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THE VISUALIZATION OF MUSIC: SYMMETRY AND ASYMMETRY

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Abstract—In this contribution the author attempts to explain the differences between music and its visualization (the score) and through various examples the relation between resonant result and score. In the same time he tries to show all the possible concepts of symmetry (and asymmetry) that exist inside this relation and in the graphical signs of certain scores. A new definition of symmetry is not formulated rather, a direction for a new way to conceive it is given.

Music before being played is always *something else*. That is, before music exists as an audible experience, it exists as an idea or plan in the mind of the composer.

The event of music at a deep level is never only music but always *something else*: this is why one can speak about it. This *something else* can be the score, that is to say, its visualization.

We cannot discuss music referring only to the impression or to the mood it creates. If we do so, our norms remain purely subjective, and must change every time the subject changes. Phenomenologically, music is only the playing of a score. The listener perceives the beginning of a resonant sensation: but if, at the same time, he can watch the score, a new formal and visual sensation is added to the first. The person who, instead, sees the score without listening to the music, has only a visual sensation: in this very moment he *sees* the music in a different way, that is to say, through *something else*, which can be defined as the mirror image of the music itself.

Music exists only in relationship to a score and to a musical instrument. The score and the instrument are related, and each relates to the music performed. These relationships can be seen as symmetrical. Following a score and saying that the musical writing is interesting, signifies that the formal elements of the graphical signs forming the sheet-music are in suitable relationship to that which they represent. If the signs are well-proportioned and well-balanced, and if a sort of concordance of the several parts is present by which they are integrated into a whole (H. Weyl), those who follow the score will have a positive impression.

The listener can only imagine the sound written or drawn in a score: when the air is moved by the waves produced by an instrument the ear is touched by those waves as the actual sound is portrayed by the score of music. The score represents the music through a reflected copy: between the sound and its visualisation there is the same relation as between an eagle and its prey, both having a role that can be defined as complementary and symmetrical.

Not all music has a score. The score may be replaced by a plan that the performer has clearly in his mind. In this case the performer becomes the composer. Folk music usually does not have a score: those performing or listening to a piece of folk music are familiar with the musical pattern. In folk music the feeling comes from the experience of continuous listening[1]. In general, all pieces of folk music are performed (i.e. composed) in the same way. Apart from small variants, the structure is always the following:

(i) a short introduction or a *ritornello*
(A) the first *stanza* with a certain type of music
(B) the second *stanza* with another type of music
(r) an interval (often a development of (i) or of ritornello)

and so on.

The resulting sequence (i)(A)(B)(r), (A)(B)(r), (A)(B) etc. is usually familiar to the audience. The repeated elements create a rhythm that shows the concordance of the several parts. In everyday language when all of these elements are well-proportioned and well-balanced something symmetrical is born.

Symmetry is a formal and structural pattern found in an infinite number of living and non-living things and is fundamental in human thought. There are many kinds of symmetry, but they can be reduced in general to four types: bilateral symmetry, spatial symmetry, symmetry of movement (rotational and translatory) and symmetry of color.

In music, all of these kinds of symmetry apply, but there is much controversy concerning them, although, as we can see ahead, we can find numerous examples of each. It is not difficult to find parts of scores illustrating bilateral symmetry and symmetry of movement. But in music we cannot limit the concept of symmetry to a sense of a good-proportion and a well-balanced concordance of parts. The art movements of the last seventy years have brought in to question all of the traditional aesthetic rules, so we can no longer say, "Beauty is bound up with symmetry" (H. Weyl)[2]. The established rules no longer dictate what constitutes beauty. Often in music what gives the impulse towards the discovery of the *new* is the rejection of the rules of symmetry. The symmetrical order reached through a rational construction of an idea, is forced to take a *swerve* resulting in a *difference* which causes the first asymmetry[3]: henceforth the *swerve* makes headway toward asymmetry and so on, in a manner producing, in the end a new symmetrical order. The formal inspiration of the composer balances the *swerves* and the *differences* in reference to the general idea and plan.

A fine example of this process is represented in music by the Fugues of Johann Sebastian Bach. The principle of imitation that embodies the fugue gives it symmetry in a very imaginative and flexible manner. The germ cell of the fugue is a thematic idea called the *subject* which is announced alone in one voice. Immediately it is answered in another, but not in exact repetition (the *difference*). Pitches and shapes are slightly altered in a way that can be defined as circular and the cells following it repeat each other in turn. Bach arranges the fugue inventing, repeating, breaking and continuously restoring the cells inside each bar: all this is made on the razor's edge and the inspiration regulates the process so completely that all becomes part of a great and unique idea and plan. Bach constantly weaves more symmetries, he discovers and focuses his attention on many possible formal asymmetries. In this process they become so numerous that they gradually become the contrary of the first symmetrical pattern and may be their mirror image.

The fugue was a vital form of theoretical symmetry during the Baroque period (1600–1750). But in the long run it could not endure and meet the changing requirements of evolving musical inspiration; more than that, it became a restraint.

In the history of human actions the discovery of the exception to the rule has always provided an impulse for the formulation of the *new*: "Freedom is the negative" (Hegel).

Arnold Schoenberg, the most revolutionary composer of the last seventy years, studying the rules of tonal harmony, found a new harmony. He invented another formal structure with its own symmetry. In confrontation with the classical main rule (tonality), the new rule invented by Schoenberg (atonality) appeared to be topsy-turvy, asymmetrical, an error . . . but errors often deserve the place of honour because they push beyond simple equation into fractions that never add up to one and their movement does not stop. The 25th and 40th bars of the *Toccata & Fugue in E Minor* by Bach are interesting examples of symmetry in music (Fig. 1)[4]. All the cells are formed by three notes: the central one is higher than the remaining two. The connection of the notes in the staff by a line results, therefore, in a conical shape with the point upwards:

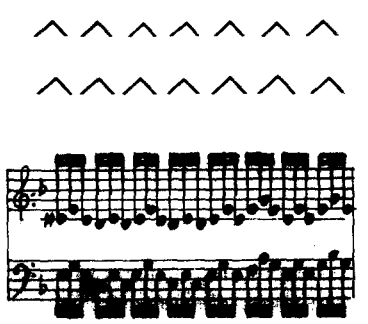


Fig. 1. Bach, *Toccata & Fugue in E Minor.*

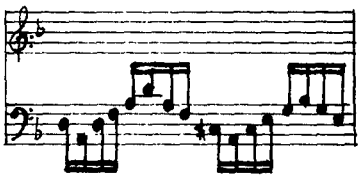
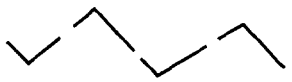


Fig. 2.

The geometrical figure that we observe is the first symmetrical pattern of the composition identified as bilateral. The cells are repeated with a variation consisting in a one-tone change. This shows the second symmetrical pattern as a clear translatory example. But in this Fugue of Bach there is another and wider symmetry and this, again, is translatory: the progression of the bars and their forms conform to one another. In the 40th bar, on the other hand, the cells are set up by four notes forming two lines:



These points are alternately upward and downward (Fig. 2). Here too, a single note connected through the progression of the bars is represented by a zigzag line. Besides being translatory, the symmetry is rotational.

We find another example of symmetry in the next two bars (the 10th and 11th) of the first *Prelude* from the *Well-tempered Clavier* by Bach (Fig. 3). Between the first and the second group of tones (in the 10th bar) the only variation is in G clef where the F# become F. In the 11th bar the second group is equal to the first. The differences in the 10th and 11th bars consist only in the movement upwards or downwards of certain notes: the beat remains the same. When played separately the two bars can be different in sound, but the sequence of the paths of each cell presented by the whole composition produces a well-proportioned and well-balanced composition.

The bilateral symmetry controls the entire fugue. In fact all groups of notes within each bar are always the same and are repeated in this way:

$$(2 + 4) + (2 + 4) \qquad \text{(semiquavers)}$$

and

$$(1 + 1 + 1) + (1 + 1 + 1) \qquad \text{(minim + quaver + crotchet)}$$

Even Ludwig van Beethoven attempted the fugue. But his contemporaries said that he was never able to compose a faultless fugue. For example in the *Sonatas for Piano* op. 110 and in the *String Quartet* op. 113, where he adopts the fugue pattern, the formal and resonant result differs from that of the typical fugue. Beethoven, by deviating from the strict rules of the fugue, was able to produce music more congenial to his time. At the same time he infused new life into the fugue.

Another special example of symmetry is the *Passion according to St. Matthew* by Bach.

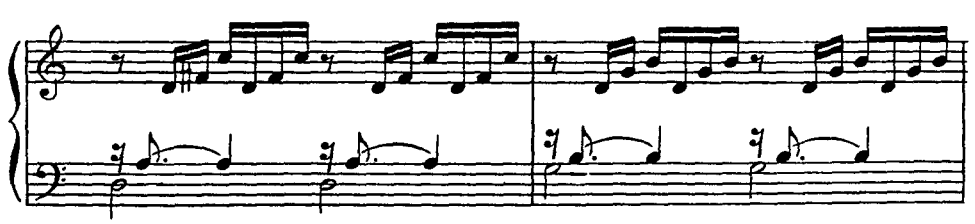


Fig. 3. Bach, "Prelude" from *The well-tempered Clavier.*

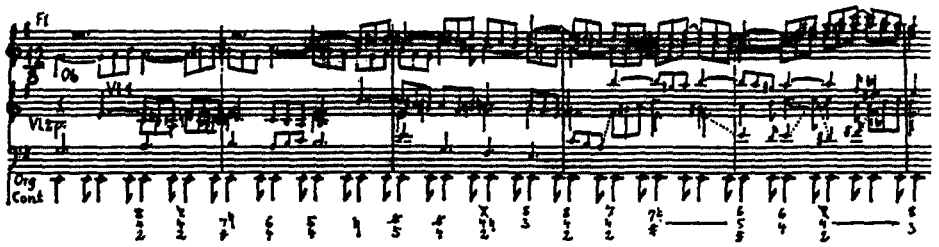


Fig. 4. Bach, *Passion according to St. Matthew.*

A passage for recitative and choir is made by three staves: the F clef maintains a constantly repeated note with a monotonous and martellato rhythm (Fig. 4). In the G clef, however, the music has a certain mobility that contrasts with the monotony of the obstinate bass. Between the static rhythm of the bass and the movement of the other voices there is a continuous attraction: the bass provides a symmetric repetition, while the other voices, in fluctuating motion, offer a clear asymmetrical pattern. This *difference* is explained as the pain of Jesus, that is to say, the torsions and the movement of the body fixed to the cross. We have here a particular instance of bilateral symmetry. When the image on the right is exactly the same as the image on the left, and the process continues on both sides a motion begins and repetition follows.

Repetition means the exact reproduction of the thing itself, but we sometimes encounter patterns which resemble, but do not monotonously repeat, one another; *differences* are then present in the whole sequence: this contrast enables one to focus on one or the other of the elements repeated. The selection of focus in the piece of Bach is made possible by the contrast between the bass and the other voices: the former (the F clef) provides the regular symmetry, the latter (G clef) provides asymmetrical resemblance. Perception is thrown by this contrast and forced to follow one of the three musical lines given by the score that is, the visual element, or by the executed music, the resonant element. Different transcribers present the same piece of music differently: their transcriptions vary in terms of visual presentation and often in term of sound. Ferruccio Busoni, an Italian composer of the twentieth century, transcribed the music of Bach—he lived in a period when the music of Bach was studied with particular interest. Many other composers of his time like Max Reger, Albert Schweitzer, Gustav Mahler, etc. transcribed many pieces of Bach. The same piece of music transcribed by different musicians illustrates what it means to resemble but to be different and to differ but to resemble.

We can compare the piano transcription of *Toccata & Fugue in C major* by Bach made by F. Busoni with the same bars transcribed by myself. Here, moreover, bilateral symmetry and symmetry of movement are presented with repetitions, differences and asymmetries (Fig. 5). The existence of a deep relation between the visual images of the score and the sensation produced by the sound is a real fact. This relation represents a kind of language. A similar

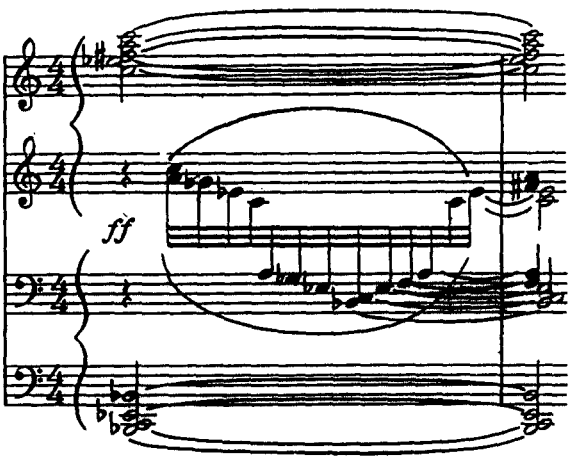


Fig. 5. Bach, *Toccata & Fugue in C major.*

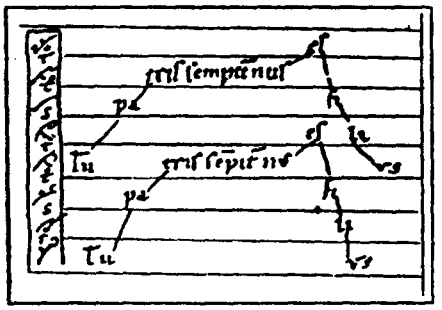
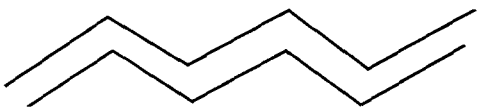
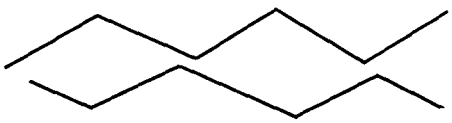


Fig. 6. Anonymous, "Tu Patris" from *Musica Enchiriadis*.

concept of language was used in music in the Middle Ages, through 12th century, that is to say, during the Ars Antiqua period. The music form was the polyphonic Organum, a way of adding (Organare) a voice to the official text of music. This addition was made in a symmetrical path: it was called *parallel Organum* if written like this:



or *oblique Organum* if written as follows:



The symbols represent a new line of music moving either parallel to or in opposite direction from the given line. Many variations upon these two ways were common, but they could always lead back to the previously mentioned symmetric patterns. In Fig. 6, a neumatic score of an Organum called *Tu Patris* from *Musica Enchiriadis* by an anonymous composer (9th century), a symmetry of movement is quite clearly shown. In another piece of the thirteenth century called *Discendit de celis* both parallel and contrary motion are presented (Fig. 7). This symbolic relation in which reason sustains both music and text was quite forceful as a musical device. For example in the latin text the word *discendit* was accompanied by a group of descending notes; while the word *levavi* was accompanied by a group of ascending notes. These two are the commonest examples: a multiplicity of cases with many nuances are found in all of the music of the Ars Antiqua and often the later Ars Nova.

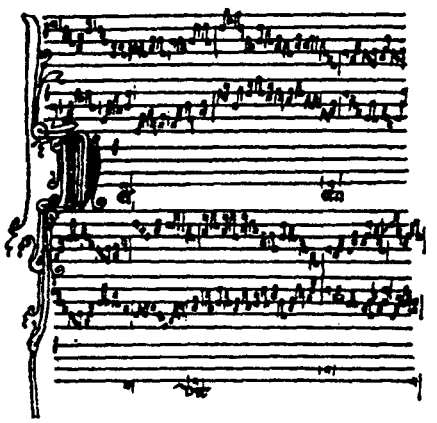


Fig. 7. Anonymous, *Discendit de celis*.

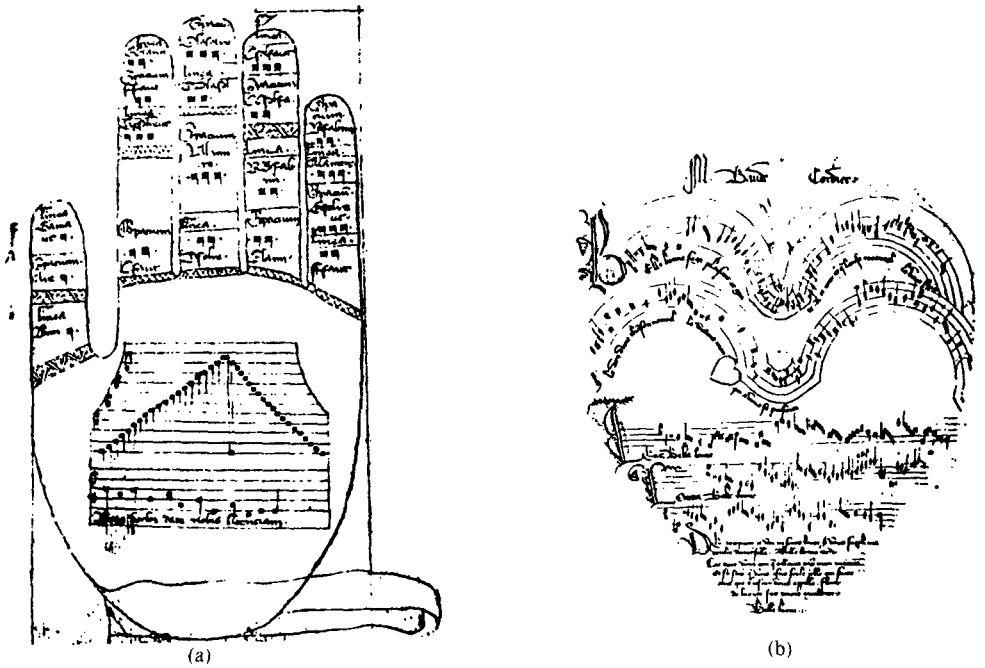


Fig. 8. (a) Diagrammatic "teaching hard". (b) Love song.

The unknown composers of these centuries tried to link the visual image of the score to the resonant image of the music—this process has never ceased. In the previous examples the median line symmetrically dividing the motion of the notes of the staff is the quintessence of the music. This graphic method represents the language binding the composer, the performer, and the listener. We recognise another connection between the look and the sound of music in the medieval composers who used red ink to set the word "blood," green for "grass," black and white for "grief," "joy," "darkness" and "light." Love-songs from the court of Avignon were written in the form of a heart: we also find circular scores and an explanation-teaching inscribed in the drawing of a hand (Fig. 8). The graphic representation of music has always been fundamental in the history of music.

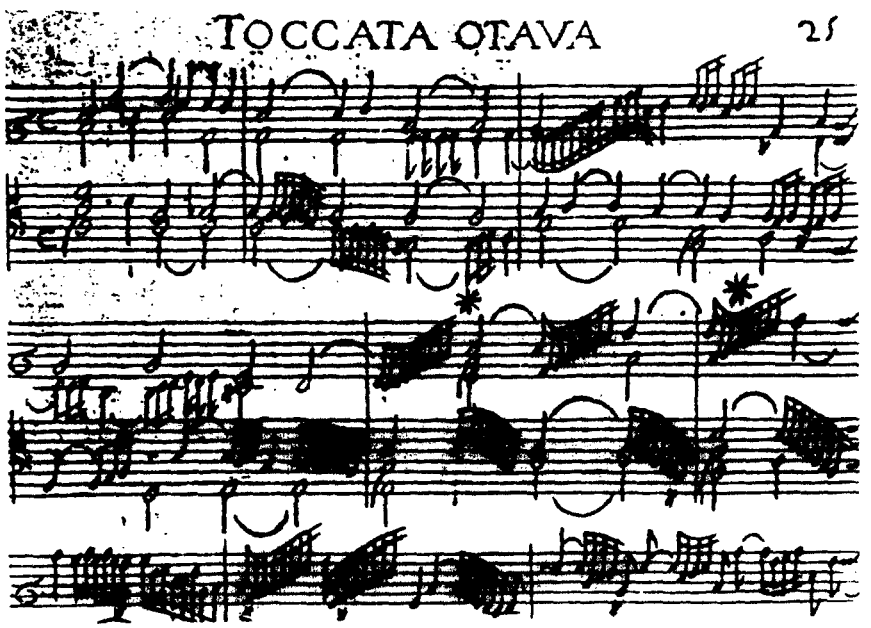


Fig. 9. G. Frescobaldi.

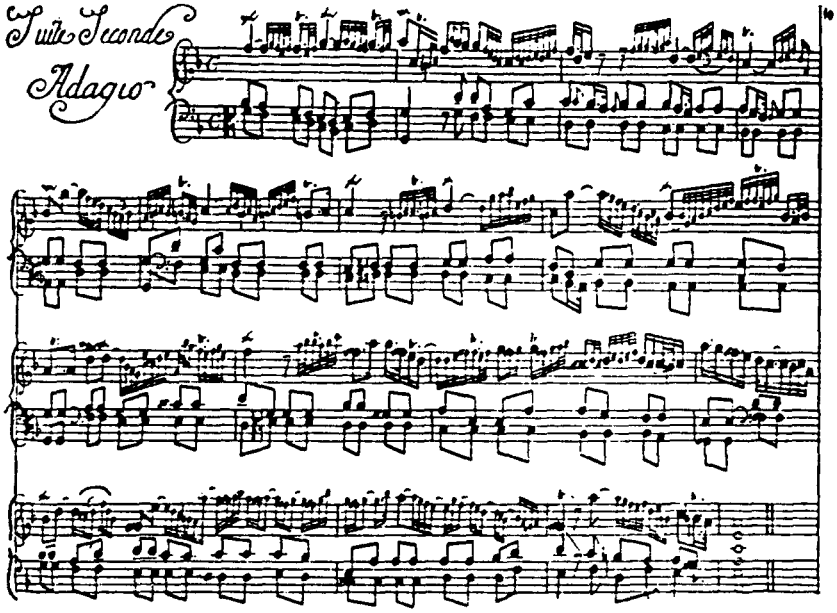


Fig. 10. Handel, *Suite des pieces pour le clavecin.*

The graphics of certain pages of the music of Giacomo Frescobaldi is very interesting. The notes of the cells pointing upwards or downwards are joined by curved and wavy lines (Fig. 9). The alternate groups of notes are marked by an asterisk. They show a certain symmetrical pattern but in general the piece is more asymmetric than symmetric. I define these points as a *spot symmetry*, which involves neither the composition nor the main idea or plan of the composer.

A case where the symmetry seems to be the basic idea of the entire composition, is the *Suite des pieces pour le Clavecin* (second suite—1720) by George Frederick Händel (Fig. 10). Both staves G clef and F clef are developed following each other in two formal ways. In this piece, Händel is too schematic and he seems to be more interested in showing the virtuosity of the performers than in the resonant result. The two line construction (G clef is thick, F clef is thin) reflects a strong formal order and a symmetrical counterpoint.

Groups of notes set in symmetrical patterns are common in certain compositions through the centuries: the following extracts are examples taken here and there from the last three hundred years.

The symmetry in the short passage by Beethoven *Variation on a theme of Diabelli* (op. 120) is too clear to require any comment (Fig. 11). In the next extract from the *Sonata in G major* by Domenico Scarlatti the elaboration is more complicated, but still remarkable (Fig. 12). The formal pattern of the short passage from *Lotosblume* by Robert Schumann is very near to the previous extract by Beethoven (Fig. 13).

We find a symmetrical pattern also in an extract from the madrigal *Tu m'uccidi o crudele* from 5th book of Madrigali by Carlo Gesualdo da Venosa (Fig. 14). Here the melodic line hides the symmetry that remains within the musical notation. The groups of two and three notes do not show it clearly: asymmetry seems to be the rule.

Comparing the sound of a piece of music where the symmetry is very evident with another

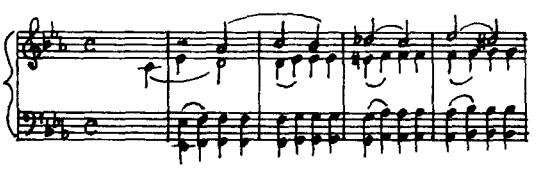


Fig. 11. Beethoven, *Variation on a theme of Diabelli.*

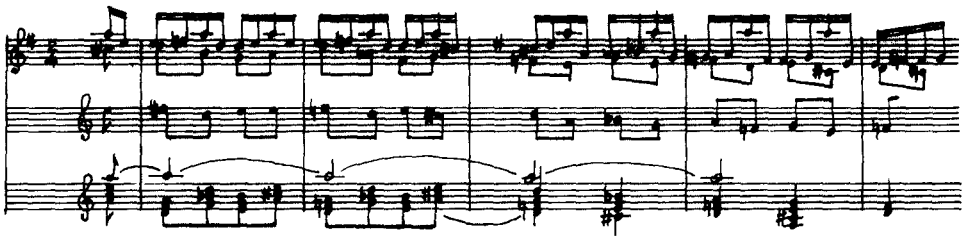


Fig. 12. Scarlatti, *Sonata in G major.*

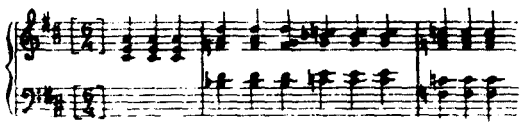


Fig. 13. Schumann, *Lotosblume.*

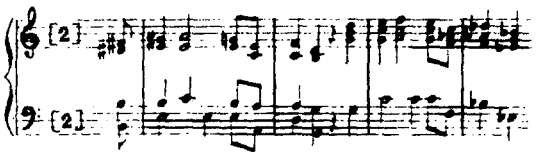


Fig. 14. Carlo Gesualdo da Venosa, *Tu m'uccidi o crudele.*

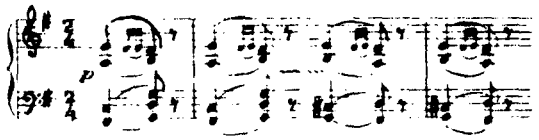


Fig. 15. Wagner, *Die Meistersinger.*

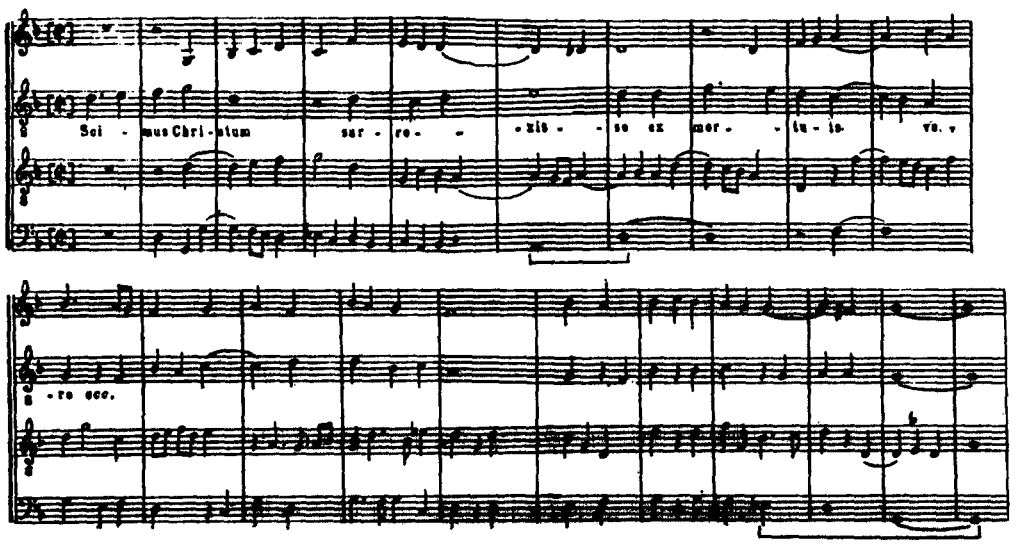


Fig. 16. Despres, *Victimae Pascali Laudes.*

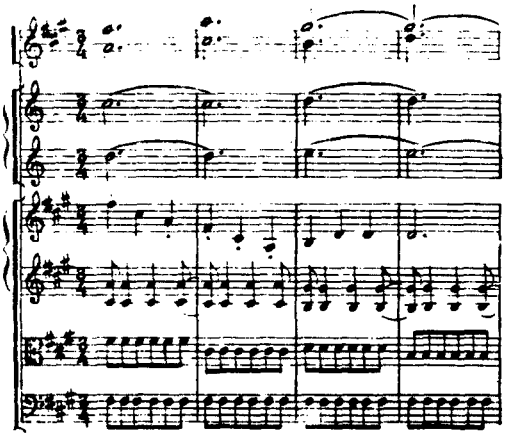


Fig. 17. Haydn, *Symphony no.* 45.

piece where it is not, we can understand how many *differences* are produced by different ways of graphical representation. In Richard Wagner's *Meistersinger* (2nd act, 2nd scene) the strong stressing prevents the development of the melody (see Fig. 15), and influences the *pathos* of the music which at this point is remarkable principally for its symmetry.

In one of the high points of the history of music, that is to say *Victimae Pascali Laudes* by Josquin Desprès (in Fig. 16 I transcribe here the final bars), the symmetry and asymmetry are perfectly integrated. In general when the asymmetrical process rules the piece, it remains as asymmetrical as the result tends to be free. The difference between the piece by Desprès and the extract in Fig. 17 from *Symphony* (no. 45) by Franz Joseph Haydn is very clear. Through these various examples we can draw some conclusion about human perception in relation to sound and noise. In certain music the more the symmetry is evident in graphic representation, the less the melody is resonant to the ears: a melodic sequence is easier to perceive if the musical writing is asymmetrical.

Harmony is in keeping with a symmetrical representation. The mental human faculties and our thinking are governed by rhythm and principles of symmetry. Humankind reacts positively on an emotional and psychological level to the sensation of symmetry and this reaction is innate. Accordingly, it would appear that the human ear is inclined toward music containing little melody, since melody is asymmetrical. But, in reality, the contrary is true. *Easy Listening*, music with facile melody, provides the proof.

Analyzing this contrast we find many other elements. The melody is an arrangement of notes in the field of tonality. But the system of tonality is a convention and depends on experiences inherent in the structures of our culture. In the world there are many different cultures and each makes a distinct response to sound. Sound does not make music, it is music that makes sound. This article is focused on symmetry in music and not on tonality or atonality which constitute the opposite terms of a musical problem.

The composer does not compose music intending to make a symmetric or asymmetric pattern. Their visualisation is born unconsciously during the development of the score. Sometimes the composer himself arranges a particular pattern or a process that could be defined as symmetrical, by which an entire score is visualized. In the fugue, the construction follows some conventional rules. One of these, well-known, is the reflection of a principal theme, that is to say, the same notes played backwards. This is a theoretical way used by composers to force their spontaneous inspirations to follow the fugue form.

A page of the *New England Psalm Songs* by W. Billings (1770) is presented by a circular pentagram since the music should never finish (Fig. 18). Here the symmetry is not inside the bar or the cells but in the formal representation of the entire composition. This is not an exception: in the history of music we can find other examples. In a composition of 1981 by Mark Jacobs called *Analemma* the continuity between old and contemporary music is quite clearly shown. He invented a score made as an eight (see Fig. 19)[5].

In the romantic and post-romantic music there is a procedure very common for many

Fig. 18. W. Billings, *New England Psalm songs*.

composers: a group of notes goes upwards through each bar everytime. Usually these parts are simple melodies and very elemental (Fig. 20). The symmetrical result of the melodic passages might seem to contradict the observation I have made: harmony equals symmetry, melody equals asymmetry. But here the melodic result is without strong variations, widening to infinity. The compressed movement arises bar by bar in a continuous fever avoiding stops and pauses and proceeding in atonality. In fact the variations keeping this unswerving progression tend to symmetry. This way of composing was used by many musicians of the 19th and 20th century: we can find it in F. Liszt, R. Wagner, F. Chopin, A. Bruckner, G. Mahler, A. Schoenberg, A. Berg, etc.

In Chopin's *Etudes* no. 1 op. 25 the passage in Fig. 21 shows another example of unswerving progression where melodic manner and classical harmony do not clash with symmetrical path.

In another very famous piece by Chopin, the *Marche Funèbre* from op. 35, two chords are repeated constantly twice in each bar in F clef throughout the composition (Fig. 22). They are missing only in the central part and their absence produces a notably different resonant result. These two symmetrical chords carry the melodic line (G clef) fitting perfectly with the F clef. Its gentle monotony leads the listener back to the symmetrical cadenza of the F clef.

The works of Claude Debussy represent a return to *Modes* and to the scale patterns of early ecclesiastical music (Gregorian Chants, etc.). He achieves a perfect melodic declamation

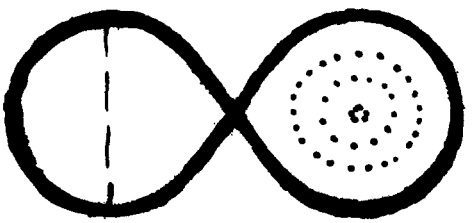


Fig. 19. This is not a score but a schematic drawing made by the author.

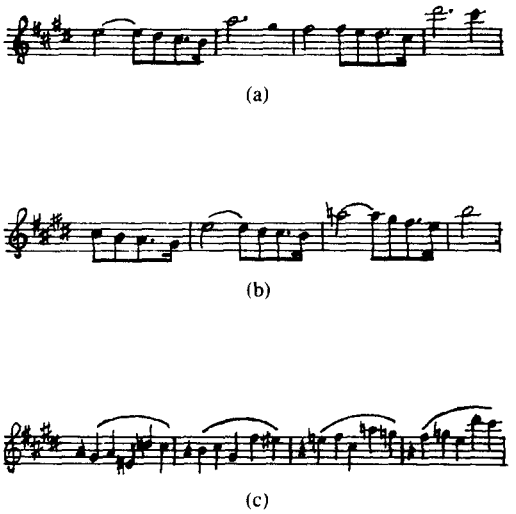


Fig. 20. (a) R. Wagner, *Valkyrie*—3rd act. (b) R. Wagner, *Tristan and Isolde*—3rd act. (c) F. Liszt, *Wedding*.

inspired by the *Modes*. The esaphonic (and/or penthatonic) scales and modes used by Debussy give the key for a vague and expressive sing-song not sung but whispered. The action should never be arrested: it should be continuous and uninterrupted. Melody is almost anti-lyrical and powerless to express the emotions.

Thus, the graphic visualization shifts the melody in a symmetrical path (Fig. 23). The melody is like a psalmodic chant with a poignant and penetrating quality. Structural support does not exist, chords make colors, the lighted and transparent resonances do not have fully formed melodic arches but only wisps and fleeting touches. The effect prevents the sound from being very melodic.

In the first and second bars from the first of the *Deux Arabesques* the representation reaches an extreme perfection (Fig. 24). The slur arches between groups of tones render the sensation of repetition more intense than ever. The movement in the staves is circular and then reversible: what is more symmetric than reversibility? The negation of symmetry is the irreversibility.

The essence of the instrumental technique of Debussy consists of a pure and resonant mosaic of fragmentary chords finely colored and a design of melodic cells composed mathematically—except in those short figurations where the *ostinatos* appear again with some small variation. All these elements fit into the composition with symmetric visualization. I believe the piece by Debussy for piano *Jardins sous la Pluie* from *Estampes* is the finest example containing all types of symmetry. The design of cells in each bar is repeated constantly: five fundamental types are present remaining more or less unchanged. Their order is given in Fig. 25. Here we can see spot symmetries, bilateral symmetry, translatory symmetry, symmetry of movement, *differences*, swerves and even a general symmetry visible through the entire piece. Moreover repetitions, invariances, and similes are frequently used. The above five fundamental cells rule the complete score and account for the broad, formal harmony that permeates the piece.

It is possible to find symmetrical patterns in another collection for piano solo: the *Preludes*. The collection is composed by many pieces with different titles as many distinct elements of a

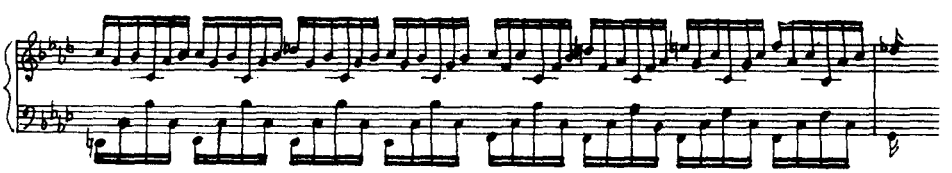


Fig. 21. Chopin, *Etude*.

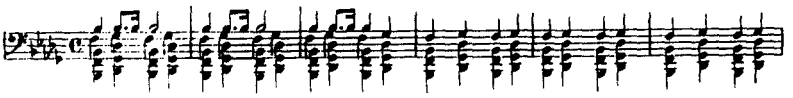


Fig. 22. Chopin, *Marche Funèbre*.

whole. All these *differences* are necessary to weld it into a unified whole. Each bar is the twofold image of the previous one and so on: the purpose of these differences is to create music and rhythm (see Fig. 26). The composition results in an indissoluble unity: the sequence of elements, designed to create the formal pattern and resonant sensation, is essential to complete the entire piece. From bar to bar the score appears to the eye to be the same, *something else* recomposes it each time rendering a unique sequence. This process creates a continuous intrigue: variations, *differences*, and repetitions, do not subdue the piece but give a dream-like monotony to its recurrent phrases. When Debussy spoke about Javanese and Balinese music, which strongly influenced his works, he demonstrated his understanding of its multiplayer structure and its rhythmic intricacy. Symmetry does not mean lucidity. In fact, Gamelan is based on a very simple theme but played simultaneously and at different paces. This process (which is the same as Debussy's) arrives at a complex figuration often very hard to translate into a complete visualization. The basic theme of one of the well known pieces of Gamelan from Bali is shown in Fig. 27. In certain old manuscripts Indonesian music is presented like this as in Fig. 28. The Chinese characters we can see, denote the cultural exchanges existing between all countries of Far East Asia. But the presence of Chinese characters invites us to approach symmetry at a different level.

Ideographic writing can be considered another example of symmetry but in a symbolic sense. *Music* in Chinese language is written by this symbol:

乐

It represents five drums as the five tones of the musical scale upon a stand of wood. All transformations are apparent in the Fig. 29. But the same symbol pronounced differently means *joy* or *pleasure*, for music gladdens the heart.

Thus, symmetry can appear through a visualization, a resonant sensation, and a reflection in the human understanding. In Japanese writing (not very different from the other East Asian Countries) there are many examples of symmetry. Through the original and the transcription of the short scores in Fig. 30 we bring the music as a picture before the ear and mind. The original graphic is the symmetrical image of the transcription: both represent a language for the same music interpreted by two different cultures and the formal result is almost identical to that of the music.

In a *Noh* chant from Japan the notation is marked on the right side of each line of text (Fig. 31). The text itself and its meaning conducts the music: there is a sort of symbolic exchange between the sound of music and the words of the text: each reflects the other's symmetric image at several levels: sonorous, psychological, emotional and visual.

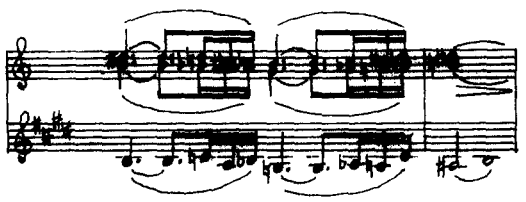


Fig. 23. Debussy, *Prélude à l'après-midi d'un faune*.

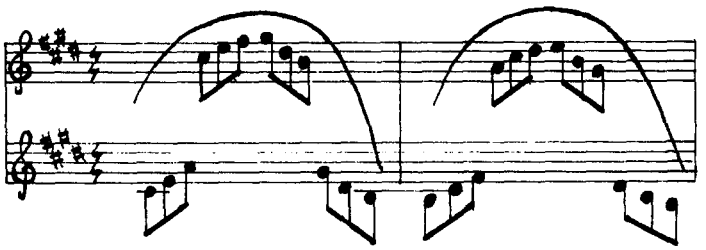


Fig. 24. Debussy, *Deux Arebesques*.

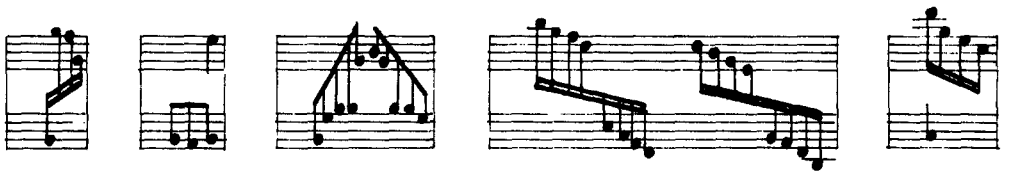


Fig. 25.

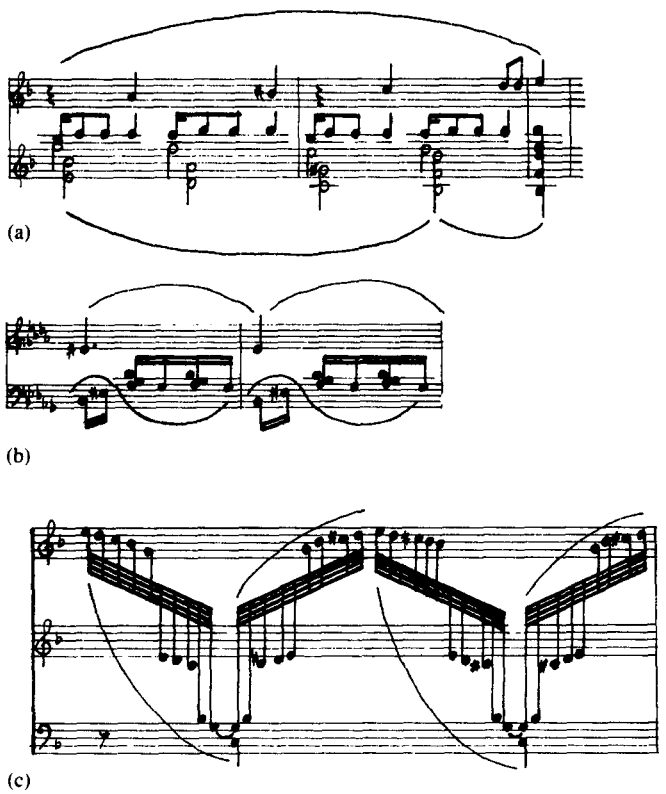


Fig. 26. Debussy, *Preludes*. (a) *Deux pas sur la neige* (5th and 6th bars). (b) *La sérénade interrompue* (98th and 99th bars). (c) Feux d'artifice (36th bar).

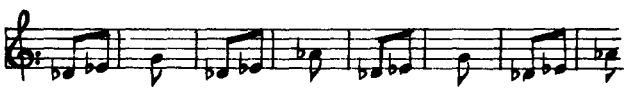


Fig. 27.

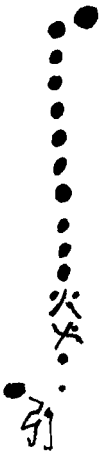


Fig. 28.

Tibetan notation reaches the maximum visual presentation of all Eastern music. We find distinct manners of notation varying for each instrument and from place to place. The musical writing is mnemonic with some descriptive elements. It consists of undulating lines drawn by black, red, or yellow ink (see Fig. 32). Likeness and memory are the properties of this kind of score. The line is the wavy connecting image of a hypothetic transcription on a western staff. Rhythm is missing in all these scores. Using the mnemonic manner of oral tradition, the Tibetan musicians do not need an exactly graphic representation of sign of rhythm: memory constantly renewed by everyday learning helps to complete the symmetric notation at the moment of playing: the rhythm comes from inspiration.

Thus, while not present in the score, rhythm is very important in the performance of the music. Rhythm is not one-dimensional, but represents a whole that composes the sense of music. Hermann Weyl seems to consider music under a single dimension, summarizing it as rhythm. I, however, consider rhythm to be a succession of regular, repeated intervals. Its result could resemble translatory symmetry, but we must remember that equal intervals do not produce rhythm. Common sense dictates that rhythm is symmetry because it creates a symmetrical pattern. But there is a difference between rhythm and symmetry. The first is a creative act and the second a formal result[6]. Asyncronies, accidentals, variations, omissions and syncopations are important elements of rhythm considered as music. All examples quoted in this article are short passages of longer compositions. They are extracts which I have defined as symmetrical because of their position and their form. A piece of music can be composed arranging these passages in a symmetrical or asymmetrical path or in any other way chosen by a composer.

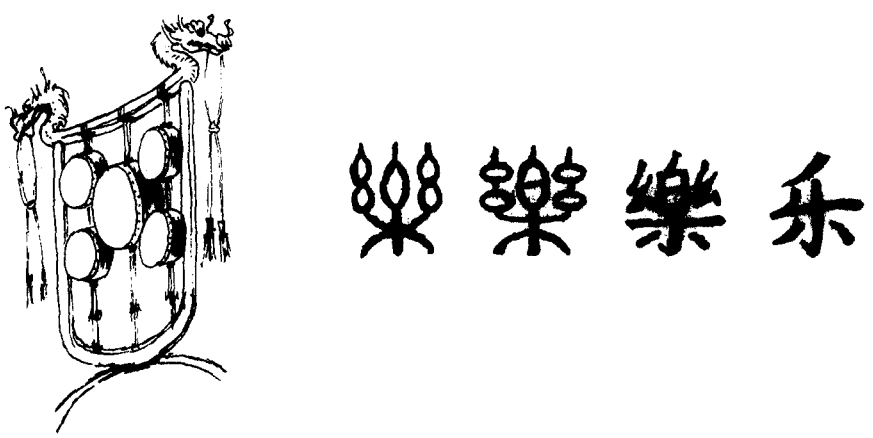


Fig. 29.

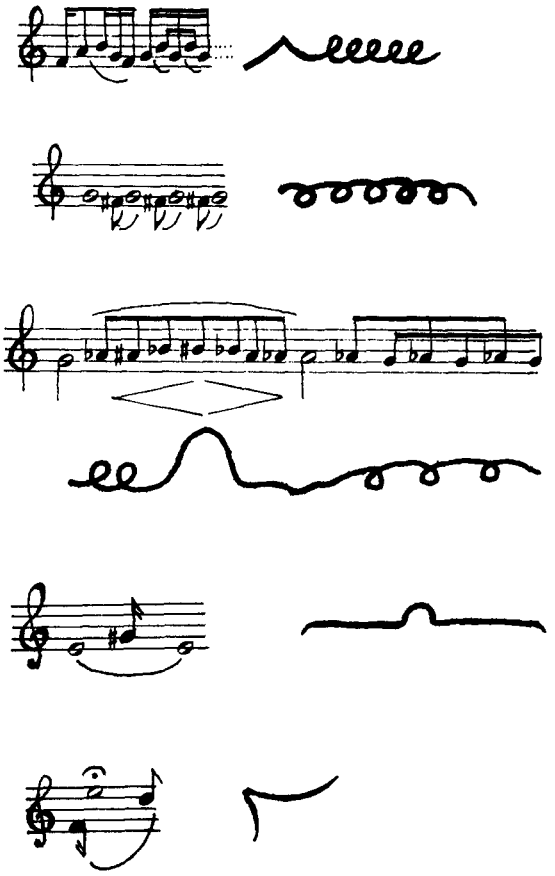


Fig. 30.

But there is a connection between these passages: on the one hand, the idea and plan, on the other, rhythm.

If we make allowance for the rhythm in the next example in Fig. 33, typical of Philippine music, we notice at once its regularity, evenness, stress and its symmetric path. But this notation is a theoretical form because all these signs are a convention that permits the score to be

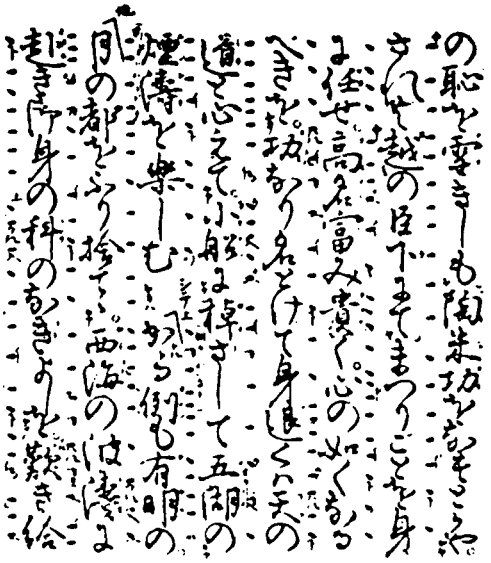
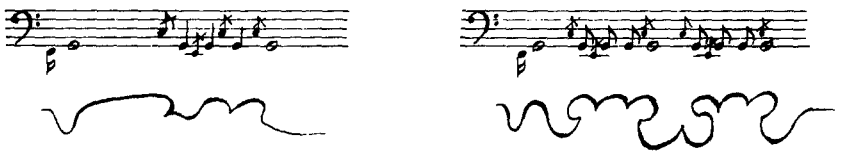


Fig. 31.

(a)



(b)

Fig. 32. (a) Conga's notation. (b) Vocal notation.

understood. I have already indicated that this convention is *something else*, something *different* from music. In reality, the sound does not have the symmetric aspect of transcription. The problem lies precisely here. We find symmetry in music but sometimes it is in the score, and not in the performed music; or else, the music produces a sensation which can be defined as symmetrical, but we cannot find graphic signs of symmetry in the score.

African rhythms are very complex because simultaneous meters with different beats are used. It is very difficult to perceive the symmetrical sensation, but through the simplification of transcription in western notation it appears very clear (Fig. 34). It is commonly recognized that in the field of music it is difficult to agree upon a unique definition of symmetry: acoustical product and score each have their own essence and consequently many specific symmetries.

As a result of the revolutionary changes in the world of Art which have taken place during this century, a new concept of notation (i.e. language) was born. Not only notes and staff but also drawings, text instructions, signs and symbols: in a word, there are no longer any conventions. Composers resort to a profusion of different notation systems with instructions in further subdivisions. Because of this, many graphic possibilities are available to a composer, and a wide area of research opens up.

Antecedents of contemporary music offer some additional examples to illustrate my point. It may be surprising to some to learn that the first bars of the 5th *Symphony* of Beethoven (Fig. 35) is an antecedent of contemporary music. The 5th Symphony can be considered as concentrated in these three chords: the continuation can appear as an appendage, that is, a development of this first special instant. The symmetry is obvious: 3 quavers, 1 minim—3 quavers, 1 minim—and so on to infinity. The sensation of infinity is reached by ceasing to listen after the first few bars. Wassily Kandinsky transcribed it with the following drawing

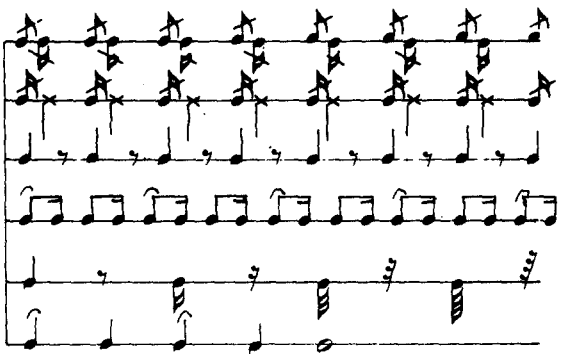


Fig. 33.

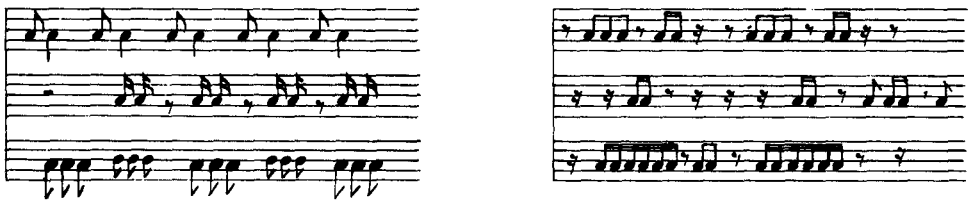


Fig. 34. African rhythms.

inventing a way to show its symmetrical visualization (Fig. 36). A contemporary composer and critic, Dieter Schnebell, considers the previous bars by Beethoven, together with the small piece from the *Passion according to St. Matthew* by Bach (quoted in Fig. above), and some passages from Schubert and Wagner as antecedents of a composition of 1960 by La Monte Young called *Composition* 1960 #7[7].

From the theory and concept of atonality a new notion of symmetry developed in Schoenberg's mind. Schoenberg's thesis on atonality proposed that each of the twelve tones of the western scale should be of equal importance because if any one tone predominates it becomes a tonal center in the listener's ear. The composer must work with a row of twelve tones and use them in such a way that they appear in the row or in the specific permutation arranged. Permutations of the main row are three: inversion (i), retrograde (r), retrograde inversion (r i). It is possible to see how the symmetry is shown in an atonal system in the permutation row of Alban Berg's *Violin Concerto* (1935) (Fig. 37). The tone-row is a device intended strictly for the composer' own use: it is not meant to be heard by the listener. In fact atonality is always composed using the previous three kinds of permutation: but following the score we do not find any symmetrical passage: asymmetry predominates.

In Schoenberg's *Five Piece for Orchestra* (1909) the last page of *Farben* is in my opinion the best example of asymmetry in western music. The form reaches the highest point attainable and its perfection tempts us to consider it as symmetry. Thus we have the reverse of the phenomenon: asymmetry becomes symmetrical. The visual form of the page is done by staves full of single oval signs with tails, where their stems are not joined. It seems that Schoenberg took a handful of notes and let them fall at random on an empty page. The articulation of *Farben* and especially this page was the turning point and the departure of contemporary music. A different concept of composing had been born. This handful of notes means that chords must change gently so that the entry of instruments is not emphasized: the concentration of performers upon timber becomes the most important feature in performing this piece.

A different relation with timber is achieved in Erik Satie's works. For my purpose, the best example is *Socrate* (1919). Here one finds all that must not be done in music: chords and tones which succeed each other without progress, non-development, jump-cuts, antivariations. In *Socrate*, Satie reaches a state of musical passiveness: no rhythm, no stasis, no movement, no variety, no color, no climax. Thus again, symmetry gives shape to its visualisation with another concept of music composition (Fig. 38).

John Cage and later Karlheinz Stockhausen, were the first composers properly named as contemporary. Their importance gradually grew through the years. The beginning of contemporary music is Cage's 4'33"—*tacet any instrument or group of instruments*—(1950–52). The piece's instruction is in the word "tacet:" the two numbers give the duration in minutes and seconds: music becomes *silence*. Cage carries to the extreme the concept of Anton Webern's.

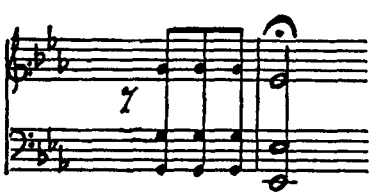


Fig. 35. Beethoven, *Symphony no.* 5.

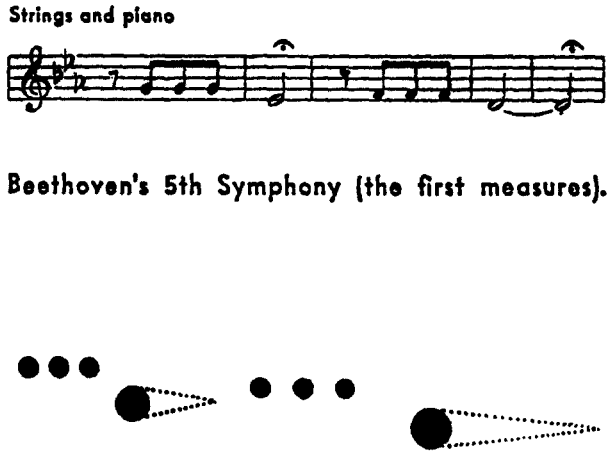


Fig. 36. Beethoven, first bar of *Symphony no.* 5, as transcribed by Kandinsky.

Webern's scores are incredibly terse, silence often becoming as important as sound. Cage with 4'33" demonstrates the meaning of silence and what music can be; any sound and any noise. In these 4 minutes and 33 seconds music reaches an instant of pause, that is to say a taking of breath in *silence* after many centuries of sounds.

In 1956, Stockhausen made the first step ahead in a composition called *Klavierstuke IX*: the same chord repeated many, many times (see Fig. 39). When this obsession finally stops and the music takes form through normal atonal proceedings, the revolutionary discovery also seems to stop. The sensation of a resonant symmetry reaches its pinnacle before the start of atonal development. As in the first bars of Beethoven's 5th Symphony of in this piece by Stockhausen a sort of interrupted plan remains in the ear of the listener. He resumed the idea of *Klavierstuke IX* many years later: *Stimmung* (1968) is the natural continuation and the logical development of the same plan. Here the music reaches a complete anti-conventional representation. A section called *Kala Kasesa Ba-ú* provides a good example of a special form of symmetry: the spiral (Fig. 40).

The resonant results have the same effect of repetition. Cage again is the initiator of a new method of rendering scores completely different from conventional notation. It consists in a casual symbolic system (an aide-memoire) which synthesises all of the rules formulated in the past to record and write down music. His composition *Fontana Mix* (1956) is the inspiration for the many scores which use it as a model. Another piece called *Kontakte* (1960) by Stockhausen for electronic tape, piano and percussions is considered fundamental for contemporary music: here, values and defects, views and limits of electronic music are quite clearly shown (Fig. 41). *Treatise* (1967) by Cornelius Cardew is another very important piece of music. Its score had a great influence on contemporary composers. As the title suggests, the score is a treatise of all of the possibilities a composer has to visualize an idea or plan through music. Here no one part of the score can be considered symmetrical. The multiplicity of possibilities must be asymmetrical because only asymmetry can accommodate the infinite varieties of music; only asymmetry permits the complete discourse of which music is capable. He avoided conventionality even while adopting the conventional staff, and succeeded in visualizing a vast variety of sound.

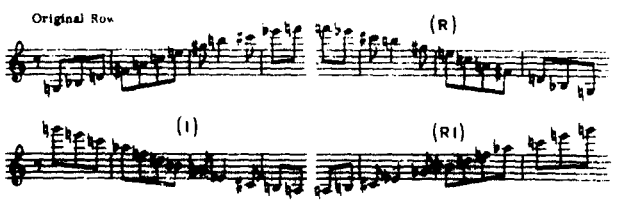


Fig. 37. Berg. *Violin Concerto.*

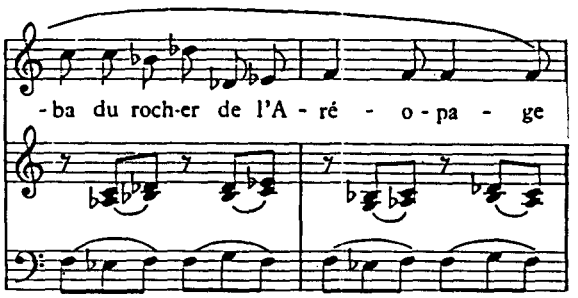


Fig. 38. Satie, *Socrate*. (© Editions Max Eschig; used by permission.)

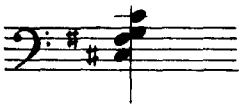


Fig. 39. Stockhausen, *Klavierstuke IX*. (© Universal Edition A. G.; used by permission.)

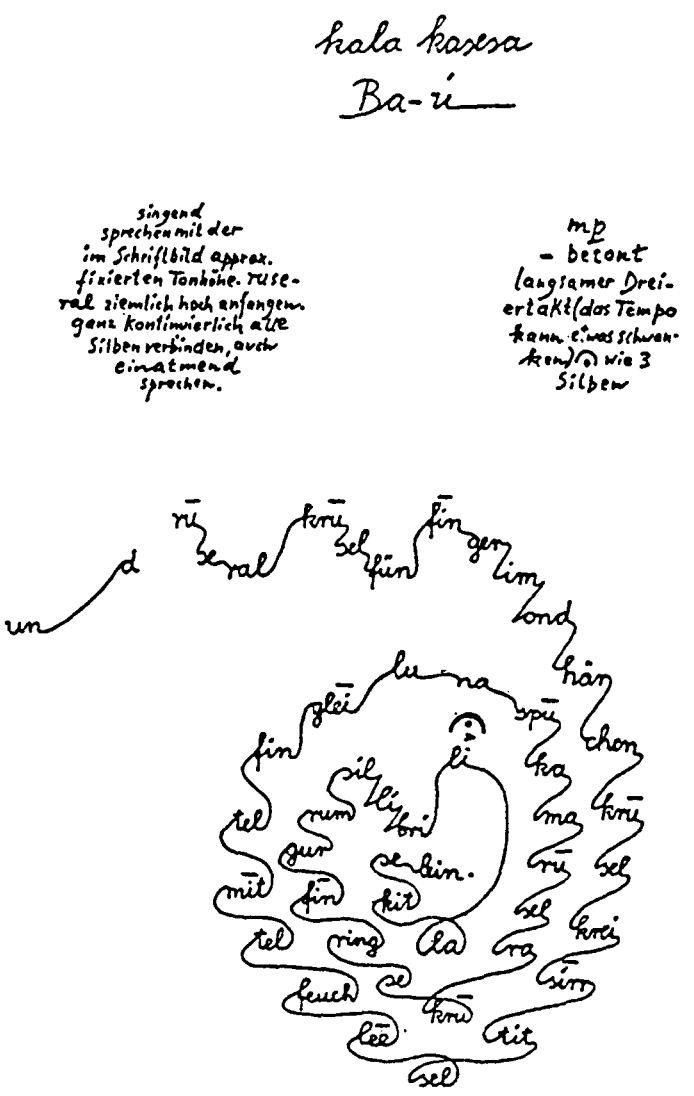


Fig. 40. Stockhausen, *Stimmung*. (© Universal Edition A. G.; used by permission.)

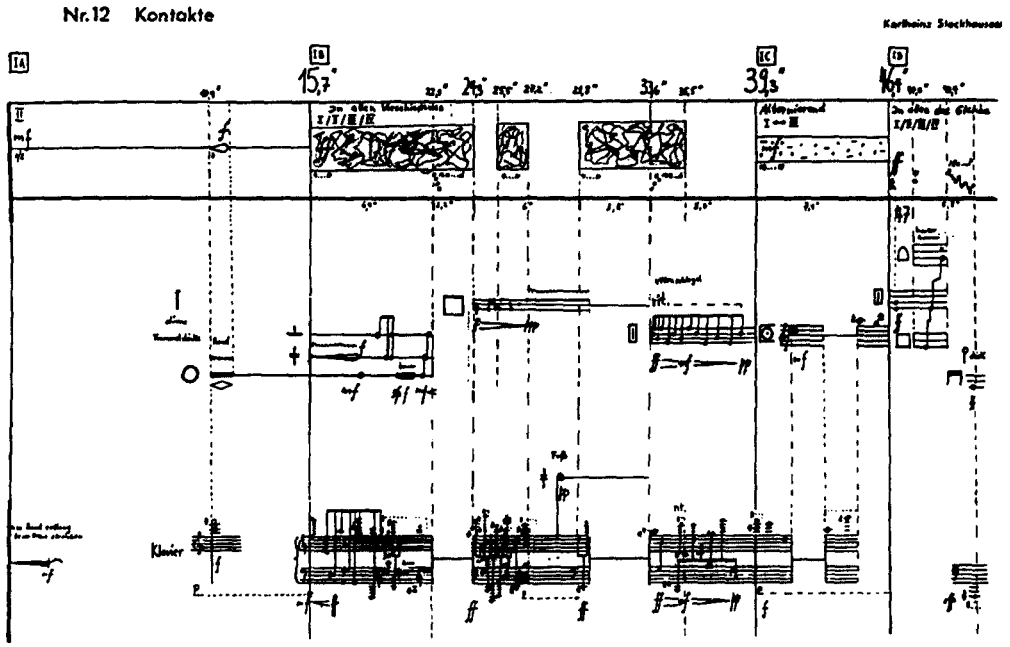


Fig. 41. Stockhausen, *Kontakte*. (© Universal Edition A. G.; used by permission.)

The symbology of its discourse attains a new level in the works of Daniele Lombardi who was greatly influenced by Cardew (Fig. 42). But Lombardi, too, needs to establish rules: graphic symbols become signs in space to help both performers and listeners who must WATCH the score during the performance. He refuses idealism in constructing his scores: sound becomes like a multiplicity of being. He calls this method *ideographic musical writing*, that is to say a method for making music comprehensible to all [8]. (See Fig. 43.) Because the listener is obliged to read the score, Lombardi gives it special attention and makes all signs very clear in order to avoid any ambiguity he uses in interpretation. In order to catch the listener's attention he uses symmetric elementary shapes such as triangles, circles, ellipses, etc.

Bill Hellermann, in a piece called *At Sea* (1977) conceived an extraordinary score: staves are not in a straight line but imitate the movement of ocean waves (Fig. 44). Their symbolic movement fills every page. The composition is meant never to stop, and every beginning is a rebirth. A kind of universal symmetry is achieved.

Today many composers continue to use the staff method with many other media and indefinite kinds of instructions. A young Italian composer Lucia Donnini[9] in a piece called *Stucklein* (1982) reaches a strange visualization of symmetry using simply staves and notes (Fig. 45).

Sylvano Bussotti, with his important composition of the 1960s *Passion selon Sade*, became the inspiration of many young composers who learned from him to arrange an original work

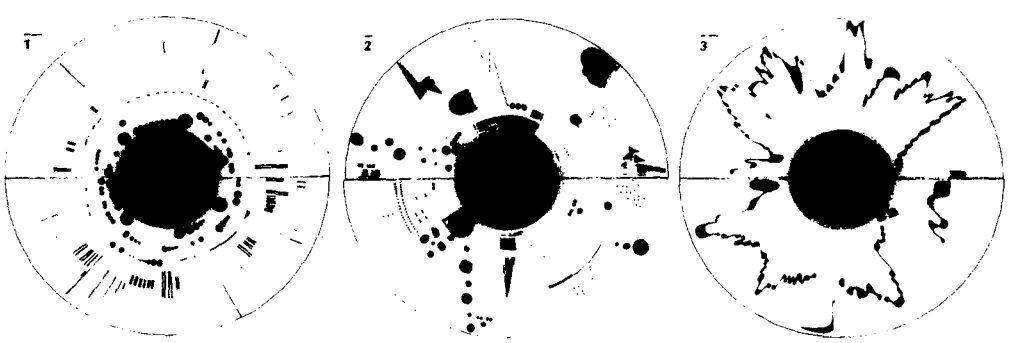


Fig. 42. D. Lombardi, *Twirls*. (© Daniele Lombardi; used by permission.)

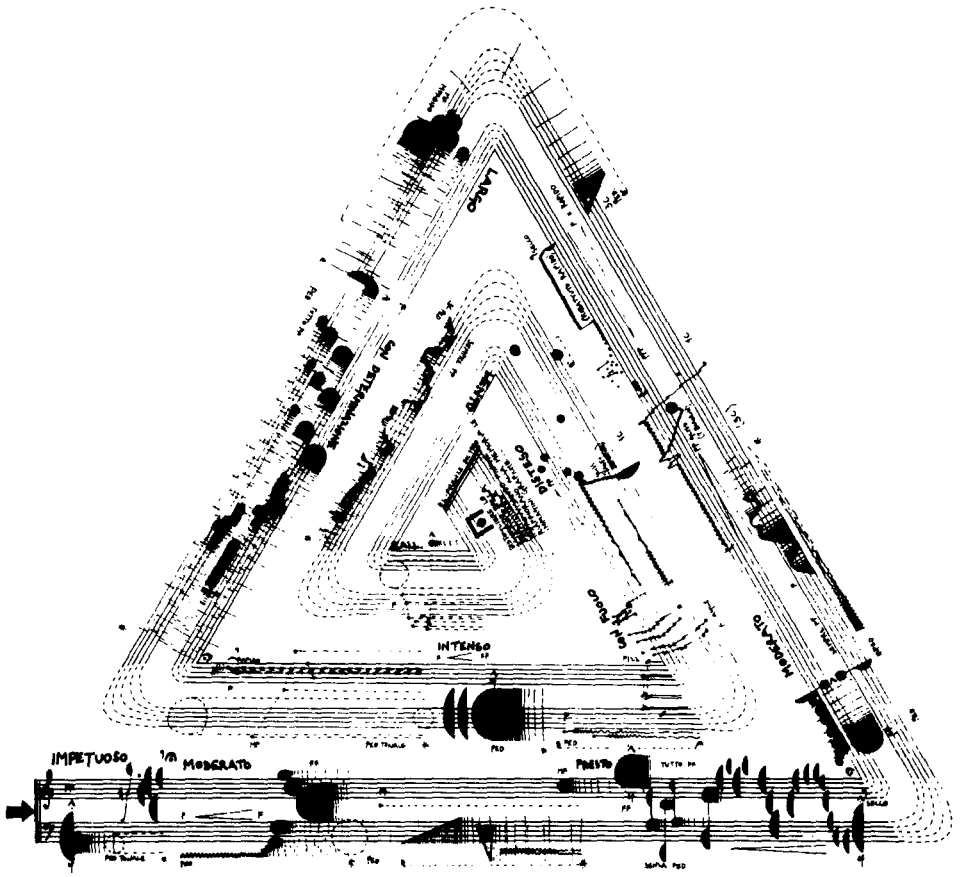


Fig. 43. D. Lombardi, *Tumbling Tumbleweed.* (© Daniele Lombardi; used by permission.)

of some magnitude with common formal structure. I wrote asking him to suggest a work which might serve as an example of symmetry in music. He answered, "In *Passion selon Sade* there are the examples that might be suitable for your work: *Solo, Rara (Dolce)*" (2/12/84).

I referred above to La Monte Young's *Composition* 1960 #7: the peculiarity of this piece is its extreme concentration. It represents the next step beyond Webern's and Cage's *silences*:

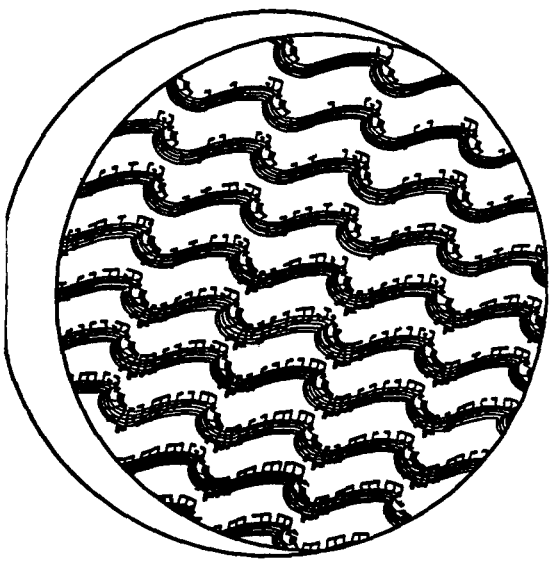


Fig. 44. B. Hellermann, *At Sea.* (© Bill Hellerman; used by permission.)

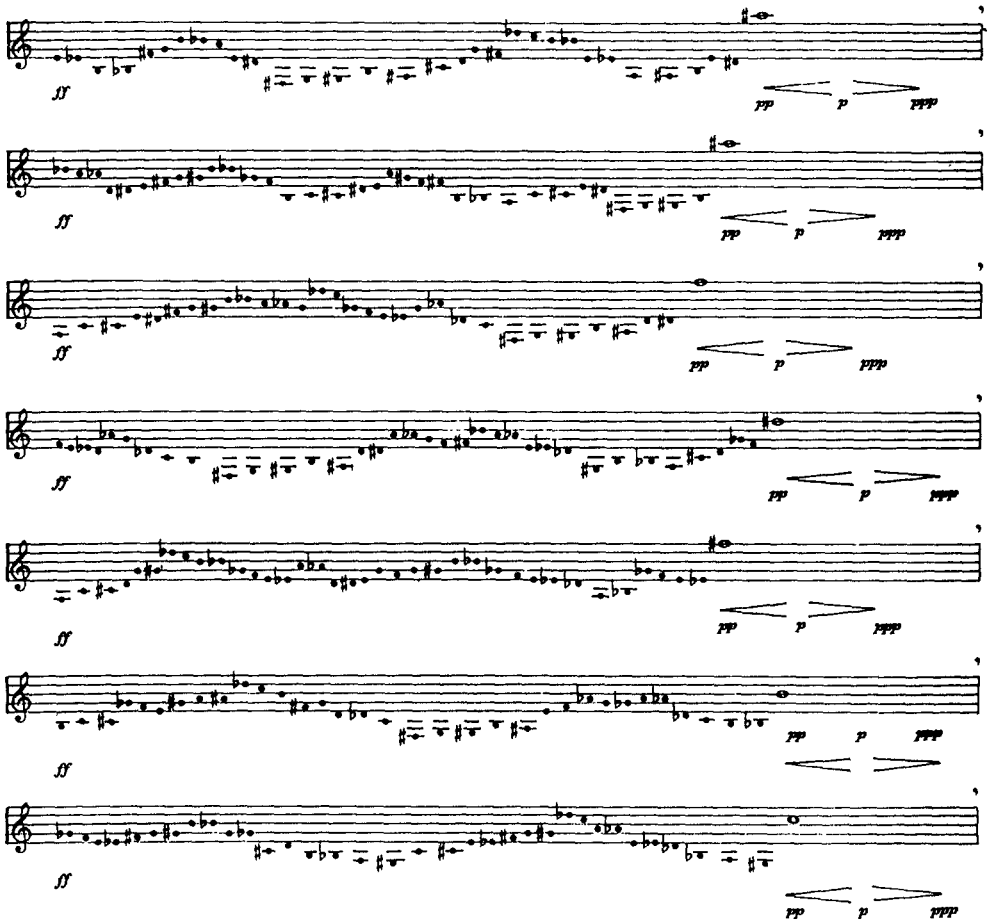


Fig. 45. L. Donnini, *Stuklein*. (© Lucia Donnini; used by permission.)

there is no longer any question of concession to the past (Fig. 46). This piece is formed by a chord of two notes with the text instruction "to be held for a long time". There have been two very famous performances: legend has it that the duration was eight hours in the previous American performance and six hours at *Darmstadter Kurse* in Germany a few years later. Here the symmetry is in sound, in resonant sensation, and in the score.

La Monte Young's piece gave rise to a group of musicians who represent the latest evolution of western music: they are T. Riley, F. Glass, S. Reich and C. Palestine. In the beginning they were rejected by other musicians and have found it difficult cultivating an audience or winning a support among conventional audiences who could apparently hear only what the music lacks in relation to the music they are used to: that is, harmonic movements and melodic perceptible forms. Their musical structure involves a steady harmonic base, often a drone and repetitive or *ostinato-like* rhythmic structure. Although all these composers have in fact received a reasonably conventional musical education, their principal support and audience has come from the world of the visual arts. Their concerts specially in the sixties and seventies took place in Art Galleries and consequently the first critical works appeared in Art Magazines. *Trio for Strings* (1958) a composition of La Monte Young, can be considered the starting point for this group of musicians (Fig. 47). *Trio* represent the antecedent of idea conceived in *Composition*

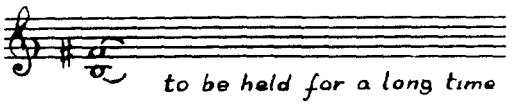


Fig. 46. La Monte Young, *Composition* 1960 #7. Reprinted from *An Anthology*. Young & MacLow, New York (1963). (© La Monte Young; used by permission.)

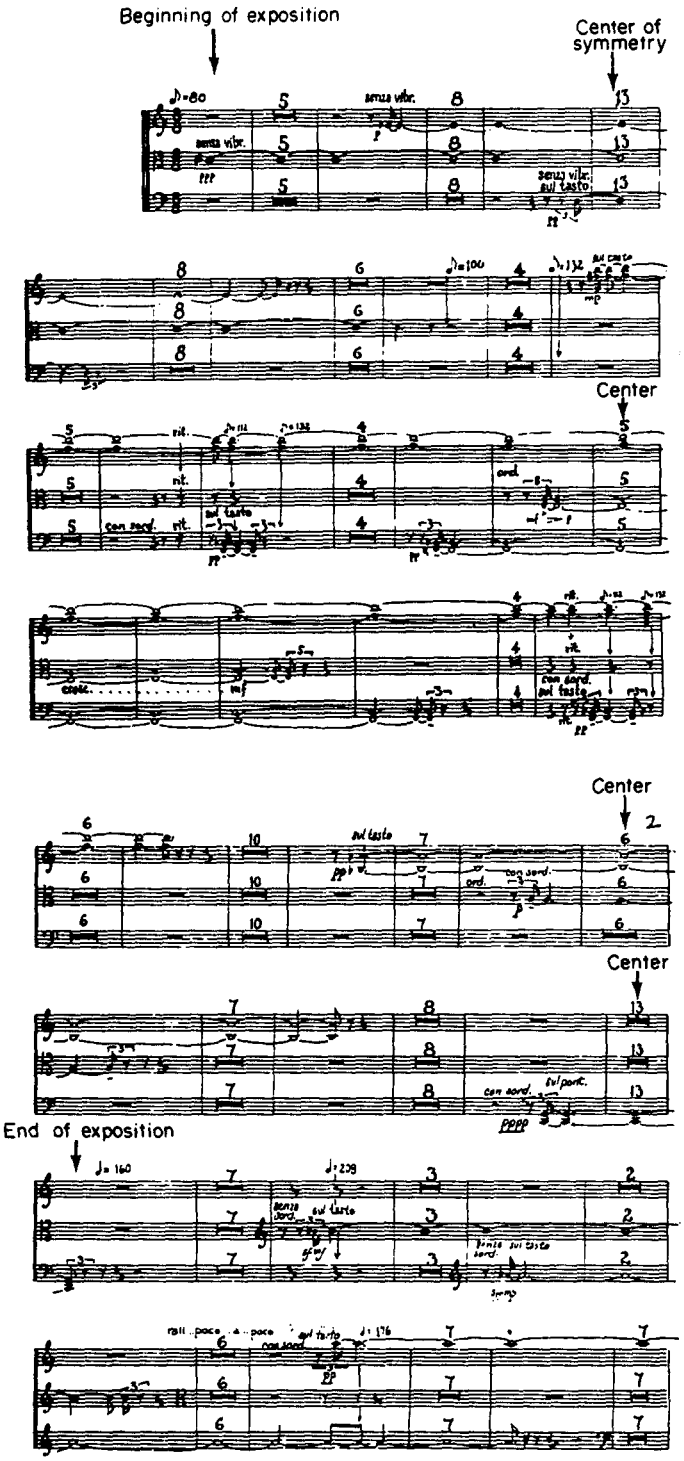
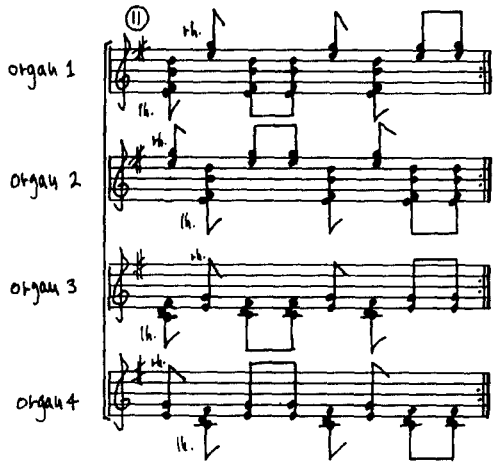


Fig. 47. La Monte Young, *Trio for strings*. (© La Monte Young; used by permission.)

1960 #7. This score presents a very interesting kind of symmetry: the piece has an exposition, a recapitulation and a coda; all these parts have one or more centers of symmetry. Fig. 47 is the exposition and the composer himself marked the beginning, the end and the three centers of symmetry for use in this article. All of the scores of this group of composers are really symmetrical in their visualisation: as an example I offer two extracts from Steve Reich's works (Fig. 48).



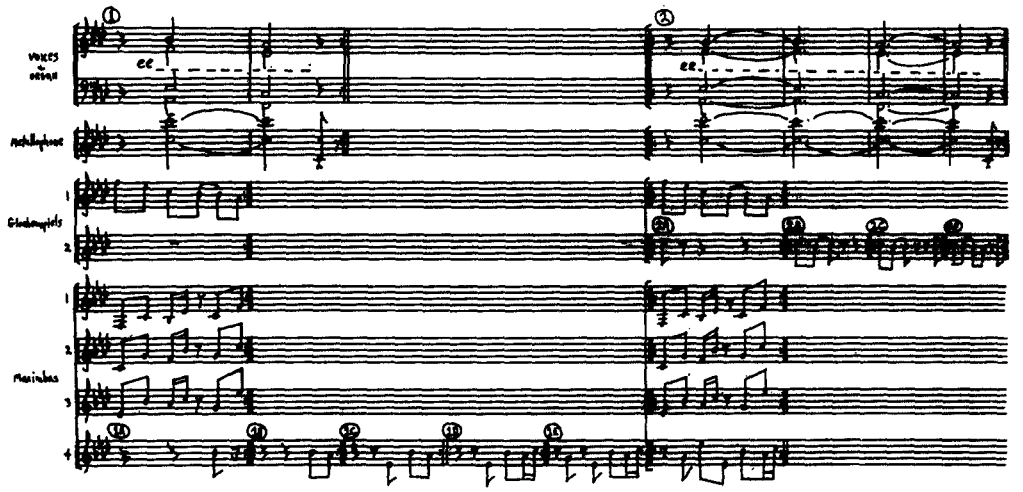


Fig. 48. S. Reich, *Phase Patterns* and *Music for Mallet Instruments, Voices and Organ*. (© Steve Reich; used by permission.)

I consider my music in its resonant result in line with the music of these composers; but my scores are different because I use more media[10]. The score (in Fig. 49) is composed of three pieces *Andar*, *Fula*, *Te-eesa* (*Suca* is another version of *Andar*) consisting of notes, staves, graphic instruction, and text instructions (not shown)[11]. The symmetry and asymmetry is quite evident both graphically and musically. Graphically, my scores are represented by formal waves of notes written in the staves displayed on an oscilloscope monitor.

In the field of music many composers have begun to use the computer to create sound. Computer music is going to replace electronic music. Computers require programs, and the score often becomes such a program, resembling a mechanical activity more than music. Music becomes numbers (frequencies, ratios, series, Fibonacci Series, Pascal triangles, etc.). In the oldest studies (specially Greek) ratios were considered to be the mathematical source of music. Because of the extensive use of computers, the theory of music in relation with mathematics and physics is once again going to be the object of research and investigation.

Stockhausen was the first composer who designed a score for electronic music: in *Studie I* (1953) the score and the music have nothing symmetrical; in explanations of the way he

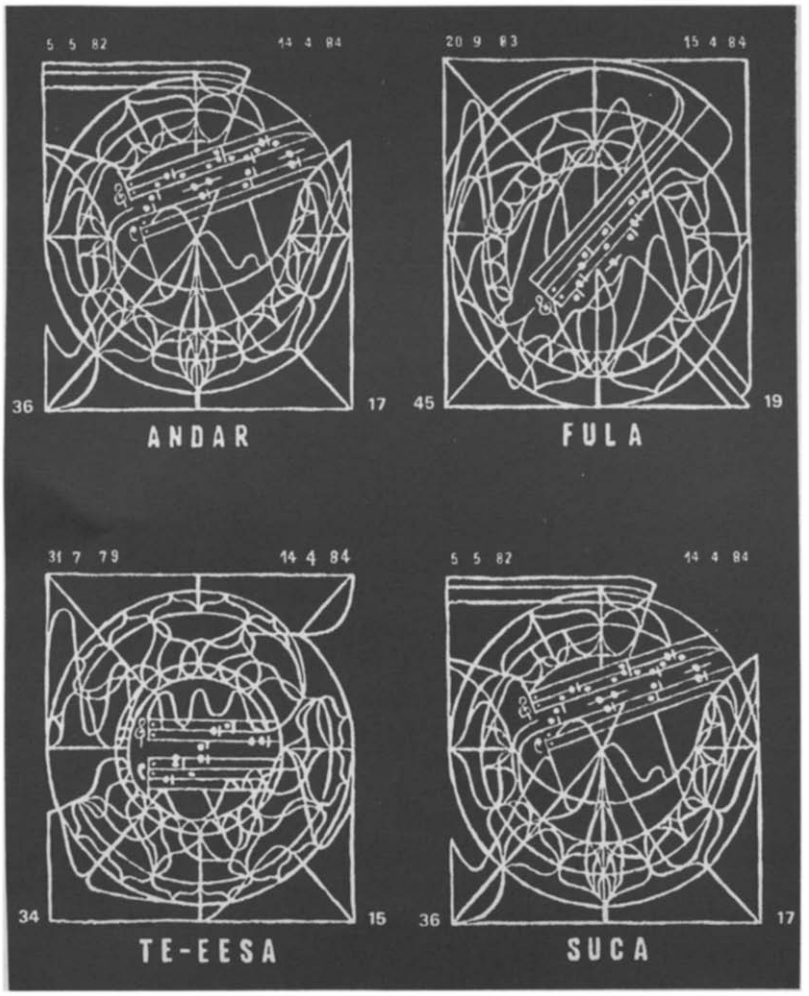


Fig. 49. R. Donnini. *Andar*, *Fula*, *Te-eesa* (© Roberto Donnini).

Albert Mayr

PERIODICITÀ 1 for 5 voices and 5 stopwatches

Each of the performers - who should be situated at a certain distance from each other - chooses one of the syllables

Pe - rio - di - ci - tà

and says it at the indicated times (try to be as accurate as possible)

Articulation should be smooth, not staccato.

Pitch, timbre and intensity may vary gradually, but always within the normal speech-register of each performer.

Pe	rio	di	ci	tà
0'06"	0'02"	0'00"	0'00"	0'02"
19"	16"	15"	16"	19"
32"	30"	30"	32"	36"
45"	44"	45"	48"	53"
58"	58"			
1'11"	1'12"	1'00"	1'04"	1'10"
24"	26"	15"	20"	27"
37"	40"	30"	36"	44"
50"	54"	45"	52"	
2'03"	2'08"	2'00"	2'08"	2'01"
16"	22"	15"	24"	18"
29"	36"	30"	40"	35"
42"	50"	45"	56"	52"
55"				
3'08"	3'04"	3'00"	3'12"	3'09"
21"	18"	15"	28"	26"
34"	32"	30"	44"	43"
47"	46"	45"		
4'00"	4'00"	4'00"	4'00"	4'00"
13"	14"	15"	16"	17"
26"	28"	30"	32"	34"
39"	42"	45"	48"	51"
52"	56"			
5'05"	5'10"	5'00"	5'04"	5'08"
18"	24"	15"	20"	25"
31"	38"	30"	36"	42"
44"	52"	45"	52"	59"
57"				
6'10"	6'06"	6'00"	6'08"	6'16"
23"	20"	15"	24"	33"
36"	34"	30"	40"	50"
49"	48"	45"	56"	
7'02"	7'02"	7'00"	7'12"	7'07"
15"	16"	15"	28"	24"
28"	30"	30"	44"	41"
41"	44"	45"		58"
54"	58"			
		8'00"	8'00"	

Fig. 50. A. Mayr, *Periodicità*. (© A. Mayr; used by permission.)

Albert Mayr
NAM PLAY FOR NAMEBEARERS

Each group of players writes its own score,using the elements given,i.e. the bitstrings resulting from the conversion of letters to binary numbers.
The bitstrings are arranged in an array (see example, there the bitstrings corresponding to the first 3 letters of each name were used). The resulting score is read as follows:
each performer plays the bitstring corresponding to his name,one bit at a time; a 1 indicates an event (acoustical,visual or other) to be performed or triggered by the player,a 0 indicates 'tacet'.
Each (vertical) column of bits represents a group-situation within a time-unit the length of which is not specified. The time-unit begins when one or more active players in a situation start(s) his (their) event(s).The other active players must begin their events before the end of the first event in the time-unit,but the events need not be simultaneous or have the same length. Once all active players in a situation have brought their events to an end the respective time-unit is considered finished.
Rests between time-units are ad libitum.
During performance the score should be projected on a screen.

example

PIETRO	0	1	0	1	1	1	0	0	1	0	0	1	0	0	0	1	0	1
GIANCARLO	0	0	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	1
FREDERIC	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	1
CHRISTIAN	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	0	0	1
PAUL	0	1	0	1	1	1	0	0	0	0	0	1	1	0	0	1	0	0
DON	0	0	0	1	0	0	0	1	0	1	1	0	0	1	0	1	0	1
BIRGID	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	0	1
YVES	1	0	1	0	0	0	1	0	0	1	0	1	0	0	0	1	0	1

Fig. 51. A. Mayr, *Nam Play*. (© A. Mayr; used by permission.)

composed this score, Stockhausen says that a series formed by the numbers 4 5 3 6 2 is the basic rule: do not use any symmetric succession and avoid repeating two or more times the same frequency in a predetermined section of music.

In computer and electronic music the frequencies and their numbers are conceived as material for a program of music composed uniquely of intensity and rhythm. In the following

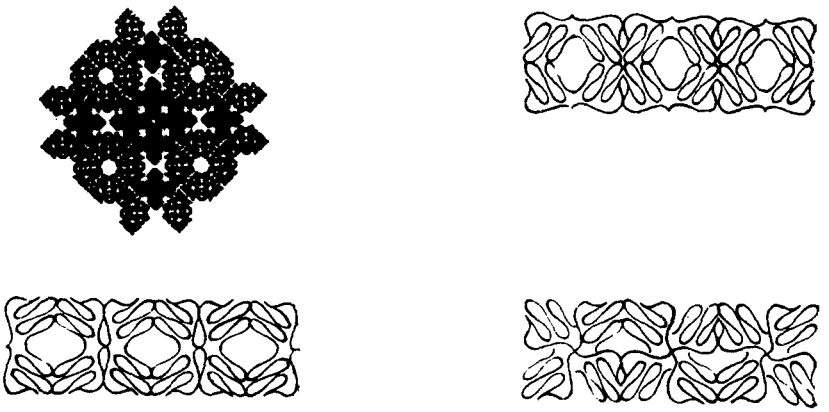
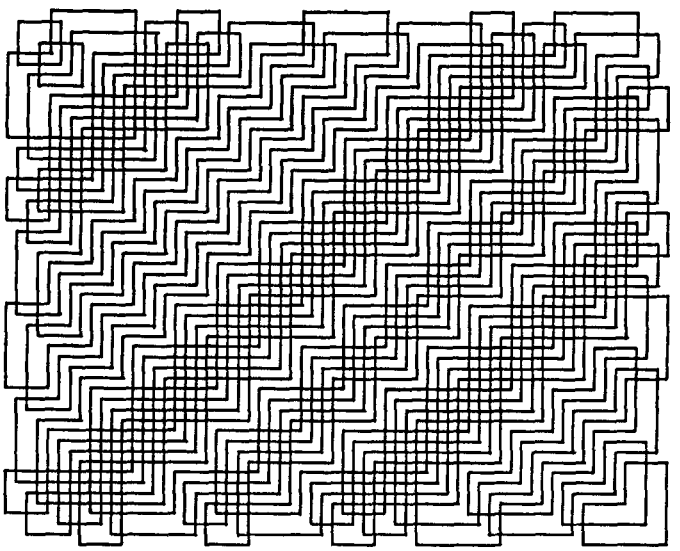


Fig. 52. M. Zazeela. Reprinted from *Selected Writings*. Heiner Friedrich (1969). (© Marian Zazeela; used by permission.)



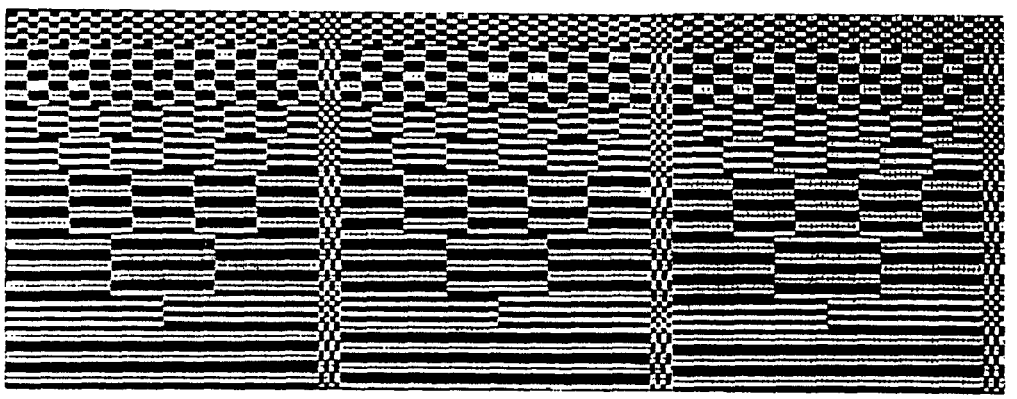


Fig. 53. J. Gibson, 15/3:5. *Primordial Relation Series* and J. Gibson and Vitalis, *Drawing for Video*. (0.9A) (© J. Gibson (1984); used by permission.)

piece by Albert Mayr called *Periodicità* (1974) the symmetry springs from the timing of the performance. Performers join simultaneously at the fourth minute the exact beat that begins again the word "periodicità" (Fig. 50). In another piece called *Nam Play* (1973) the binary system of numbers applied to the names of the players becomes the score to be played: instructions and examples are in reality the score conceived by the composer (Fig. 51).

Another branch of composers and performers uses only drawings not considered as a score, but as an aid to understanding the music when performed. Marian Zazeela's works are closely related to the music of La Monte Young (see Fig. 52). She often performs his music. During the performances slides of Zazeela's designs and drawings are projected upon the performers

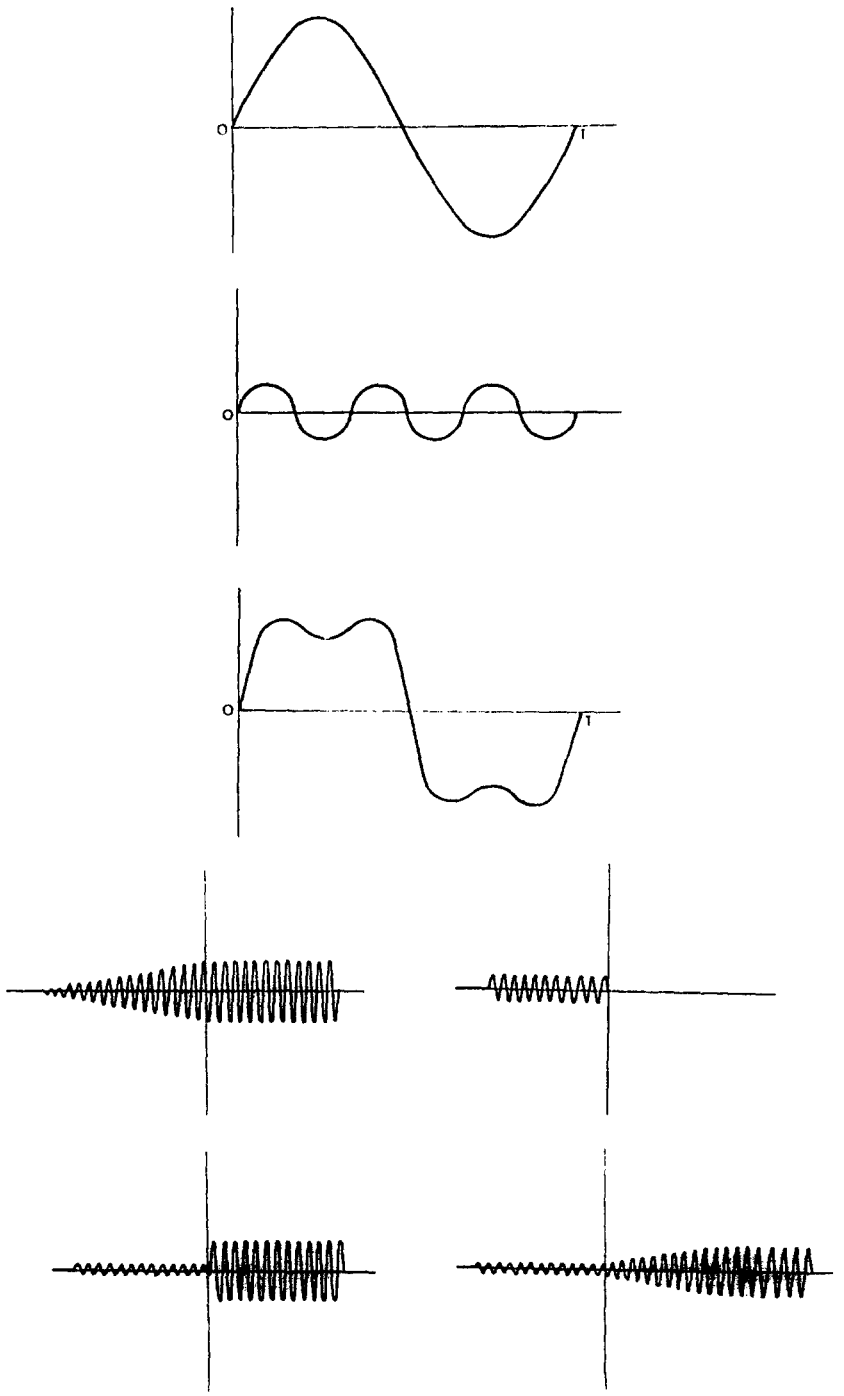


Fig. 54.

and the listeners. The sound becomes a representation of the designs and drawings, as the slides seem to be the visualisation of the music's pathos.

The drawings by Jon Gibson are different in nature but the effect on both listeners and performers is the same. But these *scores* of Gibson's have their origin in optical art, and there is apparently no symmetric intention (Fig. 53).

Music, in common with all the arts, is constantly in evolution and it is not possible to foretell the future. If it were so it would mean the certain death of the arts. It is not possible to draw conclusions about symmetry in music, because to do so would restrict its meaning. I leave the readers to their own judgement[12]. I, nevertheless, would like to finish with patterns displayed on a monitor when a frequency is visualized by a beam of electrons from a cathode-ray tube as a wave form (Fig. 54). These fluctuating lines are, perhaps, the symmetrical secret soul of music, conceived as both an artistic and a technological field of research and investigation.

REFERENCES AND NOTES

1. For example Rock music is symmetrical in a beat usually in Common Time 4/4. Rock music is the folk music of our western civilization of the last 30 years. It has no scores.
2. H. Weyll, *La simmetria*. Feltrinelli ed., Milano (1975); E. Agazzi, *La simmetria*. Soc. ed. Il Mulino, Milano (1973); Atti del Simposio, Roma 1969, *Simmetrie*. Accademia Nazionale Dei Lincei (1970); G. Rigault, *Simmetrie e Cristalli*. Loescher ed., Torino (1979).
3. G. Deleuze, *Différence et répétition*. Presse Universitaires de France, Paris (1968); E. Levinas, *Totality and infinity*. Martinus Nijhoff Publishers, The Hague (1979).
4. If not clearly mentioned, all short examples of this article are transcribed by myself.
5. The original score is in *Ear Magazine East* **8**, Number 1–2, May 1983.
6. N. Abraham, *Le temps, le rythme et l'incoscient*, in: Revue Francaise de psychanalyse, *La créativité* no. 4 Juillet 1972, Presses Universitaires de France, Paris (1972).
7. D. Schnebel, *Composition* 1960: *La Monte Young* (1971) in: Musique en Jeu no. 11 Juin 1973, Editions Du Seuil, Paris (1973).
8. D. Lombardi, *Spartito preso/La musica da vedere*. Vallecchi Ed., Firenze (1981).
9. There is no relation with the author of this article.
10. In *Leonardo*, **14**, no. 2, Spring 1981, Pergamon Press, there is an article I wrote about my scores entitled *Artistic graphic musical scores influenced by Tantric Art*.
11. A record (numbered, signed, and with hand-painted cover) of my music can be obtained from Galleria Schema, Via della Vigna Nuova 17, p.p., 50123 Florence, Italy. The record is entitled T1A, T2A (1980), Lynx Records (Ed. Lynx-xel-ha Records) (cat. no. Z 00112). Now I am preparing another record with a version of the score TUNEDLESS 2° including *Andar Fula Te-eesa Suca*: one of the instruments used in this record will be a computer.
12. I am grateful to the publishers and composers for permission to reproduce extracts from music which is their copyright. Special thanks for different reasons to Kaye Ashe, Teresa M. Brooks, Isabelle Picard, Paola Vitali, Catia Morani, Giuseppe Morrocchi, Carlo Bonomi, Aldo Golin.