curved sections as well as frequent changes of direction, one can create very complicated shapes that resemble graphs. Such courses can be endowed with some higher level regularity by reiteration of the same phases. Examples of such complicated, but at the same time regular graphs of a very aesthetic shape are electrocardiograms. (Zieliński 1968: 79-81)

One has to stress at this point that, since the notation of sound shapes is an effect of their projection onto the space of a score, the explanation of signs in terms of basic system categories concerning time and pitch is tantamount to explaining the sound shapes as textural effects constituting combinations of such terms. Plainly, the evolution of the notational devices referring to new textural effects is parallel to the evolution of those effects themselves, which in turn are dependent on the evolution of the basic system. Still, it is noteworthy that, apart from new articulatory phenomena, standard textural devices are also notated with new iconico-graphic notation. Therefore, such icons appear occasionally even before the appearance of the sonoristic system; for instance, see the lines showing a single, lasting sound in *Miniatures* for violin and piano, or in the same piece, the wavy lines for vibrati (Ex. 59a, b). One may reasonably surmise that it was precisely the iconic character of signs referring to textural effects, and having their denotation in the perceptual stage of musical communication, which brought about the feeling of adequation between the notation and the auditive result of Penderecki's sonoristic pieces. This apparent adequation was stressed by early critics such as Huber (1971) or Häusler (1969a; see Chapter 2).

If the precisionment of individual time and pitch values was not necessary for the sonoristic system, whereby the iconic signs came into prominence, then the composer should have abandoned the symbolic components of notation: meter, bars (bar-lines), and rhythmic values as well as the staff and individual notes indicating pitches. Indeed, such abandonment can be observed in Penderecki's sonoristic scores, though it is only very rarely thorough. Usually, both bar-lines and precisely indicated pitches on a staff do occur, at least in a few passages of a given piece. The reason for the retention of these signs resides mainly in the subsegmental regulations employed by the composer in order to rule relationships between individual sounds.

13.2.1. TIME NOTATION

If subsegmental regulations concern duration, time-span, or succession of sounds, then bars, bar-lines, and rhythmic values, as symbolic components concerning the notation of time, must be used. They are thus to be found in the three earlier of Penderecki's sonoristic pieces—*Threnody*, *Anaklasis*, and *Dimensions*; the subsegmental regulations concerning time in those pieces were discussed in the previous chapter. Still, in those cases the bar-line is used not to suggest a meter or pulse. On the contrary, it is intended only to govern the order of onsets between individual sounds, and in this way to synchronize the instrumental parts of the performing ensemble. This is why the composer never indicates the meter signature, the real meter used by him always being the simplest one, which is 2/4. This was emphasized by Wilfried Gruhn, in reference to the canonic section of *Threnody*:

> Because the meter here exhibits merely an external moment designed for the exact synchronisation of soloistically treated, individual voices, without any accent, what arises is a grid-like acoustical effect resulting from the stratification of individual notes of quintuplets and sextuplets, shimmering in pitch and color, and irregular in density. (Gruhn 1971: 410)

In *Anaklasis*, meter, as an undesirable effect that could arise from the usage of bars, is additionally blurred by permanent changes of the pulse between 44, 58, and 80 MM; these changes are indicated by the so-called "tempo-line" under the lowest staff, and are activated exclusively in "rhythmical" passages of the piece.[2] Otherwise, the "tempo-line" constitutes a relic of the pre-sonoristic period, where it occurred in *Strophes*. Interestingly, if its original purpose in *Strophes* was to make the temporal relations more subtle, in the score of *Anaklasis* the time-line is apparently intended to make perception of these relations more difficult. Yet because such perceptual complication can be easily achieved by a sufficient complexity of the rhythm alone, the tempo-line, as a device not exactly connected with the sonoristic system, is eliminated by Penderecki in his later sonoristic pieces.

In *Anaklasis*, *Threnody*, and *Dimensions* bar-lines also occur in passages devoid of subsegmental regulations, where progressive changes take place in the duration of individual sounds—e.g., their lengthening and shortening in *Dimensions* (28-45, 83-101) and *Anaklasis* (18-25)—or where the succession of individual sounds belonging to different instrumental parts is of importance. Thus again, bar-lines, in these cases, have a purely technical meaning, for the synchronization of instruments. If such successions are not extremely complicated, the composer tries to avoid bar-lines by means of a dotted line showing the order of entries in the course of an individual section; examples of this notation can be found in *Dimensions of Time and Silence* and *Threnody*.[3] The sections themselves are paragraphs of the score, in which exact temporal relations are not indicated, but only the global time is given in seconds, to be treated rather approximately. Such approximative notation of time occurred for the first time in *Miniatures*.[4]

A very peculiar case of temporal notation in Penderecki's sonoristic pieces occurs in String Quartet No. 1. Unlike the other pieces composed during the same period, the Quartet uses neither bar-lines nor paragraphs, but a time-scale in which one centimeter represents one second, and two pages of the score stand for one minute of the piece. Such a thorough elimination of bars, which has been observed already by earlier critics, is caused by the lack of any temporal subsegmental regulations in this piece. As stated earlier, in Chapter 12, the regulations discovered by Bilica (1983a) do not concern the duration, nor the succession of individual sounds, but the notation itself. Therefore the chart of seconds gives only points of orientation for the performers, and is not intended to be followed strictly by them. This last fact is apparent from the composer's remark in the score, which says that though "the tempo is determined by the duration of an individual one-second section", still "deviations from this tempo within the limits from 0.8" to 1.4" for each section are admissible, depending on the first violinist's choice".

Nevertheless, such a chart was still too exact for sustained notes lasting several seconds. This is why Penderecki uses it again only in *Canon*, where it helps to synchronize the orchestra with the two tape-recorder parts. Otherwise, in *Polymorphia* and *Fluorescences* charts of seconds are used only occasionally, in those passages where the temporal processes proceed quickly within

---

[3] Obviously, otherwise changes of this line would make no sense, since it refers to the value of a crochet. This is why in passages devoid of both bar-lines and rhythmic values the time-line is immobile or even disappears.

[4] In the manuscript of the first version of *Dimensions of Time and Silence* such a line was not dotted, but drawn in red. So says the composer's commentary in the program book of the Fourth "Warsaw Autumn"(see Erhardt 1975: 25).

[5] Because in this piece no meter exists, bar-lines already come to resemble here the borderlines of subsequent paragraphs, even if the duration time of one paragraph is not yet indicated.

several instrumental parts, whose sound phenomena are moreover supposed to occur in a fixed succession (*Polymorphia*: 11-24, 33-37, 57-59; *Fluorescences*: 20-22, 56-61, 76-80); in such cases, the dotted line indicating the entries of individual instruments is eliminated. In all remaining passages there occur temporal paragraphs, which thus prevail absolutely in the scores of both pieces. Such characteristics of the time-notation employed here are closely connected with the lack of subsegmental regulations concerning time, as well as with the elevation of textural models (the latter were considered in the previous chapter, with respect to *Polymorphia* and *Fluorescences*). Although resulting in quick temporal processes, textural models do not require synchronization, either between individual instrumental parts or within one part performed by several instruments. Models are repeated several times, which makes for economical usage of notation. At the same time, however, such economy of notation brings an aleatoric element to performance—the extreme manifestation of the approximative character of Penderecki's notation of time. This approximation was sometimes viewed as a weakness, and the composer was upbraided for carelessness as regards temporal notation of his pieces. One such criticism was made by Krzysztof Meyer, Polish composer and music theoretician, during the second seminar on Penderecki's music in Cracow:

> The composer, fascinated by his own music, does not pay close attention to the precision of notation. He is either not interested in this problem, or thinks it can be left to the performers (even though it adds to their troubles), or—perhaps—he has no time to invent a more exact form to notate his own music. (Meyer K. 1983: 86)

Obviously, such accusals are founded on a misunderstanding. The lack of precision characteristic of Penderecki's approximative notation results neither from the composer's carelessness, nor from aesthetic premises leading to the elevated role of performers, but from the very character of his compositional system. In fact, there is no "lack" at all, since all relevant features of segments as syntactical units are expressed in the notation as it appears in the scores of sonoristic pieces. In this sense, the notation is thus not "approximative" but exact, as the notion of exactness always is related to relevant aspects of an object recorded in a given sign. Clearly, for Penderecki's sonoristic style any more exact way of notation would be superfluous and, as such, wasteful[5].

13.2.2. PITCH NOTATION

If the bar-line and rhythmical values disappear rather quickly from Penderecki's sonoristic scores, the staff and exact pitches are much more obstinate. Of course, staves and exact pitches are necessary to control subsegmental regulations concerning pitch; these relations occur in almost all of the sonoristic pieces investigated in this book (*Threnody*, *Dimensions*, the Quartet, *Polymorphia*, and *Fluorescences*). Also involved, however, is the practical, technical aspect of pitch notation. As bar-lines constitute common points of reference and in this way help synchronize individual instrumental parts, so also the staff forms a common point of reference for operating different instrumental parts in respect of pitch. Such a point of reference is indispensable when a single pitch is to be played by several instruments, as well as when a group of instruments is

[5] What is even more, it would obliterate the intentions of the composer, as emphasized by himself in the following utterance: "*Threnody* is conceived in such a notation, that it simply cannot be written in another, since it would be no longer the same piece" ([Discussion] 1976: 37-38).

supposed to perform a cluster of several adjacent pitches. This is why the staff is kept in Penderecki's sonoristic scores. The only exception is *Canon*, where the principle of a chart is expanded to cover the vertical axis of pitches. But because this device severely limited the possibilities of shaping segments, the composer has never returned to the notational experiment he made in that piece.

Interestingly, the composer's exactness in the indication of pitches goes even further than that of traditional notation, in that he introduces quarter-tones which are marked with new symbols derived graphically from regular sharps and flats (‡, ♯, ♭, 𝄳). These "ultrachromatic" signs do not prove the existence of the quarter-tone scale in Penderecki's sonorism, as some commentators have claimed (see Pociej 1965). Instead, quarter-tones are employed merely to regulate precisely the internal structure of a cluster, that is, to give clusters the desired density. Thus, even if precisely indicated, pitch is always of secondary importance in Penderecki's sonoristic style.[6] The subordinate status of pitch follows from the organization of the musical space in Penderecki's sonorism by means of categories "high vs. low register" and "middle vs. extreme register", whose terms are fuzzy intervals on the axis of pitches. Consequently, any single pitch that occurs separately, as a spatially discontinuous sound phenomenon, is chosen arbitrarily from among several possible pitches as the representative of a given register that constitutes a term of those two categories; within the range of a given register, which otherwise is not univocally delineated, that pitch could be replaced by any other pitch, without disturbance of the identity of a given sonoristic work. For instance, the formal design of *Fluorescences* would be not compromised if—instead of the pitch c^1 filling in more than two minutes of this piece (68-85)—the composer had instead chosen b or c^1♯. No formal disturbance arises, because this pitch, here, has no structural relationship to other pitches, but merely forms a representative of the middle register. Characteristically, the secondariness of pitches composing a cluster is testified to by their notation in parentheses below the proper signs that form iconic blocks (e.g., see Ex. 7, 36, 65b).

The secondary importance of pitch and, consequently, of traditional staff notation—though basically stemming from the sonoristic system—has its reason also in several peculiarities of the system's articulation. One of these is the enlargement and elevation of percussion, which embraces mainly untuned instruments. It is also percussion that contains most of the new sound sources employed in Penderecki's sonoristic pieces—mainly the non-musical tools, whose sounds do not have definite pitches. On the other hand, the new sound sources that occur outside percussion—in the parts of strings and winds—cause these originally tuned instruments to be turned into untuned ones, when performing the so-called "percussive effects". The most striking cases are undoubtedly those of string techniques such as playing between bridge and tailpiece, striking the strings *sul tasto*, tapping sound boards, desks, and chairs. Consequently, the sequences of these articulatory effects in *Threnody* (6-9, 56-63), *Polymorphia* (38-45), and *Fluorescences* (45-54) are notated without staves. Staff notation is also not needed for highest and lowest possible notes indicated by symbols (▲, ▼). This is probably why, in the just mentioned sequences, there also occur the highest possible notes played on strings in front of the bridge, construed as the originally designed, tuned vibrator of stringed instruments. If not for notational reasons, the composer could use there any definite pitches of strings, because each of the sequences including highest possible notes represents the maximal differentiation of articulatory effects and hence the totality of musical space (as pointed out earlier, in the analyses).

---

[7] Such a conclusion is drawn also by Zieliński: "The factor that determines a sound is timbre, and not pitch which in this material looses its hitherto central importance for compositional procedures . . . A distinct pitch, occurring in some cases, is perceived as a specific sort of timbre, and not as a concrete place in the scale of pitches—as was in the tonal and modal systems, or in the twelve-tone technique" (1968: 76).

Finally, sometimes the elimination of the staff signals the inclusion of a given tuned instrument in a class of vibrators which—according to the composer's arbitrary idealization of sound-source acoustics—should be untuned. Such cases are those of the kettle drum, of the xilorimba treated as a collection of wooden idiophones, and the piano and harp when they are classified as substitutes for metal plates (see Chapter 6.2).

The foregoing discussion makes clear that the notation of textural effects in Penderecki's sonoristic scores is under the strong influence of the sonoristic system, of subsegmental regulations, and of articulation. The only autonomous notational process reflected in the evolution of the graphic signs, is the progressive elimination of redundancies, which usually are mere relics of traditional musical notation. Examples of a redundancy are the white-headed notes that are used, by analogy to traditional whole-notes and half-notes, in application to long-lasting sounds, even though they do not possess any rhythmic values and their duration is already indicated iconically by a horizontal line. Such cases occur in *Anaklasis* (1-2) and are attended also by two versions of the symbol for highest possible notes, as either a white (2) or black triangle (87-96). In all the later sonoristic pieces this double representation of the same temporal phenomenon is eliminated, and the white-headed notes remain only in parts of instruments whose vibrators belong to the class of undampened sound sources. There, they indicate sounds produced by momentary excitation events, but interpreted in accordance with the acoustical facts, as long lasting, temporally continuous phenomena.

CONCLUSIONS

14. SYSTEM IN PENDERECKI'S SONORISM

The discovery and reconstruction of the sonoristic system sheds new light on the early output of Krzysztof Penderecki. Supplying one with the proper analytic tools, the system makes possible explanatory analysis of his individual pieces. As a further consequence, knowledge of the system allows one also to unravel the inner logic of the stylistic evolution recorded in those pieces, and elucidates the role of numerous, unusual devices related to their articulation and notation. Yet, the importance of the analyses contained in Part Two, as well as the theory behind them (elaborated in Part One of this book), does not confine itself to purely technical problematics. In reality, the implications of the foregoing discussion are much more far-reaching in that they compel one to formulate anew the aesthetics of the Polish composer, which were implicit in the early period of his musical output. Such reformulation is necessary because the presence of a strict, rigorous system calls into question the common view on the interrelations between sound matter, form, and expression in Krzysztof Penderecki's sonoristic style.

14.1. SYSTEM AND SOUND MATTER

If the conviction about the primacy of sound—commonly held by commentators thus far—is to be kept, it is only in the sheerly chronological sense. Undoubtedly, sound, conceived as primitive, unqualified acoustical matter, precedes the system, and hence plays in Penderecki's sonorism a role equivalent to the "primary matter" of Classical Greek philosophy. Still, such a concept of sound lies at the basis of any music whatsoever: it is thus nothing specific to Penderecki's sonoristic music. Instead, what constitutes a true characteristic trait of Krzysztof Penderecki's sonoristic style, is a unit of this primary sound matter that forms an axiom of his compositional system. Discussions in the previous chapters made it clear that, in contradistinction to all the remaining musical styles, whether traditional or "avant-garde", the axiom of Penderecki's sonorism is not a single sound, but the sound matter taken *en masse*. As pitch, loudness, timbre, and duration naturally qualify any single sound sensation, so also the categories of the sonoristic system form natural qualifications of the sound matter as it reveals itself to a listener in the global acoustical perception of vast sound sets. The natural character is vested mainly in the categories of the basic system, independent of the means of articulation; this agrees with the observation made in Chapter 10, that the basic system was gradually discovered or learned by the composer, rather than created by him *ex nihilo*. Also, the material categories of the timbre system are natural qualifications of sound colour, even if they are so only on the basis of traditional musical instruments assembled in the symphonic orchestra.

These remarks are quite unexpectedly—and in a very interesting way—confirmed by one of the earlier Polish critics, whose recognition of the compositional problematics connected with Penderecki's sonorism was till now undoubtedly the most apt. That critic is Tadeusz A. Zieliński, who in his 1966 article "Neue Klangästhetik" (New Aesthetic of Sound) pointed out that the aspects (*Elemente*) naturally relevant for music operating with sound masses, (that is, for *Klangflächenmusik*) are as follows:

> (1) sound color (often enriched by new means of articulation); (2) dynamics; (3) sound shape in time and space (its lenght, width, and thickness, organization of lines and bands, points, inflections and arabesques in various patterns); (4) motion and stasis (various means of motion, motion in three-dimensional space); (5) combination of simultaneous layers of sound; (6) integration and variability of sound image in the temporal course). (Zieliński 1966: 212)

It is hard not to notice how close this list comes to the set of categories included in the sonoristic system. No wonder that Zieliński finds the "elements" listed above as being most fully embodied in Penderecki's sonorism, even without being aware of the systemic character of the compositional operations related to them in this musical style, and that he consequently considers Penderecki's early pieces as "a rare example of a natural and consistent deducing of compositional principles from the employed material—without recourse to any *a priori* rules elaborated outside this material, an example of an ideal conformity of the material and construction" (1968: 74).

The natural character of the sonoristic system makes it such that, in turn, its categories are not only applicable to *Klangflächenmusik*, but can also form vectors of attention in the course of perceiving other musical pieces based upon the axiom of a single sound; the only proviso being that the more global sound qualities, such as timbre or texture, are already appreciated in them, as happens, for example, in late romanticism on the basis of the symphonic style. Such a perception—which, true enough, garbles the original compositional intentions—requires merely a change of attitude. In this respect, Penderecki's comment, in a highly interesting interview he granted Zieliński in 1963, proves very instructive:

> Try listening to some of Tchaikovsky's symphonies, putting aside its harmonic course and the concrete pitches of individual sounds, instead paying attention only to the development of the instrumental strains: their timbre, dynamics, register, duration of individual sounds, density and width within the compass of the score, types of figuration in the strings, etc. It will appear that this course is in itself very interesting, rich, and entirely consciously composed. As an artistic value of a piece, it sometimes even considerably surpasses the harmonic content—it suffices to compare it with the piano reduction alone. Naturally, in Tchaikovsky these things are still closely related to each other, and the manner of listening I have proposed to you is an artificial manipulation. Yet it allows one to realize that the habits of musical perception in terms of such global sound values have been growing for a long time, though initially basing themselves on strictly intervallic procedures. . . . For me, as a composer, this aspect of a composition, enriched with new sound values through new articulatory means, is the most essential. I can see here enough possibilities to abandon in many cases the intervallic processes. (Zieliński 1963: 9)

In the above passage, the shift from the level of interrelations between individual sounds to that of the global characteristics of their masses is described by the composer primarily to demonstrate the continuity between the historical course of Western music and his own artistic interest. At the same time, however, it is precisely this shift that lay at the origin of his sonoristic system. Having been applied by Penderecki to serial pieces, it transferred the focus of attention away from the complicated network of relations on their proper compositional level of individual sound phenomena (ruled by rows of dynamics, pitch, time, and touch), and onto the level of the resulting, overall pointillist texture, thereby leading him to the concept of the maximally heterogeneous sound field; this last, in turn, implied the polar, maximally homogeneous cluster, building in this way the nuclear opposition from which the basic system subsequently developed (see Chapter 10.1).

Yet, even though the unqualified sound matter *en masse* is chronologically prior to the sonoristic system, its very qualification by means of that system's categories is an intellectual moment. Therefore the reproach of a sensualistic attitude, which till now usually accompanied the conviction about the primacy of the sound matter in Penderecki's sonoristic style, must be avoided. Just as the fact that pitch, loudness, and duration constitute natural perceptual parameters of every single sound phenomenon does not yet in itself betoken a sensualism or a lack of intellectual rigour in musical systems based on them, so also the natural character of categories qualifying sound masses in Penderecki's sonorism does not testify to any anti-intellectualism in the compositional procedures employed by the Polish composer. On the contrary, his sonoristic system, arising by way of qualifying the rough sound matter *en masse* and in this sense being secondary in relation to it, in turn becomes primary with respect to several distinct states of this matter—segments—qualified by terms chosen from its component categories. This logical dependence is clearly exhibited in the morphology of the sonoristic system. In this light, it is thoroughly understandable why the composer cuts himself off so sharply from accusations of sensualism and even from the very name given to his early output:

> I hear endlessly that I am particularly interested in sound for itself, sonorism—and it is not true. Otherwise, the whole problem of sonorism has been *invented* by Polish musicology. ([Discussion] 1976: 31)

The validity of this pronouncement has already been confirmed in the conclusion of Part One, where it was demonstrated that the rich inventory of so-called "sound effects", till now the main argument in demonstrations of Penderecki's ostensibly sensualistic attitude, was in reality not freely invented by him, but constituted a manifestation of the sonoristic system, a manifestation that was indispensable for the system's practical articulation.

14.2. **SYSTEM AND FORM**

Consequently, it is also untenable to maintain that the sound material identified with the store of articulatory devices precedes the form of individual sonoristic pieces. Just the opposite: when starting to busy himself with a new composition, Penderecki cares first off about its formal outline. Only later does he fill that form with concrete sound phenomena, sometimes invented specially for its sake. Such a course of the compositional process—from the generally outlined musical form to the elaboration of its detailed sound content—was unequivocally emphasized by the composer in the broad description given during the Cracow seminar, quoted earlier at the beginning of Chapter 4. He also stresses this property of his compositional procedure in several other statements, such as the one published in the festival bulletin of the "Warsaw Autumn '87", where Penderecki says:

> I want at first to imagine the whole, before I start to think about details. I try to catch a shape of the composition, the entirety of the form, setting aside even the sounds. Starting with the composition, I search for the graphical shape, and often what proves correct as purely graphical notation becomes the nucleus of the musical form. (Penderecki 1987: 8-9)

The same thought is repeated seven years later, in an interview given to the student magazine *Vivo*:

> When writing, I endeavour to find a form, which I subsequently sketch in a purely graphical shape, of course, imagining some music. Yet, in the first stage the most important issue is to create a sensible whole, and not to deal with details. At the outset, what is most important is some logic of graphics and music. Sometimes the preliminary notation of a symphony takes one page. (Mroczek and Wilczek 1994: 26).

Obviously, for the composer who in the same interview calls writing music "a solitary intellectual activity consisting in operating an independent musical structure" (23), form is neither a resultant of sound fluctuation led by free artistic imagination nor a mere assembly of sound effects—the latter being hidden behind the concept of "extensive form" applied to Penderecki's sonorism by

Mieczysław Tomaszewski (1994: 9). On the contrary, as proven in the present book, the forms of Penderecki's sonoristic pieces are governed by the syntax of the basic and timbre systems, thereby displaying each time an inner logic, more specifically, the logic of oppositions— contrarieties or contradictions—characteristic of their individual categories.

Still, it would be a mistake to identify the form of a given sonoristic piece with its underlying system. Instead, from the viewpoint of the foregoing discussion the musical forms of Penderecki's sonorism are to be defined as results of several different strategies of a musical narration, elaborated on the ground of the sonoristic system, for the needs of individual musical texts, owing to the area of free compositional choices left by syntactical rules. Thus the coherence of the system does not in itself predetermine the equal coherence of every one of Penderecki's sonoristic pieces. As a matter of fact, in a book such as this one—which is concerned with reconstructing a compositional system conceived as a set of recurrent rules that are valid in any and all pieces within some definite body of work—a study of forms making for the idiolects of individual musical texts, and hence accounting for their mutual differences, lies outside the main scope of the investigation. Even so, the very reconstruction of the sonoristic system furnishes one with analytical tools by means of which the forms of Penderecki's sonoristic works can be examined and, consequently, the judgments regarding their artistic values justified.

As already stated, the only piece whose subsystem is identical with the fully developed state of the *langue* is *Polymophia*. At the same time, however, the limitations imposed upon its musical narration by double regulations concerning time-spans and registers (through two pairs of hierarchically linked categories—"temporal mobility vs. immobility" and "maximal vs. minimal time-span" as well as "extreme vs. middle register" and "high vs. low register") together with the sparing use of optional expressive features (which, except for sinusoidal glissandi, are here always subordinate to the system as articulations of their categories, thereby leading to a coincidence of systemic and expressive functions) bring about a simplicity and clarity of the musical narration that is not encountered in any other of Penderecki's sonoristic pieces. It is thus the clear-cut formal layout and high economy of articulatory resources, combined with the complexity of the underlying network of paradigmatic relations, which allows one to acknowledge *Polymorphia* to be the crowning artistic achievement of Krzysztof Penderecki in the early period of his musical output and the most classical of his sonoristic pieces. In this way, the result of the analysis confirms the opinions expressed earlier both by critics (Kaczyński 1963; Pociej 1980) and by the composer himself, who values *Polymorphia* even higher than the famous *Threnody*:

> *Threnody–To the Victims of Hiroshima* is much more popular than *Polymorphia* written in the same period. But, in my opinion, the latter is better than *Threnody*, which has gained a public because of its title. (Haegenbarth 1987: 3)

On the other hand, it obviously was not only the suggestive title that determined the great international success of *Threnody*. The fame of this composition, which immediately became "one of the most popular pieces of the contemporary music in general" (Erhardt 1975: 36), seems to have its main cause in the subsystem of the piece; that subsystem is quite modest, and hence characterized by a maximal number of redundancies between the basic system categories in comparison with subsystems of all the remaining sonoristic pieces. According to Leonard B. Meyer (1967: 282-3), such increased "compositional redundancy" is highly desirable, if the rules of any new musical style are to be apprehended by the audience and its subsequent learning by individual listeners is to take place.

The example of *Polymorphia* shows also that the form of an individual piece can be influenced by premises from outside the sonoristic system. Although its narration is governed very strictly by the syntax of both the basic and the timbre systems, the piece concludes completely unexpectedly with a C-major triad. This surprising conclusion, highly puzzling for commentators of Penderecki's sonoristic output, was usually considered by them to be a sort of "trick" betraying his musical sense of humor and thus, in all likelihood, added here through sheer caprice (see Schwinger 1989: 131). According to the composer's own words, however, it was exactly this final chord which stood at the beginning of the compositional process:

> I started from writing the final chord C major in the best sounding, classical disposition and endeavoured to build the successive elements in such a way as to make them lead towards it. For instance, the bar preceding the C major chord is a quarter-tone cluster arranged such that it requires resolution. It is thus not just any cluster in a location chosen at random. ([Discussion] 1976: 31)

The traditional character of the consonant chord is completely foreign to the whole preceding course of the musical narration—a course abounding with sharp dissonances—and is separated from it by means of a five seconds rest (the only general rest of the piece). This suggests that what one is dealing with here, is one more opposition, but this time an opposition concerning not perception, but rather the reception of music. This binary opposition can be termed "traditional vs. avant-garde". In this sense, the final chord does not exactly belong to the narration of the sonoristic piece. Rather, it is to be considered as a suffix of the form and its particular point, whereby the disturbance it brings to the syntactical logic within the trajectory "temporal continuity vs. discontinuity" (see the analysis in Chapter 8) is justified.

If the extra-systemic component of the strategy assumed for *Polymorphia* is still of a musical character, at another time it can stem from outside the realm of music, for example, from the fine arts. At the outset of his sonoristic period, in 1960, Penderecki wrote:

> I am looking for deeper interconnections between painting and music. . . . For me the most important issue is the problem of solving colours, colour concentration, as well as operating the texture and time. There are, for instance, paintings in which—through multifariousness—we achieve an impression of space and time. The task of music is to transplant all these elements of time and space, colour, and texture onto music. I have attempted to manage it in *Dimensions of Time and Silence*, taking as my point of departure the painting of Paul Klee. In his paintings there exist mathematical constructions of the interrelations between some sections, closed structures, which overlap according to principles of interpenetration. Each square possesses its own structure, its time and colour. My piece *Dimensions of Time and Silence* also consists of a dozen or so closed cells, which form in themselves separate wholes and are juxtaposed on the principle of imposition. (Hordyński 1960: 8)

Once again, Penderecki commented on the original version of *Dimensions* on the occasion of the work's first performance, in the program book of the "Warsaw Autumn" festival. There, however, apart from Klee, the composer mentioned also the inspiration he took from the painting of Yves Klein (see Erhardt 1975: 24). It is not entirely clear if both these influences were important only for the first, withdrawn version of *Dimensions*, or if they are preserved in the final shape of the piece. Moreover, Penderecki denies any connections between his remaining sonoristic pieces and theories of form in the pictorial art of Klee and Klein. In spite of this, it seems that Klee's idea of *carrés magiques* ('magic squares'), referred to in the above-quoted passage, may have supported the concept of the segment as the minimal syntactical unit of Penderecki's sonorism, which—like the squares, qualified by several features of colour and texture—is defined by terms chosen from among individual categories of the basic and the timbre systems. This hypothesis becomes more plausible if one notes that the relations of overlapping and interpenetration between individual squares, mentioned by Penderecki, are in line with the possible interrelations between temporal ranges of segments within the course of a musical narration. Also, the composer's sketches of sonoristic pieces are quite often strikingly similar to the drawings and paintings of Paul Klee.[1]

[1] A very interesting demonstration of these similarities was made by Regina Chłopicka, in a paper she presented at the conference on Polish contemporary music at the Music Academy in Cracow, 6-9 December 1995.

Thus the question of possible formal interconnections between Klee's painting and Penderecki's sonoristic music seems to be worthy of future investigation—as is, on the other hand, the problem of relations between the composer's sketches of individual sonoristic pieces and their summary charts given in this book.[2]

At any rate, it is beyond doubt that the main source of inspiration concerning the formal layout of Penderecki's sonoristic pieces is of a visual character. This much is attested to by the very existence of sketches. But the significance of visual inspiration can also be easily inferred from the composer's comments (quoted above), in which he stresses the crucial importance of the graphically shortened record of an overall construction in the early phase of composing a musical work, as well as the necessary conformity between the graphic and musical logic. Both these peculiarities of Penderecki's compositional procedures originate from the visual nature of his musical imagination, a nature that goes hand in hand with his talents in the fine arts:

> I have always had to draw the piece on paper, even if I was using a graphic notation, just in order to see what I compose. As a child, I drew a lot. I was even thinking of attending the Academy of Fine Arts. Therefore, 'to see' a piece is so important for me. To hear it, is only a secondary activity. (Janicka-Słysz 1993: 17)

What appears to exert a decisive influence upon Penderecki's formal thinking is, otherwise, not exactly painting, but rather architecture. As the subject of his academic dissertation, the composer chose the classical theory of architecture by Vitruvius. Also during his first stay in Italy at the turn of 1959 Penderecki, in own words, "devoted much more time to architecture than to music" (Haegenbarth 1987: 10). "Architecture has a strong effect upon my imagination", he admitted in one interview (Penderecki 1987: 9), and in another he added:

> In my opinion, architecture and music are very close to each other. What proves correct on the paper, in a sketch—for instance, proportions— proves correct also in music. I have started from the fine arts, drawn and painted. I am gifted also in these things. Therefore, when I had not yet had any musical experience, I drew my first pieces. First I sketched the construction, and only then filled it in with music. (Haegenbarth 1987: 8)

Characteristically, in the latter statement—bringing once again the description of Penderecki's compositional procedures, which returns like a refrain in so many of his other utterances—the function of sketches is highlighted as being comparable to architectural blueprints. Indeed, the formal thinking of Krzysztof Penderecki in his sonoristic period— and, most likely, in all his musical output—is of an architectural character. What matters here are the relations among sound masses and the tensions that spring from them, while the detailed sound "ornament" is apparently of secondary importance.

At first glance, it might seem that Penderecki's main interest in musical form, as claimed in the foregoing discussion, does not accord with the rather traditional formal solutions that earlier critics found in his sonoristic pieces. The composer himself wrote: "It is not hard to notice that my experiments quite rarely concern the structure or form of music" (Wasita 1966: 60). But this sprang from his conviction that some formal procedures (such as contrasts, evolution, dynamic tensions, climaxes, and relaxations) are common to all musical techniques. Asked by Zieliński about their role in his sonoristic pieces, Penderecki answered:

> They are features which—in my opinion—generally condition any genuine musical form. Also today there is no need to give them up in the name of some falsely conceived modernity, if they perfectly suit the new sound material. It does not in the least mean any transfer of old forms onto the new material; this material itself imposes on me exactly such a shaping, in a way which seems natural to me. (Zieliński 1963: 9)

[2] The sketches in question were not accessible to the author. They are now at the disposal of the publishing house Schott, which plans to publish them as a bibliographic edition.

The only traditional formal scheme to be found in some of Penderecki's sonoristic pieces is the arch-form (ABA), which, according to the composer, is "as old as music itself" ([Discussion] 1976: 31-32). Detected already by earlier investigators, in *Polymorphia*, *Anaklasis*, and *Threnody*, the traces of this scheme were considered by them to reflect the subconscious inclination of the human mind towards symmetrically closed forms. Such a view lurks behind the question raised by Marek Stachowski, a pupil of Penderecki, during the interesting discussion at the closure of the Cracow seminar: "Is it not so that in the subconscious of the composer there exist some, quite often perhaps even hidden . . . elementary formal archetypes?" "No, it is not a matter of the subconscious", replied Penderecki ([Discussion] 1976: 31).

As a matter of fact, the nucleus of an arch-form is contained in the very organization of the sonoristic system. Its syntax, which rules the musical narration and thereby delineates the area of possible manipulations concerning the form of a given sonoristic piece, causes every trajectory governed by an individual binary opposition to constitute a chain of several alternations between opposite terms—either immediately juxtaposed or separated by mediative terms. Each such alternation, consisting in a departure from one of the opposite terms and a return to it, can be treated already as a minimal arch-link (A-B-A). Provided it exhausts the whole course of a given trajectory, which happens in cases of categories operating on the highest hierarchical level of segmentation, such alternation produces the impression of an arch-form over the whole course of the musical narration. This is exactly the case in *Polymorphia*, where the trajectory "temporal mobility vs. immobility" begins from a negative term (1-34), then after a transition arrives at the positive term (37), and returns to the initial negative term in its closing section; this much can be easily discerned from the summary chart of the piece. Equally clear, "pendular" cycles of this sort can be observed in *Fluorescences* as regards "spatial mobility vs. immobility" and "temporal mobility vs. immobility". This is so even though, in the case of the latter category, the first occurrence of its negative term, which covers the expanded initial section of the piece (1-44), is temporarily disturbed by the positive term (19), after which the musical narration immediately returns to temporal immobility. What is even more decisive for the impression of arch-form in this piece—something unnoticed in any of its earlier analyses—is the cooperation of the two just-mentioned trajectories with the course of "temporal continuity vs. discontinuity". The result is that the section comprising paragraphs 94-100 constitutes an obvious equivalent of the initial passage 1-7, bringing back the unusual sound-generation processes and extra-musical tools employed there. From this point of view, the last two paragraphs of *Fluorescences* (101-102) form a sort of coda, which impression is also supported by the closural effect of the de-tuning double basses. In this light, it is understandable why the logic of the trajectory "temporal continuity vs. discontinuity" breaks down in this section (see the analysis in Chapter 8.6). As in the case of the final C-major chord of *Polymorphia*, here, too, the syntactical rules of the sonoristic system are deliberately abrogated by the composer for the sake of his artistic, that is to say, strategic purpose—the form of a given piece—even if normally this form is supposed to be elaborated on the basis of the system.

In both *Polymorphia* and *Fluorescences* an additional factor contributes to the impression of the arch-form. This factor resides in the timbre system, or more precisely, in the representation of the individual primary material categories within the set of sound sources at the composer's disposal in his sonoristic pieces. It has already been stated (Chapter 6) that, despite the introduction of new bodies used as vibrators and inciters in sound generation, the much-desired balance between the number of metal, wooden, and leather sound sources is significantly lopsided in favour of metal, a fact which appears to be of consequence for the assortment of material oppositions activated in the course of timbre trajectories (Chapter 10). Therefore, it is mostly metal that frames individual sonoristic pieces on the level of main materials, while wood and leather dominate only short passages in the central sections of those works. Such a course on the macrolevel of the timbre trajectory, rather than the opposition between strings and percussion, grounds the ABA form of

Anaklasis. The proportions between materials, in turn, are conditioned above all by the construction of traditional musical instruments. It is thus most likely in this sense that Penderecki intended the following statement: "already the very fact of employing the traditional instruments imposes upon us the dependence on some schemata long since elaborated, which it is difficult to get rid of even when using the newest compositional techniques" (Zieliński 1963: 8). Still, that Penderecki did succeed in getting rid of such schemata is evidenced by *Dimensions of Time and Silence*, String Quartet, and *Canon*. Those pieces are shaped so that they do not display similarity to any traditional formal designs.

The above remarks show that the influence of the sonoristic system on the strategies assumed for the sake of individual pieces, and thus for their forms, is even much more significant than it was at first stated. And, because the system itself arises naturally through qualification of the primary sound matter, the forms shaped according to its syntactical rules can also be called natural. This naturalness, which manifested itself in an ideal conformity between form, technique, and material, allowed Zieliński to compare Penderecki's sonorism with the classical style of eighteenth-century music: "This is no rhetorical comparison, for in both cases technique, form and aesthetic grow out of the material, and represent a stylistically uniform and complete whole" (1962: 318).

14.3. SYSTEM AND EXPRESSION

The logical primacy of form prejudges the inferior position of expression in the sonoristic aesthetics of Krzysztof Penderecki. The composer himself hinted at this indirectly in a TV interview with Alicja Resich-Modlińska, when voicing his scepticism towards musical expression as such: "Music cannot express anything. Of course, one can give some dedication or title, but that is it. Music is abstract and ideal, it boils down to structures and forms". Thus, in spite of the ardent conviction commonly held by many earlier commentators, it appears that expression in Penderecki's sonoristic pieces does not constitute the aim of his compositional procedures. Rather, the expression arises as a side-effect of strategies elaborated on the grounds of the basic and timbre systems. However, by this statement one does not at all intend to question the power of Penderecki's music to move the listener. Quite the contrary: as the ultimate consequence, the entire investigation undertaken in this book leads one to expose the source of the powerful expression as located in the music's underlying system based upon binary oppositions.

It is precisely the tensions between opposite terms which find their outlet in eruptions of energy loaded with expressive qualities. When Tomaszewski (1994: 10) treats the superposition of two arrows indicating the highest and lowest possible tones of given instruments as a symbol of the extremes that characterize Penderecki's expression, in reference to sonorism this metaphor can be taken literally, since shifts between opposite terms of the category "high vs. low register" are one of the basic tools employed by the composer in order to obtain impressive energetic effects. Based upon such shifts, combined with alternations of opposite terms of the category "loud vs. soft dynamics", are the initial and final passages of *Fluorescences* (1-7, 94-102) as well as extended parts of *Canon* (19-33, 78-89). Also the remaining categories of the basic system—such as "temporal mobility vs. immobility" or "spatial continuity vs. discontinuity"—contribute to the increased expressiveness, owing to the energies liberated from the collisions of their opposite terms. In reference to Penderecki's sonoristic style, "expression" is thus to be treated as the flip-side of "energy". The careful scrutiny of contexts, in which both of these notions occur in previous critiques of the early musical output of the Polish composer, reveals that they are really seen in a direct, mutual connection. For instance, the "pure expression", which Tomaszewski (1994: 98) found characteristic of sonorism, evidently constitutes, in his view, the human response to the "sound energy" (either "potential" or "kinetic") in Penderecki's pieces of this period (9). In turn, the elementary character of the sonoristic expression is, according to the same author, a result of the "exploration of the elementary forces of sound" (9) which are to be seen, from the viewpoint of the reconstructed sonoristic system, as originating in the elementary categories set up by binary oppositions and qualifying the sound matter *en masse*.

Of course, the composer accepts the emotional responses of listeners to his sonoristic pieces. In one of his numerous interviews, he says: "I have nothing against it, when one treats my music as a 'confession'. In this respect I am a romantic" (quoted by Erhardt 1975: 89). But this very declaration testifies that, for Penderecki, the expression is a secondary issue. Just as he—as an artist—cannot be called a sensualist, neither is he an expressionist. Instead, all the evidence suggests that the sonoristic style of Krzysztof Penderecki was first of all an intellectual adventure.

15. PENDERECKI'S SONORISM IN THE LANDSCAPE OF CONTEMPORARY MUSIC

The conclusion of the previous chapter leads to a critical revision of the place granted thus far to Penderecki's sonorism among the multiple musical tendencies of the time. This concerns first of all its relation towards serialism.

Undoubtedly, the sonoristic style inaugurated by Krzysztof Penderecki in 1960 constituted a rejoinder to the hegemony of serialism, which was so predominant in the preceding decade as to almost be considered the very measure of avant-garde music. In the TV interview mentioned earlier, the composer expressed it unequivocally: "What I wrote in the early 1960s, was written to spite the contemporary avant-garde, chiefly the Darmstadt school". From all the foregoing discussions, however, it is evident that the contrast between serialism and Penderecki's sonorism lies not at all in the highly refined intellectual attitude of the former method, manifested in its strict compositional technique, and in the lack of any technical discipline, which supposedly testified to the anti-intellectualism of the latter. Rather, the contrast between the two methods lies elsewhere, in the different applications of equally strict compositional systems: Whereas in serial composition the systemic order rules relationships between single sounds, in Penderecki's sonoristic works the system, comprising basic and timbre regulations, governs distinct states of the sound matter taken *en masse*. The contrast thus appears to reside in the character of sound units assumed as axioms in serial and sonoristic musical thinking and, consequently, in proper levels of the compositional operations fixed by them.

In this context, it is interesting to note a rather ironic similarity: although on two different levels, both the serialism of the Darmstadt school and Penderecki's sonoristic style lead equally towards unification of all sound parameters in respect of their internal organization. Of course this aim is accomplished in opposite ways, which further sharpens the contrast between these two compositional methods. As is known, in serial technique all four parameters of sound perception are organized by means of discrete scales of values, which form the bases for building rows. Thus here discreteness (discontinuity) becomes, at least intentionally, attributed not only to pitch and duration, as the primary pattern-forming parameters, but also to dynamics and timbre (or sound colour) a patterning of which is never possible because of their normally "continuous" nature (see Meyer L. B. 1967: 247-48). By contrast, the organization of pitch, time, and loudness imposed by the basic system categories of Penderecki's sonorism is devoid of any concept of discontinuity. As demonstrated in Chapter 5 and deducible from the geometrical models of the elementary categories given there, the individual terms of the categories are represented not by separate points, but by intervals which are each time indicated within the continuous axes of real numbers and, what is more, form their fuzzy subsets. In this way, the discrete scale of values is eliminated not only from dynamics, but also from pitch and duration, whereby exact relations concerning the two latter perceptual parameters—giving out, respectively, intervals and rhythm—are not structural here, even if otherwise they are akin to such a structuration, owing to natural properties of human hearing. That Penderecki was perfectly aware of this difference between his own compositional system (characterized by the tendency towards continuity) and the technical premises of serialism (founded on the discontinuous organization of sound parameters) is testified to by one of his remarks:

> As regards the Darmstadt school, in fact I have never had any tangential points with it. The difference between its representatives and me can be—in my opinion—defined in this way: that they are mainly interested in points, while I am [interested] in lines. (quoted by Erhardt 1975: 13)

Here, lines should be understood as sections—intervals in the spaces of individual parameters proper for categories of the basic system.

In the light of the above remarks, one may say that Krzysztof Penderecki's sonorism vies with serialism, in bringing its own, competitively rigorous compositional system. Even though in his youth Penderecki took passing interest in the music of such composers as Boulez or Stockhausen, his own sonoristic output constitutes a scathing critique of the "false attitude towards the very problem of artistic creation", which he found to lie at the basis of the Darmstadt style ([Discussion] 1976: 29), whereby elements of the serial technique are here brought down to the level of subsegmental regulations. Seen from this angle, the nuclear opposition between the optimally pointillist texture characteristic of serialism and the optimal sonoristic cluster at the foundation of Penderecki's basic system (Chapter 10.1) assumes the proportions of a symbol.

Clearly, in his opposition to serialism, Penderecki goes considerably further than the remaining representatives of *Klangflächenmusik*, such as Ligeti, Xenakis, and Lutosławski. In the works of the latter composers, even though the syntactical units are sound fields, the axiom of musical thinking that fixes the proper level of compositional operations remains a single sound. As regards Ligeti, the procedures carried out on this level lead to carefully elaborated, micro-sonic webs of interrelations, which characterize such of his pieces as *Apparitions* and *Atmosphères*. In the "stochastic music" of Xenakis, the desired global character of a "sound cloud" or "galaxy" is achieved by mathematical operations that determine the place of each particular sound. The complexity of such operations ultimately led the composer to enlist the help of a computer. Lutosławski keeps his sound blocks under strict harmonic control by means of chords containing up to twelve definite pitches, assigned to fixed places in individual octaves. As one can see, even though the compositional systems employed by Xenakis, Ligeti, and Lutosławski differ, those systems have in common the fact that the character of a given set of sounds is qualified here "from inside", so to speak, through micro-relations between component sounds. In the case of Penderecki's music, however, the qualification of sound fields (segments) is made "from outside", in terms of individual categories of the basic and timbre systems. Thus in Penderecki's sonoristic music the sound content does not exactly determine the character of the sound field, but rather the features of the sound field predetermine the possible relations between sounds on the strength of the dependencies between features of segments and of their individual components (discussed at the beginning of Chapter 6). The result is that the opposition between Penderecki's sonoristic style and sound-mass music of non-sonoristic origin should be retained, though for reasons different than those usually adduced in the handbooks of music history. As a further consequence, the conformance in Penderecki's sonorism, between the axiomatic concept of sound matter on the one hand and the elementary syntactical unit on the other, elicits a coherence between the morphology and the syntax of his compositional system: the syntax forms practically a prolongation of paradigmatic relations, governed by the morphology, on the syntagmatic axis of time in the course of a musical narration. By contrast, the strict regulations of the systems elaborated by Lutosławski, Ligeti, and Xenakis concern only the morphology (that is, how individual sound fields are created), whereas the succession of such fields and their relations within the formal design of a piece are regulated (if at all) by separate rules of a comparatively looser character.

This fundamental difference provides one with an additional argument against the (sometimes suggested) influence allegedly exerted by Ligeti and Xenakis, as the Western representatives of sound-mass music, on Penderecki in his early, sonoristic period. Besides that, such an influence was not even technically possible, since in the years when Penderecki was writing his first, sensationally revealing works, the scores of Xenakis were entirely unknown in Poland; and Ligeti, though ten years older than Penderecki, started his career at the same time as the Polish composer (see Erhardt 1975: 12). On this point, it is also worthwhile to quote the highly critical utterance made by the Polish composer, regarding the style of Xenakis, with an obvious allusion to *Metastasis*:

> I don't like Xenakis's music. The only thing he can do is to turn round several sorts of glissandi. . . . Without imagination. . . . He has told people right and left that I am his spiritual pupil. But it is not true. When we met, I had a talk with him and explained to him that he was wrong about me. (quoted by Erhardt 1975: 13)

Nor can one speak of influence on Penderecki from his great compatriot and senior by 20 years, Witold Lutosławski, whose original technique of so-called "controlled aleatorism" was employed for the first time only in *Venetian Games* (1961). Thus the similarity between repetitive models occurring in that piece, in the parts of individual instruments, and textural models observed on the subsegmental level of Penderecki's sonoristic scores must be seen as pure coincidence. Otherwise, for the perspicuous listener, the thorough stylistic independence from the music of Ligeti or Lutosławski is apparent from the very first aural contact with the sonoristic pieces of Krzysztof Penderecki—operating with a "thick line" (Tomaszewski 1994: 12), without attentiveness toward details or exquisite sound nuances.

The whole discussion to this point proves that the sonoristic style of Krzysztof Penderecki stands out in high relief on the general landscape of contemporary music. This statement holds valid also as regards its position in Polish music. Though in terms of sound effects and instrumental techniques the other Polish sonorists have occasionally come quite close to Penderecki's style, any regulations comparable to those of the basic or timbre systems, discussed above, are not found in the sonoristic scores of Kotoński, Szalonek, and Górecki, nor in pieces of the next, younger generation of composers. It thus appears that the stylistic difference between the sonorism of Penderecki and that of its remaining representatives—the origins of which difference have been located hitherto mainly in preferences for different instrumental groups—lies rather in the presence or absence of an underlying compositional method. One may put it in terms applied to music for the first time by Krzysztof Baculewski (1987: 140): the followers of Penderecki referred merely to the "phenotype" of his sonoristic pieces (i.e., to the level of sound effects), while they neither recognized nor employed the "genotype" of his music—the sonoristic system. As a result, the relation of their sonorisms to the sonoristic style of Krzysztof Penderecki is analogous to that between the pointillist style without serial regulations and serialism proper.

Clearly, the isolated position of Penderecki's sonorism among the currents of the Western avant-garde, as well as new trends in Polish music, originates in the system reconstructed in this book. Let us repeat: the sonoristic system is radically different from known compositional techniques that preceded it, in its being founded on the axiom of sound matter *en masse* and on the continuous, "graded gamut" of sound parameters. From this viewpoint, the question is all the more puzzling, as to what possible inspiration led the composer to elaborate such a unique system. As far as one can guess, a source of inspiration in this respect may have been his experiences with the electronic music. Penderecki himself stresses the importance of "hundreds of hours" spent in the Experimental Studio of Polish Radio at the end of the 1950s (Janicka-Słysz 1993: 17), when saying: "The new world of electronics has influenced the shape of my output in the 1960s" (Mroczek and Wilczek 1994: 24).

So far, Penderecki's experiences in the electronic studio have been acknowledged as pertinent merely for the inventory of sound effects in his sonoristic pieces. On this view, the composer "heard there [in the electronic studio] sounds he could not hear in nature. In *Anakasis* and particularly in *Threnody*, he has transposed consciously the synthetic sounds, heard and created by himself, onto entirely traditional instruments—strings" (Ćwiklinski and Ziarno 1993: 10). However, it seems that the import of Penderecki's experiments with electroacoustic equipment does not confine itself to this surface level. In particular, the capabilities of synthetic sound generators might have directed the composer to the concept, axiomatic for his sonorism, of sound matter *en masse*, the instantiation of which constitutes white noise. Also, several categories of the basic system show the influence of musical images which could be easiest realized by electronic means. These are the categories of "spatial continuity vs. discontinuity" and "temporal continuity vs. discontinuity", whose positive terms in their strictly acoustical sense are accessible only as properties of synthetically generated sounds. This has been indicated already by Pierre Boulez, who stressed that the auditive similarity between a cluster and a coloured noise is deceptive since, in fact, the vertical continuity of the latter is never fully accomplished in the former. In Boulez's opinion, the same may also be said of glissando as a change of frequency that aims to provide continuity in the diagonal dimension:

> I have till now [in this contribution] dealt only with complexes of simple intervals; to be comprehensive, I must indicate exactly how these intervals are integrated. They give us, so to speak, sound-surfaces that either really employ the continuum of possible frequencies, or rather—by way of an accumulation of all intervallic units within a given range—produce an (otherwise quite rough) approximation of this continnum. These latter are: the cluster in the vertical dimension, and glissandi in the diagonal dimension. (Boulez 1963: 37; quoted by Müller 1974: 217)

In his book *Musikdenken heute* (*Musical Thought Today*), published in 1963, Boulez seizes this opportunity to argue against *Klangflächenmusik*, including the sonoristic style of Krzysztof Penderecki. Yet Boulez's argumentation is based on a misunderstanding since, as stated in Chapter 5, the approximation of continuity achieved in such phenomena as clusters and glissandi, as well as the approximation of horizontal continuity in sustained sounds played on traditional instruments, is quite sufficient to give the listener the impression or illusion of continuity.

Certainly, the similarities between Penderecki's sonorism and electronic music deserve further investigation. Conversely, what obviously sets Penderecki's sonorism apart from contemporary music for tape, is the transposition of concepts that arose in the electronic studio into the concert halls, and the realization of those concepts by means of traditional orchestral resources. Such transposition fell in line with Penderecki's conviction that instrumental music should not be abandoned, but rather expanded through new techniques of playing as well as by rationally employed, non-musical tools. Accordingly, "detachment from the tradition and experiences of instrumental music" was Penderecki's main objection to the work of the Italian futurists (Zieliński 1963: 9). Even so, in his remarks on Luigi Russolo's experiments with "noise generators" (*intonarumori*), it is not hard to detect a dash of hidden sympathy. Indeed, if Penderecki's sonorism is to be compared with any twentieth-century musical trend, its force and radicalism make it closest to futuristic *bruitisme*, or noise music, whose aim was not merely to unleash the elements of sound, but—and one too often forgets this—to put them into a specific *rumorarmonio*, 'harmony of noises'.

16. PERIODISATION OF PENDERECKI'S OUTPUT

16.1. PRE-SONORISM (1956-59)

The sonoristic system also provides one with a precise criterion enabling the proper periodisation of Krzysztof Penderecki's musical output. Because his earliest pieces do not display traits of either the basic or the timbre system, they are to be univocally excluded beyond the reach of the sonoristic style and, as has been done in the course of this book, to be considered to represent the pre-sonoristic period of Penderecki's artistic evolution, even if some of them contain sound effects that later on became characteristic of sonorism. The pre-sonoristic period thus embraces not only the exercises and study pieces subsequently withdrawn by the composer, such as *Sonata* for violin and piano (1953), *Two Songs* (1955/8), and the youthful *String Quartet* (1956-57), but also includes two cycles of *Miniatures* —for clarinet and piano (1956) and for violin and piano (1959)— which still appear in the catalogue of Penderecki's works, as well as three pieces mentioned several times in earlier discussions: *Psalms of David*, *Strophes*, and *Emanations*. Each of these latter works that first brought fame and prizes to the young composer, exhibited various stylistic influences: The *Psalms* were inspired by the music of Carl Orff and the late Stravinsky. *Strophes* testifies to the composer's short-lived interest in serialism, chiefly that of Boulez's *Improvisations sur Mallarmé*. *Emanations*, in turn, shows the influence of the music of Luigi Nono, whom Penderecki met in 1959. These three pieces doubtless constitute substantial artistic achievements. Yet they are considered by the composer himself as a summary of the youthful, "puppyish" period in which his musical language was only starting to crystallize (see Ćwikliński and Ziarno 1993: 61).

16.2. SONORISTIC PERIOD PROPER (1960-62)

In the early sonoristic pieces, a crucial change of compositional technique took place. Those pieces depart from the style of the pre-sonoristic works, not merely through their break with tradition, but to an even greater extent through their separation from influences of the Western avant-garde. This change was summed up years later by the composer:

> Being a young composer, I started by destroying everything I came across. Happily, I even managed to do it almost in one piece. In *Threnody* or *Anaklasis* I threw off everything I had learned in the area of harmony, counterpoint, orchestration, and instrumental technique, yea—even notation. (Grzenkowicz 1981: 12)

Besides *Anaklasis* and *Threnody*, the musical output of this period includes *Dimensions of Time and Silence*, String Quartet No. 1, *Polymorphia*, *Fluorescences*, and *Canon*. In all these pieces both the basic and the timbre systems are operative. The only exception in this respect is *Threnody*, where the timbre system does not operate because of insufficiently developed articulatory resources.

The question remains as to the regulative role of the sonoristic system in *Fonogrammi* (1961) and *Psalmus 1961*. The latter piece, designed for tape, is the only example of *musique concrète* in Penderecki's output; the electronically processed sounds in it are of a vocal character (Erhardt 1975: 30; Rychlik 1983; Zieliński 1961). Thus, even without detailed analysis, one can surmise that in *Psalmus* the timbre system probably is not operative, since its elementary structures are geared to the capabilities of a traditional orchestra.

Initial phase

The initial phase of Penderecki's sonoristic period can be delineated by the earliest four of the seven pieces investigated in this book: *Anaklasis*, *Threnody*, *Dimensions*, and the String Quartet. This (sub)periodisation is supported by Wolfram Schwinger, whose primary criterion was chronology (1989: 136). Yet in the light of the analyses in Chapter 8, and the subsequent comparison of analytic results, such a delineation also finds its justification in the evolution of the sonoristic system. As is clear from the "evolutionary tree" given in Figure 72, all four pieces under discussion remain under the influence of the "nuclear opposition" from which the categories of the basic system gradually develop. This influence is indicated by numerous intercategorial redundancies that characterize their subsystems, some of which—the total ones—elicit the general oppositions comprising two or even three elementary categories. In all four pieces, moreover, the standing articulatory definition of "temporal continuity vs. discontinuity" is the preliminary one, expanding the positive term of this category to include the quickest possible repetitions of sound phenomena that otherwise represent its border-zone term.

The evolution of the system is accompanied by a parallel evolution of articulatory resources in orchestration, instrumental techniques, and texture. Thus, in the initial phase of Penderecki's sonorism, articulation is not yet stabilized, and individual pieces bring several new inventions. As a consequence, the sonoristic notation, too, is still in a state of growth. The composer tries several experimental solutions, mainly concerning temporal organization. Also characteristic of the pieces included in the first phase of the sonoristic period, is the comparatively large scope and the complexity of subsegmental regulations. It is precisely in *Threnody*, *Anaklasis*, *Dimensions*, and the String Quartet where one finds the most impressive examples of compositional operations on the level of individual sounds—all of them to be interpreted as relics of optimally pointillist texture constituting a term of the "nuclear opposition". The attention paid to the subsegmental level of compositions results in the fact that, within expanded sound fields, the expressive features are employed mainly in order to differentiate single sound phenomena.

Interestingly, a careful comparison of the early sonoristic pieces—one focused on the evolution of the system, articulation, and notation—shows that they cannot be put into any chronological order. This is clear already from Figure 72. The figure shows that *Dimensions of Time and Silence* logically comes after the String Quartet, in that the subsystem of the former work already contains the opposition "high vs. low register". At the same time, however, *Dimensions* precedes the String Quartet in consideration of the categories "temporal mobility vs. immobility" and "spatial mobility vs. immobility", which are here still fused together and form the general opposition "mobility vs. immobility". In turn, *Threnody*, which should be acknowledged as the first of the sonoristic pieces because of its most rudimentary subsystem, already contains processes of sound generation (e.g., tapping the upper sound board and bowing the bridge) which were not yet found in *Anaklasis*. Further, the notation of the former is already free of the redundancies found in the score of the latter. These phenomena, as well as several others that can be observed in comparisons of *Anaklasis*, *Threnody*, *Dimensions* and Quartet, can be explained by the fact that all of those pieces were created at almost the same time. Thus, in the early phase of Penderecki's sonoristic period, ideas that record the consecutive stages in the evolution of his compositional technique intermingle in different, simultaneously composed pieces.

Still, although differently situated on the "evolutionary tree", the early sonoristic works share a common peculiarity in their musical narration. In those works, individual segments are mainly juxtaposed according to a law of interpenetration that resembles the tape-splicing process in certain film-editing techniques. The predominant type of interrelation between temporal ranges of segments is thus that of "softened" overlapping, which can be easily read out of the summary charts of pieces, given in Chapter 8. If in *Dimensions* such interpenetration is influenced mainly by theoretical premises concerning visual forms, which were taken over by Penderecki from the painting of Paul Klee, in the remaining pieces it already constitutes a purely musical technique. Otherwise, interpenetration complements here the predominant strategy of evolution. This last describes the fact that adjacent segments are rather similar; that is, they display a comparatively high degree of kinship in the network of paradigmatic relations set up by the categories of the sonoristic system. As a result, the narration in the four pieces mentioned above is usually quite fluid and smooth, and only rarely disturbed by sharp contrasts. This stylistic description suggests that it is here, in the early phase of sonorism, where also *Psalmus* and *Fonogrammi* should be included.

Mature phase

In turn, the mature phase of the sonoristic period proper, comprising *Polymorphia*, *Fluorescences*, and *Canon*, is characterized not only by a fully developed system of elementary categories, but also by a clear-cut formal layout. In such a layout, contrasting segments follow each other successively, so that their ranges are as a rule separated. Even in cases of overlapping, interpenetrations occur quite rarely, because the intensity of segments is usually constant; that is, they neither emerge nor decay gradually. The ultimate shape taken here by the sonoristic system stabilizes in advance the inventory of articulations of the three later pieces. The importance of subsegmental regulations decreases, and the character of those which can be found—exclusively in *Polymorphia* and *Fluorescences*—is considerably changed. What predominates now are not quasi-serial or mathematical procedures, but textural models repeated many times in the parts of individual instruments, as well as subsegmental regulations concerning sounds that occur simultaneously within clusters. The time notation of *Polymorphia* and *Fluorescences* is also the most economical, consisting of paragraphs and (when necessary) given more precisely, by means of a second chart.

Even so, *Polymorphia* and *Fluorescences* are quite different in many respects. The former, scored for strings only, is the most "classical" of Penderecki's sonoristic pieces, characterized by very sparing use of articulatory resources and simplicity of formal design. In contrast, *Fluorescences* (apart from *Dimensions*) constitutes his most complicated and extended work: "disheveled" in its narrative trajectory, and containing numerous expressive effects of an optional character. These last are, moreover, represented here by articulatory phenomena that otherwise perform a systemic function on the grounds of the fully developed basic system of this piece. The huge set of performing forces called for by the composer results from his discarding the intentional interpretation of duration vested in the sounds of undampened vibrators. To be in agreement with acoustical realities, the composer does not shrink from employing non-musical tools such as a typewriter, saws, and files—even at the risk of the scandal they caused at the first performance. In this sense *Fluorescences* really deserves the name of *ein Werk ohne Pardon* ('an unpardonable work') given it by Penderecki himself in the program notes of the Donaueschinger Musiktage.

Penderecki's arrival at the ultimate stage of the basic-system evolution, in pieces of the mature phase of his sonoristic period, was to mark the turning point in his artistic career. The fundamental demand of the avant-garde, a demand shared by the Polish composer, was that of novelty. The front-line artists of the time were dissatisfied with any ideas that had already been put to use in concrete works, and they searched endlessly for newer and newer technical realizations. Meanwhile, the result of the petrifaction of the sonoristic system in its fully developed state—inevitable after Polymorphia and Fluorescences—was that the subsystems of any subsequent pieces would be identical. "One cannot write the same piece all one's life", said Penderecki, fifteen years later; and he added: "it would be too easy" (Chłopicka 1978: 74).

> If I spent my life duplicating *Threnody* or the First String Quartet, that would be funny, ridiculous, but also deplorable. (Haegenbarth 1987: 8)

Evidently, the sonoristic system, as an original compositional method, interested Penderecki only while it was being discovered. Fully unpacked and mastered, the system seemed to have exhausted its possibilities, and thereby lost its hold on the artistic imagination of the composer.

At first, an attempt of a further exploration of the sonoristic technique was undertaken through transferring the focus of attention away from the inner organization of the sonoristic system itself, and onto strategies (predicted by the system) of musical narration. An experiment in this respect was *Canon*—the only one of Penderecki's sonoristic pieces in which the main compositional problematics concern the mutual relations of several, parallel narrative threads. The result was a particular case of "polyphony"—"a three-layer, stereophonically treated, canonic form", as the composer put it in his commentary on the piece (quoted by Erhardt 1975: 44). This polyphony was constructed by means of contrapuntal procedures used by the Netherlander schools. Here, however, those procedures were applied not to individual parts or voices, but to chains of segments, conceived as layers and performed by large groups of instruments. In the interview given to Zieliński, Penderecki explained:

> As a matter of fact, they are not polyphonic devices, since in my pieces there is no polyphonic texture. What is submitted here to imitation or retrogradation are layers and not melodic lines. These devices were first used, true, in polyphony, and what is more, in non-instrumental polyphony; but their significance is broader—they can be employed anywhere a succession of phenomena in time is involved. (Zieliński 1963: 9)

The technical realisation of this idea required two tape-recorders. In turn, as pointed out in Chapter 13, the synchronization of tapes with the orchestra led to real-time notation (a second-chart), which was otherwise relinquished by the composer after the String Quartet. The consequence of such a notation was, on the one hand, the lack of any subsegmental regulations in *Canon*; on the other hand, limitations arose as to segment-shaping procedures. This was probably why Penderecki found this direction in compositional method to be unfit for future use. Otherwise, it is noteworthy that, in the stereophonic positioning of its sound layers, *Canon* refers clearly to the earlier *Emanations*; where two string orchestras were required to be positioned properly on stage, such that the direction from which individual sounds came could be controlled. Both of these experiments—occurring, respectively, towards the ends of the pre-sonoristic and sonoristic periods, and thus at the turning points of Penderecki's early output—suggest that originally the composer scented some artistic possibilities in the regulation of musical space, understood in a sheerly physical manner, as the area of the stage or concert hall. Eventually, and in both cases, Penderecki abandoned this path.

16.3. **CHORAL WORKS**

The real change in the musical output of Krzysztof Penderecki did not occur until after *Canon*. The composer who had hitherto believed that "what will matter in 100 years is only the new", realized that "one cannot start music from the beginning, one can only continue" (Penderecki 1987: 8, 9).

> Think—is it practically possible to detach oneself from the whole of music history and to create a system of entirely new laws, without employing the achievements of earlier periods? Is there any generation of such an enormous creative potential? Perhaps each compositional generation, beginning with romanticism, dreams about it. But subsequently it always appears that the revolution was only partial, because we are too weighted-down with the huge ballast of habits, which let us hear from them even during our boldest explorations. (Zieliński 1963: 8)

The above statement was made by Penderecki in 1963, during the interview he granted to Tadeusz A. Zieliński, for the Swedish magazine *Nutida Musik* and soon after he wrote his *Stabat Mater* for unaccompanied chorus.

Characteristically, the proper sonoristic period is represented almost exclusively by instrumental pieces. Even if *Dimensions* included a mixed chorus, still the composer, in his own words, "employed it as a percussion instrument" (Hordyński 1960: 4). It is thus senseless to number this piece among "choral works and oratorios", as does Wolfram Schwinger. The division of Penderecki's early output into vocal and instrumental pieces, a division commonly maintained by earlier commentators, is to be retained, but with one caveat: the crucial point for defining a vocal work is not its being designed for a vocal ensemble, but rather the presence or absence of a sung literary text. In this respect, the exclusion of the Latin "magic square" from the second version of *Dimensions* is highly significant.

The instrumental (sonoristic) stream of Penderecki's output flows from pre-sonoristic pieces in which the idiom of instrumental music is particularly heightened, that is, from *Emanations* and *Strophes*. This statement, which is not at all new, finds its justification in the fact that those pieces contain numerous experiments in the area of instrumental technique. Originally inspired by the composer's preference for opalescent sound-colours, those experiments became a point of departure for his rigorously elaborated timbre system. In turn, the basic system, employed subsequently in the sonoristic pieces, arose through Penderecki's opposing to the pointillist texture of *Emanations* and *Strophes* the optimally homogeneous texture of the cluster. At first glance it might seem that putting *Strophes* at the origin of sonorism is improper, since this piece contains verbal texts in the singing and speaking parts. These texts, however, are in languages unknown by the average listener (Greek, Persian, and Hebrew), and are juxtaposed "on the principle not of meaning, but of timbre"; thus here the composer exploits merely the "sonalistic" (*sonalistyczne*) qualities of the texts, without paying attention to their semantic value (Hordyński 1960: 4). In contrast, *Stabat Mater* (1963) refers obviously to the *Psalms of David* (1958), in that it forms a real setting of the Latin text, one that preserves intelligibility of the words and thus enhances their literary content.

16.4. **PASSION**

Though composed at first as an independent piece, *Stabat Mater* subsequently found its place within the framework of a larger whole—the famous *St Luke Passion* (1963-66). Even so, it would be a mistake to consider the latter work, commonly acknowledged as one of Penderecki's greatest masterpieces, to be a simple extension of vocal-music experimentation. Rather, the prominence of the *Passion* in Penderecki's early artistic evolution springs from its being the place where the two streams of his earlier output meet: vocal writing based on twelve-tone thought, and instrumental writing based on the sonoristic system. These form two distinct planes of this vast musical project. The latter is employed in sections of the Gospel text that depict dramatic action; the former, in the settings of hymns, Psalms, and sequences constituting the contemplative, liturgical comments to the events of Good Friday.

The first performance of the *St Luke Passion* in Münster, 30 March 1966, brought the composer not only the admiration of the public, but also sharp attacks, from reviewers who accused him of abandoning the quest for novelty and, thus, betraying the ideals of the avant-garde. In answer to this accusation, Penderecki replied: "It is not I who have betrayed the avant-garde, but the avant-garde . . . who have betrayed music" (Sobański 1974: 6).

16.5. **LATE SONORISM (1963-73)**

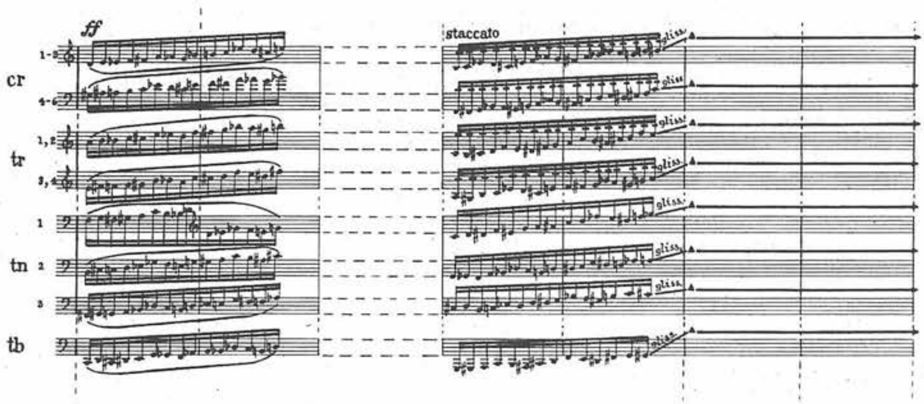
If in the *Passion* both compositional techniques—sonoristic and twelve-tone—existed side by side, they fused together in works composed at about the same time and subsequently. This fusion of techniques gave rise to the period that can be called the late sonoristic style (in contradistinction to sonorism proper, the primary focus of the present study). The late sonorism thus contains both instrumental and vocal works. Among the instrumental works of this period one finds *De natura sonoris no. 1* (1966) and *no. 2* (1970), *Sonata* for cello and orchestra (1964), *Capriccio* for oboe and strings (1965), *Capriccio* for violin and orchestra (1967), *Partita* for harpsichord and instrumental ensemble (1971-2), and the First Symphony (1972-73). Vocal pieces of the time include Penderecki's opera *The Devils of Loudun* (1968-69) as well as these extended oratorios: *Dies irae* (1967), the diptych *Utrenia*, consisting of *The Entombment of Christ* (1969-70) and *The Resurrection* (1970-71), *Cosmogony* (1970), *Canticum canticorum* (1970-73), and the *Magnificat* (1973-74). The unity in compositional technique of the vocal and instrumental music in this period is explained by the fact that, according to Penderecki, most of the instrumental pieces listed above came about as "spin-offs" from the large vocal works:

> Usually, when writing a large work, I also write a little piece. I compose it of elements which I have cast off, and which do not enter the large piece. . . . When writing *Passion*, I wrote *De natura sonoris no. 1*, and [while composing] *Utrenia* [I also composed] *De natura sonoris no. 2*. . . . When writing *The Devils*, I wrote *Capriccio* for violin and orchestra, which is easily recognizable in the *buffo* scenes. (Stachowski 1978: 62)

On the other hand, in one interview Penderecki mentions an opposite procedure, which influences the manner in which the vocal and instrumental works of his late sonorism are interrelated: "Often on the basis of instrumental music I elaborate some sound structures or forms, which I subsequently transfer to vocal music and develop further" (Grzenkowicz 1981: 1).

The fusion of the sonoristic system with the twelve-tone technique (the latter never employed in an orthodox way) caused a considerable change in compositional procedures in the late sonoristic style. In sonorism proper, subsegmental regulations governing relationships between individual sounds are rather occasional, and never embrace the entire musical narration of a given piece. Now, however, they literally permeate segments, so that the operations made by the composer proceed equally on the segmental and subsegmental level. This much can be easily ascertained from the scores. Glissando, which constitutes one of the most important textural effects in the early sonoristic pieces, here is often replaced by very quick passages; these last are evidently influenced by twelve-tone thinking, in as much as they use all twelve tones of the chromatic scale and preserve the rule of non-repetition of notes within a row.

Example 71: *De natura sonoris no.1*, 6



Much more often than before, clusters are replaced by dense, cluster-like structures, whose pitches, though indiscernible individually, are nevertheless carefully written out in vertical arrangements, in which the distances between neighbouring pitches are varied. Although the component tones of such structures are usually assigned to different octaves, their sum, as a rule, again totals to all twelve chromatic tones. Even vibrati are superseded by wavy, *legato* figures consisting of semi- and quarter-tones that oscillate round a central pitch; such figuration can be found in the String Quartet No. 2:

Example 72: String Quartet No. 2, pages 4-5

All these phenomena, in turn, have a significant impact on the notation. In late sonoristic pieces the notation becomes much more traditional, with staff- and bar-lines. Commentators have noted that this change in the appearance of his scores took place at the end of the 1960s, when the composer started to conduct his own pieces. In their opinion, the return to simplified notation—the elimination of graphic signs and the reintroduction of traditional notes—came about for the purely practical reason of making conducting and performance easier. In light of the above discussion, however, it turns out that the precise notation of pitch and time in the late sonoristic pieces was mainly the result of a change in compositional technique. This conclusion is fully confirmed by Krzysztof Penderecki himself, in a statement made during the Cracow seminar. When asked about the notation of his *Magnificat*, he answered: "The fact that 60% of the *Magnificat* is written in traditional notation follows from the fact that my musical language has changed, and not because in this way it is easier to perform" ([Discussion] 1976: 40).

From the above remarks, it is clear that the specific mutation of Penderecki's twelve-tone technique cooperates, in his late sonoristic style, with the categories of the basic system. Every segment is determined here in a complementary way, both "from the inside" by the former and "from outside" by the latter. Yet this does not preclude an occurrence of any new phenomena concerning the basic system alone. In the *Capriccio* for oboe and strings, a transition occurs between opposite terms of the category "middle vs. extreme registers", which is not to be found in the sonoristic period proper (see Chapter 6). In turn, the *Sonata* for cello and orchestra contains a dissolution of the most obstinate intercategorial redundancy between "temporal discontinuity vs. continuity" and "temporal mobility vs. immobility"; in passages of the first movement, the cello solo contains sequences of sustained notes that enter into temporal relationships by means of medium time-span values between their onsets.

However, the difference in compositional technique, separating the proper from the late sonoristic style, does not just concern the basic system. Perhaps even more important in this respect is the disappearance of the timbre system. True, the categories of the timbre system were not regulative in *Threnody*, either. But now their absence is not caused by an inadequately developed inventory of instrumental techniques, as was the case in that earliest sonoristic piece for strings. Now the timbral categories are consciously relinquished, after the timbre system has been fully elaborated with suitable orchestral resources. Penderecki most likely gave up the timbre system for a practical reason. The atypical instrumental techniques, which were required to articulate the material categories, added to the list of difficulties one encountered in mounting performances of the early sonoristic pieces; such techniques discouraged the players and sometimes even provoked conflicts during rehearsals. Also, it was incredibly difficult to assemble the performing forces (particularly with regard to percussion) that were needed to balance the proportions between metal, wood, and leather. True, the elimination of these categories resulted in the loss of a rational tool for regulating timbre, but at the same time it solved all the nasty problems mentioned above. The effect of the missing timbre system, observable in the late sonoristic pieces, is a considerable reduction in the inventory of sound generation processes and in orchestral resources. As regards the latter, the proportions between instrumental groups return to those characteristic of the traditional orchestra: the strings are the most important group, and winds the next most important. The percussion, though still exploited in significant passages, is used much more sparingly and, unlike in early sonorism, recedes into the background. Unusual instrumental techniques are still called for, but only occasionally. When they do occur, they are taken for granted, as holdovers or "constants" from the early sonoristic pieces—in the same way as regular expressive features from the pre-sonoristic output were taken over by early sonoristic pieces.

If the instrumental pieces composed in the late 1960s and early 1970s are commonly subsumed under the banner of sonorism and hence considered as a continuation of the instrumental output of the years 1960-1962, the vocal works have usually been considered by commentators as a separate and new creative strand, which began with the *Passion*. As has been stated, the hallmark of this strand is a concentration on literary texts and on the messages of universal, often religious, import which they convey. Even acknowledging the unity of compositional technique between the vocal works and the instrumental pieces of the same time, the general opinion has been that, in the vocal music, technical means were re-evaluated and pressed into the service of extramusical ideas.

This opinion cannot be accepted without reservations. First, there are vocal pieces by Penderecki in which there is no mutual dependency between text and music at all. Such a piece is *Cosmogony*, whose texts are in different original languages (Latin, Italian, Russian, English, and Classical Greek) and hence, like those of *Strophes*, mostly unintelligible to the listener (see Erhardt 1975: 159-161). Although they co-exist with music, the meanings of the verbal texts are thus not correlated with the musical narration. The resulting piece is in fact an autonomous work. The composer stresses this during the interesting discussion held at the end of the Cracow seminar in 1975:

> In *Cosmogony* the collage of texts does not influence the musical form; the musical form is autonomous. Text and music meet only at one point (the chord on the Copernican word 'sol'). ([Discussion] 1976: 32)

An even more pointed remark on the relation (or, rather, lack of relations) between texts and music in the oratorio under discussion is found in an earlier interview, given by Penderecki to Bohdan Cybulski in 1973:

> There are pieces where, without any harm to them, one can underlay an entirely different text, e.g., *Cosmogony*. *Cosmogony* is for me a double-plan piece—the musical plan, which is very strict and thoroughly independent of the text, and the plan of the text, which is constructed at the outset, and, in the first stroke, has its logic and succession of quotations. It is only at two points where these two plans meet: one, where I quote Copernicus . . . and at the very end, where there is only breathing, and no longer any text. The rest [of the piece's text] is absolutely obliterated, and one could underlay there a list of telephone numbers. (quoted by Erhardt 1975: 161)

A similar independence of text and music also seems characteristic of *Ecloga VIII* (1972), a setting of a text by Vergilius, and written for the virtuoso vocal group, the King's Singers; hence it has liberal sprinkling of unusual vocal effects, which are harmonized with the phonetic qualities of the text.

Secondly, even though in the remaining vocal pieces by Krzysztof Penderecki the correlation between words and music is unquestionable, this cannot be seen as the one-sided subordination of musical narration to verbal text. Nor is the music totally subservient to the dramatic action evoked by the text, such that the former loses its own autonomous logic (of the sonoristic system) or replaces it with the logic of the verbal narration.

> If somebody believes that it is possible to compose an opera by just writing 'melodies' to text, he is wrong, since in this way no eminent work will arise. Opera must be an autonomous work. (Haegenbarth 1987: 4)

Thus, when writing a vocal work, be it an opera or an oratorio, the composer envisages a task that resembles balancing on two lines or performing on two horse-backs. It consists in a correlation of text and music that results in their proper synchronization, such that they have equal power in regulating the work, though each of them is guided by a different logic. Fulfilling this task seems to require a dialectical activity. On the one side, the adjustment of music to text is likely accomplished by operations on individual trajectories, with the aim of arranging the terms of the musical narration so that they coincide with the proper (in the composer's opinion) words or moments of the action. However, the logic of a given trajectory ought not to be spoiled by this operation. On the other side, the text or the course of the action should be equally adjusted to the music. The possibility of manipulating or even changing the literary text is implied by the composer at the conclusion of the upcoming quote. Penderecki emphasizes that, for him, taking into account the libretto "does not mean that I go down to minute dependencies between text, music, and image, such as 'word-painting' or literal translation. I do not for a second play on representation, on some popular theatre staged with musical means. What remains most important is the musical vision, and many times it imposes dramatic solutions" (Grzenkowicz 1981: 1).

Of course, all the above remarks concerning the late sonoristic period should be motivated by careful analyses of individual pieces, which is beyond the scope of this book. Nevertheless, the limits of the present study open the way for future investigations. They ought, first of all, to describe precisely the rules of cooperation between the sonoristic system and the twelve-tone technique. Further, such investigations should try to correlate the musical narration, based on the syntax of a modified system, with the verbal narration of texts in vocal works. Only after that will it be possible to determine the relationship between music and extra-musical contents of the opera and the oratorios, and to state how the latter are reinforced, altered, or perhaps even weakened by the former. The artistic evaluation of individual pieces can then be made—as in the present study—on the basis of information gathered by means of a rigorous theoretical outline.

16.6. **POST-SONORISM**

The periodisation above, founded on the criteria of the basic and timbre systems, confirms that the end of the late sonoristic period—and thus of the whole reach of sonorism in Penderecki's musical output—happened around 1973. The first post-sonoristic piece is undoubtedly *The Awakening of Jacob*, composed in 1974. In 1976, at a seminar on "Muzyka w kontekście kultury" (Music in the context of culture) in Baranów Sandomierski, the composer himself remarked on the key position of that piece, which stood between sonorism and his new style of sacred representation in Milton's *Paradise Lost* (1976-78), with which he was engaged at that time:

> As for me, *Jacob* is written with language which descends from the *Magnificat*, but still is different. Later on it appeared that I had created a piece which would allow me to write *Paradise Lost*, if I would develop this sort of language, not to mention the orchestration. The latter is different than the orchestration of the *[First] Symphony*, where I operate with instrumental blocks. *The Awakening of Jacob* bears witness of my return to classical orchestration. After long years, I wanted to come back to orchestration based on the principles of Rimski-Korsakov, 'principles of sound certainty'. (Stachowski 1978: 62)

As is rightly emphasized by Krzysztof Droba (1978), the most crucial change in *The Awakening of Jacob* as compared with earlier, sonoristic pieces, is the turn to a harmonic conception of music whose axiom constitutes a single sound of definite pitch. "While those pieces were founded upon the autonomically treated sound qualities, *Awakening* is structurally constituted by the initial chord (the Jacob chord). And if we have called those pieces sonoristic, let us call this one harmonic. The harmonic music, understood in this way, bases itself upon a clear-cut intervallic structure" (Droba 1978: 70). Consequently, the compositional operations here descend from the level of segments, down to that of individual sounds, the level typical of traditional Western music. Seen from this angle, the late sonoristic period, with its twofold determination concerning both the segmental and subsegmental levels, already appears to be half-way to the stylistic change that produced *The Awakening of Jacob*, the Violin Concerto No.1, (1976-77), *Paradise Lost* (1976-78), and the *Polish Requiem* (1980-84).

Still, it would be a mistake to seek the difference between the post-sonoristic works and the preceding pieces exclusively in the disappearance of the basic system, preserved in the late sonoristic style, and in the shift from the level of segments to that of individual sounds. A mistake, because both of these changes in compositional technique manifest a much more fundamental shift, that is, a turn to this sphere of tradition which was thus far entirely strange to the composer. If in one of his earliest declarations, in 1960, Penderecki described his attitude towards tradition with such words as "romanticism does not come into consideration" (Hordyński 1960: 8), in the mid-1970s it was precisely romanticism that became his main source of musical inspiration. As the stylistic centre of gravity, romanticism established the basis for the "great synthesis" which, expanding in ever-widening historical circles, continues in Penderecki's music of today.

17. PENDERECKI AND STRUCTURALISM

The attentive reader has certainly noticed that, in its internal organization, the sonoristic system of Krzysztof Penderecki displays a plainly structuralist character. As is well known, the basic characteristic of structuralism is a rejection of the so-called "substantive" or essentialist view of objects in favour of the "relational" or differential view, in which objects are not seen in themselves, but as bundles of relations arising at the points where these relations intersect. In a given realm, "there are only differences without positive terms", as it was put by the pioneer of structuralist thought, Ferdinand de Saussure (quoted by Monelle 1992: 34). Accordingly, in Penderecki's sonorism, primary importance is vested in the relations between terms of individual categories, which account for differences among objects (here, segments), that is, for the paradigmatic and syntagmatic relationships between them. Noteworthy also is that the relations that determine the categories of the basic and timbre systems take the shape of binary oppositions—either contradictions or contraries. Binary oppositions constitute the type of relation most fundamental to human perception, and hence prominent in structuralism as the logical matrix that imposes universal laws onto the organization of any mental object. Consequently, here the relevant features of every segment—the features that determine the position of the segment within a web of relations—are only those that fix the terms of oppositions. All the remaining properties of a segment's sound content are not theoretically pertinent, and they lie outside the reach of the sonoristic system, in the domain of expressive features.

Segments thus turn out to constitute abstract constructs of a purely formal character, distinct from their contextual variants. In this way, Penderecki's sonorism also appears to be characterized by the structuralist distinction analogous to that made by Saussure, between the phonemic and phonetic levels of language, that is, between *langue* and *parole*. Like *langue*, the sonoristic system is a form that shapes the acoustical substance and thus a structure in the proper, structuralist sense of the word as fixed by Jean Piaget (see Hawkes 1977: 16-17). By this fact, the sonoristic system is comparable to the primordial and best-learned of all human structures—language—in that it is not merely an assemblage of independent rules, but a coherent set of laws that are bound together on the strength of logical dependencies; and, in its synchronic dimension, the system forms a closed whole. Just as language, this whole is also self-regulating, in the sense that its transformations (observed in Chapter 10) alongside the diachronic dimension are always effects of inherent logic, and not of influences exerted on the system by some exterior phenomenon. All these remarks explain why, during the present reconstruction of Penderecki's sonoristic system, the references made to structural linguistics proved efficient.

The rudiments of structuralism were laid down already in Saussure's *Cours de linguistique générale*, published in 1915. Still, structuralism became a fully developed methodology only after the World War II. The classical book of structural linguistics—*Fundametals of Language* by Jacobson and Halle, quoted so many times in foregoing chapters—appeared in 1956. Also, it was only in the post-war period when the methodology of structuralism started to expand its field of application from language alone to several relative domains. Structuralist anthropology was initiated by Claude Lévi-Strauss from *Les structures élémentaires de la parenté* (1948) through *Tristes tropiques* (1955) and *Anthropologie structurale* (1958) until *Le totemisme aujourd'hui* (1962) and *La pensée sauvage* (1962). In turn, structuralist study of literature started with Roland Barthes's *Le degré zéro de l'écriture* (1953). Because of the fundamental character of writings issued then, Francois Dosse in his *Histoire de structuralisme* (1991) calls the period up to 1962 *l'épique époque* ('epical epoch') of this intellectual trend.

Interestingly, it is exactly at the very end of this epoch when the proper sonoristic period of the years 1960-62 comes in Krzysztof Penderecki's musical output. At first glance, one might thus suppose that the structuralist traits of the sonoristic system, indicated above, exhibit the immediate influence of structuralism on Penderecki's artistic imagination. Provided one supplied documentary evidence that the composer had read the book by Jakobson and Halle, it would be easy to explain so many striking similarities between his compositional technique and the theory of structural linguistics; these similarities are manifested not only in the existence of musical phonemes and distinctive features, but even in a direct transposition of some phemic categories from natural languages into the realm of music. What is meant here is the identity of categories "high vs. low register", "loud vs. silent dynamics", and "temporal continuity vs. discontinuity" with the binary oppositions between prosodic features of language that concern, respectively, tone, force, and quantity. In turn, the logic of oppositions governing the syntax of Penderecki's sonoristic pieces might be explainable as a direct transplantation of the mythical logic in which "thought always progresses from the awareness of oppositions towards their resolution". For that to be the case, one would have to demonstrate that Penderecki knew Lévi-Strauss's article "The Structural Study of Myth", published first in 1955, then included in his book *Anthropologie structurale* (1958), from which the above quotation comes (Lévi-Strauss 1968: 224).

However, the composer denies that he has ever been interested in structuralism. Furthermore, at the turn of 1950s it would hardly have been possible for him to know about this intellectual trend. For at that time in Poland, structuralism was known only in narrow circles of investigators dealing with disciplines in which its avant-garde methodology had found application (mainly linguists), and it was still treated with reservation by older academic scholars. There existed no popularized scientific literature devoted to structuralist study, and the classical publications of the foreign authors listed above were not yet translated into Polish. The first Polish edition of *Fundamentals of Language* appeared in 1964, and Lévi-Strauss's *Structural Anthropology* even later, in 1970. Both these books were thus completely inaccessible to Penderecki in the years immediately preceding his sonoristic period, because at that time the composer's knowledge of foreign languages was rather modest.[1] That the sonoristic style did not arise from any conscious inspiration that Krzysztof Penderecki took from structuralism at that time, is also attested to by the fact that the composer began to move away from sonorism at the exact moment when the full bloom of structuralist thought was just beginning. 1963, the year Penderecki composed his *Stabat Mater*, marked the end of the proper sonoristic period in his output, and initiated a gradual retreat of the composer from assumptions of his sonoristic compositional system. In the history of structuralism, however, 1963 inaugurated *la belle époque* (Dosse 1991), when the formerly rarified method of scientific analysis became transformed into an outlook, philosophy, and ideology that took the lead in the intellectual life, and ousted the existentialism which had prevailed till that time. In this process, the key role was played by Jacques Lacan's *Écrits* (1966), which launched structuralist psychoanalysis; Lucien Sebag's *Marxisme et structuralisme* (1964) and Louis Althusser's *Lire de capital* (1965), both of which initiated a union of structuralism and marxism; as well as Michel Foucault's *Les mots and les choses* (1966), which laid the foundations of structuralist philosophy. Indeed, as Althusser maintained (see Dosse 1991: 353), it was not until 1963 when structuralism became a social phenomenon of wide compass, constituting an epistemological break and a pursuant way of thinking that became fashionable among the intellectual elite.

[1] According to Erhardt (1975: 29), the first foreign language assimilated by Krzysztof Penderecki was German, which he started to study, however, more thoroughly only in the fall of 1960. In their book, whose main interest focuses on biographical data (1993: 36), Ćwiklinski and Ziarno write that nowadays, apart from German, Penderecki has command of English, Latin, some Italian, Spanish, Russian, Classical Greek, and Yiddish. In this list, strikingly absent is French, the language in which most early structuralist writings was published.

From the foregoing discussion, it follows that the similarity between structuralism and Penderecki's sonorism—a similarity found in the internal organization of underlying methods—and the simultaneous occurrence of both phenomena among intellectual achievements of the twentieth century amounts to pure coincidence. The identity of binary oppositions employed by Penderecki in his sonoristic pieces with distinctive features of phonemes is explainable as resulting from natural properties of the acoustical channel shared equally by language and music. Still, this coincidence is all the more interesting since, in all probability, the sonoristic system of Krzysztof Penderecki is the only example of a structuralist method elaborated not for the sake of analysis, but for the generation of artistic texts; in particular, it constitutes the only true example of the structuralist attitude in music.

The latter statement may sound surprisingly grandiose, since one is used to associating musical structuralism with West-European art music of the 1950s and 1960s, mainly with such compositions as *Thema (Omaggio a Joyce)* or *Circles* by Luciano Berio, and generally with serialism. However, the structuralist character of the former pieces resides in the properties of the manipulated phonetic material, and not in an autonomous musical organization imposed on it by the composer. In turn, the common view relating structuralism to serialism is influenced mainly by the structuralist terms employed with delight by composers of the Darmstadt school, as well as by the titles of some pieces, such as Boulez's *Structures*. Even though in serial compositions individual notes are defined exclusively by their positions within "the total system of relations of the sounds with one another", as Schoenberg puts it (quoted by Lévi-Strauss 1970: 21), and thus in a relational and not substantive way, nevertheless the relations themselves are based on rows of twelve different units and not on binary oppositions. Thus serialism was not of a structu*rale*, but merely a *structurelle* character. The semantic difference between these two French adjectives is clarified in Umberto Eco's essay "Series and Structures" (1989). There Eco refers to the definitions given by Jean Pouillon: "A relation is *structurelle* when it plays a determining role within a given organization, and *structurale* when it can manifest itself in several different but equally determining ways within numerous systems" (Eco 1989: 218). A *structurale* type of relation, constituting a universal law, is represented by a binary opposition that exists equally in elementary structures of logic, language, myths, literary texts—and also in the sonoristic style of Krzysztof Penderecki.

According to Eco, the superficial similarity of the two terms had far-reaching consequences:

> The structuring activities of the avant-garde have often been related to the investigation of structures proper to structuralism. Several rash critiques (that is, most cultivated readers and all uninformed ones) have even gone so far as to consider structuralism as the critical or methodological aspect of the artistic activity of the avant-garde. This was often just naive sophistry: since structuralism is an avant-garde method, then it must be the method of the avant-garde. At other times, however, it was the result of a hasty identification that led some to apply structuralist categories to avant-garde operations, with highly questionable results. (Eco 1989: 219)

Such a "hasty identification" influenced by the intellectual "mode" of the 1960s underlay, for instance, the definition found in the Polish magazine *Ruch Muzyczny*, which says that musical structuralism is "a control of musical elements (for instance, pitch or rhythmical determinants) in respect of their mutual contacts and relations" (1960/21: 6), in this way apparently alluding to serialism. Meanwhile, serialism and structuralism are not only different, but even opposite. This statement, formulated for the first time by Lévi-Strauss in the Overture to his *Le cru et le cuit* (1964), is also confirmed, though for different reasons, in the above-quoted article by Eco. If so, the manifestation of structuralism in music is to be sought not among the compositions written in Darmstadt or Paris—at the center of the structuralist movement and in the period of its most spectacular triumphs—but rather, and most unexpectedly, in the music of a Polish composer who had not even heard of structuralism when he started to elaborate his structuralist compositional method in the late 50s and early 60s. Seen from this angle, the sonorism of Krzysztof Penderecki truly deserves the name of "sonoristic structuralism", which it receives in the title of the present book. No better example of the structuralist concept of *épistémé* (Foucault 1966) can ever be imagined than this one, which refers to structuralism itself.

18. POSTSCRIPT: A SEMIOTIC VIEW

In this book, the entire discussion of Penderecki's sonorism is founded on an analogy to language. The sonoristic style was discussed as a specific sort of musical language, and individual sonoristic pieces were called "texts" in this language, each of them characterized by a particular strategy of musical narration. The underlying compositional system of these pieces was interpreted as a generative grammar accounting for the organization of musical utterances in respect of both morphology and syntax. The present reconstruction of this generative grammar concerns exclusively what, after Ferdinand de Saussure, can be called the plane of the signifier (*signifiant*). Yet every language in the proper sense presupposes a correlation of signifiers with signifieds (*signifié*) or, in Louis Hjelmslev's terms (1961), between expression and content. It is only by means of such a correlation that a linguistic sign arises, and that the language itself becomes what it is—a semiotic system. Thus, to ascertain how far the analogy holds between language and the sonoristic style of Krzysztof Penderecki, one needs to put the latter into a semiotic perspective and consider the issue of its possible meaning.

Of course, musical meaning is not meant here as any naive translation of music into words. Music semiotics has long since abandoned the quest for verbal (referential) signification, in which music was reduced to the state of a mere derivative of natural languages. In current semiotic study music and language are viewed as two equiponderant, though different, semiotic systems. Accordingly, if meaning in language is linguistic and hence verbal, music has a "specifically musical meaning", as Hanslick puts it in his significant formula. On this point almost all music semioticians agree. Yet there remains one of the most embarrassing and vague problems, that of the substance of musical signifieds. The positions taken here can be roughly divided according to whether this substance is sought inside or outside the musical realm or, in other words, whether it is identified with or distinguished from the substance of signifiers. As stated by Leonard B. Meyer, difference between the two substances results in so-called "designative meaning", while their identification produces an "embodied meaning".

> (1) A stimulus may be meaningful because it indicates or refers to something which is different from itself in kind—as when a word refers to or denotes an object or concept which is not itself a word. This type of meaning we shall call 'designative meaning'. (2) A stimulus or process may acquire meaning because it indicates or refers to something which is like itself in kind—as when the rumble of distant thunder on a sultry day and the piling up of storm clouds (antecedent natural events) indicate the coming of a rain storm (a consequent natural event). This type of meaning we shall call 'embodied meaning'. (Meyer L. B. 1967: 6)

The existence of designative meaning in music is maintained mostly in the writings of Susanne K. Langer, and, according to this author, likens music to language. However, the fact that the substances of linguistic and musical signifieds lie equally outside their respective signifiers does not yet guarantee that they are identical. On the contrary, whereas language concerns primarily the external world of physical experience, music denotes internal experiences of emotions on the strength of its "logical similarity to the forms of human feeling". By doing this, music brings a "logical form of sentience" and constitutes a "tonal analogue of emotive life" (quoted by Monelle 1992: 8). In Langer's opinion, this difference in denotation, as well as the resulting difference in "categories" operated by music and natural languages, prohibits musical meaning from being verbalized.

In turn, most current authors place the musical denotation in the music itself, thereby endorsing the notion of embodied meaning. For instance, in a view presented mainly by Leonard Ratner and Kofi Agawu, the passages of a given piece refer to genres or "topics" that belong to the stylistic inventory of a given musical culture. The Russian writer, Boris Asafiev, locates the origin of musical meaning in "intonations", which are preserved equally in folk songs and popular music. An even more restrictive idea, according to which musical units such as motifs or phrases refer to other musical units within the same piece, lies at the basis of the "paradigmatic analysis" of Jean-Jacques Nattiez and Nicolas Ruwet (see Monelle 1992). In these theories, the identity of substances between signifiers and signifieds constitutes the main difference of music as compared with language. Undoubtedly, all the controversy and the several different views concerning musical meaning originate precisely in its non-verbal character. As Langer points out, "it seems particularly hard for our literal minds to grasp the idea that anything can be known which cannot be named" (quoted by Monelle 1991: 8). Even so, the postulate that signifieds exist only to the extent that they can be verbalized is nowadays commonly refuted, and the semiotic character of music is only rarely called into question.

Obviously, the intent of the present author is not to make any authoritative decision as regards the substance of signifieds in music, either generally or in reference to sonoristic pieces by Krzysztof Penderecki. On that score, all of the positions described above are justifiable since, as Meyer realizes, "designative" and "embodied" meanings are in reality not contradictory, but complementary. "Music gives rise to both types of meaning. . . . Although these two types of meaning are logically separable, there is in practice an intimate interaction between them" (Meyer L. B. 1967: 6-7). Moreover, since meaning in music is elusive, music semiotics focuses on the mechanisms of musical signification rather than on signification alone. Whatever the nature of signifieds, the attention goes first of all to the manner in which they arise and are assigned to the plane of signifiers. As regards the latter issue, there are two possible options.

The first option assumes a similarity between musical and linguistic semiotic systems in this respect. In language, which invariably constitutes the point of reference for any semiotic study, meaning is assigned only to syntactical units of higher levels, characterized by some degree of complexity and composed of several elementary units. The smallest meaningful unit is thus a morpheme. Its smaller, component phonemes are devoid of any specific meaning.

> Correspondingly, the two levels of language and linguistic analysis are to be kept apart: on the one hand, the *semantic* level involving both simple and complex meaningful units from the morpheme to the utterance and discourse, and, on the other hand, the *feature* level concerned with single and complex units which serve merely to differentiate . . . and partition or bring into relief the manifold meaningful units. (Jakobson and Halle 1956: 4)

This phenomenon forms a fundamental property of language, called the "double articulation". As a consequence, although both signifiers and signifieds are similarly organized as hierarchies of levels—with phemes, phemic categories and phonemes on the plane of the former and semes, semic categories and sememes on the plane of the latter (see Greimas 1966)—their relationship is indirect; that is, such a relationship constitutes a correlation in which they are displaced with respect to each other. What is assigned to the elementary level of content is one of the higher levels of expression, consisting of recurrent sequences of elementary units—morphemes, words—whose distribution is governed by syntax.

In musical styles whose elementary syntactical units are individual sounds—as in traditional Western music as well as in most avant-garde works—this option obliges one to admit that a single note has no meaning, and that the smallest semantic vehicles are recurrent sequences of notes that form motives. In the sonoristic style of Krzysztof Penderecki, however, it would imply that meaning is attached only to sequences of segments. Yet segments, which here are the equivalents of phonemes, do not join together into recurrent sequences of a higher level that would be ruled only by syntax. On the contrary, as has been shown, the syntax of both the basic and the timbre system is applied immediately to segments, the order of which is governed by the rules of presentation and of mediation of binary oppositions within individual trajectories. This property of Penderecki's sonoristic style is one of the most crucial differences separating it from the organization of natural languages. Since the works in question contain no higher level of the expression plane, the semiotic situation of Penderecki's sonorism is comparable to the situation of a linguistic system without words or of an alphabet without a dictionary. In the framework of the first option, the case of sonoristic music by Krzysztof Penderecki is thus exceptional. Still, its exceptionality can be interpreted in two ways.

First, provided the just described mechanism of musical signification is in force, one would have to admit that in Penderecki's sonorism no meaning arises; in that case, this musical style constitutes a unique musical system of expression, one consciously unconnected with any system of content. Umberto Eco calls such a phenomenon an "s-code" or structure, and not a code properly speaking, the latter being defined as a reciprocal assignment between two structures (Eco 1979: 36-40).

Secondly, however, the unique position of Penderecki's sonoristic music could be seen as issuing from the atypical relationship between content and expression established therein. Normally, in both language and music, this relationship is indirect. Yet in Penderecki's sonorism it would assume the shape of a direct correlation between equivalent levels of signifiers and signifieds, so that the ultimate constituent endowed with meaning would be a segment as the elementary syntactical unit. The origin of such an atypical correlation can be seen, in turn, in the difference between traditional music, operating with single sounds, and Penderecki's way of handling segments, which, as sets of sounds, presuppose the relations of their individual components. Following this interpretation, one becomes aware of the exceptional nature of musical meaning in Penderecki's sonoristic pieces. This is so because, just as the "meaning" of a single phoneme is nothing but its position within the web of a given phonological system, which is determined by the set of its component distinctive features, that is, the phoneme's "mere otherness" in relation to the remaining phonemes (Jakobson and Halle 1956: 11), so also the meaning of any musical phoneme (segment) would be nothing more than the set of its constitutive terms, which are chosen from individual categories of the sonoristic system and which fix its paradigmatic relations with respect to other segments. Consequently, syntactic and semantic categories would interchange here, phemes being equivalent to semes, phemic categories to semic categories, and phonemes to sememes.

What is more, the organization of the expression plane in Penderecki's sonoristic style would mirror the organization of content as described by A. J. Greimas (1987: 48-62). *Deep structures* of content, consisting in logical relations of contradiction and contrariety (modelled by the so-called "semiotic square"), would have their equivalents in contradiction and contrariety as defined in the field of "fuzzy logic", that is, as two types of binary oppositions setting up individual categories of the basic system. As regards the timbre system, equivalents of deep semantic structures are here classical contradictions and contrarieties comprised in the ternary opposition of primary materials (metal, wood, and leather). *Surface structures* as the proper level of Greimasian "narrative grammar" are parallel to the level of individual categories of Penderecki's sonorism as regards both the basic and the timbre system. Finally, *structures of manifestation* are comparable to articulations of individual categories, that is, to their definitions elaborated on the motor level. This parallelism between Greimas's structural semantics and Penderecki's sonoristic structuralism can be further observed as regards the equivalence between the paradigmatics and syntagmatics of both systems. As in Greimassian narrative grammar the relations composing the paradigmatic structures of individual levels determine, respectively, syntagmatic sequences of transformations, performances, and events of a narrative text, so also the paradigmatic relations of segments accounting for the morphology of Penderecki's sonorism pre-judge the succession of these segments, thereby determining its syntax.

As a matter of fact, both interpretations presented above give the same result. Whether the content does not exist or is identical with expression, the only self-dependent plane of Penderecki's sonoristic style is the expression plane. Mathematically speaking, the expression /a/ and /a=a/ do not differ, the latter being a tautological expansion of the former.

Still, the direct correlation of signifiers and signifieds, interpreted thus far as a peculiarity of Penderecki's sonorism, can be considered also as a normal state of music as concerns the mechanism of musical signification. As one can ascertain from the earlier discussion, the resulting identification of substances between signifiers and signifieds is assumed by those music semioticians who favour the notion of embodied musical meaning. Obviously, this second option would not affect the interpretation of Penderecki's sonoristic style, yet from this viewpoint his sonorism would no longer be interpreted as an exceptional case in music. Instead, it would be music appearing as an exceptional semiotic system, one different from natural languages. The result of the inevitable semantization of its syntactical elements would be that, for music, the only way of escaping itself and reaching some extra-musical reality would be in cooperation with a literary text. As regards Penderecki's sonorism, this happens only in vocal pieces of the later period. In light of the foregoing discussion, one may expect that, in the vocal music, the binary oppositions setting up the phemic categories are directly correlated with semantic oppositions such as "right and wrong" or "*sacrum* and *profanum*" (Chłopicka 1994).

However, the semantization of musical syntax is assumed also by an advocate of designative meaning, Susanne K. Langer. This is so because, although the planes of expression and content—the substances of signifiers and signifieds—are kept separate, their direct, "iconic" correlation results in the fact that the slightest change in the former has an effect on the latter, that is, on the evoked emotion or feeling. Even so, what musical expression—in the semiotic, but also in the ordinary sense of this term—"*can actually reflect is only the morphology of feeling*", that is, the energetic course of the music; "and it is quite plausible that some sad and some happy conditions may have a very similar morphology" (Langer 1960: 238). In turn, the qualification of a given emotional state through describing its context is practicable only verbally. Thus also, when seen from this angle, the change that takes place in the opera and oratorios of the late sonoristic period—where the energy of music is correlated with literary texts—constitutes a turn from "expression called 'pure' into one loaded with real emotions" (Tomaszewski 1994: 98).

REFERENCES

Baculewski, Krzysztof (1987). *Polska twórczość kompozytorska 1945-1984*. Kraków: Polskie Wydawnictwo Muzyczne.

Beament, James (1980). "Hearing". In: Sadie, Stanley (ed.).

Bilica, Krzysztof (1974). "*Ofiarom Hiroszimy-Tren* Krzysztofa Pendereckiego. Próba analizy jednego z aspektów utworu". *Muzyka* 2 (73): 45-71.

—(1983a). "Pozaekspresyjne porządki w Kwartecie smyczkowym". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 72-77.

—(1983b). "Treści *Ofiarom Hiroszimy-Trenu*". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 29-40.

Borris, Siegfried (1975). "Pendereckis Stellung im Synkretismus der 60er Jahre". *Musik und Bildung* 12: 609-614.

Boulez, Pierre (1963). *Musikdenken heute I*. Mainz: Schotts Söhne.

Chiarucci, Henri (1973). "Essai d'analyse structurale d'oeuvres musicales". *Musique en jeu* 12: 11-45.

Chłopecki, Andrzej (1975a). "*Pasja* Pendereckiego jako znak". *Ruch Muzyczny* 7: 3-5.

—(1975b). "Nad partyturą *Diabłów z Loudun*". *Ruch Muzyczny* 22: 8-9.

Chłopicka, Regina (ed.) (1978). "Konwersatorium na temat *Przebudzenia Jakuba* Krzysztofa Pendereckiego". In: Polony, Leszek (ed.). 67-75.

Chłopicka, Regina (1983a). "Słowo i dźwięk w *Magnificat*", in: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 187-205.

—(1983b). "Raj Utracony—koncepcja tekstu a język muzyczny". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 233-245.

—(1994). "Problem dobra i zła w twórczości scenicznej Krzysztofa Pendereckiego". In: Oberc, Anna (ed.), *Muzyka, słowo, sens. Mieczysławowi Tomaszewskiemu w 70 rocznicę urodzin*. 113-134. Kraków: Akademia Muzyczna.

Chłopicka, Regina and Krzysztof Szwajgier (eds.) (1983). *Współczesność i tradycja w muzyce Krzysztofa Pendereckiego* [*Proceedings of the Second Seminar on Penderecki's Music. Cracow, December 19-20, 1980*]. Kraków: Akademia Muzyczna.

Chomiński, Józef M. (1983). *Małe formy instrumentalne. Formy muzyczne I*. Kraków: Polskie Wydawnictwo Muzyczne.

Ćwiklinski, Przemysław and Jacek Ziarno (1993). *Pasja. O Krzysztofie Pendereckim.* Warszawa: Polska Oficyna Wydawnicza BGW.

Dibelius, Ulrich (1967). "Polnische Avantgarde". *Melos* 1: 7-16.

[Discussion] (1976). "Dyskusja na seminarium poświęconym twórczości Krzysztofa Pendereckiego". *Muzyka* 2 (81): 29-52.

Dosse, Franćois (1991). *Histoire du structuralisme. Tome 1: Le champ du signe, 1945-66.* Paris: Découverte.

Drewniak, Józef (1984). *Podstawy teorii zbiorów rozmytych.* (Skrypty Uniwersytetu Śląskiego 347.) Katowice: Uniwersytet Śląski.

Droba, Krzysztof (1976). "Hierarchia czynników formalnych w twórczości Krzysztofa Pendereckiego". *Muzyka* 2 (81): 22-28.

—(1978). "*Przebudzenie Jakuba*". In: Polony, Leszek (ed.). 67-72.

—(1988). "Kwartety smyczkowe". In: Droba, Krzysztof (ed.), *Festiwal muzyki Krzysztofa Pendereckiego*, 31-32. Kraków.

Drobner, Mieczysław (1960). *Instrumentoznawstwo i akustyka.* Kraków: Polskie Wydawnictwo Muzyczne.

Dubois, Didier and Henri Prade (1980). *Fuzzy Sets and Systems: Theory and Applications.* (Mathematics in Science and Engineering 144.) New York: Academic Press.

Eco, Umberto (1979). *A Theory of Semiotics.* Bloomington: Indiana University Press.

—(1989). *The Open Work.* Trans. Anna Cancogni. Cambridge, Massachusetts: Harvard University Press.

Erhardt, Ludwik (1975). *Spotkania z Krzysztofem Pendereckim.* Kraków: Polskie Wydawnictwo Muzyczne.

Foucault, Michel (1966). *Les mots et les choses.* Paris: Gallimard.

Gąsiorowska, Małgorzata (1983). "*Psalmy Dawida* na chór mieszany i orkiestrę". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 11-28.

Gojowy, Detlef (1975). "Avantgarde in Polen". *Musik und Bildung* 12: 618-621.

Greimas, Algirdas Julien (1966). *Sémantique structurale: Recherche de méthode.* Paris: Larousse.

—(1987). *On Meaning: Selected Writings in Semiotic Theory.* Trans. Paul J. Perron and Frank H. Collins. London: Pinter.

Greimas, Algirdas Julien and Joseph Courtés (1982). *Semiotics and Language: An Analytical Dictionary.* Trans. Larry Crist et al. Bloomington: Indiana University Press.

Gruhn, Wilfried (1971). "Strukturen und Klangmodelle in Pendereckis *Threnos*". *Melos* 10: 409-411.

Grzenkowicz, Izabela (1981). "Bogactwo świata". *Kultura 6*: 1 and 12. [Interview with Penderecki]

Haegenbarth, Andrzej (1987). "Utrafić w swój czas". *Nurt* 10: 2-11. [Interview with Penderecki]

Häusler, Josef (1969a). *Musik im 20. Jahrhundert. Von Schönberg zu Penderecki.* Bremen: Carl Schünemann Verlag.

— (1969b). "Krzysztof Pendereckis *Anaklasis*". *Musik und Bildung* 7/8: 342-343.

Hawkes, Terence (1977). *Structuralism and Semiotics.* Berkeley and Los Angeles: University of California Press.

Hjelmslev, Louis (1961). *Prolegomena to a Theory of Language.* Madison: University of Wisconsin Press.

Hordyński, Jerzy (1960). "Kompozytorzy współcześni. Krzysztof Penderecki". *Życie Literackie* 44: 4 and 8. [Interview with Penderecki]

Huber, Alfred (1971). "Pendereckis *Anaklasis* für Streicher und Schlagzeuggruppen". *Melos* 3: 87-91.

Jakobson, Roman (1989). W *poszukiwaniu istoty języka.*. 2 vols. Ed. Maria Renata Mayenowa. Warszawa: Państwowy Instytut Wydawniczy.

Jakobson, Roman and Morris Halle (1956). *Fundamentals of Language.* (Janua Linguarum 1.) 'S-Gravenhage: Mouton.

Janicka-Słysz, Małgorzata (1993). "W poszukiwaniu siebie". *Studio* 8: 14-19. [Interview with Penderecki]

Kaczyński, Tadeusz (1963). "*Polimorfia* Krzysztofa Pendereckiego". *Ruch Muzyczny* 22: 17-18.

— (1968). "Polnische Avantgarde am Scheideweg". *Melos* 1: 6-13.

Kostrzewska, Hanna (1991). "Zagadnienie sonoryzmu na przykładzie twórczości kompozytorów polskich". *Muzyka* 1 (140): 83-100.

Langer, Susanne K. (1960). *Philosophy in a New Key: A Study in the Symbolism of Reason, Rite, and Art.* Cambridge, Massachusetts: Harvard University Press.

Lévi-Strauss, Claude (1968). *Structural Anthropology*. Trans. Claire Jacobson and Brooke Grundfest Schoepf. London: Allen Lane.

—(1970). *The Raw and the Cooked*. Trans. John and Doreen Weightman. London: Cape.

Lisicki, Krzysztof (1973). *Szkice o Krzysztofie Pendereckim*. Warszawa: PAX.

Malecka, Teresa (1983). "I Symfonia Krzysztofa Pendereckiego". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 176-186.

Meyer, Krzysztof (1983). "Quartetto per archi No. 2", in: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 78-93.

Meyer, Leonard B. (1956). *Emotion and Meaning in Music*. Chicago: University of Chicago Press.

—(1967). *Music, the Arts and Ideas*. Chicago: University of Chicago Press.

Michalski, Grzegorz (1984). "Nowa muzyka". In: Ochlewski, Tadeusz (ed.), *Dzieje muzyki polskiej*. 134-197. Warszawa: Interpress.

Monelle, Raymond (1992). *Linguistics and Semiotics in Music*. New York: Harwood Academic Publishers.

Mroczek, Joanna and Maria Wilczek (1994). "Inspiracja—kompozycja—cytat". *Vivo* 1: 22-27. [Interview with Penderecki]

Müller, Karl-Josef (1974). "Krzysztof Penderecki: *Anaklasis* (1959/60)". In: Zimmerschied, Dieter (ed.), *Perspektiven Neuer Mu*sik. 215-233. Mainz: Schotts Söhne.

—(1975). "Pendereckis Musik im 'mobilen netz trigonometrischer Punkte'. Skizzierung thematischer Schwerpunkte". *Musik und Bildung* 12: 622-629.

Nattiez, Jean-Jacques (1990). *Music and Discou*rse: *Toward a Semiology of Music*. Trans. Carolyn Abbate. Princeton, New Jersey: Princeton University Press.

Penderecki, Krzysztof (1987). "Muzyki nie można zaczynać od początku". *Ruch Muzyczny* 22: 8-9.

Pociej, Bohdan (1965). "*Sonata* Krzysztofa Pendereckiego". *Ruch Muzyczny* 17: 12-13.

—(1975). "Inspiracja religijna: *Magnificat*". *Tygodnik Powszechny* 2: 3.

—(1980). "Penderecki, Krzysztof". In: Sadie, Stanley (ed.).

Polony, Leszek (ed.) (1978). *Muzyka w kontekście kultury. Spotkania muzyczne w Baranowie* I. Kraków: Polskie Wydawnictwo Muzyczne.

Porębski, Mieczysław (1986). *Sztuka a informacja*. Kraków, Wrocław: Wydawnictwo Literackie.

Rychlik, Józef (1976). "Punktualizm we wczesnej twórczości Krzysztofa Pendereckiego". *Muzyka* 2 (81): 5-21.

—(1983). "*Psalmus*". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 41-51.

Sadie, Stanley (ed.) (1980). *The New Grove Dictionary of Music and Musicians*. London: Macmillan.

Schiller, Henryk (1960). "Po prawykonaniu *Wymiarów czasu i ciszy* Krzysztofa Pendereckiego". *Ruch Muzyczny* 21: 5.

Schwinger, Wolfram (1968). "Magische Klanglandschaften. Krzysztof Penderecki und die polnische Avantgarde". *Musica* 1: 5-7.

—(1989). *Krzysztof Penderecki: His Life and Work. Encounters, Biography and Musical Commentary.* Trans. William Mann. London: Schott.

Sobański, Tomasz (1974). "Nie ja zdradziłem awangardę".*Trybuna Ludu* 358/360: 6. [Interview with Penderecki]

Spender, Natasha (1980). "Psychology of Music", I-III. In: Sadie, Stanley (ed.).

Stachowski, Marek (chairman) (1978). "Konwersatorium na temat niedokończonej opery Krzysztofa Pendereckiego *Raj Utracony* według Miltona". In: Polony, Leszek (ed.). 61-66.

Stephan, Rudolf (1969). "Das Neue in der Neuen Musik". In: Reinecke, H. P., *Das musikalisch Neue und die Neue Musik*. 55-72. Mainz: Schotts Söhne.

Taylor, Charles (1980). "Sound". In: Sadie, Stanley (ed.).

Thomas, Ernst (1960). "Musiktage für zeitgenössische Tonkunst. Donaueschingen". *Neue Zeitschrift für Musik* 10: 429-430.

Tomaszewski, Mieczysław (1983). "Siedem pytań". In: Chłopicka, Regina and Krzysztof Szwajgier (eds.). 7-10.

—(1994). *Krzysztof Penderecki i jego muzyka.* Kraków: Akademia Muzyczna.

Wachsmann, Klaus (1980). "Classification of Instruments". In: Sadie, Stanley (ed.).

Wallek-Walewski, Marian (1960). "W kręgu poszukiwań materiałowych". *Ruch Muzyczny* 17: 1-2.

—(1987). "Krzysztof Penderecki w trzydzieści lat później". *Literatura* 10: 38-41.

Wasita, Ryszard (1966). "Awangarda i dziedzictwo". *Polska* 7: 60-61. [Interview with Penderecki]

Wnuk-Nazarowa, Joanna (1983). "Postać Szatana w *Raju Utraconym*". In: Chłopicka, Regina and Krzysztof Szwajgier (eds). 221-232.

Zieliński, Tadeusz A. (1961). "Nowe utwory Krzysztofa Pendereckiego". *Ruch Muzyczny* 12: 17-18 and 24.

—(1962). "Der einsame Weg des Krzysztof Penderecki". *Melos* 10: 318-323.

—(1963). "Współczesny kompozytor a tradycja". *Ruch Muzyczny* 12: 8-9.

—(1964). "*Fluorescencje* Krzysztofa Pendereckiego". *Ruch Muzyczny* 2: 5-6.

—(1966). "Neue Klangästhetik". *Melos* 7/8: 210-212.

—(1968). "Technika operowania instrumentami smyczkowymi w utworach Krzysztofa Pendereckiego". *Muzyka* 1 (48): 74-92.

—(1975). "*Magnificat* Krzysztofa Pendereckiego". *Ruch Muzyczny* 7: 5-6.

SCORES BY PENDERECKI USED IN THE ANALYSIS

Anaklasis na orkiestrę smyczkową i zespoły perkusyjne. Kraków: Polskie Wydawnictwo Muzyczne 6691.

De natura sonoris no. 1 na orkiestrę symfoniczną. Kraków: Polskie Wydawnictwo Muzyczne 6689.

Emanacje [*Emanations*] na dwie orkiestry smyczkowe. Kraków: Polskie Wydawnictwo Muzyczne 6894.

Fluorescences na orkiestrę. Kraków: Polskie Wydawnictwo Muzyczne 6690.

Kanon [*Canon*] für Streichorchester. Mainz: Schott 42901.

Miniatury [*Miniatures*] na skrzypce i fortepian. Kraków: Polskie Wydawnictwo Muzyczne 5989.

Polymorphia na 48 instrumentów smyczkowych. Kraków: Polskie Wydawnictwo Muzyczne 6935.

Quartetto per archi. Kraków: Polskie Wydawnictwo Muzyczne 5372.

Quartetto per archi no. 2. Kraków: Polskie Wydawnictwo Muzyczne 7475.

Strofy [*Strophes*] na sopran, głos recytujący i 10 instrumentów. Kraków: Polskie Wydawnictwo Muzyczne 5610.

Tren [*Threnody*] na 52 instrumenty smyczkowe. Kraków: Polskie Wydawnictwo Muzyczne 5598.

Wymiary czasu i ciszy [*Dimensions of Time and Silence*] na 40-głosowy chór mieszany, perkusję i smyczki. Kraków: Polskie Wydawnictwo Muzyczne 6951.

Danuta Mirka teaches at the Music Academy in Katowice, Department of Composition, Conducting and Music Theory. She graduated in 1991, and in 1992 her master's thesis *Promethean Myth in the Musical Interpretations by Beethoven, Liszt and Scriabin* was awarded the first prize with special distinction at the Eighth All-Polish Competition of Master's Theses in Music Theory. The present book constitutes the doctoral dissertation prepared by the author under the guidance of Prof. Eero Tarasti at the University of Helsinki.