PART THREE

CHAPTER 7 — COMPOSITIONAL STYLE

7.1. Introduction

In a series of instrumental compositions that was started in the late 1980s, similar characteristics began to emerge with regard to pitch and rhythmic structures used in individual compositions. These similarities, as detailed below, contribute to what is referred to in this study as a personal compositional style. This chapter serves to relate key features of this style, which is partially used in both the *Study for Triangles* and *Descendant Lines*; and excerpts from two of the series of instrumental compositions, composed in 1994, are analysed. The discussed key features of the compositional style serve to demonstrate incompatibilities between compositional processes provided in commercially available software and those used in the compositional style, and also serve as a background to the succeeding chapter in which demonstrable features of the compositional style are used as a basis for the development of the *Phrase Garden* program in *MAX*.

As pointed out by Cope (1991, pp.27-30), numerous treatises have been dedicated to the subject of musical style, significantly LaRue (1970) and Meyer (1989), however 'empirical definitions of style seem not to exist' (Cope 1991, p.27). Meyer, for example, defines style as 'a replication or patterning, whether in human behaviour or in the artifacts produced by human behaviour, that results in a series of choices made within some set of constraints' (Meyer 1989, p.3). For the purposes of his own monograph, Cope has provided his own definition of musical style, his reason for this being that 'Book-length treatises and broad definitions of style do not... help much in creating computer programs for the replication of musical styles' (Cope 1991, p.30). The Cope definition is that:

> "musical style" will mean: *the identifiable characteristics of a composer's music which are recognizably similar from one work to another*. These include, but are not limited to, pitch and duration..., timbre, dynamics and nuance. As well, these elements together constitute grammars perceived on many levels, for instance as melody, harmony and counterpoint, which themselves join into introductions, motives, transitions, modulations, and cadences. Combinations of these elements constitute style when they appear repeatedly in two or more works. (Cope 1991, p.30)

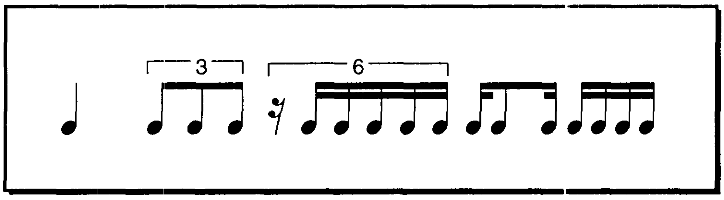
For the purposes of this study, the Cope definition of musical style is adopted, systematic evaluations of musical style, such as that given by Meyer, being problematic primarily due to the broad definitions of musical style they provide. In keeping with the Cope definition, the analyses of excerpts from two works are given in this chapter to relate demonstrable features of the personal compositional style used; and for the purposes of this study, these features are primarily limited to the parameters of pitch and rhythm.

Within the personal compositional style, pitch and rhythmic materials are drawn from one or more note series that are usually derived from some programmatic association with which each individual composition is concerned. The note series used in the *Study for Triangles*, as previously explained, takes the Pythagorean *Holy Tetractys* as a programmatic starting point, while in *Descendant Lines*, the Argentinian and Croatian folksongs provide two different note series for the work. The transpositions of a note series, starting the same intervallic series on each of the original notes of the set as shown in the *Descendant Lines* matrices of Figures 6.1 and 6.2, provide pitch material for substantial portions of the work.

Rhythmic materials in the compositional style are usually derived from interval structures of the note sets, the intervals, as numerics, mapped to rhythmic cells as shown in the *Descendant Lines* rhythms in Table 6.2. Rhythmic cells normally reflect a numeric value, either through the number of rhythmic values in a cell — for example the numeric 4 may be mapped as four 1/16th notes — or through a combination of the number of rhythmic values and tuplet values. The numeric 5, for example, may be mapped to a quintuplet figure. The *Study for Triangles*, in having its rhythmic material based on the equation for the right-angle triangle, departs from the norm of the compositional style that is seen in the *Descendant Lines* rhythmic material. The *Étude in Memoriam Allan Dagg*, in having both pitch and rhythmic materials derived directly from the *All of Me* excerpt, departs from the compositional style with regard to both pitch and rhythm. This departure was affected to make full use of the Markov processes available within *Jam Factory*, while retaining the original pitch materials of the excerpt, and focusing on a simulation of jazz improvisation.

Form within the compositional style is primarily determined by programmatic associations, as shown in the *Descendant Lines* example in Table 6.1. Section and phrase lengths within a work are normally determined by the length of numeric series, which are in turn mapped to rhythmic values. As an example, the numeric series 1 3 6 7 (the first numeric series derived from the Argentinian tango in *Descendant Lines*) might present the rhythmic phrase shown in Figure 7.1.

Figure 7.1 Rhythmic phrase (1 3 6 7) from *Descendant Lines* rhythmic mapping



Numeric series that generate phrases such as this are normally used sequentially in a work to produce varying phrase combinations and, with ongoing statements of consecutive numeric series from the numeric series matrices, the resulting rhythmic patterns are used to produce sections of any desired length, depending on which and how many numeric series are chosen for a section of a work.

In parts of *Descendant Lines*, the numerics used in the production of a phrase do not follow the numeric patterns of the rhythm matrices, as individual numerics/rhythmic cells are mapped to user defined symbols in *Symbolic Composer*. These, in turn, are controlled by algorithms such as `gen-notrans`, as shown in Figure 6.9. The use of algorithms like `gen-notrans` in *Descendant Lines* represents a departure in this work from the compositional style in which appearances of rhythmic cells are determined by sequential numbers from numeric series matrices.

As each of the three works examined so far in this study departs in some way from the personal compositional style developed since the late 1980s, short excerpts from two instrumental works composed in 1994 without computer assistance are analysed to relate key features of pitch and rhythmic techniques used in the style.

7.2. Excerpt analyses

The first excerpt is from a work entitled *Tears and Coloured Diamonds*, composed for bass clarinet doubling alto saxophone, and percussion. This work is programmatically concerned with the *Commedia dell'Arte* characters Pierrot, Harlequin and Colombine, and draws inspiration from *Les Enfants du Paradis* (motion picture) 1945. The excerpt (Figure 7.2) for vibraphone solo is from the opening of the work and seeks to represent the character of the sad clown Pierrot.

Figure 7. 2 *Tears and Coloured Diamonds* Excerpt

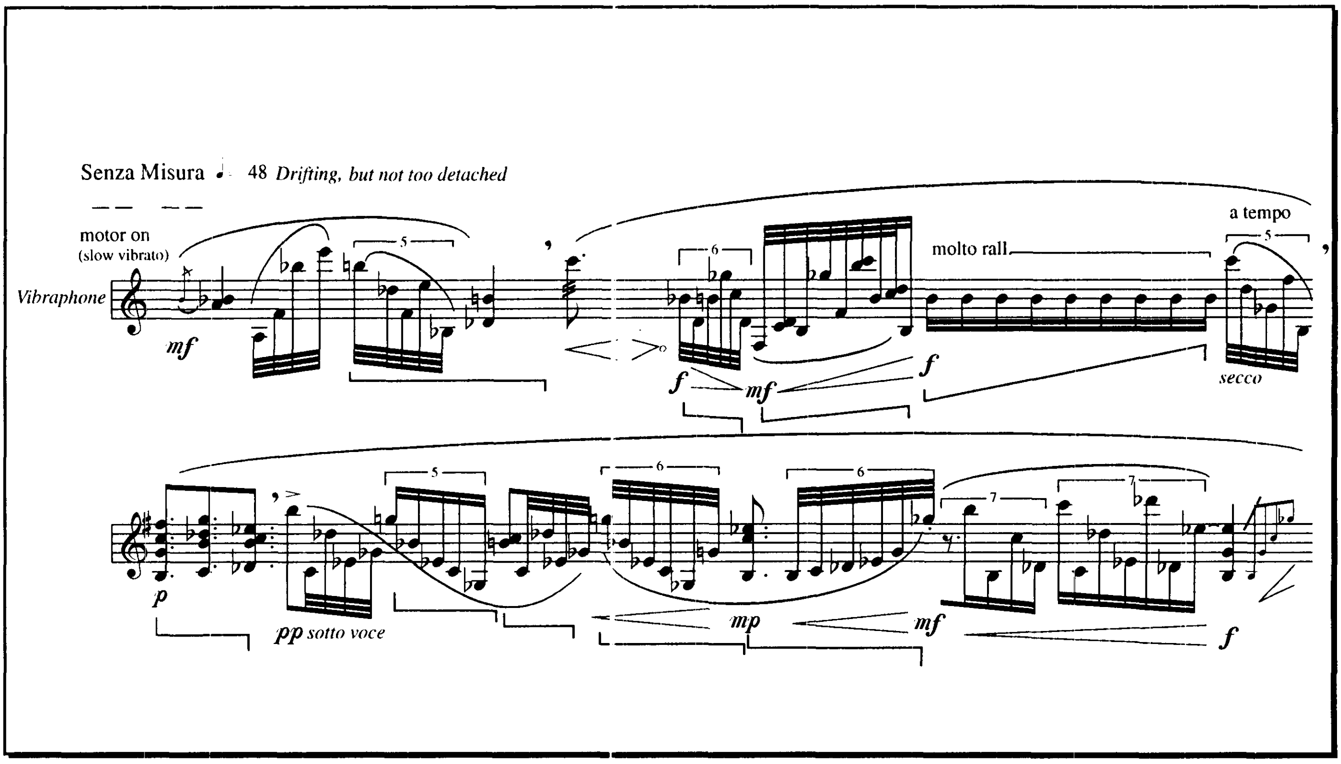


Figure 7.3 shows the note matrix used for this section of the work. The original note set shown at the top of the figure is derived arbitrarily, rather than from any intervallic or programmatic association. The first three note sets from the matrix are used in the excerpt, the notes from a note set chosen intuitively. The first set (A Bb B Db E F) is used throughout the first phrase which lasts four crotchet beats, the second set (Bb B C D F Gb) remains to the end of the first stave (phrase 2), and the third set (B C Db Eb Gb G) is used throughout the second stave (phrase 3).

Figure 7. 3 *Tears and Coloured Diamonds,* Note matrix

A	**Bb**	**B**	**Db**	**E**	**F**
Bb	**B**	**C**	**D**	**F**	**Gb**
B	**C**	**Db**	**Eb**	**Gb**	**G**
Db	**D**	**Eb**	**F**	**Ab**	**A**
E	**F**	**Gb**	**Ab**	**B**	**C**
F	**Gb**	**G**	**A**	**C**	**Db**

Whilst notes from note sets are chosen intuitively, a statistical analysis of intervals occurring between pitches in the *Tears and Coloured Diamonds* excerpt (vertical aggregate or chord events not included) reveals a strong leaning toward the use of the semitone. Figure 7.4 shows the results of a statistical analysis of intervals within the excerpt. In the tradition of Set-theoretical analysis (Cook 1987; Forte 1973), interval classes are used wherein intervals greater than 6 semitones (augmented 4th) are inverted to limit the interval range from 0 through to 6 semitones. The figure also provides the interval vector of the note set used in the excerpt, the interval vector being the description of the total interval content of the set. (Forte 1973, p.15). The interval vector reveals that within the set there is a relatively equal distribution of interval classes 1 to 6 and hence no inherent bias toward any particular interval. The predominance of the semitone in the *Tears and Coloured Diamonds* excerpt is therefore not a result of a heavy probabilistic weighting of that interval in the note set, but a conscious weighting of that interval, determined by the choice of intervals used in the excerpt.

Figure 7. 4 *Tears and Coloured Diamonds,* Excerpt statistical analysis (intervals)

0	1	2	3	4	5	6	Interval Class
18	25	15	11	9	11	11	% Occurrence

Note Set Interval Vector

1	2	3	4	5	6	Interval Class
3	2	2	3	3	2	Number of Occurrences

A second statistical analysis of the semitone-based intervals (interval class 1) in the excerpt reveals that where a semitone interval occurs it most commonly occurs as a leap in a range wider than an octave (i.e. 13 or more semitones). Within the excerpt (again vertical aggregates are not included in the analysis), 72% of the semitone-based intervals appear as leaps over an octave, 14% are within the octave (11 semitones) and 14% are actual semitone steps. This focus on a particular interval in a phrase or section is commonplace within the compositional style and is not restricted to any interval in particular. Multiple intervals may also come into focus, depending on the programmatic, or purely musical, requirements of a work. In this excerpt, leaps over an octave with interval class 1 serve to decrease the general dissonance associated with step-wise semitone or chromatic movement, while a sense of forward melodic movement is still retained with the use of the interval class. From a programmatic viewpoint, this serves to portray the character of the melancholy Pierrot and his flowing costume.

Vertical aggregates or chords in the compositional style are, in general, intuitively formed from components of a note set currently in use. They are used to aid in the provision of rhythmic cadences, and to punctuate linear pitch material. Often though, vertical aggregates will centre on, or contrast with, a particular interval which is the focus of the linear note material. In the first two phrases of the *Tears and Coloured Diamonds* excerpt 50% of the vertical aggregates are comprised of the interval class 1, in sympathy with the focus on this interval in the linear pitch material, while the remaining 50% are of interval class 2 and provide a very simple contrast to the class 1 aggregates. In the third phrase the opening three-chord statement has a limited internal ordering with the bass notes of the chords linearly presenting the first three notes of the newly introduced note set. These three notes go on to become a minor focus of the phrase in the linear note material, for example they appear as the upper voice over the two septuplet figures at the end of the phrase. The middle and upper voices in the opening chords of the phrase present the remainder of the note set.

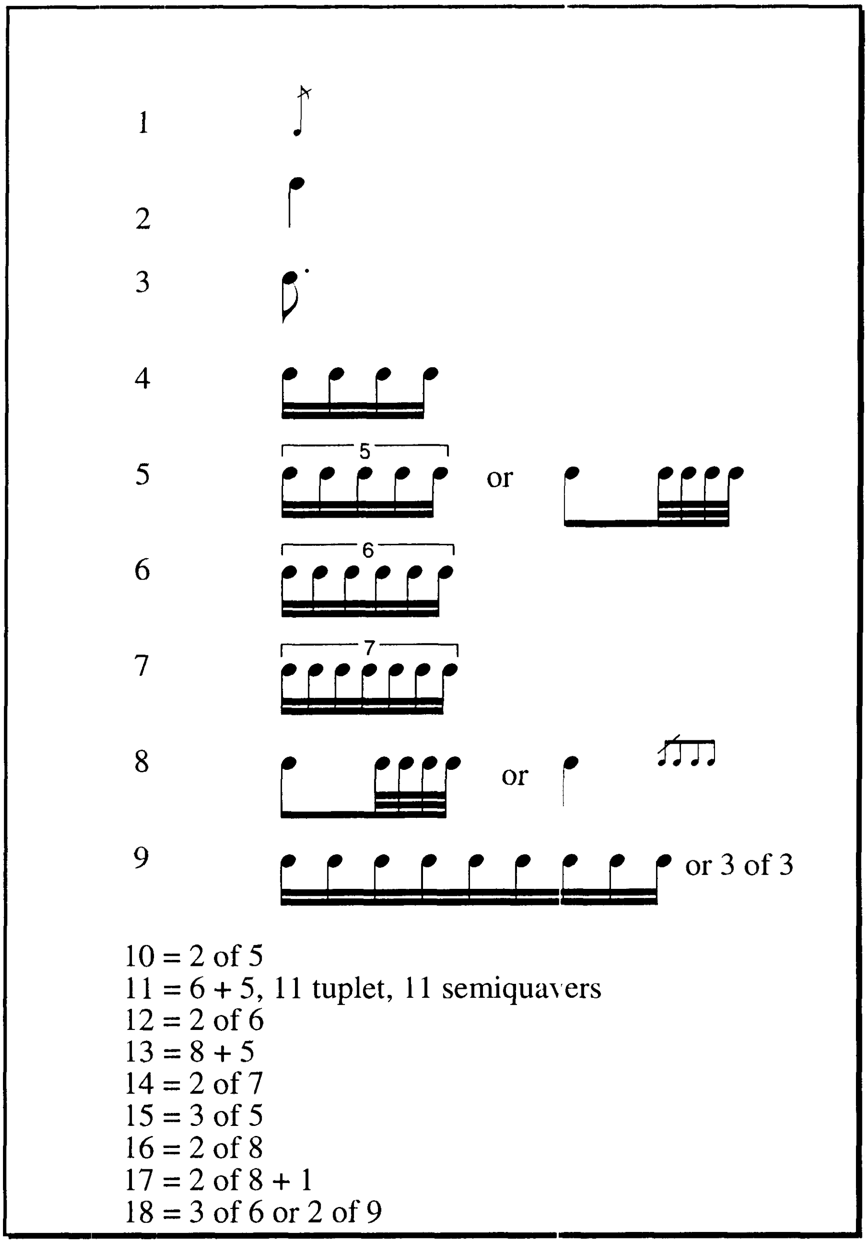
Rhythm in the *Tears and Coloured Diamonds* excerpt is dependant upon a numeric scheme which is derived from the intervals of the original note set (A Bb B Db E F). The distance from the first pitch in the set to each of the remaining pitches provides a numeric series of 1 2 4 5 4 (A to Bb gives the numeric 1, A to B gives 2, A to Db gives 4 etc.). Consecutive numerics within this series are added together to form a second series: 1 + 2 gives 3, 2 + 4 gives 6, 4 + 5 gives 9, 5 + 4 gives 9, 4 (the last numeric) + 1 (the first numeric) gives 5. This results in a second numeric series of 3 6 9 9 5. This process is then repeated with the second numeric series and is repeated again to provide further numeric series. The numeric series used in the opening section of *Tears and Coloured Diamonds* are shown in Figure 7.5.

Figure 7.5 *Tears and Coloured Diamonds,* Numeric series

1	**2**	**4**	**5**	**4**
3	**6**	**9**	**9**	**5**
9	**15**	**18**	**14**	**8**
24	**33**	**32**	**22**	**17**
57	**65**	**54**	**39**	**41**

The numeric series are mapped to actual rhythmic values that are again derived intuitively, but reflect the numeric being mapped. The rhythmic values used in the opening of *Tears and Coloured Diamonds* are mapped up to the numeric 9. Higher numeric values use combinations of the numerics between 1 and 9, as indicated in Figure 7.6. Along with the mappings shown in Figure 7.6, there is a 'wild card' rhythmic value of a single crotchet that may at any time replace any of the rhythmic figures shown in Figure 7.6.

Figure 7.6 *Tears and Coloured Diamonds,* Numeric to rhythmic cell mappings



Within the compositional style, individual note sets from a note matrix correspond to individual numeric series. For example, if the first note set from a note matrix is in use, the first numeric series from a numeric matrix will also be in use. In the *Tears and Coloured Diamonds* excerpt, the opening phrase has pitches from the original note series and, with the rhythm mappings shown in Figure 7.6, states the first numeric series from the numeric series matrix (1 2 4 5 4). The first four numerics 1, 2, 4 and 5 use the rhythmic mapping scheme above, while the final numeric of the series (4) uses the 'wild card' 1/4 note value to provide a rhythmic cadence for the opening phrase.

In the second phrase two minor departures from the rhythmic mappings are made. The first is the use of 1/32nd note values in the rhythmic mapping of the numeric 9, where according to the rhythmic scheme these values are normally 1/16th notes. Such diminution of rhythmic values in a group is not unusual within the compositional style, nor is the augmentation of rhythmic values used within the rhythmic mapping.

In the third phrase (the second stave of the excerpt) two departures are made. The numeric 18, starting on the first sextuplet group of the phrase, should present three sextuplet groups according to the rhythmic scheme. Instead, the second sextuplet group is replaced by a dotted 1/8th note. This replacement is an example of a free mixing of rhythmic mappings assigned to a numeric, wherever there is a choice of two or more different rhythmic mappings. The numeric 18 can be either three of the numeric 6, or two of the numeric 9. The numeric 9 may be either nine 1/16th note values or three of the numeric 3. The numeric 18 in the excerpt is mapped firstly to a sextuplet from the 'three of numeric 6' mapping, followed by a dotted 1/8th from the 'two of numeric 9' mapping and finally another sextuplet group. The second departure from the rhythmic mappings in this phrase is in the numeric 14 which should present two septuplet groups. The first three septuplet 1/16th notes in this group are replaced by a rest. Within the compositional style, this replacement of values with rests is a necessity as rests are not generally provided in the rhythmic mappings, and a work would otherwise contain no silences.

As shown in the *Tears and Coloured Diamonds* excerpt, rhythm in the compositional style follows a scheme of numeric to rhythm mappings, however the use of augmentations, diminutions, replacement of rhythmic values with rests, and the mixing of differing mappings provides a flexible working environment with rhythmic materials. Such flexibility allows the manipulation of rhythm wherever the normal mappings of a numeric series fail to represent musical or programmatic requirements within a composition. As an example, the diminution of the 1/16th value down to 1/32nd note values in the second phrase of the *Tears and Coloured Diamonds* excerpt provides a continuation of rapid movement presented in the previous sextuplet, as opposed to a more stolid presentation of two groups of nine 1/16th values suggested in the rhythmic mappings of the numeric 9. This rapid movement serves to provide a contrast between the two groups of nine, with the second group providing a rhythmic cadence by being slower, repeating a single pitch, and being subject to a *rallentando*.

The second excerpt for analysis is from a work entitled *Plainte faite à Londres* composed for chamber ensemble comprising flute doubling piccolo, Bb clarinet, violin, 'cello, piano and percussion. The programmatic focus of the overall work is on the thin line that exists between sanity and insanity, while the programmatic focus of this excerpt is on a real life incident reported in the *Melbourne Age* in which the reporter states that a 'police officer shot dead a mentally disturbed man who was stabbing himself repeatedly in the chest' (Saunders 1994). Notable in the excerpt shown in Figure 7.7 are the repeated left-hand piano chords which programmatically represent the man stabbing himself, and a predominance of disjunct melodic motion combined with short, rhythmically non-homogenous gestures that serve to represent the chaos of the scene.

Figure 7.7 *Plainte faite à Londres,* Excerpt

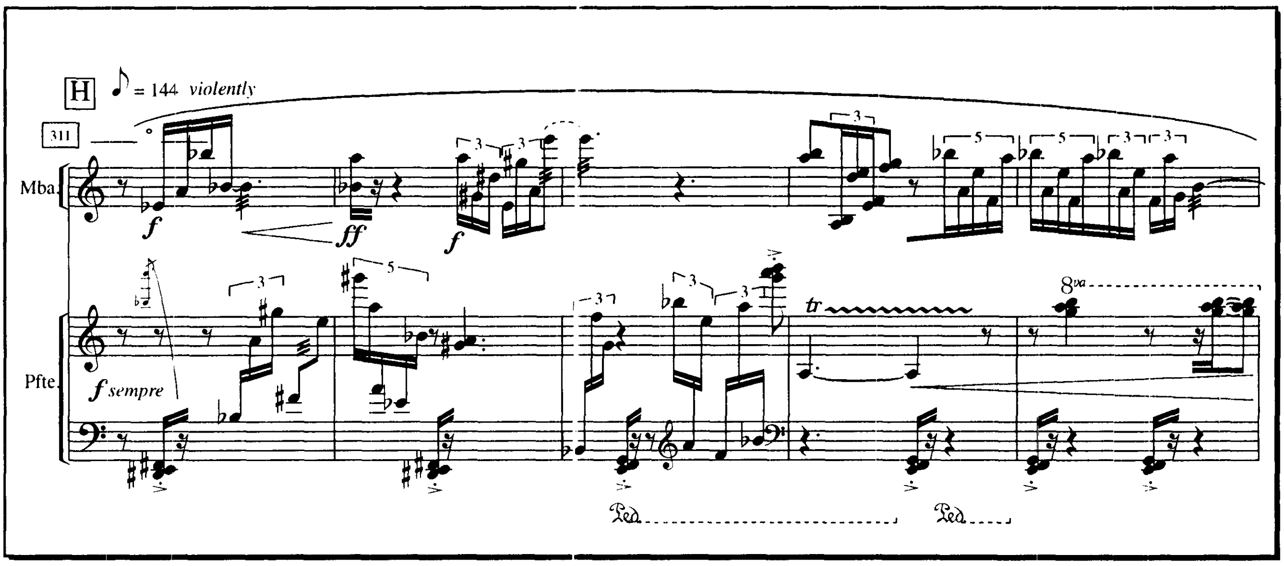


Figure 7.8 shows the note matrix used for the excerpt, the first two measures using notes from the first note set of the matrix, the remaining three measures using notes from the

second set. The predominant interval of the excerpt (chord events not included) is again interval class 1. The statistical analysis shown in Figure 7.9 reveals that interval class 1 occurs 40% of the time, and the remaining intervals each occur under 20% of the time. The interval vector of the note set is also given in Figure 7.9 and reveals that within the set there is a relatively equal distribution of interval classes 1 to 6 and hence no inherent bias toward interval class 1.

Figure 7.8 *Plainte faite à Londres,* Note matrix

D#	**E**	**F#**	**G#**	**A**	**Bb**
E	**F**	**G**	**A**	**Bb**	**B**
F#	**G**	**A**	**B**	**C**	**Db**
G#	**A**	**B**	**C#**	**D**	**Eb**
A	**Bb**	**C**	**D**	**Eb**	**E**
Bb	**B**	**Db**	**Eb**	**E**	**F**

Figure 7.9 *Plainte faite à Londres,* Excerpt statistical analysis (intervals)

0	1	2	3	4	5	6	Interval Class
6	40	18	0	12	18	6	% Occurrence

Note Set Interval Vector

1	2	3	4	5	6	Interval Class
3	3	2	2	3	2	Number of Occurrences

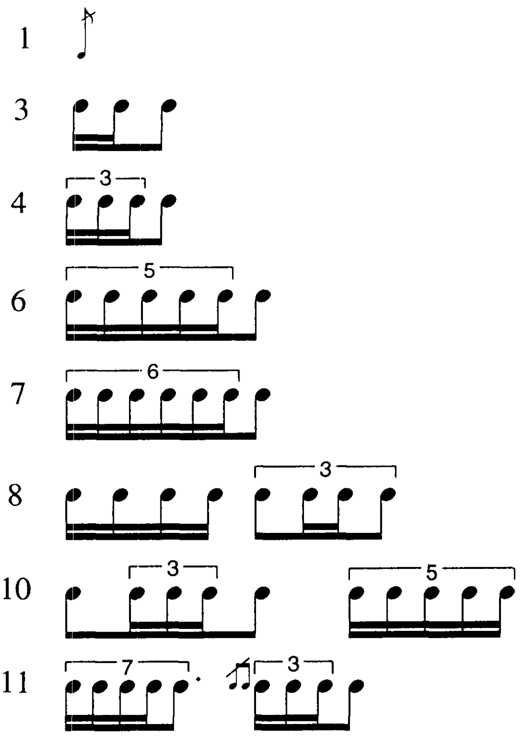
In the *Plainte faite à Londres* excerpt, the left-hand piano chords that represent the man stabbing himself are derived from the first three notes of the note set. The chord notes are spaced either one or two semitones apart, this close spacing presenting a contrast to the disjunct motion of the linear pitch material. Most of the remaining vertical aggregates in the excerpt are comprised of the interval classes 1 and 2, in which the pitches are close and are derivations of the left-hand piano chords containing the same interval classes. The widely spaced vertical aggregates of Bb and A, which are stated 11 semitones apart in the first two measures, provide a focus on this note pair. The A and Bb are the only two common notes between the first and second note sets and occur regularly in the linear pitch movement of the excerpt, particularly in the repeated motif in the marimba part at mm.4-5. This repeated marimba motif of A Bb A E F reflects in a linear fashion the repeated chords of the piano left-hand and, from a programmatic viewpoint, serves to portray the man's repetitive stabbing of himself.

Rhythmic materials in *Plainte faite à Londres* are based on a numeric series that is loosely derived from intervals of the note set. The numeric series used in the excerpt (1 3 4 6 7) is expanded in the same way as the *Tears and Coloured Diamonds* numeric series matrix and results in the Figure 7.10 matrix. The mapping of the numeric series to rhythmic cells is based on usual mappings used in the compositional style where individual numerics are mapped to a number of rhythmic values, or to tuplet values, that reflect the numeric itself. In this work rhythmic mappings are also based on French Baroque dance rhythms, a reflection on a secondary programmatic theme of the work. The rhythmic cells are primarily based on metrical feet related to passions as given by Isaac Vossius in his 1673 treatise on the alliance of music and poetry. The 'passion' used in this section of the work is 'fierce, vehement, violent and warlike and furious and mad' (Mather 1987, p.13), which relates to the *iamb* (short long), *anapaest* (short short long) and *4th paeon* (short short short long). The rhythmic cells derived from this passion and used for this excerpt of the work are shown in Figure 7.11.

Figure 7.10 *Plainte faite à Londres,* Numeric series

1	**3**	**4**	**6**	**7**
4	**7**	**10**	**13**	**8**
11	**17**	**23**	**21**	**12**
28	**40**	**44**	**33**	**23**

Figure 7.11 *Plainte faite à Londres,* Numeric to rhythmic cell mappings



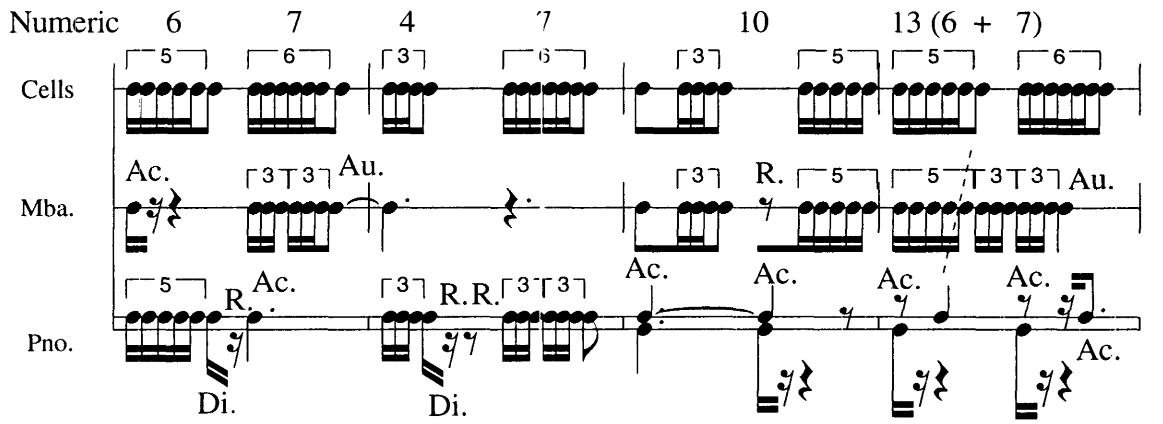
12 = 2 of 6
13 = 6 + 7
17 = 2 of 6 + 4 + 1
21 = 2 of 8 + 4 + 1
23 = 2 of 8 + 7
28 = 3 of 8 + 4
33 = 2 of 11 + 7 + 4
40 = 4 of 10
44 = 4 x 10 + 4

Within the compositional style, rhythmic values for multiple instrument phrases are assigned using one of three methods. Method 1 is the simplest, in which each part is provided the same numeric series but the entry of one part is delayed to avoid rhythmic unison. In Method 2 each part is assigned differing rhythmic series, resulting in rhythmically non-homogenous lines which are generally preferred within the compositional style. In Method 3 a single numeric series is distributed amongst all instrument parts, one part resting or sustaining a rhythmic value whilst another part is active, and/or one part doubling rhythmic material to provide accentuations of rhythmic values, often on the first rhythmic value of a rhythmic cell. Method 3 is used in the *Plainte faite à Londres* excerpt, with the exception of the opening measure in which Method 1 is used briefly.

The opening measure of the excerpt, in using the first note set of the note matrix, contains the numerics 1, 3 and 4 from the first numeric series of the numeric series matrix (1 3 4 6 7). In this measure the grace note assigned to the numeric 1 appears in the piano right-hand and also appears in an augmented form as the first 1/16th note value in the marimba part. The 1/16th note chord in the piano left-hand represents the start of the rhythmic cell assigned to the numeric 3, whilst the second 1/16th note value in the marimba part represents the start of the same rhythmic cell. The use of the same numeric series in both the marimba and piano parts indicates a use of the first method of assigning numeric series to multiple parts. The augmentation of the grace note to a 1/16th note value in the marimba part provides a delay of entry of the numeric 3 rhythmic cell in the marimba part, a hallmark of Method 1.

The remainder of the excerpt uses Method 3. In the first measure the numeric 3 rhythmic cell is stated in full in the marimba part, with the final 1/8th note value of the cell augmented to provide an accompaniment for the statement in the piano part of the numeric 4 rhythmic cell. The final 1/8th note value of the numeric 4 rhythmic cell is augmented to a 1/4 note value in a tremolo figure. Figure 7.12 shows the rhythmic figures of the remaining excerpt measures, the top line showing the rhythmic cells as they appear in the numeric to rhythmic cell mapping, the second and third lines showing the actual rhythmic materials used in the marimba and piano parts respectively. Annotations in the Figure show deviations from the original rhythmic cells. A deviation not previously explained occurs in the final measure of the figure. Here the final 1/8th note value of the numeric 6 mapping is presented in the piano part as an augmented value of a 1/4 note, instead of following the quintuplet mapping of the numeric 6 in the marimba part. The dotted line in the figure shows the placement of the final value of the numeric 6 mapping in the piano part.

Figure 7.12 *Plainte faite à Londres,* Excerpt rhythmic cells and deviations



Ac. = Accenting note (usually accompanies first rhythmic value of a rhythmic cell)
Au. = Augmentation of a rhythmic cell value
Di. = Diminution of a rhythmic cell value
R. = Inserted rest

7.3. Compositional Style Summary

In summary, the compositional style developed since the late 1980s may be defined as one based primarily on minimal pitch materials in the form of one or more note sets. A note set forms the top row of a matrix, while subsequent note sets in a matrix are simply transpositions of the first set. In the composition of a work, notes are intuitively chosen from a single note set within a matrix, however in the choice of notes used there emerges a predominance of one or more intervals, this predominance generally reflecting programmatic associations within a work. Intervallic content of a note set provides a numeric series, each numeric of a series mapped to a rhythmic cell in the form of a single rhythmic value or a motif. Addition of consecutive pairs of numerics from the initial numeric series gives rise to further numeric series. Numeric series form the basis of phrases and sections within a composition, the rhythmic cells that are mapped to numerics being applied in a work with a degree of freedom through the incorporation of augmentation, diminution, added rests and mixed mappings.

7.4. Commercial Software Incompatibilities with the Compositional Style

The relatively flexible working environment of the compositional style provides an insight into the incompatibilities between composition processes used in commercially available software and those used in the compositional style. Each of the three software programs examined so far in this study provides inflexible algorithms to deal with the musical materials of the compositional style, an inflexibility that is not suited to the freedom of the compositional style shown in the excerpts previously analysed.

With *M*, a pitch sequence is entered into the program and controlled primarily with the program's Note-order algorithm. The Note-order algorithm setting that most closely resembles the way pitch is dealt with in the compositional style is the 'utterly random' setting, the remaining settings providing either repetitions of a pitch sequence as it has been entered into the program (original order setting), or repetitions of a single re-ordering of a sequence (cyclic random setting). Repetitive pitch sequences do not tend to be used within the compositional style unless there is a specific programmatic association calling for such repetition, for example in the repeated marimba motif of the *Plainte faite á Londres* excerpt. Where repetition is used in the compositional style it is usually very brief. The 'utterly random' setting of *M*, as shown in Figure 4.14, simply presents non-repetitive random re-orderings of a pitch sequence. Whilst a lack of repetition is generally desired in the compositional style, random re-ordering in *M* is not particularly compatible with the compositional style as pitches used therein tend to provide a focus on a particular interval, while the 'utterly random' output from *M* tends to provide an equal weighting of intervallic distribution.

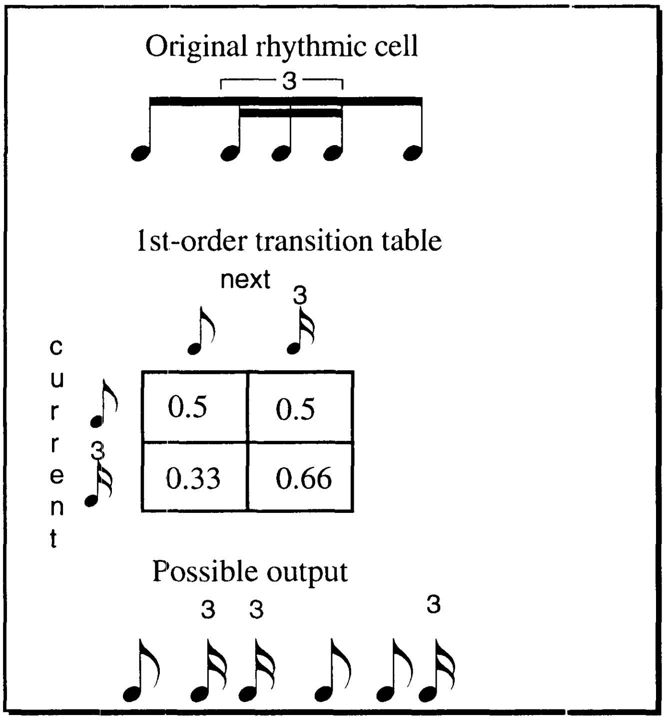
Rhythm control in *M* is detached from the manner in which rhythm is controlled in the compositional style. *M's* rhythmic settings in the Cyclic editor window (see Figure 2.5) are controlled by settings in the multiplier vertical array in the upper right of the window. The multiplier vertical array is linked to *M's* Time-base setting in the main *M* window, the values in the multiplier vertical array representing subdivisions or multiplications of the main window Time-base denominator. The settings available in the multiplier vertical array are 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, etc. If the Time-base denominator is 4, the multiplier vertical array value of 1, for example, will correspond to a 1/4 note, 0.5 to an 1/8th note, 1.5 to a dotted 1/4 note etc. Multiplier vertical array values do not provide any tuplet subdivisions of the 1/4 Time-base. To achieve a tuplet subdivision the Time-base must be altered so that the denominator value reflects a tuplet subdivision, for example 1/3, in which case all multiplier vertical array numbers will be subdivisions or multiplications of a tuplet value. A combination of normal values and tuplet values in any one *M* voice is not a possibility. In the compositional style, tuplet values are an integral part of the numeric to rhythmic mappings. Whilst rhythmic mappings could be developed without a combination of tuplet and normal values in a part, all mappings in the works developed, using the compositional style since the late 1980s, have incorporated tuplet values into rhythmic mappings to reflect the numeric being mapped to a rhythmic cell. The impossibility of combining tuplet and normal rhythmic values renders *M* incompatible with the compositional style with regard to using rhythms that contain both normal and tuplet values.

Jam Factory's Markov processes represent a departure from the compositional style with regard to both pitch and rhythm. In the pitch realm, the most simple variations can only occur in *Jam Factory* where there is repetition of a pitch within a pitch sequence, and that pitch at each occurrence is followed by a differing pitch (i.e. a pitch 1 is followed by a pitch 2 at its first occurrence, and by a pitch 3 at its second occurrence). Pitches in *Jam Factory* are treated as individual entities, for example, C3 is a different pitch from C4.

In the compositional style, notes, as indicated in the note matrices, belong to pitch classes wherein C3 and C4 are both of the pitch class C. A pitch class will usually occur numerous times within a phrase, and usually pitches from a single pitch class will appear in varied octave placements. Whilst some pitches from a pitch class may be repeated in a phrase in the same octave, these repetitions are generally minimal. *Jam Factory* depends on repetitions of pitch in the same octave to produce its variations according to Markov processes. As occurrences of a pitch class in the same octave are minimal within the compositional style, *Jam Factory's* Markov processes do not present a viable method of generating variations on phrases developed within the compositional style.

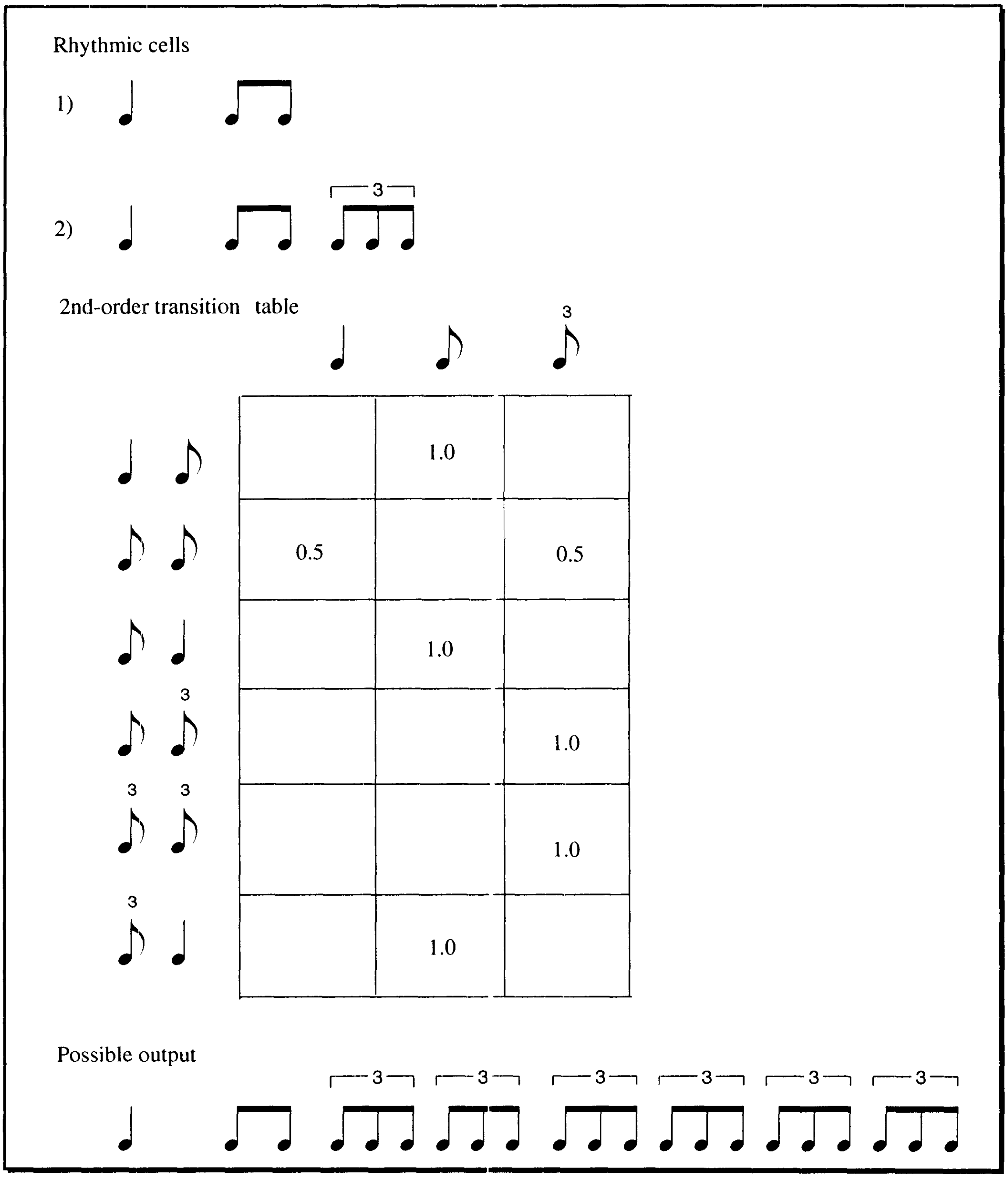
Markov processes as applied to rhythm in *Jam Factory* provide variations on rhythmic sequences that, unlike rhythmic sequences in *M*, can contain mixtures of normal and tuplet values. Whilst rhythmic cells used in the compositional style can be programmed and played back in *Jam Factory*, variations on the cells using Markov processes provide unsatisfactory results due to a fragmentation of the rhythmic cells in their original states into single rhythmic units such as a 1/4 note or a quintuplet 1/16th. As an example, the first part of the numeric 10 rhythmic cell in the *Plainte faite à Londres* excerpt is shown in Figure 7.13 and subject to a 1st-order transition table. The possible output shown in Figure 7.13 from using a 1st-order transition table shows the fragmentation of the cell, the 1/16th note triplet figure from the original cell appearing in an incomplete form.

Figure 7.13 Rhythmic cell fragmentation



Higher order transition tables will provide a cell in its entirety. However, successive rhythmic cells from the compositional style that are programmed into *Jam Factory* will inevitably become fragmented as probabilities from one cell become mixed with those from another, or the program will become 'stuck' on a rhythmic value due to similarities between one cell and another. Figure 7.14 shows an example of the latter, in which two similar rhythmic cells are programmed into *Jam Factory* consecutively and are subjected to a 2nd-order transition table. The presence of the triplet figure in the second cell means that in a 2nd-order table, which references two previous events to generate a next event, the third triplet 1/8th note is a product of the previous two triplet 1/8th notes. The next event is produced by referring to the second and third triplet 1/8ths which will produce, again, another triplet quaver.

Figure 7.14 Rhythmic cells, 2nd-order output



Markov processes as deployed in *Jam Factory* are not compatible with the compositional style due to the conceptualisation in *Jam Factory* of pitch and rhythmic events as singular entities; that is, one or more pitches in combination will produce as a next event a single pitch, and one or more rhythmic values will produce as a next event a single rhythmic value. Pitch and rhythm in the compositional style are conceptualised at a deeper level, with individual pitches originating from pitch series in which pitch classes are used while rhythms are most commonly grouped as rhythmic cells. In order for Markov processes to work effectively with the conceptualisation of pitch and rhythm in the compositional style, pitch would require an algorithm to address pitch classes as opposed to individual pitches, and rhythm would need to be dealt with either in cells or in the numerics that are mapped to the cells. *Jam Factory* offers neither of these options.

Of the three software programs examined so far in this study, *Symbolic Composer* comes closest to representing the manner in which pitch is used in the compositional style. Within *Symbolic Composer*, symbol definitions for generative algorithms such as `gen-notrans` and `gen-rewrite` can be carefully configured with the `defsym` function and an algorithm depth level to provide the interval weightings desired in the compositional style. As an example, the folksong symbol definitions used in *Descendant Lines* (Figure 6.4b and Figure 7.16a), in combination with `gen-nctrans a 4`, provide a focus on the interval class 3 when mapped to the folksong note set shown in Figure 6.1. Figure 7.15 shows the symbol output of the `gen-notrans a 4` algorithm and the common notation output with the symbols mapped to the folksong note set. Included in Figure 7.15 is a statistical analysis of the output showing interval weightings of the output in percentages. The symbols generating interval class 3 are `b-f`, `h-f` and `c-e`, the symbol pair of `b-f` occurring regularly throughout the `gen-notrans a 4` output due to symbol paths resulting from the depth level of `4`.

Figure 7.15 *Symbolic Composer,* `gen-notrans a 4` symbol output and interval occurrence

0	1	2	3	4	5	6	Interval Class
0	17	10	30	10	23	10	% Occurrence

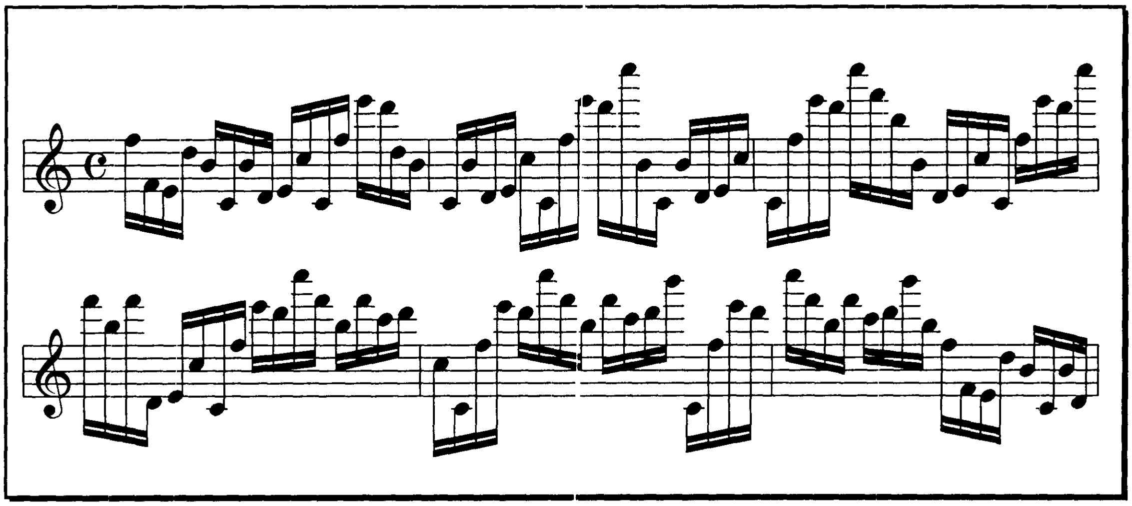
Lower depth levels of `gen-notrans a 3` or `gen-notrans a 2` do not, however, provide such a focus on interval class 3. In order to provide a focus on a particular interval with `gen-notrans` or `gen-rewrite`, careful planning is required, in combination with a comprehensive understanding of the effects of various algorithms and depth levels. This also applies to *Symbolic Composer's* chaos-based algorithms such as `gen-lorenz` and `gen-hopalong-symbol`. Certainly experimentation with different algorithms, depth levels and symbol definitions can be undertaken, but the amount of time taken to produce desired results in the context of the compositional style will generally be out of proportion with time spent in experimentation, in effect defeating an arguably primary purpose of automated composition, that of time saving.

The pitch range or tessitura presented in the output of Figure 7.15 is limited to 13 semitones due to the range of symbols defined with the `defsym` function. To achieve a more extended range such as those typically used in the compositional style, either more symbols must be defined with `defsym`, or combinations of symbol processing algorithms such as `symbol-transpose` and `symbol-transform` can be used to alter a symbol sequence. Figure 7.16a provides a *Symbolic Composer* score example of the latter, using the folksong symbol definitions from *Descendant Lines.* The `symbol-transpose` algorithm is used to alter the symbols generated by `gen-notrans a 2`, taking each symbol and replacing it with a symbol that is nine alphabetical steps away from the original (i.e. `a` becomes `j`, `b` becomes `k` etc). The new symbol sequence is defined in the example as `mel1`. The `symbol-transform` algorithm is used to transform, over time, the output of the `gen-notrans a 2` symbols into the transposed symbols from `mel1`, in effect combining the original and transposed symbol sequences and extending the resulting pitch range, as shown in the common notation output in Figure 7.16b. This extension of the pitch range represents a simple use of pitch classes used in the compositional style. With the *Descendant Lines* folksong note series mapping, the symbol pairs of `a` and `j`, and `b` and `k`, both represent pitches of the same pitch class: `a` and `j` represent B, `b` and `k` represent C.

Figure 7.16a *Symbolic Composer,* `symbol-transpose` and `symbol-transform`

```
(defsym a '(e b d))
(defsym b '(f c))
(defsym c '(e a b))
(defsym d '(g b))
(defsym e '(d h f))

(setq mel1 (symbol-transpose 9 (gen-notrans a 2)))
;a e d h f b f c d g b ---> j n m q o k o l m p k

(setq mel2
(symbol-transform
from (gen-notrans a 2)
to mel1
order '(0 1 2 3 4 5 6 7 8 9 10)
changes '(1 2)
repeats '(1))
)
;j e d h f b f c d g b j n m h f b f c d g b j n m q f b f c d g b
;j n m q o k f c d g b j n m q o k o c d g b j n m q o k o l m g b
;j n m q o k o l m p b j n m q o k o l m p k

(def-instrument-symbol
inst1 mel2
)

(def-instrument-length
inst1 '1/16
)

(create-tonality accord.set2 '(b 4 c 5 d 5 e 5 f 5))
```

Figure 7.16b Common notation output of Figure 7.16a



Both of the options for extending pitch range, either using more symbols or using further processing algorithms, substantially add to the amount of time required for experimentation within *Symbolic Composer*. As in *Jam Factory*, the incompatibility between the compositional style and *Symbolic Composer* lies primarily in the definition of pitches as single entities as opposed to belonging to pitch classes. Within *Symbolic Composer* there is no algorithm that easily enables pitches, or the symbols that map to pitches, to be controlled as pitch classes. (The version of *Symbolic Composer* used for the development of *Descendant Lines* has since been upgraded significantly, Version 4 of the program having been released in 1997, and numerous new algorithms are now available that enable composers to work with pitch class sets.)

Symbolic Composer's algorithms for dealing with rhythm enable the definition of rhythmic cells as used in the compositional style. In *Descendant Lines,* there are three methods used in assigning rhythmic cells. The first, and most laborious, is to provide each accordion part, for example accordion 1 right-hand, individual rhythmic units, e.g. `1/4`, within the `def-instrument-length` function. The individual rhythmic units are drawn from the rhythmic cells shown in Table 6.2, and are entered into the program sequentially. As an example, the numeric series 1 3 6 7 with the tango rhythmic cells is entered into *Symbolic Composer* as `1/4 1/4-3 1/4-3 1/4-3 -1/4-6 1/4-6 1/4-6 1/4-6 1/4-6 1/4-6 1/4-7 1/4-7 1/4-7 1/4-7 1/4-7 1/4-7 1/4-7 1/4`. In the second method a word or symbol is defined by the user as containing a sequence of rhythmic units, for example, the symbol pair `r4` in *Descendant Lines* is defined with the `setq` function and relates to the rhythmic sequence `1/16 1/16 1/16 1/16`. This method allows the definition of all rhythmic cells mapped to the compositional style numeric series, the series 1 3 6 7, for example, may be defined with the symbol pairs `r1 r3 r6 r7`, each symbol pair representing the actual rhythmic units in the numeric to rhythm mappings. The third method is to map *Symbolic Composer* symbols to rhythmic cells, as shown in Figure 6.9. This method allows the use of further *Symbolic Composer* algorithms to control rhythmic output. A `gen-notrans a 4` output is, for example, used to provide the rhythmic passage shown in Figure 6.9.

Of the three methods described above, the third is not compatible with the compositional style, as the ordering of rhythmic cells is governed by symbol sequences as opposed to the order of rhythmic cells in the compositional style being governed by a sequential use of numeric series. The first and second methods, because they enable a sequential use of the numeric series, are highly compatible with the compositional style. The variations in rhythmic cells used in the compositional style, (i.e. augmentations, diminutions, mixing of rhythmic cells etc.) are, by using the second method, possible to define in *Symbolic Composer* as further rhythmic cells. For example, the numeric 4 may be primarily mapped to a rhythmic cell of four 1/16th notes and defined as `r4`, whilst an augmented form of the numeric 4, with four 1/8th notes is defined as `r4a`. Both forms of the numeric 4 may then be used within the composition of a work.

7.5. Summary

As shown in the preceding section, none of the commercially available software can be used individually to automate the pitch and rhythm techniques used in the compositional style. Neither *M* nor *Jam Factory* can provide musical phrases with the intervallic weightings commonly used in the compositional style, and whilst such weightings might be achieved with *Symbolic Composer*, the time spent achieving desired results is both labour-intensive and time-consuming. Similarly, neither *M* nor *Jam Factory* can be used to automate rhythmic techniques used in the compositional style; however, *Symbolic*

Composer, with the three methods of assigning rhythm described above, and primarily with the second method, provides a viable technique for automating the rhythmic techniques used in the compositional style.

In order to implement the techniques of the compositional style defined in the previous excerpt analyses, a new software program must be developed that addresses the incompatibilities between composition processes used in commercially available software and those used in the compositional style. With regard to pitch, such a program will primarily be able to generate phrases with an emphasis on interval weightings, and treat pitches as belonging to pitch classes rather than individual pitches. With regard to rhythm, rhythmic cells in the program will contain any number of rhythmic units of any length, and will be controlled by numerics of a numeric series, these numerics themselves reflecting the intervallic content of the generated pitch material. A program developed to implement the techniques of the compositional style is extensively detailed in Chapter Eight.