MOTION IN MUSIC

A Study of Movement and Time through Musical Interpretation

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ABSTRACT

'Motion in Music' is a study of movement and time through musical interpretation. It looks at ways in which motion, both physical and conceptual, is featured in the musical performance and it is, therefore, written with the performance of music in mind. As such, it provides us with a fresh approach to music-making. The study is based on a series of definitions and a distillation of personal experiences rather than a summation of experimental observations. In view of the author's musical background, the piano is featured most prominently in this study.

In Chapter I, we examine the background on the subject and, so as to determine to what extent such motion is virtual and to what extent real, we look at it in its aesthetical, psychological and philosophical contents.

The act of music-making is then analysed in four stages: from the preparatory, to the moment contact is made with the instrument and to the passage through time from one note to the onset of the next. The concept of the 'sphere', as representing the musical tone, is introduced in order to trace the course of this sonorous body through tonal space.

In the ensuing chapters, we examine the forces which initiate sound - the mechanisms of the instrument and the mechanics of the body - and see how the tonal body reacts when these are applied. Such an investigation permits us, however loosely, to relate musical phenomena to the laws of motion and to show how the sonorous body, once set in motion, undergoes changes to its speed, shape and direction - changes we refer to as 'speed of music', 'mass of music' and 'direction of music'.

As the perception of movement in music involves directly or indirectly the participation of all our sensory system, both in the creative process of expressing the musical line and in its apprehension in the first place, we examine its effect on our tactile, auditory and visual channels of communication.

In order to enhance our understanding of musical growth and musical progression further, we impart to it a visual perspective based, amongst others, on melodic contour and bodily movement as well as on the gestures of the conductor or those commonly used in the world of pedagogy. Thus, in Chapter V, a series of free hand-produced graphic representations emerge which represent such musical activity.

By way of conclusion, we seek out various degrees of motion and their relationships. We identify these as being of paramount importance in producing aesthetically pleasing musical textures and propose further study as to the precise nature of such relationships.

PREFACE

This is a study of movement and time through musical interpretation; a concept that performing musicians have long been aware of, but which is still waiting to be defined.

In a good musician there is an instinctive sense of the part movement and time play in relation to the structure of the piece, with all the elements implied: that is, phrase content, rhythmic patterns, harmonic basis and tension, architectural structure, dramatic and emotional balance. The sense of movement and time is one of the tools of communication; it has both a theoretical application and a spontaneous application.

There are problems, springing essentially from the fluid medium; music when realized is ephemeral existing for the moment in time. Therefore stereotyped rules are unnatural. But some logical basis appears to exist. Experience shows that the more convincing performances do exhibit logical patterns, however general. These may be the result of instinct, but exhibit a surprising uniformity.

The purpose of this study is to search out this logical basis. At the conclusion, the reader should have a higher awareness of the tools at the performer's disposal. Indeed, the study explores one aspect of the search for the definition and application of what is generally termed musicality.

The study is built around the definition and the interpretation of the following concepts:

a) speed of movement
b) forces that set sound in motion
c) mass of sound
d) vehicle in motion
e) direction of movement

The research that has taken place and the in-depth reading of relevant literature which it has entailed, grew out of my own experiences in the field of music-making - as concert pianist, conductor and teacher. My daily practice in the search for improving my performances has been an inexhaustible source of enlightenment to me as to how music is performed and perceived. These "experiments" have been conducted both during practice sessions as well as during my experience on the concert platform.

The ideas put forward in this study represent many years of constant enquiry on the part of a performing musician for a logical basis upon which to construct a performance practice. They conform to a pattern which has enabled me to understand and communicate music at a variety of levels. Thus it is an enquiry which, to all intents and purposes, is written with the performance of music in mind. In my search, I questioned many colleagues about their own experiences, and was thus able to confirm that my findings were shared by many.

In the ensuing pages of this study, I have cited a number of distinguished authorities who have enabled me at times to substantiate points of view which, by their nature, can only remain speculative. MOTION IN MUSIC comprises, above all, a series of definitions of concepts and a distillation of personal experiences forming the basis for an interpretative approach, rather than a summation of experimental observations. As Eduard Hanslick says: "What makes a piece of music a work of art and raises it above the level of physical experiment is something spontaneous, spiritual, and therefore incalculable" [1].

MOTION IN MUSIC sets out to explore the nature of movement in music when performed: the physical movement which is perceived objectively as well as that which is perceived subjectively. The main thrust of this study has been to define, identify and trace movement in all its musical guises.

1. E. Hanslick - *On the musically beautiful* (1981 : pg. 42)

CHAPTER I

CHAPTER I

MOTION IN MUSIC

How the lines, some robust and some delicate, pursue one another! How they ascend from a small curve to great heights and then sink back again, how they expand and contract and forever astonish the eye with their ingenious alternation of tension and repose! There before our eyes the image becomes ever grander and more sublime...Does this mental impression not come close to that of music? [1]

(Eduard Hanslick)

1.1 INTRODUCTION:

As music is the art of expression in sound, that is, vibrations, this essay examines the ways in which such vibrations are set into motion, and how they may or may not be manipulated.

Much has been written about the manner in which a note is produced on various instruments and its resulting quality of sound. The nature of sound in the scientific context, in terms of its speed, direction, loudness, quality and pitch, has been the study of many a scientist. The concept of 'motion' as a percept in music has also been the subject of enquiry in the fields of musicology, philosophy and psychology. However, the role that motion plays both

1. In the book *On the Musically Beautiful*, Hanslick is describing the arabesque, a branch of ornamentation in the visual arts, in order to affirm his view that music is tonally moving forms (1981: pg. 29)

theoretically as well as practically in the interpretation and performance of a work of music, needs to be explored.

This study looks at what happens or what can happen to one sound in its ensuing path towards the next. The art of expression in sound is primarily determined by the artist's skill in manipulating sound and its behaviour in terms of its dynamic quality, pitch, timbre and, essentially, the way it is linked to the next sound or its position in a series of sounds. In doing so, he may create patterns of directions, densities and volumes in an infinite variety.

These manipulations are expressed in the medium of time since all music is a succession of sounds perceived as movement in time. The correlation of the behaviour of manipulated sound to the medium of time shall be entitled for the purposes of this study, **MOTION IN MUSIC.**

By its nature, music is experienced as a sonic phenomenon. As such, it is perceived through our auditory senses. Musical perception though, is a human experience that directly or indirectly involves the participation of all our sensory system. For many, it is above all, a spiritual experience. 'Motion in Music' is a concept that has a variety of implications: there are musical and scientific implications as well as philosophical and psychological implications. As a consequence, this study encompasses areas of musical cognition that are both subjective and non-quantitative.

Above all, the concept of motion in music provides us with a new approach to music-making. It deals with the movement of the human body, the movement in the mechanics of the musical instrument and the movement of the musical line. These three areas of motion are intrinsically interrelated and the understanding of this interrelationship - which up till now has remained largely intuitive - is what constitutes the "artistry" of a performance. Motion and sound are treated in this study as intrinsically inseparable. Now whilst the movements of the human body and the mechanics of the musical instrument can clearly be defined, the movement of the musical line can only be conceptualized.

The meaning of the word 'motion' is defined in the dictionary as the act, state or manner of changing place 1. In music it can be applied to a change in the state of auditory experience which occurs in time. Whilst without visual or tactile contact the sound of an object in motion can make us aware of its spatial orientation, musical sounds, in the physical sense, cannot be referred to as corporeal bodies in motion nor can they occupy space as such. Yet, in common with physical motion, changes to states of auditory experience, such as variations in pitch and rhythm, are experienced over a period in time.

There is broad consensus in the field of musical study which adopts the view that hearing music is hearing motion. For instance, we refer to the movement apparent in melody as the rise and fall of the melodic line. In the physical sense, motion is experienced when an object is perceived to move through space; in music, we perceive an impression of motion when a series of tonal progressions occur.

If motion implies the displacement of a body in space, in music, that body must be attributed to the musical tone. But as such, it is neither tangible nor corporeal. The tonal body may have bodily characteristics such as weight, colour and volume attributed to it but only in the sense of a phenomenal object.

One can therefore surmise that corporeal bodies command bodily motion whereas musical sounds exhibit psychic or 'virtual' motion. For this reason musical motion is a unique phenomenon. It is the motion of tonal entities in tonal space - the auditory space which, in Révész's words, "becomes alive through sound" 2.

1. Chambers Concise Dictionary (1991)

2. Géza Révész - *Gibt es einen Hörraum?* (1937) - cited in Zuckerkandl (1956: pg. 277)

The concept of tonal motion may well have its roots based on the dynamic qualities to which individual tones share in relation to each other: the constant polarization of tones and the extent to which these evoke kinaesthetic degrees of tension and relaxation. Ernst Kurth refers to the tension and forward motion inherent in a structure whose pervasive tension, he says, "is contained in the character of linear polyphony and whose innermost nature is illustrated by the constant energy of its kinetic tension" 1.

Moreover, the role that movement plays in the performance of music is also an important factor in determining how we perceive musical motion. Sound stimuli in general invoke kinetic impulses in our bodies. It is indeed possible to convey the impression of musical movement through such bodily actions and in particular those which propagate sound. Stravinsky has said that "seeing the gestures and motions of the different parts of the body that produce music is necessary and essential to grasping it in all its fullness" 2.

There has recently been an empirical study by Jane Davidson entitled 'Perception of Expressive Movement in Music Performance" (1991), which examines the way musicians move their bodies in performance. The study deals primarily with the visual perception of music performance through identifiable expressive motions on the part of the performer. The latter specifically identifies expressive locations in the music while Davidson searches for

1. Ernst Kurth - *Grundlagen des linearen Kontrapunkts* (1931) - cited in Rothyarb (1991: pg. 54)

2. *Stravinsky, an Autobiography* (1936) - cited in Zuckerkandl (1956: pg. 340)

specific movements which deal with the expressive content at particular junctures. A large number of techniques were used to collect a wide range of information. In her investigations there appears to be some evidence that certain movements have a relationship with musical figures and hence musical structure.

Davidson's results suggest that the performer, in this case a pianist, has expressive intentions which are literally embodied in a series of specific performance movements. These are intrinsic to what the pianist's image of the piece is and they form the basis for a vocabulary of movements which is essential to the expressiveness of the performance.

Whilst a study of this nature elucidates the degree to which movement is formative as well as functional in music performance, it nevertheless does not correlate movement with the sound itself. In my opinion, the quality of the musical sound and the physical movement which produces it, are inseparable, that is to say, the movement as applied to the instrument should produce a quality of sound which will reflect the emotional content of the music, as perceived by the interpreter and perceived by the listener.

However, there are a number of relevant points emerging from Davidson's study:

1) the pianist has expressive intentions which are literally embodied in a number of particular movements only part of which relate to the actual physical manipulation of the piano key

2) these are congruent to what the pianist's mental image of the piece is

3) there may well be one movement source for all the expressive movements, with one body area being more appropriate than another at certain times

4) certain movements have a recognizable relationship with musical figures (hand lifts tend to occur at rests and held notes) which suggests that some specific movements may be the best, or the only possible, movements to realize the expressive content of a particular locus

5) the pianist becomes aware that his body is a powerful communicative medium for expressive intention

6) the pianist thinks of the musical language and meaning in terms of physical movements and sensations.

In the experiments which took place the pianist was asked to identify certain musical junctures in a piece of music which appeared to him to be of a particularly expressive nature. These junctures were then used as focal points in order to monitor the various movements which the pianist made.

As apart from bodily movements that are apparent to the human eye or, in the case of Davidson's study, to the scientific apparatus which she used for her experiments, one may claim that there are movements of the body constantly in action which cannot at times be perceived by the eye of the observer, however vigilant, and which the musician uses in order to express the musical content of a piece of music. This is exemplified by the fact that, when asked to mark specific locations of particularly expressive nature in a work by Chopin, the pianist in Davidson's experiment responded by pointing out that the whole piece is expressive and that he *ought to encircle the whole piece.*

Expression, after all, is realized not in the movement *per se* that the pianist makes, but in the quality of the sound which it calls into being. Some of this is evident to the eye whereas some is the product of minute impulses of the pianist's body, particularly at the fingertips, which remain imperceptible.

There is no doubt, if we are to accept Davidson's findings, that bodily movement plays a predominant communicative role in expressing musical intent at the same time as it provides the physical agency. Her premise that the pianist thinks of the musical language and meaning in terms of physical sensation, is particularly enlightening and pertinent to this study.

Davidson's results also confirm quite unequivocally that certain motions of the body represent the emotional reactions of the human psyche: the sound-world to which the musician is exposed at the time music is realized, evokes emotional reactions which in turn invoke bodily actions in a continuous threeway circuit. In this way they exemplify what Descartes, first to detect and analyse this holistic process, calls the 'passions of the soul' which stimulate the action of the body: "In addition to the fact that these various movements of the brain make our soul have various sensations, they can also, apart from [the soul], make the spirits take their course toward certain muscles rather than others, and so [make them] move our members" [1].

Whilst it would be true to say that bodily movements form a powerful communicative medium for expressive intention, this study will concentrate on those specific movements which are at the same time in direct contact with the instrument thus producing sound. This study, therefore, incorporates a language which defines movement as an expression of musical structure and not movement as an emotive response to musical structure. Even though such actions generate a series of involuntary reflex actions throughout the rest of the body - an accent delivered by the hand for instance may go on to produce a simultaneous nod of the head by sympathetic reaction- these are peripheral actions which are activated by the bodily impulses first encountered at the point of contact.

1. René Descartes - *The Passions of the Soul* (1989 : pg. 36)

In the following pages an approach will be adopted which relates music to its quintessential being i.e., to its sound-world. In the words of Hanslick: "the primary object of aesthetical investigation is the beautiful object not the feelings of the subject" (ibid.). Our attention must therefore focus on the sound, or the 'tonal motion' apparent in music which impels a movement in the body and not the bodily reactions to multifarious emotional stimuli, however important these may be in signalling and corporealizing musical intent. Accordingly, those movements which cultivate the feeling of motion in music - the "beautiful in music" in Hanslick's opinion - are what need to be examined.

For this reason, one must identify some basic motions which the hand makes in the course of producing a sound on an instrument such as the pianoforte. Even though every pianist uses movements which are specifically suited to his individual temperament and physical constitution, there are basic motions of the hand which are widely accepted as formulating the basic ingredients for a fundamental piano technique.

These motions have been identified by the pianist and pedagogue Gyorgy Sandor [1]. They are altogether five: free fall (a term first coined by the German piano teacher, Ludwig Deppe); five-fingers, scales and arpeggios; rotation; staccato; and thrust. These basic technical patterns will serve as fundamental motions of the hand which directly affect the sound quality and on which the abstract concept of 'motion in music', complemented by the various graphic illustrations and images which they induce in the performer's mind, will be formulated.

1. Gyorgy Sandor - *On Piano Playing* (1981)

In postulating a notion of this kind, one is immediately confronted with the inevitable question: is it the movement of the hand which contributes to the perceived pattern of musical motion or is it the latter which induces a movement in the hand comparable to the expressive nature of the melodic flow? The answer may well be that both operate reciprocally.

While what is being proposed may seem at this stage to be casting our net rather widely, this can be justified by the fact that the concept of musical "movement", as written into our language, lies in an integrated synthesis of various elements: the motion of the hand; the play of sounds which emerges over time in terms of variations in pitch, volume and timbre; and the symbolic-linear patterns as depicted in our Western notated scores. All of these will therefore need to be looked at in the course of this dissertation.

Sandor believes in a one-to-one correspondence between these patterns of musical notation and the basic formula or formulas to be applied: "any sequence of notes, phrasing indication, or touch forms (legato, staccato, portato, and tenuto) can and must be matched with its own technical equivalent", in other words that the pattern of the melodic line as conveyed in notation or conceived in the mind is invariably matched by complementary movements in the hands of the performer.

Indeed, a physical movement which is aligned to the 'movement' of the musical line can usually be anticipated: as the melodic line rises in pitch, it may be complemented by a rise in the performer's hand; as the music 'grows', the thrust of the arm will induce a sound with increased volume and tonal weight in accordance to what the music dictates, thereby conforming tonal volume with physical impetus as applied to the instrument; as the music intensifies, the musician may experience increased tension as more pressure comes to be applied to the instrument, thereby correlating the intensity of the musical texture to a tactile sensation.

Furthermore, the speed with which the hand moves, or the bow of a stringed instrument moves, will indicate a general speed (whether tempo related or otherwise) at which the music flows, thereby relating the speed of bodily action to the flow of the musical line. In all these cases, which may range from the simplistic to the metaphorical, the movements of the hands are indicative of musical patterns and musical intent and are intuitively formed and applied with such criteria in mind.

Tracing motion as such - the speed, mass and direction of bodies which are being displaced in space and time - is a process which records bodily movement and kinaesthetic feelings aroused in the mind of the perceiver in context with musical requirements. As such, it involves the active participation of various sensory faculties all working interactively and in complement with each other.

There is much evidence to suggest that certain musical patterns or structures are a direct result of spatial patterns of movement which the musician exercises in performing on specific musical instruments. This means that the movement perceived in the flow of a passage in music may also be comparable to the movement essential in the execution of such passage.

John Baily, in his essay on 'Music Structure and Human Movement' (1985), reports on empirical evidence from research undertaken in Afghanistan on the way Afghan instruments are played, which relates bodily movements in the performance of music with structural musical patterns which accommodate such movements. Baily cites the work of von Hornbostel (1928), Kubik (1979), Blacking (1955, 1961, 1973) and Sloboda (1982) amongst others, to promote the view that musical cognition is as much a visual appreciation of the role human movement plays in formulating such patterns as it is an auditory experience:

"The auditory perception of music is only one aspect of musical cognition; of equal interest and importance is the cognition of performance...the activity of music making involves patterned movement in relationship to the active surface of a musical instrument...Human movement is the process through which musical patterns are produced: Music is the sonic product of action...there is a need to study the way that musical patterns may be represented cognitively by the performer as patterns of movement rather than as patterns of sound" 1.

Ethnomusicologists have ascertained the important role body movements play in the performance of African music and how closely linked these movements are to dance. Indeed in some African languages there is no distinction between the words "music" and "dance". Kubik (1979) suggests that African music is not sound alone as it involves a strong input of dancelike movements in performance. There are, according to Kubik, distinguishing characteristics of motional and sonic patterns:

"The difference between *rhythm pattern* and *movement pattern* is that the former term implies something which sounds whilst the latter also includes musical phenomena which are completely without sound...behind the so-called rhythm patterns of African music there are movement patterns which have both a sonic and a nonsonic dimension".

These pantomime elements behind the sonic patterns, however, are what determine the sonic pattern:

"The nature of the patterns of movement has a direct influence on the audible 'music'...The change in the motional pictures brings about a change, even if only slight, in the exact 'spacing' of the notes to be struck. This leads to delays, anticipation, slight fluctuations in tempo, and a sense of lack of *drive*. The changing of the motional picture also destroys the original accentuation and the change in the mode of striking the individual notes also exerts an influence on their sound spectrum" (cited in Baily).

1. J. Baily "Music Structure and Human Movement" - *Musical Structure and Cognition* (1985: pg. 237)

Blacking (1955) draws attention to the similar if unavowed importance of movements in the performance of Western music:

"A pianist who plays the *Etudes* of Chopin or many pieces by Liszt cannot help being conscious of the sheer physical pleasure of numerous passages, and noticing how the music grows out of the physical movement...We find numerous examples of Western classical music, where the musical form is much influenced by the properties of the instrument for which it was written" (cited in Baily).

Sloboda (1982) adopts the view that the development of performance skill on an instrument is a mastery which allows the musician to reproduce immediately musical patterns that he or she either hears or experiences as auditory images (cited in Baily). John Baily sums up as follows:

"The issue is complex and one needs to take into account many factors, such as the transfer of musical skill from one instrument to another and different levels of performance encountered in the acquisition of an instrumental skill. But it is clear that what is remarkable about musical performance is the integration of auditory and spatiomotor representations of music structure; the same pattern can be attended to by the performer both as a pattern of movement and as a pattern of sound. Auditory, kinaesthetic, and visual information may all be involved in the planning and feedback control of the pattern. Instead of viewing the spatiomotor component in musical cognition as a lower-level process through which auditory images are translated into sound patterns called music, it may be better to treat auditory and spatiomotor modes of musical cognition as of potentially equal importance".

All such evidence suggests that musical patterns, whether melodic or rhythmic, insofar as they can be described in terms of musical motion, are by the same token closely linked with the patterns of movement in performance. Whether these patterns are formulated with the thought of movements essential in their performance already in mind or whether they represent musical structures which demand designatory motor actions analogous to their structure is perhaps irrelevant. For both possibilities, in Baily's words, "assume the presence of human factors that interact".

Furthermore, the modern pianoforte, the instrument featured most prominently in this study, has been shown to be sensitive to the most subtle of touches exerted upon it by the human body, responding with a distinct quality of sound for every degree of pressure. If, as Sàndor suggests, this approach is suggested by the music itself, it would be helpful to identify concurrently a pattern of physical motion and musical progression in order to formulate patterns of musical activity through such interplay. Indeed, it would be highly desirable to correlate the two consciously as they are by nature intrinsically interconnected: the quality of the sound being determined by the movement of the playing mechanism whose motion is in turn suggested by the musical text.

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It is common practice amongst many performing musicians to describe verbally and symbolically various musical experiences which denote the qualitative as well as the quantitative nature of the musical sound. Metaphors which describe the basic approach to the note: feeling the note, pulling it, suspending it, striking it from various directions (from underneath, from above); adjectives which express metaphorically the quality of the note: heavy, dark, light; indications of the basic direction and position of notes: to the heights, to the depths, to the right, to the left and so on, feature widely in the world of instrumental pedagogy and performance practice.

It would be naive to regard such representational notions as merely fanciful or gaudy. In the words of Suzanne Langer: "it is impossible to talk about art without adopting to some extent the language of the artists...Their vocabulary is metaphorical because it has to be plastic and powerful to let them speak their serious and often difficult thoughts...The critic who despises their poetic speech is all too likely to be superficial in his examination of it, and to impute to them ideas they do not hold rather than to discover what they really think and know" 1.

Metaphorical phraseology and imagery enable the musician to construct a model for the sound image that he or she perceives, in terms beyond the auditory experience. These metaphors regard and treat sound almost as an object capable of retaining its identity despite a variety of manipulations and which manifests itself outside the common run of auditory experience. Hans Heinz Dräger in his *Concept of "Tonal Body"* 2, considers tone as "both an object and a process, not only because the perceived process traces back to an object (which is also the case in seeing), but also because in hearing, it is the process transmitted from the [originating] object, which we perceive as an object..."

1. Suzanne K. Langer - *Feeling and Form* (1953)

2. from *Archiv für Musikwissenschaft, Vol. IX, No. 1* (1952 : pp 68-77)

Dräger's concept of the "Tonal Body", which possesses properties such as volume, density and weight, will be considered in detail when we come to talk about these qualities in relation with the dynamic process of motion in music. Suffice it to say that the concept of "tonal body" is of structural significance in the process of music-making and musical understanding.

There are two clearly identifiable areas of sensory perception which manifest themselves in what has been proposed so far: that which moves and that which is sensed to move. The one pertains to a mode of visual characterization whilst the other relates to a mode of tactile sensation. Together with the auditory manifestation of musical sound, they form the basis of communication: auditory, visual and tactile. The performing musician hears sound, "feels" sound and "sees" sound.

Charles Seeger (1971) [1] proposes an accretional aspect of the process by which "Speech and music, as species of auditory communication are linked inescapably with visual communication on the one hand and with tactile communication on the other". Seeger lists these three "media, channels, or avenues of communication: tactile, auditory, visual", near the top of his conspectus of communicatory consortium. He regards the relationship of these various systems of tactile and visual thinking as prime subjects for musicological investigation. He believes that music and dance function as communication and, as do all the other means of communication, "function in the same general (outward) spacetime". In his essay on a "Unitary Field Theory" (1970) [2] he finds a counterpart of the sound space of music, in the space which the dancer's body occupies:

1. Charles Seeger - "Music as Concept and as Percept" - in: *Studies in Musicology* (1978: pg. 38)

2. Charles Seeger - "Toward a Unitary Field Theory for Musicology", Los Angeles (1970) - in: *Studies in Musicology* (1978: pg. 136)

"The dancer's own space is always his, however he may move in general spacetime. He uses another of our three media, tactility. The prime sensation of the dancer is the touch of the ground upon which and the air in which he moves, the speed and relative durations of the movements he makes. In many respects, the rhythmic density of dance can be identical with that of music. The movement of dance is, however, mostly with the outer musculature, not an inner, as with music. Spatially, however, that is, in terms of mass, the semiotic medium of dance is quite, though not, of course, totally, different from that of music". However, "a musical instrument is an artifact; the musician dances upon it - even with it, as may a dancer..." Moreover, Seeger considers instrumental music "a real composite of all three media".

Jean d'Udine in *L' art et le geste* takes a similar view when he relates music and the performance of it with dance: "All the expressive gesticulations of the conductor are really a dance...all music is dancing...All melody is a series of attitudes...Every feeling contributes, in effect, certain special gestures which reveal to us, bit by bit, the essential characteristic of Life: movement" [1].

In considering what Seeger says, it is important not to forget the source of all music-making which is the direct contact of the human body with the body of the musical instrument. The percept is a tactile one. In the experience of piano playing, the source of music-making can be traced back to the moment at which the fingertip makes contact with the key. In this sense, the nucleus of all musical sound in piano-playing is concentrated on the minute area which the fingertip controls. The simile, as proposed by Seeger, would then be that in pianoforte playing, the fingers of the pianist "dance upon the keys".

1. Cited in *Philosophy in a New Key* by Susanne Langer (1942 : pg. 226)

If musical sound - what Jacques Handschin describes as "the essentially musical being, that is, musical tone" [1] - is to acquire "bodily characteristics", as Hans Heinz Dräger [2] suggests and as this study proposes, it must be conceived at the time bodily contact is made with the sound-producing mechanism. Furthermore, if the "tonal body" is to acquire the various characteristics that are attributable to it: volume, density, weight, shape, it must conform to a structure that is manageable throughout a series of voluntary bodily actions.

In this respect, musical tone is represented in this study as a "spherical mass". Its satisfactory inception at the point of contact with the instrument has more often that not been described as "rounded" tone and it is not for nothing that it has evolved over the years to be portrayed as such in classical Western notation. As a 'sphere', it attains various 'bodily characteristics' as the 'art of touch' is applied to it. Dräger treads a similar path when he represents *the Sonal Character* of the musical tone in the image of the sphere: "If we conceive the piano tone in the image of a sphere, tones of both high and low frequencies must be regarded as spheres. Then the high frequency tones might appear pointed because of their smallness, but not because they have changed their form".

One cannot talk about motion without examining the scientific criteria that define motion. If we agree to speak of musical sound as possessing "tonal body", we cannot then deny it bodily characteristics. As such, it is governed by the laws of motion. As various forces act upon it, it is susceptible to a number of changes which determine its shape, speed and direction. At its conception, the "tonal body" is subjected to the force that the human body applies to it. As a consequence, its overall shape, weight, density and volume change. The "body" is subsequently projected in various directions at different speeds. It is this "voyage" of transformation, from the moment the "tonal body" is conceived to the moment it ceases to exist, which needs to be traced.

1. Jacques Handschin - "The character of Tone" - (Der Toncharakter; Zürich, 1948) – cited in Dräger (ibid.)

2. Hans Heinz Dräger - "The concept of 'Tonal Body'" from *Archiv für Musikwissenschaft*, Vol. IX, No. 1 (1952 : pp. 68-77)

There are likewise visual surrogates inherent in the conventional Occidental notation. These - the so-called Cartesian co-ordinates - represent a linear identification of high and low points in pitch with high and low points on the manuscript score, and identification of time elapsed from the onset of one musical sound to the onset of another with references from left to right on the page. Thus the page represents a partial visual parameter on a two-dimensional plane though failing to portray what happens *between* the notes.

The following description of the process by which musical sound is initiated is all too familiar: a note of music emerges when an instrumentalist, say a violinist, embarks on the performance of a work by drawing the bow over the string. As sound emerges it may grow in volume to the degree in which speed and pressure increase. Vibrato is also applied at some stage after the note is heard, first slowly and then gradually faster. Vibrato may then cease as and when another finger prepares to play the next note in the series. When the bow changes direction, the continuous flow of the sound may momentarily cease.

What has just been described is what may happen, or indeed happens frequently, when a single note of music is played. The elements at play (the speed and pressure of the bow, the precise time at which vibrato is applied, its variable speed and so on) cannot be traced in the conventional score of our Western musical culture. Yet they constitute the wherewithal for imparting meaning and expressiveness to the musical line. Should one, therefore, seek a notational system other than our own symbolic notation of distinct noteheads in order to trace the course of the musical line?

Charles Seeger, in the 1950s, pioneered the development of the **melograph** as a scientific instrument which recorded accurately the pitch and loudness of a melody in relation to time in a continuous graphic representation which could not otherwise be shown in conventional notation. The Seeger melograph model C went further to incorporate the function of the sonagraph which in addition to pitch and loudness, explored the spectrum of the examined material.

There are advantages in seeking a notational graph because, as we have seen, there are large areas of musical function which cannot be depicted in conventional notation. Pitch, for instance, is only roughly indicated in the score: a note can vary in pitch depending on the particular degree of the scale it represents. For example, such a note can have a different frequency rate when played on the pianoforte which is tuned on the well-tempered scale than when played on the violin. Similarly, the same note in the score can vary in pitch according to the way an instrument is tuned. Furthermore, the slight wavering of pitch that results from the use of vibrato cannot be represented by our conventional Occidental notation.

Likewise, the dynamic markings which are encountered in the score are not indicative of any specific dynamic levels of loudness. They refer the performer to vague indications which need to be almost always interpreted in relative terms.

The conventional notational format is also a poor indicator of tempo. Minute deviations from strict metronomic time have proved to be the underlying factor in determining the expressive nature of a musical performance [1].

A notational graph or a melogram can show changes in time to within a tenth of a second and to the pitch of a sound to within one tenth of a tone (20 cents). It can thus serve as an accurate indicator of "what happens between notes". As Seeger says:

1. Neil Todd - "A Model of Expressive Timing in Tonal Music" - *Music Perception* Vol 3, No 1 (1985) "Expressiveness imparted to a performance lies in the departure from metrical rigidity and constant intensity".

"Each of the many music traditions in the world probably has its own distinctive ways of connecting or putting in what should come between the notes. Conventional notation can give no more than a general direction as to what these are... In the graph they are all there for anyone to see in clear detail. If it causes us some trouble to find out just what the notational equivalents are, we should be glad that the performer did not render notes. Rather, we should be glad that instead of rendering notes he rendered music, and that we may set ourselves with greater assurance to the task of finding out what he did sing or play, without preconceptions that he meant to, or should, have sung notes" [1].

The graphing apparatus which brings to our existing notational techniques the needed complement of showing "what happens between the notes" is, for all intents and purposes, much more than what Seeger modestly claims it to be - a strictly musicological tool. Indeed, it is from a scientific perspective the closest we come to charting the flight course of our "sonorous body" as it describes its motion from one notationally "fixed" state to another (granting that any such fixed state is at the same time a highly fictitious state for anything of which the quintessence is motion and flux).

The performing musician may benefit from close scrutiny of the graphical "traces" of his performances obtained through such means so that he can draw valuable information on which to base an imagery that serves to portray as much as possible the sensory and perceptual character of his creative music-making as a whole.

1. Charles Seeger - "Prescriptive and Descriptive Music Writing" *Musical Quarterly*, XLIV (1958)

However, as a purely musicological scientific tool, the melograph cannot and does not tell the whole story. For instance, it cannot portray the various changes in the speed of the bow or the celerity of the pianist's hands which are so intrinsic to the perception of the innermost subtle speed variations in the flow of the musical line. As Seeger points out, technological devices report only upon the physical stimulus to the outer ear. The conception of a writing system in which the full sensory and perceptual reaction of a person is comprehensively represented visually is clearly an impossibility: "automatic music writing by such aids as those referred to must no more be taken for what we think we hear than most conventional notation" (ibid.).

Moreover, this treatise exemplifies the study of music-making as a creative process, which is by nature ephemeral, and not music as a product of this process. In this process we intuitively record the experiences to our sensory and perceptual faculties which formulate various impressions in our minds, and portray these in free hand-produced representational graphs based partly upon the notation, partly on what we feel, 'see' and hear as well as on how the body's playing mechanism moves in performance. Such graphic representations are commonly used in pedagogy enabling the student to trace the musical line and correlate this to the motions of his playing mechanism.

For instance, in dealing with the basic direction of the melodic flow we may choose to record a pattern which represents the salience of notes in a melody as experienced in the process of creative music-making. We would thus be formulating a pattern close to that of melodic contour which is in itself, according to a theory put forward by Edworthy following a series of experiments carried out in 1985, a meaningful psychological entity in music perception [1].

1. Melodic contour is, by Dowling's definition (1978), the representation of the sequence of ups and downs in a melody independent of the precise interval sizes.

Indeed there is ample evidence to suggest that melodic contour, as a psychological entity in musical perception, is a more useful representation of the melodic line than a representation of a precise sequence of intervals (Edworthy 1985). Otto Abraham (1923), in a series of investigations to determine whether people tend to sing more in equal temperament or just intonation, reported in the *Psychologische Forschungen* (Berlin, 1923), that the singers' intonation wavered between the two modes and that the discrepancies always appeared at a point where a rise or fall of the melody occurred. In most cases the direction of the discrepancy followed the upward or downward direction of the melody (cited in Zuckerkandl, *Sound and Symbol,* Princeton: 1956).

This shows clearly, as do Edworthy's results, that generalized interval information or contour, while strikingly different from precise interval information, may be a more useful representation of melodic perception as well as melodic execution in musical performance. In this respect, the very essence of tonal motion has, in Zuckerkandl's words "its origin not in differences of pitch but in differences of dynamic quality" (ibid.).

If we were to consider melody as flowing along a sinuous course in an almost unbroken stream as Seeger suggests, then we should be compelled to trace its course if only to determine its integral characteristics. The performing musician is not oblivious to this. After all, he uses bodily movement to express musical content (Davidson 1991). However it may be represented or constructed, the graph will contain important data enabling the musician to capture on paper the very "motion" of the melodic line which gives it its power to affect us. At the very least it will represent, as Seeger points out, the almost infinite variety of interplay between and within beats, which "defines more closely the fault so often found with the unskilled performer: that he rendered the notes correctly but left out what should have come between them..."

Motion in music, as a concept of musical growth and progression, can only be understood when all its constituent elements: metaphoric, manual and acoustic, are clearly defined. Furthermore, motion, as a concept applied to music, must adhere or at best appear to be analogous to the principles and laws which govern physical motion. In this respect, the speed, shape and direction of that which moves must also be defined.

Whilst music has traditionally and unquestioningly been located in the realm of auditory experience, we may well be surprised at the decisive part such visual corollaries and analogies play in gaining us access to and profit from its store of riches - the same surprise as that occasioned by Baudrillad when he challenged the long-accepted precedence of speech and "writing".

SUMMARY AND CONCLUSION:

'Motion in Music', as applied in terms of an interpretive enquiry, attempts to show how motion features in the creative process of expressing the musical line just as it does in its apprehension in the first place. This creative process is constantly being fed through a synthesis of the tactile, auditory and visual channels of communication. It accounts for the way the hand moves while playing a musical instrument, the way the melodic line moves in terms of its undulations and what the performer feels tactilely when contact is made with the musical instrument. These three-way experiences give rise to a mental imagery which has an audio-visual-tactile impact on our sensory perception.

A fruitful line of enquiry may be to perceive of musical sound as a concept of "tonal body", possessed of bodily attributes. As such, it would be governed by the laws of motion through which its various functions vary according to its shape, speed and direction. The patterns which then emerge would be seen to owe as much to our sense of touch as pianists, as they would to our auditory and visual sense. Sound, we would then argue, as the source of all music-making, is inextricably linked to what we feel and what we see, so that what we see and what we feel is ultimately what we hear. In this respect, the ultimate musical experience may well lie in the hands of the performer.

1.2 AESTHETICAL, PSYCHOLOGICAL AND PHILOSOPHICAL CONSIDERATIONS:

The concept of 'motion in music' and visual representation of the musical line, which implies that music is not merely a sonic phenomenon but that it has spatial as well as visual associations, has aesthetical, psychological and philosophical implications. These faculties, each in their own discipline, have contributed copiously to the discussions and arguments of moving elements in musical structures.

Eduard Hanslick, back in 1891, attested to a lack of serious inquiry with regard to the concept of motion in music which he regarded as fundamental and most fruitful to an understanding of the nature and effects of music (ibid.). He regarded active imagination as the real organ of the beautiful in art. Music represented to him a range of ideas which, corresponding to the organ which receives them, relate to audible changes in strength, motion and proportion. Included are ideas of increasing and diminishing, acceleration and deceleration, simple progressions and clever interweavings.

Hanslick searches for the aesthetical significance of music and finds it in a concept which he calls 'tonally moving forms': "in music the concept of 'form' is materialized in a specifically musical way. The forms which construct themselves are not empty but filled... music is actually a picture, but one whose subject we cannot grasp in words and subsume under concepts" (1981, pg. 30).

The musician's employment of analogies, metaphors and visual representations of his sensory perceptions, is no more than a synaesthetic realization of the beauty that lies in the dynamic qualities of its structure. In this respect they furnish the criteria for an aesthetical enquiry into what Hanslick terms 'The Beautiful in Music'. They are conceived of as portraying the autonomous beauty of tone-forms in music. Analogies such as those used by Hanslick to express the aesthetic appeal of music and to convey its attribute of motion never detract from the object in view. As Hanslick says: "If some sensitive music lover objects that our art is degraded by analogies..., we reply that it is not much to the point whether the analogy is precise or not. We do not degrade a thing by becoming better acquainted with it". In the following extract from his treatise, Hanslick contemplates an analogy which is particularly pertinent to what is being proposed in this study:

"In pitch, intensity, tempo and the rhythm of tones, the ear offers itself a configuration whose impression has that analogy with specific visual perception which different sense modes can attain among themselves. Just as physiologically there is a substitute of one sense for another up to a certain limit, so also aesthetically there is in vogue a well-grounded analogy between motion in space and motion in time, between the colour, quality and size of an object, and the pitch, timbre and intensity of a tone. Thus one can in fact portray an object musically [or music as an object is what he might better have said]".

The dynamic qualities of tones as forces which perpetuate sound when music is in motion, has been explored in the field of music psychology and cognitive psychology, and in particular by the Gestalt psychologists.

The theorist Ernst Kurth wrote a series of music-theoretical studies in which he blends harmonic and melodic analyses with psychological interpretation. He speaks about individual melodic tones containing energy derived from a pervasive dynamic current *(Bewegungszug)* and proposes the idea that melody - and music generally - is sonically manifest psychic motion: "The actual sustaining content of the [melodic] line is the dynamic currents that manifest themselves perceptibly in the individual tones" [1].

1. Ernst Kurth - *Grundlagen des linearen Kontrapunkts* (Foundations of linear counterpoint, 1931) – cited in Rothfarb (1991: pg. 21)

The totality of what Kurth calls the 'dynamic current', brings his thoughts in line with Gestalt psychology based on the theory of holistic perception 1. For Kurth, a melodic line is "kinetic energy" which can be characterized as "that relationship of individual tones where (in succession) they form a whole rather than a sum, the continuum of the line that arises from the melodic energy flowing over the individual tones". Max Wertheimer, Kurt Koffka and Wolfgang Köhler base their theories on similar ideas of dynamically organized wholes. Max Wertheimer contends that "moving is something different from being successively in successive places" 2. Köhler speaks of the dynamic knowledge of bodies and introduces the concept of "tonal body" 3 whilst for Koffka, a "trace field" is anticipated when hearing a melody which is produced by the residual force of a tone reaching forward 4.

Even before the Gestalt theory was established by Max Wertheimer's studies in 1911, both Ernst Mach 5 and Christian von Ehrenfels 6 referred to the super-summative properties in melodies. Mach regarded audible and visible *Gestalten* as closely related.

1. It is interesting to note that *Gestalt* theories are almost invariably illustrated by visual rather than auditory examples in psychology textbooks. See Walter Ehrenstein - *Probleme der ganzheitpsychologischen Wahrnehmungslehre* (1947)

2. Max Wertheimer - *Experimentelle Studien* (1911) - cited in Zuckerkandl (1956: pg. 133)

3. Wolfgang Köhler - *Die physischen Gestalten* (1924) - cited in Präger (1952)

4. Kurt Koffka - *Principles of Gestalt Psychology* (1935 : 450-51)

5. Ernst Mach - *Beiträge zur Analyse der Empfindungen* (1886)

6. Christian von Ehrenfels - *Über Gestaltqualitäten* (1890)

Henri Bergson regarded real motion as the transfer of a state rather than of a thing. For Bergson true time was a duration: "a melody to which we listen with our eyes closed and thinking of nothing else, is very close to coinciding with this time which is the very fluidity of our inner life; but it still has too many qualities, too much definition, and we should first have to obliterate the differences between the tones, then the distinctive characteristics of tone itself, retain of it only the continuation of that which precedes in that which follows, the uninterrupted transition, multiplicity without divisibility, and succession without separation, in order at last to find fundamental time. Such is duration immediately perceived, without which we should have no idea of time" 1.

Susanne Langer puts forward the theory of "virtual motion", an image or an illusion, for all forms in art: "What we call 'motion' in art is not necessarily change of place, but is *change made perceivable,* i.e. *imaginable,* in any way whatever. Anything that symbolizes change so we seem to behold it is what artists, with more intuition than convention, call a 'dynamic' element. It may be a 'dynamic accent' in music, physically nothing but loudness..." 2. For Langer, musical motion is a "semblance" 3 : motions that are only seemingly there.

The problem of musical hearing has also been the subject of an enquiry by Helmut Reinold which would seem to go far to justify Hanslick's views of a previous century 4. Audial perception he argues, is primarily a sequence that takes place in time and therefore can only be experienced as movement that requires not only time but space:

1. Enrie Bergson - *Durée et simultanéité* (1922)

2. Susanne Langer - *Feeling and Form* (1953 : pg. 66)

3. A term used by Carl Jung - cited in Langer (1953: pg. 48)

4. Helmut Reinold - "On the Problem of Musical Hearing" *Archiv für Musikwissenschaft,* Vol. XI, No. 2 (1954: pp. 167-187)

"Besides primary temporality, primary spatiality and primary motility must be attributed to audial perception. This characterization may be extended to music; music is sounding motion in temporal space. The tension between the equipollent and complementary elements of time, motion, and space is of the greatest importance for the understanding of music...". Reinold cites the work of the physician V. von Weizsäcker whose work on sensory physiology suggests that perception is an "unlimited co-operation in the nervous system of all parts during every activity...; a principle of synaesthesia involving all sensory fields" 1.

Victor Zuckerkandl has theorised extensively on the role that motion plays in the perception of music, both from a psychological as well as from a philosophical point of view 2. These are the main points raised in his treatise:

The philosophical concept of reality draws a parallel between what he calls the "inner world" and the "external world" - what our senses perceive in physical, tangible and measurable quantities on one hand with what seems immaterial nonphysical and nonmeasurable, on the other.

He defines the outer world as a visible-tangible world, a corporeal world. The inner world as nonphysical, nonbodily, in which thoughts and feelings pertain. But nature includes the purely dynamic, the nonphysical and the nonmeasurable.

1. V. von Weizswäcker - "Einleitung zur Physiologie der Sinne" - *Handbuch der normalen und pathologischen Physiologie*, Vol. XI

2. Victor Zuckerkandl - *Sound and Symbol: Music and the External World* (1956). For an extended essay on *Sound and Symbol* please see Appendix 3

In Zuckerkandl's assessment, the inner and outer worlds meet or rather "penetrate each other". The mode of such an encounter is different: in the physical world, or outer world, objects are from without, at a distance, reinforcing the separating barrier; in the inner world, tones penetrate and communicate in a way that makes the listener participate in their actions. Colour, for instance, is something that *is without;* tone as something that *comes from without.*

Zuckerkandl investigates the very essence of music. He defines the various qualities apparent in musical sound and distinguishes between what he calls "musical tone" and "acoustical tone". Acoustical tone is a phenomenon of the external world. It can be described in terms of frequency, intensity, envelope and amplitude which go to make up the physical process: a change in the physical process means a change in the tone heard.

He defines musical tone as belonging to an inner world. It possesses dynamic quality that permits tones to become the conveyors of meaning. It is the dynamic quality of the tone that makes music out of acoustical phenomena. Dynamic quality is the properly musical quality of tones.

The encounter with the tonal world includes the three fundamental experiences of motion, time and space.

On writing about 'motion', he says that the dynamic quality within a musical tone, is the very essence of musical motion. It reflects the state of an object, not the object itself: the relations between tensions, not between positions; the tendencies, not the magnitudes.

Musical contexts are kinetic contexts. The melody we sing or hear is not simply tone, or tones of a predetermined pitch; it is motions represented in tones.

He dismisses theories which refer equivocally to the motion of music as ideal or abstract. He cites Wertheimer's experimental investigations and concludes that music and motion are synonymous; that every experience of motion is, finally, a musical experience.

Zuckerkandl dismisses the theory that change of pitch constitutes the basis for musical motion. In his assertion, pitch is an acoustical phenomenon and possesses none of the acoustical characteristics that makes tones elements of musical contexts. The association of the rise and fall of tones with differences of pitch does not in itself grant tones spatiality. To talk about the rise and fall of tones in terms of spatial motion is merely a verbal and emotional subterfuge; a characteristic of aural perception which can only be described metaphorically by parameters from the realms of the other senses. The experience of tonal motion has its origin not in differences of pitch but in differences of dynamic quality.

In accord with Kurth's theory, he considers the dynamic quality of a tone as a statement of its incompleteness, its will to completion. It is inherent in any musical context, in an interval, in a step from one note to another, in the basic properties of one tone in its ensuing path toward the next. To hear a tone as dynamic quality, as a direction, means hearing at the same time beyond it and going toward the expected next tone. Listening to music, we are not first *in* one tone, then in the next, and so forth. We are always *between* the notes, *on the way* from tone to tone [1].

1. In this respect, it would be difficult to determine the precise onset time of a particular tone in music because it is sometimes only 'apparently' there and will often 'emerge' in time rather than 'appear' at a precise moment in time. A note of music is often fully realized in terms of its tonal qualities after it is 'heard'. But even then, the tone is constantly in motion. For this reason, studies such as those by Sloboda (1983), Clarke (1989), Shaffer (1984) and Todd (1985), which look for specific variations in the onset and offset times of each note, might prove to be methodologically incongruous.

In Zuckerkandl's assessment, the usual concept of melodic motion as motion from tone to tone and of the individual step from tone to tone as the bridging of the distance in pitch between two tones, does not prevail. Dynamic qualities are not stationary, they are completely of the nature of a step, of a transition: they are dynamic not static. As such, the process of motion can be represented on two levels: on a "lower", where there is nothing but the pillars, tones of definite pitch; on a "higher" level, where there is nothing but the transition:

b e t w e e n

tone | tone

The motion we hear is not "tone - tone" of the lower level; it is the "between". Stasis of the tones and motion of the melody, gaps here and uninterruptedness there, discontinuity and continuity do not enter into opposition because they concern phenomena on different levels.

There are, as one might expect, conflicting views as to what constitutes motion in music. For instance, Bergson's concept of *la durée pure*, has been criticised by Langer, Charles Koechlin [1] and Gabriel Marcel [2], even though they both remain in basic sympathy with his thesis. What is unequivocally clear in what has been cited so far, is that the idea of musical motion is not only a recurrent philosophical one (e.g. Hanslick, Bergson, Husserl etc.) but equally an all-pervasive psychological percept, whether it is referred to as a moving 'tonal body' in Köhler's concept, a psychodynamic force or process in Kurth's, an illusion based on the 'self-deception theory' (*bewusste Selbsttäuschung,* Konrad Lange) or a 'semblance' of 'virtual motion' by Langer. It is therefore, in the forces that stimulate and simulate motion that we need to pursue our line of enquiry.

1. Charles Koechlin - "Le temps et la musique" - *La Revue Musical*, VII (1926)

2. Gabriel Marcel - "Bergsonism and Music" - *La Revue Musicale*, Vol VI (1925)

Kurth refers to the animated force of the melodic line as the *energy* in the "psychodynamic sense of the music" (*Bruckner*, 1925): "This phenomenon of pervasive tension contained in the character of linear polyphony lies even in the distinctiveness of the melodic lines themselves, whose innermost nature is illustrated by the constant energy of their kinetic tension". Harmonic textures and chords are also "imbued with dynamic tensions". According to Kurth, even harmonic consonance - the vertical relaxation - "does not signify full musical relaxation, because the permeation of the harmony with unreleased tensions arising from melodic-kinetic energies comes into consideration" (*Grundlagen*, 1917).

As Zuckerkandl says: "Every psychological investigation into how we listen to music centres around the interval...The musical interval is *alive* and, like the tone, derives its life from tonal forces, not from tonal positions. Only because it is alive by virtue of forces active in and through it can one interval be linked to another..." [1].

The psychodynamic forces that perpetuate motion as dynamic currents (Kurth), or the dynamic knowledge of "tonal bodies" (Köhler), are directly perceived by the performing musician as movements of the body through which these residual forces reach forward to establish a trace-field (Koffka), which may be regarded, as Mach proposes, as a closely related audible and visible *Gestalt*. The experience is a fusion of physical as well as psychological motion. It synthesizes the outer experiences with what Hegel describes as "the motions of the inmost self" [2]. It accounts for the dynamic effects of the audible as well as the visionary experience. Visually, the eye is 'persuaded' to trace the lines the mind conceives, giving us the sensation of movement [3].

1. Victor Zuckerkandl - *Man the Musician* (1973: pg. 112)

2. Hegel - *Vorlesungen über die Aesthetik* (1931) - cited in Zuckerkandl (1956: pg. 142)

3. Based on the theory put forward by Theodor Lipps - (*Aesthetic*, 1903)

The concept of the 'spherical tonal body' that is being proposed in this study, reflects the mobility of a 'medium' which we register as being in constant and perpetual motion. The shape and plasticity of the 'spherical tonal body' allows it to be constantly elusive and mercurial. Its fluidity generates a continuum in which there exists what Bergson calls "multiplicity without divisibility" and "succession without separation". The performing musician perceives a tactile, audible and visible sensation of the 'spherical tonal body' in motion not as the actual object but as the dynamic properties of the object. Real motion is, in this sense, what Bergson calls the "transfer of a state rather than of a thing". The 'spherical tonal body' exemplifies the psychodynamic force that perpetuates motion. It represents what Wertheimer calls the "purely dynamic living interval".

CONCLUSION:

It is clear through the large literature of psychological, philosophical and aesthetical enquiry in this field that 'motion' is a concept without which it is next to impossible to make sense of the musical experience and that there are other sensory fields besides the auditory, which are directly involved in the perception of musical motility [1].

The psychological aspects of musical perception as well as the philosophical and aesthetical considerations of what is being proposed in this study need to be conciliated: the motion of the music as perceived by a performing musician and which correlates the quality of the emerging sound to a visual format, as well as the characteristics of a 'tonal body' as propounded in this treatise, are of course illusory. There is nothing tangible or corporeal about them. Yet they do exist as reflected images just as real images exist in a dream and have been as useful in philosophical and aesthetic theories as they have in the intuitive practice of performers. They are virtual, non-actual semblances. They are conceived not only to portray the autonomous beauty of tone-forms but to exemplify the psychodynamic force which motivates them and within which so much of this beauty lies.

1. In other art forms too, movement and lines are intimately related in conception as lines and growth, (Langer, 1953).

1.3 THE CONCEPTS:

'Motion in Music' is a concept that treats music as a passage in time, through movement, growth and progression. Tobias Matthay, insisted upon the doctrine of progression and movement, as the basis of all shape in performance. Indeed, this was his most important teaching principle. In his book, *Musical Interpretation,* he draws a parallel between the art of music and the art of painting, which, he says, "have a strong parallelism in the basis of both, inasmuch as both depend upon Progression or Movement". He goes on to say:

"In painting or drawing the movement is upon the canvas, and this in a double sense; for there is an actual movement of the painter's brush or pencil in the act of making the picture; and secondly, an actual movement again, in viewing the picture - an actual movement of our eyeballs in following its lines, or at least a suggestion of such movement.

"In Music, the distinction is that the movement is upon a time-surface, as it were - instead of upon a canvas...We also find that our musical ideas of "Time" and "Progression" are closely correlated; since to enable us to determine the precise "time-spot" of any note, we must think of music itself - in its aspect of progression or movement...It is of no use trying to think Music unless you think of progression, that is, Movement towards something or other.

"In fact, this forms the best definition of all form or shape or structure in music, be it phrase, section, sentence or a complete piece. This idea of movement is the vitalising spark which turns mere notes into living music, this sense of purpose - this sense of progressing somewhere...This idea of motion in music, continuous movement, we must make clear to anyone and everyone..."

When a performing musician uses sound, he or she produces a variety of patterns which appear as changing the course as well as the speed and density of the sound.

In order to understand the behaviour of manipulated sound, it is important to identify and define the various elements that appear in motion when music is realized.

The following need to be defined:

1) What moves?
2) Where and how far does it move?
3) How fast does it move?
4) How does it move?
5) What sets it in motion?

Movement in musical performance occurs at various levels: that which is visible by the eye and that which is audible by the ear. The first is objectively discernible, the second is conceptually discernible. The first pertains to an outer mode, real and tangible; the second, pertains to an inner mode, notional and conceptual:

The performing musician activates the muscles of his body to delivering a stroke to the musical instrument: the sound-producing mechanism of the instrument is physically motivated to producing a series of vibrations that translate to musical sound.

Sound, or musical sound, is then conceptualized by the listener as being motivated towards achieving progress through notional movement.

This study sets out to define the various stages where movement, perceptible in one way or another, takes place.

A simple process during which various stages of musical encounter take place, is therefore proposed - a process that commences from the moment that the body of the performing musician prepares to play a note of music, to the moment of impact with the instrument, right through to the next moment when impact is made with the ensuing note and the preceding one is released. The procedure is as follows:

MODUS OPERANDI:

When a musical instrument is played, each individual note that is heard has been produced by applying a variety of stimuli or forces to the sound-producing mechanism of the instrument in varying degrees of speed of motion. The mechanism of a musical instrument is such that it responds sensitively to whatever force is applied to it.

When music is realized, the forces that initiate and manipulate sound are in motion at various stages: at a preparatory stage prior to the realization of sound; at the moment of impact when, at the same time, it is subject to an opposing force; and in order to motivate the sound that has been produced towards the next moment of impact. The various stages of this procedure or *modus operandi*, realized as it is in time, can be broken down as follows:

Stage I

This preparatory stage accumulates energy and prepares to release it on impact. There are two sources from which energy is gathered: muscles and the force of gravity. The medium through which energy is transferred to the sound-producing mechanism is the locomotor system. The stimulus that is required to produce a sound is delivered through human agency to the sound-producing mechanism. The speed, weight and direction of the moving locomotor system will determine the quality and quantity of the ensuing sound when impact is made.

Stage II

At stage two, impact is made. An instrument reacts sensitively to a variety of impulses delivered by the human body. The various qualities apparent in a note of music are subject to the manner in which this force is applied. In musical terms, one uses various metaphors to express and define these qualities: heavy or light; deep or shallow; long or short, dark or light, and so on. Furthermore, references are made to the manner with which a note is struck: "from above", "from underneath", "head-on".

All such metaphors are common-place in most fields of music-making and all serve a useful purpose: to define in words the various qualities of sound perceived as forming the context of a work of music.

In real terms, we can only quantify the frequency of application measured in time (rhythm), and the dynamic and pitch levels at which a note of music is being played. In musical terms, we not only express the weight, mass, density and direction of a sound in metaphorical phraseology, but we 'sense' these qualities and motions through vivid characterizations.

Therefore, a medium that fulfils the requirements of an object in motion, whose weight and mass as well as speed and direction can vary, is proposed in this study: metaphorically speaking one could imagine sound as a spherical mass in motion, whose weight, density, speed and direction are susceptible to change as various forces are applied to it. This has the advantage of enabling us to establish motion at a notional and conceptual level of musical perception and cognition.

As impact is made, a mass of sound is formed. This mass acts as an opposing force to the force of impact [1]. This opposing force sets the 'vehicle' in motion which reacts and behaves accordingly. Its speed of motion, density and shape are determined.

1. This phenomenon is dealt with in more detail at pg. 128

The quality and quantity of the sound is determined by the speed, weight and direction of the force that has been applied to the sound-producing mechanism. The dynamic level of the sound is thus determined, as is the colour (timbre) and direction of the musical line.

Stage III

As the mass of sound is manipulated in time, its body is subjected to various transformations: its speed of motion, density, dynamic level and direction are all subjected to change depending on the same characteristics of the note or notes that follow [1].

Stage IV

At this stage, the whole process is repeated as at stage I, with all the elements implied: speed of motion, weight, direction, mass of sound, dynamic level as well as pitch level and timbre.

As the whole procedure is experienced in time, the speed and precise moment at which various interactions take place, such as: holding notes, releasing notes, applying vibrato, applying the pedal of a keyboard instrument, have to be defined.

1. In this respect, direction is also interrelated and appropriate to melodic contour.

TABLE I

MODUS OPERANDI

STAGE I	STAGE II	STAGE III	STAGE IV
PREPARATION	IMPACT	MOTION	IMPACT/RELEASE
cause	effect cause	effect cause	effect
FORCES:	FORCES/ OPPOSING FORCES:	FORCES/ OPPOSING FORCES:	FORCES/ OPPOSING FORCES:
s/w/d	s/w/d	s/w/d	s/w/d
locomotor system	mass of sound (vehicle):	motion in time $\longrightarrow$	mass of sound (vehicle)
sound-producing mechanism	(O)	1) speed of music 2) mass of music 3) direction of music	(O)

s = speed
w = weight
d = direction

In the following chapters, each stage of the *Modus Operandi* shall be dealt with separately:

a) STAGE I - Preparation:

Defines the forces that set sound in motion as they prepare to initiate sound

STAGE II - Impact:

Defines the mass in motion as impact with the sound-producing instrument is made

STAGE III - Direction:

Defines the direction of the moving vehicle in motion as one note of music leads to another

STAGE IV - Impact/Release:

As impact is made with the following note of music in a series, the preceding one is released at the relevant moment in time.

Defining the forces that set sound in motion makes it necessary both to account for certain musical phenomena and to connect them loosely to other natural phenomena and to the laws of Newtonian physics.

In general, the principles involved are universally applied to any instrument. Nonetheless, in view of the author's musical formation, the pianoforte has been chosen as the instrument to figure most prominently in the research that follows.

The forces which set sound in motion in the preparatory stage, prior to delivering a note of music, may be divided thusly:

a) the locomotor system of the performing musician

b) the mechanics of the sound-producing instrument.

While the two forces are interactively related, each is examined separately; the locomotor system comprises the use of the finger, the wrist, the arm and other constituents while the sound-producing mechanism comprises the components of the lever-mechanism of the modern pianoforte. Both are considered as forces that propagate sound.

The question as to how comparable the pianoforte is to any stringed or wind instrument in manipulating sound will inevitably arise. For instance, is a crescendo possible on a single note on the piano as it is on either of the latter?

For this reason, I feel it is important that the mechanics of the pianoforte which initiate sound should be looked at in some detail, so as to make clear the full extent to which the quality as well as the quantity of the sound may be transformed.

In addition, temporal patterns which constantly manifest themselves at all stages of musical motion, will form the subject of a separate chapter, entitled: "Speed of Music".

The following are three notional concepts, pertaining to an inner mode of musical apprehension, which arise through an awareness of musical intent and musical movement:

1. SPEED OF MUSIC (s/m)
2. MASS OF MUSIC (m/m)
3. DIRECTION OF MUSIC (d/m)

These are notional concepts and, as such, subjectively perceived. They constitute an awareness of musical structure that remains within the domain of inner consciousness and musical insight. The source from which these concepts are derived is closely associated with the principles of motion, whereby an object in motion is susceptible to a change of speed, direction and shape, commensurate with the forces acting upon it.

In the *outer mode,* the original speed of each application is stepped up which results in difference in dynamic levels just as the frequency of repeated applications results in changes of tempo. In the *inner mode,* 'speed of music' is a term that applies to the psychological grouping of impulses which a musician makes to form such aggregates as the meter of a musical phrase or what Matthay calls "bar-rhythm". It represents any change to the minute divisions and sub-divisions of the main beats or units, which alter the speed (s/m) at which music progresses from one note to another and it is related to the speed at which the hand moves to deliver a stroke.

The term Mass is here loosely associated with weight as applied and weight as perceived, resulting in an increase in dynamics. Mass of Music, a notional concept, refers to notes and musical textures which sound, and are therefore perceived as, heavier than others: it takes in not only differences in dynamics but also the leaning towards a particular note which produces time-inflections (agogic accents). The mass of sound which is experienced when contact is made with the key-bed of the instrument is closely associated with a tactile sensation which relates to the overall tone quality of the sound produced. The term Mass incorporates tonal phenomena such as volume, weight and density of sound.

Direction implies a change to the direction of the musical line. In *outer mode,* it refers to the variation in individual pitch; in *inner mode,* it refers to the notional concept of the wave pattern which constitutes, amongst other things, melodic contour as well as the direction in which the locomotor system moves in executing a musical phrase.

The following table summarizes the various activities which take place in *outer mode* and *inner mode*:

TABLE II

Outer Mode

SPEED OF CONTACT	difference in dynamics
FREQUENCY OF CONTACT	change of tempo
WEIGHT OF CONTACT	difference in dynamics
DIRECTION OF CONTACT	variation in pitch

Inner Mode

SPEED OF MUSIC:	the number of impulses that the mind discerns as well as the speed at which the hand or any constituent part of it moves; these are dependent on: a) speed of application b) duration of contact c) resistance to the opposing force
MASS OF MUSIC:	the quality of the musical tone that is perceived as sounding heavier or lighter as a direct cause of variations in dynamics and duration, premature or delayed, of contact. Both weight of the arm when it drops to the keys as well as the tactile sensation which is experienced when contact is made are significant in determining the mass of sound.
DIRECTION OF MUSIC:	the direction of the musical line which the mind perceives as a direct result of variations in pitch, dynamics and duration of contact as well as direction of the hand

1.4 VISUAL REPRESENTATION AS A MEANS TO ACQUIRING A DIFFERENT PERSPECTIVE TO MUSICAL EXPERIENCE:

Even though music is a sonic phenomenon, perceived in terms of the quality and the quantity of the sound that a musical instrument produces, it is common practice, particularly in the world of pedagogy, to express the musical experience through a language of musical "shapes" and "symbols". These are presented visually as gestures - hand-produced - which indicate quite unequivocally the manner in which a musical line unfolds. They assist the performer in realizing the importance 'movement' plays in the process of musical performance. Such symbolism may take into account the direction of the musical line in terms of its pitch orientation, the speed at which the musical phrase unfolds, the tone-quality of the musical sound and the way the instrumentalist's hand moves around the keyboard.

There are, of course, no preconceived references to a symbolic language of this kind. However, every performer who draws upon such visual representations of musical structure will instinctively conceive patterns which are recognizably familiar. In this respect, there seems to be a logical basis on which certain patterns, however individual, are formulated.

Cheironomy

Visual representation of the musical line is not unknown to musical performance. The idea that music can be depicted in graphic terms is ancient. Cheironomy, the doctrine of hand signs, is the ancient form of conducting whereby the cantor indicated melodic curves and ornaments by means of spatial signs. Indeed, in medieval times, melodic patterns were taught with the help of visual hand signs (Guidonian hand). The Egyptian hieroglyph for music appears to have been a representation of the hand.

Some of these hand movements were eventually transcribed into neumatic notation and formed the basis for stylized graphs: their source can be traced to the outlines of the various hand movements.

In Byzantine musical notation neumes imitate the movements of the melody produced by the human voice and consequently the movements of the hand of the conducting precentor. Egon Wellesz, in his study of Byzantine music and hymnography, explains the practice of cheironomy in the early days of Byzantine chant which, he says, dates back to the 7th century A.D. and was brought to a high degree of perfection in the Byzantine church:

"[The precentor] directed the singers with the movements of his right hand and with certain gestures: raising, lowering, extending, contracting, or putting together his fingers, and instead of the musical signs he formed the various melodic groups and the inflections of the voice in the air. And everyone watched the leader of the choir attentively and followed, as one might say, the structure of the composition" [1]. Similarly, in the Gregorian plainchant tradition, neumes were featured extensively and came into existence on a cheironomic basis.

To this day, conducting remains the one music-making medium that uses visual patterns in order to indicate time as well as musical expression: the conductor, by the use of a visual design, can indicate the volume of sound required, manner of approaching various notes, direction of musical line, moments of increased or decreased intensity. I have always been fascinated by the spatial design that conductors of distinction "carve" in the air denoting various directions and intensities of the musical line. I have often found these patterns to enhance my musical understanding of the music, rather than hinder it [2].

1. Egon Wellesz - *A History of Byzantine Music and Hymnography* (1945 : pg. 234)

2. I am referring here to the expressive pattern of the hands of a gifted conductor, and not to a conducting technique that is a sterile and rigid indication of every main beat in a musical phrase.

The conductor illustrates by his motions in the air, much more than time and dynamics: he can indicate the basic approach to the note, the speed at which any note is played and the overall direction of the musical line - all the constituents which are inherent in producing expression of musical intent and overall quality, the very elements which are defined in this study as 'speed of music' (s/m), 'mass of music' (m/m), and 'direction of music' (d/m), pertaining to an inner mode of perception and execution. The conductor, through his use of contrasting motions cajoles from the orchestral players a variety of colour and expression. His gestures form a language of musical intent which, in d'Udine's description of music, "serve as prototypes of musical function" (ibid.).

Instrumentalists are equally capable of tracing the direction of the musical line visually in motions which result from performing on a particular instrument and which are themselves suggestive of the overall character as well as the overall design of the musical line. The performer can trace the movement of the musical line in his mind in an imaginary format, thus enabling him to make whatever changes are necessary to constitute a well-balanced and a well-proportioned musical texture.

The essence of music as represented by visual patterns, has been touched upon by Douglas R. Hofstadter [1], in his book *Metamagical Themas: Questing for the Essence of Mind and Pattern*:

"I have been fascinated for many years by the idea of trying to capture the essence of the musical experience in visual form. I have my own ideas as to how this can be done; in fact, I spent several years working out a form of visual music. It is perhaps the most original and creative thing I have ever done. However, by no means do I feel that there is a unique or best way to carry out this task of 'translation', and indeed I have often wondered how others might attempt to do it."

1. Author of the Pulitzer Prize winning *Gödel, Escher, Bach*

Hofstadter, in his book, cites the work of William Huff, a professor of architectural design at the State University of New York at Buffalo. Huff writes:

"Though I am spectacularly ignorant of music..., I have students 'read' their designs as I suppose a musician might scan a work: the themes, the events, the intervals, the number of steps from one event to another, the rhythms, the repetitions... These are principally temporal, not spatial, compositions (though all predominantly temporal compositions have, of necessity, an element of the spatial and vice versa - e.g., the single-frame picture is the basic element of the moving picture)."

Having established the notion that musical sound is based on the experiences of motion, time and space, and that the principal faculties for perceiving its effects lie with the sense of touch as well as with the ear, it is possible at this stage to suggest that another component may be added to enrich our musical awareness: the visual representation of musical tones.

As Victor Zuckerkandl points out: "As shaped and organized time, as a time image, a tonal work stands before the auditor's perception, offers itself to his view. If it has nothing spatial about it, nothing material in the usual sense, nothing objective, nothing for the eye, this does not prove that it is not an image, but only that viewing, beholding, is not the sole privilege of the eye....the world of spatial images is a world of symbols. Symbols are for the eye, the eye of the body or of the mind; we *look* at symbols, the eye looks at them. Even on to the 'nonrepresentational' symbols of modern science, our whole symbol world is profoundly rooted in the visible, is born of space, is created by the eye, under the guidance of the eye, for the eye" (ibid.).

The process of sound production in the human body is visually accessible. Visual behaviour as expressed in space complements sound images as expressed in time. As has already been noted, Stravinsky, in his autobiography, expresses his disapproval of people shutting their eyes when listening to music:

"I have always abominated listening to music with closed eyes, without the eye taking an active part. Seeing the gestures and motions of the different parts of the body that produce music is necessary and essential to grasping it in all its fullness".

Zuckerkandl considers the eye as an auxiliary organ which enhances musical perception: "It is certainly a valuable idea, pedagogically, to call upon the eyes as an auxiliary organ in order to concentrate upon the kinetic character of music...It cannot be denied that the eye is the organ of our most intimate and strongest connection with space....Can the eye perhaps hear too?" (ibid.).

In consequence to what has been suggested it seems clear that one can enter a world in which visual images, at once recognizable and familiar, represent suggestively and metaphorically musical phenomena.

A language of musical "shapes" and "symbols" is required which would reproduce as faithfully as possible the pattern that sound, musical sound, suggests to the ear and to the hand as much as to the eye. To objectify metaphorically all that musical tones contain in the way of motion, time and space involves the production of consciously conceived and subjectively contrived graphic equivalents. These form the basis for charting free hand-produced graphical representations which constitute a highly individual, yet highly informative view of musical activity.

In proposing such a metaphoric translation of one medium into another, one brings to light, to use Zuckerkandl's words: "a previously concealed meaning in that to which it relates": a new dimension that enriches our musical perception.

If, as performing musicians, we confer upon our musical awareness a visual surrogate, we then not only hear the dynamic quality of musical tones, we not only sense and feel these through our body, but we "see" these as tones in motion, we "see" their speed of motion and we "see" their mass in motion.

1.5 TONAL BODY:

When we speak about motion we must first of all determine and identify that which moves. Besides the movement of the human body which impels the mechanics of the pianoforte into action, there exists, as a percept, a flow of movement from the sounds which are being produced by the performer. In this respect, there is in music a 'body' in motion which perceptually possesses certain physical characteristics such as weight, mass, density etc., analogous in the physical realm.

As a concept, which we have already explored to some extent on p. 30, the 'tonal body' is neither tangible nor corporeal. Yet its integral characteristics are perceived not only audibly but also tactilely: the performing musician feels a certain weight in his arm as he plays a note of music and accordingly hears the resulting tone as possessing tonal characteristics which relate to that weight. An increasingly heavier application will result in a sound whose tonal body will increase in weight and which will be perceived as sounding 'heavier'. At first glance, this might appear to be the result of pure transference: arm-weight to 'weighty' tone - however, acquaintance with Gestalt psychology teaches us otherwise.

In this context, I propose to represent the 'tonal body' as a spherical mass whose physical attributes relate to those perceived by the ear as well as by the touch. The tonal body will therefore be subject to various transformations like any other moving object whose speed, shape and direction is susceptible to change as various forces are applied to it.

By its means, we can now determine three distinct areas of musical activity:

a) tonal characteristics

b) tonal motion

c) the behaviour of musical sound when various degrees of pressure are applied to the instrument.

There are also practical considerations which stem from a variety of experiences in performance practice. A moldable object such as the sphere, with all its natural characteristics, can 'appear' in performance to represent the tonal characteristics of the musical sound while at the same time being analogous to the motility of the hand; thus when the movement of the musical line awakens a bodily response, the tip of the finger, which makes direct contact with the key, constantly moves in all directions almost as if it were resting on a spherical surface - its own. Furthermore, the elasticity of the arm and all its constituent parts relate to the free-floating detachedness of sphericity. For instance, when pressure is increased on the surface of the key, this results perceptually in a change to the shape of the sphere.

As a performing musician I have often experienced the 'presence' of an imaginary spherical object which lies between the tip of my finger and the key of the instrument which I am playing. [1] This feeling of resting my finger on a spherical object enables me to move around the key in all directions. It enables me not only to 'feel' each note as I play, but to 'feel' the resilience and resistance that exists as contact is made with the key when various degrees of pressure are applied. The plasticity and suppleness of the tissues that surround this area at the tip of the finger as well as the abundance of nerve-endings which are concentrated in this minute area enable me to ascribe the semi-sphericity of the finger-tip itself to the plane

1. It has been suggested that tones are perceived as 'bodies of sound' by those who perceive them as entities through absolute pitch association. Alan Costall, in his article on the "Relativity of Absolute Pitch" (cited in *Musical Structure and Cognition*) concludes that the "current conception of absolute pitch assumes that some people can immediately identify tones as entities in their own right."

surface of the key and thus give rise to such an illusion [1].

Tactility

The role that tactility plays in communicating musical content as well as musical intent has been dealt with by Seeger:

"While auditory and visual systems of communication have been extensively and elaborately studied in terms of speech, tactile systems of communication have been little thought of as such. Even its principal categories are not named *tactile*. Tactile communication is produced by bodily movement, which is perceived, primarily, as touching.

"...Speech and music, as species of auditory communication, are linked inescapably with visual communication on the one hand and with tactile communication on the other. The facial expression, the body stance, the gestures, and the affective states and motor behaviours manifest in these, as well as in the making of the sounds of both speech and music, are invariable concomitants of both speech-making and music-making. Sometimes they communicate in their own ways as much as or more than does the auditory. The speaker or musician who is near - within touching distance - of another speaker or musician communicates also by fact of that nearness and all the more so if the two actually touch.

1. There are, besides, further practical considerations: I hope the reader will permit me, for a moment, to indulge in the world of metaphors; after all, as Langer says, it is through such plastic and powerful language that artists often express their difficult thoughts: a beautiful sound is a sound which is 'alive'. It is alive because it pulsates - just as any living organism does through regular pulsations of the heart. The performing musician feels these regular pulsations tactilely on the underside of his fingertip. If a note is played by a stroke which is void of any flexibility, the note will sound 'dead'. As Heinrich Neuhaus says, "good tone is dependent on the elasticity and the flexibility not only of the fingertip but of the whole locomotor system" (see page 89). The imaginary existence of a malleable sphere between the fingertip and the key makes the production of good tone easier: as the finger rests on such a surface, it can 'feel' its elastic properties and thus give the illusion that the musical tone is 'alive'. Furthermore, as the sphere attains a variety of physical properties by different modes of contact, speeds of finger attack and pressure applied to it, it will change in shape and in character and correspond accordingly to the shape and character of the musical line.

One has seen this - and, perhaps, felt it oneself - in the kind of vocal quartet singing in the United States called 'close harmony' or 'barbershop quartet' singing, in which the shoulders of the singers are pressed as closely as possible against each other, so that the tensions, tonicities, and detensions of each tonal, rhythmic, and formative progression are felt as if it were, by precise 'tuning' of touch as well as by pitch, loudness, and phrasal agogic. Often as not, the eyes are closed, as if one were seeing and feeling, as well as hearing, inwardly" (ibid.).

Zuckerkandl, in his book *Man the Musician*, refers to the sensitivity of the human skin which detects sensations of sound. In this respect he likens the sense of touch to that of hearing:

"The human skin may be regarded as the prototype of a sense organ combining the functions of barred window and open door, which separates the organism from its environment and at the same time exposes it. The shedding of all natural protective covering of the skin, which distinguishes man from animal at least as basically as man's erect posture, may well mark the turning point in evolutionary history where self-preservation as the highest goal of a living being was subordinated to self-assertion in the encounter with the world, to knowledge of self and world as the highest goal of a spiritual being.

"The ear has much more in common with the skin than with the eye: this is why, in deaf persons, the ear's function as organ of 'musical' sensation is taken over by the skin, not by the eye. No graphic representation of sounds in the form of lines and curves on the oscilloscope screen can serve as substitute for sensations of sound. In contrast, when an area of skin sensitive to subtle vibrations is exposed to sound waves, it has sensations which, however shadowy, correspond to sensations of sound".

It is possible, therefore, to infer that musical sound can also be conceived at the point where contact is made with the key and that it is directly controlled and constantly manipulated by the finger-tip. In this respect, musical sound originates at this juncture and is intuitively portrayed, visualized and sensed tactilely as a spherical body. This 'body' symbolizes none other than the embodiment of the psychodynamic energy inherent in the musical tone. We must therefore examine its properties in more detail.

Certain characteristics of the tonal body are tacitly accepted through a system of association which has long been based on notational convention. J. Chailley (1963) has shown that this apparently natural symbolism was originally an association of external ideas with musical phenomena which arose through long and constant praxis - through our identifying with the associations in such a way as to make it impossible for us (without repudiating all our instincts) to abandon a convention which we take in good faith to be musical expression itself (cited in Nattiez, 1990) [1].

In this respect we may say that we have been conditioned, by convention, to associate, for instance, low sounds as being heavy, deep and dark, and high sounds as being light, luminous and clear [2]. Jacques Handschin investigates comparable conditions with regard to the characteristics of musical sound in his book *The Character of Tone (Der Toncharakter;* Zürich, 1948). He refers to the properties of musical tone as pertaining predominantly to the sense of touch rather than to the sense of hearing. These sensory qualifications refer to form: round-pointed or compressed; to surface properties: hard-soft, smooth-rough; to temperature sense: warm-cold; to internal structure: full-hollow, dense-loose; or to weight: heavy-light. (cited in Dräger, 1952).

1. J.-J. Nattiez - *Music and Discourse: Toward a Semiology of Music* (Princeton: 1990 , pg. 122)

2. The Greeks used the expression 'heavy' for a low tone and 'pointed' or 'sharp' for a high tone.

Handschin considers whether the integral properties of musical tone can be separated in the same way as an object can be separated from its fundamental properties - whether tone, which he says is not just another object, should even be regarded as an attribute of an object. He concludes that a tone is "neither tangible nor visible but fundamentally a process" (cited in Dräger, 1952).

Dräger, on the other hand, maintains that tone is both an object and a process: "...not only because the perceived process traces back to an object (which is also the case in seeing), but also because in hearing, it is the process transmitted from the [originating] object, that we perceive as an object (which is not the case in seeing). Accordingly, a tone is a hypostatically perceived process."

Dräger attempts to show that the material characteristics of tone, which he says "offer the best justification for Köhler's concept of 'tonal body', have particular structural significance in music. His enquiry revolves around three such tonal characteristics: volume, density and weight.

Volume

Dräger cites the annotation on a sketch of Beethoven's *Pastoral* Symphony in which the composer notes that "the bigger the stream the lower the tone" in order to correlate frequency with volume. Dräger defines volume as a tonal property which is determined and conditioned by the frequency of the tone. Thus a low-frequency tone will be perceived as possessing a larger volume than a high-frequency tone, the natural ponderousness peculiar to low-frequency tones being partly due to the long inception period of their vibrations: "due to the amount of material involved, and also because of the greater latency period of their development in the ear" [1].

1. Dräger refers the reader to A. Wellek's work on this subject, "Der Raum in der Musik", *Archiv für die gesamte Psychologie*, 1934.

"The corporeal impression of a greater or lesser inertia can also be attained by interpretative means. Thus, for example, in the answering string-quartet style the inceptive vibration period is shortened as much as possible in the attack on low tones. Conversely, on the piano, with its less differentiated inceptive reaction to high and low frequency, the latency period is simulated by means of agogics".

A tone has also what Dräger calls a *loudness volume* which is not frequency-related so that a tone of identical frequency will be perceived as attaining greater tonal volume with increasing loudness. He relates this phenomenon with the experience that approaching sound waves become louder whilst receding ones softer: "To the human perceiver, coming nearer generally means becoming larger (for physical objects) or becoming louder (for sound). In the case of tone, the two impressions fuse, since tone is both an object and a process".

Density

The density of a tone is frequency-related, loudness-related and timbre-related. E.M. v. Hornbostel (1926) and G. Albersheim (1939) both agree that a low-frequency tone is less dense than a high-frequency tone (cited in Dräger). This relates tone-density to the vibration rate so that a high-frequency tone with an increasing number of vibrating particles would seem to be more compact, concentrated and therefore dense. Dräger distinguishes between these tonal attributes which constitute the physical density of tone and what he calls the *auditory density* of tones which he says remains approximately constant throughout the musically relevant ranges of frequency.

Furthermore, Dräger maintains that the density of a tone is also determined by amplitude. Its density is therefore increased by means of dynamic intensification. This would be its *loudness-density*. Thirdly, the tonal density is according to Dräger and Albersheim also timbre-related. A clarinet tone, writes Dräger, "has less timbre-density than an equally loud oboe tone".

Weight

"A low-frequency tone is heavy; a high-frequency tone light". Most musicians and psychologists are in sympathy with this observation of Dräger. It constitutes what Dräger calls the *frequency-weight* of tones. Its *loudness-weight* is perceived through an increase of its volume and similarly an "enrichment of the gamut of overtones" will cause an increase to the tonal weight. This *timbre-weight* is therefore, according to Dräger, dependent on the timbre-density.

There are many instances where compensatory factors emerge in order to equalize different quantities of volume, density and weight of tones so that, for instance, the equalization of weight is possible in tones of different frequency by means of increasing the volume. Similarly, by means of greater loudness a clarinet tone can attain equal density to an oboe tone (Dräger 1952).

Dräger's concept of 'tonal body' is musically convincing if terminologically confusing. The notion that tone is "both an object and a process" is one to which I fully subscribe and one which substantiates the view proposed in this study of music being the result of such a 'tonal body' being set in motion.

Whilst Dräger's concept enabled him to consider the structural significance of tone in musical composition, the same concept can be made to apply to its structural significance in musical performance. One of the most important aspects of tonal perception to the performing musician is the sense of touch, so that, in addition to what Dräger proposes, we can contemplate touch-related tonal characteristics such as *touch-weight, touch-density* and *touch-volume*. These would be dependent and related to the amount of weight, density and volume one senses in touching the keys of the instrument.

A heavier approach would naturally result in a tone sounding louder and heavier but the auditory experience is not always so straightforwardly aligned to the tactile experience. For instance, a low-frequency tone played lightly could feel 'lighter' than a high-frequency tone played 'heavily'.

Similarly, a tone would become denser when increasing pressure is applied to the key. This is analogous to what Dräger describes as a tone's timbre-density. There is, Dräger writes, a special "play with density" when string players play in lower positions instead of crossing the strings in passing to the higher frequency tones. Because of the radically changed relation of thickness and length, the string assumes a more compact form and the tone a new timbre character, a greater timbre-density". Whilst this is true, one must also allow for the fact that the player would feel tactilely the increased natural resilience of the string as he moves higher up the fingerboard. Therefore, 'density' is not confined solely to the auditory experience. As each sound acquires different tonal characteristics relating to the type of contact which the human body has with the instrument, be it stringed or keyboard, the tactile experience performs an important and determining role in identifying the tonal image.

Furthermore, the time-factor is important in determining various 'quantities' of tonal character. Dräger refers to the interpretative factor that relates the latency period of tones through agogics to the long inception period of vibrations of low frequency tones. As a result of this procedure the tone whose value is increased acquires a higher tonal volume and can be perceived as sounding 'heavier'.

To sum up, there seems to be a combination of determining factors which affect the tonal character of a musical sound. These include volume, density and weight, as proposed by Dräger, Albersheim, Handschin and Hornbostel as well as the tactile and time factors. These encompass the natural tendencies of tones (i.e. those of different frequencies) as well as those which are under the direct control of the performer (i.e. the time and tactile factors).

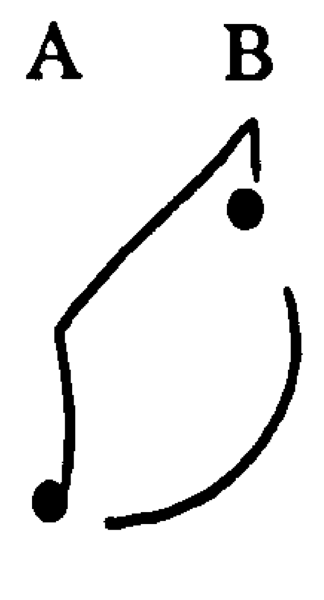
The significance of this line of enquiry lies in the possibility of calibrating the various 'quantities' both in composition (as Dräger proposes) and in performance. This means that an awareness of 'tonal bodies' will begin to play a conscious role in the structuring of a composition just as it will in the subsequent act of interpretation so as to ensure in both well-balanced and homogeneous musical textures.

TABLE III

DRÄGER'S CONCEPT OF TONAL BODY

VOLUME

1. FREQUENCY FACTOR:	low tone - high volume high tone - low volume	
2. TIME FACTOR:	short spacing - low volume large spacing - high volume	
3. INTERPETATIVE FACTOR:		
4. LOUDNESS-VOLUME:	increasing loudness - increasing volume	



latency period analogous to long inception period of vibrations of low-frequency tones, i.e., note B arrives late: note A has higher volume

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DENSITY

1.	FREQUENCY FACTOR:	a) physical:		variable density
		b) auditory:		constant density
2.	LOUDNESS FACTOR:	increasing loudness	-	increasing density
3.	TIMBRE FACTOR:	Example: clarinet tone has less timbre-density than an equally loud oboe tone.		

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WEIGHT

1.	FREQUENCY FACTOR:	low-frequency tone	-	heavy
		high-frequency tone	-	light
2.	LOUDNESS FACTOR:	increasing loudness	-	increasing weight
3.	TIMBRE FACTOR:	Although Dräger does not define this clearly, it is possible to assume that the clarinet and oboe example given by him to elucidate timbre-density would similarly apply to indicate timbre-weight. Therefore, clarinet tone would be lighter than an equally loud oboe tone.		

Whilst the various compartmentalizations applied by Dräger and others are most enlightening and informative, they tend to produce a picture that is at times, as Table III might suggest, somewhat tortuous and confusing. Dräger's analysis of the various conditions which pertain to tones seems to border at times on tautology. For instance, the loudness of a tone will determine its volume, density and weight. An intensified tone will increase all these accordingly. A tone that emerges from playing a stringed instrument in one position will acquire density while at the same time increasing in weight. Dependent on the frequency of the tone produced, it will also possess tonal characteristics which are frequency-related. If this tone is compared to one which is lower in pitch, the increase in weight which is density-related would be contradicted by the decrease in weight which is frequency-related.

The contradictory factors increase when one proceeds further to introduce elements of timing and tactility. For this reason, it would be desirable to seek out a primary, dominant and all-prevailing condition capable of identifying the tonal characteristics of that particular tone. In this respect, only the individual's awareness, drawn from a wealth of musical experiences, can be summoned to gauge the overall effect to his sensory perception.

Nevertheless, whilst maintaining the individual characteristics of tones, it is possible and indeed desirable to simplify these and introduce one umbrella term that loosely encompasses all the criteria involved. For this reason I have chosen to apply the term 'mass' to denote, more or less in general, the volume, weight and density of musical tone. Where pertinent, I shall still refer to the individual qualities of tones as defined by Dräger. An increase to the 'mass', therefore, would imply an increase of either tonal weight, tonal volume or tonal density, an increase of a combination of these or an overall increase of all three.

From an interpretative point of view, the performer must be aware of the malleable character of tones and how these behave as a result of his contact with the instrument. Therefore, we must now consider how the character of a tone is affected by the forces that act upon it. Firstly, we must identify and define these forces.

CHAPTER II

CHAPTER II

FORCES THAT SET SOUND IN MOTION

PART I: MECHANISMS

As each class of instruments corresponds to a distinctive stimulus for propagating sound, this chapter looks at the mechanism that the modern pianoforte possesses, and assesses the extent to which this mechanism responds to various manipulations.

2.1 THE PIANO:

On most instruments, the player controls the manner in which sound vibrates by interfering with its pattern of vibration. In this way, the player can produce a variety of tone colours, known as *timbre.* On the piano, there has been a great deal of controversy as to whether the pianist can influence the timbre and overall quality of the sound produced by the way in which he or she strikes the key.

Musicians claim, on empiric grounds, that control of quality lies in the hands of skilled players. Tobias Matthay (1924) suggests that a variety of "touch" will induce a variety of tone colours. "The more *gradually* a key-speed is attained the more beautiful is the tone *character* - the fuller, more 'sympathetic' singing and carrying in its *quality.* The more *sudden* the key depression the harsher is the resulting tone quality" [1].

1. See Appendix 1

Matthay supported his views by subscribing to the theories of Hermann Helmholtz [1]. Helmholtz, in his *The sensations of tone, as a physiological basis for the theory of music,* maintains that "in pianoforte playing the effect of the tone-excitation by means of the hammer depends on the length of time the latter *remains lying* on the string. For if the soft elastic surface of the hammer is brought against the string without audible blow, then the movement has time to propagate itself before the hammer springs back, and *increases* gradually and constantly during the time of contact".

Indeed, many notable figures in pianoforte playing subscribe to Matthay's theory: Joseph Lhevine [2] refers to the "Forte-Piano" which he says "could do far more than play loud or soft. It permits the production of different classes of sound quality within its range. These are controlled by touch".

Heinrich Neuhaus [3] identifies the elements in what he calls "the locomotor system" which induce a variety of tone colours: *F* force, *m* mass, *v* velocity and *h* height. He upholds the view that "every experienced pianist knows that to get a tender, warm, penetrating tone you have to press the keys very intensively, deeply, keeping the fingers as close to the keys as possible, with "h" at a minimum".

Scientists, on the other hand, maintain that the only variable response to the style of striking the piano key is the intensity of the sound produced.

1. Hermann Helmholtz - *The sensations of tone, as a physiological basis for the theory of music* (1863)

2. Joseph Lhevine - *Basic principles in pianoforte playing* (1924 : pg. 1)

3. Heinrich Neuhaus *The art of piano playing* (1973 : pg. 72)

William Newman (1984) [1] points out that "the thesis has been established beyond reasonable challenge, a few diehards notwithstanding, that the style of striking the key cannot affect the timbre that results...".

Otto Ortmann (1925) [2] summarizes his research into the "the physical basis of piano touch and tone" by concluding that "what we actually do, when playing the piano, is to produce sounds of various pitch, intensity and duration. Nothing more".

Furthermore, Hart, Fuller and Lusby (1934), [3] in their study of piano touch and tone, carefully recorded and compared the wave patterns of sounds produced by a pianist with those produced by mechanical means. The results showed that the wave traces were indistinguishable whether produced mechanically or by a pianist.

Nevertheless, scientists agree that certain criteria may influence the quality of a single tone on the piano. C.A. Taylor (1965) [4] says that "a consideration of the mechanics of the hammer mechanism of the piano suggests that it is unlikely that the pianist can have any control over the hammer other than the velocity with which it strikes the string. Working from this basic fact it was at one time claimed that it could only result in the pianist being able to control the intensity of sound produced, and that no control of quality was possible". The claim by musicians however, that control of quality did in fact occur, prompted further investigation in which essential elements have emerged: elements that have been ignored in the earlier discussions, and which seem to reconcile the views of the physicists and the musicians. Some of these essential elements are:

1. William Newman - *The pianist's problems* (1984 : pg. 117)

2. Otto Ortmann - *The physical basis of piano touch and tone* (1925)

3. Hart, Fuller and Lusby - "A precision study of piano touch and tone", *The Journal of the Acoustical Society of America*, (1934)

4. C.A. Taylor - *The physics of musical sounds* (1965)

1) that although the velocity of the hammer is the only variable under control, the velocity does in fact have an influence on other aspects of the tone than the intensity - in general, the higher the velocity the greater the predominance of higher harmonics (Hart, Fuller and Lusby). Thus, the pianist controls both loudness and timbre at the same time.

2) that the use of the sustaining pedal, which raises the dampers from all the strings, can have a considerable effect on the overall quality by determining the amount of overlap between notes. It also permits a certain amount of sympathetic vibration which influences the shape of the original vibration. The new overtone constellation is heard as a new timbre.

3) that the use of the left pedal, which allows only two strings to be struck, produces a weaker overtone texture, resulting in a different timbre.

4) that the noise element resulting from the impact of the finger on the key, of the hammer on the string and of the return of the rebounding hammer, all form a significant part of the piano tone.

Duration of impact

Furthermore, considerations such as the length of time during which the hammer remains in contact with the string, is of utmost importance. Ortmann describes the effect this has on the vibrating body: "the hammer remains in actual contact with the string for a certain time. The duration of contact between hammer and string decreases as we increase hammer-speed. A very short contact time permits a string to vibrate in small as well as larger segments; a longer contact time destroys these smaller vibrations. Hence, with a very short duration of stroke we should expect a tone rich in high upper partials, and with a longer duration of stroke a tone with fewer upper partials.

In this respect, Ortmann's observations are compatible with those of Matthay and both are based on the theories of Hermann Helmholtz.

Resonator

Another factor to consider in the production of tone colour on the piano, is the resonating effect the body of an instrument has on sound. Ortmann maintains that: "the duration of a tone depends upon the speed with which the energy of these vibrations is absorbed by the resonator. That often misused expression, "singing" tone, when applied to the piano, is due to the above-mentioned phenomenon. That is, the tone-quality of an instrument is largely dependent upon the resonance relationship between generator and resonator".

Multiple tones

When two tones are heard simultaneously or in close succession, the two resulting overtone series will influence each other. Levarie and Levy (1980) [1] point out that "resonance will amplify some overtones, interference will cancel others. Whatever the subtle interplay, a change of timbre is the result. The pianist's control over loudness indirectly affects the resultant timbre. By striking one of the keys harder, the pianist brings to life this tone's higher partials. The infinite possibilities in which the player can grade the dynamic relationship of two tones are reflected in an infinite variety of timbre shadings. The "singing legato" melody is the result of a good performer's carefully holding over one tone to the next while sensitively diversifying the successive dynamic levels. The timbre potentials of two tones are steeply increased when three and more tones are in play".

"Timbre" is therefore undeniably present when two or more tones are produced either successively or simultaneously.

1. Levarie and Levy - *Tone: a Study in Musical Acoustics* - 2nd edition (1980)

Personal Experience

Over many years I have found that an increase of pressure on the key after the note has been played induces a slight change in its sound quality, almost imperceptible to the ear.

At the moment that pressure is increased, the sound becomes minutely richer in quality. In observing the mechanics of this action, it is found that the two components affected when pressure is applied on the key are the hammer and the damper.

The hammer moves closer to the string by no more than two or three millimetres. The damper, likewise, moves away from the string by approximately the same distance. In explaining this phenomenon, I could only speculate that the damper, while moving away from the string, increases the resonating properties of the instrument in some way or another, thus producing an intensified sound colour.

Conversely, if pressure is reduced so that the key moves slightly away from the key-bed, the intensity of the sound is lessened.

Whatever the precise action of the mechanism or the scientific explanation, the result is barely audible, but if one listens extremely attentively, one can discern a slight alteration to the quality of the sound. The technique which is applied to the key when producing this effect is not difficult to master: the key has to be struck precisely (as to produce a good resonating sound) but it must not reach the bottom level of the key-bed. It can therefore continue its way to its final resting position by an extended pressure of the finger to the key, thus resulting in a change of sound intensity.

I am sure that many artists apply similar techniques with equally efficacious results. Closer scrutiny of the generating and resonating properties of the instrument, as it is affected by a change of pressure applied to the key, might well produce results capable of challenging the age-old notion that once a key has been depressed, the sound escapes any further control.

Aesthetic Considerations

My theories on this score come in direct contradiction with much that has been written on the subject, including the principles put forward by Tobias Matthay (See appendix 1). Some may argue, however, that the change in colour, if any, which is induced as a result of finger-pressure to the key, is so imperceptible as to render the theory void of real substance. It may well be that other considerations, psychological as much as physical, shed more light on the belief held by many artists that sound inducement, real or illusory, is indeed possible on the piano.

Beyond a level in which constant physical laws prevail, there exists an illusory level which nonetheless has the power to prompt our complicity. Levarie and Levy explain: "time and again, the suggestive character of acoustical impressions asserts itself. We hear, not so much what there is, but what we want to hear. The suggestion of timbre as a product of changes in dynamics and in articulation (legato-staccato) has well demonstrated its irresistibility by the belief among pianists, which is still lingering on, that they are able to produce it physically - an obvious impossibility. In suggestive or, as we should rather say, evocative power, the piano is foremost among music instruments. It has been jokingly called an 'illusion machine'".

Louis Kentner [1] makes a similar assertion: "no doubt the singing tone on the piano is partly an illusion; but to do everything in his power to create such an illusion is surely one of the foremost tasks of the great illusionist that the great pianist has to be".

1. Louis Kentner - "PIANO" in: *Yehudi Menuhin music guide* (1976 : pg. 81)

Tactile Sensations

One important aspect, which is still to be considered adequately 's the physical sensation of playing an instrument. In this respect, the physical sensation of a heavy descent onto the key, 'feels' heavy, even if the resulting sound quality is accounted for not in terms of weight but in terms of hammer-speed alone. Equally, the physical sensation of an increased pressure to the key would be perceived by our sensors as an increase in the sound intensity.

CONCLUSION:

My own conclusions, based partly on scientific theories and partly on empirical knowledge as outlined in this chapter, is that sound quality, as expressed in the medium of the piano, is susceptible to a variety of tonal gradings, illusory or otherwise, according to the manner in which a force is applied to the sound-producing mechanism.

As Ortmann points out: "every pianistic effect existing for audition, including the most subtle shades of emotion, can fully be explained in terms of the physical attributes. And when these fail to explain all the effects, this does not establish the presence and operation of other mysterious, super-psychological stimuli; it means, merely, that piano playing as an art is not entirely auditory in character, but appeals also to other sense departments. Chief among these are the kinaesthetic and the visual senses, which, in the music appreciation of today, are of very decided importance".

For the purposes of this study, Ortmann's assertion, which in one way or another is compatible with as well as complementary to our other premises, shall suffice. In this respect, the piano is capable of all the nuances that other instruments are heir to.

PART II: THE HUMAN APPARATUS

When a musical instrument is played, each individual note which is heard has been produced by applying a variety of stimuli or forces to the sound-producing mechanism of the instrument. How this force is applied and what its mode of action and movement are will be discussed herewith.

Musical experiences which result from a variety of stimuli exerted by the human body on the sound-producing mechanism may be expressed against a background of natural phenomena. The following is a list of definitions and axioms:

FORCE: A force is a push or a pull. It causes three things:

a) a change to the shape of the object on which it is exerted
b) a change to the speed at which an object moves
c) a change to the direction in which an object moves.

WEIGHT: The force that gravity exerts on an object. The greater this force, the greater the weight.

MASS: The amount of matter which a body contains irrespective of its volume or shape.

PRESSURE: The amount of force that is concentrated on a specific area.

DENSITY: The mass of an object calculated on a unit volume.

ELASTICITY: The property of matter that extends and retracts to its original size after a force has been exerted on it.

SPEED: Speed is defined as the rate at which distance is covered. It is calculated in respect to distance travelled in time.

VELOCITY: Velocity is the speed and direction of an object in motion.

ACCELERATION: Acceleration is an increase of velocity in time.

MOMENTUM: Momentum is the product of mass x velocity

IMPULSE: Impulse is a change of momentum

Laws of Motion

1) When a force is applied to an object, it will cause a change in its velocity. When there is no force, the object remains still or moves at a constant speed [1].

2) The amount of acceleration of a body is directly related to the amount of force applied to it [2].

3) The momentum prior to an impact equals the momentum after an impact, or action and reaction forces are equal and opposite [3].

1. Newton's first law of motion

2. Newton's second law of motion

3. Newton's third law of motion

2.2 LOCOMOTOR SYSTEM:

The locomotor system is the human apparatus which permits a series of actions being carried out through the sound-producing mechanism of a musical instrument by means of which sound is initiated.

In piano playing, the physical components most evidently in play when the locomotor system is activated are: the upper arm, forearm, hand, wrist, fingers, as well as all their respective joints and feet. In some cases the whole body is activated. The playing mechanism, therefore, comprises the individual components just as it does the totality of the human body.

The same components are in use, in a greater or lesser degree, when other instruments are played. Therefore, most of the principles concerned with the way the locomotor system is activated when playing the piano might equally apply to playing other instruments as well.

The human mechanism draws energy from two sources: the muscles of the body and the force of gravity. In the case of the piano, this energy is transferred from the body to the instrument at the point at which the fingertip meets the key.

Sound Production

When a body is in motion, it possesses three fundamental properties: mass, speed and direction. The subtleties of sound production arise from the interplay of these fundamental agents.

1) ***Direction:***

The hand basically moves in four directions: up and down, to the right and left, to the side and deep into the keybed [1].

A combination of these basic movements, involving the various components of the human apparatus (finger, wrist, forearm, etc), produces an infinite variety of motions: both physical and 'musical'.

2) ***Mass:***

As the gravitational forces act upon the mass of an object, mass turns into weight. As weight increases, sound increases.

Tobias Matthay differentiates between a movement which draws energy from gravitational pull and a movement that draws energy from muscular contraction: the former, according to him, induces a more 'sympathetic' sound, whereas the latter produces a more 'aggressive' sound.

Similarly, it has been suggested that the magnitude of the force of impact, called weight, produces a change in the volume and as a consequence, to the quality of the sound.

These notions, however, have been discounted on the grounds that weight increases the speed at which the hammer hits the string and that it is speed alone that determines the volume of the sound. György Sandor makes this point clear:

1. One may liken the motions of the hand to the three basic movements of the aircraft which take place about three axes at right angle to each other and called the *longitudinal, lateral* and *vertical or normal* axis. Furthermore, the hand may move deep into the keybed.

"The notion that the full weight of the arm produces more sound than a lighter weight is erroneous: the fact is that the activation of a longer lever generates more speed than a shorter one and therefore we add the upper arm to the forearm. The activation of the whole arm serves to increase the speed of the fingertips in a whiplike action. *We should not equate great tonal volume with a larger weight but rather with the speed that a longer lever can generate*" 1.

Nevertheless, the more components that are involved in striking the key, the heavier the blow appears: an isolated finger movement produces a lighter touch; as the leverage is extended by the use of other components such as the wrist, forearm and upper arm, the weight increases.

3) *Speed:*

Speed directly affects the dynamic level of the sound that is produced. As we have seen, it bears significance to the quality of the sound as and when the duration of contact between hammer and string increases and decreases: the duration of contact decreases as hammer-speed increases and vice versa 2.

Matthay distinguishes between a slow and a fast speed of approach to the key. He maintains that "the more *gradually* this key-speed is attained the more beautiful is the tone *character* - the more *sudden* the key depression the harsher is the resulting tone quality" 3.

1. Gyorgy Sandor - *On Piano Playing* (1981 : pg. 38)

2. For further explanation to this phenomenon, I refer the reader to Part I of this chapter: 'Mechanisms'

3. See Appendix 1

It has also been suggested by Matthay (and many pianists subscribe to this) that a flat position of the last phalanx of the finger on the key, produces a 'warmer' sound than does an upright position. Matthay calls these two positions the 'Thrusting (Bent) Finger-Attitude' and the 'Clinging (Flat) Finger-Attitude'. Louis Kentner suggests that flat-finger technique, which produces a more 'cantabile' touch, is more properly an arm-touch than a finger-touch. This suggests that more weight - thus greater hammer-speed - is employed in producing the desirable 'cantabile' effect [1].

Contrary to this is the principle, put forward by Otto Ortmann, that curved-finger touches produce greater hammer-speed than flat finger touches and therefore louder tones [2].

Kentner's suggestion that flat-finger technique involves the use of the arm would suggest that the resulting sound is dynamically more intense even when applied to *cantabile* playing. This is the result of an extended leverage inducing greater hammer-speed. Ortmann on the other hand, suggests that flat-finger technique produces a slower hammer-speed and therefore a less dynamically intense sound quality.

Whilst there is a clear discrepancy here, this would indicate that for Kentner a flat-finger technique produces a richer and more sonorous *cantabile* sound, whereas for Ortmann, it produces a softer, lighter *cantabile* sound.

1. Louis Kentner - "PIANO" in *Yehudi Menuhin Music Guide* (1976)

2. Otto Ortmann - *The Physical Basis of Piano Touch and Tone* (1925)

Elasticity

The notion prevails amongst many pianists that a 'flatter' finger, in which the fleshy pad on the underside of the fingertips touches the key, is more resilient and therefore more able to 'feel' the vibrations that sound generates. This leads to the assumption that a flat-finger technique produces a more 'cantabile' sound because it is related to the cushioned properties of the fingertip at the point of contact with the key.

In piano playing terms, elasticity is analogous to flexibility. For this reason, according to Heinrich Neuhaus, good 'tone' is dependent on the elasticity and the flexibility not only of the fingertip but of the whole locomotor system: *la souplesse avant tout* [1].

Joseph Lhevinne states the importance of maintaining a flexible wrist: "If the cushions of flesh on the ends of the fingers are the pneumatic tires in piano playing, the wrist is the spring or the shock absorber. For this reason it is next to impossible to produce a good singing tone with a stiff wrist. The wrist must always be flexible. The more spring the less bump; and it is bumps that make for bad tone on the piano" [2].

Complete freedom and relaxation of arm and wrist is, according to Neuhaus, the *sine qua non* of a good tone.

1. A phrase attributed to Chopin and Liszt

2. Josef Lhevinne - *Basic Principles in Pianoforte Playing* (1924 : pg. 19)

Basic Technical Patterns

Sandor has identified and defined five basic technical patterns which he applies to performing a work on the piano, as and when these are required. He contends that the musical text clearly indicates which of these five technical patterns to select as the appropriate technical solution [1].

As a basis, these five patterns serve a useful purpose by bringing technical patterns into conformity with musical patterns in the score. Though it is certainly useful to identify these basic technical patterns, it is their combination which one encounters in practice:

A	free fall
B	five-fingers, scales and arpeggios
C	rotation
D	staccato
E	thrust

In essence, they can be defined as follows:

Free Fall:

The basic concept of a free fall is that the force of gravity is allowed to pull the weight of the locomotor system to the keys, with as little interference as possible from the muscles of the body. It is done in three stages in a successive series of motions: lift, drop and landing.

1. Gyorgy Sandor - *On Piano Playing* (1981 : pp. 35 - 137)

Heinrich Neuhaus describes this effect as "pure weight" falling on to the keys. This technique, he says, is applied "by raising the hand above the keyboard and dropping on to the key with the "pure weight" of the hand without any pressure, but also without any holding back, *come corpo morto cadde* (as a dead body falls) as Dante puts it" [1].

Five-fingers, scales, and arpeggios:

The use of the five fingers in playing scales and arpeggios involves the intricate participation of all the different components of the human playing mechanism. Independence of the fingers is achieved by interdependence with other components. The main source of energy is the muscles aided by the force of gravity. The basic concept is that the finger falls vertically on the key while supported by the other parts of the locomotor system. The vertical direction of the finger to the key is in line with the vertical direction of the key during descent.

As a pattern, five finger technique is employed when a sequential series of rising or falling motives are encountered in the score. This pattern implies the use of a separate finger attack when notes are separated and the increased involvement of other components, such as the whole arm and wrist, when notes are grouped together.

The motions of the fingers are described within the three dimensions: vertical, horizontal and depth (depth refers to the plane from the back of the key to its edge). The fingers reach their optimal functioning by adjusting their positions along these three lines.

In slow passages, the fingers are placed in their positions and then activated, whereas in faster passages, they are 'thrown' toward their desired position.

1. Heinrich Neuhaus - *The Art of Piano Playing* (1973: pg. 100)

Rotation:

The principle of rotary movement is that it allows the hand to move on its longitudinal axis which is activated by the forearm. The fingers are notionally active. This technique is employed when passages move up and or down in sequence. It is a technique that is widely used in the execution of trills:

Chopin - Etude Op 10 No 5

A pattern that could be executed using rotational movement

Staccato:

The staccato technique involves the use of the strongest muscles which transmit their energy through the entire arm, the wrist or the finger. We can thus have: arm staccato, wrist staccato and finger staccato.

The duration of contact on the surface of the key is a mere fraction of a second. The playing equipment rebounds on impact. Motions that use the various combinations of upper arm, forearm, wrist and finger generate different tone qualities and quantities according to the way the equipment is used. The four components involved can vary their speed, height and position, and can vary the prominence given to any one of them or to any combination of these components.

Thrust:

Whereas in the free fall, muscles do not participate during the downward motion of the arm (its fall and acceleration being caused exclusively by the force of gravity), thrust is executed purely by active muscles. Neither the force of gravity nor weight is employed. The direction of the push is vertical:

high wrist $\uparrow$

low wrist $\downarrow$

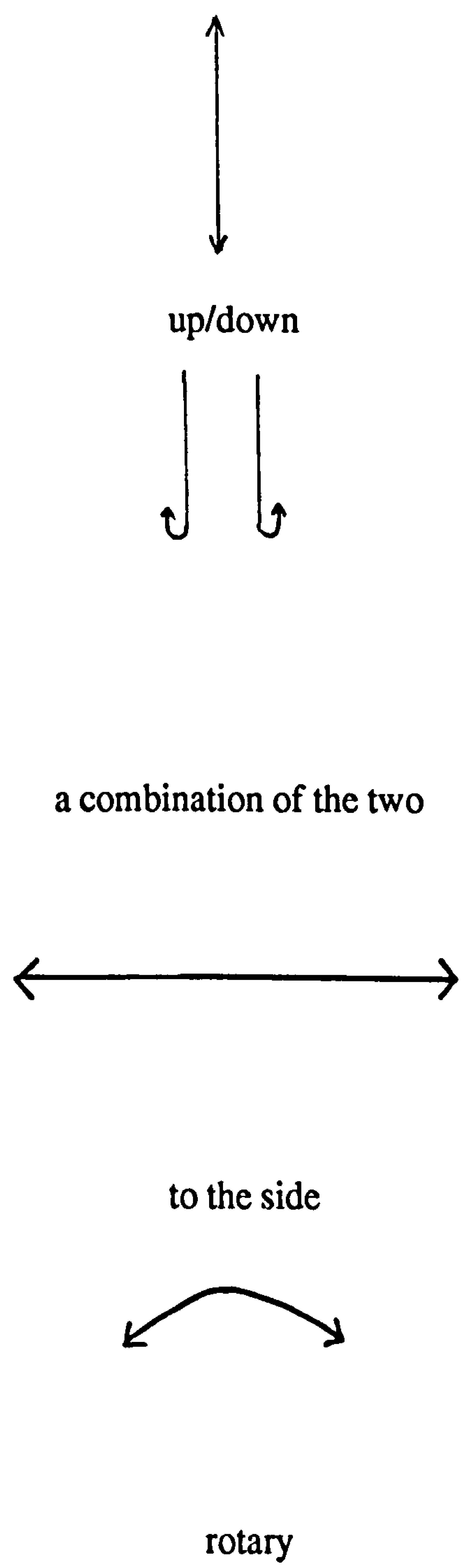
The patterns discussed involve use of the two sources from which a pianist draws energy: the force of gravity and the muscles, either independently or in combination.

Heinrich Neuhaus makes extensive use of certain symbols to indicate a variety of touch that can be applied to the piano: *F* (force), *m* (mass), *v* (velocity), *h* (height) [1]. These symbols, he says, "I have borrowed from physics and mechanics. They are a great help for understanding and using the physical possibilities of the piano, considered as a mechanism....by gradually increasing the force of the action - *F* and the height at which the hand is raised - *h* we come to the upper limit of volume (*ffff*), after which we get not tone but noise, since the mechanical (lever) arrangement of the piano does not allow excessive speed (*v*) coupled with an excessive mass (*m*). The energy of the blow which the key receives is determined by the force - *F* - which we apply to the hand and the height -*h*- to which the hand is raised before being lowered on to the key. The speed of the hand at the moment when it strikes (*v*) varies depending on the value of *F* and *h*. It is precisely this figure (*v*) and the mass (*m*) of the body (finger, hand, arm etc.) striking the key that determines the energy which acts on the key".

1. The practical meaning of these values was so thoroughly mastered by his pupils, that he had merely to make brief observations such as: too much *v* or too little *h* or not enough *F* and his pupils would respond accordingly.

The basic movements of the pianist's locomotor system, which will be featured to a greater extent in this study, are the following:

Figure II - 1:



2.3 STAGE I OF *MODUS OPERANDI* (Preparation):

The forces that set sound in motion, as defined in this chapter, prepare for action before sound is realized. For many musicians, music begins at this preparatory stage which is commonly referred to as the preparatory beat: the intake of breath of a singer or a wind player, the upbeat of a conductor, the mobilization of the hands ready for action. Edward T. Cone [1] implies as much by suggesting that "perhaps some of the silence immediately before and after a composition is actually a part, not of the frame, but of the work itself".

There are two stages to this preparation: stage one draws energy and stage two discharges this energy. As sound is realized at any time during stage two of this process, we will examine its impact at stage II of the *Modus Operandi* in the proceeding chapter.

Suffice it to say, that the preparatory beat is, by all accounts, one of the most important integral stages to music-making. For instance, every reliable authority on conducting confirms the importance of the preparatory beat:

Awareness between performing musicians:

Daniel Barenboim, writing on "conducting" [2], states that the conductor's upbeat has a direct influence on the first note, whether it should sound hard or soft; on the way it is sustained; and to what extent it should vibrate.

1. Edward T. Cone - *Musical Form and Musical Performance* (1968 : pp. 17-18)

2. Daniel Barenboim - *A Life in Music* (1991 : pg. 84)

Likewise, Furtwängler says that "The power to affect a note - and this cannot be emphasized too often - lies in the preparation of the beat, not in the beat itself...According to the nature of the beat and its preparation, so will be the sound that is created..." 1.

André Previn once observed that once the preliminary beat has been set in motion, the moment of impact has been predetermined. Any delay in delivering the downbeat "in time" would cause an undesirable musical effect.

The mobilization of forces during the preparatory stage creates a certain "aura" that by nature forms an important constituent element to the composition 2.

1. Furtwängler on Music - *Essays and Addresses* edited and translated by Ronald Taylor (1991: pg. 20)

2. Recently I had to choose a take from a recording session to begin Beethoven's Piano Sonata Op 110. I found one in which the first chord seemed to me to have the right approach and attack resulting in a sound that emerged slowly out of nowhere. I was surprised when I heard the first edit of my work, that the first chord did not seem to me to be as well judged as I remembered it. It somehow started rather suddenly and did not come into focus slowly. This was of concern to me, so I went back to the original session takes to listen to it again. To my amazement I realized that just a fraction of a second before I struck the chord, there was a slight stool noise which the engineer very studiously edited out. He did not interfere in any way with the actual sound, but edited out the "aura". When I mentioned this, he agreed with me and restored the original "noisy" take, but with the intensity created by the upbeat, fully revived.

CHAPTER III

CHAPTER III

MUSIC IN MOTION

(STAGE II - IMPACT)

SPEED OF MUSIC* - PART I

3.1 INNER METRE:

The forces that set sound in motion, as defined in the preceding chapter, now proceed to realize themselves in sound. The resulting musical experiences will be described in terms of physical phenomena and laws which govern all bodies in motion.

The phenomena to be encountered at this stage of the *Modus Operandi* pertain to the *inner mode* of this operation: they are perceived in the mind and can only be explored and explained in metaphorical terms. Mass, speed and direction of the body in motion, which we encounter in the *inner mode*, we shall call: **mass of music, speed of music and direction of music.** Even though one influences the other, each will be dealt with separately.

* Several years ago, a student was playing in class so feverishly that the pace of the music was hectic to the point of breathlessness. I said to the student:

'Please slow down'

'You mean,' he said, 'make a *ritenuto*?'

'No,' I replied

'I see,' he said, 'you mean play at a slower *tempo*'

'No,' I replied again, 'what I am asking you to do is slow down the **speed of the music**; think of crochet impulses instead of semiquaver ones and exercise fewer and thus slower physical movements in which a greater number of notes will be delivered'.

What I was really saying to the student was: slow down the 'speed of music'; not the *tempo*, but the pace in which the music 'proceeds'.

Methods of production which alter the nature of sound quantitatively as well as qualitatively, produce contrasting patterns. Patterns of similar character also emerge. The periodicity of these related patterns establishes a rhythmic pattern that adds another dimension to musical perception. This concept, which we call 'Speed of Music', will be examined in detail in this chapter.

Velocity and Speed

In musical terms, the word 'speed' can be defined as the measurable distance between the moment at which sound starts and ceases in relation to other sounds or in relation to a basic pulse or beat. In this respect, it is closely associated with duration and particularly with duration of contact with the key.

The velocity of sound, i.e. vibrations, is identical for all wavelengths and does not depend on how loud or how high a note is made to sound. But velocity of sound does depend on the density of the sound medium.

Music is a succession of sounds perceived in time. It can therefore vary its speed according to the musical text. It can slow down; it can accelerate. What we perceive as a change in motion is nothing more than a mere change of an auditory condition governed by the application of a series of forces by the player. To apply Newton's first law of motion (a force needs to be applied for a change in velocity): in music, a series of interventions interfere with the natural course of the vibrating sound and establish varying degrees of motion [1]. These are susceptible of analysis, definition and systematisation.

1. A string will follow its natural course when left free to vibrate. Once further contact is made with the string, as when the bow is applied on a stringed instrument for instance, it interferes with its natural course thereby giving the impression that the player 'manipulates musical sound and sets it in motion'.

It is important, therefore, to distinguish between the speed of sound, the *tempo,* of a piece of music and the speed with which various degrees of motion are applied by a player, first in producing a note and then in manipulating it once in motion.

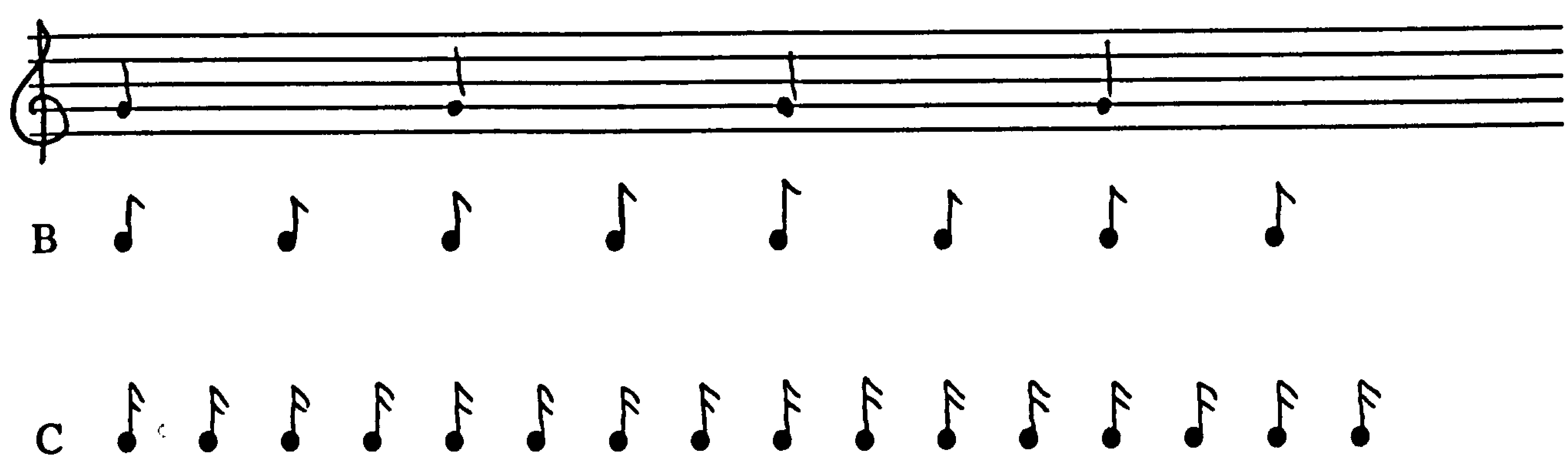
There exist in music architectonic levels [1] comprising the various subdivisions of regular metrical stimuli, which form a very important temporal hierarchy. Such rhythmic patterns are divisible, in the mathematical sense, by their unit values.

Thus, in the following example, a regular succession of sounds are heard which on one level (call it higher level A) are structured by periodicity: while on another two levels (call them lower levels B and C) they exist as a series of metrical impulses which are perceived as subdivisions in our minds and by our physical senses and responses.

1. Architectonic levels are different levels of musical activity - as defined by Cooper & Meyer (1960)

Example III - 1:

Articulated notes on a higher architectonic level A:



Metrical impulses on lower architectonic levels B and C

At the lower level, we encounter an aspect of pre-rhythmic perception which is difficult to define. Its spatiotemporal pattern is of utmost importance to the musician, as it forms a metrical underlay which determines the relative timing and interactions between notes [1]. For the purposes of this study, the metrical orientation on this lower architectonic level shall be defined as *Inner Metre* [2], of which we always remain to some degree subliminally aware. It must have been to this that Leibniz was referring when he described music as "unconcious counting". Even a composer like Messiaen, who prefers to keep rhythm and metre strictly apart, nevertheless uses birdsong and other devices so as to make audible this basic pulse as a means of "measuring" rhythmic permutations which might otherwise be lost on us - a process which he refers to as *monnayant* (=minting) [3].

1. While attending classes with the late Nathan Milstein several years ago, I was able to observe how he would control the pace with which musical lines unfolded as played by a student, by strumming along on his violin in metrical impulses based on the subdivisions of the main beats.

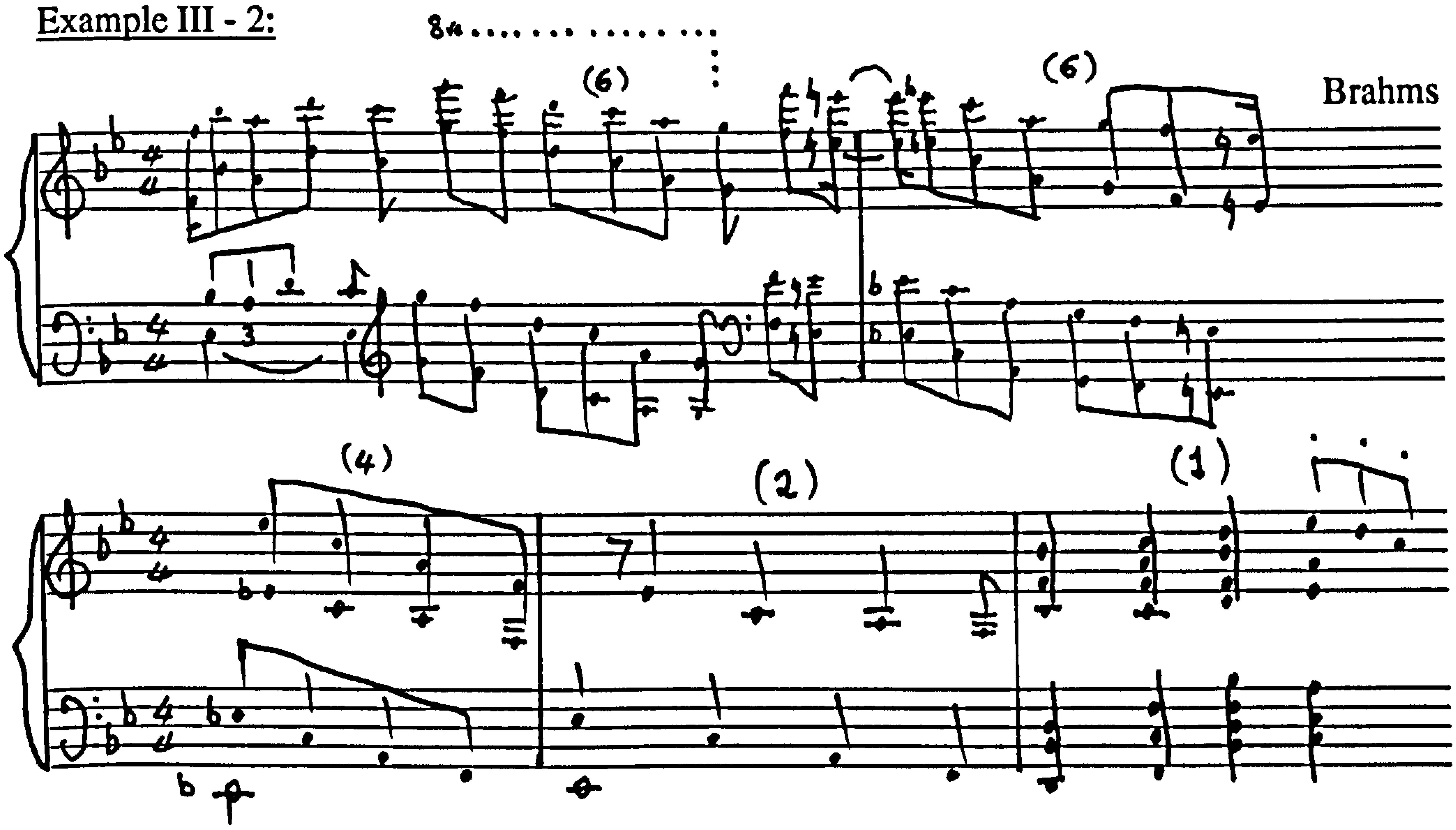
2. *Inner Metre becomes Inner Rhythm* as we shall see later on.

3. Malcolm Troup: "Orchestral Music of the 1950s and 1960s" in: *Messiaen Companion* pg. 413

As a given unit is compounded into larger metric ones, our physical sensors perceive this in an abstract and subjective manner as a slowing down process. Conversely, as a given durational value is divided into ever smaller units it is perceived as a speeding up process. In this example, the response of our physical senses to the compounded rhythmic pattern would thus be one in which the music would be perceived as moving at a faster pace at 1B and faster still at 1C. Conversely, the fewer impulses one discerns, the slower the speed of the music.

In the following example from the Piano Concerto no 2 in Bb major by Brahms, the listener perceives a slowing down process as the pervading pulse - the unit value - is divided progressively first by six, then by two and finally one unit as the main theme is introduced:

Example III - 2:



In order to elucidate this phenomenon further, we can look at the behaviour of a mechanical metronome. If set at ♩ = 60, the pendulum should cover a given distance in one second. If set at ♩ = 120, the pendulum should cover the same distance in half a second. In order to do this, the pendulum has to travel at a faster pace.

The human mind responds to the incoming data from these changes in temporal organization, against the memory store of experience. Thus in a compounded metrical pattern, our sensory perception discerns a larger number of completed oscillations in any one given time [1].

In the hierarchical sense, there are various architectonic levels at which rhythmic patterns begin to emerge and co-exist, some of which are absolute in definition, and some of which are subjectively chosen. Numerous architectonic levels could therefore be created based on the various rhythmic patterns that are preeminent in the periodic structure of:

a) melody
b) harmony
c) pedal
d) vibrato
e) metre

A series of notes played on, say, a stringed instrument, will produce temporal patterns of infinite variety, on various architectonic levels. On one level, there exists a pattern determined by the notational durations of the notes, which are absolute. On another level, there exists a speed of motion determined by the frequency of pulsations, as for example when vibrato is applied.

On yet another level, there exists a metrical pattern which is divisible by the unit value, and in which the speed of music is identical or proportionately slower or faster than that at a different architectonic level, depending on the pulsating stimuli the mind chooses to perceive. The slower the impulse, the slower the speed of music; the faster the impulse, the faster the speed of music.

1. Cooper & Meyer maintain that "our judgements of speed are not absolute. They depend upon what takes place in a given segment of chronological time and on how a segment is filled...so the psychological tempo of a musical passage depends upon the number of identifiable events or changes which take place in a given segment of time" - *The Rhythmic Structure of Music* (1960: pg. 66)

3.2 MOTOR MECHANISMS AND SPEED:

In performance, musical patterns are produced by bodily movement. Therefore, musical motion, as it varies, can be represented visually within a defined spatial framework. For example, on a visual level, one senses a change in the speed of music, through the change in the speed of the bow.

Bow Speed as Inner Metre

In this example, two notes of equal length are played on a string instrument using a different speed of bow:

Example III - 3:

a)

time: 00"____01"

distance covered by the bow

𝅗𝅥 𝅗𝅥

b)

time: 00"________________________01"

distance covered by the bow

𝅗𝅥 𝅗𝅥

Once activated and left free to vibrate, a string has its own natural mode of vibrations. The bow initiates and maintains this vibration but constantly interferes with it. The bow seizes and releases the string in cycles whose rate of recurrence depends on the speed with which the bow is drawn [1].

If the bow is drawn faster, the number of times in which the bow 'bites' on the string is greater than if the bow is drawn slower. Whether the weight applied is varied makes no difference to the pulsating string which obeys strictly the application of the bow and its speed of motion.

In both cases, the frequency of the cycle, that is the pulsating rate of the string, is too swift to be obviously discernible. Therefore, a slower musical motion is perceived psychologically, when not by the ear, only through the visual movement of the bow.

The difference in pace can therefore only become apparent in relative terms, once an equilibrium has been established as a focal point to which any movement can be related.

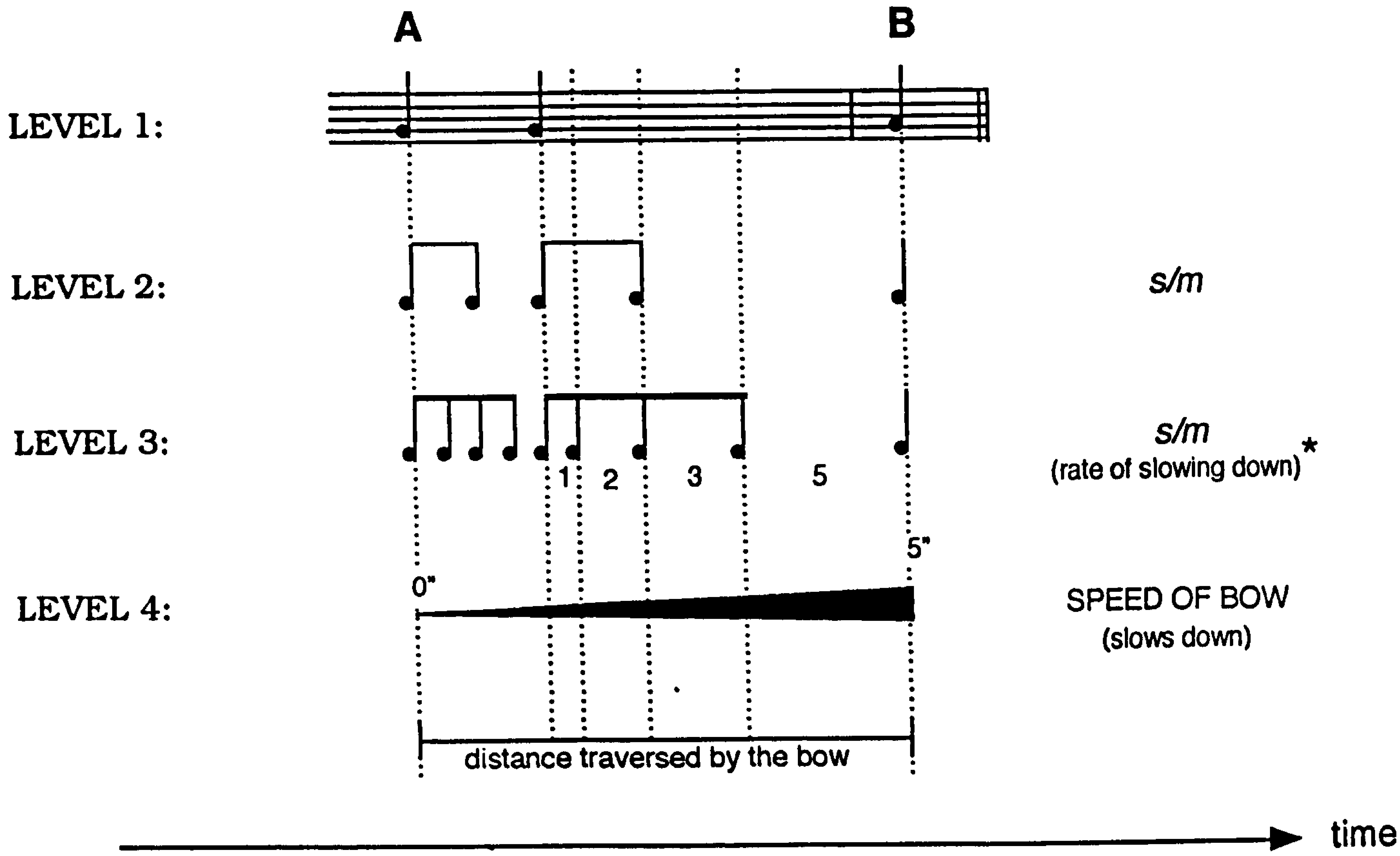
In this context, musical perception depends on the function of our sensory systems, both auditory and visual. A faster bow speed that emits a higher rate of pulsations and therefore a faster inner rhythm, would be perceived as possessing a faster 'speed of music' than a slower speed of bow that emits fewer rates of pulsations.

Variations in Constant Elements

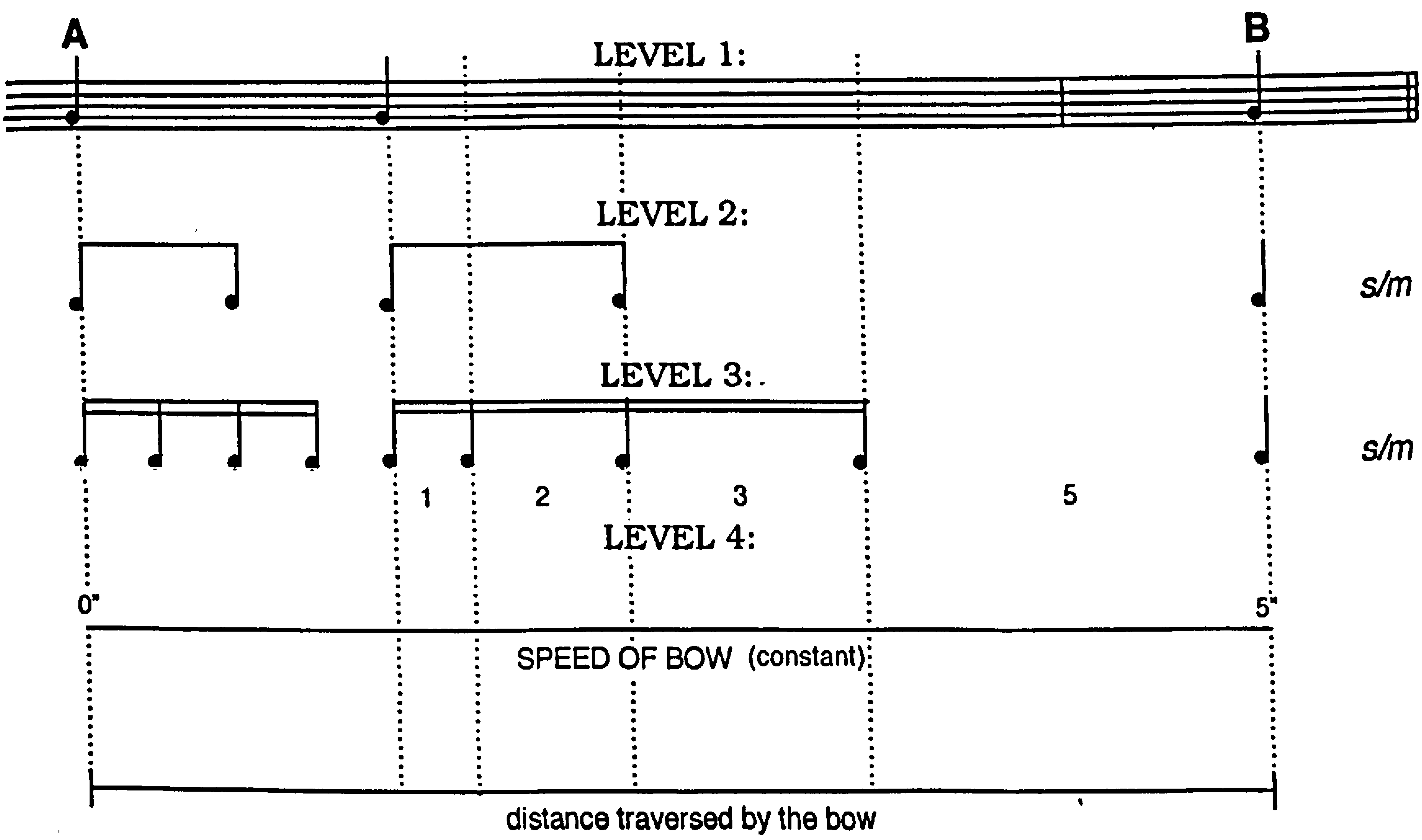
When a force is applied to a moving element it will cause a change in its velocity. Thus, in example III - 4, the bow is drawn gradually slower while in motion:

1. When the bow is placed on the string and drawn to one side, the static frictional force is quite substantial and the string can move a considerable distance laterally before the elasticity of the string overcomes the frictional force and the string slips along the bow. Immediately the dynamic frictional force is much lower and although the bow continues to move in its original direction the string can slide over it; the string moves rapidly across to the other side of its undisplaced line position until the elastic forces bring it to rest; it once again 'sticks' to the bow and the cycle repeats. (source: *New Grove Dictionary of Music and Musicians* (1980); article on "Sound", §6: Quality). The recurrence of this cycle depends on the speed with which the bow is drawn.

Example III - 4:



Example III - 5:



* The progressive rate of slowing down (1, 1, 2, 3, 5) is part of the Fibonacci Series

The speed of the music slows down as the inner metre gradually decelerates. This causes the third note of example III - 4 at level 1 to arrive slightly late. The overall musical result is one in which a slight ritenuto is experienced at the end of the passage, causing a minute temporal adjustment to the temporal pattern. Minute deviations from exact metronomic subdivisions of the beat occur frequently in music.

Level 3, could represent the pulsating rate of the vibratoı, which is audible and can be adjusted proportionately.

3.3 OUTER FLOW:

Bow Speed

There are two areas of particular interest in the various levels of activity as outlined in example III - 4:

1) the inner metre as represented at levels 2 and 3, and
2) the general speed between points A and B which is represented by the speed of the bow. In this instance, the speed of the bow slows down.

In example III - 5, the inner metre slows down at the same rate as in example III - 4, but the speed of the bow remains constantly the same. In this instance, the distance traversed in time is the same whereas the distance traversed by the bow is extended and represents a general outer flow and speed of music.

Whereas the distances in time between the various impulses that are heard are identical in both cases, there are qualitative differences between examples III-4 and III-5. The differences between the speeds of the bow, produce a distinctively different musical effect.

Speed of the Pianist's Playing Mechanism

The speed of the bow as outlined above functions as a medium which indicates a general speed of motion between two points: A and B. It is analogous to the amount of air with which a wind player excites the wind column of his instrument and also to the speed at which the hand of the pianist drops on to the key.

It is possible, indeed desirable at times, to control the speed with which part of the playing mechanism moves between two points of reference in the music in order to produce certain musical results. Thus, one could identify two different hand positions and examine the speed at which the hand moves from one to the other. This will depend on the distance between one position and the other. In figure III-1 and III-2 the pianist's wrist moves from a lower wrist position A to a higher wrist position B in five seconds in one continuous flow. In figure III-2 the wrist moves higher and, therefore, faster. As the time taken to complete the movement is the same in both cases, this means that in figure III-1 the wrist moves slower than it does in figure III-2:

Figure III-1:

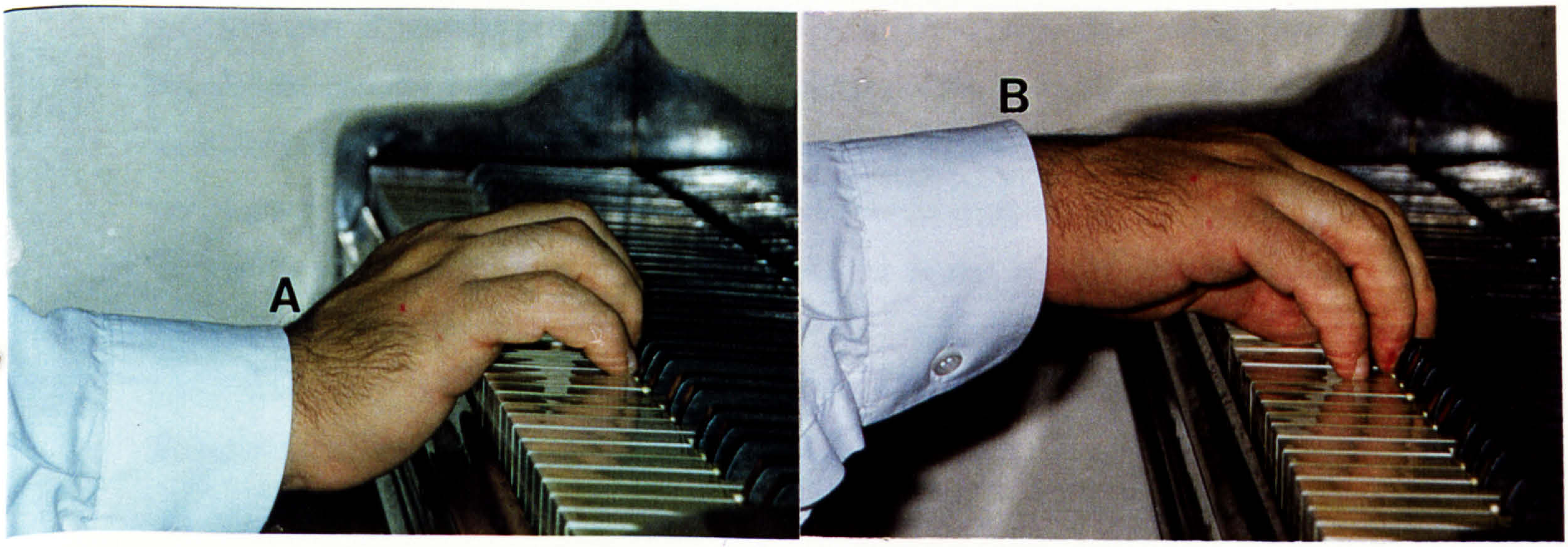
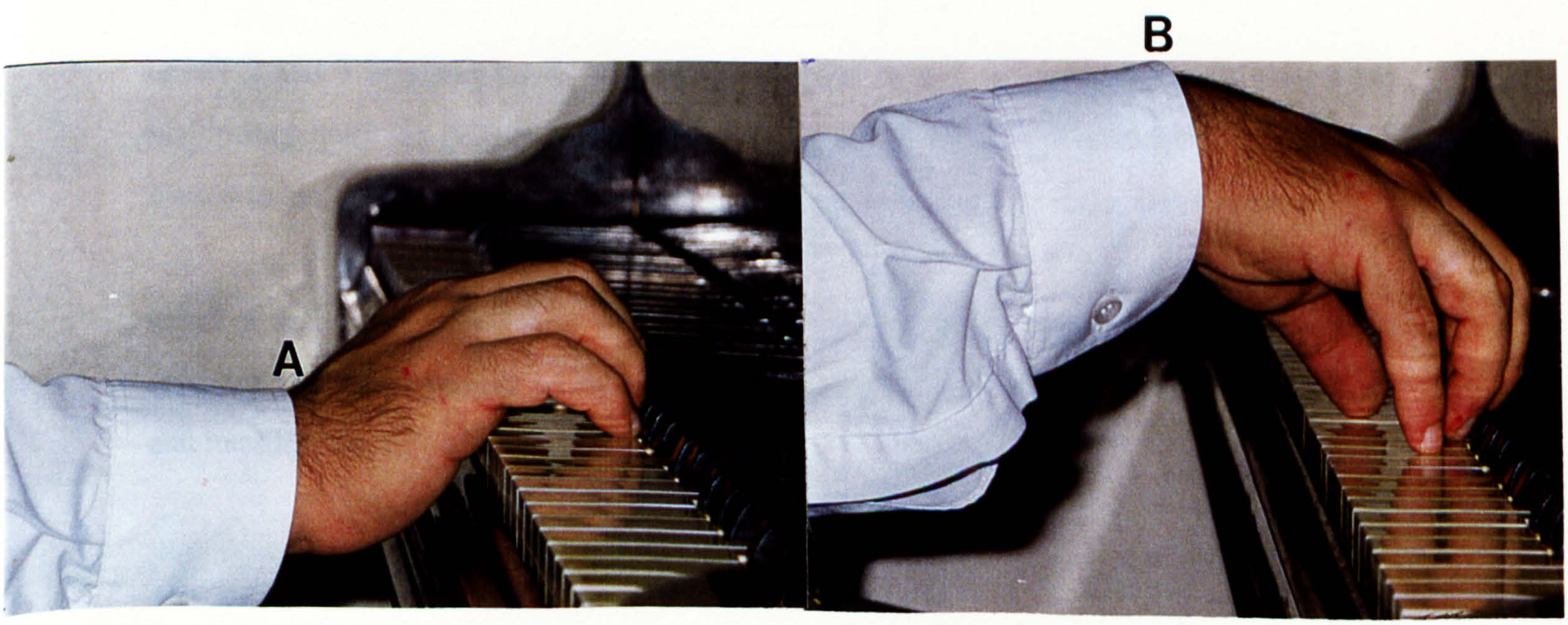


Figure III-2:



The speed at which the wrist moves is analogous to the speed at which the bow moves as exemplified earlier. In both cases, it represents the speed of the moving sound-producing mechanism which suggests, in turn, a speed of musical motion. As the speed of the physical agency conditions the quality of the musical sound, it must also, by implication, constitute an important part of musical perception (see pg. 17). As has already been noted, Stravinsky regarded the gestures and motions of the different parts of the body which produce music as "necessary and essential to grasping it in all its fullness". Therefore, instead of viewing the spatiomotor component in musical cognition as a lower-level process, as Baily says (pg. 25), "it may be better to treat auditory and spatiomotor modes of musical cognition as of potentially equal importance" (ibid.).

'Speed of Music' therefore, represents two areas of activity:

1) the area of activity as represented in examples III-4 and III-5 at levels 2 and 3,

2) the area of activity at level 4 in both the above examples as well as the speed of the locomotor system in action - as in figures III-1 and III-2.

Levels 2 and 3 in examples III-4 and III-5 indicate an area of metrical activity which the performing musician defines and monitors by an act of subliminal perception - we might liken it to his 'biological clock'. It is termed, for the purposes of this study, *inner metre*.

Level 4 and figures III-1 and III-2 indicate a general flow whose speed is manifestly apparent at a more general level of sensory perception. The various levels are interrelated and interdependent.

3.4 INNER METRE BECOMES INNER RHYTHM:

In a musical phrase, there are notes which accept stronger impulses than others. There are also various notes which are grouped together and which form a single rhythmic cell comprising smaller subdivisions. Thus, rhythmical patterns emerge 1.

In performance, it is possible to group together notes by various means: a string player would play two or more notes in one bow; the pianist would do likewise by using one movement of the arm to deliver a series of notes.

Nicolaus Harnoncourt, in the book *Der musikalische Dialog* 2, explains the significance of grouping notes together and the metrical and periodic structure which occurs as a result of slurring notes together:

1. According to Cooper & Meyer (1960), rhythm may be defined as the way in which one or more unaccented beats are grouped in relation to an accented one. The five rhythmic groupings may be differentiated by terms traditionally associated with prosody:

a. iamb ∪ —
b. anapest ∪ ∪ —
c. trochee — ∪
d. dactyl — ∪ ∪
e. amphibrach ∪ — ∪

On the other hand, *metre* is the measurement of the number of pulses between more or less regular recurring accents. Rhythm is independent of metre in two separate senses:

a) it can exist without there being a regular metre, as it does in the case of Gregorian chant or *recitativo secco.*

b) any rhythmic grouping can occur in any type of metric organization. For instance, an *iambic* grouping can occur in duple or triple metre.

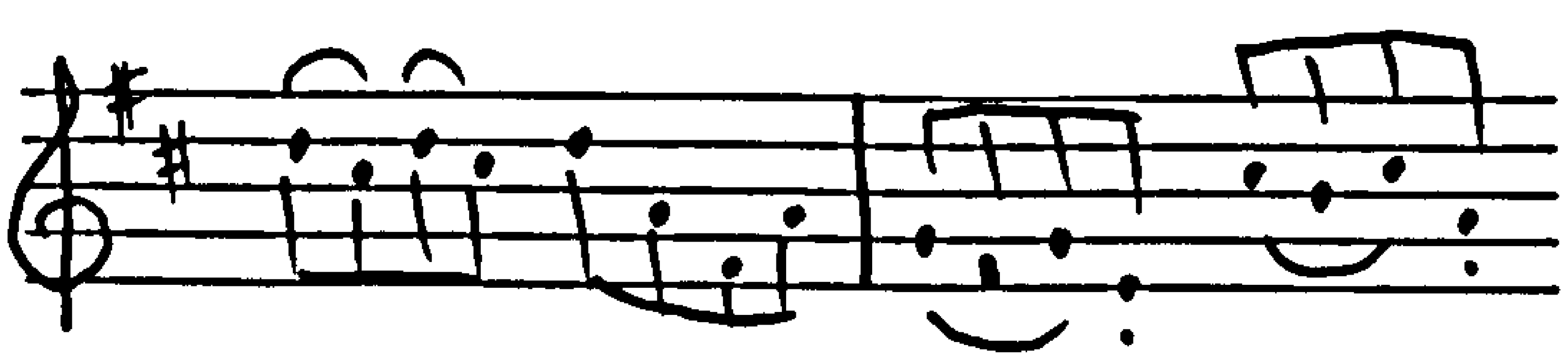
On the question of rhythm, there is an interesting theory that relates the word (from Gk. *ρυθμός*) etymologically to the word *Ρέω* which means 'to flow'. The history of the word shows also that it was close in meaning to σχήμα ('shape', 'form', 'figure' - Leemans, 1948). Source: The *New Grove Dictionary of Music and Musicians* (1980); Liddel and Scott *Greek-English Lexicon* (Oxford, 1977).

2. Nicolaus Harnoncourt - *Der musikalische Dialog* - The musical dialogue: translated by Mary O' Neill, (1984: pg. 108)

"In the 18th century, articulation on an instrument was basically the responsibility of the interpreter. The composer had to mark only those passages in which he expressly desired an execution which deviated from tradition, from the established norm. At the time of Mozart, it was not necessary to write a slur over a dissonance and its resolution, because the unity of these two notes was taken for granted; they *had* to be slurred. If this slurring, which was obligatory at that time, is performed today, the effect is a clear rhythmic and harmonic change in the customary sound pattern. We have grown accustomed to the error of omitting the slurs once taken for granted".

"...in this movement, [the final from the "Haffner Symphony"], Mozart wrote only *very* few slurs, and when it is typically played today "as written", for long stretches, thus determining the character of the movement, the impression of a hailstorm of eighth notes arises. But as a matter of course, musicians of the period articulated according to recognizable patterns in the music, e.g. violas and basses in measures 9ff.

or all strings, measures 20 ff.



and all similar figures in accordance with the same principles. But if we treat the slurs, as was customary at the time, not as bow strokes, but rather as emphasis signs, a pronounced rhythmical order emerges:

in the first passage: 

in the second passage: 

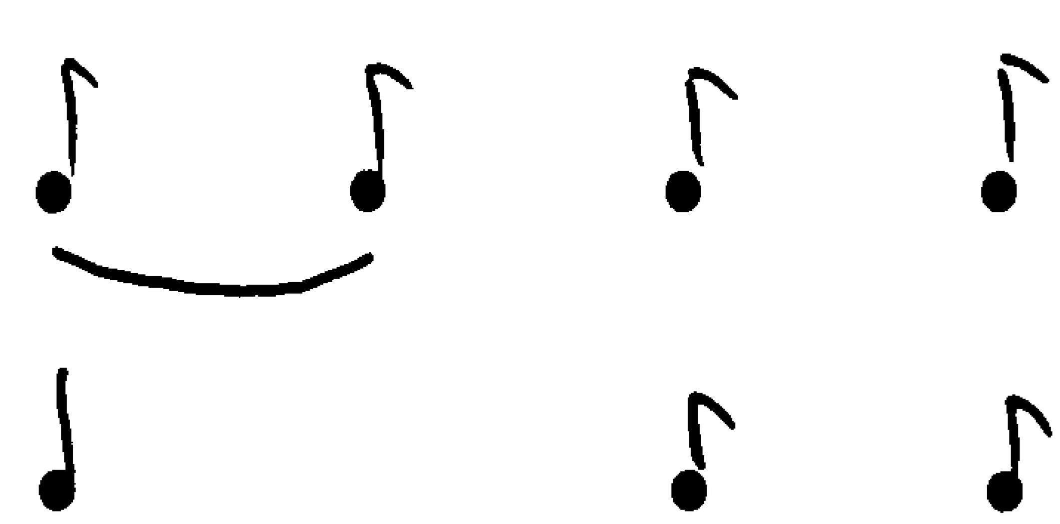
"This movement thereby acquires a completely different rhythmical structure than when all of the eight notes are played with a regular spiccato. If Mozart actually expected such an organized articulation from his interpreters (and I am firmly convinced that he did), then his work is distorted by an *unarticulated* manner of playing, so the interpretation that is true to the notes can never be true to the work".

Periodic structure determines the manner with which a phrase of music is articulated and defined. In this respect, there are various 'speeds of music' that emerge from close adherence to the periodic structure of a musical phrase: a slur, by which two or more notes are incorporated into one metric unit, slows down the s/m, as compared with notes that are articulated separately, which increase the s/m. This is complemented by a bodily movement (which, as we have said, represents *outer flow*) moving at a slower pace. The following example shows uniformity at different levels of musical activity. Therefore, it correlates *inner rhythm* with *outer flow*:

Example III - 6

Written score: Level 1

Inner rhythm: Level 2



Bodily movement:	slow	fast	fast	Level 3
SPEED OF MUSIC:	slow	fast	fast	

At level 1 we encounter a familiar musical figure in which the first two notes are slurred. It would be common practice to play the first two notes on a stringed instrument using one bow or applying one movement of the arm when slurring on the keyboard. Thereafter, separate bows and separate hand movements would apply respectively.

At level 2, it is presumed that the bow is drawn faster when playing the 3rd and 4th notes in the series. As a consequence, fewer pulsations are perceived between the 1st and the 3rd notes than between the 3rd and the 4th. Likewise, the arm moves at a slower pace between the 1st and the 3rd notes than it does when playing the 3rd and 4th.

As a consequence, all levels converge to signify a s/m which attends to the meter of this musical statement, to the inner rhythm which one perceives as well as the to speed at which the body moves. In this respect, the musical text provides the criteria on which an execution is based: the music slows down, then quickens; therefore, a bodily movement which complements this is applied.

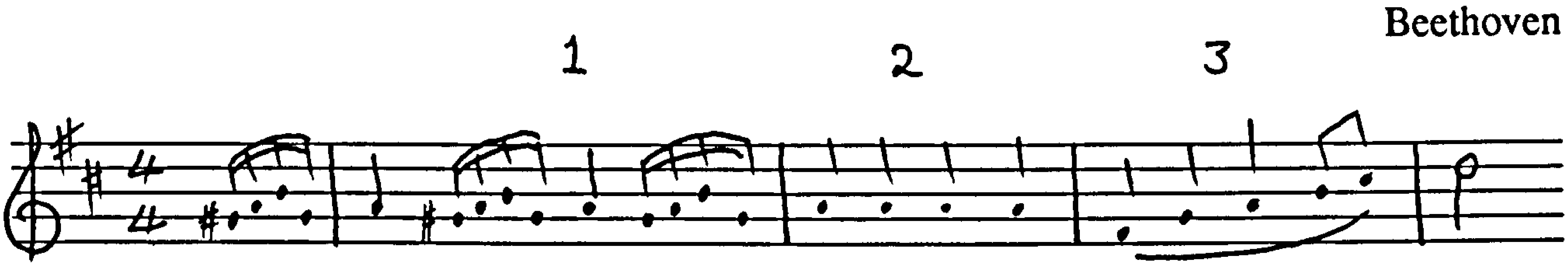
3.5 APPLICATION:

Frequently in music, there are instances where a work marked *Allegro* in 4/4 time, switches the main pulse from four in a bar to two in a bar [1]. This occurs when a brisk four in a bar movement of a work, introduces a more lyrical and contrasting second subject in two in a bar. An example of this, is to be found in the first movement of Beethoven's violin concerto, at the junction where four in a bar switches into two in a bar, at the introduction of a more lyrical, contrasting second subject:

1. Similar to the 'alla breve' principal in which note shapes diminished in relative value in ratio 2:1.

Example III - 7:

Beethoven



The 'Speed of Music' slows down as the second subject material is introduced. It is advisable, indeed desirable, for the conductor to switch from beating in four to beating in two in a bar, for the more lyrical second subject. There is an interesting "junction" here in the second bar of the above example, where the conversion from four into two takes place:

A faster s/m implies a speed of motion in the hands of the conductor which almost invariably results in an accent, however small, on impact. Conversely, a slower s/m implies a speed of motion which avoids an attack on the first note of impact, making it sound more lyrical [1].

The conductor's speed of movement is therefore important here in determining the overall quality of the first note of the second subject: the inner rhythm that the musicians perceive during the first bar of the above example is the semiquaver sub-division of the main beat:

while the conductor conducts four in a bar.

1. This phenomenon is explained in more detail in a later chapter.

At the onset of the second subject at bar 3 of the above example, the conductor switches into two in a bar, while the inner rhythm that is perceived could comprise a series of quaver, crochet or even minim impulses, whichever is applicable. Therefore, beating four in a bar indicates a motion that is swift, whereas two in a bar, slows that motion down [1].

If the conductor were to continue to beat four in a bar, there is always the danger of indicating the onset of the first note of the second subject, with a movement that is too swift and which would consequently induce an attack on the first note of a lyrical theme. This would clearly be musically unacceptable.

In order to avoid this, so that the quality of the first note of this theme is lyrical, the movement of the conductor, as well as the 'speed of music', have to slow down prior to activating bar 3.

One way of achieving this would have the conductor switching into two, half way through bar 2. The 'speed of music' is slowed down and the attack on the first note of bar 3 is delivered without an accent thus producing a sound by the wind players of the orchestra that has a lyrical and "singing" quality. At the same time, a series of semiquaver impulses continues to be 'heard' throughout bar 2. Here again, the bodily motion, represented by the conductor's gesture, is in harmony with the temporal pattern suggested in the music.

1. Even though this may appear to contradict the notational principle of 'alla breve' which has been interpreted by some to mean a way of doubling the speed by beating the breves rather than the semibreves, I associate switching from four into two with the commonly applied compositional technique (as shown in example III-2, pg. 101) with which the pace of the music appears to slow down as the metrical impulses progressively increase in value. Besides, the conductor's movements, which are slower when beating in two, would substantiate this point of view further.

PART II

3.6 SPEED AND DURATION OF CONTACT:

The hand, upon striking the key, returns to a resting position. The speed at which the finger descends onto the key as well as the time it takes between the moment of impact and the time of rest are significant in determining the speed of music.

Newton's third law of motion states that when a force is applied to another body, an equal and opposite force is encountered on impact. With this in mind, the musical tone (one could reintroduce here the concept of the 'spherical mass' representing the musical tone) will react according to the intensity of the force (see pg. 128). As it is set in motion, its 'speed of music' (s/m), its 'mass of music' (m/m) and its 'direction of music' (d/m), are susceptible to change. Speed of music should vary in relation to the speed of attack. As the speed of attack in *outer mode* increases, so the speed of the musical tone in *inner mode* increases accordingly.

Rapid Attack:

In applying A (Free Fall) from Sandor's five basic modes of contact (see pg. 90), the hand, in a reflex action, rebounds swiftly. As a consequence of this reaction, and in the absence of any pressure applied to the key - implied by implementing mode A - the speed of music is proportionate to how quickly the hand rebounds in that the mind discerns a larger number of impulses [1]. The metrical impulses discernible are proportionately greater than the given value

1. On the piano, the higher the speed of the hammer, the greater the predominance of higher harmonics. The duration of contact between hammer and string is shortened so that the string vibrates in small segments, producing a tone rich in higher partials (based on the theories of Hermann Helmholtz as outlined in Chapter II: "Mechanisms"). This phenomenon may also contribute to our perception of a higher number of impulses.

of the note thus increasing *speed of the music* - if the given value is a crochet, a series of shorter durations are perceived as metrical divisions, (semi-quavers, demi-semi-quavers or shorter still), depending on the tempo of the piece being interpreted. [1].

This phenomenon, which occurs when 'Free Fall' is applied, can be made clearer if we were to compare it with throwing a ball: the faster the throw, the faster it will bounce; conversely, the slower the throw, the slower the rebound.

There is a conducting technique which is often applied to cadential musical junctures whereby the conductor's beat fractionally anticipates the main downbeat, usually on a subdivision of the main beat. Hence it is called a 'syncopated beat'. As this is usually delivered by a technique similar to the pianist's 'Free Fall', the hand of the conductor will bounce back according to the speed of the throw. The faster the hand is allowed to drop, the faster it will bounce and *vice versa.* The conductor will therefore apply a 'syncopated' beat on a subdivision of the main beat so that on the first or second 'bounce' the main beat on which the orchestral players must play is established. The speed of the downfall would thus condition the precise moment at which the rebound will occur.

In piano playing, unlike conducting, we do not usually pay too much attention to the 'preparatory' beat like conductors do. For instance, in applying the 'Free Fall' on the opening chord in Beethoven's Sonata Op 13, we must decide on the speed of the upbeat which will establish a metrical pattern and which will conform to the *tempo* of the opening *Grave.* The speed of the 'throw' will establish a metrical impulse 'on the rebound' comparable to the speed at which a ball will bounce. It would be desirable in this case to apply a slower rather than a faster 'Free Fall' in order to establish a metrical pattern based on the quaver.

1. The duration of contact, to be discussed in more detail later, will likewise have an influential effect on our perception of the speed of music.

Slow attack

As the key is approached slowly in this mode, the hand will rebound at a slower rate [1]. The hammer maintains a longer contact with the string, therefore the pulsating rate which the mind discerns in this mode is a slow one.

A graphic illustration of either mode of contact could thus be as follows:

Figure III-3:

STAGE I	*attack*	↓	*direction*
(outer mode)		O	*spherical mass*
STAGE II	*rebound*	O	*spherical mass*
(inner mode)		↑	*direction*

SPEED OF MOTION

Duration

The three modes of contact with the key which have so far been implemented concerned the use of A (Free Fall), D (staccato) and E (Thrust). With the exception of D (staccato), the hand[1] maintains contact with the key for as long as the durational value determines. Naturally it is possible to apply D (staccato) as a staccato feature to a *Free Fall*, though E (Thrust) implies a longer contact with the key.

1. The hand here implies the whole of the human apparatus, with all its components, which is used to make contact with the instrument.

The three areas to which duration applies when sound is initiated on the piano are:

1) length of time during which the hand maintains contact with the key,

2) length of time during which the hammer remains in contact with the string,

3) length of time during which sound is kept in vibration.

1) ***Length of time during which the hand maintains contact with the key - Tactility:***

The hand remains in contact with the key for as long as it is required - a minimal duration in the case of staccato.

When the hand remains on the key, its duration of contact is contingent to the mode of attack. The elasticity of the hand is here of particular significance [1]. When the hand falls on to the key with no increasing pressure, as it would do under A (Free Fall), the hand reacts with a reflex action on impact: the faster the attack - the faster the rebound; conversely, the slower the attack - the slower the rebound.

1. Elasticity of application is discussed in Chapter II, Part I: "Mechanisms". Furthermore, Otto Ortmann states that "the laws of elasticity teach us that the displacement of an elastic body is directly proportional to the force, within the limits of elasticity".

The duration of this reflex action determines the rate of pulsations which the mind perceives during contact time with the key: faster action/faster reaction will thus render a faster speed of music, whereas a slower action/slower reaction will render the opposite. Though not exclusively so, this is a tactile sensation [1].

2) ***Length of time in which the hammer remains in contact with the string:***

It has been shown that the duration during which the hammer remains in contact with the string, though limited to the degree that the lever mechanism would allow, influences the mode of vibration of the string [2]. Variations in contact time are generally modest [3]. The contact time increases as the speed of the contact point decreases and, conversely, decreases as the speed increases. As the hammer maintains a longer contact with the string, however infinitesimal, the note, in musical terms, acquires a more "sostenuto" quality to it.

From this, we deduce that a shorter contact time, as a result of a quicker approach to the key, increases the rhythmic impulses that the mind discerns and, as a result, the speed of music is increased; conversely, a longer contact time as a result of a slower approach to the key results in a slower speed of music.

1. Under these circumstances, *inner mode* and *outer mode* converge - if ever they were apart.

2. I refer the reader to Chapter II, Part I: "Mechanisms".

3. But as Otto Ortmann points out: "variations in time range approximately between the limits of .001 and .005 of a second, for the middle and lower regions; but this is ample time to produce tonal differences when we consider that fraction in relation to the rate of vibration of the string". This view is substantiated in C.A. Taylor's study on "*The Physics of Musical Sounds*" in which he cites the work of Kauffman (1895), who he says has "shown that the time of contact is relatively long compared with the period of vibration of the string".

3) ***Length of time in which sound is kept in vibration***

The length of time in which the string is allowed to vibrate is subject to:

a) the length of time that the hand remains in contact with the key; when contact is withdrawn, the string ceases to vibrate at the time at which the damper falls back on to the string

b) the length of time that the pedal is kept depressed when the hand is no longer in contact with the key; by the use of the pedals, the piano allows the strings to vibrate freely when contact with the key is withdrawn. The same applies when a string player plucks the string of his instrument.

There exists a discernible difference to the musical quality of the tone thus conditioned by the prolongation of contact with the key (or the plucked string in the case of a stringed instrument) regardless of the time that the vibration is allowed to continue.

We shall define this difference as a) the *actual duration* of the musical tone and b) the *apparent duration* of the musical tone.

The *actual duration* of the musical tone exists when contact is maintained with the key for as long as is deemed necessary. In this case, constant weight pressure is maintained throughout contact with the key [1]. For instance, a crochet will realize its full value and potential when contact as well as weight pressure is maintained constantly throughout its whole notational value.

1. Weight can increase as pressure is increasingly applied, but this produces a different effect which will be dealt with later.

The *apparent duration* of the musical tone exists when the string is allowed to vibrate freely for the notational value of a note, even when the hand has ceased contact with the key [1].

In this respect, the *actual value* of the note is contingent on the actual length of time that the hand remains in contact with the key. This can be quantified: if in a piece of music the written value of a given note is a minim, and the hand remained in contact with the key for precisely half a second, the *actual value* of the note will be a quaver when the metronome marking indicates ♩ = 60. The *apparent value* of the note, real as it may be, will be a full minim.

Duration of contact in this instance, signifies to the mind the rhythmic impulse that is discernible: shorter contact will effect a slower speed of music; a more prolonged contact will effect a faster speed of music.

1. It is a generally accepted phenomenon amongst professional pianists that apparent duration is not a "sustained" duration. In this respect, a note of music which is required by the musical text to be played "tenuto", is only realized when full contact with the key is maintained throughout its whole notational value. This point was made clear to me in my earlier years of training, during my few encounters with pianist Vladimir Ashkenazy.

CHAPTER IV

CHAPTER IV

MUSIC IN MOTION

4.1 MASS OF MUSIC:

For the purposes of tracing the direction, speed and mass of sound in musical terms, it has been suggested that sound, or musical tone, is represented as a 'tonal body' which perceptually possesses certain physical characteristics; the image of a sphere lends itself well as the "object" to represent sound as a manageable entity.

There are some pianists, myself included, who sometimes practise away from the keyboard: on a flat surface or on a dummy keyboard. Even though no sound is heard as a consequence of such practice, pianists attest to the fact that they are able to detect the quality of the imagined sound by touch alone. This correlates the auditory experience with a tactile sensation. We can therefore separate the two and examine what it is that one feels and sees when striking the keys as apart from what one hears.

In my own experience, a 'spherical mass' represents, firstly, the free-floating area between the finger-tip and the key - enabling me to move my arm and wrist around freely - and secondly, the plasticity and suppleness of the tissues that surround this area which enable me to exert various degrees of pressure on the key. Furthermore, as a concept and a percept, the sphere represents the inherent psychodynamic energy in musical tones which perpetuates motion or simply, to use Köhler's words: "the dynamic knowledge of 'tonal bodies'".

Immediately the question arises: does this 'sphere' represent a series of notes or is each note represented by a separate 'sphere', all its own?

At first glance, it would appear that a separate entity for every musical tone would serve to define the purpose of such a concept. There are, however, problems: Zuckerkandl, in considering the dynamic qualities of tones, says that these can be represented by scientific instruments which, however, do not show the dynamic currents which propel tones to their predestined destinations. This may suggest that the flight course of musical tone is the course of a single tone which is constantly transfigured and transferred so that its predetermined destination is 'in sight', as it were. No scientifically conceived graph can tell us that after C comes G until G is being played. The musician though, sees C transferred through tonal space to reach G - space which, according to Révész, "becomes alive through sound" (cited in Zuckerkandl - *Sound and Symbol*). Tonal space is made apparent by the forward momentum which musical tones carry and which perpetuates motion [1].

Musicians often refer to the 'quantity' that exists between two adjacent notes. This means that they are able to 'feel' a certain quantity of unspecified substance between two notes of music. This enables them to trace the flight-path of the musical tone which is heard both in stasis and in transit. This is why when the second note is played there is a feeling of simultaneity as if both notes are played together. Indeed, it is common practice to play a series of adjacent notes together before playing them in succession in order to determine their exact location.

1. On tonal space, Helmut Reinold makes the following comment: "music is sounding motion in temporal space. The tension between the equipollent and complementary elements of time, motion, and space is of the greatest importance for the understanding of music" (cited in S. Langer's *Reflections on Art*, 1960: pg. 271).

To be aware of the 'quantity' of a note is very important because the player can then condition his approach to meet the requirements of the note to be played. We could thus deduce the following very important principle in music-making:

$$A \longrightarrow B$$

I must be aware of what I want to achieve at B, so that I may condition A. I must be aware of what I want to achieve at B already at A so that I may condition B.

In view of what has been discussed so far, it seems to me that one has to identify a 'vehicle' which conveys the 'tonal body' in its various transmigrations through tonal space and accounts for the sensations musicians experience in predeterming its course.

In my view, based on intuition and personal experience, the illusory spherical mass which musicians may experience in playing a keyboard instrument can also be conceived as a pluralistic entity representing a series of musical tones in tonal space. This is not as far-fetched a concept as it seems: for practical purposes, pianists are often advised to hold an apple so that they may determine the precise position of the fingers to the keys [1].

One of the most important attributes of the sphere is its resilience to pressure applied by the hand. A body in motion is susceptible to a change in its shape due to the various forces acting upon it. These include the gravitational force as well as the force of impact. As a result of these forces acting upon the tonal body, its density, weight and volume change. This change is loosely referred to for the purposes of this study as 'Mass of Music' (m/m). In musical terms, it denotes the feeling of 'heavy' or 'light' to describe the properties of various musical textures (see pg. 74).

1. Daniel Barenboim, in discussing technical aspects of piano-playing in his book *A Life in Music*, suggests this practice by which pianists can determine the correct position of the hand.

Changes to the mass of music can be made apparent by examining in detail the execution of the two-note slur:

<u>Example IV - 1:</u>

The two-note slur would normally be executed in one bow on a stringed instrument, in one breath by a wind instrument and a vocalist and in one continuous movement of the pianist's hand. It would almost invariably cause a delay to the onset of the second note which is also played softer in relation to the first [1].

1. The two-note slur is considered further in the proceeding chapter.

There are certain conditions under which changes to the m/m can be made apparent:

1. *Interpretative Factor - Agogics:*

We perceive a change to the weight of the musical tone when the duration of the attack is prolonged. This is analogous to the long inceptive period of low-frequency vibrations whose latency period is simulated by means of agogics on the piano (Dräger, see p. 68).

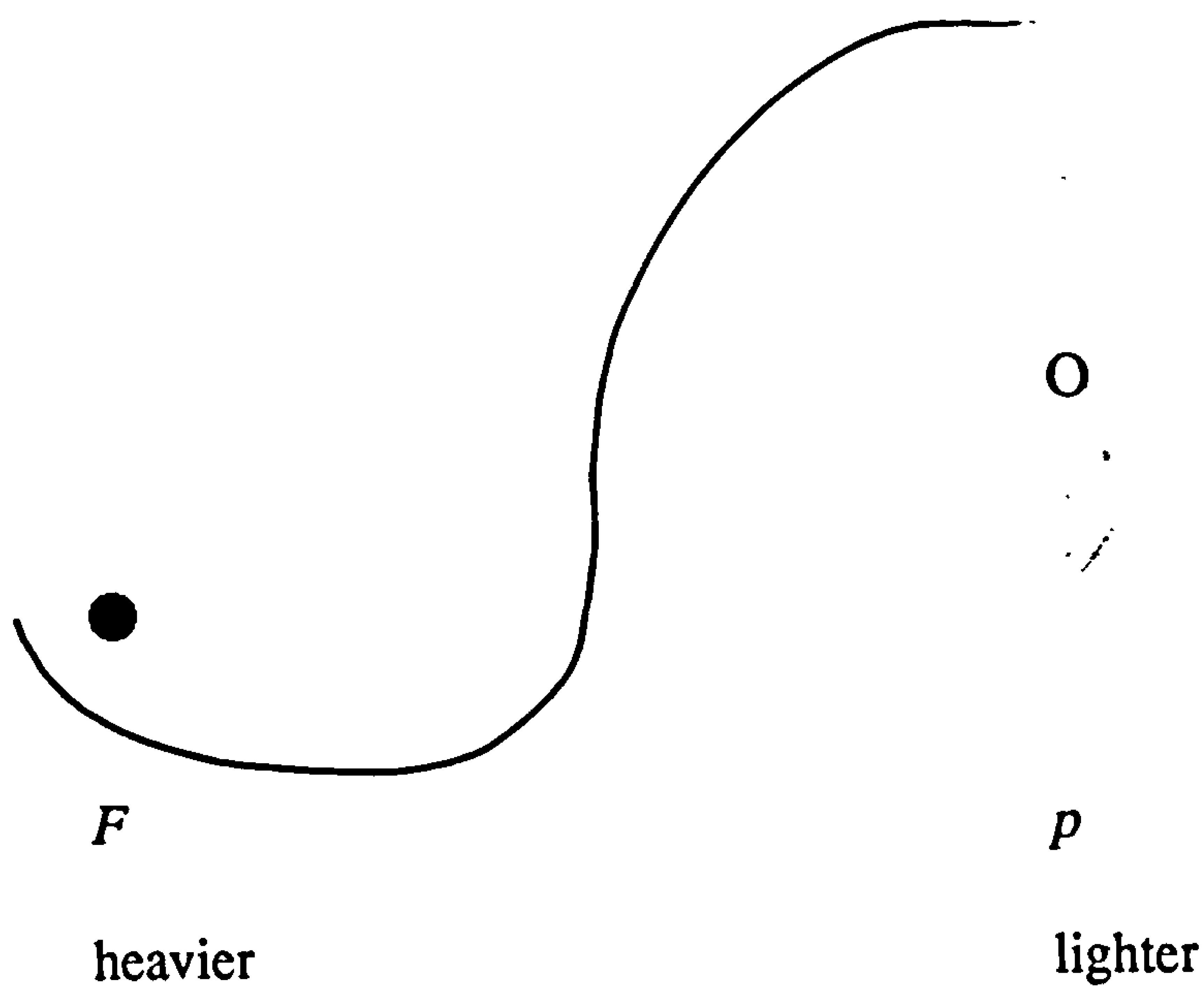
Thus a series of notes whose duration, both actual and apparent, is long in relation to others which are short will be perceived as heavier. Any one note whose duration is longer than the preceding note would be perceived likewise. Conversely, a shorter duration in relation to a longer one would be perceived as a lighter note: heavier *mass of music* - lighter *mass of music* respectively [1].

In a musical context, a slur on two notes where the second note is momentarily delayed for instance, would indicate that the first note would feel "heavier" than the "second" note.

2. *Loudness Volume:*

The difference in weight between two notes becomes even more apparent when there is a difference in dynamics between two notes. This is what Dräger calls the *loudness volume* (see pg. 68) of musical tones. The combination of a) duration of note value or duration of contact and b) changes in the dynamics will determine m/m. The following illustrates graphically the change in the weight of two notes:

1. The distance between two notes plays a predominant role in determining the weight of the note. This will be dealt with later.



3. *Resistance - Density:*

It has been shown (Newton) that when a force is applied to an object, the object reacts with an equal and opposite force. This causes the object, the key-mechanism or the illusory sphere, to 'spring back'. When there is resistance to the opposing force the density of the object increases. In musical terms, an increasing pressure to the key would thus intensify the musical tone [1].

Sandor explains this phenomenon in pianistic terms: "When we play loud and fast, we throw the fingers to the bottom of the keys; since the keybed is made of elastic material, it responds with considerable rebound. When we come down with vigour, we feel quite a strong recoil. This counteraction to our action can be of considerable advantage in lifting the equipment..."

1. The theory prevails amongst many pianists that increasing pressure on the key of the instrument is a hindrance and is to be avoided at all costs. The theory maintains that increasing pressure induces no change to the dynamic intensity or the quality of the sound, but rather increases tension in the muscles of the player causing an undesirable physical condition. This may be so, but there is another school of thought, to which I subscribe, that treats the increase in pressure on the key as a tactile sensation of the increase in the tension of the music. This pressure should naturally be applied discretely and without undue stress to the muscles.

Every mode of contact meets with some resistance. However, in calibrating the amount of time in which resistance is maintained, we find that Sandor's mode of contact (E): Thrust, sustains a longer resisting force, thereby increasing the tone's density and, consequently, its 'intensity' [1].

Should the first note of the two-note slur be dynamically intensified as a result of this mode of contact, its density would be determined by amplitude. This is what Dräger would call the musical tone's *loudness-density.*

However, an increase in intensity in musical terms or an increase to the density of the musical tone does not necessarily mean dynamic intensification. In fact, there are many instances in *pianissimo* where the tension of the music is highly charged. A musical texture can maintain intensity without sounding loud. In terms of what the instrumentalist feels there exists a density-related experience which is perceived by touch alone. Thus, in addition to the density of a musical tone which is *frequency-related, loudness-related and timbre-related,* we can have one which is *touch-related.*

A mode of contact, therefore, which increases the tone's density as a result of forces acting upon the surface of the key increases m/m.

1. I must make clear the distinction between the word 'intensity' meaning a dynamic amplification and 'intensity' meaning an overall increase in the tension of the music or any object in question. Whilst one does not necessarily preclude the other, the later definition usually applies. For the purposes of this study, I will refer to tensions in the music, for example the tensions within a chord, as possessing 'musical intensity'. When musical intensity is encountered the performer reacts accordingly by being stimulated emotionally as well as physically. The pressure applied to the key in resisting the opposing force (the force which attempts to push the sphere back to its original shape) stimulates physical as well as emotional intensity. The terms to be used throughout this treatise would thus be: 'musical intensity' meaning tension in the music; 'emotional and physical intensity' meaning a reaction to the musical intensity which stimulates the performer's emotional and physical responses and dynamic intensity meaning an overall dynamic amplification i.e., a *crescendo.* For a more elaborate discussion on this subject I refer the reader to page 165.

4. *Arm Weight:*

If the mode of contact employs the use of various components of the locomotor system simultaneously (i.e. the whole arm) it would carry more weight (see pages 86-88). When playing a two-note slur on the piano it is common practice for the arm to drop on the first note and rise on the second. Sandor says: "... for the notes tied together by a slur, we use an upward motion of the arm and hand. At the beginning, we always use a relatively low wrist, hand, and arm position, and at the end of a group, the wrist, hand, and arm position is higher; this is a firm rule with no exceptions".

Sandor does not confine this mode of contact to the two-note slur but extends it to a series of notes which are grouped together by a slur. This constitutes one of the five technical patterns which he identifies and which he calls *five fingers, scales and arpeggios (B)*, in legato mode:

"...at the beginning of the phrase the wrist is low and at the end of the phrase, it is higher...No matter how many notes there are in the group, there is always an upward motion at the end of the group".

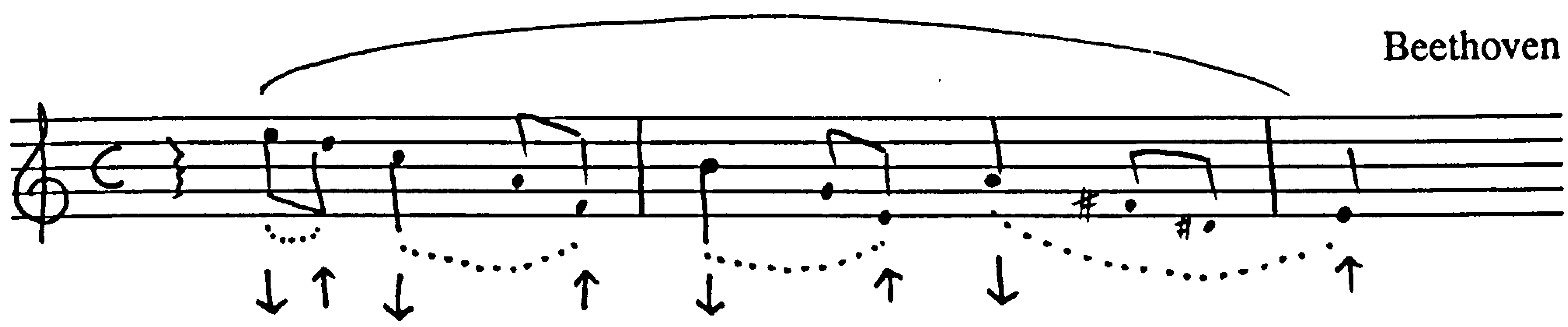
There are several implications which arise from applying this mode of contact:

1) as the arm drops on the keys on the first of a two-note slur, it feels heavier than when it rises on the second

2) as a result, the first note is dynamically more intense than the second: as the arm rises, the finger maintains less contact with the key and acts in opposition to the force of gravity, so that by the time the second (or the last in a series) note is reached, minimum contact is maintained. By its very nature, therefore, the rising motion of the hand results in a difference in dynamics between the first and the last notes in a group.

In explaining this mode of contact further, Sandor introduces the following example:

Example IV - 2:



The arrows indicating a rise and fall of the arm are inserted by Sandor. Here, he indicates a technical solution (or motion pattern as he calls it) suggested by the written text. This way, he attempts "to 'translate' visual patterns to motion patterns" (1981: pg. 118).

All things considered, we may deduce the following with regard to the execution of the two-note slur:

a) the score indicates a pattern of motion to be applied - in this case the legato slur

b) duration of first note value is increased (analogous to Dräger's inceptive period)

c) duration of contact time with the key is likewise increased (actual duration, see pages 118-122) as a result of the motion carried out by the locomotor system

d) as a result of the force applied and resistance to the opposing force, the first musical tone acquires denser tonal characteristics than the second; this is touch-related

e) the force applied increases the amplitude of the first musical tone: its *loudness-volume.*

In view of the above considerations, we can say that m/m is increased at the point when contact is made with the first of two, or more, notes in a group which is slurred.

Finally, there are practical considerations in contemplating the presence of a 'sphere' when executing the slur: besides its representation of musical tone in which all the characteristics outlined above can be implied by association, the 'sphere' acts as a tool that enables the hand to move smoothly from the first moment of impact to the last. If one imagines the finger resting on such a spherical surface, its course is then determined by the revolving sphere to which it is attached. As a result, the hand rises as the sphere revolves. This produces one uninterrupted flow of movement which can result in a musically satisfying interrelationship between the two notes.

4.2 SPEED OF MUSIC IN RELATION TO MASS OF MUSIC:

There are two aspects of motion which relate s/m to m/m: speed of arm movement and weight of contact; both act as outer flow and inner rhythm (see chapter III).

The arm movement which is applied in executing the slur as outlined above moves at a certain speed which is indicative of a speed in the flow of the music, termed for the purposes of this study, *speed of music.* It would be possible to play a two-note slur on the piano using different speeds of contact with the key, by varying the swiftness of finger attack and by alternating the speed with which the wrist rises, but without changing the basic tempo of the music (see pg. 106). Likewise, two notes can be grouped together on a stringed instrument using different speeds of bow without affecting a change in tempo (see pg. 103). Similarly, a conductor can indicate a given tempo with larger or smaller gestures. These speeds of movement are, for me, not only indicative of the quality of the tone which the conductor requires from his orchestral players or the quality of tone that the instrumentalist produces as a result of such action, but also significant in relaying the pace in which music flows [1].

1. I cannot stress this point enough: these movements, their speed and direction, are not 'choreographed' movements. As they directly affect the quality of the musical tone they must form an integral and important part of the musical experience.

In order to determine the speed of action one has to define the parameters within which movement can take place. For instance, the pianist must determine the extent to which the wrist will rise in executing a slur. Thus, at a given tempo the hand will rise to a certain height and thus determine the speed of such action. Changes to the boundaries will affect the speed of motion and consequently the quality of the musical tone. Hence the importance attached to s/m.

It has been said already that an increasing pressure to the key intensifies the musical tone. This is comparable to applying continuous and increasing bow pressure to the string of a stringed instrument.

In analogous terms, the resilience of the sphere would allow considerable pressure to be applied to it as a result of which its density and shape will change. As pressure on an object in motion is increased, we may expect, as a result of increased resistance to the force applied as well as friction, a slowing down of the object or the process in motion. In musical terms, we can demonstrate this phenomenon by looking at what happens when increasing pressure is applied to the bow: the sound is intensified and the speed in which the bow is drawn freely slows down [1].

As a result of the slowing-down process, the s/m, in terms of discernible pulsating beats slows down (see chapter III). One can therefore surmise that at a musical juncture where a slur occurs, s/m is decreased as a result of an increase in m/m and vice versa. Conversely, s/m increases when m/m decreases.

1. It would certainly be possible to draw the bow faster when pressure is increased in order to maintain unanimity in the speed of the movement, but this would act against the natural tendency of the body in motion which would slow down when pressure is applied, and it would require another force, a pull in this case, to counteract the pressure applied.

In general terms, the speed of the action is indicative of the amount of musical intensity inherent in the music. The slur, for instance, may be encountered at moments of such increased musical intensity that the arm, while still rising upwards, moves very little. This may imply that the pressure applied is such that it would allow very little movement (see footnote 1, pg. 181).

We can now consider the changes to the shape of the sphere resulting from different modes of contact. These different shapes correspond to the changes experienced tactilely at the tip of the finger by the instrumentalist as a result of different modes of contact applied. A variety of shapes will therefore conform to a variety of tonal shades.

These can be considered on two fronts: duration of impact and the shape of the player's fingertip.

4.3 DURATION OF IMPACT AND SENSATION ON THE UNDERSIDE OF THE FINGERTIP:

The sphere will remain condensed for as long as pressure is maintained. When pressure is withdrawn, the sphere will retract. The greater the force applied the greater the opposing force. The more force required to counteract the opposing force the greater the musical intensity. In the absence of any pressure continuing to be exerted on the key, the finger will lie freely at the top of the sphere. Impact may vary in length whereas contact may still be maintained for as long as the finger continues to hold the key. The duration of impact is therefore an important factor in determining the quality of the musical tone (see pages 118-122, actual/apparent duration).

When applying Sandor's mode of contact (D): staccato, contact with the key is at a minimum. In his own words: "Since we are playing staccato, we spend as little time as possible on the surface of the keys; when landing on the keys, the time spent on the surface will be a mere fraction of a second. The moment the fingers touch the keys, we immediately lift the entire equipment...The hand and fingers must bounce back immediately as if dribbling a ball, or as if the keys were sizzling hot!"

Contact time with the key is increased if a larger area of the finger comes into contact with it and vice versa. The 'cantabile' touch, attained by gradually depressing the key and making contact with a flatter position of the last phalanx of the finger, attests to this theory: the finger remains in contact with the key for a longer period in order to cover a larger area. As this mode of contact is largely implemented when playing legato, it would seem that a more curved finger position covering a smaller area can be applied for playing staccato or for producing a more articulated sound.

In taking into account the sensation on the underside of the fingertip and the duration of impact, we can proceed to show what perceptual effect these have on the shape of the sphere:

a) O

b) O

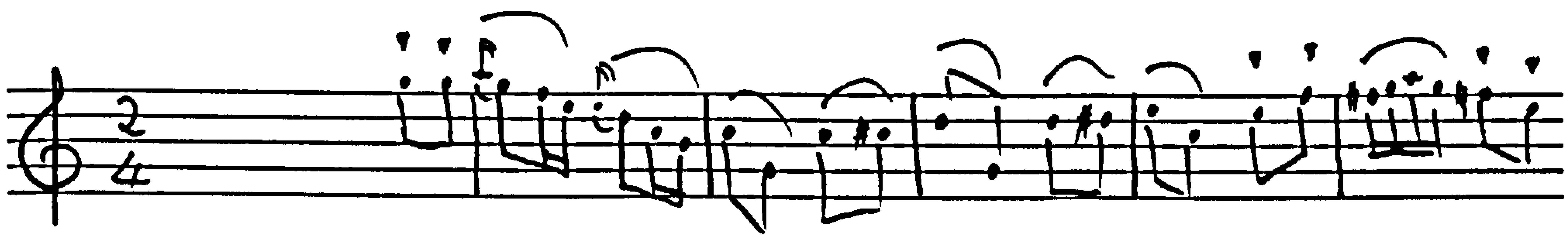
a) represents a shorter duration of impact applicable when playing staccato and b) represents a longer duration applicable when playing legato.

It would therefore seem that the pattern which serves to portray graphically a prolonged duration of contact/impact, an increased m/m and a slow s/m, is a curve. Conversely, a shorter duration of contact/impact, a lighter m/m and a faster s/m can be represented schematically as a shorter curve or a wedge.

The following musical example, in which the various means of cenveying perceptual knowledge of tone-production converge, exhibits a surprising uniformity. The slurs and staccato indications are Haydn's. In following Sandor's example, we can draw a table showing the patterns of motion to be implemented as suggested by the text:

<u>Example IV - 3:</u>

Haydn



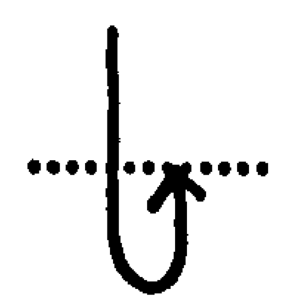
Mode of contact	D	B	B	B	B	B	B	B	D	B	D
s/m (fast/slow)	f	s	s	s	s	s	s	s	f	s	f
m/m (light/heavy)	l	h	h	h	h	h	h	h	l	h	l
shape of the sphere											

It is interesting to note that the shape the sphere takes resembles closely the shapes of the composer's articulation signs, i.e. the curve and the wedge. Such conformity may not be as coincidental as it seems, after all.

The Curve has Further Implications

The curve, as a pattern denoting longer duration of contact/impact, slower m/m and so forth, has further implications.

Musicians often use metaphorical phraseology to express in words an image of musical activity. Musicians, for example, refer to a mode of contact by which, they say, the note is approached from 'underneath'. The conductor demonstrates this with his baton by using a pattern which 'carves' the note into position:



In playing the piano the performer feels as though he 'encircles and then picks up the sphere'. If the voice were to approach a note 'from underneath', there would be a slight slackening of the pitch downwards before the note is stabilised in terms of its pitch: a technique that is applied to *bel canto* singing.

The curve, as a pattern of musical activity, serves to portray this perceptual experience: its drooping line is representative of the mode of contact which approaches the note from underneath: by tracing the line of the curve, the sensation of 'encircling' and 'picking up' the note is experienced. Furthermore, the curve serves to portray graphically the slight slackening in pitch experienced when a vocalist sings *bel canto.*

Finally, as the hand moves closer to the sphere before contact is made, physical intensity is increased. It is almost as if the two bodies, fingertip and tonal 'sphere' which it is on the verge of setting in motion, attract each other and, in doing so, induce a magnetic field that stimulates contact. In applying a slow approach, the sphere is set in motion slowly. It is as though it is given an initial push before it begins to accelerate.

In making and maintaining full contact with the sphere the element of tactility establishes itself as the leading constituent which propagates and manipulates sound. Thus, we can now establish one important principle: that the source of music-making ultimately lies in the fingertip of the hand. The nucleus of all musical sound and the nerve centre where all musical activity takes place is concentrated on the minute area which the fingertip controls.

Music is realized when contact between the tip of the finger and the small imaginary sphere is established. This point of contact is then communicated to all other areas. This establishes further the notion that the hand in motion, its change of speed, its change in weight and its direction, acts as the main catalyst that establishes the speed, mass and direction of musical sound. A line that traces the properties and the course of the moving elements - that is the hand and the sphere- can now be established.

CHAPTER V

CHAPTER V

(STAGE III)

MUSIC IN MOTION

DIRECTION OF MOVEMENT

In contemplating musical motion further, one may impart to it a visual perspective which may enhance one's understanding of musical growth and musical progression (see pg. 57). Besides our tactile and auditory experience and perception of the mass and motion of what we call 'tonal body', we can visualize its course and thereby conceive in our minds a variety of patterns which we can represent schematically.

These patterns can only be subjective, based on experience and intuition, and are therefore non-discursively exhibited. They do, however, serve a useful purpose in portraying and recording our perception of an abstract concept of musical motion in a linear image and, thereby, giving substance and credence to its existence. As Suzanne Langer puts it: "All motion in art is growth - not growth of something pictured, like a tree, but of lines and spaces" [1].

The patterns which emerge reflect the movements experienced by the musician both in performance and in the preparation of a performance; they are images representing the illusion of musical growth as well as images of the artist's physical movements in performance. In this respect, they portray a language of symbols and shapes which is musically oriented and a design which expresses musical structure and musical intent.

1. Suzanne Langer - *Feeling and Form* (1953: pg. 64)

R. Francès (1958) has said that "every melody encloses a kinetic scheme involving certain musico-rhythmic resources ... that can be projected as space, figured as a contour of bodily movement or bodily repose appropriate for characterizing an attitude, a state, or a feeling" (cited in Nattiez, 1987). Nattiez himself adds: "In melody, in effect, organization of duration (length of the notes, silences) can be interpreted. in the sense of a motor or driving force: tonal amplitude suggests amplitude of movement... the direction of the melody suggests a movement from high to low or vice versa"(ibid.).

Once a mass of sound has been initiated, a musician may visualize its direction towards the next point of impact, that is the next note of music. What needs to be defined in this Chapter is, therefore, its behaviour and overall direction.

In order to determine the direction of the musical sound, we need to consider the position of the next note that is to be played: its exact location in terms of distance and pitch.

5.1 DISTANCE:

Distance is defined in temporal terms [1]. As a work of music is played or listened to, a tempo is established which denotes the number of impulses at any given time. Speed is dependent on distance traversed in time. In musical terms, tempo, that is speed in music, is indicated when time, a quantitative measure, is calculated against a series of impulses that, in musical terms, represent distance. When the metronome marking indicates crochet equals 60, it means that musical sound travels from one point of reference to another, i.e., from one crochet to another, in one second. The position of one crochet in relation to the next is therefore the distance from one note to the other. This is calculated and measured in time.

1. A similar analogy is made in the article from *The New Grove Dictionary for Music and Musicians* (1980): "Metre is the means by which rhythm can be perceived and described. It is therefore analogous to the measurement of distance; this analogy becomes especially clear if one compares measurement by quarter-inches with so-called common time, in which there are four crochets in a bar and each crochet is given one beat" (See Apendix 4 for an illustration).

Thus, in musical terms, we can <u>hear</u> distance. If, as often happens in music, a series of notes is delayed, i.e. when a ritenuto takes place, then the distances between the notes gradually increase.

Distance, as expressed merely in temporal terms, can be indicated along a horizontal axis:

<u>Example V-1:</u>

distances in time

Pitch

The frequency of vibration is the single factor that conditions pitch. As the frequency of vibration increases, a higher-pitched sound is heard; conversely, as the frequency of vibration decreases, a lower-pitched sound is heard. The relationship between one pitch and another is measured in musical terms and is expressed as an interval in music [1].

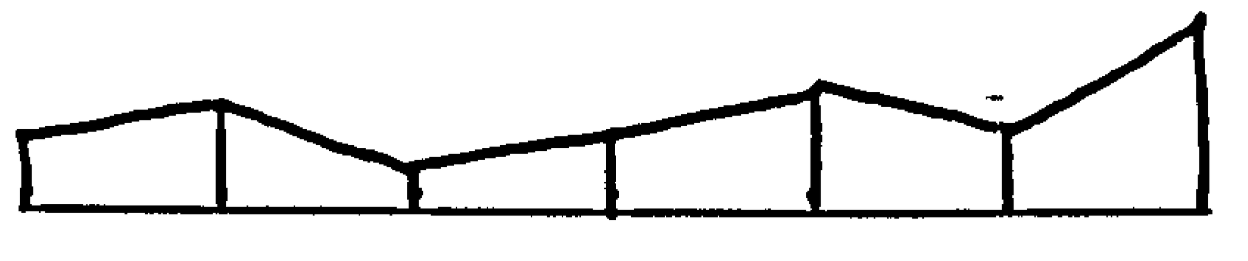
In notational terms, the difference in pitch is indicated by positioning a note whose frequency of vibration is high, at a higher level on the stave than a note whose frequency of vibration is low. Thus, in music, a series of relatively high and low tones with a rise and fall in the musical line between them is an accepted perceptual phenomenon:

1. Precise measurement of such difference is expressible acoustically by statement of the vibration numbers, but we need only concern ourselves with pitch differentiation between notes found in the various major and minor keys of our diatonic system.

Example V-2:

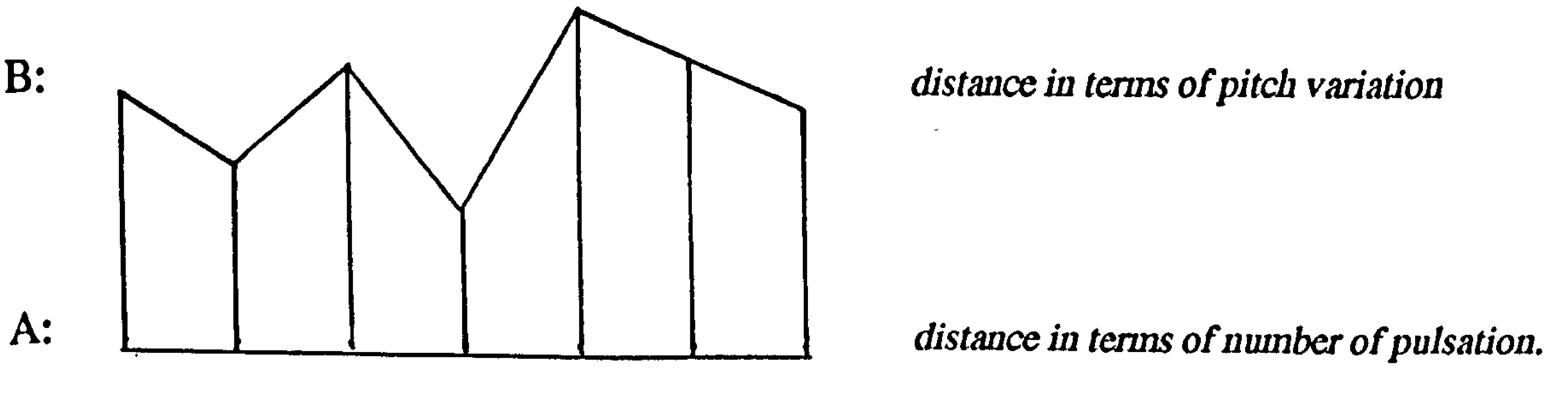
The frequency of vibration which determines pitch is quantifiable by the human ear - what the philosopher Leibniz referred to as "unconscious counting". If one were to measure the difference between pitches as they appear on paper, we see that a series of differently pitched tones are located at various distances apart:

Example V-3:



We can now establish the distance between a series of notes in temporal terms on a straight horizontal line (line A), and the distance between a series of notes in terms of their difference in pitch, (line B):

Example V-4:



If a series of notes were to be played in strict metronomic time (with no consideration to the 'intensity' of each note at this stage), this would hardly represent a "musical" rendering of the musical line. In other words, to hear a difference in pitch alone against a metronomically equal pulse as in line A, is not deemed to be musically satisfactory.

If on the other hand, distance were accounted for in terms of pitch variation as it would be in line B, there would be a series of impulses that deviate from strict metronomic time according to the degree of the musical interval [1]. The extent of each interval would then be fully realized in temporal terms. Therefore, the distance between two notes must be considered in melodic terms. More time is required between the onset of one note and the onset of another note if the interval between the two is a larger one than if it were a smaller one [2].

Naturally, there are many other factors which determine the exact distance between any two notes. These are beyond the present scope and confines of this study. But one could mention a few in reference to what is being discussed here. Primarily, one needs to consider the effect of a change of equilibrium in the relationship between any two points of reference which causes a change to the musical intensity.

1. The idea of relating pitch to time is not new and runs from Obrecht to Stockhausen. The latter has shown that duration, pitch and timbre are all reducible to a single common factor - the acoustical impulse. The number of impulses in any sound will determine its duration; their frequency will determine its pitch; and their rhythmic organization will determine its timbre (source: *Grove Dictionary* - Vol 18).

2. Deviation from strict metronomic time according to the degree of the interval is minute and at times almost imperceptible.

5.2 MUSICAL INTENSITY:

When a moving object reaches a state of constant motion, it establishes an equilibnum. In music, this equilibrium could apply when a constant beat is maintained throughout a certain period and when the melodic line is monotonous and the intensity of each note is the same:

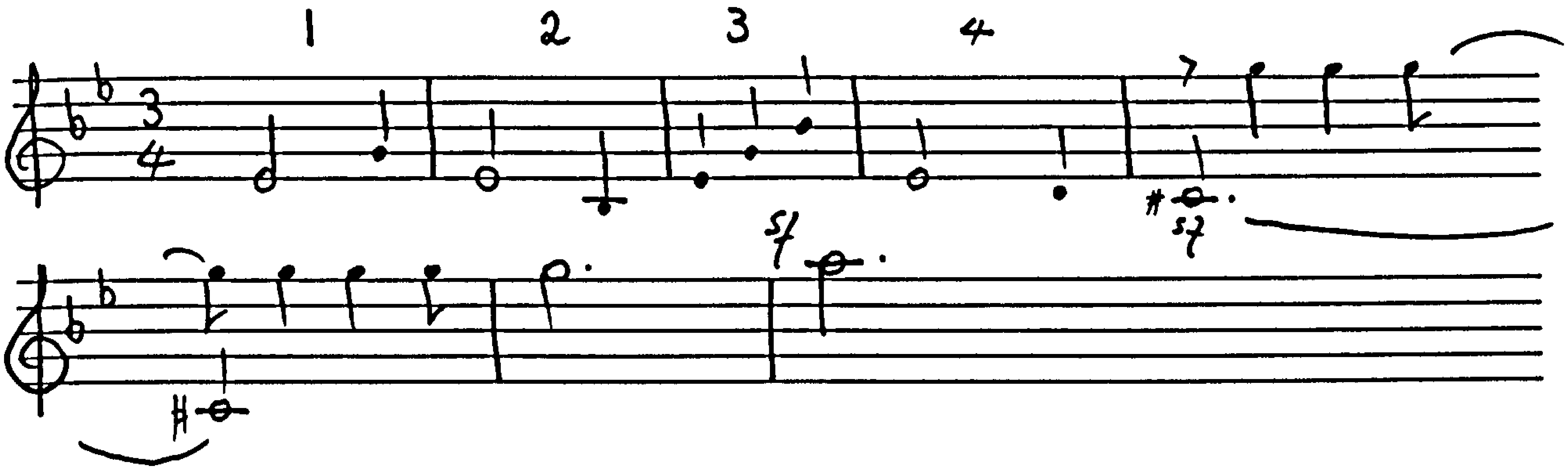
Example V-5:

In example V-5, no force is applied other than the one that is required to maintain a constant motion. Any deviation from this constant state would unbalance the equilibrium causing a state of instability. This would represent what Seeger calls "the salient deviation from the mean of variance" (ibid). As the elements are disturbed, the equilibrium is set off-balance. This, in musical terms, causes an increase or decrease in the tension of the music. In the example given above, the state of equilibrium will be disturbed even when pitch changes. But as this monotonous state in which time impulses, pitch and dynamics are for ever the same is hardly ever encountered in music, it means that music is constantly in a state of unrest: one note leads to another as it pulls and pushes in various directions.

Stability can be reached through the use of a single predominating harmony throughout a musical statement:

Example V-6:

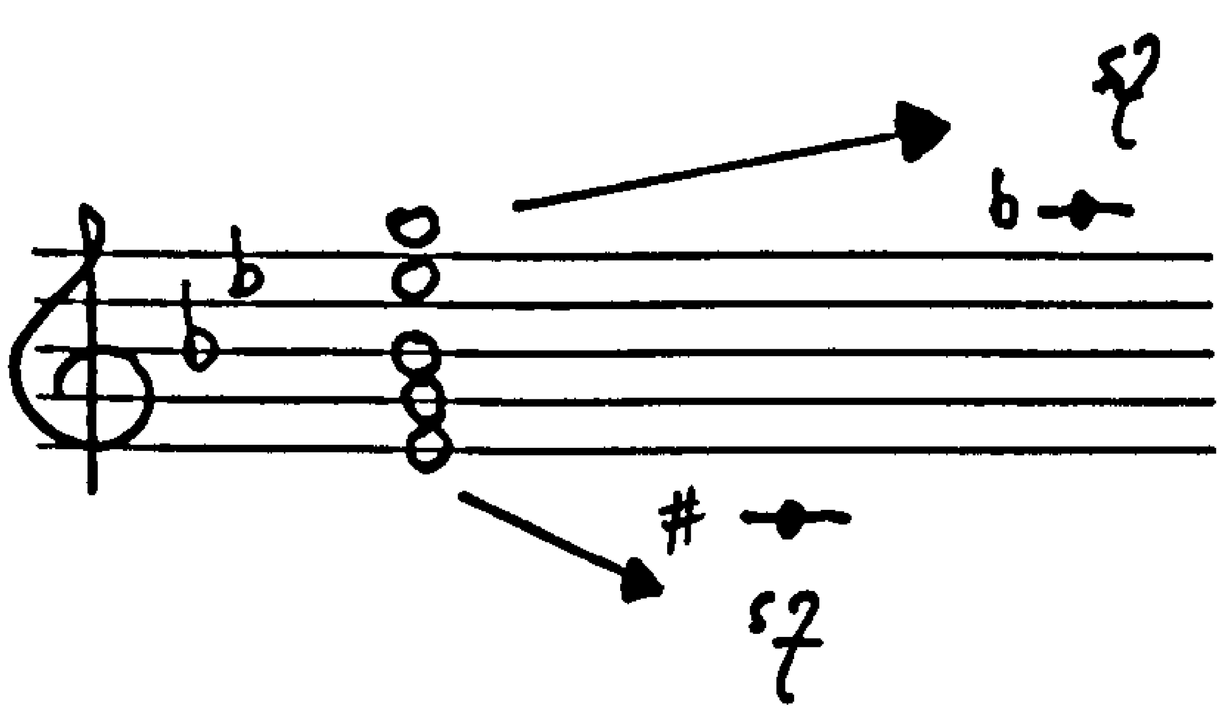
Beethoven



In the above example, from the opening of Beethoven's 'Eroica' symphony, there are three bars in which the tonality of Eb major is being established, through the use of the tonic harmony. This represents a state of equilibrium in harmonic terms. In melodic terms, the same applies with the line swinging around the central Eb. Thus, a movement away from equilibrium only takes place in bar 4 by the harmonic dissonance and melodic movement towards the C#. In this respect, tension is heightened at this point. It is heightened further in bar 8 of this example, when the Ab emerges. The notes C# and Ab represent the lowest and highest points of reference respectively, throughout this opening statement.

From this point of view, it is possible to regard the area of relative stability which is being established in the first three bars of this opening, as follows:

Example V-7:



Stable conditions prevail throughout the function of the tonic harmony, establishing a periphery in which regular activity, such as the fanfare motif, takes place. A movement downwards to the C# as well as a movement upwards to the Ab, forces these two notes out of the periphery of the equilibrium, thus creating unstable conditions which, in turn, increase the tension of the music. As if to guarantee that their effect is felt to the full, Beethoven marks them both *sf.*

The degree of tension, which is determined by the distance between two notes, is dependent on many factors. Apart from the pure variation in pitch, distance is dependent on:

1) whether the interval is, in context, a concordant or discordant one. For example, a major 7th, even though it is a degree smaller than an octave, would take more time to realize due to the intensity that the discordant leap creates

2) how any one melodic interval will behave according to the intensity of the harmonic movement

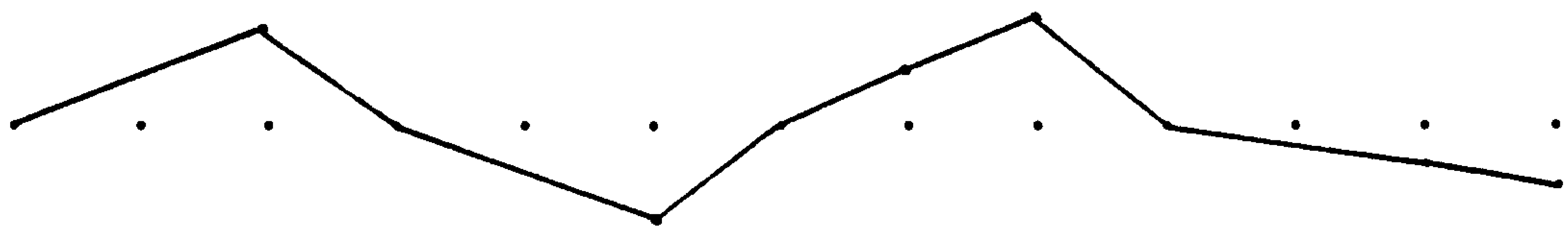
3) whether the interval is rising or falling in relation to melodic movement: a rising interval will sometimes require more time to realize than a falling one

4) the ability of *tempo rubato* to balance a protracted section of the musical line, regardless of whether the interval is a larger or smaller one

5) whether an interval is encountered on a strong or weak beat of the bar.

The line on which we therefore need to concentrate in order to identify movement is the one at the top - that which would signify pitch and time:

Example V-8:



In example V-8, the musical line is represented as a zigzag between various pitches at various distances. However, such a line would come in direct contradiction with much that has been suggested in this study about spherical masses and states of perpetual motion so that it would be more appropriate to replace the zigzag with a curve.

Victor Zuckerkandl makes the following observations: 1 "the motion I hear in the scale does not simply disappear; it reaches a goal. Our ear leaves us in no doubt that the last tone is not simply a last tone but is a goal tone...the motion follows the general schema: advance toward . . . attainment of a goal.

"If 'away from', 'reversal', 'back to' are to be made apparent in our representation, the tones must not appear arranged side by side along a straight line. Rather, we must dispose them in a curve... Motion in the dynamic field of tones is essentially motion in terms of this curve" 2.

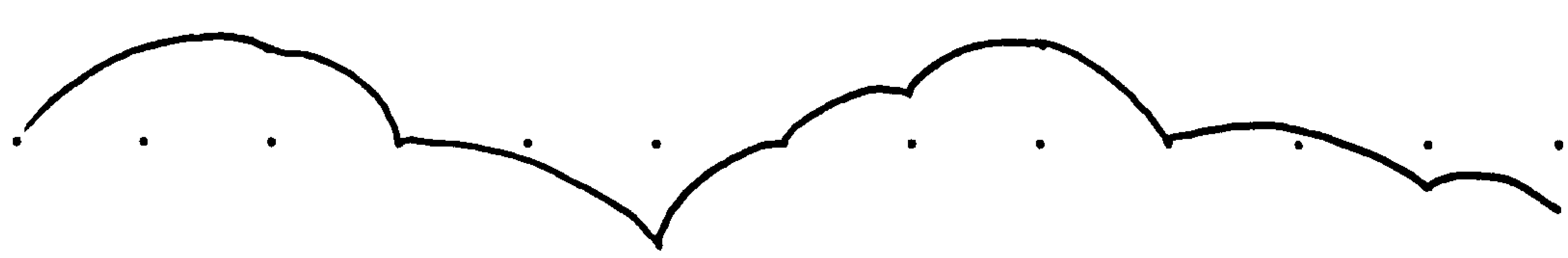
1. Victor Zuckerkandl - *Sound and Symbol (1956* pg. 96)

2. In relativity theory, the behaviour of moving objects is represented by lines (called world-lines) in the space-time continuum, on the same principle as a four-dimensional graph. If an object moves with uniform speed in a straight line (as in Newton's first law of motion), then its world-line is straight. If it moves under the influence of gravity, then its world-line is curved.

5.3 CURVATURE:

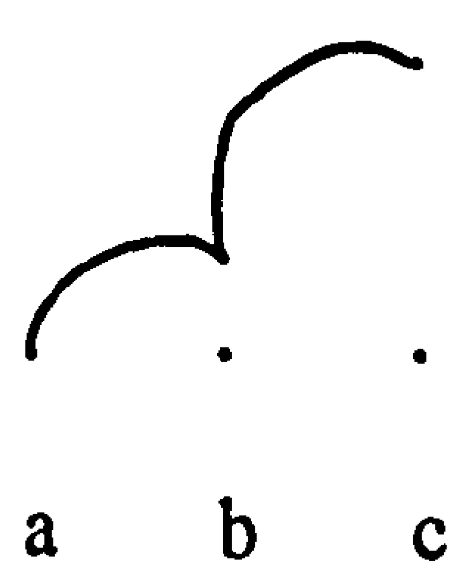
A curve would thus indicate that there is a starting point at the beginning of the line and that there is purposeful direction towards a point of arrival at the end of the line. Thus, the line in example V-8 could now be represented as follows:

Example V-9:



Density of the Curve [1]

Example V-10:

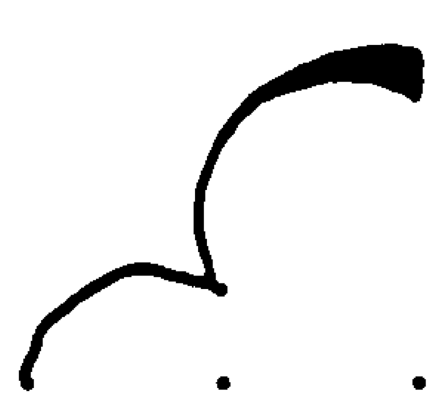


The above example needs to be examined and considered in detail: the curve between a and b indicates a small step, say an interval of a third; the curve between b to c indicates a larger step, say an interval of a sixth. The time needed to complete the curve between a and b would thus be smaller than the time needed to complete the curve between b and c.

1. In Greek architecture, a convex curvature was called *entasis*, which means, intensity.

If, for whatever musical reason the note at point c needs to be intensified further, then the time required to complete the curve between b and c would be extended further:

Example V-11:



a b c

Even though in example V-11 the distance measurable from the variation-in-pitch position is the same as that in example V-10, more time will be taken to complete the curve between points b and c, as the Mass of Music (m/m) increases and the Speed of Music (s/m) decreases when the density of the line increases towards the intensified point c. [1]

5.4 DYNAMIC LEVELS:

It has been suggested, and substantiated by this study, that an increase in the dynamic level of a note is associated with an increase in the speed of the mode of contact which in turn increases the speed at which the hammer falls on the string. Similarly, such an increase on a stringed instrument depends on the speed at which the bow is drawn just as, on a wind instrument it depends on the speed of the air-supply into the tube.

1. In this respect, as already indicated in the previous Chapter, more mass has to be concentrated in a larger area so that more time is taken for the mass to traverse the two points between b and c.

There is a distinction to be drawn here between an increase in physical instensity which implies a resistance to the opposing forces (see pg. 128) and the increase in loudness of a musical tone as a result of increasing speed of contact.

An increase in physical intensity would imply, as shown earlier, a slowing down of the s/m. We can imagine the bow been drawn increasingly slower or the air-supply conveyed to the wind instrument gradually decreasing.

If the speed of the moving mass is increased, the distance between the two points must also increase:

<u>Example V-12:</u>

a b c

an increase in the s/m takes place between points b and c.

The main difference between example V-11 and example V-12 is the difference in the distance we "hear" and the distance we "see". Whereas the distance we hear between points b and c is the time taken to complete the curve b to c in time, the distance we see in example V-12, is the length of the curve between points b and c, which is longer. As the speed at which movement takes place is faster in example V-12, the curve between points b and c in both examples is completed in the same length of time. Example V-12 incorporates a crescendo.

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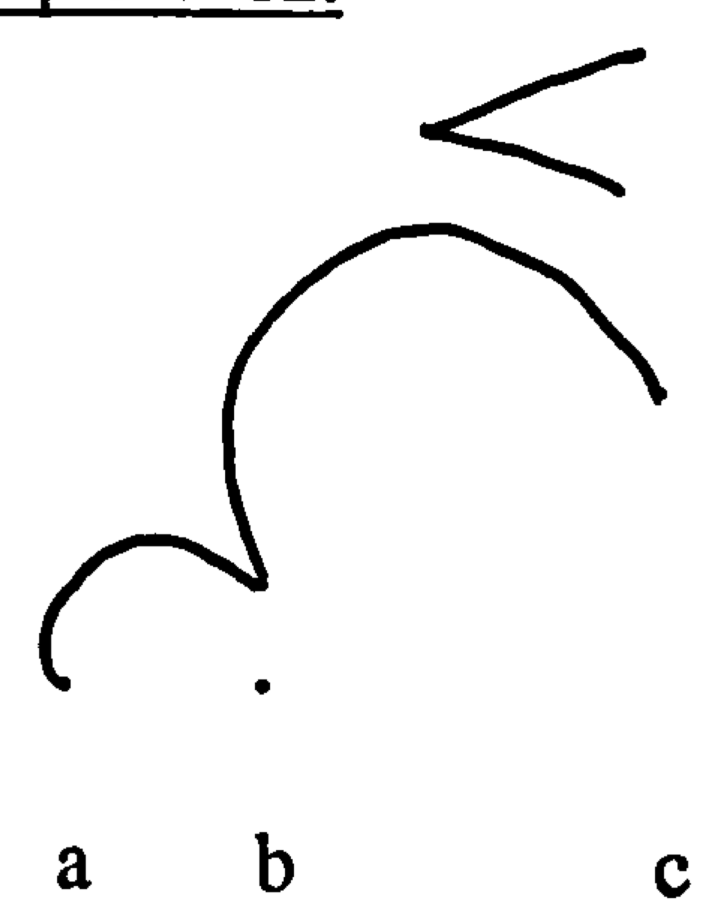

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In example V-11, we could envisage the bow being drawn progressively slower as increased pressure is applied and, in example V-12, progressively faster with no excess pressure applied. In relative terms, more physical intensity is required for executing example V-11 than V-12. Whilst both may induce a *crescendo*, the musical result is distinctively different. An effective *crescendo* should, in most cases, be associated with an increase in emotional and physical intensity (analogous to the bow's increasing pressure on the string) though, when administered in some impressionistic music it is highly effective as, for instance, in Ravel's *Daphnis et Chloé* (an example given by Francès - cited in Nattiez, ibid.), where the composer evokes feelings of space by using *crescendos* and a rise in pitch [1].

****

1. A crescendo that stems from an increase to the speed of contact is much more difficult to control, as the overall length of the curvature is longer and the distance larger. To maintain full contact with a longer curve is more difficult than to maintain contact with a shorter curve. An increase in intensity as such implies a shorter curve and therefore enables the performer to maintain sight and contiguity with the moving elements. This area of discussion will be explored further at a later stage.

5.5 WAVE PATTERNS:

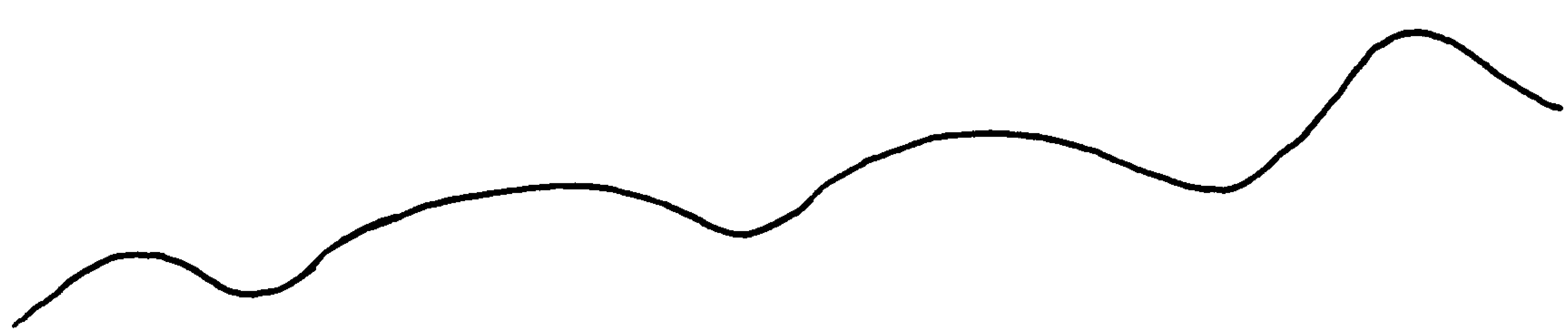
It is clear that we must now establish various notional wave patterns so as to reflect the ideas which have been proposed in the foregoing.

Firstly, we need to delineate the various patterns which emerge when notes are approached individually.

Before going any further, let us establish a basic linear pattern in a free hand-produced graph which reflects the melodic contour of Chopin's etude Op 10 No 3:

Example V-13:

Example V-13a:

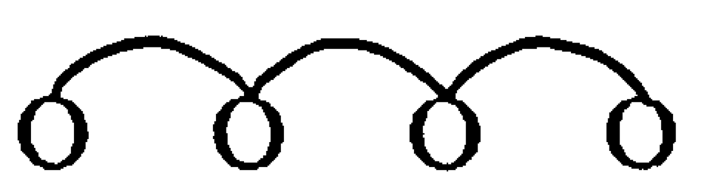


We can now introduce and itemize simple patterns which depict the basic movement in a series of notes. These fall into three categories: a) articulative, b) passive and c) transient notional wave patterns:

a) *Articulative*

This pattern represents a series of contacts in which the "sphere" is left free to bounce after each impact. The wave pattern rises after impact, reaches a climax and thereafter recedes. The cycle continues with similar applications to each individual note of a series:

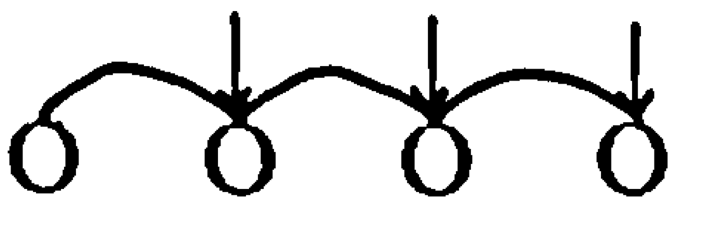
Example V-14:



On the piano this is obtained whenever the human locomotor system, or any component thereof, falls freely onto the key. In this respect, each note is separately approached and the articulation of the musical text clearly defined.

The wave, as it recedes, cannot indicate the force required to set the next note in motion. We therefore have to introduce another line which would indicate a further impact:

Example V-15:

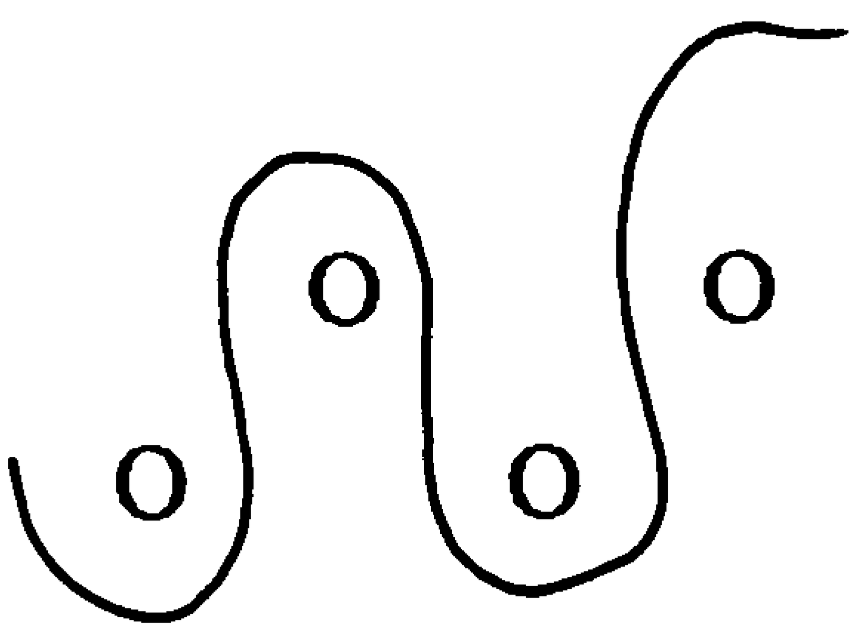


Let the vertical line shown here represent the finger falling onto the key. In this respect, the two lines join at a precise point in place and time.

b) ***Passive***

this pattern represents a series of contacts in which the "sphere" is slowly approached from different directions as outlined in the previous chapter. In the example that follows, the "sphere" is approached from underneath and from above consecutively:

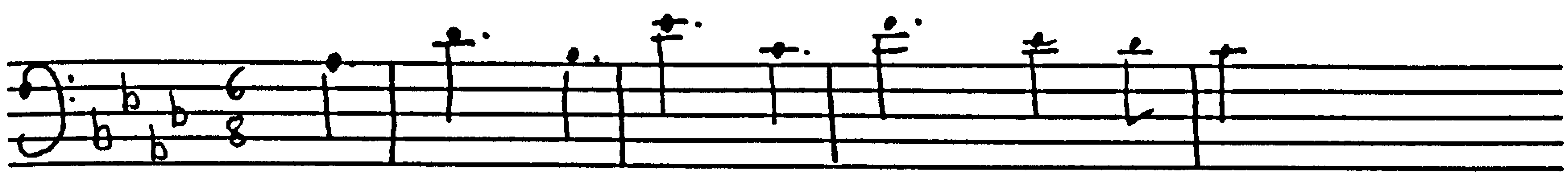
<u>Example V-16:</u>

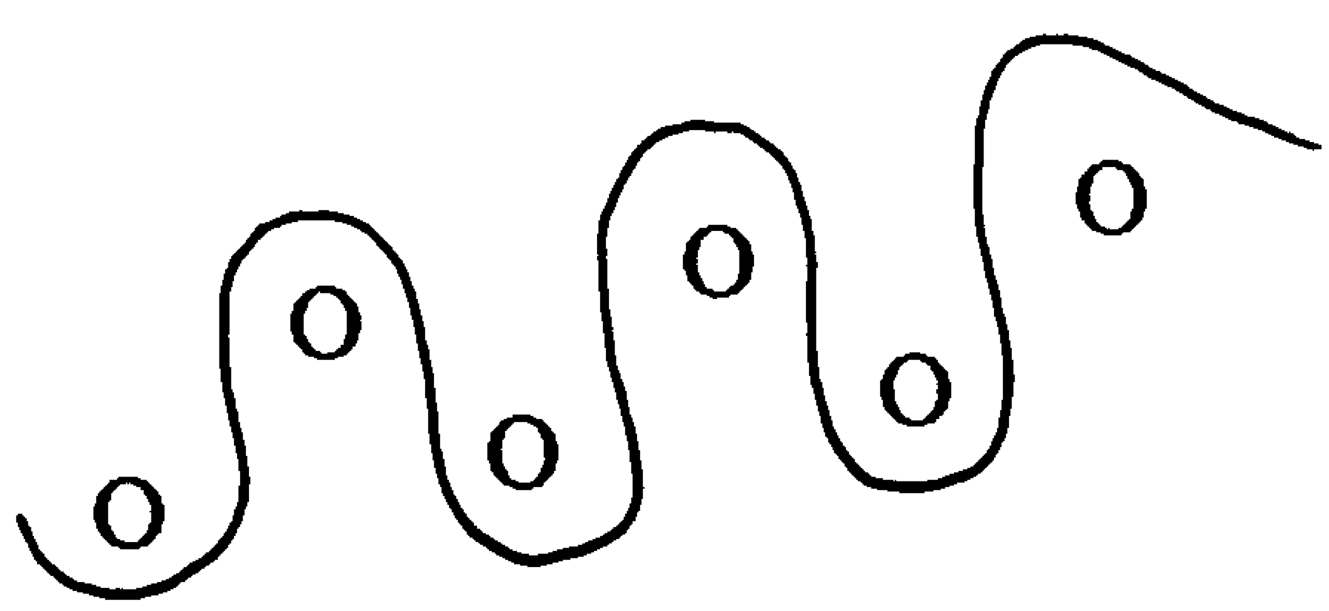


As the note is approached on the descending direction of the line, it is pulled downwards and as it is approached on the ascending direction of the line it is pulled upwards. As already mentioned in the previous chapter, a singer would often refer to "singing over the note" or "moving underneath the note". The first approach would increasingly sharpen the note slightly and the second approach flatten the note slightly. The same would apply to any other instrument where *intontation* is of essence. On the piano, the same experience is sensed tactilely and is expressed in variations of dynamics and time.

The finger is brought into contact with the key at any point during the rise or the fall of the line indicated in example V-16. In this respect, the "sphere" is made to revolve from side to side. The bounce is at a minimum and the musical result would be that of a *legato.* This approach could be appropriately applied to the beginning of the first fugue in Beethoven's piano sonata Op 110:

Example V-17:

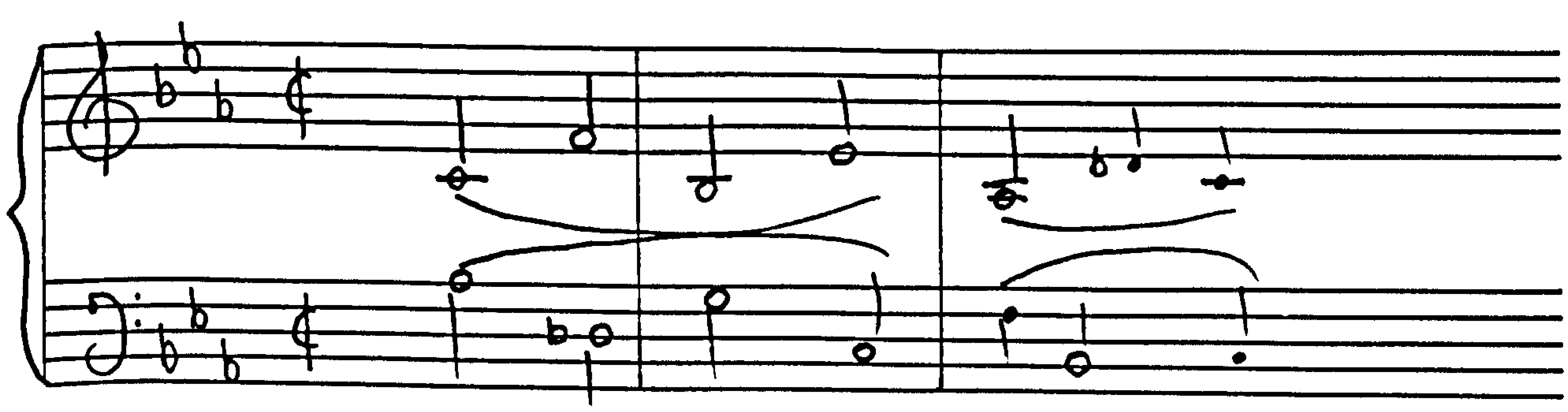




(The movement downwards and upwards would also imply a movement of the wrist in the same direction).

or, to the following passage in Beethoven's Sonata Op 13, last movement:

Example V-18:

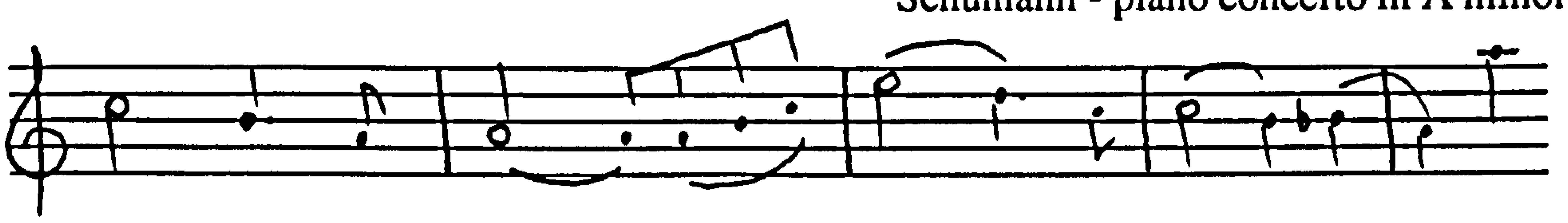


c) ***Transient***

This pattern represents an extended mode of contact in which several notes are heard within one unbroken movement. It is associated closely with the long slur [1] and is conditioned by the "five-fingers, scales and arpeggios" (B) mode of contact, as identified by Gyorgy Sandor. This is probably the only pattern indicated extensively in general terms by the composer:

Example V-19:

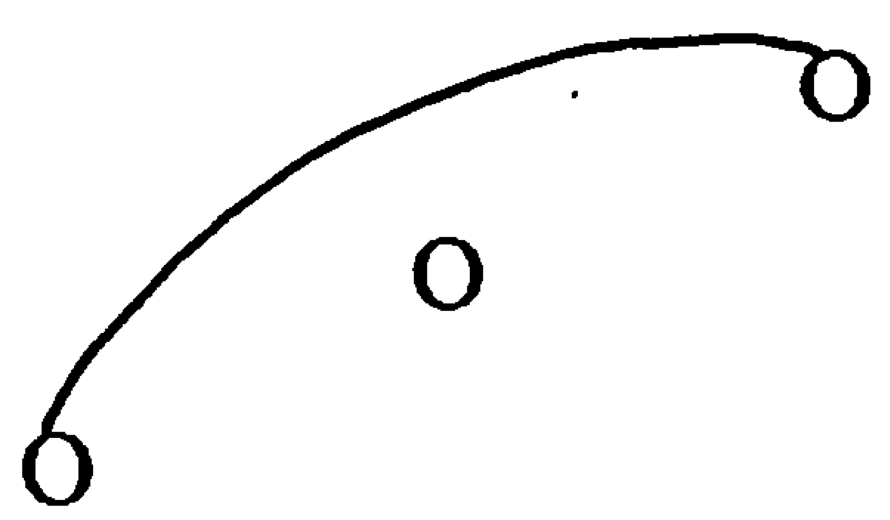
Schumann - piano concerto in A minor



The curves, or slurs as they are referred to in musical terms, are those of the composer. The notes which are slurred are to be grouped together. If played by a stringed instrument, they would have to be played in one continuous bow. On the piano, the same effect is achieved when the three slurred notes in bar 2 are incorporated in an upward movement of the arm and wrist. The fingers lie low and the main thrust comes from the use of the arm and wrist. As the hand begins to move, it rises. As it rises, less contact is made with the key at the highest point that the hand has reached. This in turn would reduce the weight that is applied to the key, and therefore, a natural *diminuendo* occurs at the closing of the slur.

1. Though the two-note slur can best be illustrated with a passive notional wave pattern. This will be discussed later on.

Example V-20:



This pattern often emerges when, as Sandor points out, the performer executes scales and arpeggios and when the performer employs the use of the five fingers in succession.

The motion that the hand follows is one in which the "sphere" is made to roll from the bottom to the top. Each finger is then applied at the point the rolling "sphere" has reached.

The technique of producing a series of notes with one movement is ideal in many circumstances as it conserves energy: one movement, one infusion of energy to carry the musical line further forward - like a pebble thrown into a lake which bounces successively over its surface. The momentum at impact is such that it induces a series of impulses which stem from a single source of energy. In faster passages, this technique is almost invariably preferred by performers, as it produces great speed with little effort. It is often referred to as the "throwing" technique.

This phenomenon is experienced as a result of the keybed's ability to rebound (see pg. 128). Sandor explains: "When we play loud and fast, we throw the fingers to the bottom of the keys... the elastic hand and arm receive considerable help from the keybed itself... the staccato action may be reduced to a purely downward active throw; the upward motion is automatically taken care of by this [counteractive] upward motion" (ibid.).

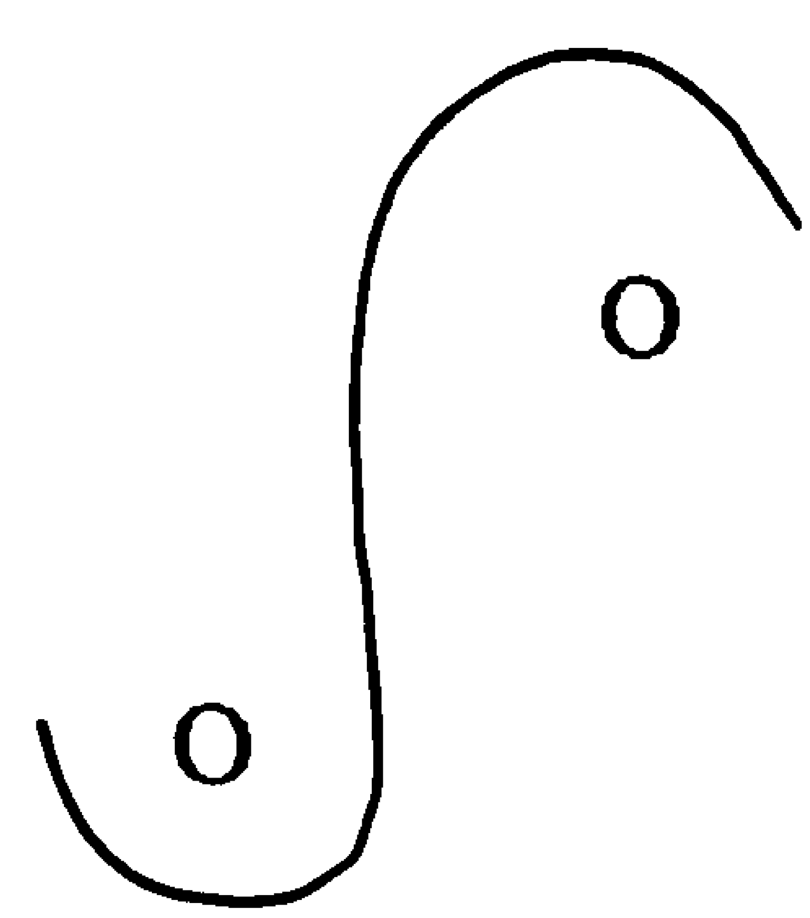
Similarly, if the line is to be maintained for as long as possible, or for as long as the musical text specifies, it is important that it discharges its energy slowly, evenly and continuously no matter whether it concerns wind-player, singer, string player or pianist, who must avoid accents and "bumps" which would cause the wave pattern to drop vertically.

The Two-note Slur Considered Further

The two-note slur is best represented by what we call a passive notional wave pattern (see pg. 154). This slur, which groups two notes together, diffuses energy on the second note of the slur, while intensifying the first. As the energy is increased, the note is pulled downwards, hence the line that is directed below the "sphere". As it then moves towards the second note, it slowly discharges the concentration of energy. As it does so, the line gains height and rises above the second note:

<u>Example V-21:</u>

pattern a)



The two-note slur can therefore best be illustrated by a passive notional wave pattern.

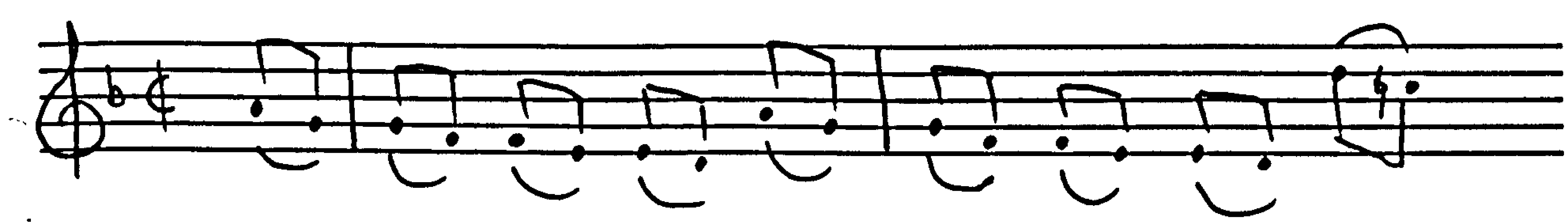
There are various important phenomena taking place in a two-note slur:

firstly, the mass of music (m/m) and speed of music (s/m) condition the extent to which a slur can be made to sound expressive. As already mentioned in the previous chapter, the m/m depends on the weight of contact (and as a result the weight of the resulting sound) in relation to the weight of the release. As the direction of the line as well as the direction of the locomotor system moves over the "sphere", the weight is decreased.

The two-note slur is usually associated with points in the music of increased musical intensity: [1]

Example V-22:

Beethoven - piano sonata in D minor



The musical intensity is heightened when a stable state of the musical flow is disturbed. The amount would depend on the amount of instability being caused. There are several ways of instigating such a change to the equilibrium. A two-note slur would almost invariably cause a delay to the onset of the second note which in itself would create a sense of instability. But it is, as we noted previously, the approach to the second note which conditions the place and time of the second note. In other words the line, its direction and speed, determines the "quantity" and consequently the quality of the second note.

1. The "pleading" slur as it is often called.

A change therefore, to the exact placing of the various impulses that condition the speed of music (s/m) and determine the exact distance between the onset of note one and that of note two, is essential. There are several ways that one can distribute the various impulses in order to implement a variation in time and place. One such way would be to increase the speed of music (s/m). S/m can accelerate as it moves towards the second note. This means that the impulses that the mind discerns at the hearing of the first note, are longer in length and become successively shorter as the second note is approached [1].

In pianistic terms, the hand follows a downward movement on impact while it rises from the wrist to meet the second note [2]. The procedure which conditions a well-executed slur also implies a *diminuendo* towards the second note as well as a shortening of the second note. The second note is further delayed. The process renders a variation to the s/m, m/m and d/m. These variations can be represented as follows:

1. The idea of delaying the initial tempo before gradually increasing it between two points of reference, has far-reaching implications. There exists an interpretative view, to which I subscribe, that to render an effective accelerando, the tempo first of all slows down with a ritenuto before acceleration takes place.

2. There is general consensus amongst many performers as to this mode of contact.

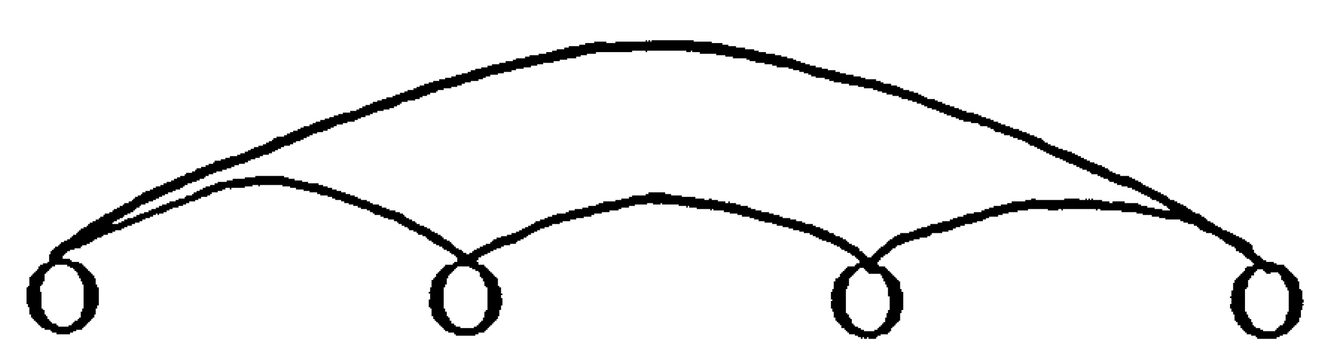
Example V-23:

notation:	♩	♩
duration:	longer	shorter
direction of hand:	↓	↑
dynamics:		
d/m:	o	o
s/m:	fast	slow
m/m:	heavy	light

5.6 COMPOSITE PATTERNS:

A transient notional wave pattern ensures continuity of line. It is possible, indeed mandatatory at times, that during the course of this curve, notes may require clearer definition. In this case, the articulative and transient patterns can be applied simultaneously: [1]

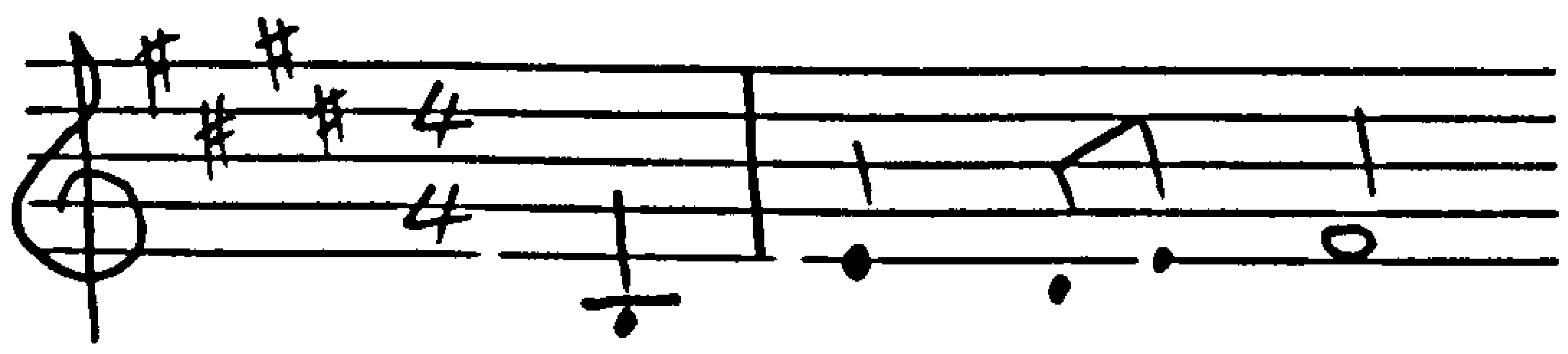
Example V-24:



A transient pattern may often be broken to allow a change in direction of the musical line or to emphasize a point of increased intensity or a point of arrival. A vertical placing can now be conferred on what has been hitherto a horizontally moving musical line:

The same Chopin etude as before illustrates further the various points mentioned above. In particular the notes D#, E to F#:

Example V-25:

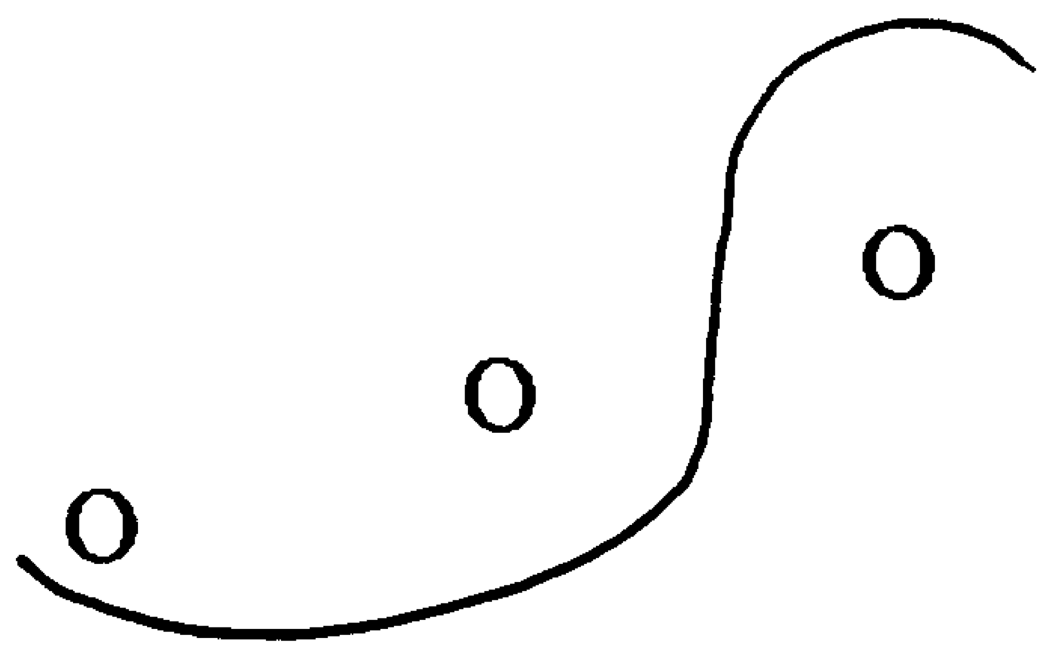


1. The individual's attention to such detail would testify to his sense of style and musical purpose. Some performers would, for instance, articulate every note even when legato is the end in view. Others keep the overall activity of the fingers at a minimum. The musical results are interestingly similar, however divergent the quality and musical "colour" of the textures. But such disparity will always be the hallmark of any artist's individuality.

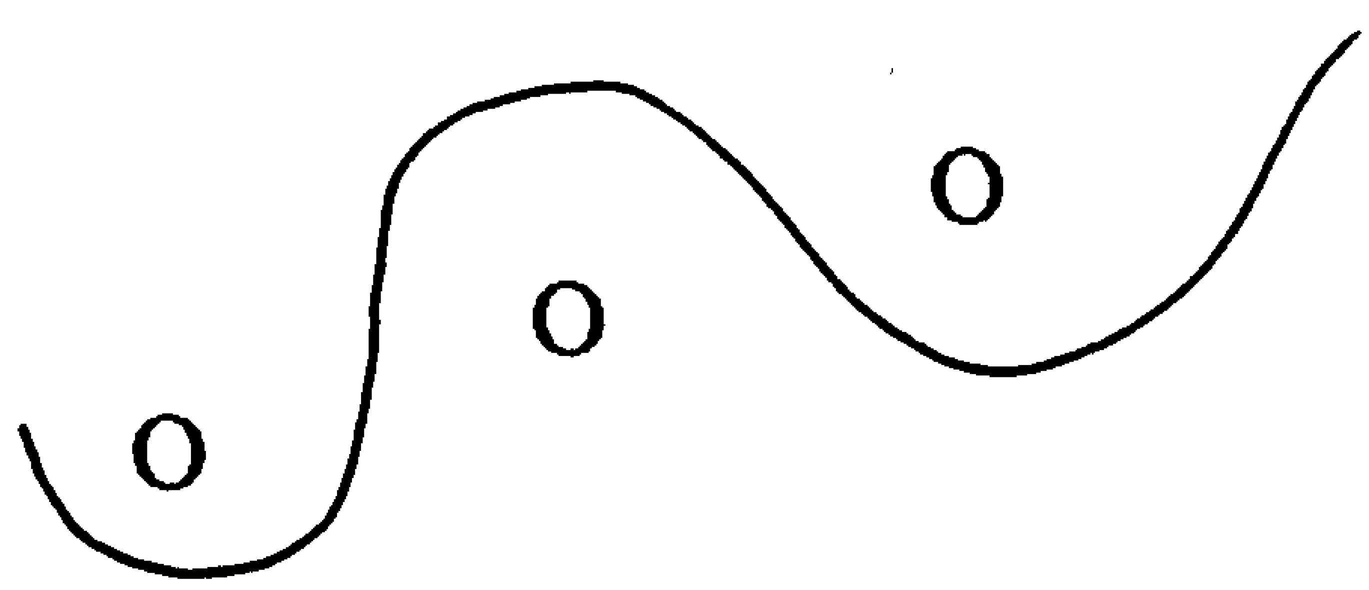
There are several ways of approaching these three notes; all succeed in rendering the melody in a *cantabile* manner. Two of these produce different though musically acceptable results:

<u>Example V-26:</u>

a)



b)



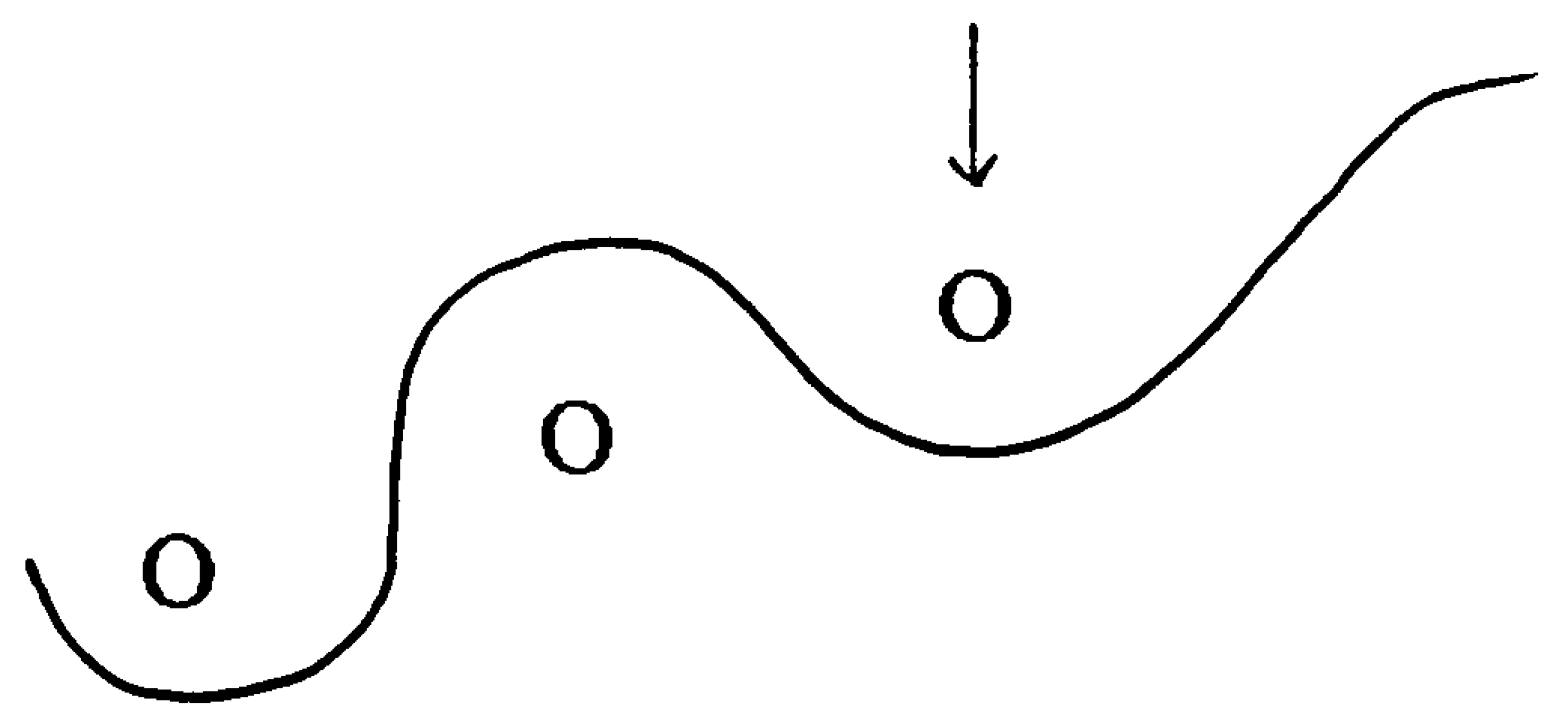
Pattern a) keeps notes d# and e natural under continuous stress and releases the tension while approaching the note f#. A transient notional wave pattern emerges, followed by a passive one.

Pattern b) treats the notes d# and e as a slur. A passive notional wave pattern emerges. The f# is placed with relatively more weight as it is pulled downwards. This puts more emphasis on the note f#. If this is what is desired in terms of the overall phrasing of the melody, then pattern b) is clearly to be implemented.

There will be performers who will aim towards an arrival point on the note f# on a stronger footing than the present wave pattern and its associated manner of contact would allow. A composite pattern in which a vertical line is simultaneously applied to the pattern would place more emphasis on the arrival point on the note f#.

Example V-27:

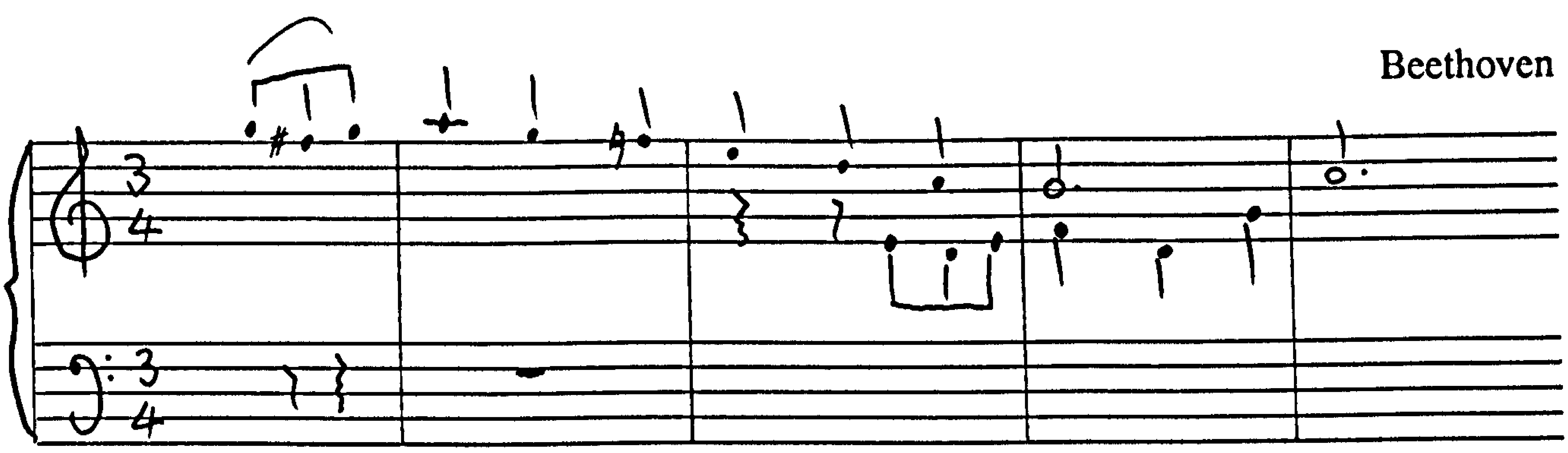
pattern d)



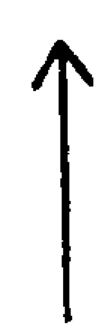
5.7 FOLLOW-THROUGH:

There are moments in music whereby a note is released, much like the last note of a series in a slur, but which is placed on a strong beat of the bar, thus demanding an emphasis of some kind to indicate its arrival point:

Example V-28:



Pattern:



arrival point

The technique which needs to be employed here is referred to as the **follow-through** technique. This is a technique akin to the stroke of a tennis player, by which the ball is struck while the arm of the player follows through even after contact with the ball is made. In this respect, contact with the ball is increased. So a follow-through stroke increases contact time with the ball.

In musical terms, the follow through of the locomotor system, once contact is made with the key, increases the duration of contact with the key, thus increasing the duration of the note. This in turn increases m/m.

As a consequence of this mode of contact, the thrust of the upbeat is released on the down beat, whilst rendering the downbeat as a point of arrival, with emphasis given to it on account of its longer duration.

5.8 MOMENTS OF INTENSITY CONSIDERED FURTHER:

What must be becoming increasingly clear, when considering the various wave patterns which have emerged in the course of our investigation, is the importance of the line connecting one note of music to the other.

The overall rise of the line has hitherto been associated with the release of tension. This is in accord with much that has been discussed previously concerning the speed, mass and direction of the various phenomena which constitute a performance. In particular, our consideration of the *mass of music*, as it has been defined previously, promotes the view that heavier m/m causes the line to drop while a lighter m/m allows the line to rise. This, again, is in accordance with physical laws with which many of the musical phenomena introduced in this study conform: a lighter object would rise more readily than would a heavier one.

As a young student of Ilona Kabos in the late 60s, I would often hear her speak of performances which lacked "intensity" and, as she put it, "backbone". Intensity in musical performance is a physical and emotional reaction to states of tension within a musical structure created as a result of the constant polarization of opposites: systole and diastole, consonance and dissonance. In reacting to such musical stimuli, the performer will sometimes be compelled to exert a certain amount of pressure on the instrument he plays. This is certainly true in the case of a string player who, accordingly, would increase pressure on the bow. In piano playing, increasing pressure to the keys would not necessarily result in dynamic changes; it would, nevertheless, result in an emotional and physical heightening of tension. The more pressure applied, the more resistance encountered. In analogous terms, it would be like bending a resilient object: the more one bends, the more resistance, the more tension created. An elastic object capable of returning to its original shape after being bent will react with increasing force as pressure is exerted upon it. The more the force, the more the tension (for more on this phenomenon I refer the reader to pg. 128). However, the resilience of objects which possess elastic properties has certain limits. If bent or stretched too far, such objects lose their resilience and would not be capable of returning to their original shape.

All this may be applied to the musical tone as we have been describing it. Our hypothetical sphere which lies at the undertip of the finger, has elastic properties and is, therefore, resilient (this reflects the elastic properties of the flesh - the 'cushion' as it is often referred to by pianists - on the underside of the fingertip). One may compare this sensation to manipulating a small ball: the more pressure applied to the ball, the more it will want to bounce back. Its density changes as a result of a change to its shape and, consequently, its resistance increases. This, in turn, increases tension. In musical terms, to play, as my teacher used to say, with 'intensity' would mean to react to musical stimuli both emotionally and physically by increasing pressure as applied to the instrument [1].

1. It has been said that Herbert von Karajan experienced so much tension during the course of conducting a highly emotive passage of music that the sheer strength with which he held his baton caused the object to break!

In graphic terms, this musical activity which is often highly charged, could be conceived as a low-lying horizontal line. The reason for this can be traced to the shape of the sphere: as pressure is increasingly applied the sphere condenses; the hand resists the rebound and rises very little. As pressure is increasingly withdrawn, the line retracts and rises upwards to show the moment in music where a resolution approaches [1]. As it does, one feels as though the music begins to 'breath' again as the density of the object decreases. With this in mind, one could surmise that the higher the rise of the line, the more breathing space there exists. A closer examination of the various phenomena considered earlier in the execution of the two-note slur would substantiate this view further (I refer the reader to pages 126 and 158).

Analogies can be found in other fields of music-making. For example, one often talks about an 'intense' vibrato in string playing [2]. Such vibrato is executed by increasing pressure to the finger-board and/or by increasing the speed of the vibrato. In either case, 'molecular activity', to use a metaphorical phrase which I think describes the sensation felicitously, is heightened: when pressure is increased, the fingertip feels denser (a sensation similar to that experienced when applying pressure to the sphere) thus giving the impression of increased inner activity. When vibrato either slows down and/or is relaxed, the musical line is allowed to breath and is drawn upwards [3].

1. Indeed, it is the pull and push, the rise and the fall which ultimately maintain music in motion. One often refers to the degree to which a musical phrase is allowed to breathe. Indeed, the ability to identify areas of increased activity against areas of repose, and implement skilfully the rise and fall of a notional wave pattern, will always prove to be the hallmark of a true artist.

2. One may associate this with Dräger's "play with density" in which a tone's 'timbre-density' is increased when string players play in higher positions (see pg. 70).

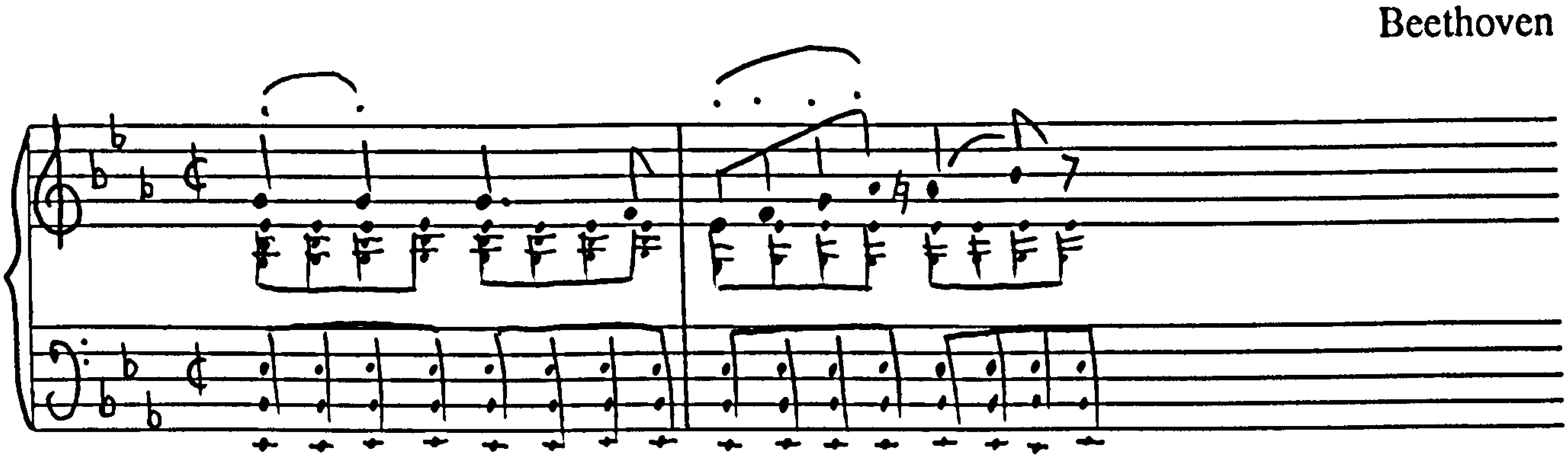
3. It is also possible to begin a note on the violin without vibrato - this also heightens the tension. As vibrato is slowly and skilfully applied, the oscillations produced appear to allow the musical line to rise.

There are further important considerations which follow on from a line of thought of this nature. As pressure implies a force directed towards an object measured as weight upon a unit (*Chambers Concise Dictionary* 1991), it would follow that a gradual reduction of pressure will reach a stage where weight applied to the instrument has been reduced to such a degree that continuous contact with the key is no longer possible. As a result, the *actual duration* and the *apparent duration* may cease to coincide (see pg. 121). It is at this stage of contact with the instrument that one may experience spaciousness between each impact giving rise to the illusion that the music is allowed space in which to breathe [1].

In practical terms, we may employ a mode of contact when playing in order to increase or reduce the feeling of space between notes. In the following example from Beethoven's Sonata Op 27 No 1, we may attack each chord lightly and with minimum weight maintaining little contact time with the keys:

Example V-29:

Beethoven



1. It is interesting to note that the ancient Greeks used the word αραιό (areo, -a, -os - also in common use in neo-Hellenic language) to express the opposite of dense. The English word "area", given to mean an open empty space, is, according to the Chambers Concise Dictionary, derived from the Latin (16th century). Nevertheless, the word's close proximity to the Greek word meaning thin, sparse, spaced out, spread out and so on, may give rise to speculation that the two words have a common derivative and share the concept of open space: area = open space, αραιό = spaced out. One could then speak about a tonal body occupying more space as its density decreases. (sources: Liddell and Scott (1977), Chambers Concise Dictionary, 1991).

Such a mode of execution would allow each chord time to breathe in the musical space created. As contact time with the key increases, we experience each chord sounding heavier with less room to breathe. Furthermore, a mode of contact whereby each chord is struck by an upward motion of the wrist gives the added impression that the musical sound travels upwards. Again, as contact time increases, the sound seems to become more concentrated - more firmly rooted to the ground.

Indeed, there are instances in music where this mode of contact is asked for by the composer in order to suggest open space where musical textures can be projected. In the following example from Rachmaninov's Prelude Op 32 No 12, the composer explicitly marks the chords in the left hand to be played *staccato* in what is otherwise a rich sustaining musical statement:

Example V-30:

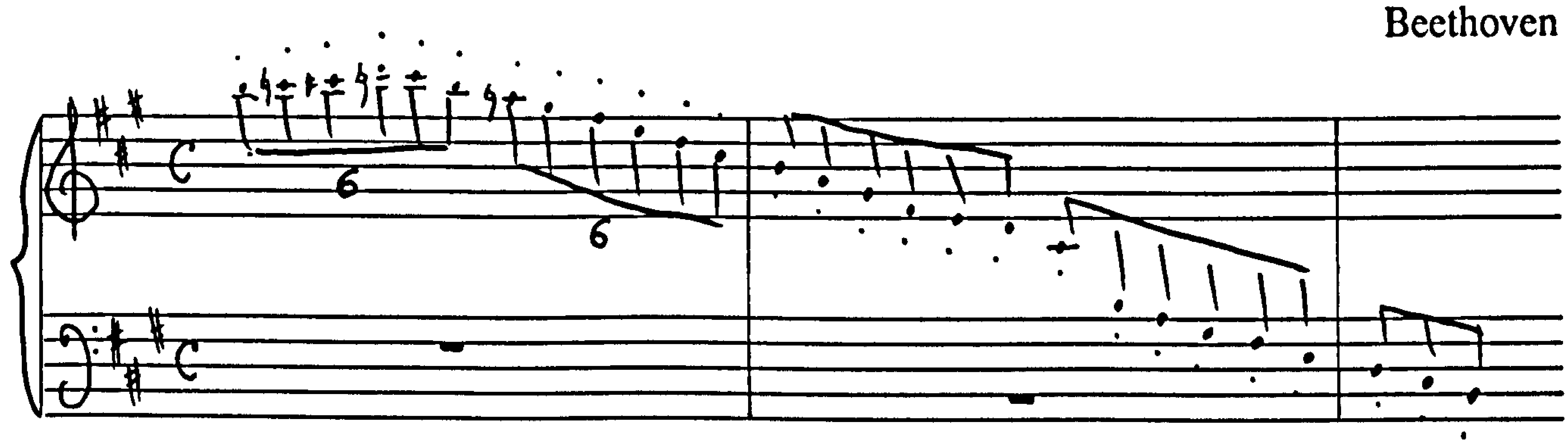
Rachmaninov

Such a mode of contact produces a rich and sonorous sound. This is an example where musical intensity is high whereas physical intensity, as described earlier, is low, despite an increased emotional intensity experienced by the performer.

As far as the graphic means with which one may represent such activity, the more flowing the musical line the more horizontal the line to represent it whereas a wavering line may, at times, represent moments of repose. Often in achieving a long musical line, the performer tends to surge forward. In fact, there are many instances where, in order to achieve this effect, we gain speed, if only slightly:

Example V-31:

Beethoven

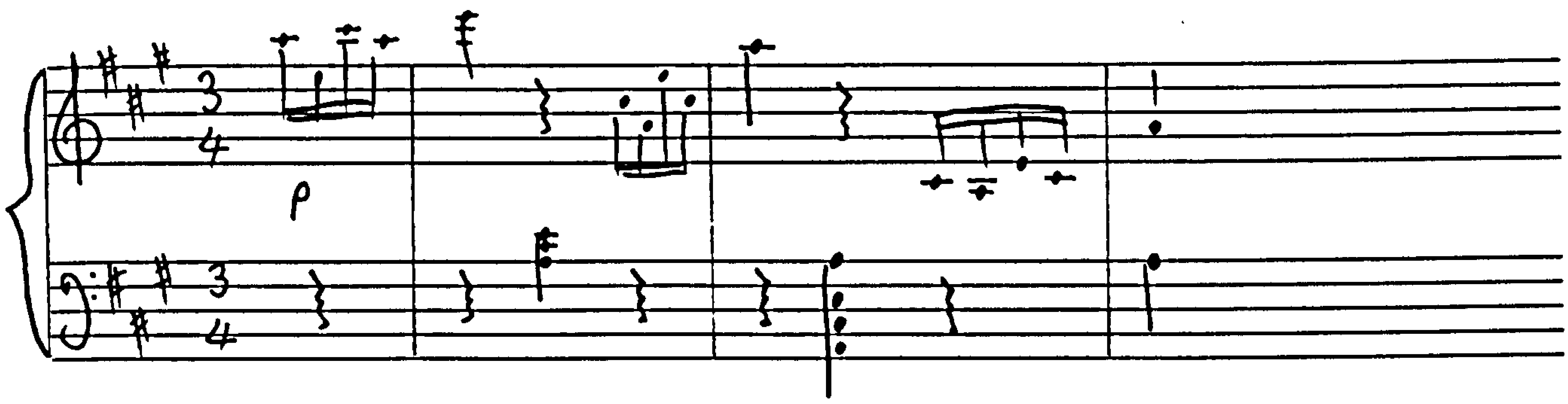


The above extract from the last movement of Beethoven's Sonata Op 2 No 2 achieves the sense of constant forward momentum when the musician accelerates slightly through it. If played metronomically, a passage of this kind may well feel rather stagnant and, ultimately, shapeless.

There are, however, many instances in music where an emphasis and vertical placing of the musical line is called upon. It is sometimes within the performer's prerogative to decide where such placings should apply. In the following extract from the third movement of Beethoven's Sonata Op 2 No 2, one contemplates two distinctly different ways of interpreting the musical line:

Example V-32:

Beethoven



One can either treat the second beat as part of the first beat, in other words, tie it together, or place it separately in such a way as to give it prominence. To tie it together with the first beat would mean to establish a metric pattern of a minim followed by a crochet, whereas as to treat it separately would establish a metric pattern of three distinct crochet beats. To discuss the musical and structural criteria for imposing one or other method of execution is beyond the confines of this study but, suffice it to say, prominence given to the second beat as a separate entity is, within the parameters of this movement, more expedient. Be that as it may, it is more important for us here to establish the course of the musical line and to see how this affects our awareness of its direction and its duration. To treat and place the second beat as a separate musical entity would seem to delay the onset of the chord in the left hand.

There is empirical evidence, presented by Eric Clarke (1985), which supports our theory that the onset of the second chord would be slightly delayed if emphasised: "The stronger the metrical position occupied by a note, the greater the amount of positive deviation in the note's IHI [inter onset interval]: conversely, the weaker the note's metrical position, the greater the amount of negative deviation in its IHI". Discrepancies found between temporal properties in the performance and those indicated by the score are, according to Clarke, related to the structural properties of the music and the organising processes of the performer:

"...the relative duration of a note is a property that emerges from the interaction of a number of features that include its symbolic representation, its metrical position and position within a group, and its melodic and harmonic significance".

5.9 THE INTENSIFICATION OF THE CURVATURE:

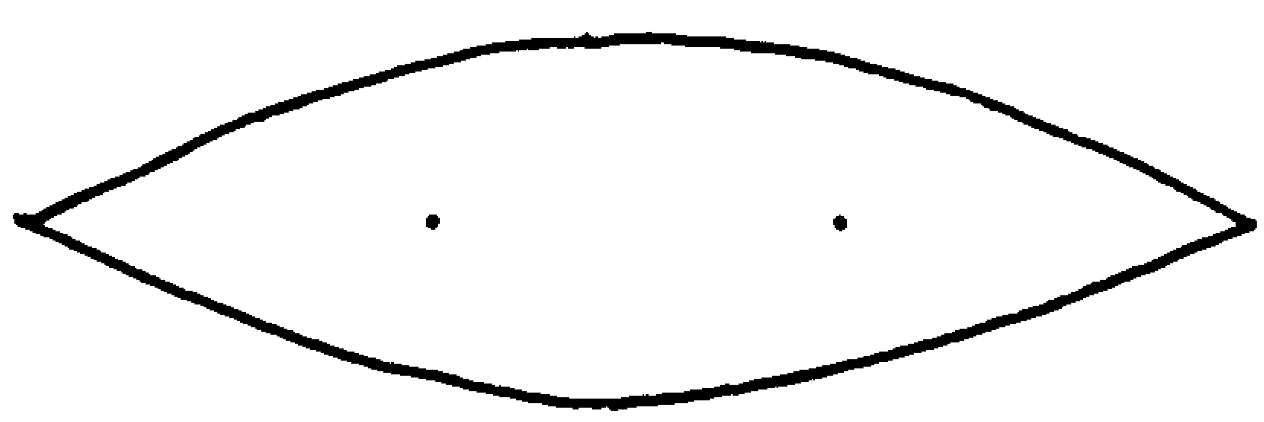
A convex curve, by nature, indicates a low starting point which grows towards a higher middle point before receding back to the lower point at the end of the curve or vice versa. As already indicated, the return to the lower point at the end of the curve suggests that there is a purposeful direction to the line that reaches a goal at the point of return.

The rise of the line to a higher position in the middle of the curve, suggests that this is the point of maximum tension. In an arpeggio chord, such as the one indicated below in example V-33, the point of least resistance would be found in the two extreme notes which share the tonic, and the point of heightened intensity in the middle two:

Example V-33:

a)

b)



The line at a) illustrates a curve that is conditioned by the rise of the musical line. The bottom curve b) indicates the musical intensity which is created in the middle of the arpeggio.

In the following example from Mozart's Piano Concerto K456, the semiquaver passage is musically more expressive when the "middle" notes of the passage are given more prominence, more weight:

Example V-34:

To render this passage in a way that would give prominence to the beginning of each group of four, or even eight semiquavers, would not treat the scale as a melodic feature and would make this passage sound rather superficial and shapeless. To be aware of the rise in the sloping line which indicates points of heightened musical intensity, would be to execute this passage in a melodious and expressive manner [1].

Chords

A similar treatment to our playing of the arpeggio in example V-33, and which pays attention to the various intensifications of the notes, should be applied when the four notes of the arpeggio sound simultaneously, i.e. in a chord.

It is clear that in polyphony or homophony, melodic considerations that have so far been implemented on a horizontal axis have to be placed on a vertical one. The same criteria which condition the emergence of an arpeggio as an organic entity with a starting point, an intensification at mid-point and a return, govern equally any texture which sounds the various notes simultaneously, i.e. on a vertical plane.

1. This curvature relates to various natural phenomena with which one is familiar in everyday life: a person for instance, would encounter increasing resistance as he attempts to dig deeper into the soil. The resistance is least when the object with which he is digging skims the surface of the soil.

In this respect, the middle of the chord will have more power directed towards it. With this in mind, the centre of a chord will possess an increased mass of music (m/m) and a slower speed of music (s/m). In metaphorical terms, such a central point will move slower with increased weight and density, while any satellites controlled from the centre will move with a faster and lighter momentum. The middle of a chord is the heart of the chord - the point of most resistance. It is an area of heightened musical intensity as opposed to the outer area, in which notes have less weight but which branch out from an intense inner core. This bears out the notion that highly charged musical activity is slow-moving and vice versa.

When a chord is played by an orchestra, for instance, it is desirable to direct the inner textures played by the instruments or sections which hold the centre ground [1], to play with sustaining power while the outer voices move with faster and lighter momentum. This way, the textures will not sound thick or overbearing, but will have "body", power and clarity.

On the piano, the same principles apply: the middle of the chord should be sustained as the outer notes of the chord rotate around the central area of activity or inner core [2].

Voicing of a Chord

In piano playing, the voicing of a chord is usually associated with making the top line of a texture sound more prominent [3]. In this sense, the bottom note, i.e. the bass note, is related directly to the top note. The middle of the chord still represents an area of heightened

1. These are often the clarinets, violas, horns and trombones.

2. This, in piano terms, might only translate in terms of an increase and decrease in the dynamic levels.

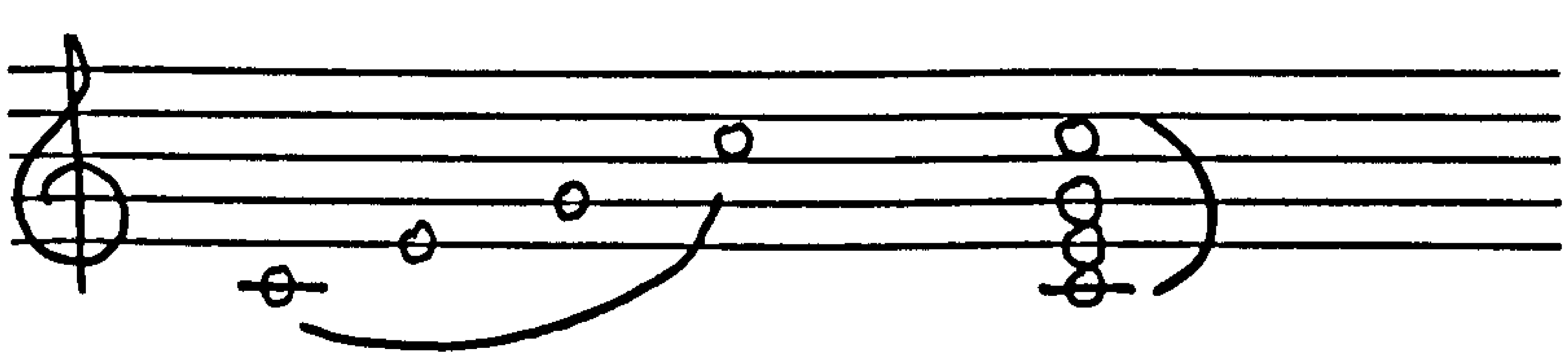
3. In the strictest sense, voicing would also incorporate the manner in which the middle of a chord is made to sound more intense, as described earlier. Voicing as such would take into account areas of least resistance against areas of increased resistance. Voicing on the piano, though, is usually associated with an increase in the dynamic intensity of the top line.

musical intensity but, in this instance, the curve reaches its peak at the top note of the chord: 1

The same principles hold true in the execution of a dyad: to make the top note of a two-note chord sound more prominent would mean increasing the volume from the bottom note to the top. Indeed, this is a practice that is common-place amongst many performers when playing an octave: to lead with the top note.

Textures, then, which sound several notes simultaneously must conform to the same principles that govern a series of notes on a horizontal plane. The curve is turned around from its horizontal axis to its vertical axis:

Example V-35:



In this way, the curve continues to conform with the ideas which have been proposed in this study and which apply to all moving elements inherent in a piece of music, namely, those dealing with distances, intensities, speeds of music, mass of music, directions etc.

1. The arpeggio serves to chanel the momentum to the top of the broken chord. When the four notes are played simultaneously, the four notes are voiced in such a way as to indicate the goal-direction suggested by the arpeggio. In this case, the top note should carry more weight so as stand out.

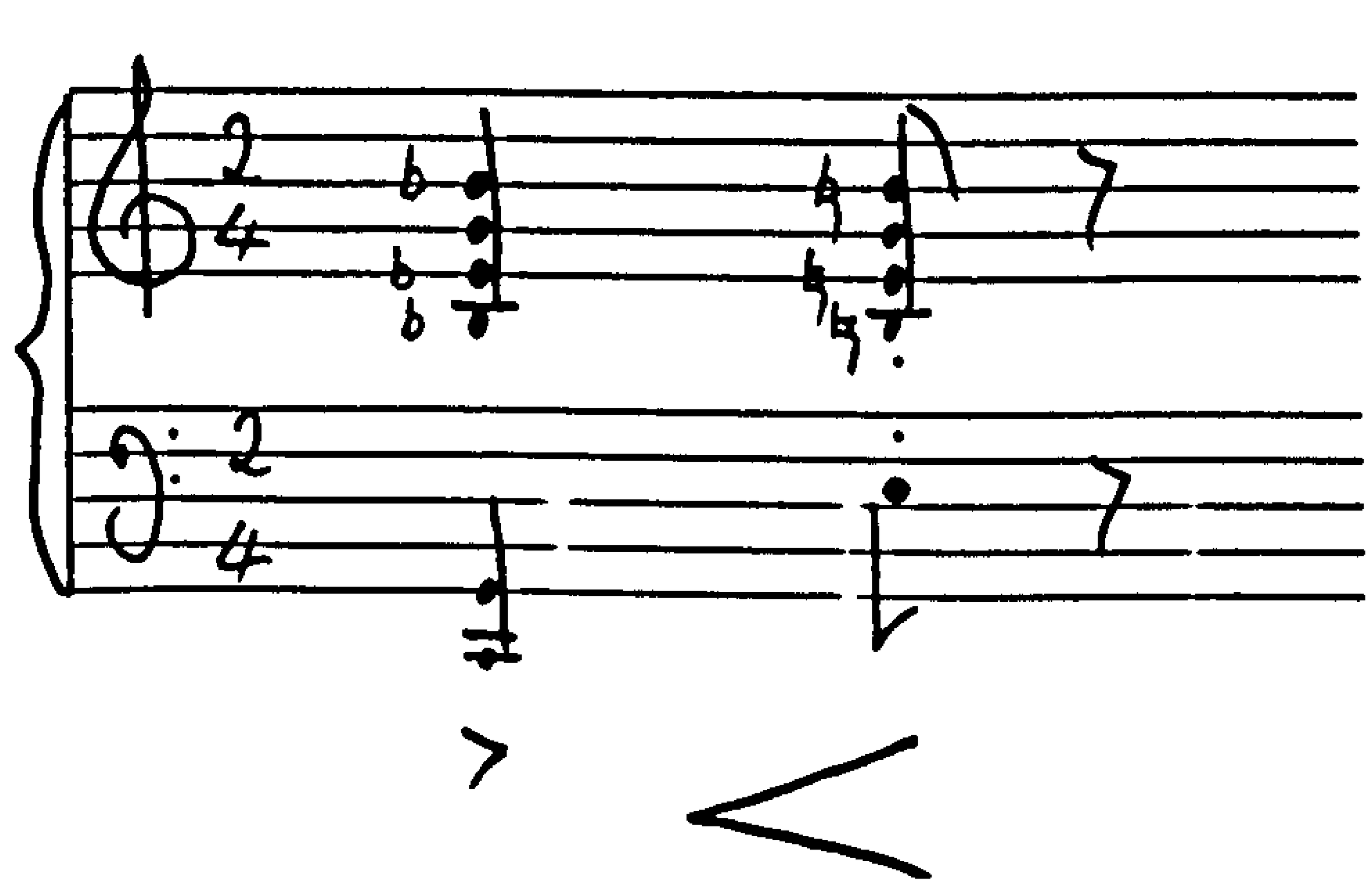
Distension

This is a common phenomenal occurrence in music. It conveys the increasing dynamic instability of a note or series of notes as a result of an increase in dynamic, emotional and physical intensity.

The sound suddenly er upts from a previous dynamic level. The higher the concentration of energy, the more high-powered the release. As more matter is increasingly condensed into an object, it causes the object to be increasingly distended. The larger the distension, the more powerful the eruption. The sound that behaves in this manner is comparable to the behaviour of a balloon which is being inflated: the larger the balloon becomes as a result of more air being pumped into it, the more powerful will be the explosion when it bursts. The more the energy is increased or the more *crescendo* one applies to a sound, even if only in the mind's ear, the more powerful will be the discharge.

The following example from Stravnsky's Concerto for piano and wind, last movement, indicates a distension:

Example V-36:



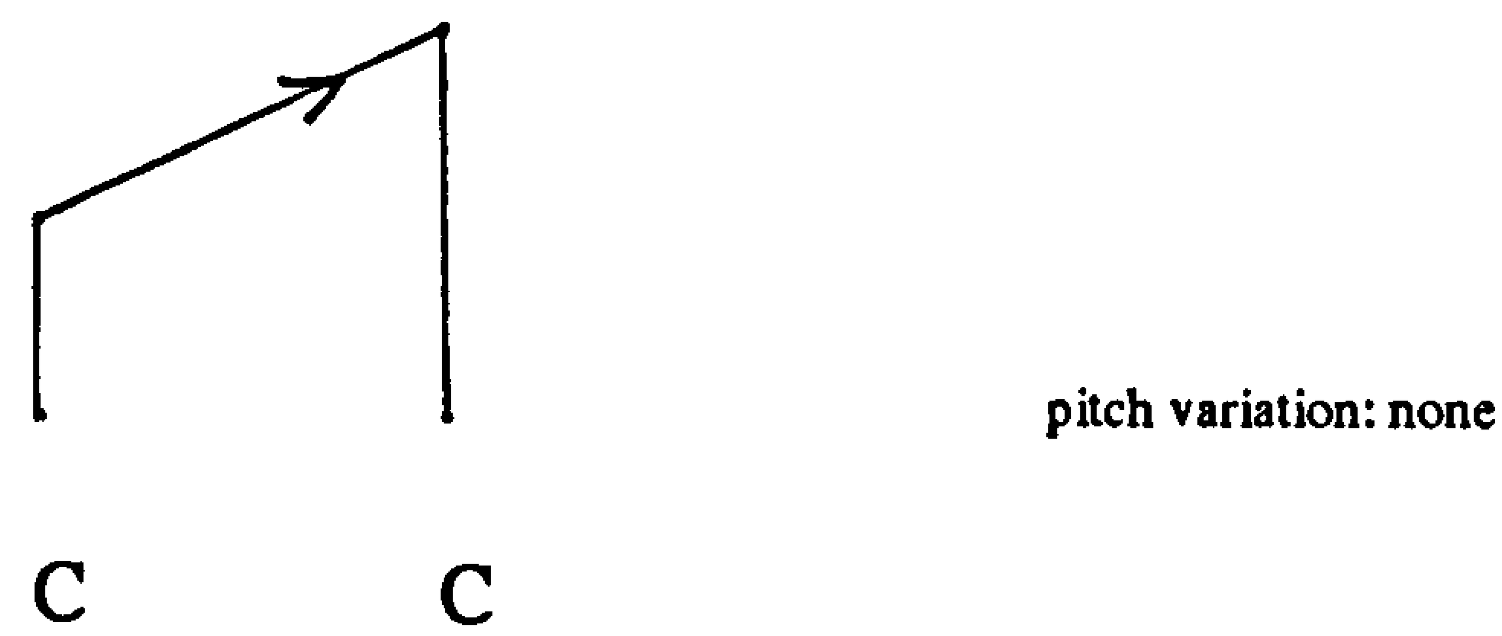
Here, the piano is required to intensify the chord sharply so that the discharge is as powerful as possible. In this respect, the performer is called upon to use every method at his disposal to produce the desired effect: by applying increasing pressure to the keys; by delaying the second chord and making it as abrupt and as short as possible; by making the second chord louder than the first and by applying the right pedal at some stage between the onset of the first chord and the onset of the second, so that the impression given, illusory or not, is that the first chord has undergone a sudden *crescendo.*

5.10 THE REPEATED UPBEAT:

Example V-37:

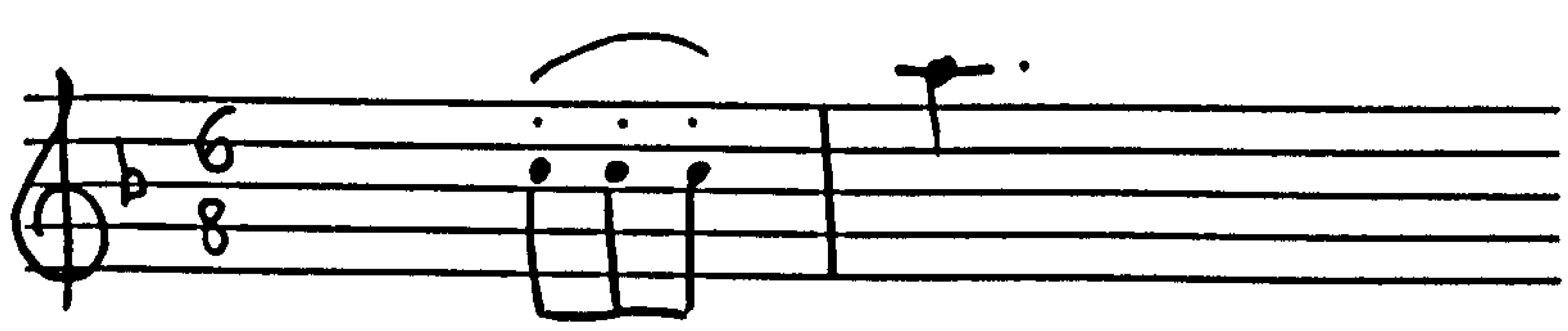
In the above example, the upbeat C is prolonged by being repeated twice. It is a common interpretative practice to treat the protracted upbeat in such a way as to avoid a monotonous repetition of the same note. In this way, the two Cs would have to be graded so that each is positioned on a higher plane giving the impression that the musical line rises, even though the two Cs remain on the same level in terms of their actual pitch: [1]

1. This may be achieved by increasing the dynamic gradient throughout the repeated upbeat but not necessarily so.



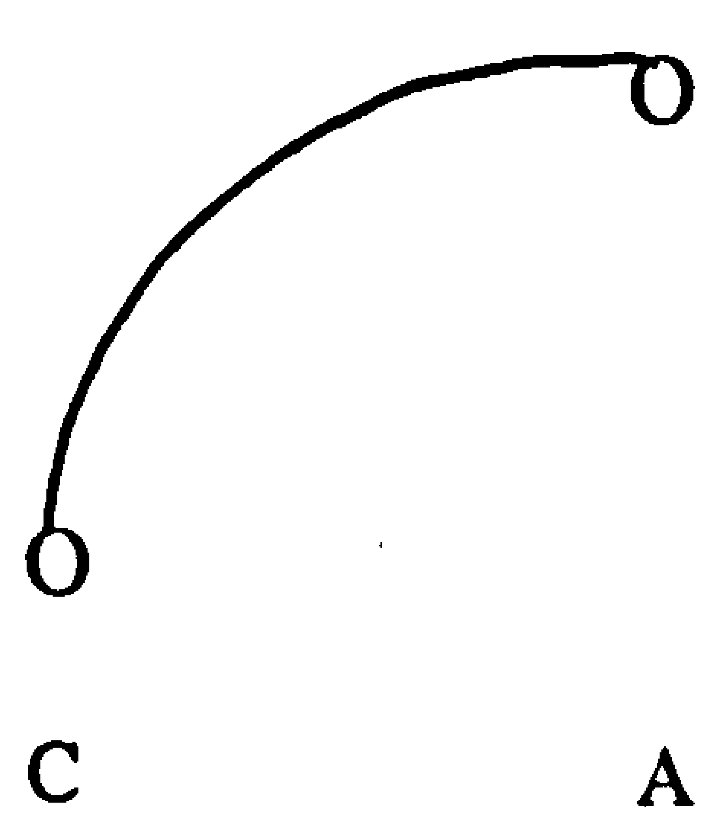
In the following example from John Field's Nocturne in F major the upbeat is a three-note one:

Example V-38:



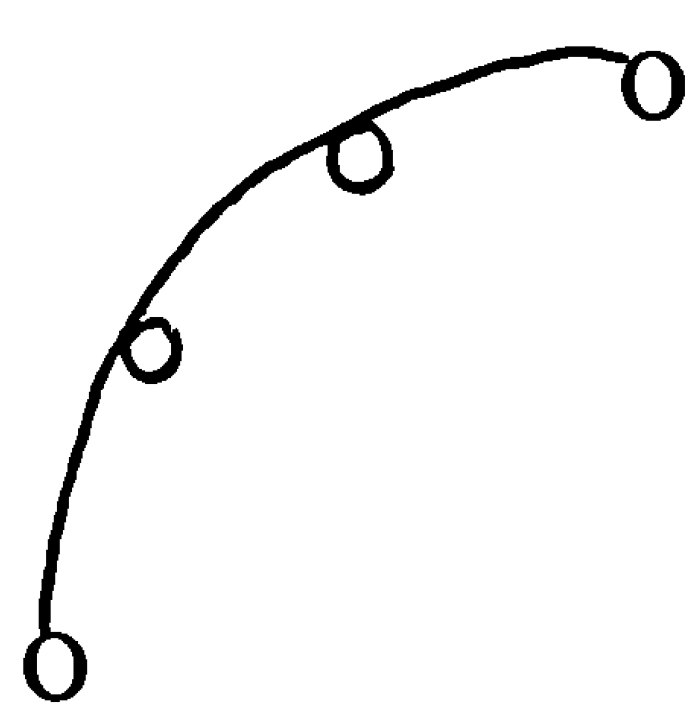
The following curve indicates the rise in terms of pitch from the C to the top A:

Example V-39:



In order to begin to formulate a pattern of various musical activities, we may now incorporate into one line both the rising Cs and the rise in pitch as it might appear in the gestures of a conductor or, in the motion of the pianist's wrist which gradually rises throughout this prolonged upbeat. 1 Such graphic illustration indicates the illusory 'transference' of the three Cs through tonal space to the top A 2.

Example V-40:



A transient notional wave pattern has therefore been established in which the three Cs move along one curve in one movement. This is musically satisfactory. But, in this instance, what does a rising curvature exactly portray? It could indicate one or more of the following:

1) a variation in pitch

2) an outright *crescendo*

3) a gradual increase between the various distances from one note to the other, i.e. *rubato or ritenuto*

4) an increase in tension, through any combination of these

5) direction in which the locomotor system moves

1. Indeed, this represents one of many such gestures often encountered in the world of pedagogy by which the teacher assists the student in playing *con espressione*.

2. The virtual transference of one note through tonal space to another could be likened to the *portamento* technique used by string players to slide from one note to the other. In metaphoric terms, the note feels as though it 'glides' towards the next one - a technique which is, unfortunately in my opinion, rarely in vogue these days but one which has served music so well for so many years in the past.

For one, it represents a variation in pitch: the interval of a major 6th. It could also imply a *crescendo* (though, it must be pointed out, it is quite possible to render the opening of this Nocturne with no apparent *crescendo*). A gradual increase between the various distances from one note to the other creating a *rubato* or *ritenuto*. Any combination of these would increase musical intensity and, subsequently, heighten emotional and/or physical intensity in the performance.

As already indicated previously in this Chapter (paragraph under sub-heading 'Transient') the manner of executing a transient notional wave pattern, and in particular this opening "repeated-note upbeat", would be to imagine the "sphere" turning from the bottom to the top. Each finger is then applied at the point the rolling "sphere" has reached at the time contact is to be made. In this sense, a rising wrist would lend itself ideally to producing the desired effect [1]. The rising curvature therefore, may also represent schematically the direction of the locomotor system [2].

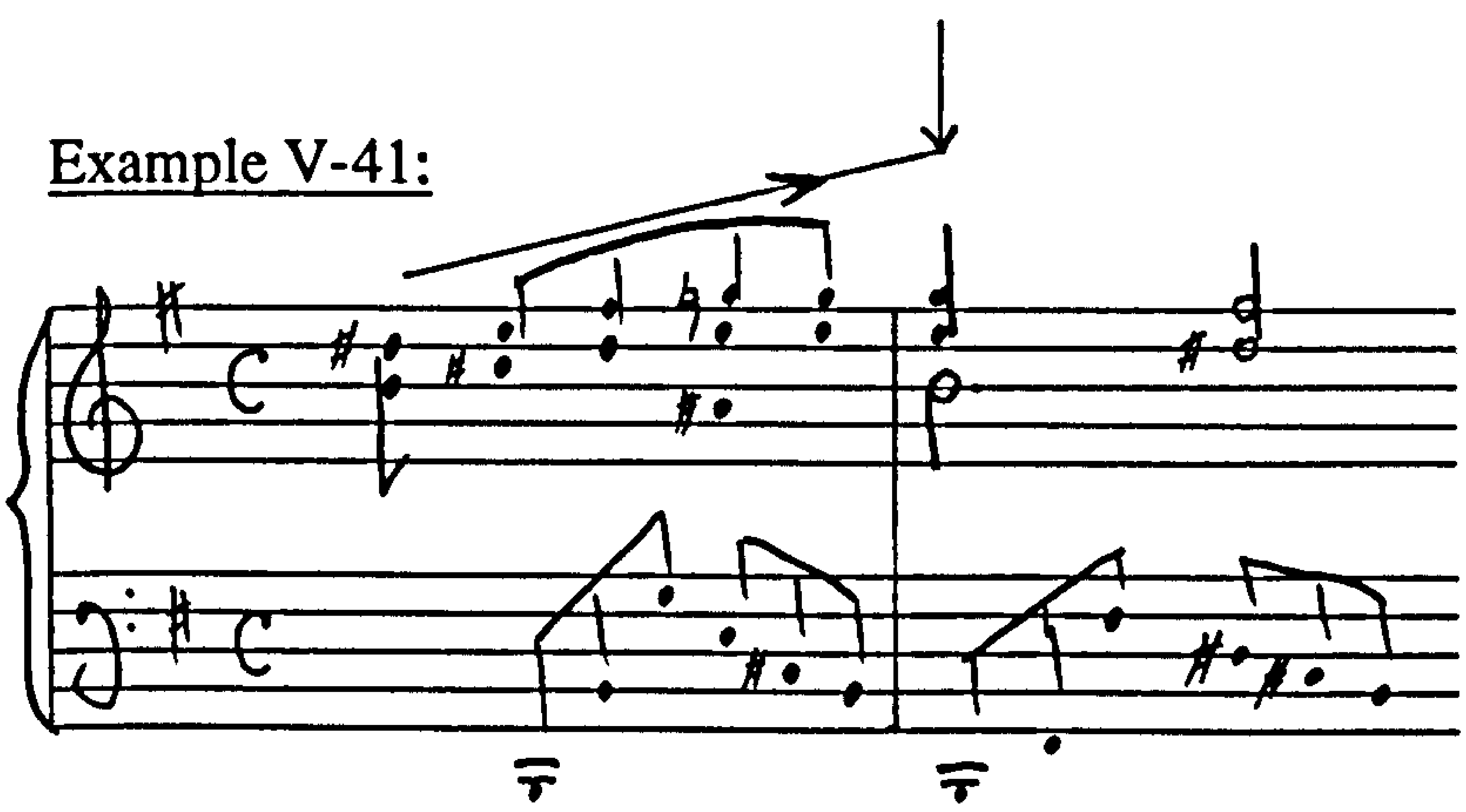
It is therefore possible that, apart from an indication of the variation in pitch and direction of the locomotor system, any one of the other three options (or a combination of the three), available to the performer for producing an "increase" of one kind or another, can be implemented according to the expressive manner with which the performer chooses to interpret the opening of this work.

1. There are some teachers who ask their students to raise their wrist while they apply physical pressure to oppose the rise. As the student encounters resistance, he will feel the sort of physical intensity which he should experience whenever he raises his wrists. Whilst there are times when such action should be void of physical tension, in many cases, particularly at moments of heightened musical intensity, physical intensity should be experienced.

2. It is common performance practice by many pianists, when faced with such a passage, to change fingers on each of the repeated notes. This produces the desired 'rounded' effect which moves in line with the revolving "sphere".

In the following example, taken from Chopin's Nocturne in E minor, the resulting increase is achieved even though there is no variation to the pitch of the note:

Example V-41:



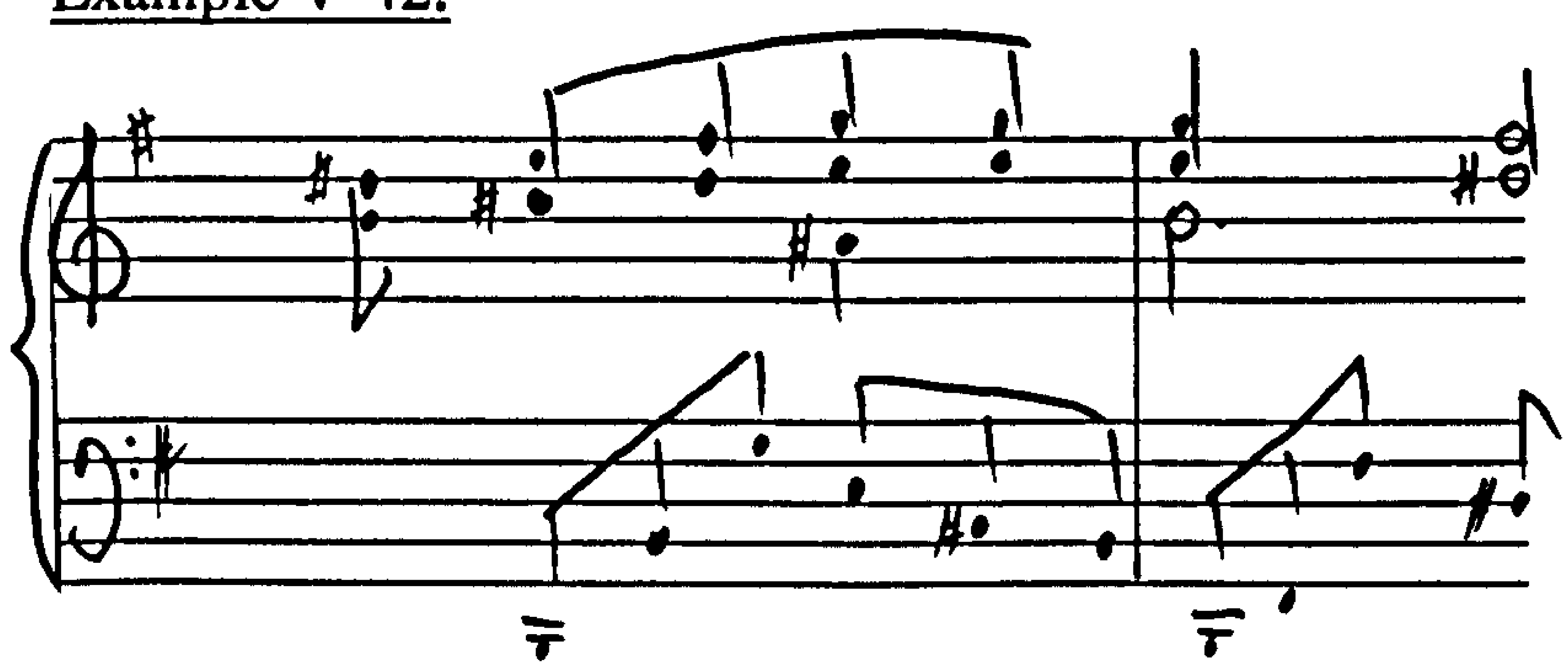
The same criteria as before, which condition the rise of the curvature, apply to this example, even though it would be hard to imagine such a rise here without a corresponding increase in the emotional, physical and dynamic intensity.

****

5.11 THE AMALGAMATION OF THE VARIOUS CONFIGURATIONS:

It is clear from what has been said earlier, with regard to the examples given above, that there are various musical phenomena represented by a variety of patterns: each indicating schematically the overall direction of the musical line. An attempt will now be made to identify and then amalgamate these various configurations. Chopin's Nocturne in E minor will continue to serve as the work from which the various configurations are derived:

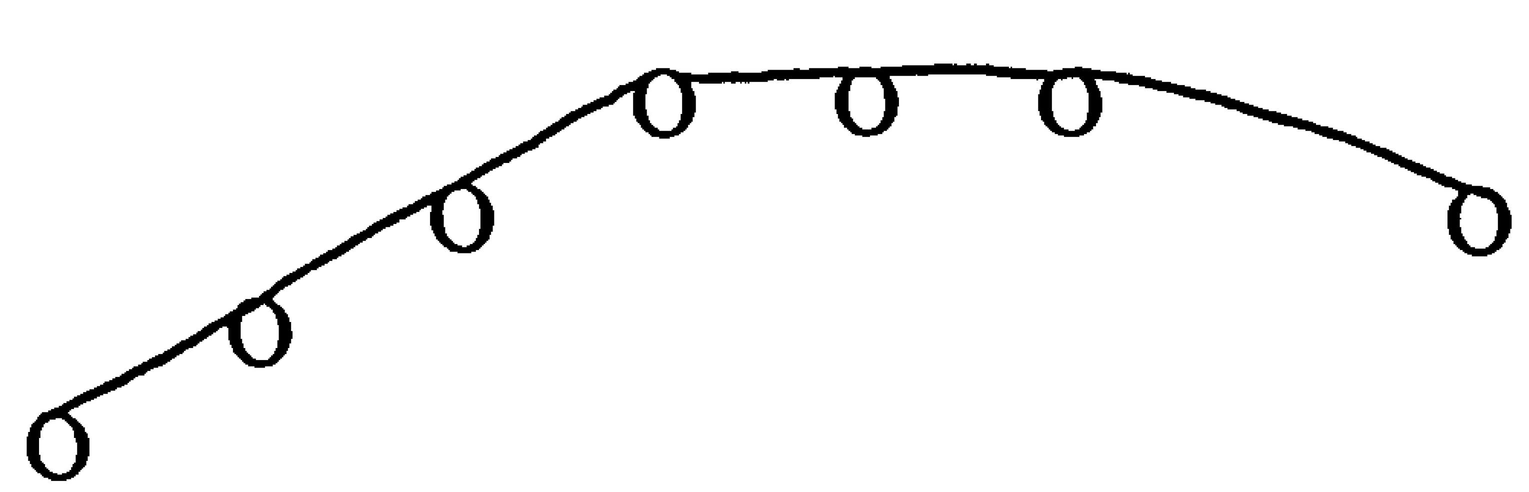
Example V-42:



1 2 3 4 5 6 7 8

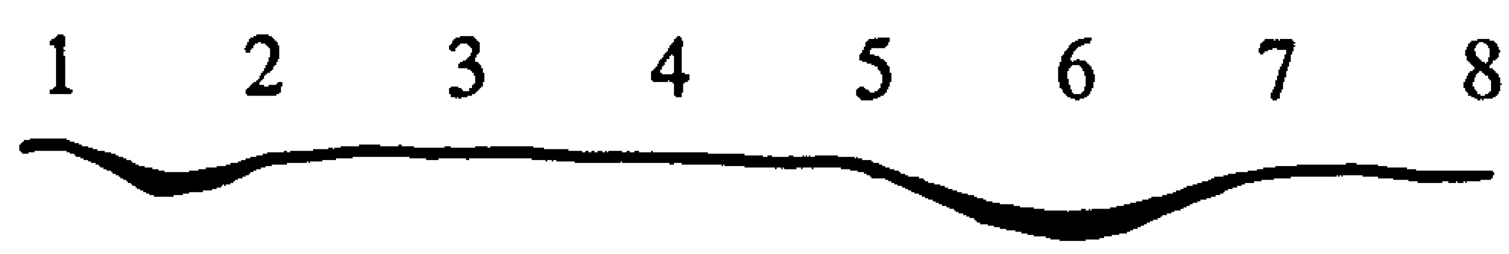
Each unit represents a quaver impulse.

On level 1, we have a line that represents the variation in pitch: [1]

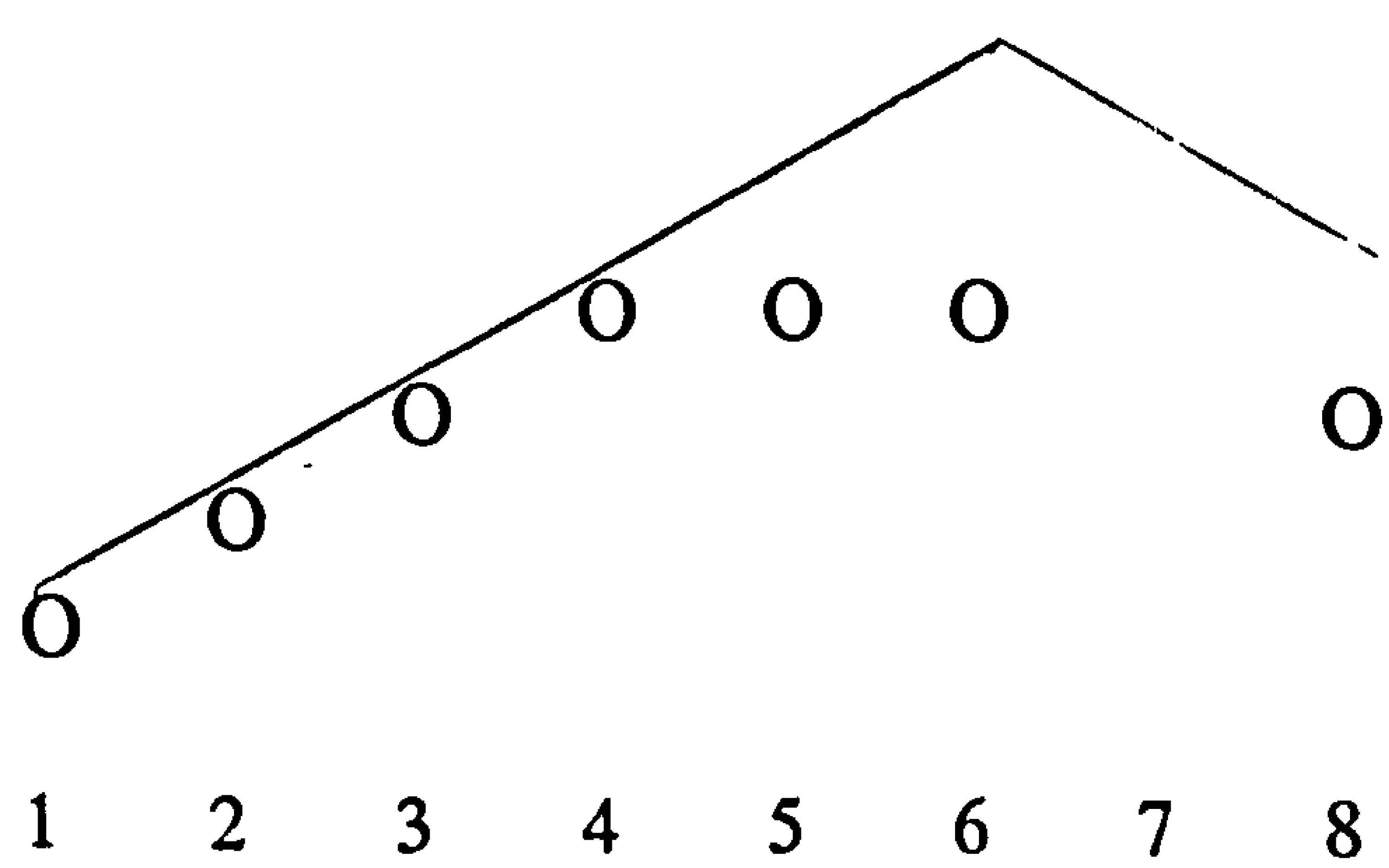


1. The result of this process of accumulation can be seen on page 187, Table 4.

On level 2, the moments of greater musical intensity, complemented by emotional and physical intensity, are represented. These are located at point 2 to a lesser extent and point 6 to a larger extent:

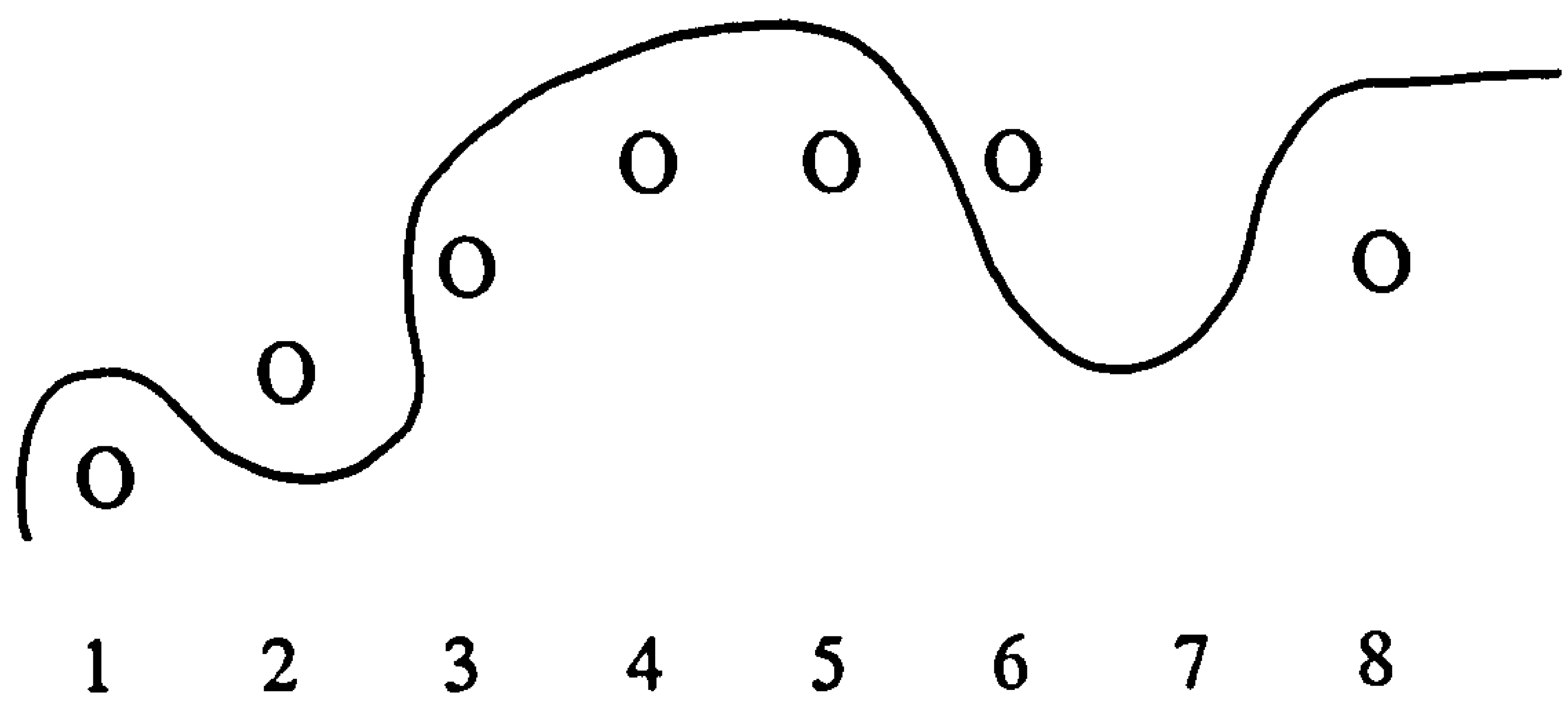


On level 3, dynamic levels are being represented:



Here, the line continues to rise right through to point 6 and falls through points 7 and 8. This represents a crescendo to point 6 and a diminuendo thereafter.

On level 4, we have a line indicating moments of greater musical intensity in which the notes are approached from underneath or from above [1], according to the manner in which this musical phrase is being interpreted and is deemed musically most satisfying. A composite pattern emerges:



Accordingly, there are variations to the speed of music (s/m) and mass of music (m/m) at various points:

between points 2 and 3, there is an increase to the m/m as well as decrease to the s/m. This leads to a heightening of the tension. Points 3,4,5 decrease m/m while increasing s/m between points 3 and 4. This renders a release of tension while a slight accelerando takes place between points 3 and 4. This slight increase to the pace is a result of a *rubato* which balances time taken with time given. S/m is then decreased between points 4 and 5 and decreased even further between points 5 and 6, where m/m is also increased. This renders a further intensification at the arrival point 6. Thereafter, an increase to the s/m as well as a decrease to the m/m gradually takes place.

Distances between the various notes are kept here at uniform length. The shaded-in and wider line which indicates increases to the musical, emotional and physical intensity, also reflects the decrease in the s/m as more matter is concentrated in a line separating points at equal distances.

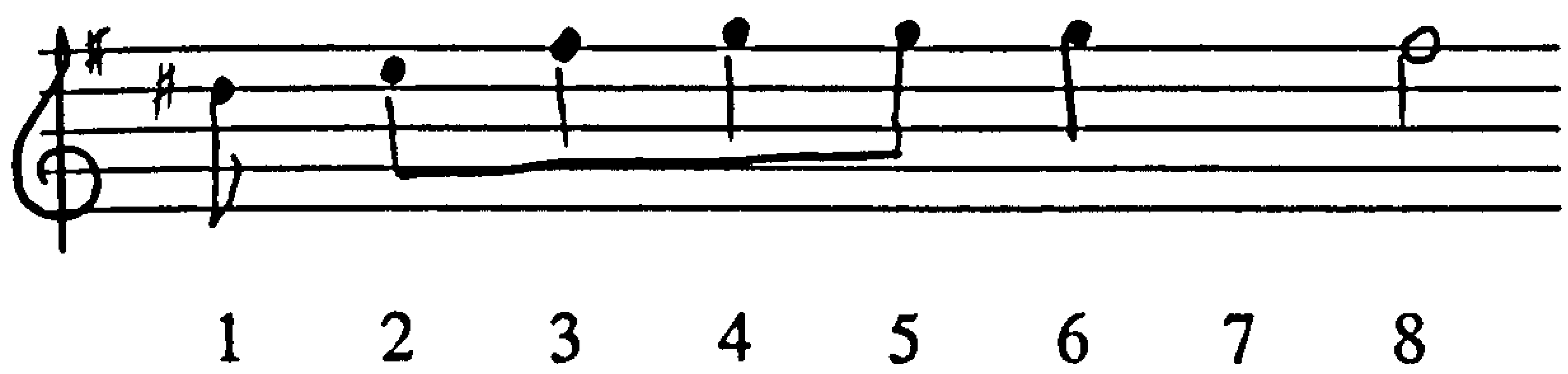
1. Accordingly, the hand makes contact with the "sphere" through a variety of approaches as described and identified in a previous section.

The four levels which have been identified are illustrated clearly on Table 4 overleaf. These represent the different levels of activity which relate to the basic direction of the musical line in the excerpt in question.

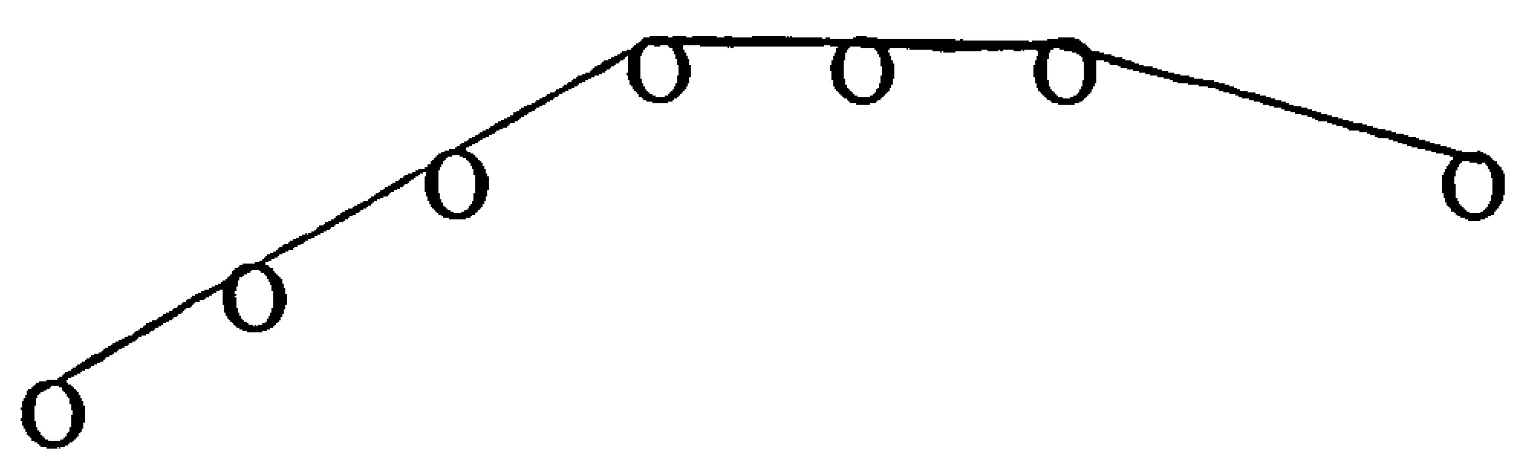
The performing musician ought to be in a position to identify each pattern separately. As each pattern indicates a different level of activity which is in itself indicative of important processes taking place musically, it is impossible to dispose of these patterns on a hierarchical basis. Nevertheless, all four patterns are interrelated and interdependent.

The performing musician can identify one level in order to clarify, for instance, the contour of the melodic line in terms of its variations in pitch and the basic motions of the hands. At the performance stage, though, the musician will ultimately be aware of one line which unites all the others and forms a pattern reflecting all levels of activities. Such an amalgamation is required in order to produce a schema capable of adumbrating the activities and individual properties of each separate pattern. This would then form the one master curvature plan taking in variations in pitch, dynamics, moments of intensity and directions of approach, as well as moments at which crucial changes take place to the mass and speed of music.

TABLE 4

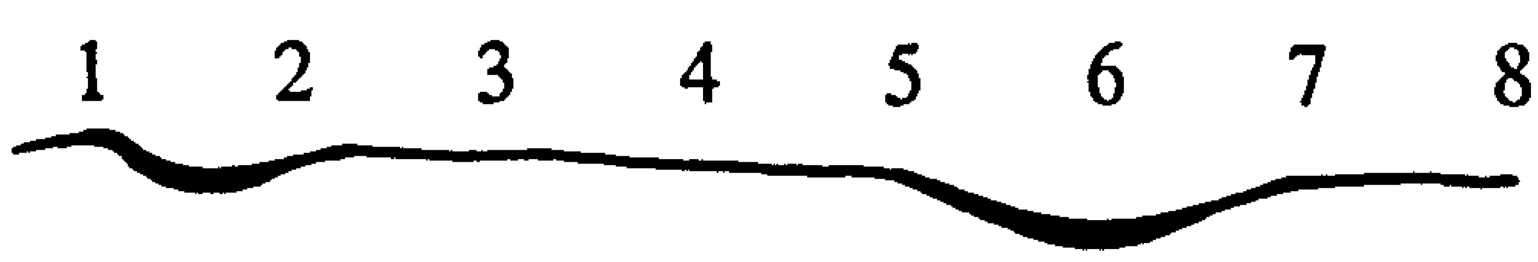


LEVEL I



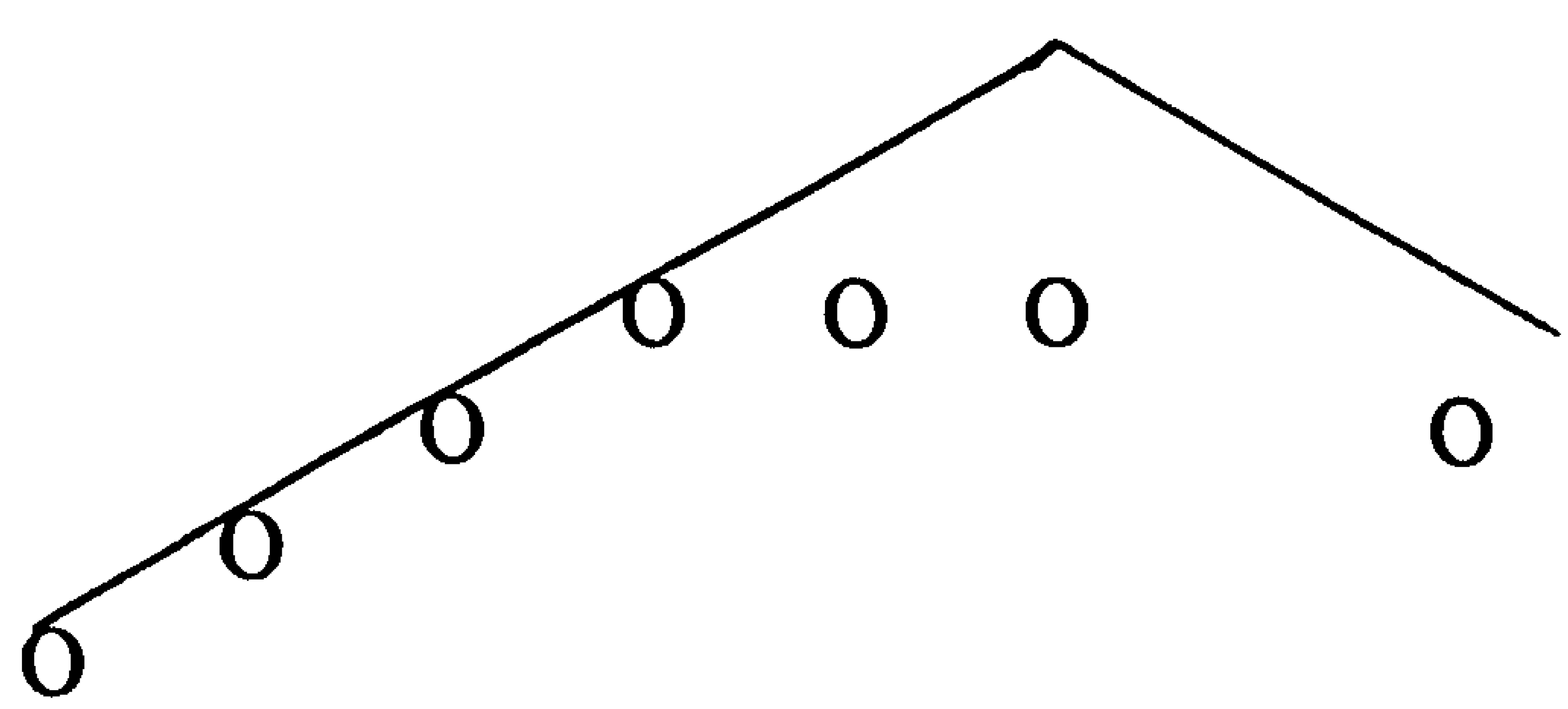
(Pitch pattern)

LEVEL II



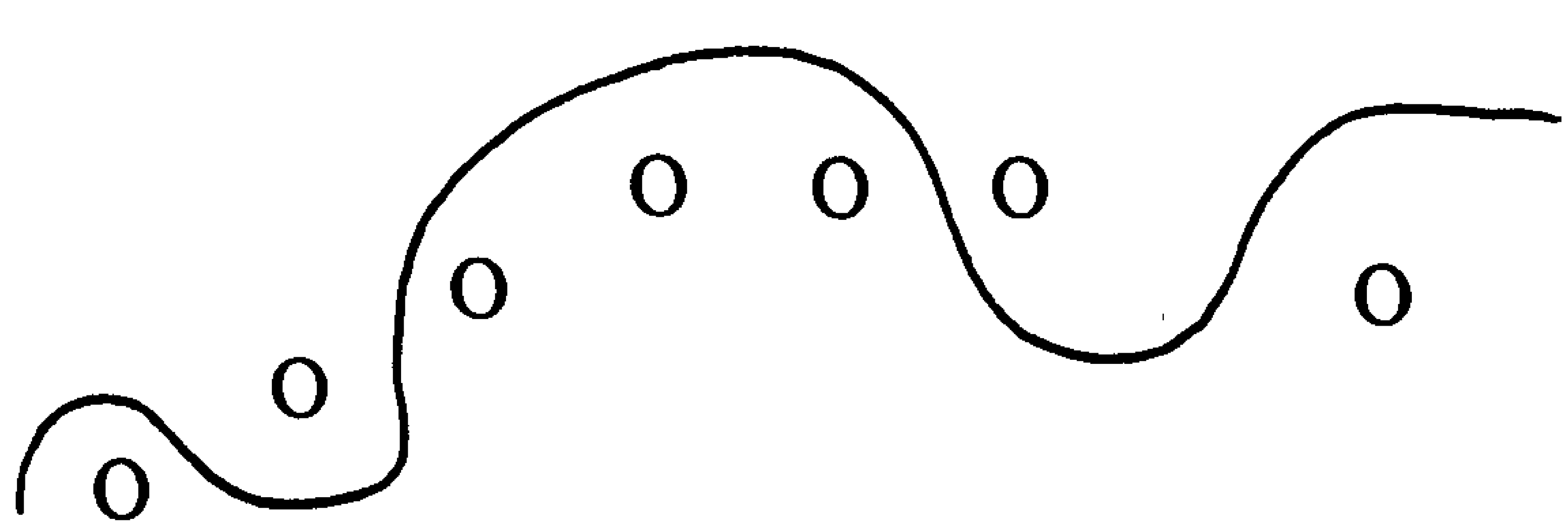
(Points of intensity)

LEVEL III



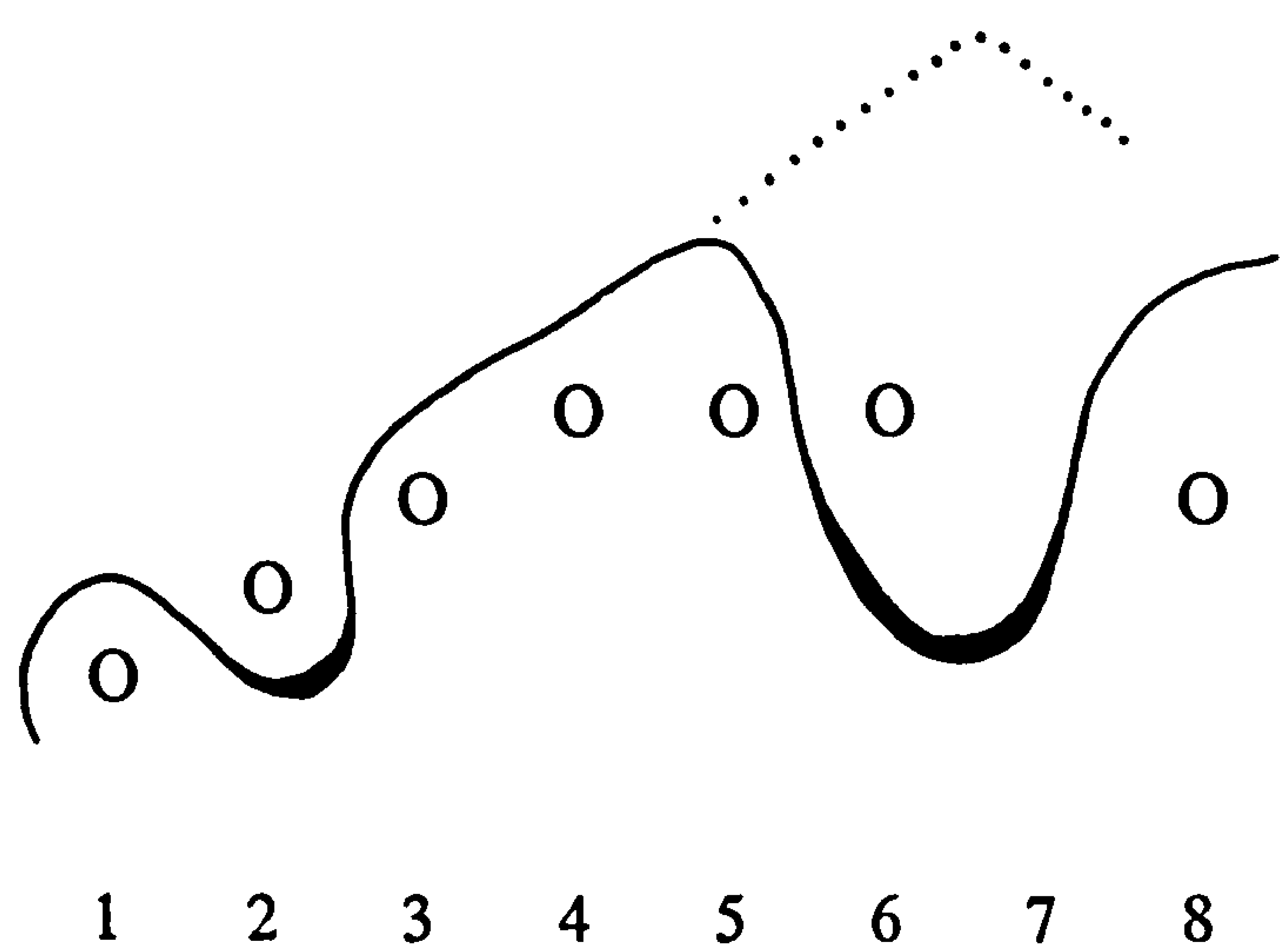
(dynamics pattern)

LEVEL IV



(Pattern of approach)

The following pattern is indicative of the various properties at every level and represents the musical line as motion, progression and growth:



This pattern takes into account the shape of the line in terms of its pitch variation with the curvature rising. It rises further as the dynamics increase. Points of intensity are darker which indicate a slowing down of the s/m and an increase to the m/m. As notes are approached from different directions this causes the notes to move up or down.

Furthermore, the shape of the above curvature illustrates also, quite unequivocally, the basic direction in which the hand moves when playing this passage: the wrist drops at point 2, then rises through points 3,4, and 5, then drops again at the arrival point 6. Thereafter, it rises as it would in a two-note slur.

With whichever instrument the above melody is played, the performer and the listener can be made aware of this basic essential pattern. An instrument like the violin, for instance, would make every nuance indicated in the pattern clearly audible, because it would manipulate the sound accordingly:

it would *crescendo* through to the top of the line; it would intensify the sound by increased pressure to the bow at points 1-2 and 5-6: it would increase the distances at the various points at which such intensification is encountered. The slowing down of the s/m can also be conveyed by the player slowing down the speed at which the bow is moving through a change to the pulsating rate of his vibrato. The notes at points 2 and 6 can be made to sound fractionally flat as they are pulled downwards. This, again, is indicated in the pattern. As intensity is released the notes rise and are discharged.

Other instruments playing the same musical phrase could equally convey the same pattern, even though they might not be in a position to manipulate sound the same way. On the piano, for instance, the impression of a *crescendo* is achieved by careful dynamic gradation of each note towards the top of the curvature. Moments of heightened musical intensity are created through awareness of distances, that is to say, through timing and *rubato*, as well as through changes to the physical intensity experienced in the act of playing. The overall pattern would be as discernible if played on a violin or any other instrument which controls the sound-envelope once initiated.

The harpsichord, for instance, can neither *crescendo* nor alter the dynamics of the sound. It can still clearly convey the pattern though, through its one means of expression, timing: the location of the various points at various distances apart, hence the importance of *rubato* in the Baroque harpsichord repertoire [1].

1. The inability of an instrument to manipulate the sound to the degree prescribed by the pattern does not in any way eradicate the pattern. On the contrary, the pattern, as a visual model of the organic growth of the musical line, serves to enhance the performer's capacity to portray it as veraciously as his instrument may allow.

CONCLUSION:

The organic growth of a melodic line implies motion, progression and therefore direction. The direction of the melodic line in this respect incorporates far more than that of pitch variation alone. It takes on board criteria which condition the dynamic qualities of the various tones. As a line, a curvature, emerges it forms a path through which these are made apparent. The curvature indicates moments of increasing or decreasing musical, emotional and physical intensity in which the *speed of music* and the *mass of music* (the perceived weight of various notes) are clearly indicated. Furthermore, through this process, the line of music "comes alive". It breathes and it rests; it intensifies and it grows; it accelerates and it slows down; it becomes heavy and it becomes light. The line emerges as a musical shape; a shape that Heinrich Neuhaus calls "*intonation* of the music" [1]. The pattern which has been traced in the preceding pages is an attempt to reflect this shape.

Some such pattern is being realized to a greater or lesser extent whenever, and by whatever, instrument it is played. Instruments like the piano or the harpsichord would emphasize certain perspectives of the pattern whereas other instruments, like a stringed instrument or the voice, would indicate others. A two-dimensional design, though, can still portray the depth of an object which is being depicted. Likewise, an instrument which is limited in its capacity for subsequent changes to each sound that it produces, can still suggest the various nuances as set forth in the overall curvature of this pattern.

Awareness of the various phenomena which determine the safe arrival of the musical line at its destination assist the discerning performer in producing a curvature true to the principal qualities inherent in the music. The performer is thus able to form a pattern according to the demands of the musical text on the one hand, and according to the way he or she chooses to interpret these demands on the other. The line is then drawn in the confidence that it represents a cohesive view of, and by the same token a musical insight into, the work to be interpreted.

1. Heinrich Neuhaus - *The Art of Piano Playing* (1973)

CHAPTER VI

CHAPTER VI

MASS IN MOTION

(STAGE IV - IMPACT/RELEASE - and beyond)

At the time that contact is made with the next note in a series, the preceding note is released: the nature of this release will form the focus of investigation in this chapter.

The speed with which a note is released, as well as the time of release in relation to the note which follows, produces a variety of motion which determines further the quantitative and qualitative differences of the musical textures [1].

6.1 RELEASE:

Instantaneous

Instantaneous release occurs when a note is released at the precise time at which the ensuing note is played. This involves an intricate process founded on good muscle co-ordination and muscle reflexes so that control over the rise and fall of the fingers with regard the keys is exercised at all times.

The speed at which the damper of the piano returns to dampen the strings is directly controlled by the speed at which the key is released: the sound ceases instantaneously when the key and damper are returned swiftly as a result of rapid finger action.

1. It is within this complex process that an endless variety of colour can be achieved on the piano - I refer the reader to Chapter II - "Mechanisms".

The difficulty in delivering a well-timed and well-controlled release of the key lies in the inability of the finger to remain still while others are being motivated to play. In other words, when a finger is lifted and mobilized to strike, it tends to "pull" the finger holding the key upwards. This causes a release, however minimal, prior to the finger reaching its destination. This, in turn, breaks the link between one note and the other and results in unevenness of sound. That is why independence of finger movement is so sought after [1].

Retarded

A retarded release occurs when the finger releases the key slowly, thereby causing the damper to fall back gradually. As a result, the sound too disappears gradually. In a retarded release lie the basic principles which constitute a legato technique.

In instantaneous release, the note is fully in focus when one finger depresses one key simultaneously as another finger releases another [2]. In a retarded release the ensuing note is realized while the preceding one is being released. The note being played is therefore brought into focus slowly and gradually.

It is for this reason that experiments which look for specific variations in the onset and offset times of each note (Sloboda, Clarke et al), particularly when these are played in *legato* mode, may prove to be inept. A note may fully 'emerge' only when the previous one has been fully released. But even then it is constantly in a state of motion and flux.

1. The strain such independence of finger-action exerts on the muscles of the body, as professed by the old school of piano-playing, has been recognized by many as being impractical and even physically dangerous. Whether it is finger-action alone which propagates the sound or whether it is action involving the use of other parts of the locomotor system, the principal of evenes in execution, and therefore eveness in sound, remains the same: the action which prepares any part of the locomotor system to strike the key must not disturb any other part of the system holding the key firmly in position.

2. In an instantaneous release, impact and release occur almost simultaneously. The tactile sensation of impact/release is such that, on impact, the finger makes contact with the "sphere" right at the centre. In a retarded impact/release the "sphere" is susceptible to more varied approaches. For further information on the variety of applicable approaches, I refer the reader to page 137.

As with an instantaneous release, the speed at which the finger releases the key is analogous to the speed at which the finger moves to initiate the ensuing note.

In the performance of certain works for orchestra where intense legato is required, a technique whereby notes are held by certain players of a violin section well after others have moved to the next note of a melodic line is exercised in order to intensify the legato. The section is divided in such a way as to allow certain players to move on to the note before others. When this technique is applied skilfully and tastefully, the musical result is one in which immense intensity is achieved through the "pull" that the note creates as it is slowly and painstakingly released [1].

On the piano a similar technique is practised: one finger moves to another note while the previous one is held momentarily before being released. This practice requires skilful manipulation and the release does not occur arbitrarily: it is timed to co-exist in relation to the *speed of music* [2].

6.2 PEDAL LEGATO:

The pedal (that is, the right pedal of the piano), when depressed, induces vibrations of the harmonic series. This enriches the sound quality and serves as a device by which a wide range of colours can be attained. The implementation of the right pedal has been compared with the vibrato produced by instruments other than the piano. Just as a violinist, for example, would use a choice of vibrato to alter the quality of the note, so would a pianist avail himself of the pedal.

1. I refer the reader to the recording of Puccini's *Tosca* by the Vienna Philharmonic Orchestra, conducted by Herbert von Karajan, on Decca, catalogue no: 5BB 123-4, in particular, the tenor aria: "Recondita Armonia".

2. In the early stages of training to attain control over this type of belated release, the player delays the release of a note by one beat. Once co-ordination is attained, the process can develop to a more complex level according to the textual and emotional demands of the score.

A string player applies vibrato at various stages during the course of a single note thus changing its quality and timbre. The pianist, likewise, 'colours' the note by adopting the use of the pedal at a given moment during the course of a note or chord. The timing as well as the deftness with which the pedal is implemented will determine the qualitative nature of the musical line.

The pedal has been applied erroneously many a time in order to assist the player in sustaining textures. Whereas this use of the pedal can serve a useful purpose at times, it is nevertheless unwarranted as a mere device with which, as Arthur Schnabel put it, to "glue" notes together. In this respect, sustaining power lies in the hands, rather than the feet of the performer.

In order to maintain unity of execution and co-ordinated motion, the right pedal is lowered and released at various sub-divisions of the main beat, and not indiscriminately. Similarly, the speed at which the pedal is inserted and released relates to the speed the finger attacks and releases the key. In this context, a slow release all around would render a finger legato as well as a pedal legato.

In this respect, the string player's use of a vibrato in which the left hand begins to oscillate slowly after a note has been heard can be imitated on the piano by depressing the right pedal slowly and gradually after the finger has made contact with the key.

6.3 MOVING ELEMENTS PRIOR TO IMPACT:

It is common performance practice to motivate all the elements which enter into the playing of a note or group of notes well before the note is actually heard. In ensemble playing, for instance, the instrument which joins the ensemble when others are already playing begins to 'move' in time with the other instruments before joining in the general flow of the musical performance.

This means that when there is a rapid flow of, say, semiquavers being played by the other instruments, the newcomer begins to "feel" the pulsating semiquaver movement *before* playing, so that when the moment of his entry arrives, he joins in unobtrusively and in time [1]. Failure to move, prior to impact, in time with other moving elements is likely to cause a late and "bumpy" entry.

Likewise, the player in the ensemble who ceases to play will leave off at a pace which relates to that of the ongoing moving elements. Impact and release, therefore, are aligned to the speed of music (s/m).

The locomotor system of the pianist is similarly motivated at all times during the process of delivery, impact and release, in the same way that instruments within an ensemble 'move' during moments of activity and repose. As a finger prepares to strike and release a given key, it moves in relation to the speed in which the preceding note was delivered.

In string playing, the left hand frequently begins to vibrate before the bow comes into contact with the string. In this way, the note is prepared and motivated prior to it being heard. Metaphorically speaking, the note is brought to life and begins to pulsate before it is heard. It therefore exists and is perceived as an entity at the time that it begins to move (see pg. 95).

1. This could be likened to the experience of someone wishing to leap on to a moving bus from a stationary position; he would do so with less risk of an injury if he begins to move first at the same speed alongside it.

The experience of the string player in setting a note in motion prior to impact is paralleled by the pianist when he refers his mind to the intangible, abstract, yet conceptually real realm of the "sphere", as proposed in this study, which prior to impact begins to revolve.

This experience establishes further the idea that musical performance is the quintessence of motion and that the performing musician who initiates the intricate process of movement and growth must at all times maintain absolute contact with all moving elements. In this respect, a oneness of purpose and execution is what the performing musician ultimately aspires to in this much coveted state of complete harmony between inner and outer world.

6.4 PHANTOM NOTES:

Frequently, physical contact with the key is interrupted, even when two or more notes seem to be joined together. This experience is brought about either by the fact that two notes are so far apart that to physically join them would be impossible or that the performer decides, for whatever musical reason or musical effect, to detach one note from the other, or that the composer explicitly requests that notes should be played in *semi-staccato* or *portamento*, or that the composer creates silent pauses through rests in between notes.

Whatever the reason for leaving the key, contact between any two notes may still be maintained through a musical relationship. The bond that connects two points of reference is still achieved even when physical contact ceases to exist. In this respect, the preceding note 'lies' as a 'phantom note' whose particular quality is perceived even when tactile contact is withdrawn.

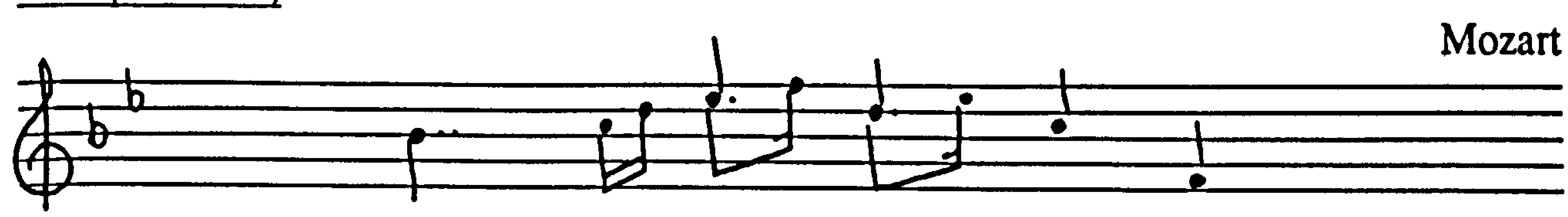
When the composer specifically requests that two notes are detached through a rest, a silent pause may occur in which sound ceases to exist. In this respect, the "phantom" experience is particularly significant as it implies that there is always a connection between any two points of musical reference even when sound is inaudible. A silent pause, in this case, forms part of the musical structure and is perceived as an integral and organic occurrence of the music itself.

6.5 POLYPHONIC TEXTURES:

The "phantom note" phenomenon is particularly applicable when polyphonic textures are encountered. In the following example, played by the clarinet, the melodic line is distributed in such a way as to form a single and a two-part musical line at the same time:

Example VI-1a;

Example VI-1b;



Example VI- 1a indicates a single melodic line as it is written in the score. Example VI-1b suggests a two-part melodic line at the end of this phrase. This constitutes what Kurth calls a linear-polyphonic structure in which *apparent voices* come into play [1].

The player who interprets the above phrase along the lines indicated by VI-1b has, therefore, to maintain constant contact with the notes Eb, D and C. The clarinet player, while leaving the note Eb to play the next note F, must maintain contact with the Eb, even though physical contact is not possible, in order to relate the Eb to the D and then to the C. Consequently, notes Eb, D, and C, become "phantom notes". Contact in this respect, is maintained by a physical awareness of the quantity that is preserved within the "phantom notes" when physical contact is no longer possible.

In musical terms, the main body of the musical line lies in the notes Eb, D and C, whilst the other notes, F and D, are peripheral.

The pianist who plays similar passages (of which there are plenty) would treat it the same way: whilst physical contact with the key might be lost, the fingers which play the notes D and C after F and Eb have been played, return to a position of close proximity which enables them to maintain contact and relate the D to the previous Eb, and the C to the preceding D.

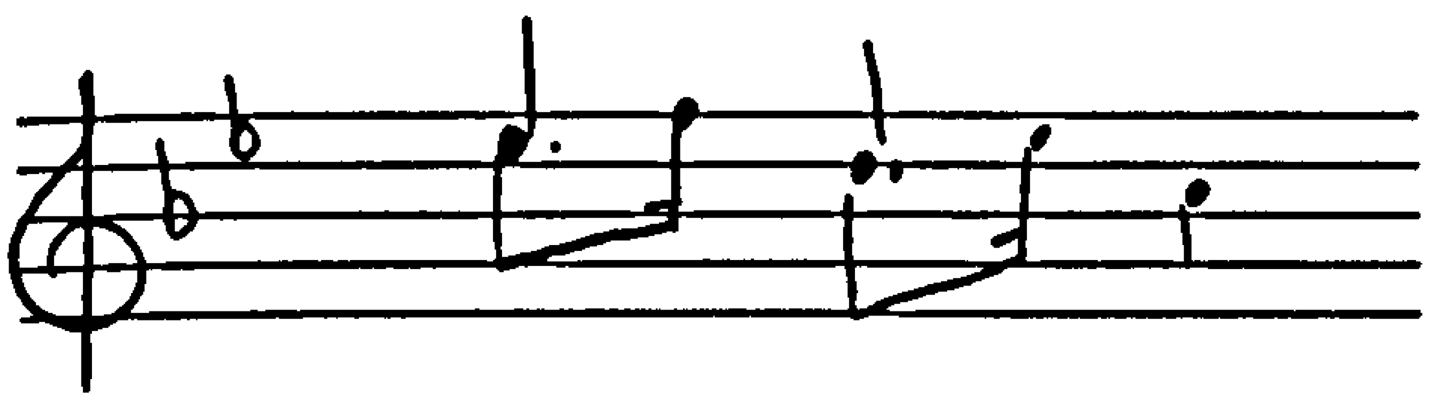
1. In Kurth's definition an *apparent voice* is an overriding melodic continuity composed of registrally highlighted, non-adjacent tones that are associated by virtue of their long-range stepwise relationships. As opposed to this, an *actual voice* is the literal, note-to-note melodic development (see pg. 197). Kurth maintains that Bach, for instance, brings apparent voices into play in order to achieve intensification by means of a transition from parallel motion to a staggered apex with an actual voice (cited in *Ernst Kurth -Selected Writings* by L.A. Rothfarb, 1991: pg. 81)

For a more scientifically-based exegesis of this phenomenon I refer the reader to a study by West, Howell and Cross, entitled "Modelling Perceived Musical Structure", in: *Musical Structure and Cognition*(1985: pg. 47).

6.6 FINGER PEDALLING:

It is possible, indeed desirable at times, to physically hold the notes Eb, D and C:

Example VI-2;

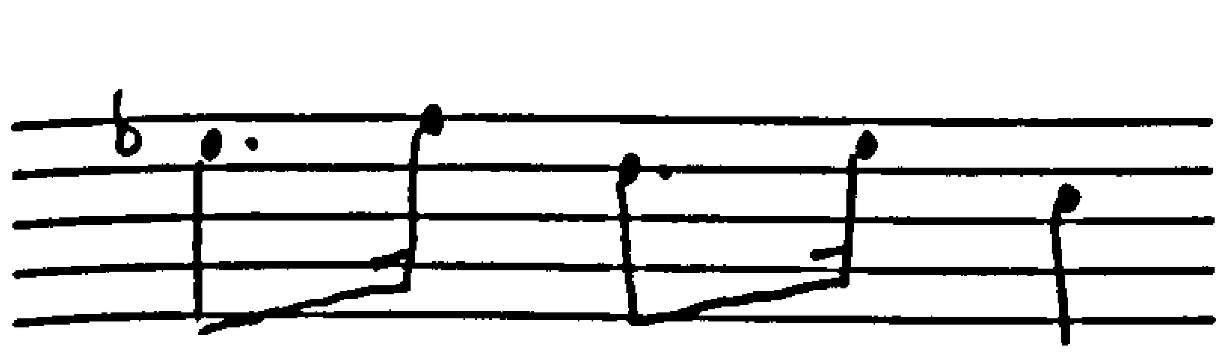


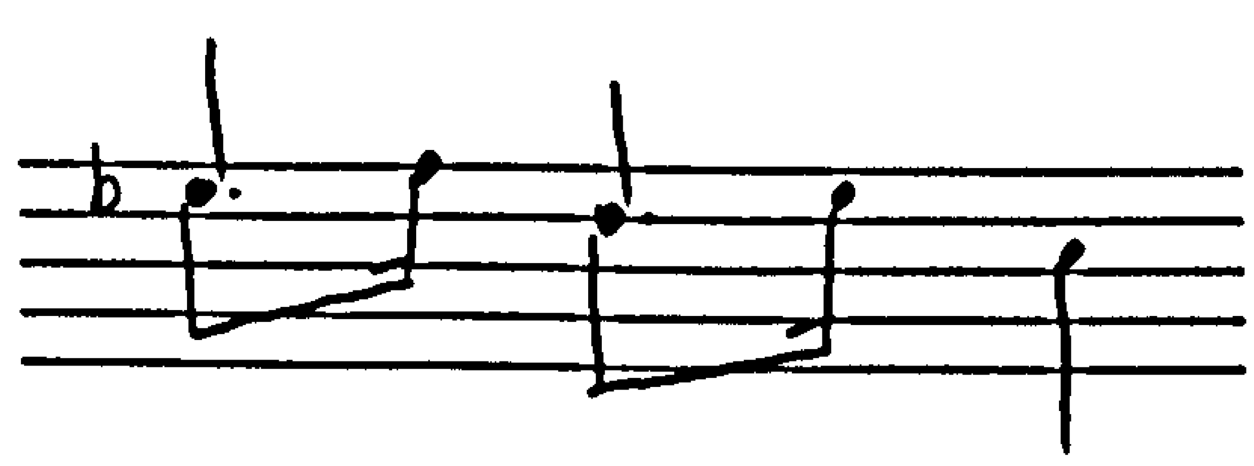
The finger that plays the Eb is released only when the D is played; and the D is released only when the C is played.

This technique of holding down notes on the piano frequently occurs and produces a pedal-like effect. Whereas the right pedal would release the dampers setting all the strings of the instrument into sympathetic vibration, holding certain notes will only release those dampers to which these notes are connected. The overall line is therefore more concentrated and focused. At times the pedal can be used in conjunction with sustaining certain notes in order to enrich and 'colour' the sound whilst still maintaining it focused and well-centered.

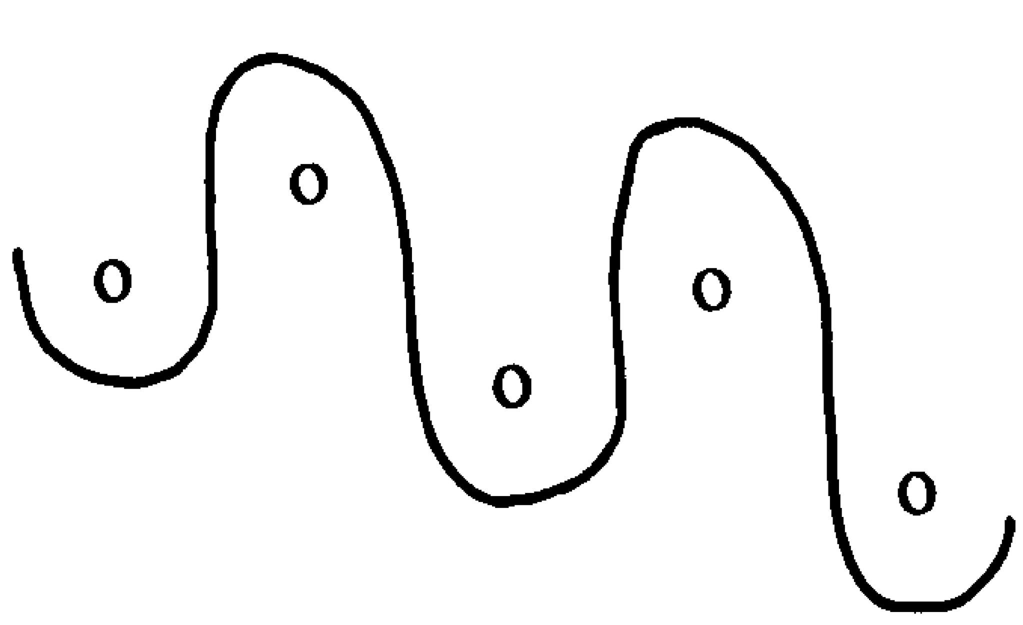
By thus rendering a melodic line in such a way as to unravel it into segments which suggest a polyphonic texture, the conceptual wave pattern is curtailed:

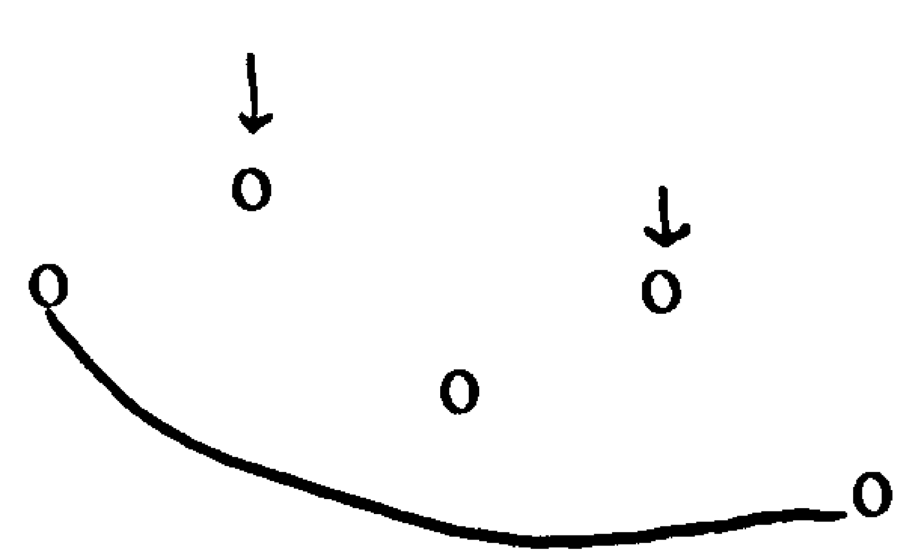
Example VI-3:





nominal wave pattern:



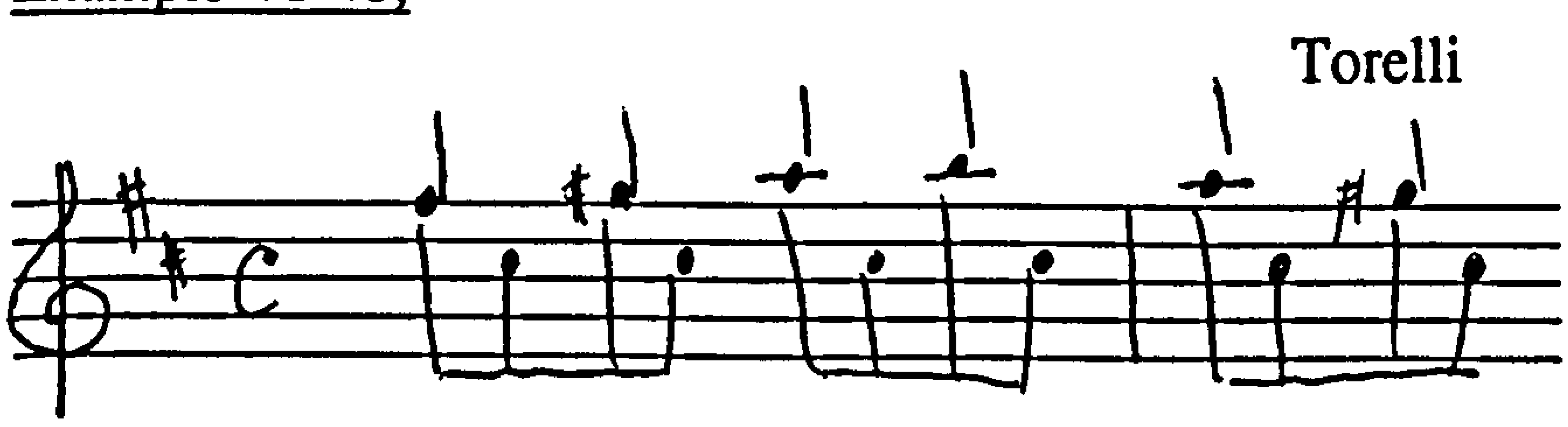


A similar technique can be employed in orchestral playing when a single melodic line is divided into two (or sometimes more parts), by having certain instruments or sections of the orchestra play only the *apparent* voice whilst others play the *actual*:

Example VI-4a;

The above is played in unison by the first and second violins of the orchestra:

Example VI-4b;



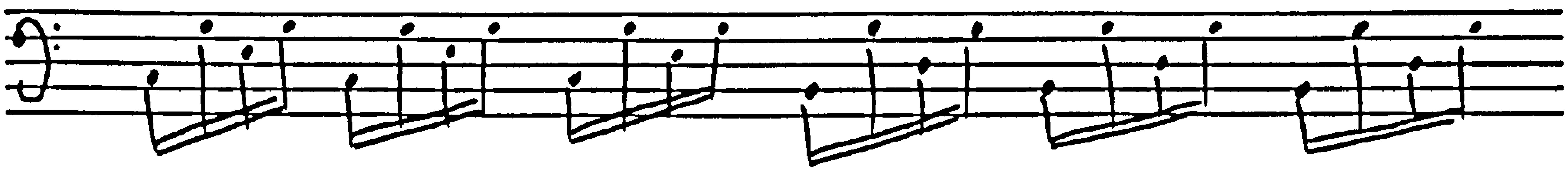
An orchestral technique is here employed whereby the second violins play the top line and the first violins play the bottom line.

Such a division of the violin section is hardly discernible to the ear, whereas the musical result is most satisfactory as it focuses the sound on the main body of the melodic line [1].

1. This effect can be heard on a recording of this work, Torelli's concerto for two trumpets and strings in D major, catalogue no PCD 1004, by the City of Oxford Orchestra, conducted by the author.

As the notes which constitute a musical pattern become more triadically gapped and mechanically repetitive they lose their "melodic" character. An Alberti bass, for instance, comprises a series of notes which have the sole merit of turning the vertical (harmony) into the horizontal (pseudo-melodic line) - representing what Kurth calls "rhythmically enlivened arpeggiations of chord progressions" - nevertheless a substantial merit in non-sustaining instruments such as the harpsichord:

Example VI-5;



The melodic character of this device must still be addressed, but the main body of the melodic line is situated in the pedal notes C and B. These notes can be held for longer than their given value, particularly the C in the third group of four semiquavers moving to the B, as well as the E in the same place moving to the D.

A distinction must however be made between such harmonic patterns where the pedal may be applied and melodic patterns which, however arpeggiated they may appear, are deemed to be melodic and not harmonic in character and consequently should be approached cautiously with regard to pedalling.

Indeed, the use of the pedal, based on the idea that notes which belong to the same harmony readily accept it, has the effect of reducing the melodic character of a musical theme. In Beethoven, where many of the main themes are based on the arpeggio, the linear character of the melodic flow is often abated by excessive use of the pedal.

A harmonic texture like the one indicated in example VI-5 simply strums the ubiquitous triadic chords in an *ostinato* movement of semiquavers. On the other hand, a genuinely arpeggiated melodic texture focuses the attention on each individual note of a developing line.

Heinrich Neuhaus makes this point unequivocally clear:

"In Beethoven the subject is frequently constructed on the notes of a triad which sometimes gives learners the wrong idea that since 'there are no wrong notes' the subject can be played on one pedal because 'it sounds good'. One cannot imagine anything more mistaken. Melody (which is individual) is turned into harmony (which is general). Instead of a subject you get a sort of background on which a theme no longer appears. The theme has been swallowed up. It was drowned in the harmony. Strange as it may see,. I still have to make remarks of this nature in class. Frequently, also, I have to indicate that passages made up of arpeggios which abound in Beethoven lose their energy if they are played on full, too thick pedal, their shape is blurred, the 'meander' is effaced" [1].

This chapter completes our examination of the process by which any worthwhile performance is realized through a series of actions whose motions emulate the motions to be found in the music itself. These motions which take place both physically, psychically and aesthetically need to be considered in relation to each other if the interpretation of music is to attain its full cohesive stature.

1. Heinrich Neuhaus - *The Art of Piano Playing* (1973: pg. 163)

CHAPTER VII

CHAPTER VII

CONCLUSION

By way of conclusion, we may spare a moment to contemplate the far-reaching implications which arise from applying 'motion' as a key to musical interpretation. By seeking to locate motion in the experience of the performing musician, we have increasingly been able to equate it with what Ernst Toch has called "the shaping forces in music":

"Stagnation is the worst enemy of form; and since form and inspiration are so intimately interrelated, we may well say that stagnation is the worst enemy of inspiration. If inspiration dies, form is doomed to die with it. What keeps them alive, is essentially *movement.* Movement is far more than just a sign of life; indeed, it is, *'the very essence of life'*[1].

The fundamental forces, which generate this movement which music celebrates, derive their energy from the primordial properties of opposing elements. Ernst Kurth defines these as follows:

"Harmonic dissonance consists in the continued influence of unabsorbed forces that stimulate further activity, particularly as a vertical equilibrium. What is characterized as resolution in the chordal sense is the *release* of forces directed at the specific basic forms (the consonant triads). Further, harmonic consonance, the permeation of the harmony with unreleased tensions arising from melodic-kinetic energies, comes into consideration" (ibid.).

The performing musician must identify the kinetic properties inherent in the music and seek out physical modes of contact, as defined in this study, which embody and complement them. It would be incongruous, for instance, to render an increase in s/m/ or m/m when the music clearly opposes it.

1. Ernst Toch - *The Shaping Forces in Music* (1948 : pg. 194)

One may liken this to the experience of riding a horse: the rider, whilst guiding the horse, will follow its course otherwise he is likely to lose balance and fall. Analogously, the musician, while guiding the performance, must follow the course it takes so that he may be at one with it. To alter the course of the music by imposing a line contradictory to its natural flow would be highly prejudicial.

As Zuckerkandl says: "I experience [the tone's] motion as my own motion. To hear tones in motion is to move together with them" (ibid.). To realize motions in performance in conformity with motions in the music then, would be to render performances of artistic value. This, ultimately, must be the artist's task.

This is echoed by Suzanne Langer when she considers that motion in all art is an illusion, a semblance, the most primitive fulfilment of which is the sense of life symbolized by growth and manifested by motion. She adds: "To produce and sustain the essential illusion, set it off clearly from the surrounding world of actuality, and articulate its form to the point where it coincides unmistakingly with forms of feeling and living, is the artist's task" (ibid.).

Whilst our own investigations have been confined mostly to defining the existence and operative mode of motion in musical performance, structural analysis of a work of music, as apart from intuition, must take precedence in order to ensure that motions applied by the performer align themselves to movements in the music.

In seeking musical performances of artistic merit, in which all contributory elements move in harmony, one must determine, in relative terms, the degree of motion to be applied. Whilst this must form the basis for a separate and in-depth investigation, the following may be interesting to consider:

7.1 RELATIONSHIPS:

A performing musician is required to establish a tempo at which the performance of a work takes place. This is an arbitrary decision in which the tempo chosen by the interpreter accounts for the 'time' or the speed of the performance. But the very essence of 'Motion in Music', as documented in this study, implies a constant variation to the elements that constitute a work of music. Movement, progression and growth, the essential ingredients in the formation of a musical line, appear when the three variables (pitch, dynamics and time) are constantly changing, or 'on the move'. In this respect, the tempo chosen by the performer or the tempo as indicated by the composer signifies the *mean* speed at which the music proceeds.

Establishing such a tempo means, in musical terms, establishing an equilibrium through which any variation to the basic pulse can be, theoretically, calculated. In this sense, *tempo rubato*, what Seeger calls the "salient deviation from the mean of variance" (ibid.), indicates a return to stable rhythmic conditions after slight metronomic deviations [1]. Similarly, an increase to the dynamic levels is balanced by a decrease just as a rise to the pitch level of a melodic line is balanced by a fall [2].

In terms of its relationship to a state of equilibrium, a deviation away from it can be quantified. The question is: by how much? For example, when a *crescendo* occurs, by how much should the dynamic level increase? When the weight of a note is increased through an increase to the mass of music, the question that has to be asked is: how heavy should the note become? By how much should, for instance, the speed of music decrease at a particular moment? All these questions dealing with quantities need to be addressed.

1. In this respect, symmetry and balance are achieved through a process of assymetry and imbalance.

2. In a work of music the tonic key functions as just such an equilibrium. Any movement away from this equilibrium would be related to the tonic key.

To this effect, representations of changes to the equilibrium on a visible scale, as indicated by the various graphic illustrations in the preceding pages, can serve as areas of reference by means of which relationships can be formulated.

It is clear that a departure away from a state of equilibrium has to be related to the state itself. It is not desirable to increase the intensity or the dynamic quality of a note further than this relationship would allow. For a player to introduce suddenly a chord *fff* when he has been confined to playing *pp, p, mp, mf,* and *f* throughout most of a work would be nonsensical unless of course he has a mischievous motive like Haydn in his 'Surprise' Symphony [1].

The air-flow which is disturbed by the wing of an airplane provides a good analogy. The curved shape of the wing is such that it allows the air to flow smoothly over it, but without breaking the continuous flow of air. As the mass of air is disturbed around the wing when it flows over it, it creates an area of increased intensity, or an area of *low pressure* in technical terms, that causes the wing to rise. As the angle at which the wing meets the air-flow is increased the pressure is increased. If the angle is increased beyond a certain point the air-flow would no longer flow smoothly over the wing, causing the airplane to stall.

The same could apply to a note of music: it can be intensified to the degree that its relationship to the notes surrounding it would allow. Any increase over and above its maximum resilience in relationship to those would cause a break in that relationship. This would cause the musical line to sound fragmented and disorderly [2].

1. In this sense, dynamic markings are relative. A *ff* cannot be quantified as a precise measure in terms of dynamic levels. It can only be quantified in relative terms.

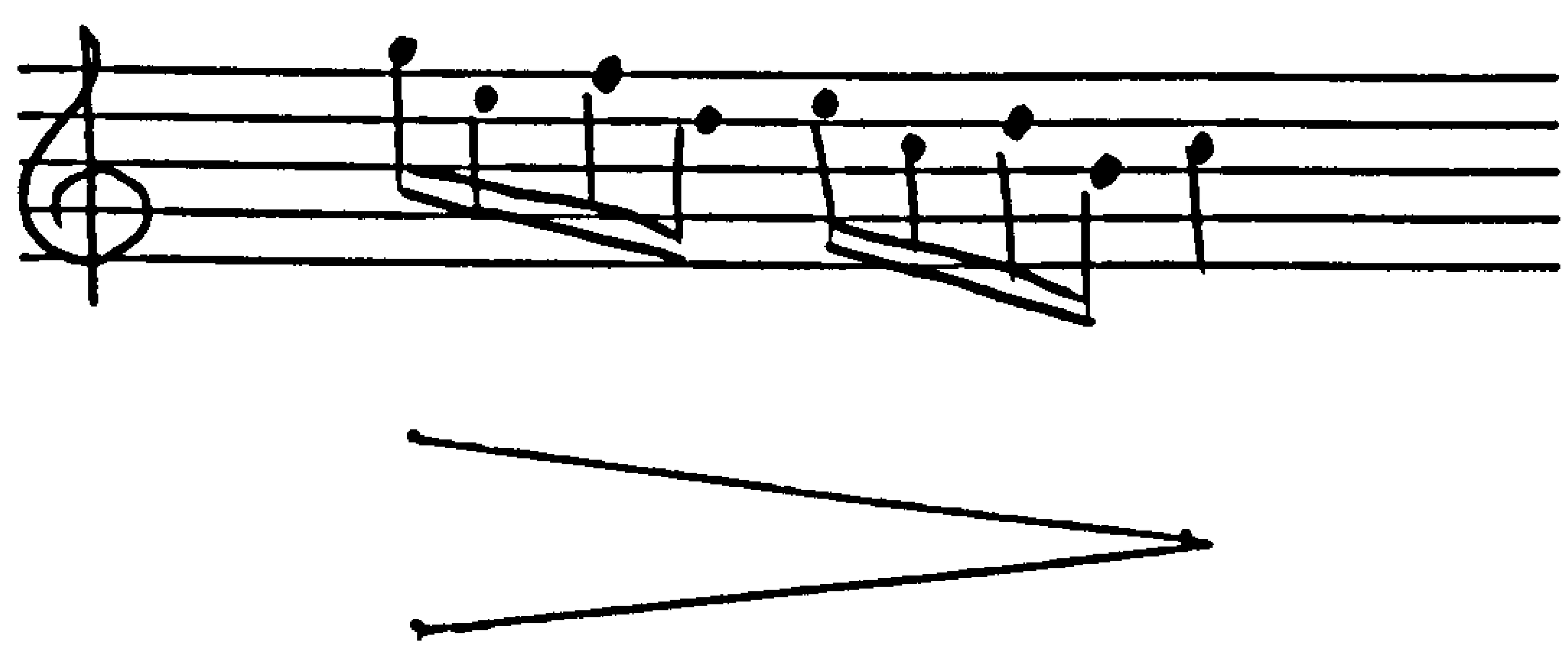
2. An object which possesses elasticity will stretch only to the degree that its elasticity allows for a return to its original form. Any stretching beyond a certain point would distort the original shape and size of the object. In this respect, a musical line could be likened to a string that possesses elastic properties.

7.2 PROGRESSIVE QUANTITATIVE TRANSITIONS:

a) ***dynamics:***

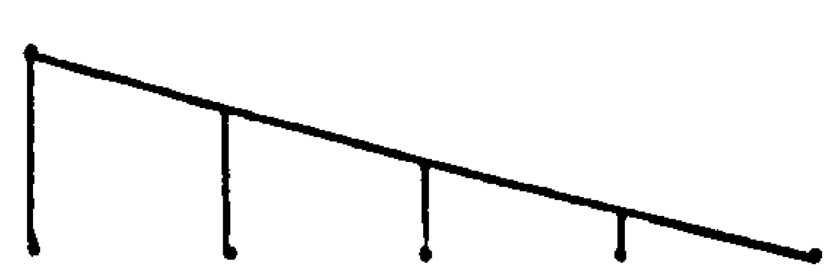
It is a common performance practice for changes in a work's dynamics to be implemented gradually: by grading one point of reference to another in consecutive rising or falling degrees of increased or decreased dynamic levels [1]. The following example of a *diminuendo* can best be achieved if the top line of notes decreases in volume as it descends in a stepwise manner:

Example VII-1:



1 2 3 4 5

By this means, the line achieves a gradual *diminuendo* in which the top notes become progressively softer, step by step:



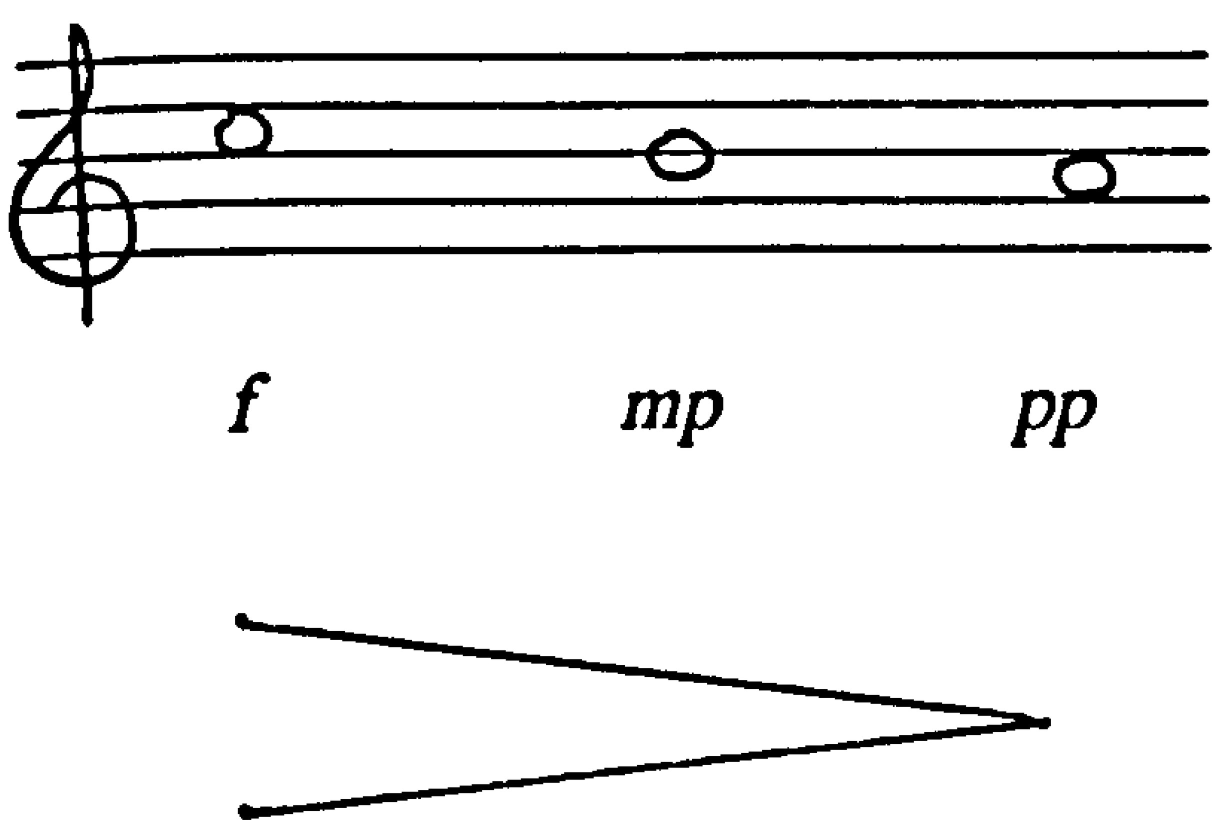
Here an important gradient is formed in which the rate of decline is proportionate to the time it takes for the process to be completed.

The line denoting the pattern of dynamic decline is here quantified in relation to other moving elements, thus giving rise to a uniformity in the rate of decline.

1. In any case, the form of the hair-pin traditionally indicating a *crescendo* or *decrescendo* would suggest likewise.

Heinrich Neuhaus used an exercise for developing keyboard control over a gradual diminuendo:

Example VII-2;



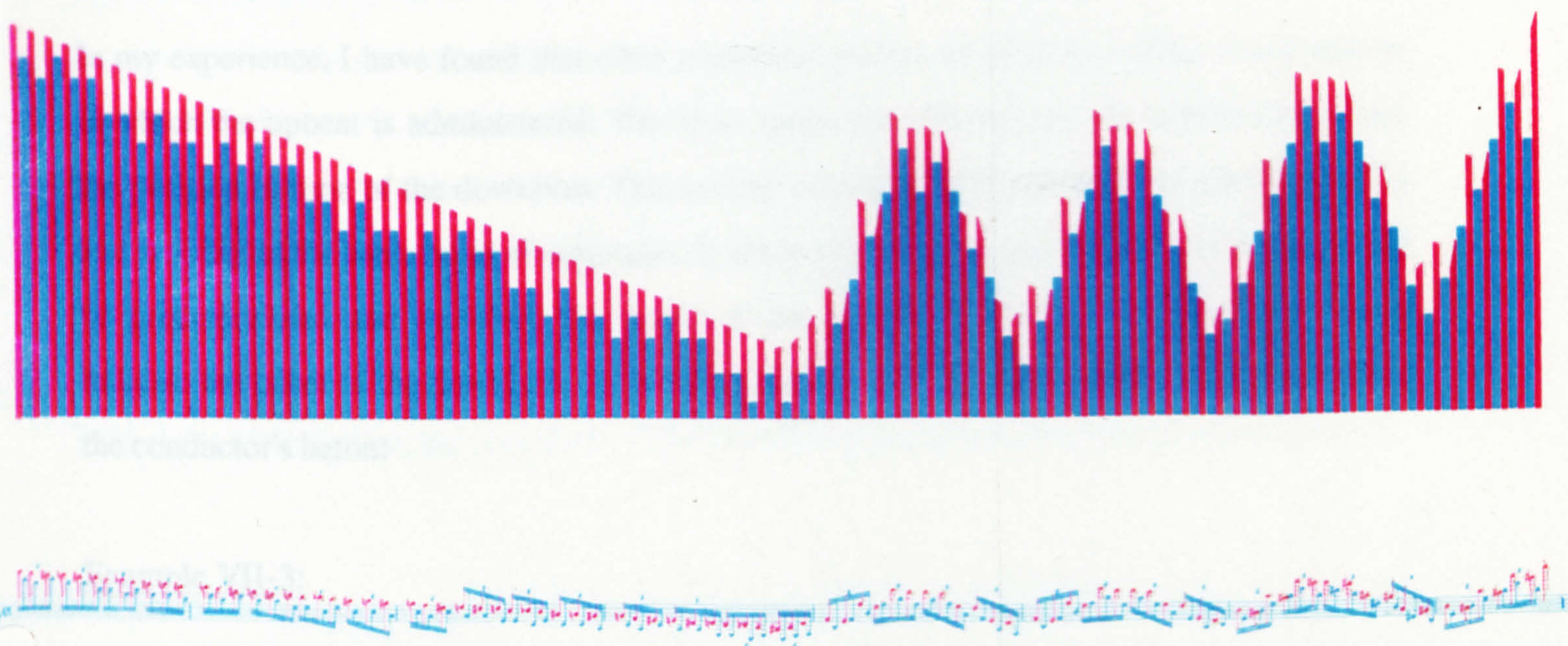
According to him, "the significance of this exercise lies in the fact that each consecutive note is played at the same level of volume as that to which the previous note has dwindled at the time and not at the level at which it was originally struck" (ibid.).

b) ***pitch:***

Applying similar logistics, one could propose a comparable decrease in pitch level. Thus, to create a gradually descending or ascending line which illustrates a variation in pitch, similar to that which pertains to a gradual variation in dynamic terms, a semitonal progression is required.

The following illustration, represented here from Douglas R. Hofstadter's book *Metamagical Themas*, illustrates graphically such a descending semitonal progression:

Figure VII-1:



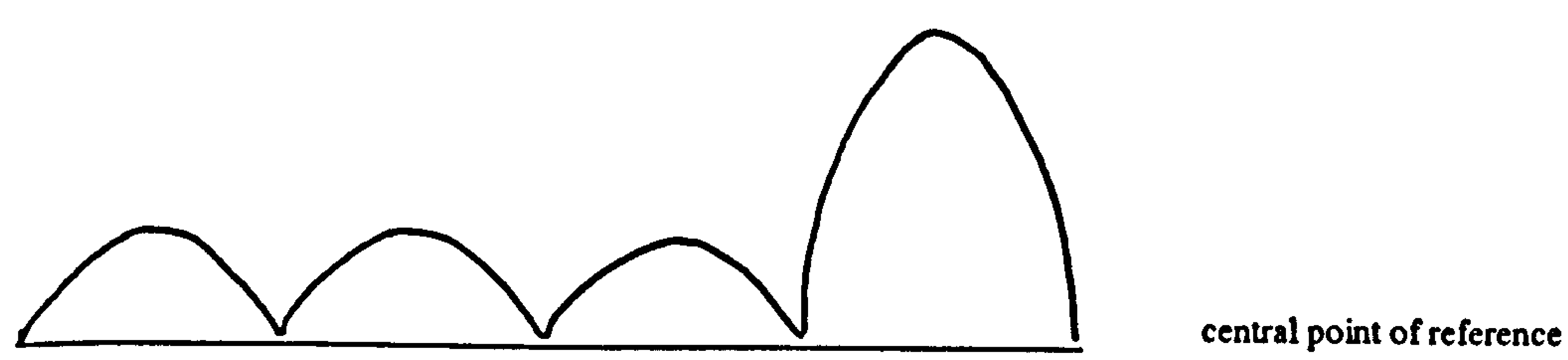
A graphic representation of the opening bars of the right hand of Etude Op 25, No 11 by Frédéric Chopin. Underneath it and aligned with it is the conventional notation. [Computer graphics by Donald Byrd and Douglas R. Hofstadter. Music notation printed by the SMUT music-printing system, developed by Donald Byrd at Indiana University.]

c) *temporal:*

I have for years been fascinated to know what it is that makes orchestral players respond to the beat of a conductor and play together, even when there is no evidence of a central point of arrival or departure to which the beat relates. This phenomenon poses some interesting questions: a definite beat once having been established by the conductor, the musicians play consecutive impulses which relate directly to it. They can continue doing so for as long as the pulse remains constantly the same. When a metronomic deviation is required, the conductor will have to direct the players towards a slowing down or a speeding up.

In my experience, I have found that often orchestral players respond according to the manner in which the upbeat is administered. The flow, speed and direction of the upbeat determines the position in time of the downbeat. This is clear enough if all the beats were departing from and arriving to the same point of reference. In other words, the position of the downbeat would be predetermined and therefore the return of the conductor's gesture to this point would indicate the onset of the downbeat. In this way, the players respond visually to the position of the conductor's baton:

Example VII-3:



There are times though, when the downbeat might be placed at a different location than the hitherto central point of reference. The response of the orchestral player to the exact positioning of the downbeat is in this case just as precise. The question which arises from such an observation led me to what I suspect to be the reason for the co-ordinated accuracy in delivering the downbeat in time: the speed at which the upbeat is moving determines the time at which the downbeat has to be positioned.

As the speed of the conductor's hand slows down in order to indicate a *ritenuto*, there has to be a reason for predetermining its course other than a return to a centrally targeted point of reference. The pace at which the speed is slowing down is evidently the cause for determining the ultimate course and destination of the downbeat. The rate of deceleration is such that it slows down the course of the upbeat progressively so that each subsequent impulse becomes gradually and progressively slower. Thus, a gradient is formed in which the rate of decrease in time is established, as opposed to the gradient for examples VII-1 and VII-2, in which the rate of decline in dynamics is established.

In its most basic format, the progressive rate of decrease in time can be represented as follows:

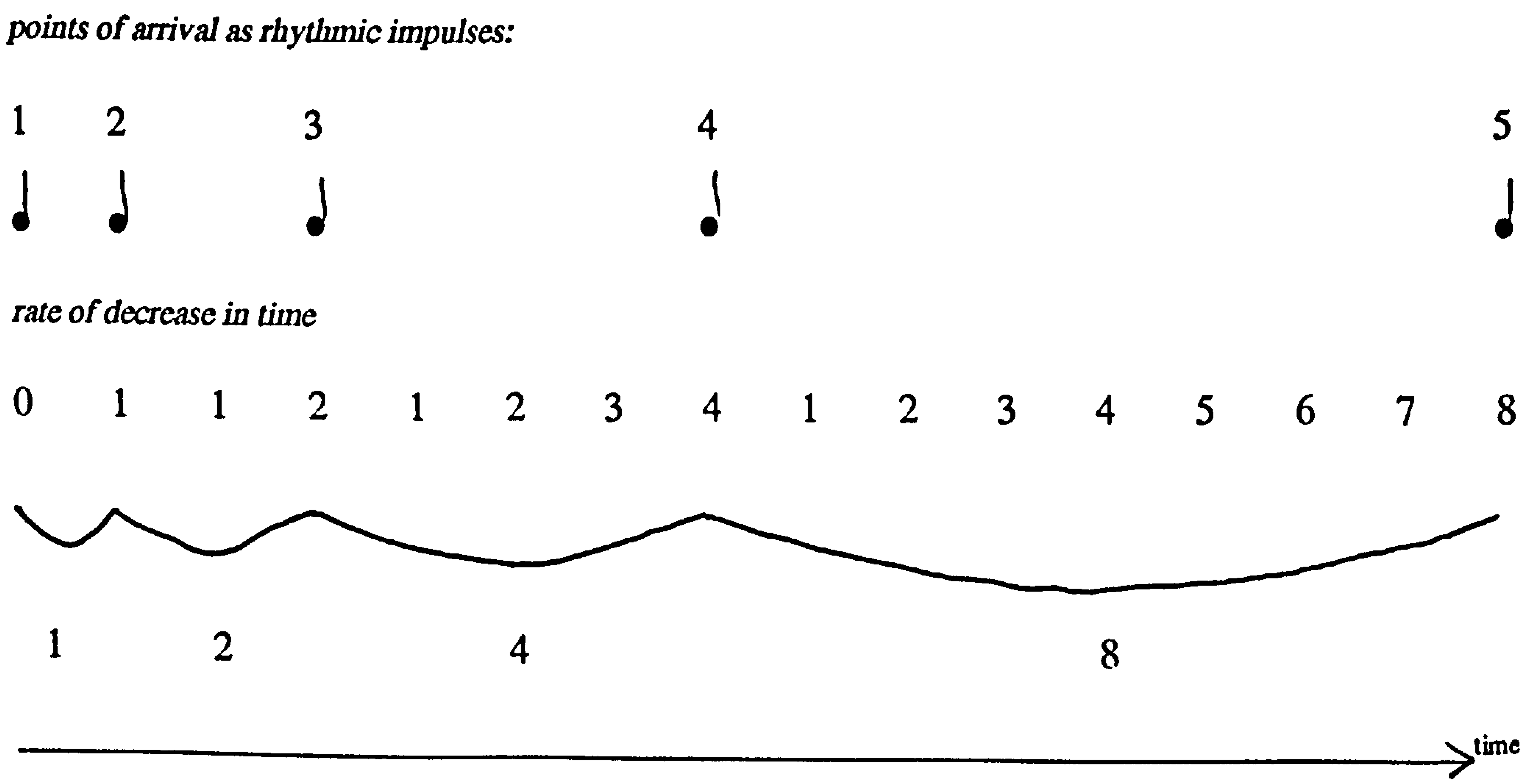
This indicates a slowing-down at a rate which multiplies the time taken from one point to another by two: 1, 2, 4, 8. The flow of the upbeat slows down at a progressive rate which predetermines the downbeat. The orchestral player would expect to place the note at point number 5 without the conductor having to indicate its precise position in time.

This establishes unequivocally another relationship, in which a series of rhythmic impulses which constitute the slowing-down process in music-making, are proportionately interrelated.

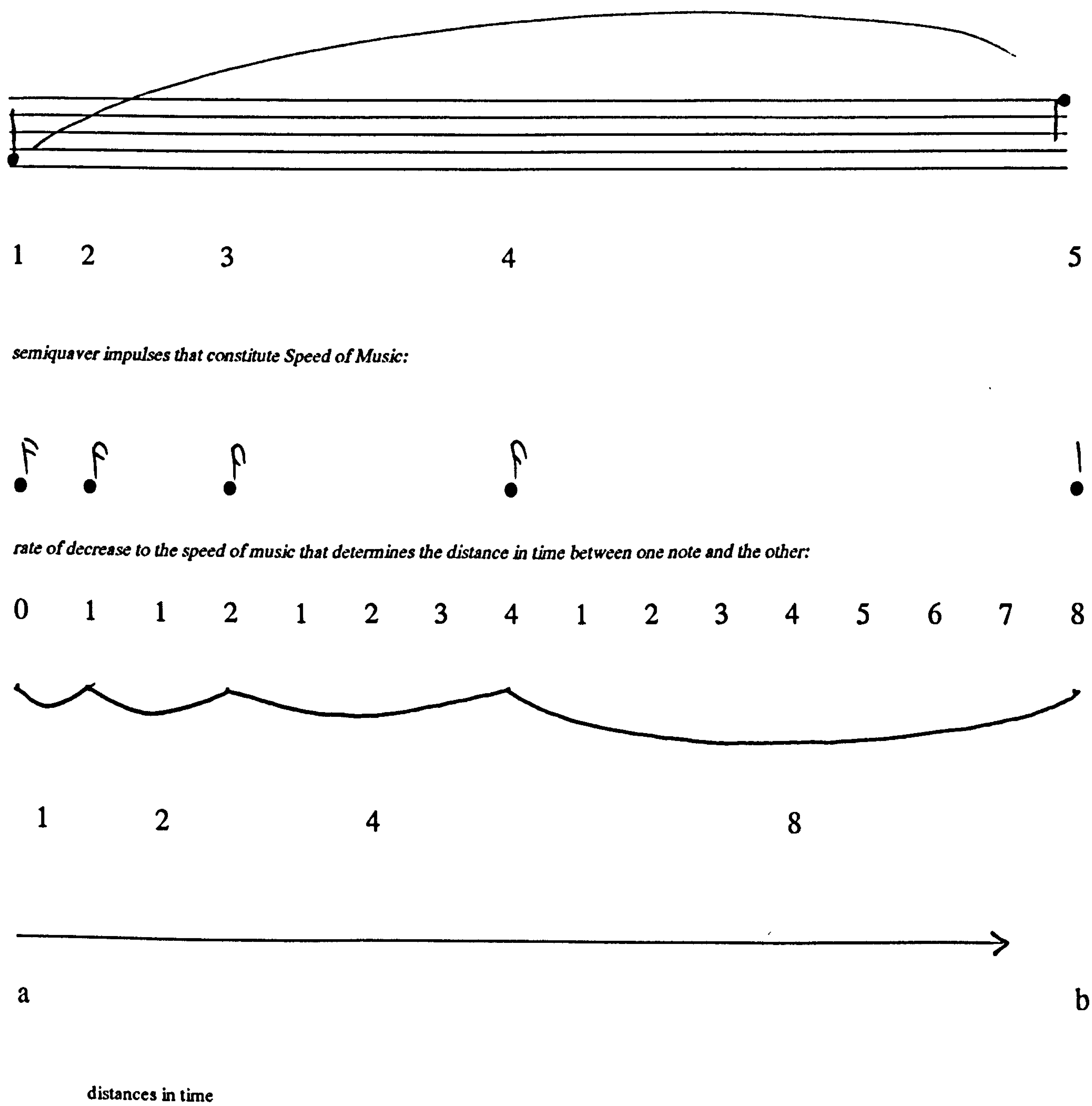
Points 1, 2, 3, 4, and 5 in example VII-4, could indicate a series of crochet impulses or equally, represent the speed of music (s/m) between two crochets at points 1 and 5. In this case, points 2, 3, and 4 would be perceived as semiquaver impulses spaced out proportionately in order to deliver an orderly slowing-down between points 1 and 5.

In example VII-5, this process is illustrated. What is heard is an octave leap from a bottom F to a top F. The timing between the two notes is determined by the s/m which, on a different level, processes the connecting impulses and governs the precise timing between the onset of one note and the onset of the other:

Example VII-4:



Example VII-5:



At this stage, I would refer the reader to a statement made in a preceding chapter (page 125) to the effect that: I must be aware of what I want to achieve at B, so that I can condition A. I must condition A so that I can achieve what I want at B. This statement holds true and is substantiated further by the example just given.

7.3 THE CONNECTING BOND:

The potency of the connecting line between two consecutive notes is becoming increasingly clear: if this bond is broken, the relationship between the two notes is broken. It is this connecting line through which changes take place which condition the qualitative properties of the ensuing sound. If this area of musical activity is orderly, the line will remain intact. If not, the 'motion' of the line loses direction.

It is the cord in which the speed of music (s/m), mass of music (m/m) and direction of music (d/m) are braided together. The visual representation of this line through various schemata enable the performer to trace the qualitative and quantitative changes which occur over time.

In conducting terms, the preparatory beat is synecdochic of the connecting line. Wilhelm Furtwängler paid particular attention to the preparation of a downbeat. He regarded the conductor's preparatory beat as the determinant of the quality and quantity of the downbeat. In an excerpt from one of his essays, he points out the following: [1]

"It is not the instant of the downbeat itself that produces the precision with which the orchestra enters, nor is it the precision of the conductor's gesture but the way he prepares for it. Its clarity may affect the subsequent downbeats through its characterization of the pulse as a whole but as far as the opening note of the piece is concerned - the note at which the beat is aimed - this is irrelevant. All those who conduct solely in terms of fixed points, i.e. with a strong downbeat - and ninety per cent of conductors do - are completely unaware of this.

1. Furtwängler on Music - *Essays and Addresses*, edited and translated by Ronald Taylor (1990: pp. 19-20)

"A strong downbeat has considerable disadvantages. It binds the movement of the piece to specific points, thereby restricting the natural flow of the music and reducing its expressiveness. A point remains a point, and an orchestra that is conducted in a series of points will obviously play accordingly. That is to say, the purely rhythmic substance will be conveyed with the requisite precision, while melodic substance, everything that lies between the individual beats - which can amount to a very great deal, witness the numerous crescendos, diminuendos and other dynamics central to the music of many composers - is left totally untouched. It is characteristic of such an interpretation - and a commonplace these days - that while the rhythm and the tempo receive due attention, the music itself does not.

"The power to affect a note - and this cannot be emphasized too often - lies in the preparation of the beat, not in the beat itself...According to the nature of the beat and its preparation, so will be the sound that is created - precisely and absolutely so".

Indeed, Furtwängler's ability to produce compelling readings of great masterpieces relied on his inimitable skill at cultivating the horizontal line which binds two notes together. Furtwängler, above all, aimed through his interpretations at achieving an organic unity from an awareness of the connecting bond between the various elements apparent throughout the whole course of a work.

Indeed, it is clear throughout this study that all elements apparent when music is in motion are interrelated and form an integral part of a whole. That organic unity which dispels any notions of fragmentation is evident in the patterning which emerges from close scrutiny of the relative properties of the various moving elements. Ultimately, the oneness of the conception depends entirely on these relationships.

But what exactly is the relationship? In all the above examples, considered individually, the relationship between one state of being and another is a step-by-step progressive transformation of one unit into another. Some of these relationships, formed by progressive series, can be aligned to a graphically depicted sloping line of gradual descent (examples VII-1,2, and figure VII-1). This line would indicate a constant change represented as a ratio between the rate of decline and the time taken.

The musical results emanating from gradations of this sort are pleasing to the ear. The question is, are there other, more complex, 'mathematical' relationships which condition what is termed 'aesthetically beautiful' in musical performance? In other art forms, such numerical relationships dominate structure: [1]

The ancients gave considerable attention to the study of musical proportions in relation to the study of mathematics and geometry. The origin of this tradition is generally associated with Pythagoras (560-490 BC) and his school. The sounding of the octave represented the beginning and goal of creation. Without any intervention of thought or concept or image, the recurrence of the initial tone is immediately recognizable. This timeless, instantaneous recognition is universal among humans.

On a scientific level, the frequency of vibrations produced when the tone is raised by an octave, is double that given by the whole string. The string length has been divided by two, and the number of vibrations per second has been multiplied by two: 1/2 has created its mirror opposite, 2/1. Thus in this moment an abstract, mathematical event is precisely linked with a physical, sensory perception; our direct, intuitional response to this phenomenon of sound coincides with its concrete, measured definition.

1. The following is an excerpt from an extensive article on 'Geometry in Art', found in Appendix 5.

It was by means of geometry that the Pythagoreans poised themselves at this unique crossroads where heard vibration becomes seen form; and their geometry explores the relationships of musical proportions.

It was the goal of many traditional esoteric teachings to lead the mind back toward the sense of Oneness through a succession of proportional relationships. A proportion, known in Greek thought as *analogy* (αναλογία), is formed from ratios, and a ratio is a comparison of two different sizes, quantities, qualities or ideas.

In proportional thought there are no fixed quantities, only fixed relationships. The most fundamental proportional relationship is based on a unique geometric proportion of two terms and has been given the name 'Golden Proportion' or 'Divine proportion'. It is designated by the 21st letter of the Greek alphabet, phi (Φ), although it was known by cultures much older than the Greek. It is the first issue of Oneness, the only possible creative duality within Unity.

The harmony of the Golden Section is evident in much Greek architecture. Artists of all ages have instinctively used its pleasing proportions and it appears in the human body and in many living things. Leonardo da Vinci made use of the Golden Section in *St Jerome*, an unfinished canvas, taking special delight in what he called 'geometrical creations'[1].

1. The figures of both Leonardo da Vinci and Albrecht Dürer conform to the ancient biometric symbol of the body divided in half by the sex organ and by Φ at the navel. Similarly, the relationships between the bone-lengths of the human finger, hand and arm is another instance of the numerous Φ relationships which occur in the human body.

A rectangular frame with sides in the ratio of the golden section or a vertical division in this ratio are said to have a particular beauty. The Parthenon represents the proportions of the Golden Section as calculated by a mathematician who lived in the Middle Ages - Leonardo of Pisa, known as 'Fibonacci' (the 'Fibonacci' series are applied to illustrate the example in this study found on page 105). He established a remarkable connection between a mathematical series and a pleasing rectangular shape whose length is in the same proportion to its breadth as half its perimeter is to its longer length: 1.618, i.e. Φ.

In musical terms, Erno Lendvai's pioneering analytical work on the structure of Bela Bartók's compositions, is most revealing. Lendvai analysed the proportions of Bartók's musical structures as being based on the golden section. His view was that Bartók's 'chromaticism' is distinguished by intervals based on the golden section or, in numerical terms, on the 'Fibonacci' series. This kind of numerological analysis has been carried out by other scholars too, notably by Van Krevel on the masses of Obrecht and by Marianne Henze on the music of Ockeghem [1].

Proportions and 'harmonic' relationships then, predominate in the world of art as much as in nature itself. It is quite conceivable, even probable, that they condition much of what can be termed as aesthetically beautiful in musical performance. The idea of 'Motion in Music' sets out to explore movement in which such relationships can have perceptual meaning. For it is in these relationships that beauty ultimately lies.

The discerning performer measures and weighs his touch constantly in order to produce crystalline textures and expressive singing lines. He does this by carefully listening to and relating the various sounds so as to produce balanced and proportionately related textures. In producing such gradual and progressive gradations of sound the relationships and the resulting quality in the relationships is clear to determine.

1. Source: *New Grove Dictionary for Music and Musicians (1980)* Vol 1 - pg. 369

The overall effect other more esoteric relationships may have in producing aesthetically pleasing musical results must remain, at least for the moment, in the domain of the mysterious or in the hands of the musically gifted. It is, perhaps, possible to suggest that the various relationships which the performer intuitively assesses have dimensions based on geometrical proportions. Whether this holds true or not might form the subject of further investigations.

In the course of this dissertation we have more than once cited the names of Eric Clarke and Jane Davidson, both previously of City University. The main thrust of their researches into the psychology of performance had to do with the study of expressivity in performance, whether in regard to what we normally understand as 'expression' (Clarke) or, in Davidson's case, the physical movements associated with such heightened moments. Both have identified such 'departures from the norm', if I may so call them, with important structural points in the musical argument. Now if we are to believe Lendvai, Ghyka and a host of others that the Golden Section can be shown to play a determining role in the structural landmarks of a work, and that these are immediately conveyed in the interpretative 'expression' (= dynamic, phrasing, rubato, etc), can there be any doubt that the 'motion in music' through which such expression comes into being, is directly affected by the same considerations.

At the conclusion of this study, we find ourselves at a new beginning. An investigation as to the precise nature of these relationships should be undertaken, irrespective of how such a process of enquiry might be initiated, and whether or not science has the means to enter the realm of the audible enough to uncover conclusive evidence as to the numerical relationships involved.

Music-making, as a product of material and immaterial forces, of physical phenomena as well as poetic imagination, remains the proper prerogative of the performing artist who initiates it. The patterns which the artist discerns are largely intuitive ones and cannot therefore be reproduced. For this reason, musical performance is often dismissed as an ephemeral experience. Contrary to this, 'Motion in Music' is founded upon the premise that musical performance is as much an intellectual process capable of being grasped in images or forms, as it is a dynamic nonphysical musical experience which ultimately lies in the realms of the sacred, spiritual and mysterious.

It is my abiding conviction that to deliver an interpretation of artistic worth is by the same token to comprehend, implement and realize 'Motion in Music'. In conclusion, I can do no more than echo Ernst Toch's words:

"Give up the stubborn, unfruitful view of the static and adopt the more productive view of the instantaneous image of an ever-fluid, ever-changing relation of a stellar body to the rest of the universe, the view of the Heraclitean axiom, 'Πάντα ρεί': 'Everything is in flux'".

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APPENDICES

Excerpt from Tobias Matthay's book *the Act of TOUCH in all its diversity*

The pianoforte key is a machine to facilitate the production of speed in the string. It is a compound lever, akin in principle to the see-saw. It follows that tone production can only be effected by giving motion to the string. Energy brought to bear upon the key *ceases* to create tone the moment that the place in key-descent is reached where the hammer's motion culminates and causes sound to begin. The act itself of tone production can hence never take longer than it does in the most extreme staccatissimo. The ear appraises us of this moment more quickly than any other of our senses: hence, we must *listen* for the beginning of sound if we would have accuracy in tone production. The more *gradually* this key-speed is attained the more beautiful is the tone *character* -the fuller, more 'sympathetic' singing and carrying in its *quality*. The more *sudden* the key depression the harsher is the resulting tone quality; it may be more 'brilliant' but it will be less effective in carrying power...It is futile to squeeze the key upon its bed with the object of inducing tone, since sound, if produced at all, is given off *before* the key reaches its full depression. It is almost as futile to attempt to obtain good tone by *knocking* the key, since the concussion here caused at the key surface forms *waste* of energy intended to create tone, and thus engenders *inaccuracy* in the tonal result - the actual tone obtained not corresponding to the tone intended.

Beginning in 1960, Dr. Zuckerkandl was an annual lecturer at the Eranos Conference held each August in Ascona, Switzerland, and his papers appeared in the *Eranos Jahrbücher* (Zurich). From 1964, when he retired from St John's College, until his death on April 24, 1965, he resided in Ascona and lectured at C.G.Jung Institute in Zurich.

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A SUMMARY OF THE MAIN POINTS IN Dr. VICTOR ZUCKERKANDL'S TREATISE ON 'SOUND and SYMBOL' RELEVANT TO THIS STUDY

The philosophical issue which Dr Victor Zuckerkandl addresses in his book *Sound and Symbol: Music and External World* is based on his concept of reality: a concept that draws a parallel between what he calls the "inner world" and the "external world" - what our senses perceive in physical, tangible and measurable quantities on one hand with what seems immaterial, nonphysical and nonmeasurable, on the other.

He defines the outer world as a visible-tangible world, a corporeal world. The inner world as nonphysical, nonbodily, in which thoughts and feelings pertain. But nature includes the purely dynamic, the nonphysical and the nonmeasurable.

In Zuckerkandl's assessment, the inner and outer worlds meet or rather "penetrate each other". The mode of such an encounter is different: in the physical world, or outer world, objects are from without, at a distance, reinforcing the separating barrier; in the inner world, tones penetrate and communicate in a way that makes the listener participate in their actions. Colour, for instance, is something that *is without;* tone as something that *comes from without.*

Zuckerkandl investigates the very essence of music. He defines the various qualities apparent in musical sound and distinguishes between what he calls "musical tone" and "acoustical tone". Acoustical tone is a phenomenon of the external world. It can be described in terms of frequency, intensity, envelope and amplitude which go to make up the physical process: a change in the physical process means a change in the tone heard.

He defines musical tone as belonging to an inner world. It possesses dynamic quality that permits tones to become the conveyors of meaning. It is the dynamic quality of the tone that makes music out of acoustical phenomena. Dynamic quality is the properly musical quality of tones.

The encounter with the tonal world includes the three fundamental experiences of motion, time and space:

MOTION:

The dynamic quality within a musical tone is the very essence of musical motion. It reflects the state of an object, not the object itself: the relations between tensions, not between positions; the tendencies, not the magnitudes.

Musical contexts are kinetic contexts. The melody we sing or hear is not simply tone, or tones of a predetermined pitch; it is motions represented in tones.

He dismisses theories which refer equivocally to the motion of music as ideal or abstract. He cites Wertheimer's experimental investigations and concludes that music and motion are synonymous; that every experience of motion is, finally, a musical experience.

Zuckerkandl dismisses the theory that change of pitch constitutes the basis for musical motion. In his assertion, pitch is an acoustical phenomenon and possesses none of the acoustical characteristics that makes tones elements of musical contexts. The association of the rise and fall of tones with differences of pitch does not in itself grant tones spatiality. To talk about the rise and fall of tones in terms of spatial motion is merely a verbal and emotional subterfuge; a characteristic of aural perception which can only be described metaphorically by parameters from the realms of the other senses. The experience of tonal motion has its origin not in differences of pitch but in differences of dynamic quality.

The dynamic quality of a tone is a statement of its incompleteness, its will to completion. It is inherent in any musical context, in an interval, in a step from one note to another, in the basic properties of one tone in its ensuing path toward the next. To hear a tone as dynamic quality, as a direction, means hearing at the same time beyond it, and going toward the expected next tone. Listening to music, we are not first *in* one tone, then in the next, and so forth. We are always *between* the notes, *on the way* from tone to tone.

In Zuckerkandl's assessment, the usual concept of melodic motion as motion from tone to tone and of the individual step from tone to tone as the bridging of the distance in pitch between two tones, does not prevail. Dynamic qualities are not stationary, they are completely of the nature of a step, of a transition: they are dynamic not static. As such, the process of motion can be represented on two levels: on a "lower", where there is nothing but the pillars, tones of definite pitch; on a "higher" level, where there is nothing but the transition:

b e t w e e n

tone | tone

The motion we hear is not the "tone - tone" of the lower level; it is the "between". Stasis of the tones and motion of the melody, gaps here and uninterruptedness there, discontinuity and continuity do not enter into opposition because they concern phenomena on different levels.

TIME:

Zuckerkandl continues: one factor without which motion cannot be, is time; motion in a realm from which time is absent is self-contradictory. The principal manifestation of time in music is rhythm. The temporal succession of tones exhibits a definite organization, a definite order that establishes a pattern that we call meter. The process from one point of reference to another is to and fro. In this sense, we do not experience equal fractions of time, but differently directed and mutually complementary cyclical phases. The entire process of "away from-back to" is a constantly repeated cycle, for the "one" that closes one cycle simultaneously begins another. But since in time there can be no going back, this process is visualized as a wave.

The dynamic quality of the meter is not evident in the dividing points but in what goes on between them. The rhythmic quality of a tone does not rest upon its comparative duration but upon the fact that in it the wave attains its goal and beyond, to a new cycle. It is not the length which makes the beat, but the kinetic impulse.

Strict time banishes rhythm. Mechanical accuracy does not imply musical meter. If the meter of an automaton is substituted for the meter of music: music ceases to exist. At the same time, unequal lengths of beats can equally be disturbing if they do not give rise to the metric wave. The commandment that is broken in a performance in poor time does not refer to equality in length between intervals of time but to symmetry of mutually complementary wave phases: equality of time proves to be a rhythmic quality, rhythmic balance.

Visible and tangible things are not time objects; they are in time but time is not directly perceived through them. What comes to direct perception in them, just as temporal extension does in tone, is spatial extension: they are space objects. Tones are time become audible matter, as corporeal things are space become visible and tangible matter.

Visual art is something else besides the image of an object: it is always also a space image, space become image. Artists shape materials while at the same time shaping space; the result is a composition made up of a trace of the objective and a great deal of emptiness which has now become space.

Works of musical art are time images in the same sense in which works of the representational arts and architecture are space images. A true image of time must be an image for the ear, an audible image, an image made of tones. Tones are time become audible matter; to form in tones is to form in the stuff of time; an image composed of tones is always at the same time a time image - not an image in time but an image made of time.

Forming images and thinking are the two gifts that distinguish human existence from animal existence. The whole teeming world of images, the world of our symbols is a world of spatial images. In music of earlier times, tones were bound to words or to actions that called for regular movement. Once freed from these ties, they became a language out of their own content. If tones now seek to be linked with words or actions, they do not lose any of their freedom; on the contrary, they bring a new dimension to view in them.

The new dimension by which music enriches our image world is a phenomenon that is comparable to the acquisition of a new sense; it is time: flowing, becoming, change, motion. With music, time broke into our image world; in music our formative powers took possession of time. Hearing receives its credentials as an image-creating and image-visualizing function.

SPACE:

Musical experience has a spatial component; he who hears music is aware of space. The spatial nature of music is magnificently revealed when polyphony presupposes order in auditory space. Simultaneously sounding of different tones does not produce a mixed tone, as a new colour emerges when two colours are mixed. In a chord, each tone reveals itself independently. The chord is the fruit not of the simultaneous existence of tones but of their mutual relation. Noises, odours, do not relate to one another. They are connected only in my consciousness, not among themselves. Tones, on the contrary, encounter not only the listener but one another; in the mutual relations of what is encountered, space reveals itself as order.

The different tones of this interpenetration are tones in different dynamic states, not tones merely different in pitch. Tones of different pitch are simply present simultaneously, just like noises. Only through the quality that also distinguishes the musical from the acoustical phenomenon, do tones become capable of constituting an order that expresses itself in forms, in chords - an audibly spatial order.

Place differences in visual space would be matched by differences in dynamic state in auditory space: a condition that wants itself perpetuated, that points beyond itself, directed tension. In this respect, tonal dynamic qualities are audibly spatial states.

The space experience of the ear in tones and the normal space experience of the eye coincide only in the most general sense: both fulfil the definition of space as the "whence of encounter". The eye discloses space to me in that it excludes me from it. The ear, on the other hand, discloses space to me in that it lets me participate in it. Space is given to the eye as that which is without, the ear knows space only as that which comes from without.

The notion put forward by William James that musical tones are order without is keenly contested and repudiated. Zuckerkandl however, draws a distinction between corporeal and auditory space. Dynamic quality of tone, he says, is something nonbodily that comes from without, an immaterial natural factor; yet the audible and the visible occupy one space, one reality.

Eye or hand keeps the physical thing that I meet away from me; tone penetrates into me. The current schema "inner world-outer world" reflects our passive encounter with the outside world. "Inner" and "outer" , I and world, face each other like two mutually exclusive precincts on either side of an impassable dividing line. But if what we encounter is nonphysical, purely dynamic - as it happens to be in the case of musical tones - the quality "out there" is replaced by the quality "from-out-there-toward-me-and-through-me". This encounter causes "inner" and "outer" to penetrate each other. Music brings to expression the mode of existence of the world that is of the same nature as my "within", my psyche. And as such, in our encounter with bodies, we experience not only bodies but also ourselves as the physical organ of the encounter.

COMMENTS AND FURTHER THOUGHTS:

Zuckerkandl's thoughts on musical experience are relevant to the main thrust of this study, which is to distinguish musical experiences from natural phenomena. His reference to the dynamic qualities of tones reflects the opinions of many musicians that the cohesive element which constitutes a musically defined statement is the ability of the musician to relate one tone to another by determining the quality and quantity of the bond between them. This, in turn, implies that the wave phases of motions are symmetrical and mutually complementary.

Relations in Time

Zuckerkandl dismisses quite unequivocally the nonspatiality of music: musical experience has a spatial component. In my research, it is evident that space is experienced only when relations are properly co-ordinated. In this respect, the time element, to which Zuckerkandl refers as the phenomenon comparable to space images in visual arts, is the foremost component through which music acquires spatiality.

He quite properly refers to chords, for instance, as "being the fruit not of simultaneous existence of tones but of their mutual relation....in the mutual relations of what is encountered, space reveals itself as order". A chord played on the piano is not a simultaneous sounding of different tones of different volumes and pitch: they are, or have to be, in a state in which the tones of the chord relate to each other. In such a state, the chord "blends" and sounds as one texture in the same way as two colours blend to form a new colour. The difference is that in the new colour the components that have composed it are imperceptible, whereas in a chord they are clearly detectable.

Reconciliation of "Inner" and "Outer" World

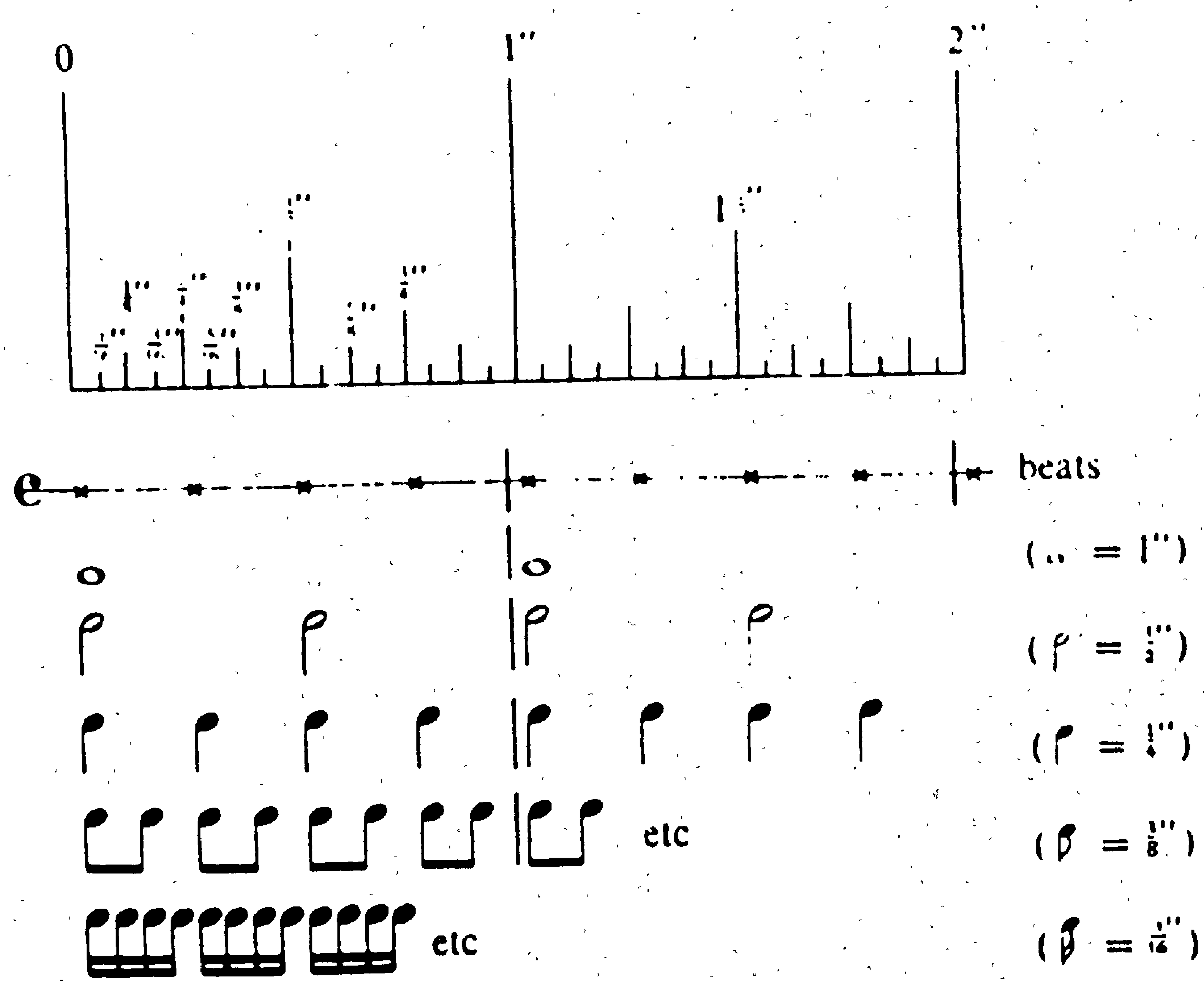
The schema, "inner world-outer world", which Zuckerkandl preserves throughout his treatise, is one in which the two elements, though different in mode, are of the same nature. In reconciling the two, the two "worlds" encounter each other and interpenetrate.

This interpenetration, the "from-out-there-toward-me-and-through-me" concept, equally applies when other elements, such as the ones proposed hitherto by the writer, are involved. The performing musician, through a bodily movement, produces an image of sound - an intricate and complicated process that involves the active participation of all the elements that have been hitherto defined: physical and nonphysical, tangible and nontangible, corporeal and spiritual.

Totality

For this purpose to succeed in conveying a meaningful musical message, all elements involved, those "without" as those "within", must coalesce together to form a uniformity of purpose. Such interpenetration can only establish itself on a basis of interdependency. All contributory elements must move in harmony. The result should be a homogeneous flow of interrelated media. "Unity", "totality", "oneness", all characterize most pertinently the profound and purposeful syntheses inherent in "musical" interpretations of artistic validity.

METRE ANALOGOUS TO DISTANCE



This illustration has been reproduced from the article on *Metre* found in the *New Grove Dictionary for Music and Musicians*, (1980).

GEOMETRY IN ART: 1

Geometry is the study of spatial order through the measure and relationships of forms. Geometry and arithmetic, together with astronomy, the science of temporal order through the observation of cyclic movement, constituted the major intellectual disciplines of classical education. The fourth in this great fourfold syllabus, the Quadrivium, was the study of harmony and music. The laws of simple harmonics were considered to be universals which defined the relationship and interchange between heavenly bodies and life on earth.

Geometry deals with pure form, and philosophical geometry re-enacts the unfolding of each form out of a preceding one. It is a way by which the essential creative mystery is rendered visible. Inseparable from this process is the concept of Number, and for the Pythagorean, Number and Form at the ideal level were one. When Pythagoras said, 'All is arranged according to Number', he was not thinking of numbers in the ordinary, enumerative sense. In addition to simple *quantity*, numbers on the ideal level are possessed of *quality*, so that 'twoness', 'threeness' or 'fourness', for example, are not merely composed of 2,3, or 4 units, but are wholes or unities in themselves, each having related powers.

Number is considered as a formal relationship, and this type of numerical relationship is called a function. The square root of 2 is the functional number of a square. Pi is the functional number of a circle. Philosophical geometry - and consequently sacred art and architecture - is very much concerned with these 'irrationals', for the simple reason that they demonstrate graphically a level of experience which is universal and invariable.

1 Most of the comments made here with regards to 'Geometry in Art' have been quoted from *Sacred Geometry - Philosophy and Practice* by Robert Lawlor. There are also references from 'Mathematics in Art' in *The Mind Alive Encyclopaedia of Basic Science.*

The universality of Number can be seen in another, more physical context. We learn from modern physics that from gravity to electromagnetism, from light and heat and even to what we think of as solid matter itself, the entire perceptible universe is composed of vibrations, perceived by us as wave phenomena. Waves are pure temporal patterns, that is, dynamic configurations composed of amplitude, interval and frequency, which can be defined and understood by us only through Number. Thus our whole universe is reducible to Number. Every living body, all elemental or inanimate matter vibrates molecularly or atomically, and every vibrating body emits a sound. The study of sound, as the ancients intuited, provides a key to the understanding of the universe.

The ancients gave considerable attention to the study of musical harmony in relation to the study of mathematics and geometry. The origin of this tradition is generally associated with Pythagoras (560-490 BC) and his school. The sounding of the octave represented for them the beginning and goal of creation. Without any intervention of thought or concept or image, the recurrence of the initial tone is immediately recognizable. This timeless, instantaneous recognition is universal among humans.

On a scientific level, the frequency of vibrations produced when the tone is raised by an octave, is double that given by the whole string. The string length has been divided by two, and the number of vibrations per second has been multiplied by two: 1/2 has created its mirror opposite, 2/1. Thus in this moment an abstract, mathematical event is precisely linked with a physical, sensory perception; our direct, intuitive response to this phenomenon of sound coincides with its concrete, measured definition.

Hence we experience in this auditory perception a simultaneous interwovenness of interior with exterior, and we can generalize from this response to invoke the possibility of a merger of intuitional and material realms, the realms of art and science, of time and space. It was by means of geometry that the Pythagoreans poised themselves at this unique intersection where heard vibration becomes seen form; and their geometry explores the relationships of musical concordance.

Golden Proportion:

It was the goal of many traditional esoteric teachings to lead the mind back toward the sense of Oneness through a succession of proportional relationships. A proportion is formed from ratios, and a ratio is a comparison of two different sizes, quantities, qualities or ideas. A ratio constitutes a measure of difference to which at least one of our sensory faculties can respond. A proportion is more complex, for it is a relationship of equivalency between two ratios, that is to say, one element is to a second element as a third element is to a fourth. It represents a level of intelligence more subtle and profound than the direct response to a simple difference which is the ratio, and it was known in Greek thought as *analogy.*

In proportional thought there are no fixed quantities, only fixed relationships. The quantitative value may shift but the relational configuration remains the same. The most fundamental proportional relationship is based on a unique geometric proportion of two terms and has been given the name 'Golden Proportion' or 'Divine proportion'. It is designated by the 21st letter of the Greek alphabet, phi (Φ), although it was known by cultures much older than the Greek. The Golden Proportion is a constant ratio derived from a geometric relationship $\Phi = 1.6180339$ which is 'irrational' in numerical terms. It is first and foremost a proportion upon which the experience of knowledge *(logos)* is founded.

The Golden Proportion can be considered as supra-rational or transcendent. It is the first issue of Oneness, the only possible creative duality within Unity. It comprises a three-term continuous proportion, a:b::b:(a+b), so that actually only two terms, a and b, are found in the three term proportion. The fact that it is a three-term proportion constructed from two terms is its first distinguishing characteristic, and is parallel with the first mystery of the Holy Trinity: the Three that are Two. By means of further algebraic formulation, it can be geometrically demonstrated that a and b are in relationship to one another as a root is to a square. This reduces the proportional thought to the causal singularity so that the mathematical metaphor for the Trinity can be expressed as 'Three that are Two that are One.

As the ancients say 'The Universe is God regarding himself'. Creation cannot exist without perception, and perception is relationship: 'To be is to relate'. The archetypal patterns of relationship can be contemplated through the laws of proportion contained in pure number and geometric form. The Golden Proportion is the transcendent 'idea-form' which must exist *a priori* and eternally before all the progressions which evolve in time and space.

There are grand philosophical, natural and aesthetic considerations which have surrounded this proportion ever since humanity first began to reflect upon the geometric forms of its world. Its presence can be found in the sacred art of Egypt, India, China, Islam and other traditional civilizations. It dominates Greek art and architecture; it persists concealed in the monuments of the Gothic Middle Ages and re-emerges openly to be celebrated in the Renaissance. Whenever there is an intensification of function or a particular beauty and harmony of form, there the Golden Mean will be found.

Several authors of the 19th and 20th century have observed the same aesthetic principle in certain works of art - in sculpture, painting, and architecture - as in anatomy and other forms and patterns of nature [1]. A rectangular frame with sides in the ratio of the golden section or a vertical division in this ratio are said to have a particular beauty. The Parthenon represents the proportions of the Golden Section as calculated by a mathematician who lived in the Middle Ages - Leonardo of Pisa, known as 'Fibonacci'. He established a remarkable connection between a mathematical series and a pleasing rectangular shape whose length is in the same proportion to its breadth as half its perimeter is to its longer length: 1.618, i.e. Φ.

1 Leonardo da Vinci made use of the Golden Section in *St Jerome*, an unfinished canvas, taking special delight in what he called 'geometrical creations'. The figures of both Leonardo da Vinci and Albrecht Dürer conform to the ancient biometric symbol of the body divided in half by the sex organ and by Φ at the navel. Similarly, the relationships between the bone-lengths of the human finger, hand and arm is another instance of the numerous Φ relationships which occur in the human body.

Modern painters, Impressionists and abstract artists, have especially made use of this mathematical ratio. Le Corbusier, the French architect, devised a design philosophy based on the Golden Section. He designed buildings on a system of Golden Rectangles, which he called *le modulor*, and showed how this proportion is related to the dimensions of the human body, much as da Vinci had done earlier. From experiments conducted by the physicist and psychologist Gustav Theodor Fechner, on the appreciation of rectangular frames (*Vorschule der Aesthetik*, 1876), it may be asserted inductively that a ratio close to the golden section actually has a special aesthetic appeal.

In musical terms, Erno Lendvai's pioneering analytical work on the structure of Bela Bartók's compositions, is most revealing. Lendvai analysed the proportions of Bartok's structures as being based on the golden section. His view was that Bartok's 'chromaticism' is distinguished by intervals based on the golden section or, in numerical terms, on the Fibonacci series, just as are the main divisions of his compositions.

In contemporary architecture, whether functional or decorative, the application of such complex mathematical curves as the hyperbolic paraboloid are practically commonplace. Buckminster Fuller, probably the leading exponent of mathematically designed architecture, has revolutionized our concept of building structures with his now famous geodesic dome, based entirely on equilateral triangles.

There are many more examples of geometrical relationships in art: the Baptistery at Pisa is a brilliant example of Renaissance architecture, embodying many degrees of rotational symmetry. The 12th century architecture of the Cistercian Order achieves its visual beauty through designs which conform to the proportional system of musical harmony. Many of the abbey churches of this period were acoustic resonators transforming a human choir into celestial music. St Bernard of Clairvaux, who inspired this architecture, said of their design, 'there must be no decoration, only proportion'.

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MARIOS PAPADOPOULOS

BIOGRAPHICAL PROFILE

The pianist and conductor Marios Papadopoulos was born in Cyprus and began to play the piano at a very early age. He came to live in London in 1967 where he studied with the late Ilona Kabos. In 1973 he was selected as a Greater London Arts Association 'Young Musician 1973', an event which was followed by his formal recital debut at the Queen Elizabeth Hall, London. The success of this recital led to concerts and broadcasts throughout Europe and the United Kingdom, including appearances at London's Royal Festival Hall, Royal Albert Hall and recordings for the BBC. Three years later Marios Papadopoulos made a highly acclaimed tour of the USA, making his New York debut at the Lincoln Centre and his orchestral debut with the Saint-Louis Symphony Orchestra. The following year he was nominated one of the 'Young Artists of 1977' by High Fidelity and Musical America.

He has since performed, broadcast and been televised widely all over the world, both as pianist and more recently as conductor.

In July 1985, Marios Papadopoulos appeared with the London Mozart Players at London's Queen Elizabeth Hall in a series of three concerts, playing and directing nine Mozart piano concertos. He has since performed twice the entire cycle of the 27 Mozart piano concertos.

Making his debut at the Barbican in 1985, he was soloist in Tchaikovsky's Piano Concerto No 1 with the Royal Philharmonic Orchestra and he has been acclaimed for his recording, as conductor/soloist, of the Stravinsky Concerto with the Royal Philharmonic Orchestra. He has also recorded piano works by Mozart for a Readers' Digest album, works by Mussorgsky, including the *Pictures at an Exhibition*, piano works by Cesar Franck, the 24 Preludes and Fugues by Shostakovich on three CDs and two CDs featuring the 'Nocturne'. He has also recorded the Beethoven Piano Sonatas Op 109, 110, 111, which marks the beginning of a major undertaking to record all the 32 piano sonatas for IMP Classics, over the next two years.

As conductor, Marios Papadopoulos appeared with the European Community Chamber Orchestra as well as with the London Mozart Players at the Barbican in two concerts in March 1989. In May 1989 he conducted the Philharmonia Orchestra and Chorus at the Royal Festival Hall. In May 1991, he made a highly successful debut as an opera conductor in a production of Mozart's *Magic Flute* at the Greek National Opera in Athens, and in September 1991, he conducted two performances of Verdi's *Il Trovatore* for the same company.

In November 1992, he was appointed Chief Guest Conductor of the City of Oxford Orchestra. In this capacity, he has recently embarked on a major recording project with the City of Oxford Orchestra. The first of these recordings has recently been released featuring an anthology of Baroque masterpieces.

DISCOGRAPHY *

MARIOS PAPADOPOULOS - pianist/conductor

1)	STRAVINSKY	Concerto for Piano and Wind;
	JANACEK	Capriccio;
	JANACEK	Piano Sonata (1905);
		Marios Papadopoulos Conductor/Pianist Royal Philharmonic Orchestra. (Hyperion CDA66167);
2)	SHOSTAKOVICH	24 Preludes & Fugues (3 CDs/Kingdom Records) Vol I: KCLCD 2023 Vol II: KCLCD 2024/5
3)	BEETHOVEN	Piano Sonatas Op 109, 110, 111. Pickwick IMP Masters series
4)	NOCTURNE	2 CDs/Kingdom Records (featuring 30 Nocturnes by 20 different composers) Vol I KCLCD 2030 Vol II KCLCD 2032

* A practical supplement to some of the examples and illustrations given in this thesis will be found in these recordings.

5) CESAR FRANCK — Piano Works/Meridian

Choral, Prelude and Fugue
Prelude, Aria et Final
Prelude, Fugue et Variation
Premier Grand Caprice

6) MUSSORGSKY — 'Pictures at an Exhibition'

Gopak
Souvenir d' enfance no 2
Intermezzo in modo classico
Une Plaisanterie
Une Larme
Au Village
(Helicon HLR143).

7) MOZART — Sonata in A major K331.

Fantasie in D minor K397,
(One record in an 8-record set released by Reader's Digest)

8) BAROQUE ANTHOLOGY — Carlton Classics PCD 1104

City of Oxford Orchestra
Conductor: Marios Papadopoulos

9) CLASSIC FM Nocturne — A compilation of "Music to suit the midnight mood"

Track no 12: John Field - Nocturne no 4 in A major
pianist: Marios Papadopoulos