

Terretéktoth : Space and Timbre, Timbre and Space

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In this article, we will analyze the way in which Xenakis uses space, fills it with sound and colors it according to the processes of composition used in his work *Terretéktoth*. Does there exist a particular way of spatializing the timbre in Xenakis and in particular, in this work? Do there exist rhythms of timbre? We will try to understand and answer these questions in the course of this study. *Terretéktoth* has been selected because it is a very rich work in this domain. Even in the placement of the players, Xenakis reveals a vast undertaking: he granulates the entire orchestra over a circular space with the percussion on the periphery of the instrumental circle to enclose the sounds.¹

The disposition of the instruments throughout all of the available physical space allows Xenakis specific possibilities in the spatial treatment of sound. Timbrally, it places the instruments in such a way as to create specific local colors, mixtures and fusions, oppositions, reliefs and sonorous waves. The disposition of instruments similarly allows him the creation, in the space, of maps, figures and particular sonorous constellations, enveloping the listener in the sonic phenomenon which, in his work, possesses characteristics of rare force and power.² Via the game of timbres, of rhythms, of dynamics, of densities etc., Xenakis produces the unique illusion of movement of volumes and masses³. Xenakis moreover compels us with such a disposition of instruments to a multi-directional listening and a multi-dimensionality of sound. Multi-directional because the sounds are emitted in different places in the concert hall - multidimensional because one can listen to

¹ Xenakis deals with space and the spatialization of sound in several of his works *Eonta* (1963-64) for piano and 5 brass, *Terretéktoth* (1965-66) for large orchestra. *Nomos Gamma* (1967-68) for large orchestra, *Persephassa* (1969) for 6 percussionists, *Windungen* (1976) for 12 'cellos, *Alax* (1985) for 3 instrumental ensembles and 6 spectacles of sound and light, *Polytopes* (1967-78) are examples of this. These works use diverse compositional procedures and the space and spatialization of sound, differently in each work. *Terretéktoth* was premiered on the third of April 1966 in the International Festival of Contemporary Art of Royan, by the Orchestre Philharmonique de l'ORTF under the direction of Heinrich Scherchen. The orchestral complement of this work involves: 3 flutes (piccolo), 3 oboes, 2 clarinets (clarinet in E \flat , bass clarinet) 4 horns, 4 trumpets, 4 trombones, tuba, 3 percussionists and strings (16, 14, 12, 10, 8), plus supplementary instruments. Each player is provided, in addition to his or her own instrument, with a whip, a wood block, maracas and a siren.

² Astronomy terms constellation, a group of stars which, because of their great stability of stellar direction, conserve the same configuration. Certain of these groups recall the forms of objects or animals. The Lyre, the Great Bear, or the Bull are examples of this. I allow the metaphor here to designate the sonorous configuration obtained by the emission of the same sounds by instruments disposed in different places in the instrumental circle. These constellations have quite varied forms.

³ Nevertheless, it is in *Pithoprakta* (1955-56) that Xenakis realizes his first attempt to conquer space. At the end of the work, he fixes the entire orchestra on the same pitch level, in order to permit the spatialization of this pitch by several stringed instruments.

the work on several dimensions. This listening can reflect upon the treatment of space, on the treatment of timbres, the created sonic movements, oppositions, fusions, the mixture or the transformation of elements of composition etc.⁴ The space filled with sound is transfigured thus by the magic of the composer.

In studying the score, it is noted that Xenakis specifies in this work, and for the first time ever, the disposition of the orchestra and the public in the concert space. They are positioned in a ring around the conductor. (Figure 1) Most importantly and innovatively, this necessitates that the public be within the sound. The sound comes from all sides, the work being, according to the composer, the translation into music of phenomena from nature.⁵ The public finds itself submerged in the sound.

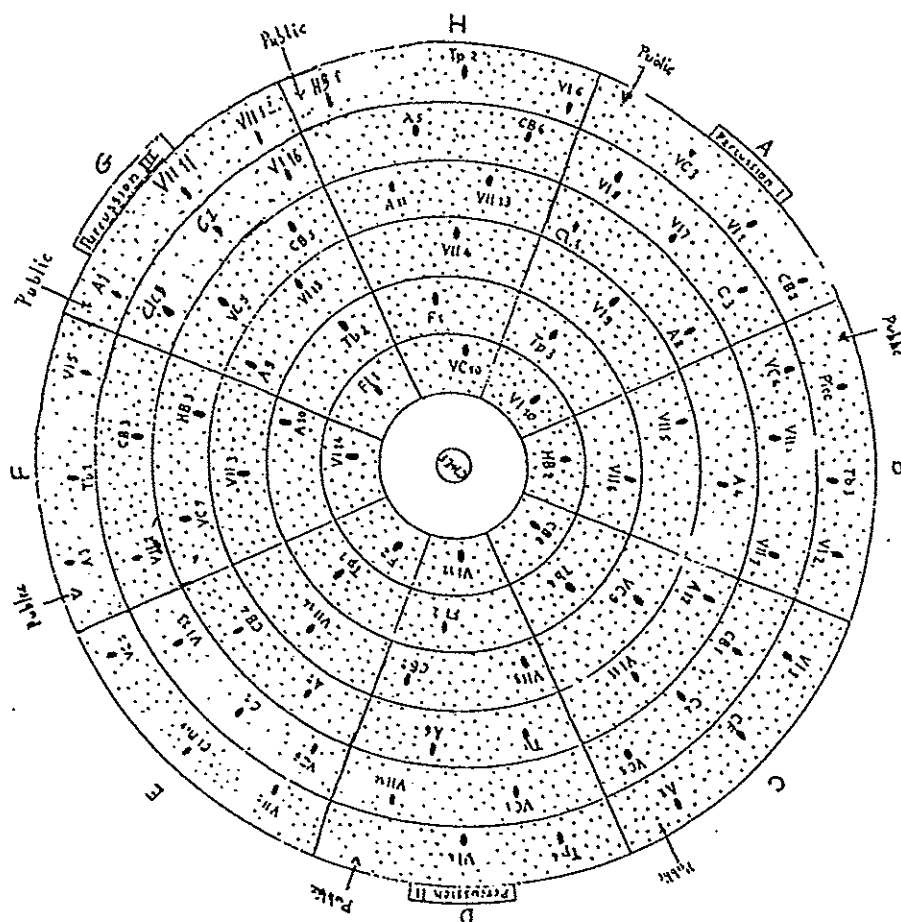


Figure 1: Orchestral Map

⁴ It is understood by elements of composition, the different manners of playing, dynamics, phrases, harmonies, rhythms or sonorous objects used in the conception of a musical work.

⁵ As Xenakis tells us "... when I was camping, I heard the sounds come from everywhere: I tried to reproduce the same thing in the space of the concert hall." (Szendy, Peter, "Ici et là - entretiens avec Iannis Xenakis," *Espaces les cahiers de l'IRCAM*, Paris IRCAM/Centre Georges Pompidou, 1994, n° 5, p. 110).

...Each person will find himself individually perched on the summit of a mountain in the middle of a storm which assails him from all sides, or in a frail boat struggling the high seas, or even in the bosom of a universe sprinkled with little sonorous stars⁶

Placed on the inside of the work, the public is more easily entreated by the composer. One does not remain indifferent to the sound, it surrounds us constantly.

The spatialization of musical material and the modulation of timbre are the processes most often utilized by the composer in *Terretéktorh*. Concerning the spatialization of musical material, Xenakis frequently utilizes sonic spatial movement, notably the rotation of sound. This movement which is primary in the conception of the work, is a consequence, not just of the spatial disposition utilized, but also of the desire of the composer. From the beginning of the work we perceive this characteristic. In it Xenakis uses several of these types of movement, the rotation of sound being determined by specific curves: the Archimedean spiral, the hyperbolic spiral and the logarithmic spiral.⁷ Thus, by analyzing the score, it can be seen that in the course of measures 1 to 9, Xenakis realizes the first movement of rotation of sound: a circular movement. Played by the following instruments,

violins I 8,7,1; 'cello 3 and doublebass 2 in sector A;
 violin I 2; violins II 8, 7 and 'cello 4 in sector B;
 violin I 3; viola 2; 'cello 3 and doublebass 1 in sector C;
 violin I 4; violin II 10 and 'cello 1 in sector D;
 violins II 13,1 and 'cello 6, 2 in sector E;
 violin I 5; violin II 2; viola 3 and doublebass 3 in sector F;
 violin I 15; violins II 12,11 and viola I in sector G;
 violin I 6; viola 5 and doublebass 6 in sector H.

it is effected from left to right on the same pitch (E3). Realized on the periphery of the orchestral circle (areas 6 and 5 of the map), its speed of rotation is constant: the duration of sound sustained in all of the sectors (10 quarter notes, except for sector A) and the similar dynamic in all of the cases (*pp* < *f* > *ppp*, see Figure 3). The sound on the periphery of the space surrounds the public and the orchestra (Figure 2)⁸.

⁶ "... Chacun individuellement se trouvera, soit perché au sommet d'une montagne au milieu d'un orage qui l'assaille de toutes parts, soit dans une barque frêle que ballote la pleine mer, soit encore au sein d'un univers parsemé de petites étoiles sonores ..." Matossian, Nouritza, *Iannis Xenakis*, Paris Payard/Fondation Sacem. collection "Musiciens d'aujourd'hui," 1981, p.224.

⁷ Cfs. Harler, Maria Anna "Spatial sound movement in the instrumental music of Iannis Xenakis," *Journal of New Music Research* Alblaserdam Swets & Zeitlinger, vol 23 1994 n°3, p. 291 - 314.

⁸ The orchestral map was devised by Xenakis in 8 sectors named A to H. Each sector was again divided into 6 others which are named from the center to the periphery from 1 to 6.

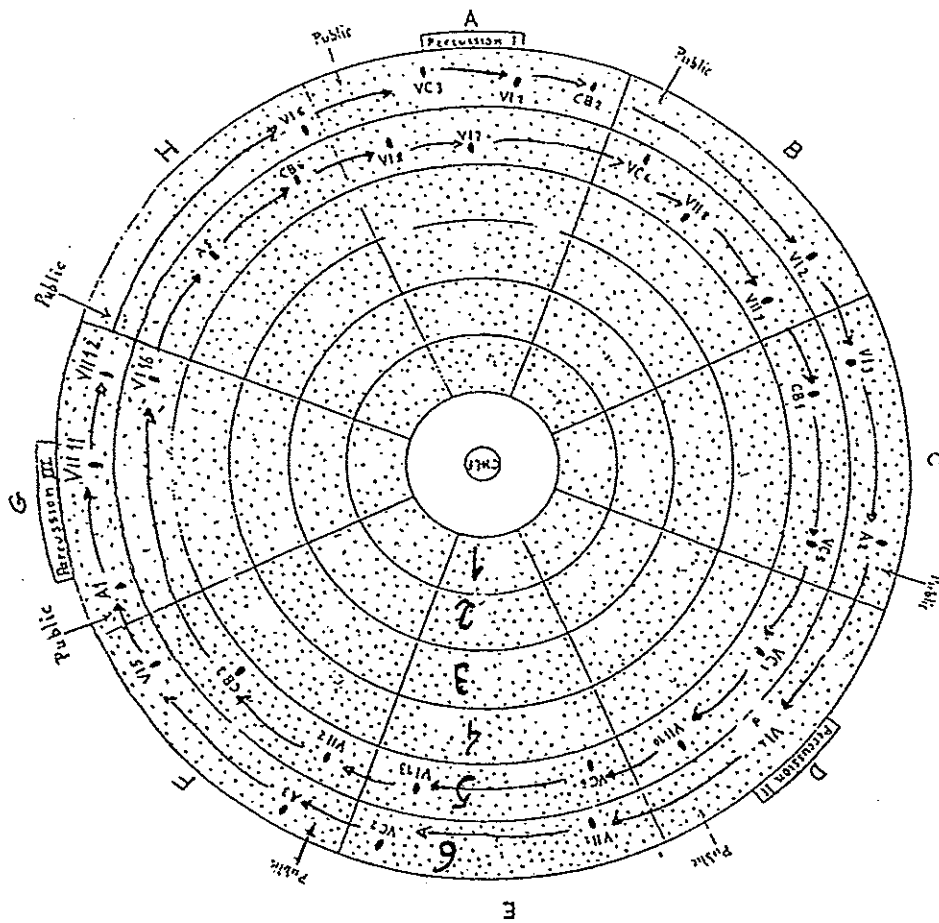


Figure 2: Orchestral Map

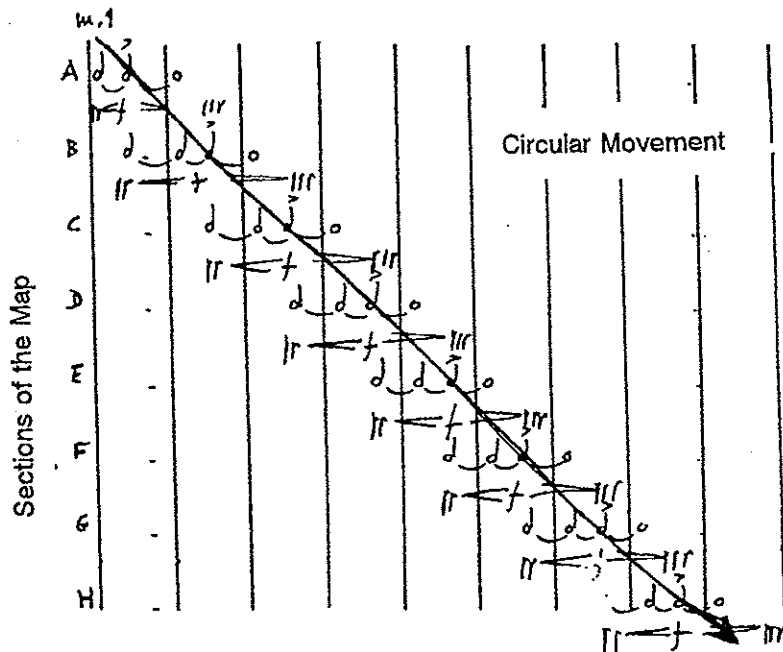


Figure 3: Rhythmic Schema of Sound Movement in mm. 1 - 9.

In measures 9 - 24, we see a rotation of sound realized according to a precise curve: the Archimedean spiral⁹ (Figure 4).

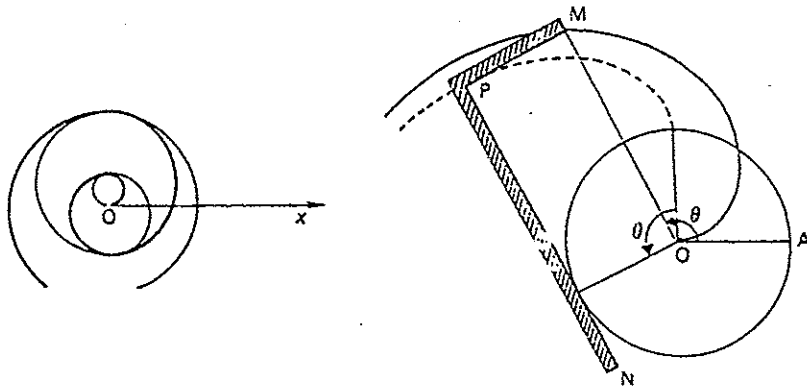


Figure 4: Archimedean Spiral

Colored by a *tremolo* in the maracas in a *pianissimo* (*ppp*) dynamic, (mm. 10-23) in the players of areas 4 to 1 of the orchestral map, this movement is realized on the same pitch, on the same instruments and according to the same direction of rotation of the preceding sonic movement (left to right). Nevertheless it contains an acceleration created by the use of an evolving dynamic from *ppp* < *mp* > to *ppp* < *mf* > *ppp* and to *ppp* < *f* > *ppp*: thus *mp* to *mf* to *f* and in shorter and shorter durations in each sector of the orchestral map. This produces an acceleration of rotation. The use of a stronger and stronger dynamic creates a more obvious spiral in sectors D, E, F, G and H, and in consequence, and sonic relief in this region of the space. (Figure 5).

In the course of measures 23 to 24, Xenakis also uses the Archimedean spiral. This time we find a *ritardando* of the sound movement obtained by the progressive use of longer and longer durations. This movement is brought about on the same pitch, in the same instruments and according to the same rotation (left to right) of the preceding movement (Figure 6).

⁹ The Archimedean spiral is a curved plane of polar equation $\rho = k\theta$ where k is unreal non nul. The first spiral in music appeared in *Gesang der Jüngling* (Karlheinz Stockhausen, 1955). Rotations are combined in a growing velocity. By this procedure, a rotation is transformed into a spiral and gives the impression that the sound is coming closer and closer. Other works by the same composer use the spiral: *Gruppen* (1955-57); *Carré* (1959-60); *Kontakte* (1959-60); *Hymnen* (1966-67); *Spiral* (1968); *Stimmung* (1968) and *Tunnel Spiral* (1969) are examples. See Purce, Jill "La Spirale dans la musique de Stockhausen," *Musique en Jeu*. Paris éd. du Seuil, septembre 1974, n°15, p. 7-23.

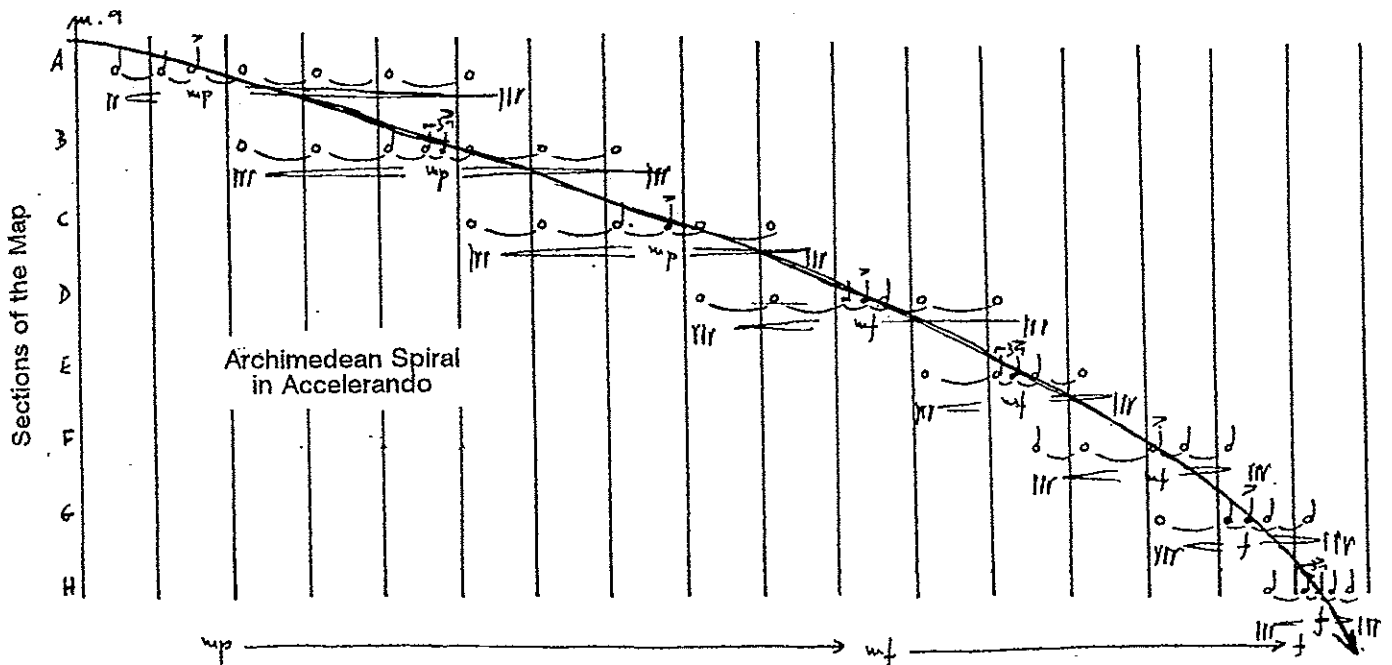


Figure 5: Rhythmic Schema of Sound Movement in mm. 9 - 24.

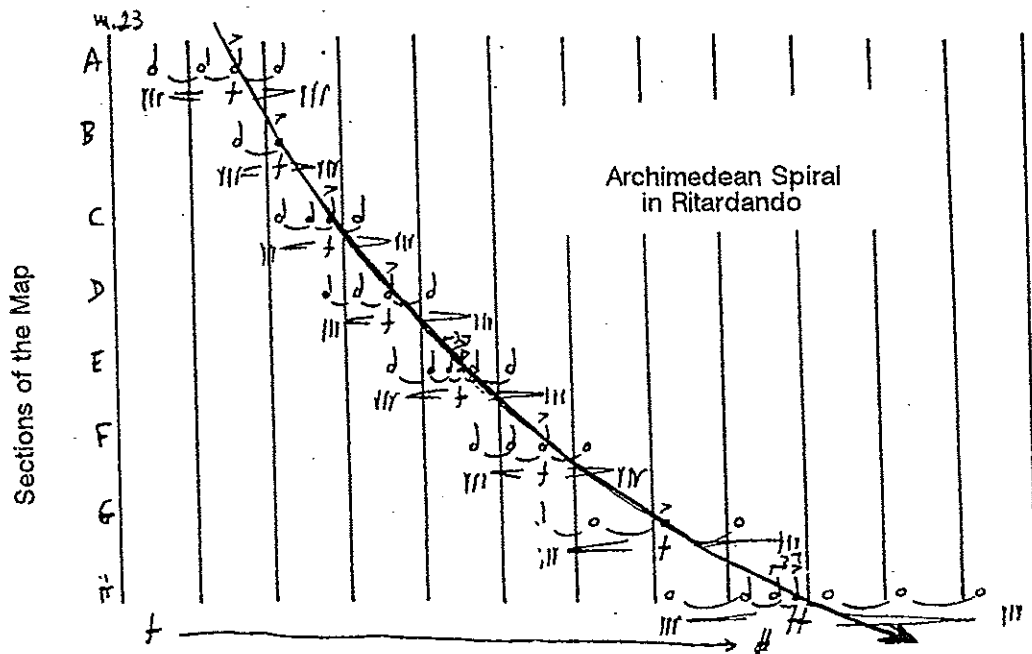


Figure 6: Rhythmic Schema of Sound Movement in mm. 23 - 24.

In the course of measures 32 - 45, the sonic movement follows a new curve: the hyperbolic spiral¹⁰ (Figure 7).

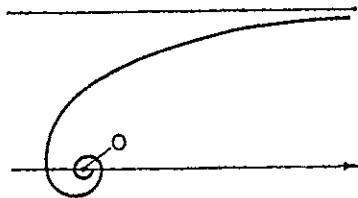


Figure 7: Hyperbolic Spiral

This sonic movement is realized in a continuous *accelerando*, the sonorous durations become shorter and shorter. Produced on the periphery of the orchestral circle (sectors 6 and 5 of the orchestral map) on the same pitch, the same instruments and with the same rotation (left to right), it contains an evolving dynamic *ppp < ff > ppp* to *ppp < fff > ppp* and to *ppp < sfff > ppp < sfff >*: thus an overall *ff < fff < sfff*. Linked to the continuous *accelerando* in the speed of rotation, this dynamic produces a *crescendo* of continuous tension (Figure 8).

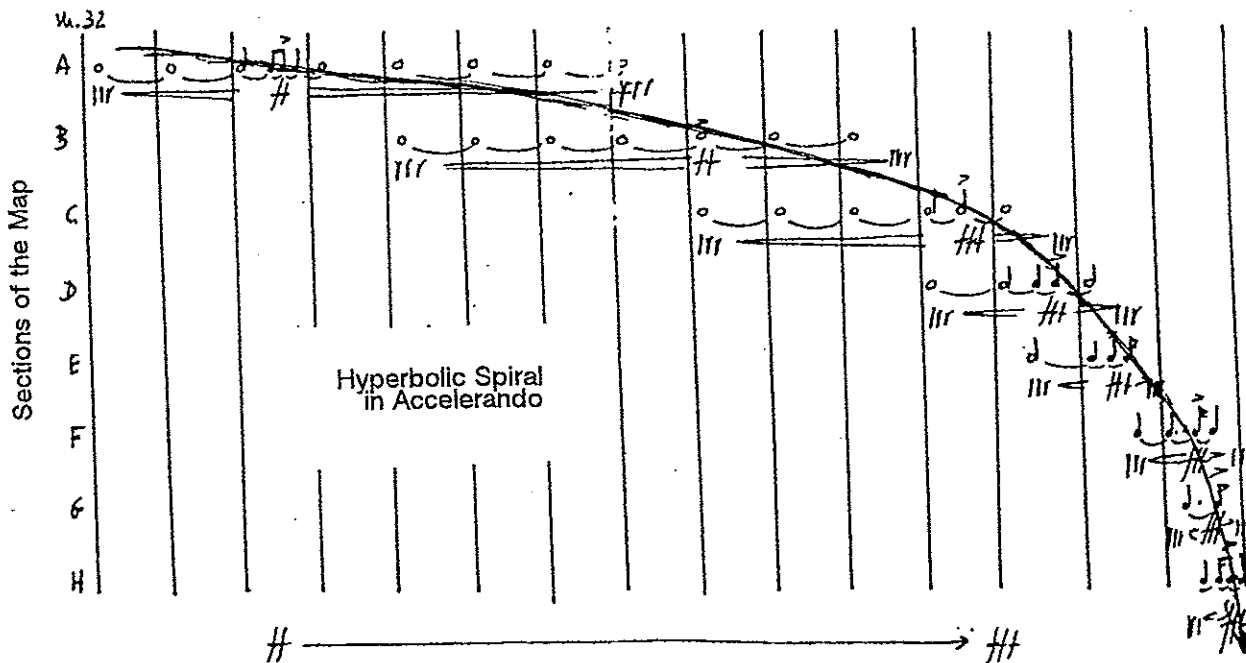


Figure 8: Rhythmic Schema of Sound Movement in mm. 32 - 45.

After an angular movement (mm. 45 - 47) and a polyrhythmic *tutti* (mm. 49 - 50), the direction of sonic rotation is modified. Now they turn from right to left and obey a

¹⁰ The hyperbolic spiral is a curved plane of polar equation $\rho \theta = a$ where a is real non nul.

different curve: the logarithmic spiral¹¹ (Figure 9).

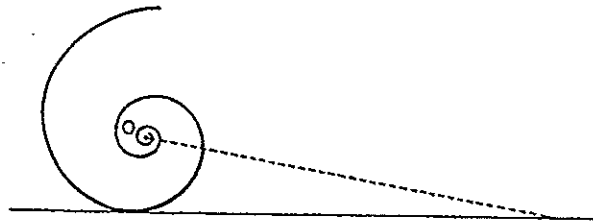


Figure 9: Logarithmic Spiral

In the course of measures 51 to 74, Xenakis makes 8 rotations in a continuous *accelerando* controlled by logarithmic spirals. We find the first rotation in measures 51 to 60. Realized on the same pitch as the previous ones (E3) it produces an evolving dynamic from *ppp < ff > ppp* to *ppp < f > ppp* and to *p < f > ppp*: thus *ff > f*, a *decrescendo*. This is opposed to the *accelerando* of the rotation (Figure 10).

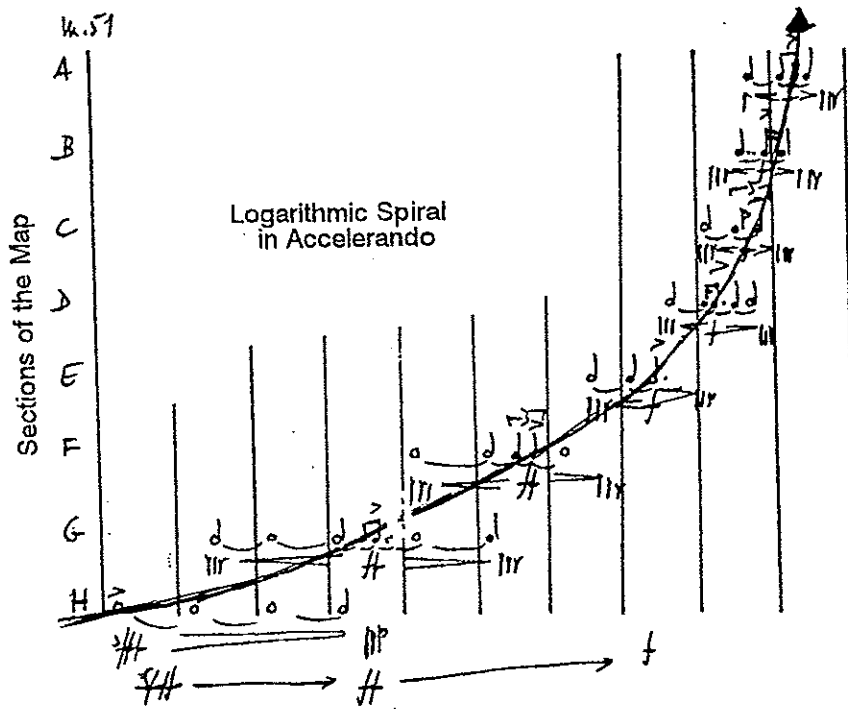


Figure 10: Rhythmic Schema of Sound Movement in mm. 51 - 60.

The rotation becomes faster in turn: this is the second rotation (mm. 65-69). The dynamics evolve from *p < f > ppp* to *ppp < mf > ppp* and to *p < mp > ppp*: thus *f > mf > mp* overall. This dynamic *decrescendo* is opposed to the *accelerando* of the movement of rotation controlled by the above mentioned curve (Figure 11):

¹¹ The logarithmic spiral is a curved plane of polar equation $\rho = e^{m\theta}$ where l is real non nul. It is also called an equiangular spiral, or Bernoulli spiral.

ex tempore

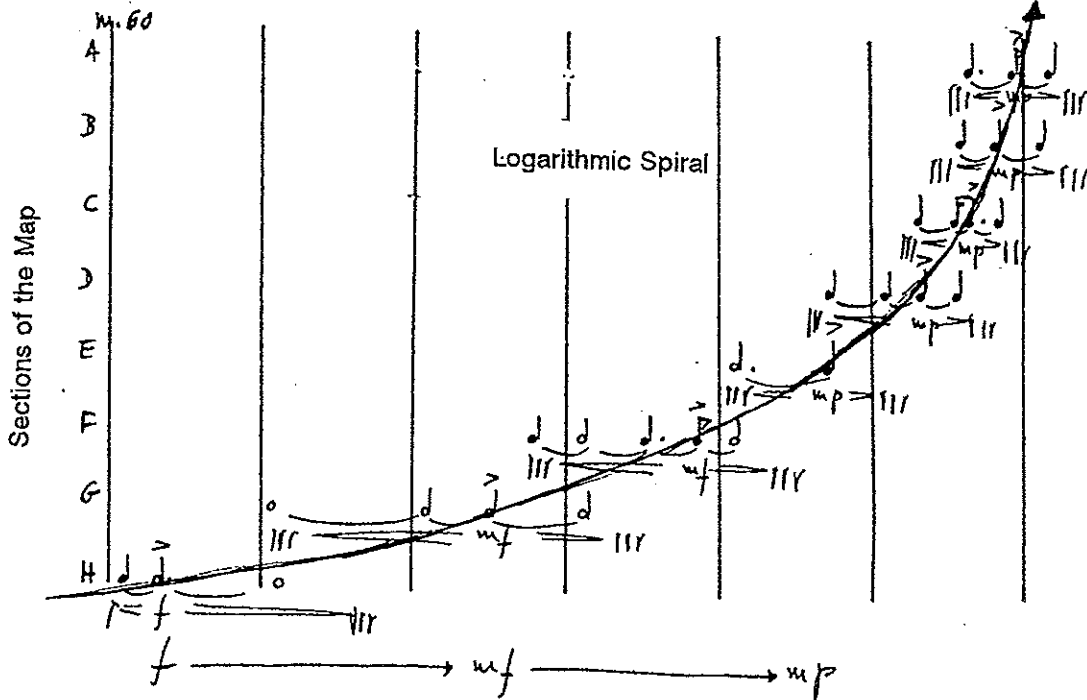


Figure 11: Rhythmic Schema of Sound Movement in mm. 60 - 66.

During the third rotation (mm. 65 - 69), the dynamics evolve from $ppp < mp > ppp$ to $ppp < p > ppp$ and to $ppp < pp > ppp$: thus $mp > p > ppp$. The speed of the rotation is greater than that of the preceding spirals (Figure 12).

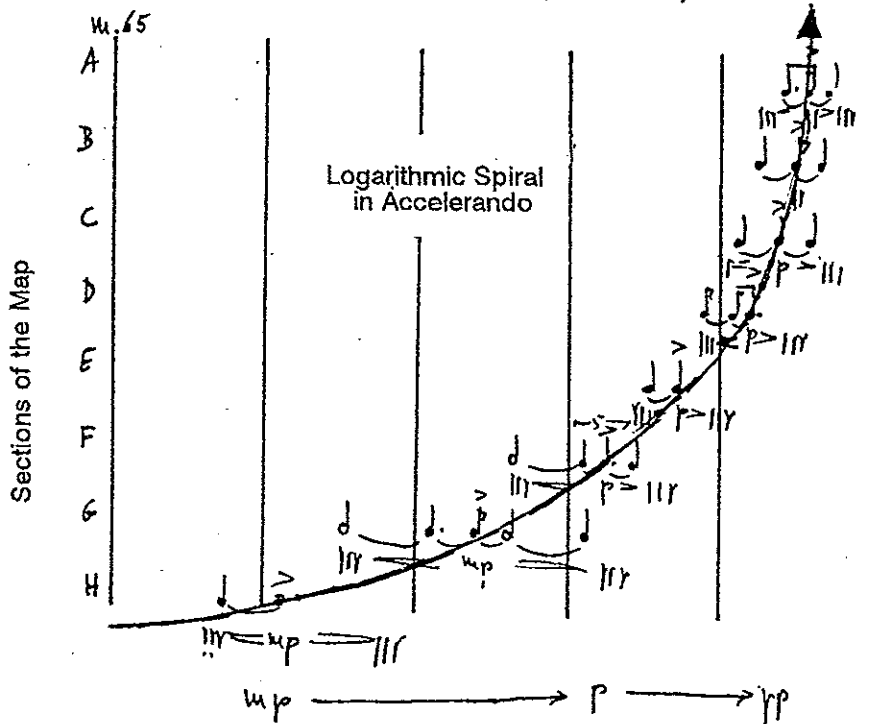


Figure 12: Rhythmic Schema of Sound Movement in mm. 65 - 69.

In measures 69 - 71, the fourth spiral, the dynamics evolve from *ppp* < *pp* > *ppp* to *ppp* < *p* > *ppp*: thus an overall *pp* > *p*. The durations are shorter and shorter. Consequently, the speed of rotation increases (Figure 13).

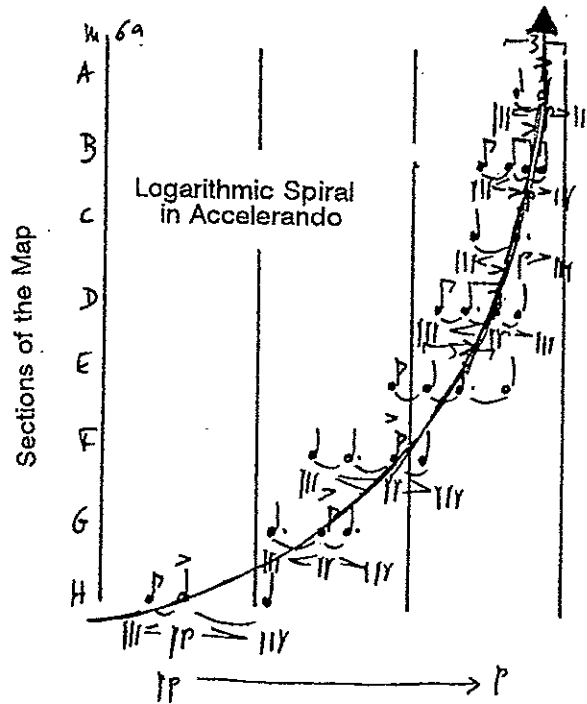


Figure 13: Rhythmic Schema of Sound Movement in mm. 69 - 71.

The fifth rotation, (measures 71-73), possesses a dynamic which evolves from *ppp* < *p* > *ppp* to *ppp* < *mp* > *ppp* and to *ppp* < *mf* > *ppp* and to *ppp* < *f*: thus *mp* < *mf* < *f*. There exists another continuous *accelerando* in the speed of rotation of the spirals (Figure 14.)

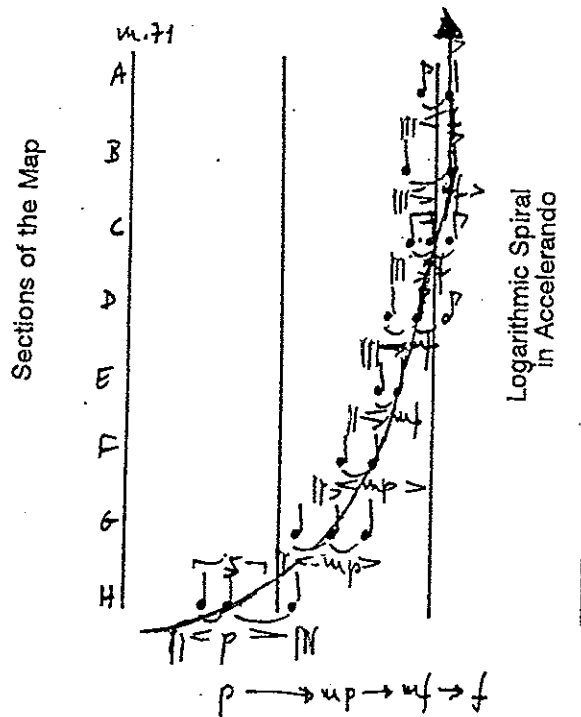


Figure 14: Rhythmic Schema of Sound Movement in mm. 71 - 73.

In the sixth rotation, measures (72 - 73), the dynamics evolve from *ppp* < *f* > *ppp* to *ppp* < *sff* > *ppp* and to *p* < *sfff* > *ppp*: thus *f* > *sff* > *sfff* overall. The speed of rotation is already very great (Figure 15).

Contrary to the preceding, the dynamic of the seventh rotation (measures 73-74), remains constant (*ppp* < *sfff*), being the point of maximal tension (Figure 16).

The same process is utilized in the course of the eighth rotation (measure 74); the dynamic is maintained (*sfff*): the speed of rotation and the tension being at the maximum (Figure 17 below).

These rotations are colored by a *tremolo* in the maracas during measures 55 to 74. Realized in sectors 4 to 1 of the orchestral map, it is opposed to the sonorous movement effected in sectors 6 and 5. The dynamic utilized creates reliefs, waves and diverse movements within the sonorous movement itself. In summary, it can be seen that Xenakis has been creating, since measure 51, a continuous *accelerando* of tension produced by an *accelerando* in the speed of rotation of sonorous movement. The dynamics of the *decrescendo* up to measure 70 are opposed to this movement. Beginning in this measure, they reinforce it. Everything contributes to the *crescendo* of tension which culminates in a homorythmic section in m. 75. The meter changes similarly (at this point). It becomes ternary (6/4), as does the tempo - the dotted half-note equalling 60 MM. We have remained on the first 74 measures because this is the point in the work where the rotation of sound is used most distinctively. The duration of this section of the work - 2 minutes and 30 seconds, attests to the importance of the procedure used. Subsequently the sonorous spatial movement is used differently, becoming diverse and less extended.

The tension and the expressive force of this section of the work are produced not only with the movement of rotation of sound, but also by an economy of means. Xenakis utilizes the same instruments, the same pitches and the same method of operation for 74 measures. He modifies only the speed of rotation and the dynamic; his only means of variation. The change of the speed of rotation of sound contributes to the creation of waves of sound. In this case, Xenakis utilizes the spirales which are always situated at the periphery of the instrumental circle and at the same pitch level. He plays with the dynamic, the speed and the direction of rotation of the movements to envelop us in the sound.¹²

¹² In his work *La Légende d'Eer* (1977), Xenakis utilizes the spiral differently. The spiral is not realized on the orchestral map (on one pitch level); it rises and descends in the musical/registral space. In this work, the continuous modulation of sound and of timbres predominates. The sound moves continually and remodels the musical space in spirals or in atmospheres of granular sounds. The spirals are obtained by the transformation of movements of rotation. These transformations are realized in register, intensity and speed of rotation. By the combination and modification of these parameters, Xenakis thus creates several spirals. If the sonorous sources remain fixed, the sonorous material unchangeable, and this is combined with a rising register, in a weaker and weaker intensity, and decreasing speed of rotation, the spirals rise and expand. If the register descends, the intensity becomes stronger and stronger with a growing speed of rotation, the spirals resemble whirlwinds. If the register rises, the intensity becomes stronger and stronger and the speed of rotation increases the spirals rise and become narrower and narrower. If, on the contrary, the register is maintained, the intensity becomes stronger and stronger and the speed of rotation grows, the spirals unfold remaining in an unchanging

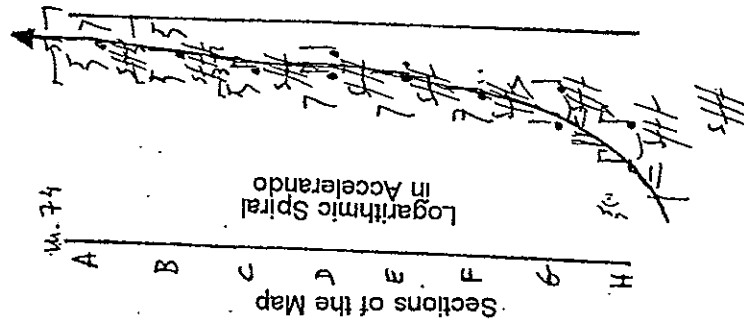


Figure 15: Rhythmic Schema of Sound Movement in mm. 72 - 73.

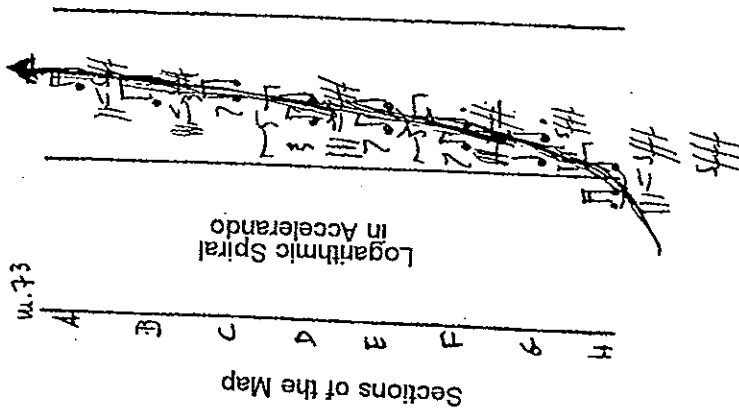


Figure 16: Rhythmic Schema of Sound Movement in mm. 73 - 74.

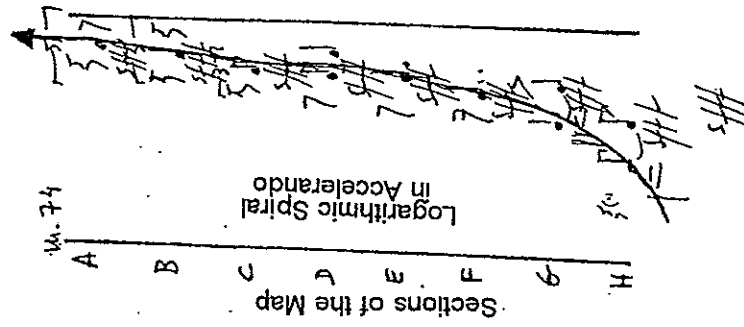


Figure 17: Rhythmic Schema of Sound Movement in m. 74.

Our perception of the sound and the musical texture is conditioned not only by its localization in the space but also by its timbre: the latter is used as a means of delineation of the space.

In its treatment of the modulation of timbre, *Terretêktorh* is a very rich work. The orchestral color of *Terretêktorh* is modified and transformed continually by the instruments, the manner of playing, the registers, the dynamics and the musical textures employed. We will show subsequently examples of timbral spaces and the processes of variation used to modulate them. Conceived differently, these timbral spaces are placed at distinct places of the orchestral map. Creating the constellations of timbre and changing spatial color, they are moved (or not moved) producing movement of timbre in space. Consumed by the timbre in perpetual change, the space becomes plastic.¹³

In measures 146 - 194, we see an example: three timbral spaces which are continuously opposed. One of these spaces is formed by static sounds of a (specific) very long duration, in an instrumental group (woodwinds) of all of the instrumental sectors (except sector C) and in the extreme upper register of the instrument. The ensemble of these instruments include the following:

- clarinet 1 at sector A
- oboe 2 and piccolo a sector B
- flute 2 at sector D
- soprano clarinets at sector E
- oboe 3 at sector F
- flute 1 at sector G
- oboe 1 at sector H (See Figure 18)

The other timbral space is obtained by the interpretation of a melody in the low register of the following instruments:

- horn 3 in sector A
- contrabassoon and trombone 4 in sector C
- tuba in sector D
- horn 1 in sector E
- clarinet, contrabassoon and trombone 2 in sector G (See Figure 19.)

position in the musical space. Thus they are localized higher or lower in the musical space, in relation to the register utilized.

In modifying the register of the spirals, the composer also influences timbre, or color. These are made clearer or darker by the use of higher or lower frequencies. According to the speed of rotation, and more or less substantial energy, the spirals become open or closed. The change of intensity creates sounds with more or less partials, either more brilliant or less brilliant sounds and spirals which retract or expand in relation to the respective growing or decreasing intensity. (Cf. da Silva Santana, Helena Maria, *L'orchestration chez Iannis Xenakis: l'espace et le rythme, fonctions du timbre*. Doctoral Thesis, University of Paris Sorbonne (Paris IV) 1998, p. 190-191.

¹³ By "constellations of timbre" we refer to groupings of sound sources having one (or more) timbres and one (or more) specific configurations.

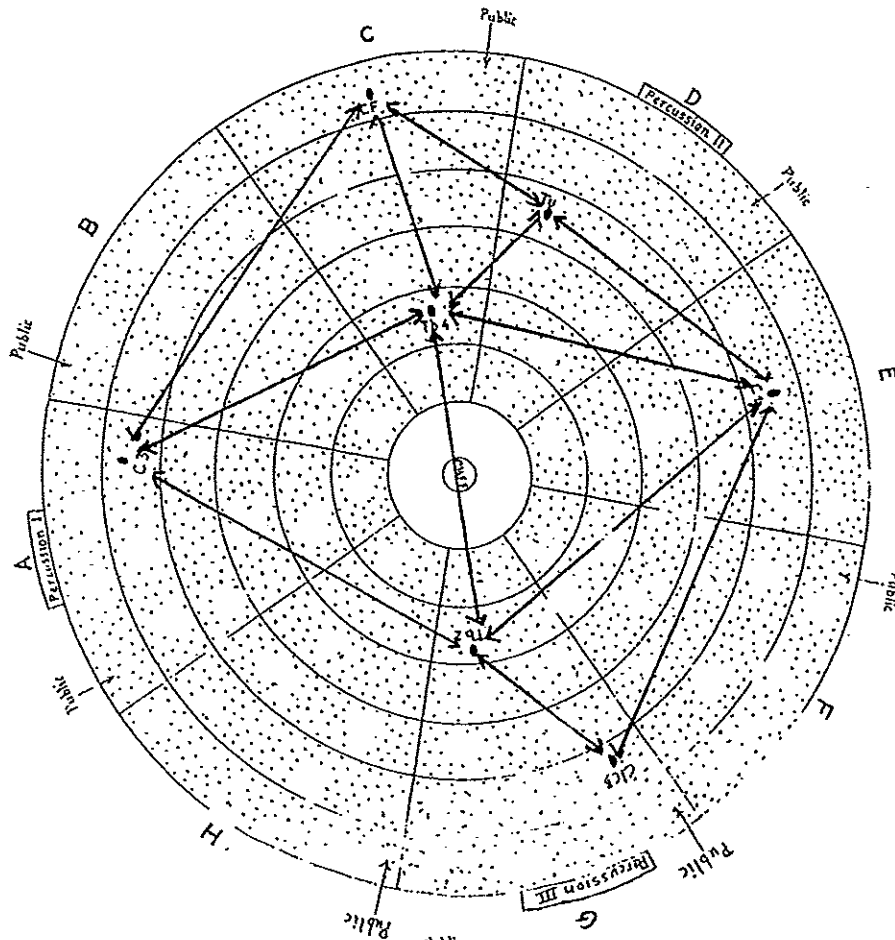


Figure 19: Terretékterh Timbral Space (#2) mm. 146 - 194

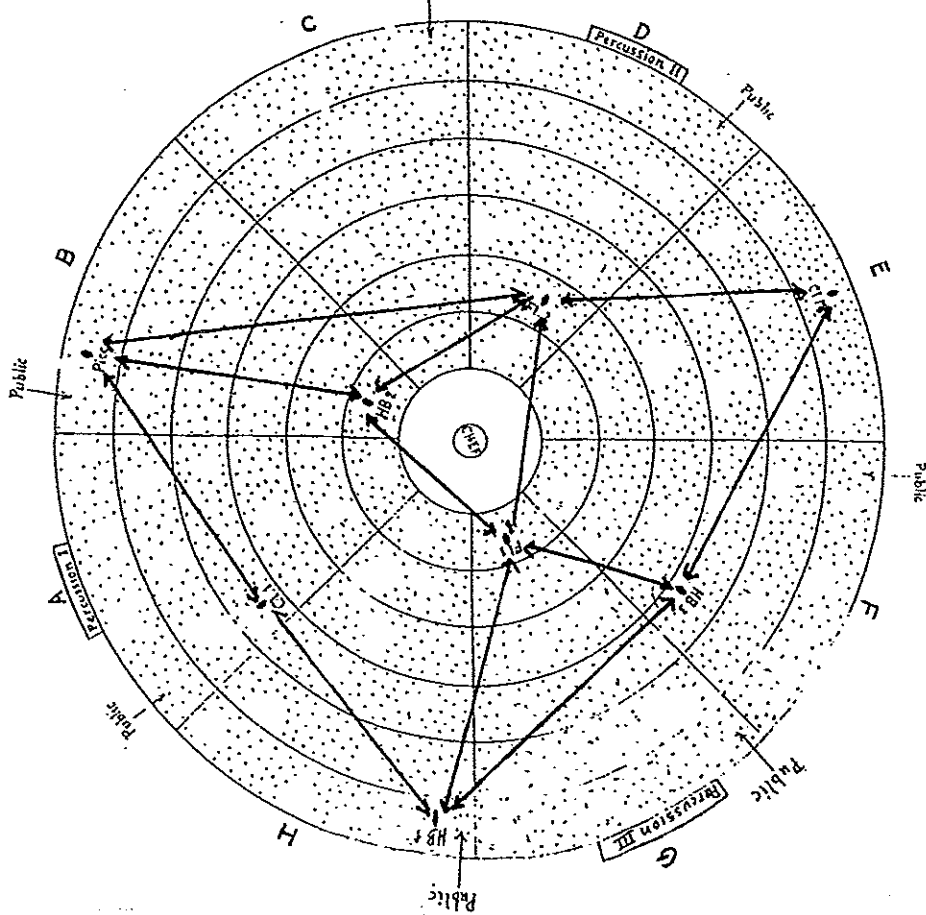


Figure 18: Terretékterh Timbral Space (#1) mm. 146 - 194

This melody always begins in opposite sectors of the orchestral map. (See Figure 20 below.) Xenakis thus creates two limits (one in the extreme upper register, another in the extreme low register) by the static sounds and the chromatic melodies in the type of stochastic rhythmic superposition which is realized by the other instrumentalists who play supplementary instruments (maracas, wood-blocks and whips) - the third timbral space.

<u>Measure</u>	<u>Instrument</u>	<u>Sector</u>
m. 146	contrabassoon	C
m. 146	contrabass clarinet	G
m. 158	contrabassoon	C
m. 159	contrabass clarinet	G
m. 163	horn 1	E
m. 165	horn 3	A
m. 166	trombone 2	G
m. 168	trombone 4	C
m. 176	tuba	D

Figure 20: *Terretêktorh* Timbral Space (#3) mm. 146 - 194 - Instruments Used

Beginning in measure 206, Xenakis modulates the timbre of these spaces. The sounds of a (specific) long duration are played here in a dynamic (*ppp*), muted in the mid-register (A4) of the instruments.

- trumpet 3 in Sector A
- trumpet 4 in sector D
- trumpet 1 in sector E
- and trumpet 2 in sector H (Figure 21)¹⁴

The melody in the extreme low register of the instruments is played in a variable dynamic *legatissimo*, and is realized in the following instruments:

- horn 3 and contrabass 2 in sector A
- trombone 3 in sector B
- contrabass 8, trombone 4, horn 4 and contrabassoon in sector C
- contrabass 7 and tuba in sector D
- horn 1 in sector E
- contrabass 3 in trombone 1 in sector F
- trombone 2, contrabass 5, contrabass clarinet and horn 2 in sector G
- and contrabass 6 in sector H (Figure 22)

Here Xenakis uses instruments of all the sectors of the orchestral map. He expands the timbral space and he transforms and modulates their timbre.

The other timbral space is composed of *glissandi* and a *fff* dynamic, going from the extreme high register to the low, played with mutes in the following instruments:

- violins I 10, 9, 8, 1 in sector A
- violin I 2 and violins II 7, 6, 5 in sector B:
- violins I 11, 3 in sector C
- violins I 12, 4, and violins II 10, 9 in sector D
- violin I 13 and violins II 14, 1 in sector E
- violins I 14, 5 and violins II 3, 2 in sector F
- violins I 16, 15 and violins II 12, 11 in sector G
- violin I 6 and violins II 13, 4 in sector H (Figure 23 below.)

¹⁴ The instruments used, the trumpets, radically modify the timbre of this sonorous element. Xenakis transforms a sound of woodwind into a sound of brass.

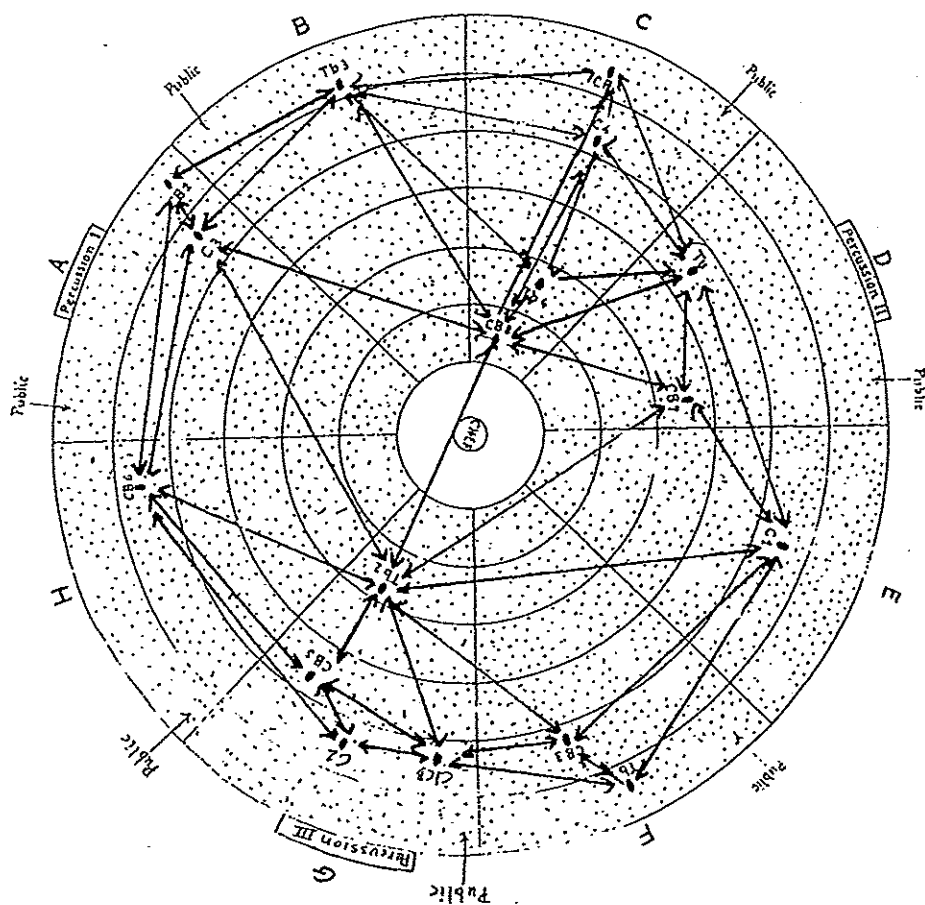


Figure 22: *Terretêktorh* Timbral Space Extreme Low-Register Melody m. 206

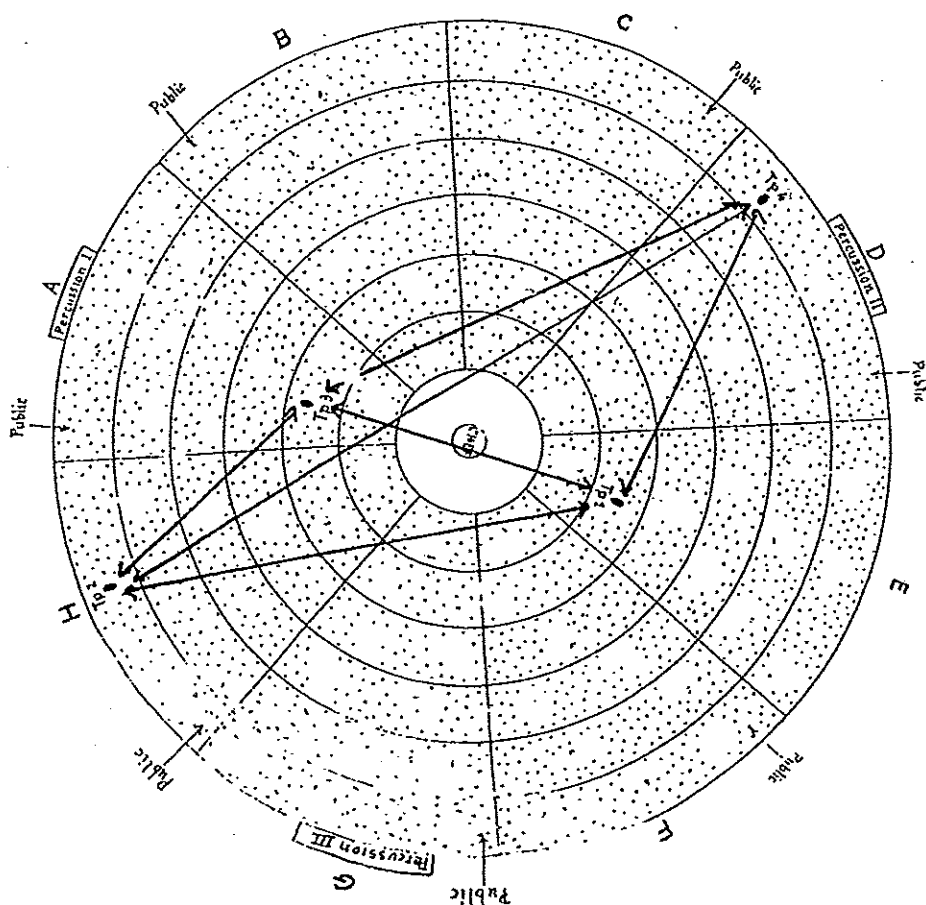


Figure 21: *Terretêktorh* Timbral Space Sounds of Long Duration m. 206

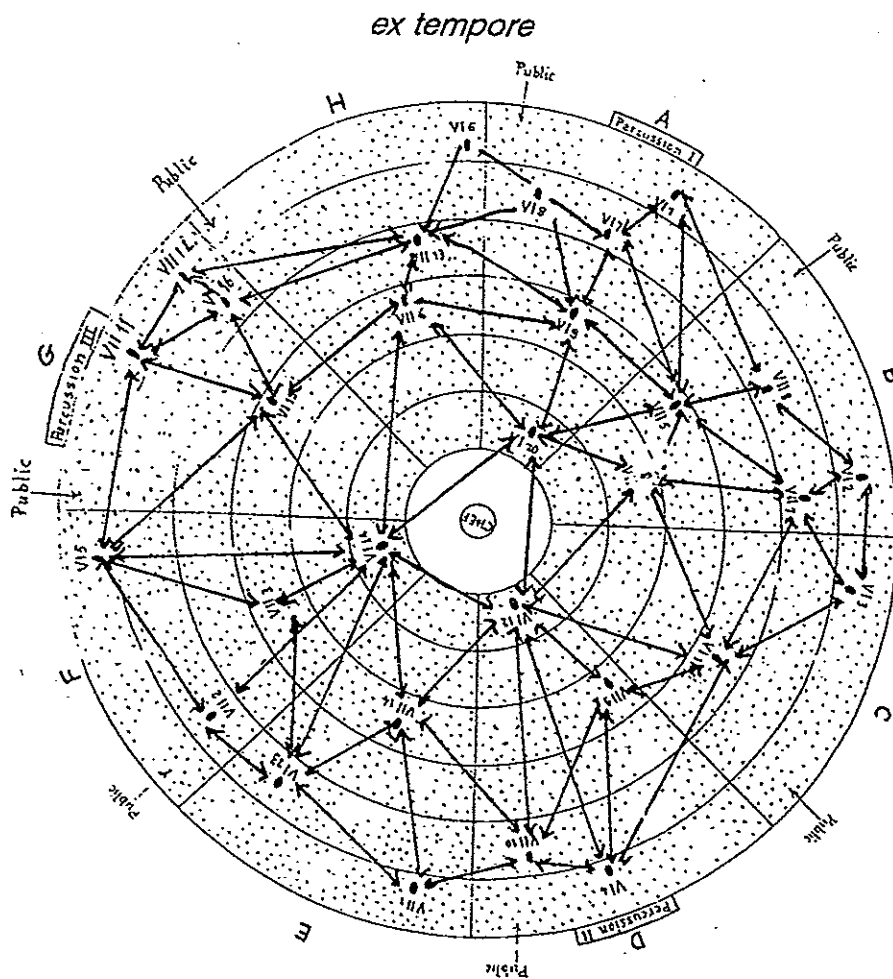


Figure 23: *Terretéktorh* Timbral Space of *Glissandi* m. 206

Xenakis thus utilizes three timbral spaces which he transforms. In the first, he modifies a woodwind sound into a brass sound, as well as the position and the dimension of the timbral space - it becomes smaller. In the second, he enlarges it greatly and he adds the sound of woodwinds to the existing brass. The timbre is transformed, enriched with harmonic partials. The third involves only the sound of the highest strings of the orchestra - the violins - which are distributed throughout the available physical space. The opposition between timbral spaces, sonorous objects and disposition within the space is manifest.

The homogenous texture from measure 216 to measure 255, is based on the following:

- a static sound (of long duration)
- a *glissando* (of strings or of wind instruments) and
- a melody (in a very narrow ambitus)

Static within the entirety of the work, this texture is seen upon more careful analysis to be very rich. We find, for example, an intense inner movement like a timbral, melodic and rhythmic modulation. The three elements referred to previously are indicated by instrumental groups and by precise and homogeneous timbres.

Played with the bow and at a *fff* dynamic, the static sounds are presented in the following instruments:

- violins I 10, 9, 8, 7, 1; 'cello 3 and contrabass 2 in sector A
- violins II 8, 7, 6, 5; viola 4 and 'cello 9, 5 in sector C
- violins I 12, 4; violins II 14; viola 6 and 'cello 1 in sector D
- violin I 13; violins II 14, 1; viola 7; 'cellos 6, 2 and doublebass 4 in sector E
- violin I 14, 5; violins II 3, 2; viola 10, 3 and 'cello 7 in sector F
- violins I 16, 15; violins II 12, 11; violas 9, 1 and 'cello 8 in sector G
- violin I 6; violins II 13, 4; violas 11, 5 and 'cello 10 in sector H (See Figure 24)

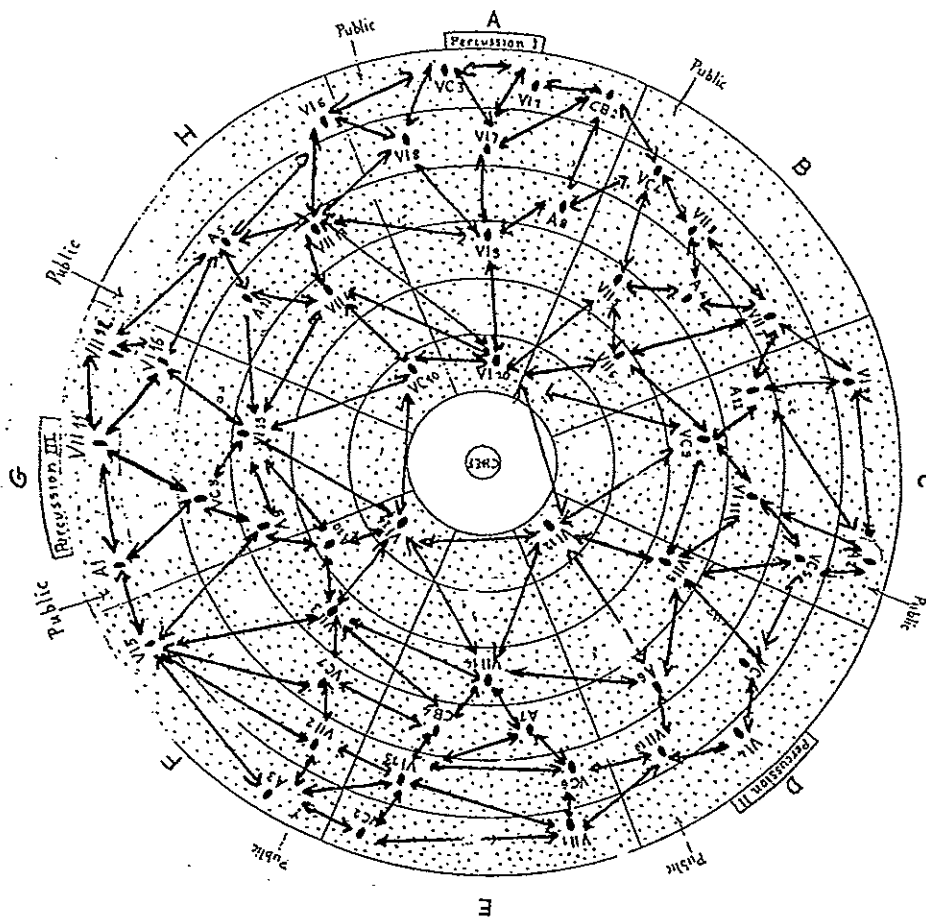


Figure 24: *Terretêktorh* Timbral Space of Homogeneous Textures mm. 216 - 255.

Harmonically, the existing registral movement mid/low to the extremes high/low as well as the change in manner of playing create a timbral modulation. In measure 126 the strings play *normal*, in measure 226 *sul ponticello* and return to normal in measure 228.

Creating instability in the extreme low register, we find a melody played *legatissimo* in a continuously changing dynamic from *pianissimo* to *fortissimo* and vice versa. Xenkai uses the lowest instruments of the orchestra:

- horn 3 and contrabass 2 in sector A
- trombone 3 in sector B
- contrabass 8, 1; horn 4; trombone 4 and contrabass in sector C
- contrabass 7 and tuba in sector D
- horn 1; bassoon 2 and contrabass 4 in sector E
- contrabass 3 and trombone 1 in sector F
- trombone 2; contrabass 5; clarinet contrabass and horn 2 in sector G
- contrabass 6 and bassoon 1 in sector H (See Figure 25 below)

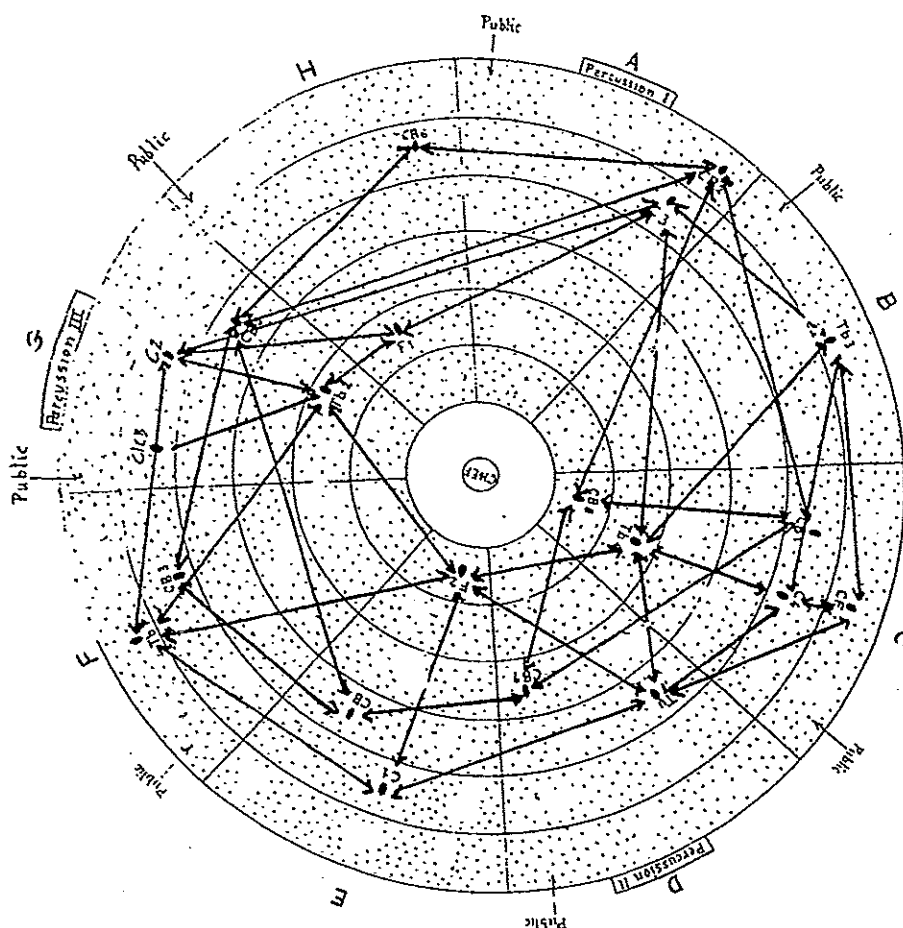


Figure 25: *Terretéktoth* Timbral Space Low-Register Melody mm. 216 - 255.

This timbral space contains two sub-spaces, one formed by the ensemble of wind instruments, and another formed by the ensemble of strings. The interaction between them is undeniable. In measures 240 - 247, the composer introduces a new timbre, eminent and aggressive, played by the uppermost wind instruments of the orchestra in the extreme upper register, at a dynamic of *fff* and a characteristic mode of playing - *flatterzung* ("fluttertongue"). The following are the instruments used in their respective sectors:

- clarinet 1 and trumpet 3 in sector A
- piccolo and oboe 2 in sector B
- flute 2 and trumpet 4 in sector D
- soprano clarinet and trumpet 1 in section E
- oboe 3 in sector F
- flute in section G
- oboe 1 and trumpet 2 in sector H

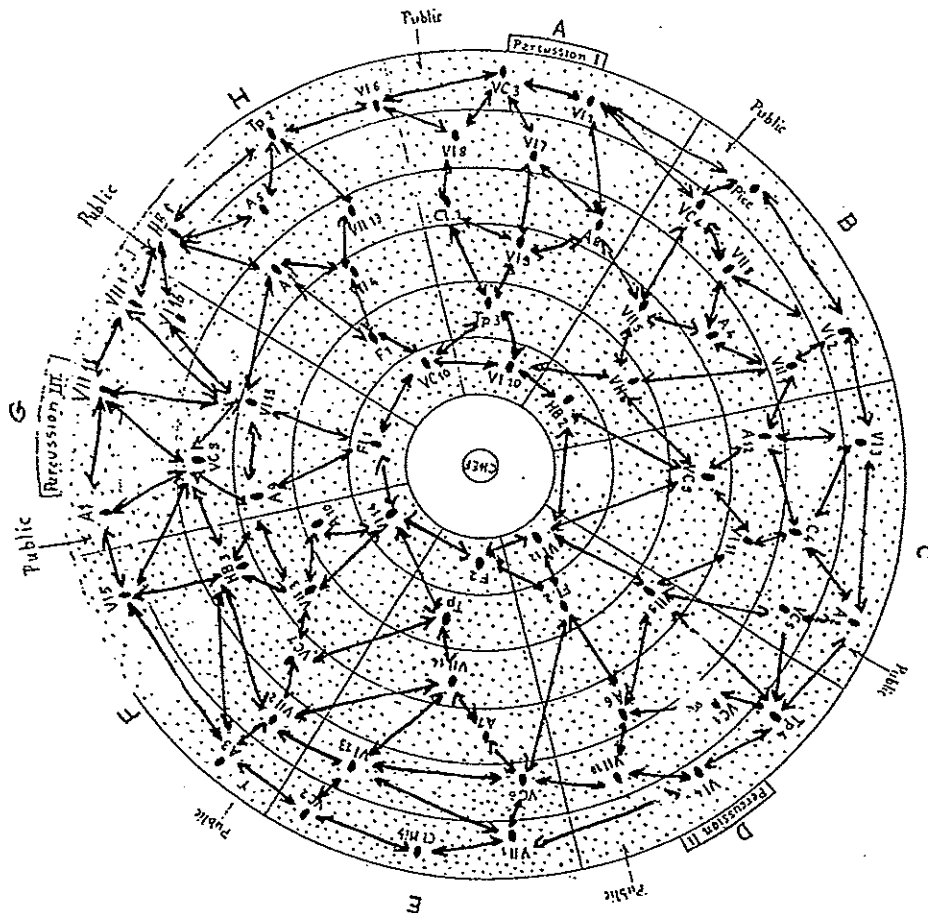


Figure 26: *Terretêktorh* Extreme Upper-Register Timbral Space mm. 240 - 247.

The harmonic modulation and the use of different registers also influences the timbre of this passage.

The sirenes intervene for the first time in measures 258 in all of the instruments *except* for:

- horn 3 and doublebass 2 in sector A
- trombone 3 and contrabass 2 in sector B
- trombone 4; contrabassoon and doublebasses 8, 1 in sector C;
- tuba and doublebass 7 in sector D
- horn 1 and doublebass 4 in sector E
- trombone 1 and doublebass 3 in sector F
- contrabass clarinet; horn 2; trombone 2 and doublebass 5 in sector G
- and doublebass 6 in sector H (Figure 26)

which always play the melody in the extreme low register of the orchestra. This brusquely modifies the orchestral color. Xenakis introduces a timbral space which is opposite and contrasting with the preceding. The *glissando* of the sirenes of a duration of two measures with a dynamic of $mf < f > mp$, brings about a circular movement in all of the sectors, from H to A, of the orchestral map. The movement is repeated three times, the last being incomplete.

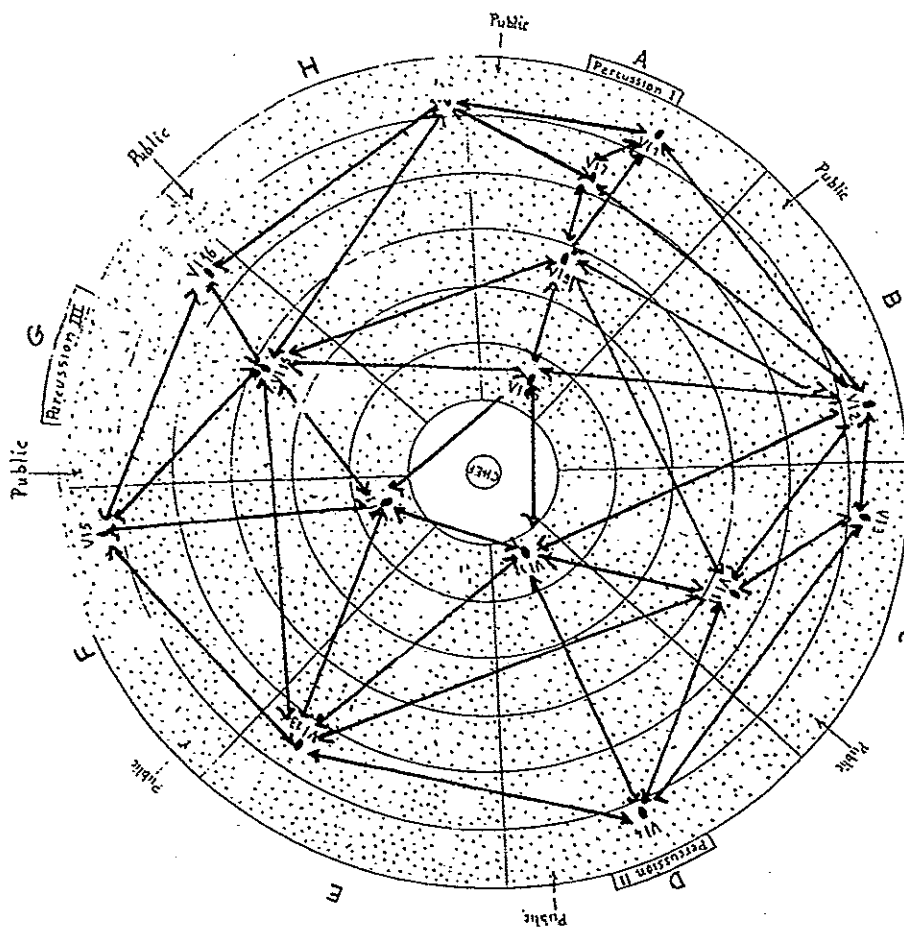


Figure 27: *Terretêktorh* Timbral Space m. 258.

They stop in measure 268. In the course of the passage we find yet another timbre space constituted by descending *glissandi*, realized from the extreme upper register to the mid register (A4) by the following instruments:

- violins I 10, 9, 8, 1 in sector A
- violin I 2 in sector B
- violins I 11, 3 in sector C
- violins I 12, 4 in sector D
- violin I 13 in sector E
- violins I 14, 5 in sector F
- violins I 16, 15 in sector G
- violin I 6 in sector H (Figure 27)

In measure 271, these instruments, the strings, play a muted *tremolo sul ponticello* in a *fff* dynamic, then ascending and descending *glissandi*. There exists a progressive diminution in the orchestral density. The number of instruments diminishes constantly down to twelve in measure 281. Measure 289 presents the same type of texture but the strings play unmuted. In its changes the collective timbre produces new luminosities and sonorous colors.

When Xenakis uses a single instrumental timbre, its spatialization is achieved by the use of different manners of playing and of diverse registers and sonorous objects. The use and their opposition in the orchestral map leads Xenakis to spatialize diverse timbres and to elaborate spaces and movements of timbres, as in sonorous architectures. These architectures, conceived as sonorous structures which take their origin in the links established by the sound emitted by the different sources, are continuously transposed. They have quite varied forms and are modulated, permuted and endlessly combined in vitalizing ways by the composer.

In measure 316, Xenakis introduces once more the sirens. They play a polyrhythm based on the superposition of 4, 5, and 6 pulsations per measure, in a *mf* dynamic. The entry of the sirens occurs according to a circular movement. Realized from sector A to sector G, it ends in measures 334 - 335 in a *tutti*. Next, Xenakis introduces the wood-blocks in opposite sectors of the orchestral map. The sonorous movements are effected here from the center towards the periphery and vice-versa (Figure 28). From measure 344 up to measure 353, Xenakis continues this type of movement in each instrumental sector, over the entire circle simultaneously or in opposite sectors. Here the sirenes diminish progressively in importance.

<u>Sections</u>	<u>Measures</u>	<u>Types of Movement Used</u>
G	m. 336	periphery → center
C	m. 336	center → periphery
A	m. 339	periphery → center
E	m. 339	center → periphery
G	m. 340	periphery → center
C	m. 340	center → periphery
A	mm. 341 - 342	periphery → center
E	mm. 341 - 342	center → periphery
H	mm. 342 - 343	periphery → center
D	mm. 342 - 343	center → periphery

Figure 28: Types of Movement Utilized.

The last part of the work is heard from measure 354 to measure 447. The modulation of timbres, a constant in all of the work, is also present in this sector. The change of orchestral color is realized by the use of different playing modes (*normal* and *sul ponticello* for the strings, *ordinary* or *stopped* for the horns, and drifting to the end of the breath for the wind instruments, or using harmonics in micro-tones [m. 357] for the strings) and by the dynamics (similar for all of the instruments). The percussion (three ensembles), is utilized in this section of the work in a more marked fashion: from its beginning to its

end.¹⁵ On the periphery, it surrounds (and adjoins) all sounds. The force of the passage is seen in the process involved - the change of orchestral color. Xenakis creates in this way an internal movement to the texture. The modulation of timbre as well as the spatialization and the spatial delineation of timbre, is brought about by its musical composition through the use of different manners of playing, mutes, dynamics, or even by the change of the position of the direction or of the nature of the instruments (the use of supplementary instruments) in the course of the work.

Xenakis uses in his works, different modes of playing. For example *col legno tratto*, *col legno battuto*, *sultasto*, *sul ponticello*, *arco*, *pizzicato*, *pizzicato glissando* (ascending and descending), detuned strings, *harmonics*, *tremolo*, metallic sounds on the bridge, *au talon*, *legato*, *glissando*, *divisi*, with or without mute, with or without *vibrato*, etc. for the strings; *glissando*, *glissando plus fluttertongue*, wide *vibrato*, *fluttertongue*, overblown/"cracked" sounds with or without *vibrato*, wide *vibrato*, with or without mute, and *quillisma*¹⁶ for the wind instruments.¹⁷ These modes of playing modify the timbre coloring in various ways in the musical textures.

In *Terretêktorh*, Xenakis arrives, through other elements - the registral extremes of the instruments and of the orchestra (measure 147, for example), the use of *glissando* (measure 289 for example) types of stochastic rhythmic superpositions (measure 336, for example) of composition in micro-tones (measure 336 for example) and the massive orchestrational complement (measure 357 for example) - at the original sonorities however spatialized differently. Timbral spaces are mixed, transformed, opposed or fused without end, producing vast sonorous gestures. For example, in measure 240, a mixture of *fluttertongue* and *glissando* is produced. Beginning in measure 206, we find a progressive transformation in the manner of playing. In measure 206, the strings play *arco with mutes*, in measure 216 *arco*, in measures 226 *sul ponticello*, measure 228 *normal*, and in measure 247 *sul ponticello*. In this way there exists a transformation of the orchestral color.

In measure 191 we find the opposition of two manners of playing in the strings: the *glissando* played with the bow and mute, and a chromatic melody in the extreme low register played with the normal bow and *legatissimo*. In measure 281, we have the opposition of *tremolo glissando* and *ponticello* playing manners with *fluttertongue* in the wind instruments. The fusion of playing modes is used in several moments in the work. In measure 249, there exists the fusion of *fluttertongue* in the wind instruments and *tremolo* in the strings. In measure 305, we find the fusion of *legatissimo* (strings and wind instruments) and *glissando* playing modes plus the sirens (m. 313). Xenakis engulfs the space with sound

¹⁵ The percussion is used in three moments of the work: m. 119 - tones played with soft sticks; m. 250 - tones played with soft sticks; m. 377 - tones played with hard sticks.

¹⁶ Slow and irregular oscillations in pitch.

¹⁷ Cfs. Solomos, Makis, *A Propos des Premières Oeuvres (1953 - 69) de I. Xenakis pour une Approche Historique de de l'Emergence du Phenomene du Son*, Thèse de Doctorat du 3^eème cycle. Université de Paris IV, janvier 1993, tome I, chap. IX-XI.

and fills it with sonorous colours which are moved according to specific designs and continuous transformation. He elaborates it again in such a way as to create remarkable sonorous effects, and new forms of listening and architecture. He attempts to fill the sound space in all its volume and area, working it vertically and horizontally by particular processes of composition - movements in circles or spirals, in lines in all the directions. The timbral space is revealed at different times to create reliefs and effects in texture; orchestral colors which are opposed or fused in changing spaces and modulating sound masses, configurations and constellations of particular timbres which remain stable or move in the space, realizing distinctive sonorous and spatial choreographies. The changes of timbres moreover obey a specific rhythm which can be called a "rhythm of timbres" which regulates the color of the work. Used as a means of delineation of the space, timbre plays a fundamental role in this piece, and the timbres, the registers and the manner of playing, linked to its singular spatialization make *Terretéktoth* a unique work.

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