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Some Observations on Pitch, Texture, and Form in Xenakis' *Mists*

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Mists is one of Xenakis's major works from the 1980s and his third and largest work for the piano. It makes use of several of Xenakis's theoretical concepts, including stochastic composition, sieve theory, and his general theory of musical time. In addition, the use of arborescences (branching structures) in this work provides an opportunity to demonstrate the use of graphic images and their transformations in Xenakis's compositional process. The first two sections of this article, devoted to pitch and texture respectively, introduce the musical materials used in the composition of *Mists*. The interaction of these materials is discussed in the third and final section, which explores various aspects of the work's large-scale structure.

KEYWORDS: Xenakis, twentieth-century piano music, analysis, stochastic music, sieve theory, form in twentieth-century music

I. Introduction

In his long and prolific compositional career, Xenakis produced only four mature works for piano solo. Each of these represents a period in his stylistic development in microcosm. The first, *Herma* (1960–1961), comes from relatively early in his career. It is an example of "symbolic music," i.e. music composed according to the principles of symbolic logic. This logic is applied to pitch sets and their transformations, which are then realized musically according to the principles of stochastic composition.[1] These ideas are explored further in *Evryali* (1973), where they are combined with branching processes, or "arborescences," and percussive rhythmic patterns (cf. Squibbs 1997: 146–180, Squibbs 2001). *Mists* (1980) is the third and most expansive of Xenakis' piano works. In *Mists*, the ideas introduced in the earlier compositions are further developed and refined. Among the new ideas introduced are scales that cover the entire range of the keyboard and spatial transformations of arborescences in pitch and time (cf. Castanet 1986, McCoy 1993, Squibbs 1997: 180–202, Squibbs 1998). The fourth and final work is *à r.* (*Hommage à Ravel*) (1987). This brief composition was written to commemorate the fiftieth anniversary of the death of Maurice Ravel. It contains a reworking of a short passage from *Mists* along with new material.[2] Consistent with Xenakis' other works from the late 1980s, *à r.* is concerned largely with scales and cluster chords (cf. Solomos 1996: 86–99, Squibbs 1997: 203–225).

Xenakis is well known for his application of mathematics to the composition of music. Many musicians who have been attracted to his music have found the

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composer's writings, with their proliferation of equations and mathematical terminology, to be nearly impenetrable. In this essay, every attempt has been made to avoid specialized mathematical terminology. The article focuses instead upon the musical significance of Xenakis' compositional techniques as they are applied in *Mists*. The emphasis here is on musical intuition and on analogies with traditional concepts of musical structure. This recourse to familiar musical concepts in no way compromises the originality of Xenakis' work. On the contrary, it contextualizes his originality within the tradition of Western art music to which he rightfully belongs. It is the author's hope that this approach may lead to a greater appreciation of his distinguished position within that tradition.

The remaining parts of the article explore various aspects of musical structure in *Mists*. Section II introduces the pitch materials used in the composition. The work's characteristic textures are introduced in Section III, followed by a discussion of specific examples of each texture in Section IV. The interaction of pitch and texture is discussed in Section V, where several aspects of the work's large-scale structure are explored. Some concluding remarks are presented in Section VI. The analysis will be most meaningful to a reader who has access to both a copy of the score (see Xenakis 1981) and a recording.[3]

II. Pitch

Most of the pitch material in *Mists* is based on a scale that Xenakis created specifically for this work. This scale is shown in figure 1, both in musical notation and in the integer notation that appears in the composer's sketches.[4] The full length of the scale is ninety semitones, which is two semitones larger than the 88-note range of the standard piano keyboard. Consequently, only twenty-nine of the scale's thirty pitches actually appear in the published score. (The highest, *C♯8*, is enclosed in parentheses in figure 1 because it falls outside of the instrument's range.[5]) The scale that appears in *Mists* is therefore an approximation, an imperfect realization of the scale originally conceived by the composer.

A possible explanation for the discrepancy between the ideal scale and its imperfect realization may be found in Xenakis' theory of sieves. According to this theory, scales of any length, based on units of any size, may be constructed by performing standard set-theoretic operations on interval cycles (cf. Xenakis 1992: 180–200, 268–288, Squibbs 1997: 57–66). The scale used in *Mists* is based on cycles of two, five, and nine semitones. The period (i.e. the full length) of the scale is

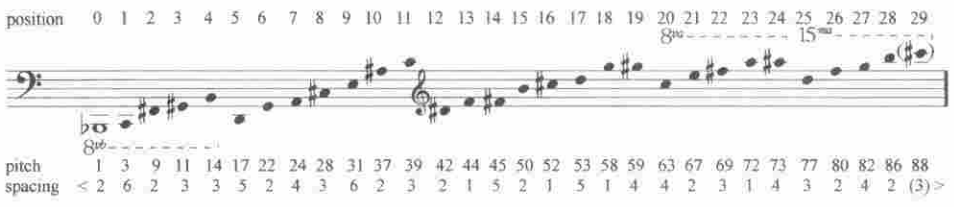


Figure 1
Scale prototype.

equivalent to the lowest common multiple of its constituent interval cycles. The lowest common multiple of 2, 5, and 9 is 90, which is the period of this scale.

Additional scales are derived by an operation known as cyclic transposition. This operation also has a basis in sieve theory, but is perhaps best introduced intuitively. Cyclic transposition is not unique to Xenakis' music, but is actually a common procedure. Consider, for example, the task of constructing various diatonic modes on a single tonic pitch. The C major scale, or Ionian mode on C, may be represented by the following set of pitch classes: {C D E F G A B}. Likewise, the Dorian mode on C may be represented as {C D E♭ F G A B♭}. Two pitch classes have changed while the others remain the same. Informally, one can say that the Dorian mode on C has the same notes as the B♭ major scale, only it begins on C. This assessment implies a two-step process:

(1) first, transpose the C major scale down a whole step to B♭; then
(2) wrap the B♭ around to the end of the scale so that it fits within an octave that starts on C.

This two-step process – transposition followed by the wrapping around of pitches so that they fit within predefined boundaries – results in a cyclic transposition of the original scale.

In *Mists* there are two sets of predefined boundaries. First, there is the scale's ideal period of ninety semitones; and, second, there are the registral limits of the piano keyboard, which extends from A0 to C8. Figure 2 shows the first three transpositions of the scale prototype from figure 1. The scales in figure 2 are shown in order of their first appearance within the work. The scale in figure 2a results from the transposition of the prototype's origin (i.e. its lowest pitch) up thirty semitones, from B♭0 to E3. The original scale and its transposition in figure 2a are both shown in open noteheads. The pitches in the lower part of the scale in figure 2a, extending from C0 to C♯3, result from wrapping the upper portion of the original scale around to the low end of the keyboard following transposition. The scales in figures 2b and 2c are derived from the prototype in similar fashion, by transposing the origin up thirty-eight and ten semitones, respectively. The pitches in the transposed scales that extend beyond the registral limits of the keyboard are C♯8 and D8 in figure 2a and C♯8 in figure 2b. Because these pitches extend beyond the range of the keyboard, only twenty-eight of the thirty pitches in figure 2a and twenty-nine of the pitches in figure 2b are represented in the score. All thirty of the pitches in figure 2c, however, fit within the instrument's range.

The number of common tones held between a scale and its cyclic transpositions varies as the transposition level changes. Where the number of common tones is high, there is a greater degree of similarity in the sound of the scales than when there are fewer common tones. This property may have been one of the factors that guided Xenakis in choosing the transpositions that appear in *Mists*. Unless a scale is symmetrical under transposition – which is a property that the scale used in *Mists* does not possess – the number of distinct transpositions is equivalent to its period.[6] Since the scale in figure 1 has a period of ninety semitones, it has ninety distinct transpositions. Of these, Xenakis chose eleven transpositions for inclusion in *Mists*. The number of common tones between pairs of scales varies from zero to sixteen. The scales with the highest number of common tones (16) are the pair found in figures 2b and 2c. This fact is given dramatic compositional

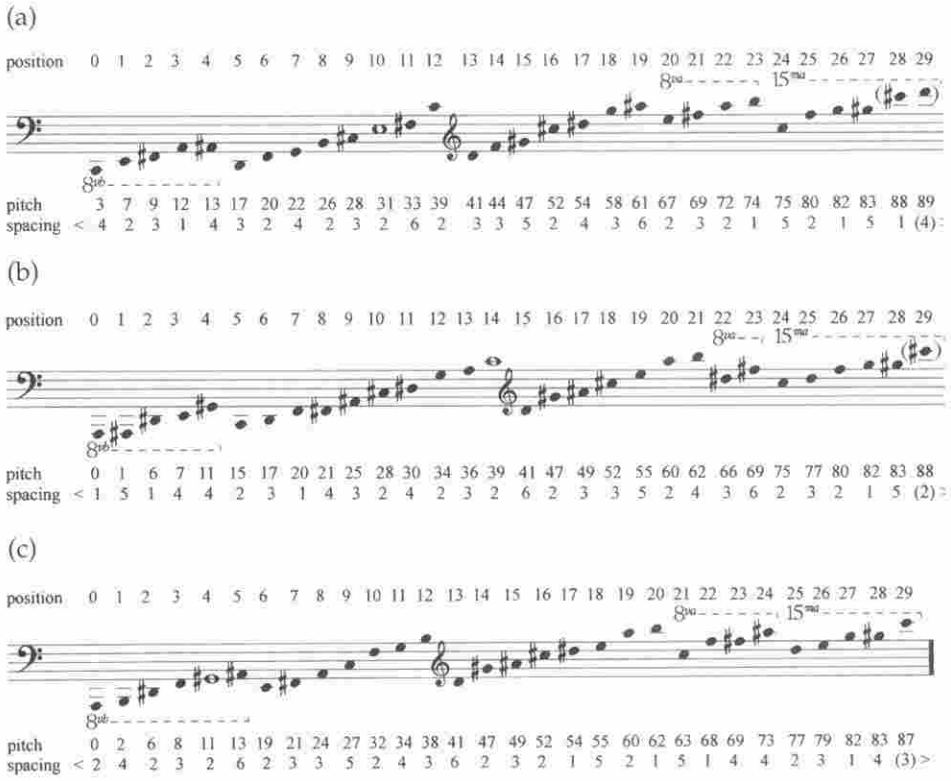


Figure 2
Transpositions of scale prototype: (a) transpotion by 30 semitones, (b) transposition by 38 semitones, (c) transposition by 10 semitones.

expression in mm. 39–40, the conclusion of the first part of the work, where the common tones between these two scales are presented in ascending order (figure 3).

While the number of common tones varies between different transpositions of the scale, the order of the intervals between adjacent pitches remains constant regardless of transposition. The ordered interval succession, or spacing, of each of the scales in figures 1 and 2 is shown in angled brackets directly beneath the line of pitch integers. The spacing of the prototype scale begins at the origin and shows the interval for each pair of adjacent pitches throughout the scale. The final

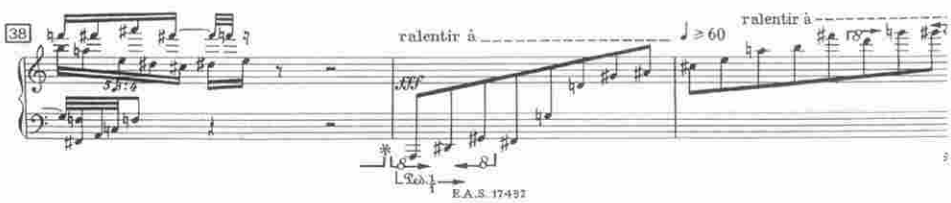


Figure 3
***Mists*, mm. 38–40. Reproduced with the kind authorization of Éditions Salabert.**

interval, enclosed in parentheses, is the interval that is required to complete the period of ninety semitones. At the completion of its period, the scale is free – hypothetically, given an instrument of sufficient range – to cycle through another period. Whereas the origin in figure 1 is at position number 0, the transposed origin in figure 2a occurs at position number 10. (Position numbers are shown above the staves.) Corresponding to the shift of the origin ten places to the right in figure 2a, the spacing that began at position number 0 in figure 1 now begins at position number 10. The ten intervals that are shifted beyond the upper boundary of the scale in figure 2a wrap around to occupy position numbers 0–9. (Compare the intervals at position numbers 20–29 in figure 1 to those at position numbers 0–9 in figure 2a.) An interval of size 4 is shown in parentheses at the end of the spacing in figure 2a since this has now become the interval required to complete the period of ninety semitones.

Despite the shift in the positions of the intervals, the order in which the intervals occur is the same in the spacings of figures 1 and 2a. In fact, the order of the intervals remains the same in every transposition of the scale prototype. The preservation of the order of intervals within their spacings establishes the scale prototype and all of its transpositions as a class of scales that are equivalent under transposition. To say that the scales are equivalent under transposition does not imply that their pitch contents are identical, for each transposition is distinct in this respect. Rather, equivalence signifies that there is a single ordered interval succession to which every transposition of the scale refers. This equivalence class is analogous to the one that contains the C major and C dorian scales illustrated above.

The intervallic equivalence of the scales used in *Mists* may be expressed explicitly or implicitly, depending on the method used to present them. For example, the scales may be presented in their entirety or only partially, and their pitches may be presented in ordered successions – ascending or descending "stepwise" motion – or in unordered, randomized successions. These differences in presentation determine whether the scales constitute a feature of the musical surface or whether they serve only as a background source for the harmony of a given passage of music.

The use of scale transpositions in *Mists* is not only the basis of the work's harmony, but is also related to its form. The form of *Mists* is ABA′ ternary, with a short transitional section leading from A to B. The scales in figures 1 and 2a are the only ones to appear in both the A and A′ sections (mm. 1–30 and mm. 122–134). The appearance of these scales at measure 122, where they occur in combination, is one of the features that signals a return to the opening material. Although the prototype scale occurs briefly during the transitional section (mm. 31–40), the scale in figure 2a is used to link the end of the A section to the transition, and the transition to the beginning of the B section (mm. 41–121). The scales in figures 2c and 2d are first introduced in the transition and also appear in the first part of the B section. The remaining seven transpositions, not shown in these examples, are found exclusively within the B section. The original scale returns near the end of the B section, thereby linking it with the A′ section. Thus, as the scale in figure 2a helps to take the music from the A section into the B section, the scale in figure 1 performs a corresponding function with respect to the B and A′ sections.

If the transposed scales are seen as the harmonic foundation of *Mists*, it would

appear that the harmony is relatively stable in the work's outer sections and less stable in the transition and the middle section. The contrast between relative stability and flux in the harmony, and the coordination of these harmonic characteristics with the work's basic design, are clearly analogous to the interaction of harmony and design found in traditional ternary forms.

III. Texture

Texture is the most immediately perceptible aspect of the musical surface in *Mists*. Xenakis' music, which is non-thematic for the most part, depends largely on the presentation of distinctive textures for the delineation of formal sections. In this respect, textures perform a function analogous to themes in traditional music. The textures of *Mists* may be divided into three distinct categories: (i) linear, (ii) non-linear (or pointillistic), and (iii) quasi-polyphonic. In Xenakis' writings, these categories are given somewhat more scientific names: (i) continuous, (ii) discontinuous, and (iii) arborescences, i.e. textures resulting from branching processes (Xenakis 1981: Preface).

The first two categories fall under the more general heading of random walks. The random walk is a concept used in physics to describe unpredictable motions in space. It may refer to the motion of subatomic particles, of molecules in a gas, or to the random wanderings of insects, animals, or humans. In the context of a piano work such as *Mists*, a continuous random walk consists of stepwise motion through a scale. Though the motion is stepwise, its speed and direction may vary unpredictably, thus giving it a random quality. A discontinuous random walk, on the other hand, consists of unpredictable "quantum leaps" between pitches. These leaps result from stochastic composition, in which the intervals between pitches and time points are selected randomly according to specific probability distributions (cf. Xenakis 1992: 1–42, 131–154, Squibbs 1997: 70–109). The musical effect produced by discontinuous random walks has been described by the composer as sonic "clouds" or "galaxies." It is possible that "mists" was chosen as the title for this work because of the clouds of sounds that dominate its middle section.

The arborescences in *Mists* function as an intermediate category between the linearity of the continuous random walks and the spatially oriented, pointillistic texture produced by the discontinuous random walks. Arborescences are essentially linear in that they consist of lines that branch off to form other lines. But they have a spatial aspect as well, for the proliferation of lines in an arborescence spreads in several directions across the pitch space. When arborescences are realized on the piano, legato articulation substitutes for true continuity of pitch. This effect is enhanced when chromatic scales are used in place of the scales described in Section II. Perhaps the ideal manifestation of arborescences is on string instruments, where *glissandi* can be used to realize a genuine continuity of pitch. Xenakis manages to produce some stunning effects in *Mists*, however, even though the continuity of the random walks and arborescences is compromised by the inevitable limitations of the keyboard instrument for which it was written. Each of the three textural types is described in further detail in the following section. Measure numbers are given for specific instances of each textural type and a general account is given of the transformations of the types over the course of the work.

IV. Textural Types

Continuous Random Walks

Mists opens with a succession of five overlapping continuous random walks. Figure 4 shows mm. 1–5, which contain the first two walks in their entirety and the beginnings of the third and fourth walks. The beginnings are displaced temporally in quasi-canonic fashion. Each walk is shorter than the one that precedes it, lending an overall sense of acceleration to the opening passage (mm. 1–7).

All of the walks in this section draw their pitch material from the scale prototype (figure 1). Each moves upward through the scale, with individual changes in speed and direction occurring along the way. In addition to the individuality of their contours, rhythm is also used to distinguish the overlapping walks. Points of temporal intersection between them are relatively few. (These points are marked with dashed vertical lines in the score.) In general, the rhythms of the individual walks in combination may be described as non-coinciding. The use of non-coinciding rhythms in the opening passage establishes a norm for the presentation of simultaneously occurring random walks elsewhere in *Mists*.

The uniqueness of contour found in the walks in the opening passage is abandoned at the end of measure 7 in favor of direct upward motion. This simplification in contour is accompanied by the presentation of walks in several voices simultaneously. A two-voice walk is presented in mm. 7–9, followed by a four-voice walk in mm. 9–11. The four-voice walk then becomes the norm for the remainder of the first section of the work (to m. 30).

Independent contours return in the transitional section (mm. 31–40), which is also marked by a sudden change to a faster tempo. The walks in this section cross one another frequently, sometimes creating mirror-symmetrical patterns in the process. There is some minimal rhythmic differentiation among the lines at the beginning of the section, but this quickly gives way to steady streams of thirty-second notes. The section ends with an extreme simplification of rhythm and

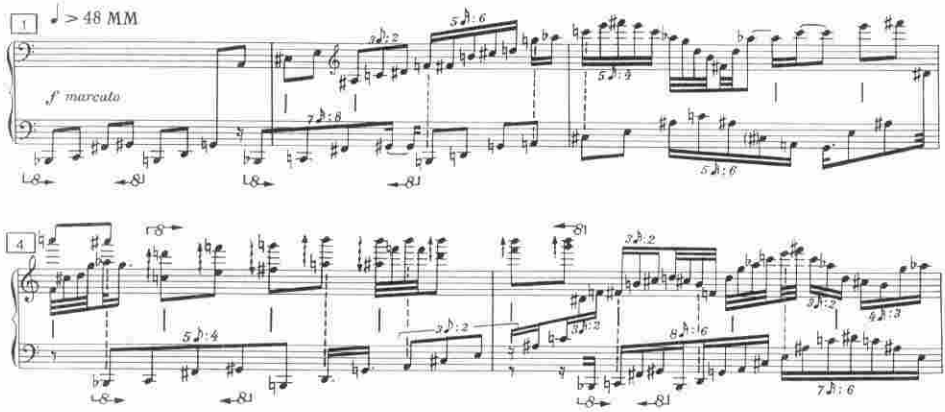


Figure 4
Mists, mm. 1–5. Reproduced with the kind authorization of Éditions Salabert.

contour, in the previously mentioned ascending succession of eighth-notes (see figure 3).

The transformations undergone by the continuous random walks in the first section and the transition are combined when the random walks return in measure 122. This return, which marks the beginning of the work's final section (mm. 122–134), features a spectacular configuration in which two pairs of rhythmically differentiated walks cross each other repeatedly, ultimately leading to a direct descent in all four voices. This configuration is followed by another descending motion, also in four voices. This descending contour, which is found only in the walks in the final section, complements the ascending contours in the first section. It thus acts as a closing gesture, signaling the work's immanent conclusion.

Discontinuous Random Walks

Discontinuous random walks make up most of the material in *Mists*. They are confined to the work's long middle section (mm. 41–121), where they form a contrast to the continuous random walks found in the outer sections. The notation of the discontinuous walks is unusual (figure 5). The beams and elongated stems in this notation form a temporal grid within which unattached noteheads are located spatially in order to indicate their time points. At the beginning of measure 41, for example, C2 occurs approximately halfway between the first and second sixteenth-note stems of the measure. G♯2 occurs on the second sixteenth-note, with A5 occurring directly after it and B5 following soon after. A♯0 occurs next, a little more than halfway between the second and third sixteenth-note stems, and so on. This notation provides a practical solution to the problem of reconciling the mathematical precision of stochastic composition – the method used to produce discontinuous random walks – with the established conventions of musical notation.

Xenakis has explained how stochastic composition grew out of Olivier Messiaen's application of modal principles to various aspects of sound (cf. Xenakis 1992: 5–8). In particular, it was developed as a reaction against the application of similar principles in integral serialism. Like both of these other methods, stochastic composition treats the various aspects of musical sound separately. After the different aspects are manipulated individually, the results are reintegrated in order to form a musical texture. Instead of modes or series,

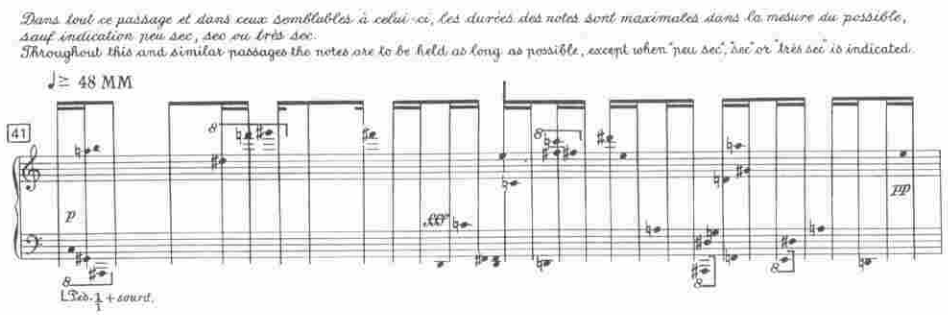


Figure 5
***Mists*, mm. 41–42. Reproduced with the kind authorization of Éditions Salabert.**

however, stochastic composition uses probability distributions to organize the different aspects of sound.

Different probability distributions are associated with individual aspects of sound, such as pitch, time point, dynamic level, and timbre. By choosing an appropriate distribution for each aspect, it is possible to generate randomly chosen intervals that may be used compositionally. In *Mists*, the intervals between time points and pitches have been composed stochastically, while other aspects – such as dynamics, pedaling, and articulation – remain constant or change gradually over the course of each discontinuous random walk.

To calculate the intervals between time points, Xenakis typically uses the exponential distribution, in which the probability of generating small intervals is exponentially greater than the probability of generating large intervals. The musical result is a rhythm in which most of the time points are clustered close together, with relatively few large gaps between points. This statistical control ensures that the rhythm will not become too diffuse to be musically interesting. The exponential distribution also allows the composer to determine the average frequency of the time points with reasonable accuracy. This makes it possible to control the density of the musical texture. Changes in density may thus be used to create varying degrees of similarity and contrast between the discontinuous random walks.

In the preface to the score of *Mists*, Xenakis mentions two distributions that were used to generate intervals between pitches. Both of these distributions – Cauchy and hyperbolic cosine – generate positive and negative values, thus producing ascending and descending intervals. Since the pitch material in the discontinuous random walks is based on scales and not on the chromatic pitch collection, the intervals are calculated between the position numbers in the scales rather than between the pitches themselves. For example, the pitch succession of the first random walk in figure 5 (m. 41, dynamic level *p*) is C2, G♯2, A5, B5, A♯0, D♯6, F7, G♯7, F♯6. These pitches are drawn from the scale in figure 2b, where they correspond to position numbers 5, 4, 20, 21, 1, 22, 26, 28, and 23. Thus, the interval succession used to select these pitches is, starting from position number 5, < –1, 16, 1, -20, 21, 4, 2, –5 >. The values generated by these probability distributions are rounded to whole numbers, since the distances between position numbers are measured in integers. This is not the case, however, for the time point intervals generated by the exponential distribution. Those values are generated as decimals and the resulting time points are then realized to whatever degree of accuracy the composer desires.

The middle section of *Mists* contains sixty-four discontinuous random walks, interspersed with some arborescences and rests. These walks are differentiated by changes in dynamics, pedaling, articulation, density, and scale transposition. Any one, or any combination, of these characteristics may change from one walk to the next. The degree of change varies, resulting in a relatively homogeneous overall texture that nonetheless contains a good deal of internal differentiation. The musical effect produced by this differentiation resembles a constantly changing sonic "mist" rather than a succession of disconnected sections.

From the perspective of the work's large-scale structure, the most significant changes between discontinuous random walks are those that involve their upper and lower registral boundaries. At the beginning of the section (mm. 41–49), the music roams freely over several registers. In mm. 50–53, it moves to the highest

register and then descends slowly toward the middle. Following this restricted use of pitch space, the register opens up again until both high and low pitches are gradually filtered out, sculpting the register into a two-and-one-half octave band in the treble, where it remains for a relatively long period (mm. 63–76). The dominance of the treble is brought to an end by a dramatic descending gesture across the entire range of the instrument (mm. 76–77). This gesture anticipates the descending contour of the continuous random walks in the final section. Thereafter, the use of registers becomes relatively scattered and unpredictable. The middle section approaches its end with the obsessive repetition of two pitches in the highest register – B♭6 and G7, mm. 117–118 – before the register opens out one last time in preparation for the return of the continuous random walks in measure 122.

Arborescences

Arborescences occur throughout *Mists*, providing local contrast with the continuous random walks in the outer sections and the discontinuous random walks in the middle section. Over the course of the work, the arborescences are subjected to a greater degree of change than either of the other two textural types. Despite the variety of forms they assume, most of the arborescences are clearly related to one of two basic prototypes.

A visual representation of the first prototype is shown in figure 6. Its first manifestation is in mm. 14–16 (figure 7). The pitch material for this arborescence is drawn from the scale prototype. It begins on position 13 (F4) and the first branching proceeds from position 14 (F♯4), which passes up to position 15 (B4) and down to position 12 (D♯4). The durations have been chosen for musical reasons, to facilitate the realization of the arborescence as a compound melody

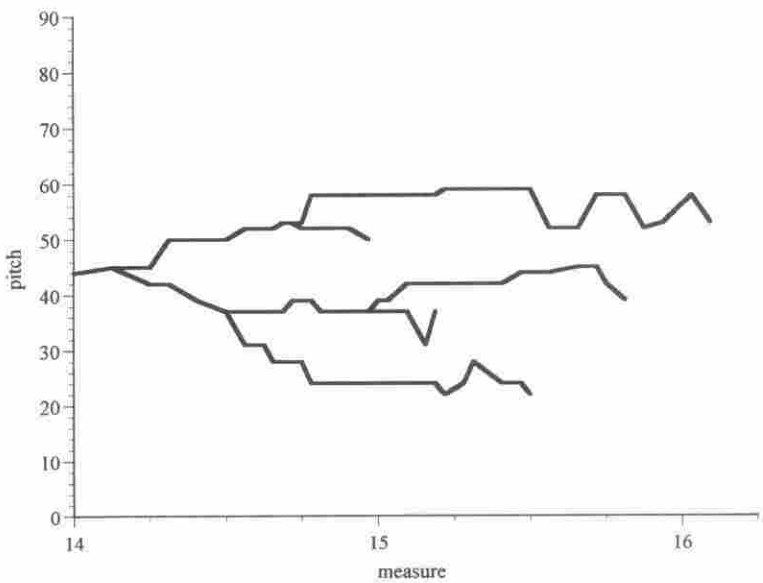


Figure 6
Arborescence prototype (1).

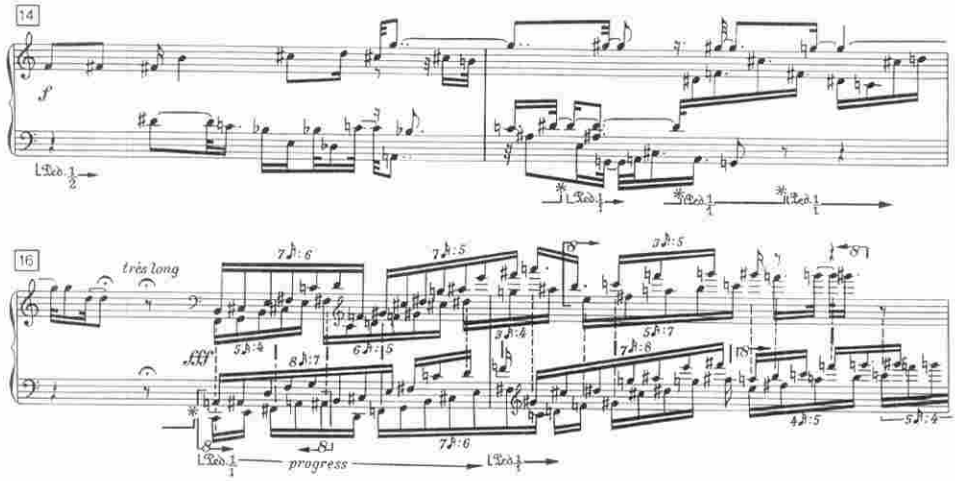


Figure 7
***Mists*, mm. 14–17. Reproduced with the kind authorization of Éditions Salabert.**

that is to be played legato. The second occurrence of this arborescence (mm. 22–24) uses the same pitch material, but the durations of the notes have been shortened.

The third and final realization of this arborescence occurs in mm. 28–30. This time, the pitch material is drawn from the scale in figure 2a. This passage, like the others, begins on F4, (position 14 in the new scale). Several of the pitch intervals in this scale are wider than the corresponding intervals in the original scale. Consequently, this arborescence occupies a wider range of the pitch space than the previous two. It is also the longest of the three, thereby providing a fitting conclusion to the work's first section.

The fourth arborescence (mm. 36–38) grows out of the rapid continuous random walks that precede it in the transitional section. The end of this arborescence is shown in figure 3, where it precedes the continuous random walk in eighth-notes. Like the random walks, this arborescence draws its pitch material from a scale, in this case the one shown in figure 2c.

The remaining arborescences draw their pitch material directly from the chromatic collection. The first of these occurs about halfway through the work's middle section (mm. 80–83). With the shift to the chromatic collection comes a return to the non-coinciding rhythms found earlier in the continuous random walks. Here, as in the random walks, rhythm is used to differentiate the individual lines in a multi-voiced texture.

The last five arborescences form a well-defined group that is based on a single prototype (figure 8). The arborescences are represented in the figure by their time points only, owing to the complexity of their linear structures. Despite this limitation in their graphic representation, the basic outlines of their forms are still discernible. The prototype for this group of arborescences appears in mm. 93–94. Its graphic representation should be compared with its musical notation in figure 9. The musical notation shows that this arborescence draws its pitch material from the chromatic pitch collection and that non-coinciding rhythms are

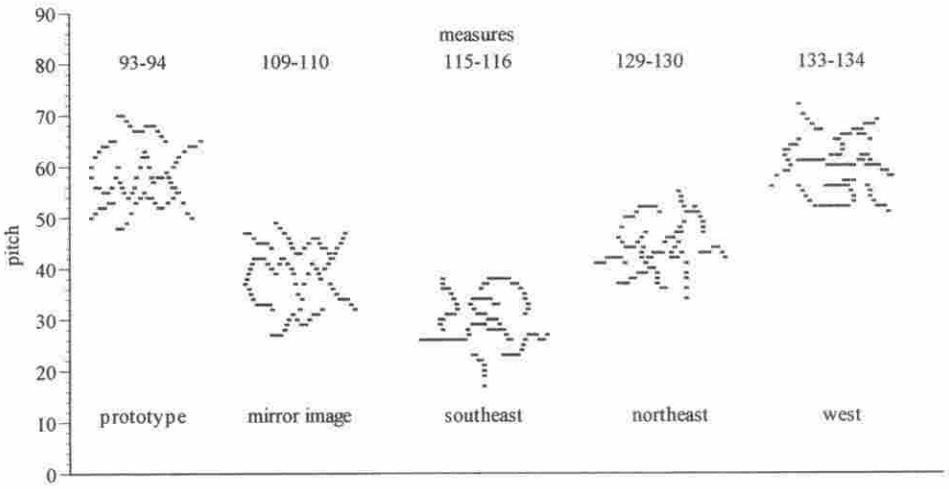


Figure 8
Arborescence prototype (2) and transformations.

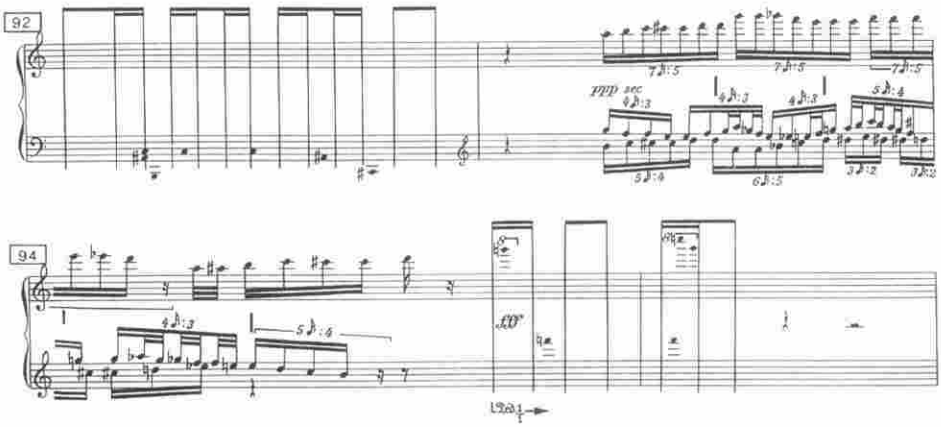


Figure 9
***Mists*, mm. 92–95. Reproduced with the kind authorization of Éditions Salabert.**

used to differentiate between its component lines. Both of these features relate it to the previous arborescence in mm. 80–83.

This prototype is transformed in two ways. First, there are changes in register. There is a descent to the first transformation, followed by another from the first transformation to the second. The third and fourth transformations are presented in progressively higher registers, with the result that the fourth transformation appears in approximately the same registral position as the prototype (see figure 8). As a group, the five arborescences produce an inverted arch in pitch space.

The second type of transformation involves changes in the spatial orientation of the arborescences. The prototype is treated as if it were an object that may be flipped or rotated within the two dimensions of pitch and time. In the first

transformation (mm. 109–110), the prototype is flipped around an imaginary horizontal axis that runs between pitches 47 and 48 (A4 and B♭4). The first transformation is thus a mirror image of the prototype with respect to this axis. For the remaining transformations it will be helpful to imagine an axis running vertically through the prototype. If the vertical axis through the prototype is interpreted as pointing north, its rotations may be identified according to the compass directions in which their axes point. The axis through the second transformation (mm. 115–116) points southeast. The axes through the third and fourth transformations (mm. 129–130, mm. 133–134) point northeast and west, respectively. These transformations result in a succession of arborescences that are similar in duration and registral span but unique with respect to the orientations of their component lines.

This transformational process is contained within a well-defined temporal structure. As each transformation is presented, there is a tendency for the time interval between the arborescences to decrease. There are nearly fifteen measures between the end of the prototype and the beginning of the first transformation, but only four measures between the end of the first transformation and the beginning of the second. There is a considerable gap between the end of the second transformation and the beginning of the third. During this gap the middle section of the work comes to an end and the final section begins (m. 122). The final two transformations of the arborescence, however, are separated by only two measures of rests. Thus, there is a gradual process of acceleration in the appearances of the transformations, interrupted only by the change from the middle to the final section. The compression of the last two arborescences into a mere five measures represents the culmination of this process and provides a decisive, if abrupt, conclusion to the work.

V. Form and Proportion

Form is the large-scale structure that results from the sequence of, and interactions among, the small-scale structures in a work. At the local level, it is possible to divide *Mists* into segments based on changes in one or more characteristics. These characteristics include pitch collection, dynamics, articulation, density, and texture. Segmentation of this kind has been demonstrated above, particularly with respect to the discontinuous random walks. At a more general level, the work divides into sections according to the predominance of particular types of texture as well as changes in tempo. Continuous random walks predominate in the first and final sections and in the transitional section, which is marked by a change to a faster tempo. The original tempo returns in the middle section, where discontinuous random walks are predominant. At an even more general level it is possible to posit a three-part structure for *Mists*. The first part contains both the first section and the transitional section, while the second and third parts are coextensive with the middle and final sections, respectively (figure 10). The figure shows the changes in textural type with respect to time. The eleven-minute duration indicated in the figure is based on a literal interpretation of the metronomic indications in the score.[7]

Form concerns not only the division of the work into parts, sections, or segments. It also has to do with the proportions among these elements. Temporal proportions have long been a concern of Xenakis', dating back at least as far as

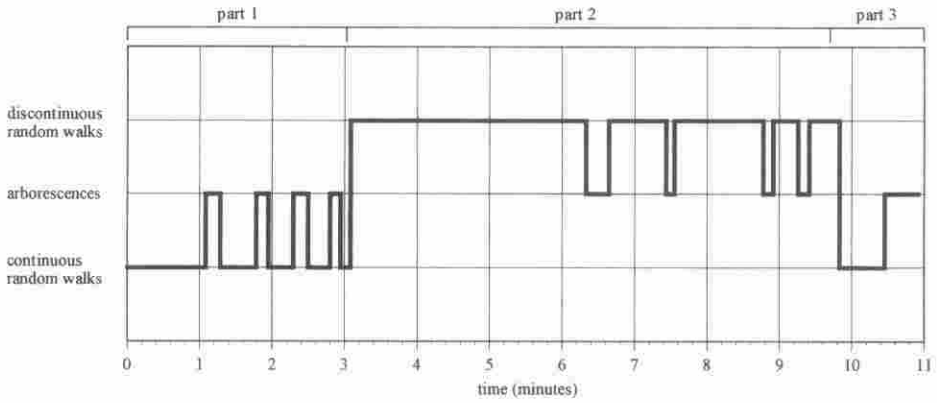


Figure 10
Form chart for *Mists*.

Metastaseis (1953–1954) (cf. Flint 1989, 1993, Baltensperger 1996, Squibbs 1997). At that time, Xenakis was employed by the famous architect Le Corbusier, who had developed a system of measurement based on the Golden Section. He called this system the "Modulor," and published two books about it. The second of these ends with a postscript by Xenakis in which he likens the temporal proportions of *Metastaseis* to the spatial proportions of an architectural structure (Le Corbusier 1958: 326–330).

Complementing the notion of proportional temporal structures in Xenakis' music is his general theory of musical time. This theory has been stated in fragmentary form in the composer's writings (cf. Xenakis 1992: 155–177, 180–200, 255–267). One component of the theory is the distinction between aspects of musical structure that exist only in specific temporal contexts and those that are independent of any temporal context. The former constitute musical structures "inside-time," the latter, musical structures "outside-time." As a simple example, consider the distinction between a melody and the scale upon which it is based. The melody has a unique inside-time structure, whereas the scale on which it is based may also serve as the basis for many other melodies. The scale, therefore, has an outside-time structure that is independent of any potential inside-time manifestations. With regard to *Mists*, one can make a similar distinction between the various scale transpositions, each of which has an outside-time structure, and their inside-time manifestations as continuous or discontinuous random walks, or as arborescences. The probability distributions used in the creation of the discontinuous random walks also fall into the category of outside-time structures, as do the graphic designs that serve as the prototypes for the arborescences.

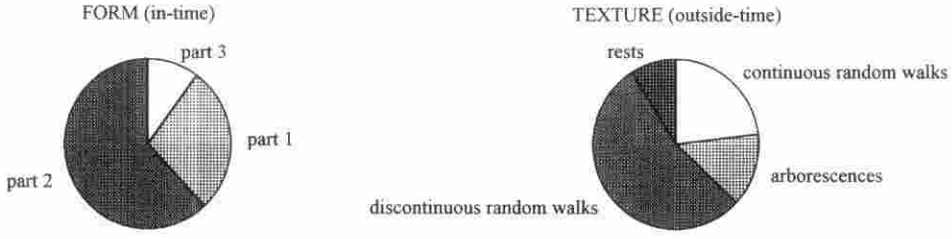
While particular random walks and arborescences may be classified as inside-time structures, the textural types to which they belong may be said to constitute general categories of musical material outside time. From this perspective it is possible to regard the individual musical segments as inside-time realizations of the outside-time textural types. The interpretation of textures as outside-time structures constitutes one aspect of the analysis of temporal proportions in *Mists* presented below. The corresponding inside-time aspect is based on the work's division into three parts.

Figure 11 contains two pie charts. The graph on the left shows the proportion of the total duration of *Mists* that is occupied by each of its three parts. Since these are the formal divisions that one is likely to hear as the work unfolds in time, this graph may be taken to represent the inside-time aspect of the work's large-scale temporal structure. The graph on the right shows the proportion of the work's total duration that is occupied by each of the three textural types and by rests.

The proportion of time in each textural category signifies the cumulative duration of all instances of a given texture regardless of where they occur within the work. The total amount of time devoted to each texture represents a quantifiable aspect of musical structure that exists independently of the temporal flow of the music. From this perspective, duration may be seen to exist as a (potential) quantity of time irrespective of the temporal sequence of individual segments of music. Thus, the total duration assigned to each texture may be regarded as an outside-time structure. This represents an extension of Xenakis' general theory of musical time, in which the durations of individual notes are classified as outside-time structures (Xenakis 1992: 160–170).

Given the resemblance between the proportions of the inside-time and outside-time models of large-scale structure shown in figure 11, it is reasonable to speculate that the composer wished to realize the textures according to a specific proportional scheme. Working from large-scale to small-scale structures, the amount of time devoted to each texture may be divided up to form the lengths of individual segments of music. These segments, in turn, may be sequenced in order to construct the work's formal layout. The formal layout may be designed so that its proportions correspond to the ones used in dividing the work into textural types.

It cannot be proven that Xenakis worked this way in the composition of *Mists*, but planning of this kind certainly played a part in the composition of early works such as *Metastaseis*. When questioned regarding the conscious use of proportions in later works, however, Xenakis has been known to be equivocal. During an interview that touched on this topic, he is quoted as saying:



part 1	.28
part 2	.62
part 3	.10
total	1.00

continuous random walks	.23
arborescences	.14
discontinuous random walks	.54
rests	.09
total	1.00

Figure 11
Inside-time and outside-time proportions in *Mists*.

"Musicologists may analyze scores and come up with their conclusions – and they may be perfectly right – but their findings need not indicate anything conscious on my part" (Varga 1996: 294).

Disregarding for the moment the composer's equivocal attitude toward proportional analysis, let us now consider in greater detail the specific proportions that are observable in the inside-time and outside-time structures of *Mists*. The table below the graph on the left side of figure 11 shows that Part 2 (mm. 41–121) occupies 0.62 of the work's total duration.[8] This proportion is very close to the Golden Section, which is 0.618034. . . . The outer two parts divide the remaining 0.38 of the work's duration into 0.28 for Part 1 and 0.10 for Part 3. The Golden Section is located in the work's interior rather than being used to divide the work into a larger and a smaller part, a more commonly used application of this proportion (cf. Howat 1983).

As mentioned above, Part 2 is associated mainly with discontinuous random walks, while Parts 1 and 3 are associated with continuous random walks. Arborescences, on the other hand, occur in all three parts. The table and graph on the right side of figure 11 show that discontinuous random walks make up more than half of the material in the work, occupying 0.54 of its total duration.[9] The rests, on the other hand, occupy the least amount of time, at just 0.09 of the total duration. The discontinuous random walks and rests combined occupy 0.63 of the total duration, which is remarkably close to the 0.62 of the duration occupied by Part 2 (inside-time). The continuous random walks and arborescences divide the remaining 0.37 of the duration, with 0.23 going to the random walks and 0.14 to the arborescences.

Even from an abstract outside-time perspective, there seems to be a basic opposition in *Mists* between the continuous and discontinuous random walks, for each of these textures occupies the larger part of the outside-time proportion with which it is associated. That is to say, if 0.63 is interpreted as an approximation of the Golden Section, the discontinuous random walks are dominant within its larger portion while the continuous random walks are dominant within its smaller portion. It may well be that the composer had this basic opposition of materials, and these proportions, in mind when he conceived and realized this work. Then again, the proportions may have been worked out intuitively during the course of the composition. Whatever the case may be, the results display a remarkable command of form on several levels of musical structure.[10]

VI. Conclusion

Mists is a representative work from the middle period of Xenakis' maturity. Although confined to the timbrally restrictive medium of the piano, it nonetheless presents a comprehensive demonstration of several of the composer's theoretical ideas. These ideas include his theories of stochastic composition, sieves, and his general theory of musical time. In addition, the use of arborescences in this work, and the availability of compositional sketches, have provided an opportunity to demonstrate the use of graphic images and their transformations in Xenakis' compositional process.

Like many of Xenakis' works, *Mists* demonstrates the use of relative indeterminacy at the local level countered by a large-scale structure that is simple and robust in its general outlines. It is possible to interpret the contrast between these

apparently incompatible structural traits as evidence of a conflict between a desire for order and an attraction to the excitement that may be engendered by disorder. This conflict could be taken as evidence of a structural contradiction, revealing the music to be at cross-purposes with itself.

On the other hand, the differences in the structural levels of Xenakis' music and the resulting tensions between them may be seen, and heard, in terms of an aesthetically stimulating dramatic conflict. From this perspective, the apparent structural conflicts in Xenakis' works could be regarded as artistic manifestations of an archetypal battle. This battle occurs again and again as a reflection of the struggle for existence that occupied Xenakis ever since he nearly lost his life as a member of the Greek Resistance during and after World War II. As a Resistance fighter and as a musician, Xenakis frequently looked to the traditions of ancient Greek philosophy and drama for inspiration. For all the peculiarities of his musical materials and the uncompromising modernity of his compositional style, at a basic level Xenakis has remained true to his Hellenic origins. As he once remarked, "I am a classical Greek living in the twentieth century."[11]

References

Baltensperger, André (1996) *Iannis Xenakis und die Stochastische Musik: Komposition im Spannungsfeld von Architektur und Mathematik*. Bern: Paul Haupt.

Castanet, Pierre (1986) "*Mists*, oeuvre pour piano de Iannis Xenakis". *Analyse musicale* 4, 65–75.

Flint, Ellen Rennie (1989) "An Investigation of Real Time as Evidenced by the Structural and Formal Multiplicities in Iannis Xenakis' *Psappha*". Doctoral dissertation, University of Maryland at College Park, USA. Ann Arbor, MI: University Microfilms Incorporated. UMI #9012457.

Flint, E. R. (1993) "Metabolae, arborescences and the reconstruction of time in Iannis Xenakis' *Psappha*". *Contemporary Music Review* 7, 221–248.

Helffer, Claude (1994) *Mists*. Auvidis Montaigne 782005; reissued in 2000 as Auvidis Montaigne 782137.

Helffer, Claude (1996) *Mists*. Accord 205652.

Howat, Roy (1983) *Debussy in Proportion*. Cambridge: Cambridge University Press.

Le Corbusier (1958) *Modulor 2*, trans. P. de Francia and A. Bostock. Cambridge, MA: MIT Press.

McCoy, L. Scott (1993) "Duration, Pitch/Space, and Density in Iannis Xenakis's *Mists*". Master's thesis, University of Maryland at College Park, USA.

Matossian, Nouritza (1986) *Xenakis*. London: Kahn & Averill.

Montague, Eugene (1995) "The Limits of Logic: Structure and Aesthetics in Xenakis' *Herma*". Master's thesis, University of Massachusetts at Amherst, USA.

Solomos, Makis (1996) *Iannis Xenakis*. Mercuès: P.O. Editions.

Squibbs, Ronald (1997) "An Analytical Approach to the Music of Iannis Xenakis: Studies of Recent Works". Doctoral dissertation, Yale University, New Haven, CT, USA. Ann Arbor, Michigan: University Microfilms Incorporated. UMI #9714309.

Squibbs, R. (1998) Forma i Material Dzwiekowy w Muzyce Fortepianowej Iannisa Xenakisa (Form and Sonic Materials in the Piano Music of Iannis Xenakis), trans. W. Bolkowski. *Muzyka* 31(4), 35–61.

Squibbs, R. (2000) "Musical composition as applied mathematics: set theory and probability in Iannis Xenakis's *Herma*". In *Bridges: Mathematical Connections in Art, Music, and Science; Conference Proceedings, 2000*, ed. R. Sarhangi, pp. 141–151. Winfield, KS: Central Plain Book Manufacturing.

Squibbs, R. (2001) "A methodological problem and a provisional solution: an analysis of structure and form in Xenakis's *Evryali*". In *Présences de Iannis Xenakis / Presences of Iannis Xenakis*, ed. M. Solomos, pp. 153–158. Paris: Centre de Documentation de la Musique Contemporaine.

Sward, Rosemary La Grow (1981) "A Comparison of the Techniques of Stochastic and Serial Composition Based on a Study of the Theories and Selected Compositions of Iannis Xenakis and Milton Babbitt". Doctoral dissertation, Northwestern University, Evanston, IL, USA. Ann Arbor, Michigan: University Microfilms Incorporated. UMI #8125021.

Aki Takahashi (1999) *Mists*. Mode Records 80.

Uno, Yayoi (1994) "The Roles of Compositional Aim, Syntax, and Design in the Assessment of Musical

Styles: Analyses of Piano Music by Pierre Boulez, John Cage, Milton Babbitt, and Iannis Xenakis circa 1950". Doctoral dissertation, Eastman School of Music, Rochester, NY, USA. Ann Arbor, Michigan: University Microfilms Incorporated. UMI 9424593.

Uno, Y. and Roland Hübscher (1995) "Temporal-gestalt segmentation: polyphonic extensions and applications to works by Boulez, Cage, Xenakis, Ligeti, and Babbitt". *Computers in Music Research* 5, 1–37.

Varga, Bálint András (1996) *Conversations with Iannis Xenakis*. London: Faber & Faber.

Xenakis, Iannis (1981) *Mists pour piano* [score]. Paris: Editions Salabert.

Xenakis, I. (1992) *Formalized Music*, revised edn, ed. S. Kanach. Stuyvesant, New York: Pendragon Press. (First published in English in 1971, Bloomington, IN: Indiana University Press.)

Notes

1. The theory behind the composition of *Herma* is described in Xenakis (1992: 155–177). Analyses of *Herma* include Montague (1995), Squibbs (2000), Sward (1981: 374–400), Uno (1994: 234–282), and Uno and Hübscher (1995).
2. I am indebted to Scott McCoy for drawing my attention to the pitch material relationships between *Mists* and *à r*.
3. The currently available CD recordings of *Mists* are by Claude Helffer (Auvidis Montaigne 782005, 1994, reissued as Auvidis Montaigne 782137, 2000; Accord 205652, 1996) and Aki Takahashi (Mode Records 80, 1999).
4. I am grateful to Scott McCoy for lending me his copy of the sketches to *Mists*. Excerpts from the sketches appear in McCoy (1993: Appendix 3), and Squibbs (1997, v. 2: 46, 50, 57.)
5. Octave numbers refer to pitches from C to B within a single octave. For example, C4 is middle C, C5 is an octave above C4, C3 is an octave below; B3 is a semitone below C4.
6. A set is said to be symmetrical under transposition when, at some level of transposition other than 0, its pitch classes are duplicated. An example is the whole-tone scale, whose pitch classes are duplicated at transposition levels 2, 4, 6, 8, and 10.
7. Actual performance times may differ. Claude Helffer's (1994) recording of *Mists* has a duration of 12'26"; Aki Takahashi's (1999) has a duration of 12'51".
8. The calculations are based on a total duration of 10'54.677". The durations are: Part 1 – 3'04.667"; Part 2 – 6'45"; Part 3 – 1'05".
9. The durations on which these calculations are based are: random walks – 2'29.479"; arborescences – 1'33.852"; stochastic textures – 5'50.938"; rests – 1'00.398".
10. Corresponding proportions between inside-time and outside-time structures are by no means limited to *Mists*. Correspondences of this kind are demonstrated for each of the works analyzed in Squibbs (1997).
11. This statement, attributed to Xenakis, heads the opening chapter of Matossian (1986).