New Sounds and Extended Composition Techniques

A folio of musical compositions and a written commentary submitted in fulfillment of the requirements of the degree of Doctor of Philosophy

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Abstract

This commentary supports my PhD composition portfolio. The composition processes of each piece are related to my central research questions, which concern the creation of new sounds using overtone-based scales and extended instrumental techniques. I have developed four main conceptual composition themes and these are represented in the thirteen compositions in the portfolio. In this commentary I consider how each composition was developed around these conceptual themes.

Contents

Acknowledgements

I wish to especially thank my first supervisor, Christopher Fox, for helping me develop my composition a little more. I have very much appreciated his advice. I thank my second supervisors, Richard Barrett and John Croft, and the mentor of the BBC Symphony Orchestra/Sound and Music project, Peter Wiegold, for all their advice. For this commentary, I have had one-to-one consultations at Brunel International and thank my English teachers, David Jones and Jishan Uddin.

I am also grateful to the Nomura Foundation, Japan for a research grant, Brunel Graduate School for the Vice Chancellor's Travel Prizes (2010 and 2012), and for the PRSF and Bliss Trust Composer Bursaries which enabled me to undertake some further courses and complete my study at Brunel University. Many thanks also to all of my friends and the staff at Brunel University for helping me.

Introduction

I started my MPhil studies at Brunel University in September 2008, after a break of a few years from composing. After six months, I eventually completed a new piece for a workshop with the London Contemporary Orchestra. The piece has a symmetrical structure and a pitch-structure based on elements of the overtone scales. Many of the research topics which I subsequently explored in this portfolio developed out of listening to the performance of this piece.

My first main area of research was into the creation of new sounds and especially the use of the overtone scale. In the work of spectral composers such as Gérard Grisey and Tristan Murail the emphasis is on the use of overtones to create natural, bright sounds. But I wanted to consider how to make dense and dark sounds by opposing different overtone scales. Each piece presented here began with sketches in which different parts of the overtone scale were juxtaposed and sometimes transposed to different pitches to create the different kinds of sound characters I was imagining.

Secondly, I investigated the music that I find particularly exciting. I am attracted to the so-called 'complex' music of Brian Ferneyhough, Michel Finnissy and James Dillon, most readily characterised by its complex musical notations. But I wanted to compose pieces which combined simplicity with complexity and the contrast this creates. I also wanted to explore different instrumentations, from solo to orchestral, and create pieces with extended instrumental techniques, particularly for strings, so that there would be a wide range of different sound colours in my composition portfolio. The work fall into three categories:

Small instrumentation: solo cello, solo flute, alto flutes duo, piano duo, trio (baroque recorder, harpsichord and baroque cello) and string quartet (2vl, vla and cello)
Medium instrumentation: clarinet quintet (cl, 2vl, vla and cello), vocal ensemble (SSAATTBB) and mixed ensemble (fl, cl, hr, tp, per, pf, vl, vla and cello)
Large instrumentation: two chamber orchestra (fl, ob, cl, bsn, hr, tp,tb, per, pf, 2vl, vla, cello and db) and symphony orchestra (3fl, 3ob, 3cl, 3bsn, 3hr, 3tp, 3tb, 3per, hp, 16 vl I, 14 vl II, 12 vla, 10 cello and 8db)

The compositions as a whole also use extended instrumental techniques, such as microtone fingerings, for woodwind and brass, and natural harmonics for strings. Most of the acoustic instruments of Western European art music are represented in the portfolio. I also had what, for a Japanese composer, was the unusual and valuable experience of writing for older European instruments: baroque recorder, harpsichord and baroque cello.

After initial research, in which I analysed work by contemporary composers, such as those mentioned above, making a particular examination of instrumental techniques they used, I then developed a number of different underlying conceptual ideas. In retrospect, I can now see that four main conceptual themes represented in the thirteen compositions in the portfolio are:

Natural Phenomena: *ElectroCardiogGraphy* and *Shade ←→Light*
Natural Science: *The Enthalpy of Vaporization*, *Crystallization*, *The Butterfly Effec*t and *Double Helix*
Visual Art: *Rococo Decorations*, *Romeo and Juliet* (Morse code signals) and *Kaleidoscope*
Japanese traditions: *Sa-Ku-Ra*, *Sakura Variation*, *Rising Eels* and *Semi-Shigure*

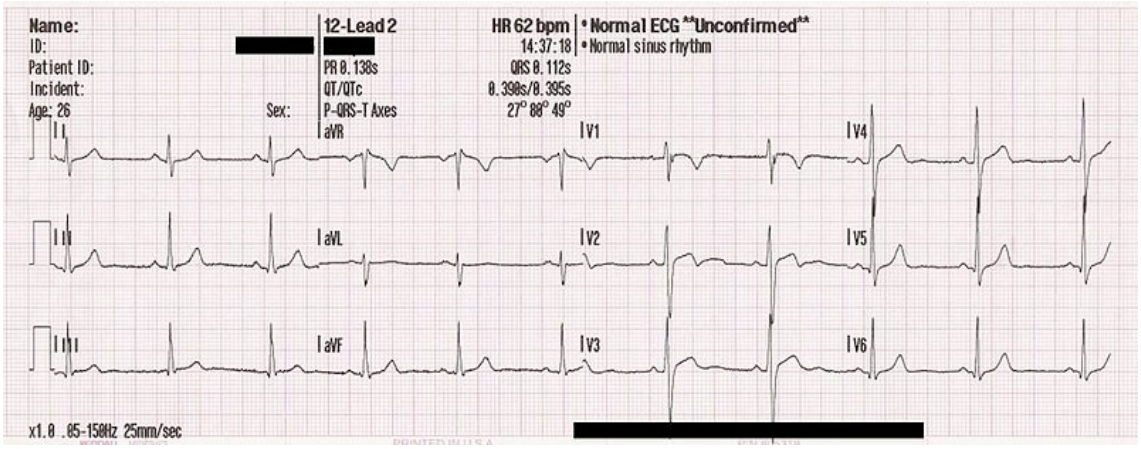
Before embarking on this PhD, I had been conscious of a problem in my work of not maintaining structural focus, but by developing the compositions in this portfolio around conceptual themes I gave myself clear structures for the compositional processes, which I used to create pitch-structures, rhythmic materials and instrumental functions. The conclusion of this commentary will examine the extent to which the composition concepts have been successful and the experience I have gained in hearing the performances of these pieces. I expect that new research topics will develop out of these considerations.

Commentary on the individual compositions

1. ElectroCardioGraphy for chamber ensemble

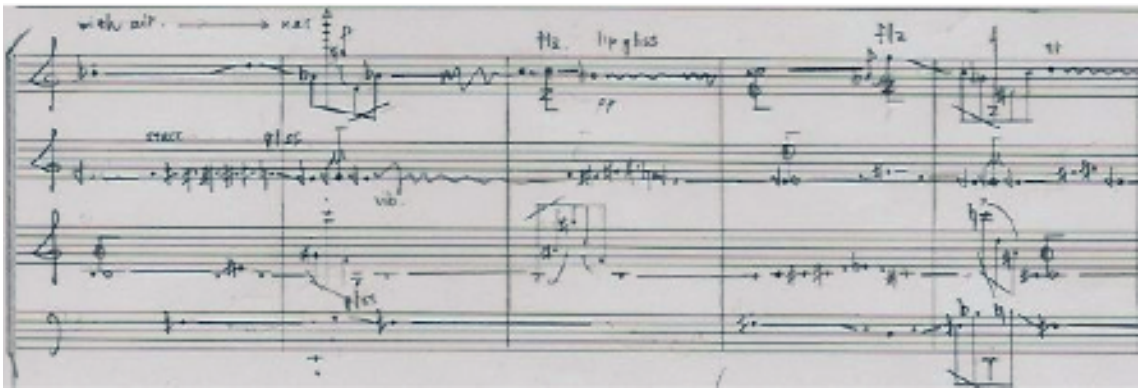
This was the first piece which I completed at Brunel University; it was written for a composition workshop with the London Contemporary Orchestra, conducted by Peter Wiegold, at the Antonin Artaud Building, Brunel University on 18th March 2009.

ElectroCardioGraphy is a transthoracic interpretation of the electrical activity of the heart over a period of time, as detected by electrodes attached to the outer surface of the skin and recorded by a device external to the body. I decided to use twelve instruments because there are usually twelve of these electrodes in the standard 'twelve-lead' used in electrocardiography (see below).



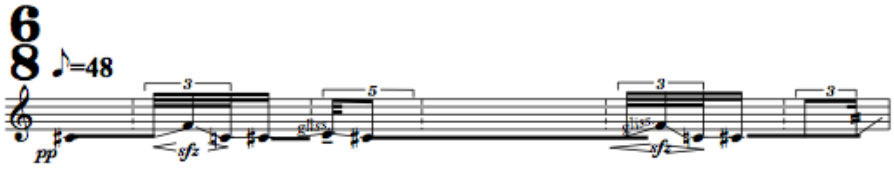
[Fig. 1-1. standard 'twelve-lead' for *ElectroCardioGraphy*]

I tried to transfer the 'twelve-lead' idea to musical notation, using a free graphic notation in my sketches (see below) based on the notation of Hans-Joachim Hespos's *Gelb,* for eight clarinets. At the start of the piece he combines air sound and pitches and his notation very effectively connects with the character of the piece.



[Fig. 1-2. violin I, violin II, viola and cello, first hand-written sketches for *ElectroCardioGraphy*]

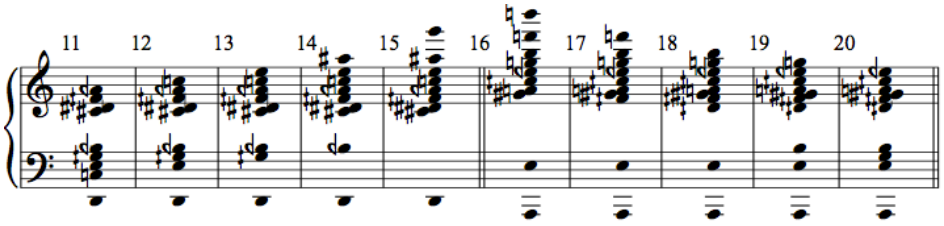
I had never used graphic notation for such a large ensemble before, and eventually I decided not to complete the piece with this notation because it was too complicated. Instead a dotted bar-line marks every quaver, and horizontal lines show the durations of notes, particularly in the string parts.



[Fig. 1-3. bar 1, *ElectroCardioGraphy*]

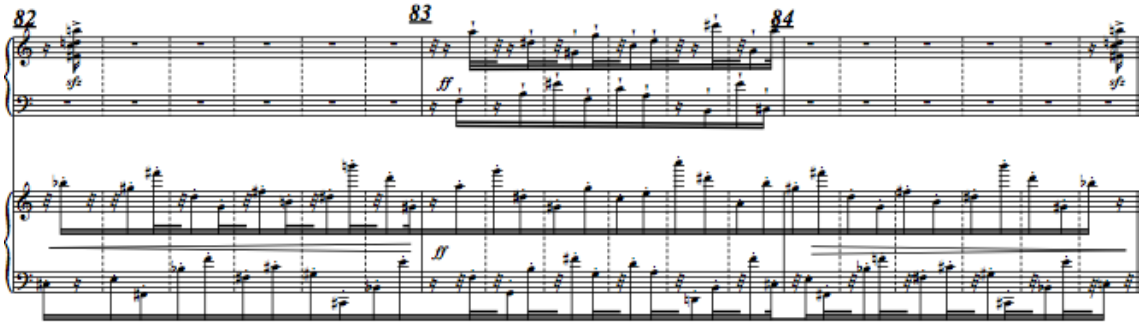
This notation also reminded me of Grisey's *Periodes* (1974) a piece also based on a fundamental pitch (E), which is structured by a constant cycle of three-part periods analogous to the respiratory rhythm: inhalation, exhalation and rest.

I also created a scale which combined pitches from the overtone scale into a symmetrical scale. Then, I took some notes from the scale and organised a chord for each bar (see below). The notes move to form different intervals to represent different aspects of the process of electrocardiography.



[Fig. 1-4. chords for the woodwinds and string parts, bars 11-20, *ElectroCardioGraphy*]

The piece consists of nine sections whose tempi and time signatures are arranged symmetrically: ♪= 48, 72, 96, 120, 144, 120, 96, 72, and 48; 6/8, 4/8, 3/8, 2/8, 6/8, 2/8, 3/8, 4/8 and 6/8. The pulse is maintained by the piano and the marimba throughout the piece, apart from the middle section and at some other points to facilitate page turning. The tempo always changes suddenly (no *accelerando*), as if there is a sudden jump in pressure in the music. Wave-shapes are created in the string parts and there are temporary pulses in the woodwind. In the middle of the piece (♪=144) there is a piano solo with marimba *glissandi*. The pianist must span large intervals and in the workshop it was necessary to reduce the tempo in this section (see next page).



[Fig. 1-5. bars 82-84, marimba and piano, *ElectroCardioGraphy*]

I felt the piece effectively presented the idea of electrocardiography, but that I should have given more consideration to orchestration and instrumental colour, with more varied combinations of instrumentation. These issues would become a significant part of my subsequent research. I also felt I wanted to develop a greater command of instrumental techniques and to work with performers more closely.

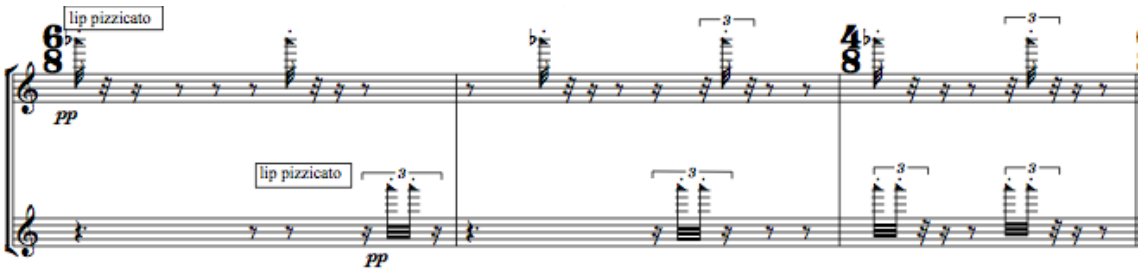
2. Sa-ku-ra for alto flute duo

Sakura means cherry blossom in Japanese and the light pink and white of its petals are popular colours in Japan. I imagined the Japanese cherry blossom petals falling down one by one in the wind, a beautiful sight. In Japan we also have a tradition of people drinking *Sake* under the tree in spring.

[Fig. 2-1. a picture of the Sakura]

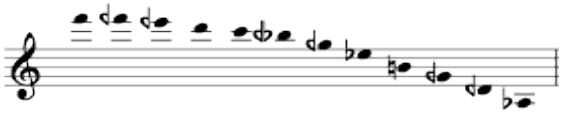
In writing for an alto flute duo I particularly wanted to use the lip effects, which occur at the beginning of the piece, to represent the tiny petals falling.

The piece consists of five sections. The first section starts with lip pizzicato in flute I, with flute II following, both gradually descending from a very high register. This is a very soft sound and the players are required to stand close to the microphones. The rhythms are made from sequences of odd numbers for flute I and even numbers for flute II, with the value of the notes based on 𝅘𝅥𝅯 triplet. For instance, 1x 𝅘𝅥𝅯 triplet + 23 x 𝅘𝅥𝅯 triplet rest + 1 x 𝅘𝅥𝅯 + 17 x 𝅘𝅥𝅯 triplet rest for flute I, and 2 x 𝅘𝅥𝅯 triplet + 20 x 𝅘𝅥𝅯 triplet rest + 2 x 𝅘𝅥𝅯 triplet + 14 x 𝅘𝅥𝅯 triplet rest for flute II (see the next page).

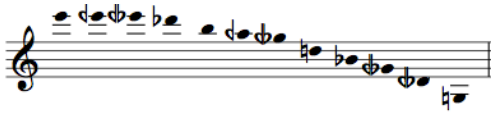


[Fig. 2-2. bars 1-3, alto flute I and II, *Sa-ku-ra*]

The numbers of notes gradually increase and the numbers of rests decrease, so the sound becomes denser. I created a contrast between long tones and scales. The scales start in a high register and include quarter-tones for each flute; each flute has a different principal scale.

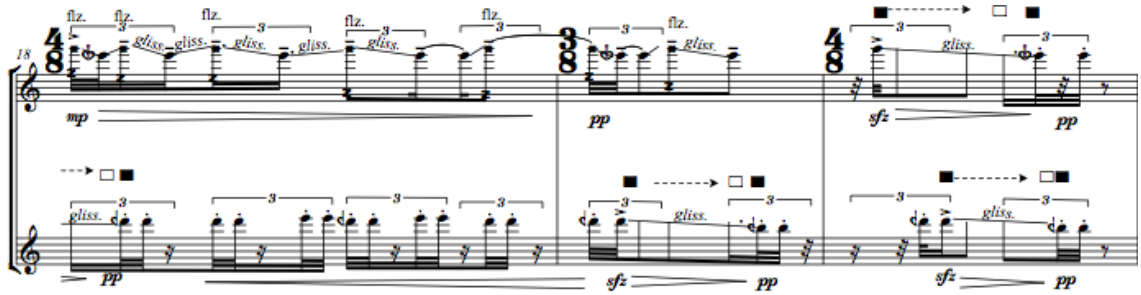


[Fig. 2-3. principal scale for alto flute I]



[Fig. 2-4. principal scale for alto flute II]

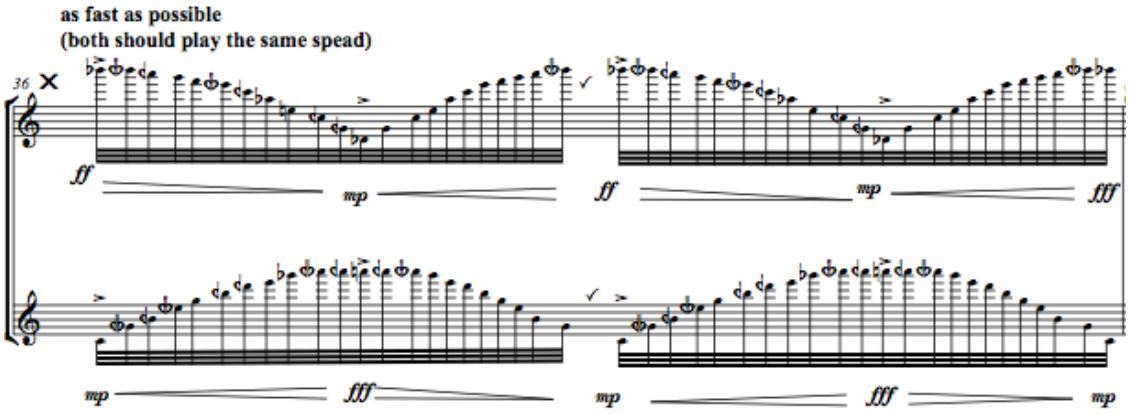
Glissandi are an additional element, their rhythmic values becoming longer, sometimes interrupted by lip vibrato and pitched air sounds. At bar 18 flute I adds flutter-tonguing to the glissandi; in contrast flute II plays staccato at that time (see below).



[Fig. 2-5. bars 18-19, *Sa-ku-ra*]

At the end of this section different kinds of elements are mixed. The notes gradually get lower as the petals fall, their fluttering represented by short slurred groupings. This mix of techniques creates timbral variety even though there are only two instruments.

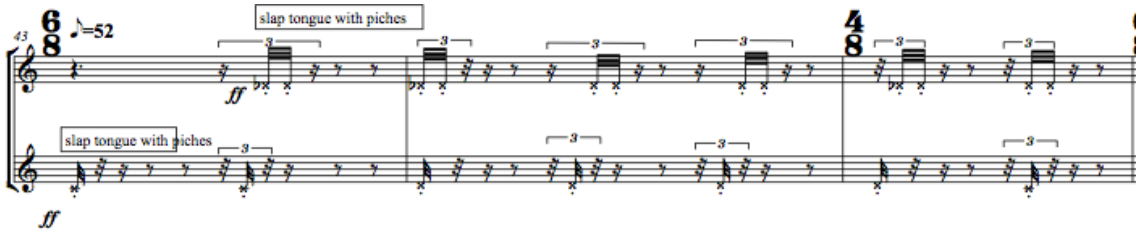
The second section starts at bar 28 at a faster tempo (♪=78). For this section, one flute has trills to represent slightly moving petals and the other plays fluttering combinations of notes. Scales are introduced using pitches from earlier in the piece and, finally, in bar 36, both flutes play these scales as fast as possible (see next page).



[Fig. 2-6. scales, bar 36, *Sa-ku-ra*]

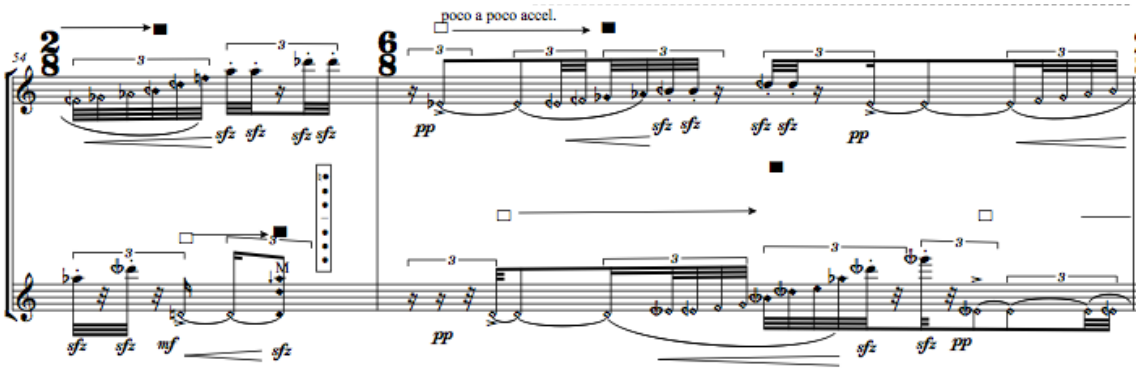
There are many multiphonics in the third section and the tempo is extremely slow (♪=26), in contrast to the previous section. I found *The Techniques of Flute Playing* and *The Techniques of Flute Playing volume II* by Carin Levine and Christina Mitropoulos-Bott particularly helpful for the instrumental techniques and multiphonic fingerings in this section.

The fourth section starts in bar 43 and, in contrast to the first section, uses the lower register with slap tongue (see below). Both alto flutes play air sounds on the indicated pitches; the rhythms of flute I are now based on sequences of odd numbers and the rhythms of flute II on even numbers.



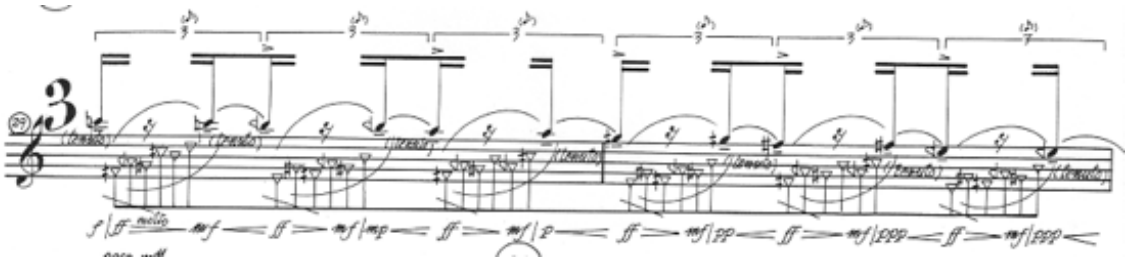
[Fig. 2-7. bars 43-45, *Sa-ku-ra*]

Air sounds sometimes appear between the slap tongues and the number of notes in the scale increases with air sounds. The scales continue rising until bar 59. To change from air sounds to pitched sounds, it is necessary for the alto flautists to change their embouchure and so I notated white and black square symbols between bar 53 and 56 (see below).



[Fig. 2-8. bars 54-55, *Sa-ku-ra*]

After a gradual *accelerando*, the tempo changes to ♪=78 and an 'aeolian' effect is introduced, something I discovered in James Dillon's *Sgothan* (see below); I particularly liked the combination between the lower-pitched 'aeolian' sounds and pitched sounds in the high range.



[Fig. 2-9. bars 29-30, James Dillon, *Sgothan*]

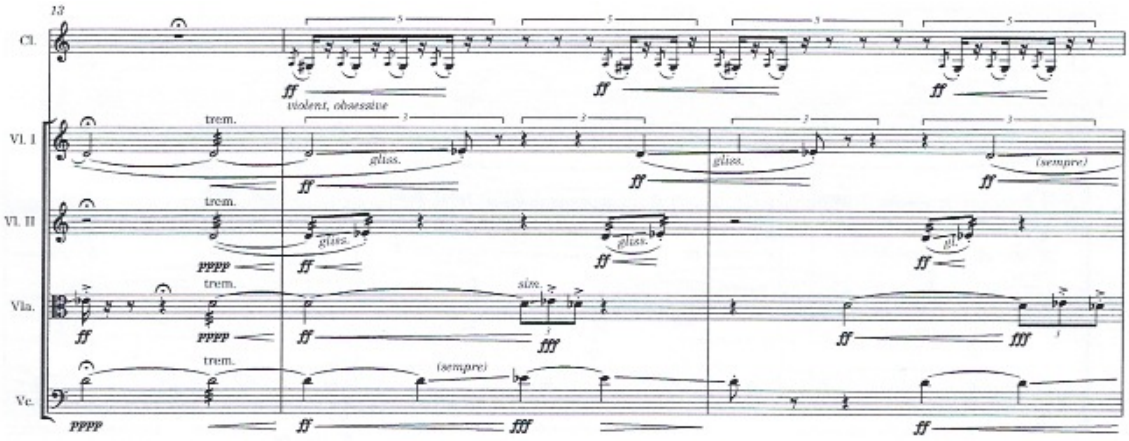
The fifth section reverses the processes of the third section and is also played at a slow tempo (♪=26). The dynamics change from *mf* to *pp* as if the sounds are moving into the distance. Then, at the end, as the petals finally drift far away, I use harmonics, different fingerings producing different dynamics.

Looking back on this piece, I now think that each section is too short, and that I should have sustained the first element for a longer time.

3. Shade ←→Light for clarinet quintet

This piece was performed by members of the BBC Scottish Symphony Orchestra during the University of Aberdeen Music Prize Weekend (20-22 November 2009). The concert was in the Sound Festival 2009, and the final stage of the competition was judged by James Macmillan.

Before writing the piece, I listened to other music with the same instrumentation, including Birtwistle's *Clarinet Quintet* (1981) and James Macmillan's *Tuireadh* (1992). In the Birtwistle I liked the echo effects between clarinet and strings and the use of strongly accented string pizzicati. The Macmillan piece is dedicated to the victims of the Piper Alpha disaster and their families (*Tuireadh* is the Gaelic term for a lament for the dead) and is very emotionally charged. I was particularly impressed by the *fortissimo* writing in the clarinet's chalumeau register and by the use of closely pitched string glissandi in the first section (see next page). This has something in common with my own piece, which contrasts long notes with more complex materials in the middle section.



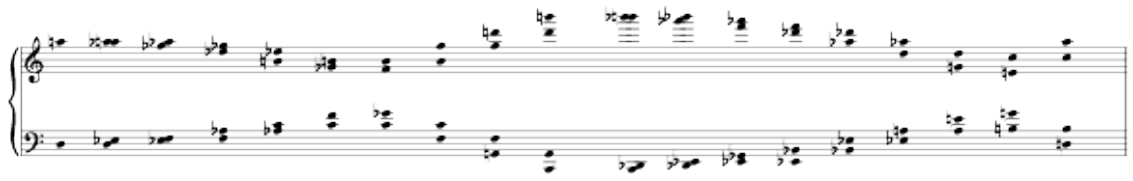
[Fig. 3-1. bars 13-15, *Tuireadh* by James Macmillan]

The title of my piece refers to the grey zone between shade and light and, since the fundamental concept of my piece is based on this, the most important part of the title is the symbol ←→. The idea came from the sounds of the clarinet itself, and the differences between its low and high ranges, the low notes being dark and the high notes being bright. To create sounds between shade and light, I also gradually added microtonal pitches in the first half of the piece and then reduced them again in the second half.

I set up two principal pitches, high A and low D. Below the A and above the D I added further pitches, increasing the number of semitones in each successive interval (semitone, whole-tone, minor third, etc.) until a low C and high A were reached. Then when the process is repeated, creating this overall pitch-structure:

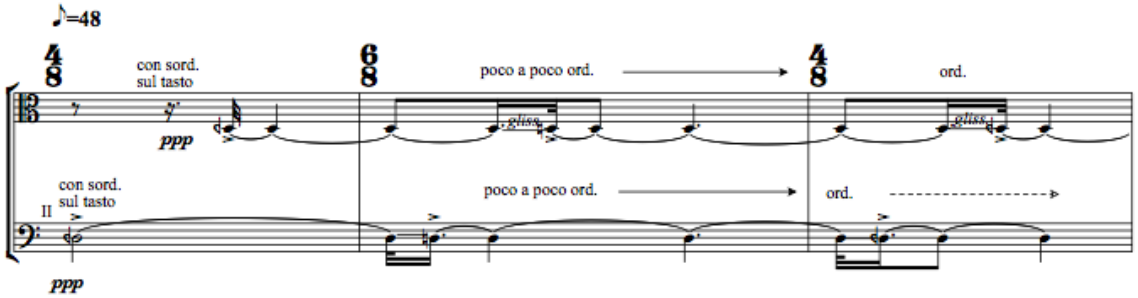
[Fig. 3-2. structure of the pitches I, *Shade* ←→*Light*]

One note of each chord is carried over to the next to make a shadow-like chord (see next page). The four pitches of each chord are played by the string quartet and the clarinet usually takes one of the middle pitches, some pitches reappearing in later chords. Not only are these pitches included but also quarter-tones; notes in the strings start a quarter-tone lower in the first section and do the reverse in the third section, so the sound becomes more unstable and has a grey colour.



[Fig. 3-3. a structure of the pitches II, *Shade* ←→*Light***]**

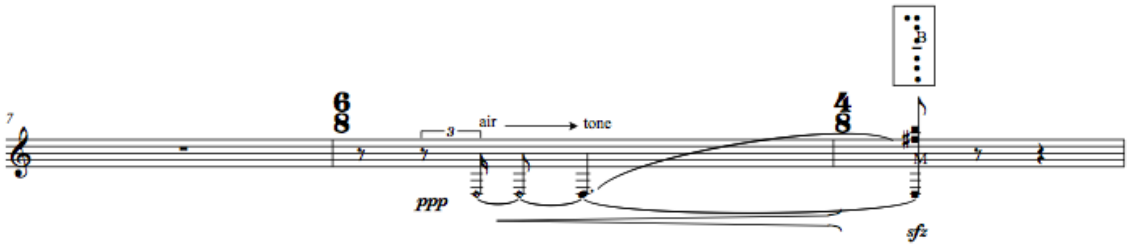
The piece consists of three sections, A (bar 1-37), B (bar 38-59) and A' (bar 60-92). At the beginning of the piece, I used prepared pitches which are a quarter-tone higher than A for the second string of violin I, and a quarter-tone lower than D for the second string of the cello. I wanted to use peg *glissandi* for these strings, the players changing pitch whilst playing the first nine bars, the pitches returning to normal in bar 9 (see below). This seemed a particularly effective way to show the character of the piece.



[Fig. 3-4. bars 1-3, viola and cello, *Shade* ←→*Light*]

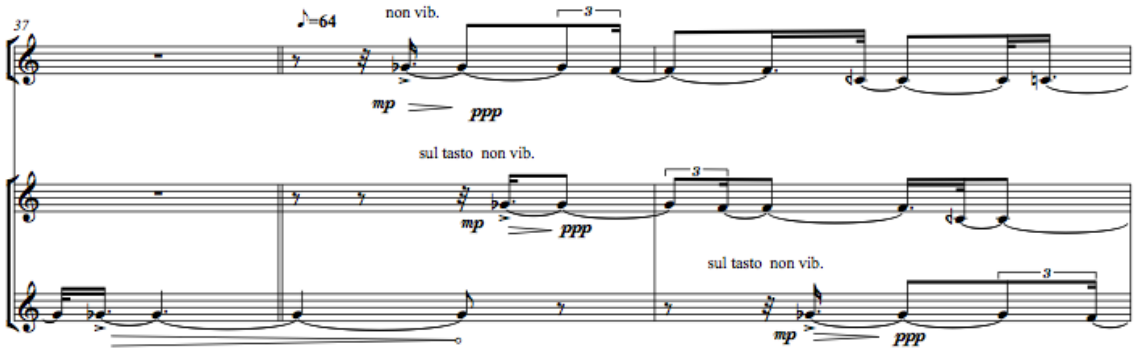
However, in the workshop on the day before the concert, the performers said they wanted to avoid risky techniques, so I changed the peg *glissandi* to normal *glissandi* in the rehearsal, although I still hope that these techniques can be restored if the piece is played by specialist contemporary musicians.

The opening string parts are played without vibrato to make the microtonal intervals audible, while the clarinet goes from air sounds to pitched tones and then to multiphonics, as if moving from dim shade to clear light and then into deep shade.



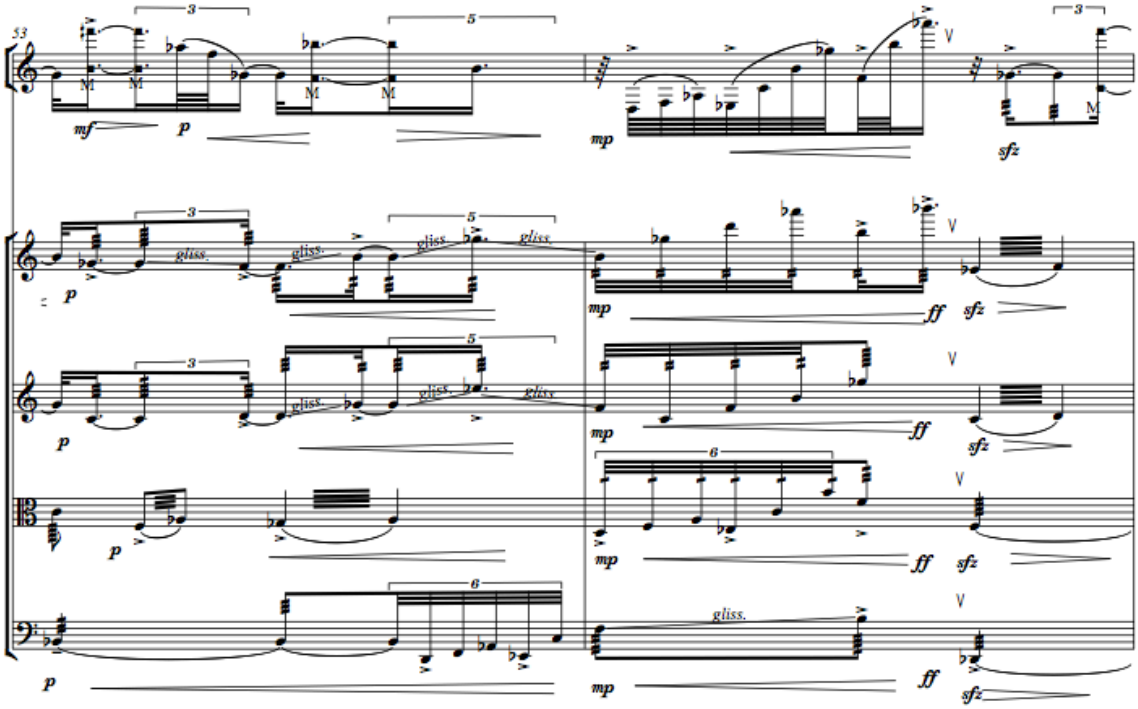
[Fig. 3-5. bars 7-9, clarinet, *Shade* ←→*Light*]

In the middle section, I used a series of canonic repeats of phrases, first clarinet, then violin I, then violin II, to outline the pitch structure.



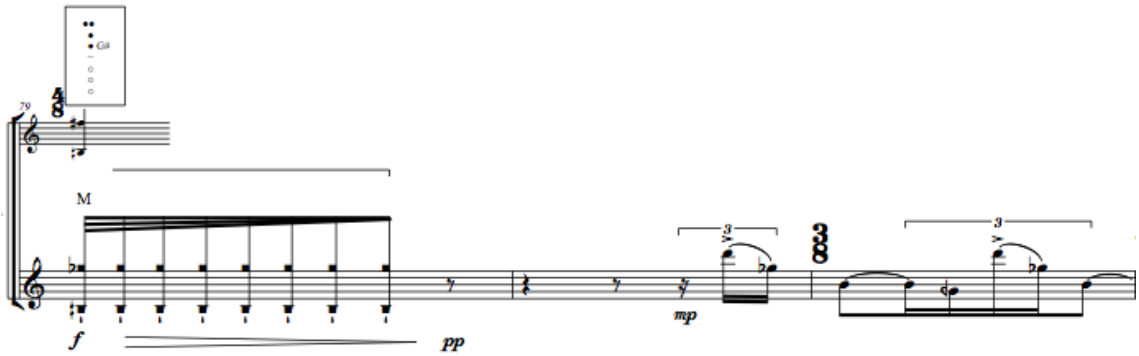
[Fig, 3-6. bars 37-39, clarinet, violin I and violin II, *Shade ←→Light*]

In place of the earlier clarinet multiphonics I used viola and cello harmonics – a brighter sound. The music moves towards a climax with large intervals, straddling three octaves, in the clarinet, and agitated tremolos for strings (see below).



[Fig. 3-7. bars 37-39, full score *Shade ←→Light*]

After this, the third section starts suddenly, high on violin I, followed by harmonics on violin II. The sounds are different from the previous sections and the clarinet plays high harmonics and harmonic tremolos, which are very sensitive and bright, although the clarinetist in the premiere found it difficult to control the dynamics and duration of the notes. I referred to Phillip Rehfeldt's book, *New Directions for Clarinet* for the techniques and fingerings.

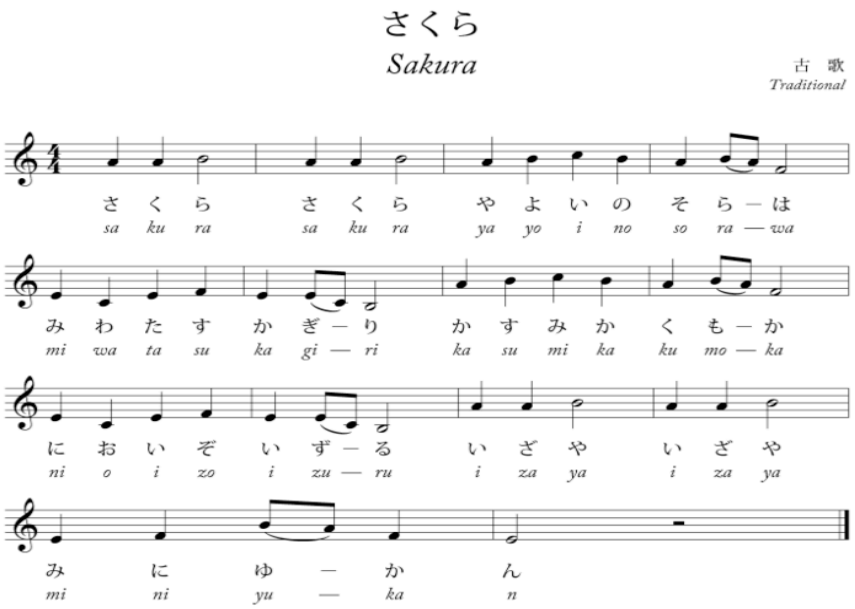


[Fig. 3-8. bars 79-81, clarinet, *Shade* ←→*Light*]

Overall I found the underlying concept of *Shade* ←→*Light* very stimulating and by sustaining the idea throughout the piece I found myself imagining unusual musical shapes and an excitingly complex climax which I might not otherwise have created.

4. Sakura variation for solo cello

Sakura variation is a short piece, only 2 minutes, composed for a workshop with Anton Lukoszevieze at Brunel University in 2009. As I explained earlier, the title *Sakura* means cherry blossom in Japanese and 'Sakura Sakura', also known as 'Sakura', is a Japanese traditional folk-song depicting spring, the season of cherry blossom. This song has been very popular since the 18th century and was adopted as a piece for beginner koto students by the Japanese Department of Education. Only five pitches are used in the song and sometimes they are transposed to the other fundamental pitches of the song and instrument.



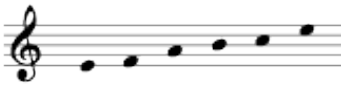
[Fig. 4-1. Traditional tune of the 'Sakura' folk-song]

Cherry blossoms

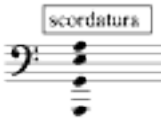
Cherry blossoms, cherry blossoms,
On Meadow-hills and mountains
As far as you can see.
Is it a mist, or clouds?
Fragrant in the morning sun.
Cherry blossoms, cherry blossoms,
Flowers in full bloom.
Cherry blossoms, cherry blossoms,
Across the Spring sky,
As far as you can see.
Is it a mist, or clouds?
Fragrant in the air.
Come now, come now,
Let's look, at last.

[Fig. 4-2. Translation of Sakura folk song]

The tune of the folk song uses a five-note scale, one of the Japanese traditional scales (see Fig. 4-3). Many musicians have used the tune and composed variations on it, because it is easy to sing the tune and it feels very traditional. Children often play the tune, not only with koto but also with recorders at school. I used a fundamental pitch A and re-tuned the cello C string to a low F and the D string to E to recreate the sound world of the Japanese traditional scale (see Fig. 4-4).



[Fig. 4-3. a Japanese traditional scale]

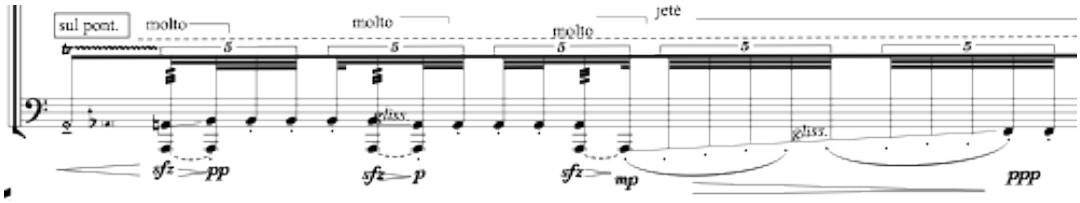


[Fig. 4-4. scordatura of *Sakura Variation*]

Helmut Lachenmann used this tune in his *Sakura Variation* (2000) for alto saxophone, piano and percussion, basing his piece not only on the folk song but also on the variation for koto by Michio Miyagi (1894-1956), a core work for koto students. Miyagi was a composer and koto player and also invented the seventeen-string koto. There is also a version of Lachenmann's piece, arranged by Roberta Vidic, which uses harp instead of piano, and in this I particularly like the beautiful combination of harp and bowed vibraphone and the way the alto saxophone matches the dry sound of the harp played *a la table*.

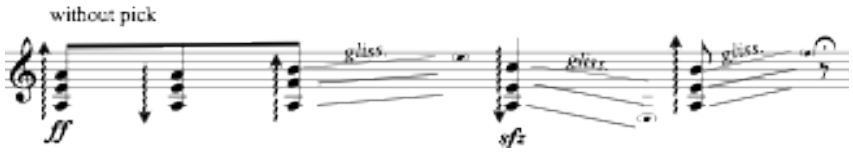
I had expected more noise-based sounds in Lachenmann's piece, but perhaps he wanted to respect the Japanese traditions represented by the tune. However, I wanted to re-work the traditional tune as a contemporary piece and, to keep the idea of playing the koto with plastic nails, I use a plastic guitar pick in the beginning with notated triangle note heads.

The piece starts with a combination of the G string played *pizzicato* and the F string played *pizzicato* with the guitar-pick, because I was interested in giving a different kind of function to each string with different techniques. The combination of both types of *pizzicato* with glissando was very effective in the workshop, but to create harmonics and trills the cellist has to put the pick down and play *arco* after the 2nd staves. The *pizzicato* techniques are changed to *jete* or *battuto* later on. These techniques are more effective when combined with *glissandi*.



[Fig. 4-5. page 1, 1st stave, scordatura of *Sakura Variation*]

I kept the quintuplets through the piece - an idea based on the number of the petals of a cherry blossom - but the continuations of quintuplets are sometimes interrupted by finger pizzicato and pizzicato arpeggios played with the pick. These in turn are extended to *arpeggios* with *glissandi* on the 2nd stave shown on page 4.



[Fig. 4-6. page 4, 2nd stave, extended parts of the pizzicato arpeggios, *Sakura Variation*]

I had become interested in the microtonal difference between different natural harmonics, and sometimes I notated the expected pitches on small sub-staves on the staves. Most of these harmonics proved effective in the workshop, and the only significant problems were in turning pages and the time taken to take and put down the guitar-pick. Eventually I intend to add a few more movements, which will reference Miyagi's *Sakura Variation*.

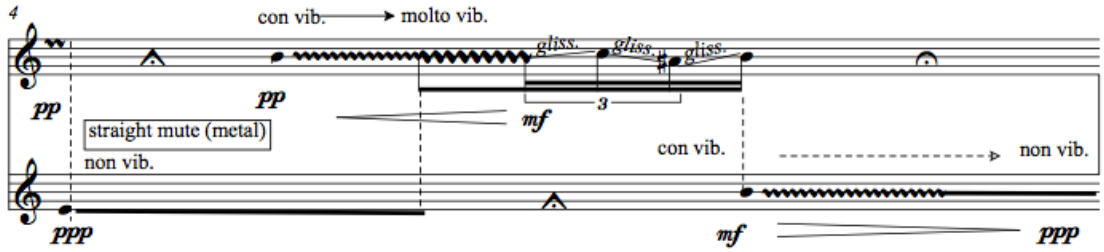
5. Rising eels for oboe and trombone

This piece was commissioned by Catherine Pluygers, the director of the London New Wind Orchestra, and was premiered by her and Alan Tomlinson at the 12th London New Wind Festival in 2009. The piece was also performed by the same players at the 13th Festival in 2010. The director requested a short piece of around 3 minutes that should not be too difficult and, although generally I prefer to write complex pieces with new techniques, I decided to compose something more straightforward.

'Rising eel' (*Unaginobori*) is a Japanese expression meaning something that rises rapidly or skyrockets, like an eel moving vertically through water, up a waterfall perhaps. The idiom is especially used in business as a metaphor for soaring prices or rapid promotion, but it can also suggest an accidental surprise, and this piece for oboe and trombone imagines two 'rising eels'.

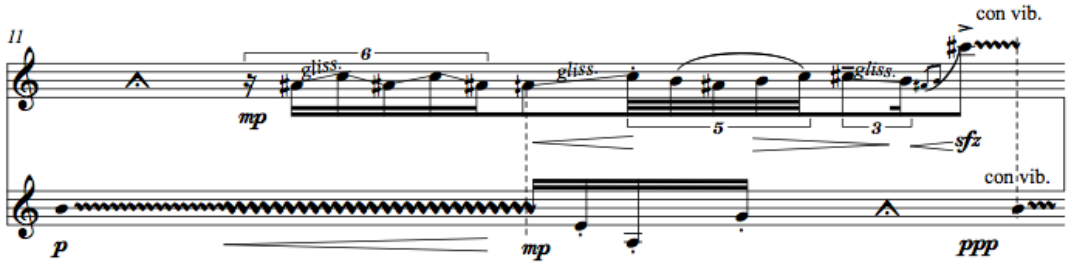
I wanted to notate the score without time-signatures or bar-lines so that both players have to cue one another in performance; particularly important cue-points are marked with dotted lines and *fermata* indicate three different values of rests.

The E of 'eels' provides the starting pitch of the piece and the use of vibrato (and subsequently glissandi) is intended to sound like the wriggling of an eel. At the beginning of the piece, the instruments play *senza vibrato*, changing to *con vibrato,* then to *molto vibrato* for the oboe. The *vibrati* finally become *glissandi* and then the trombone joins on the 4th stave. Both instruments wriggle around one another in interlocking pitch ranges.



[Fig. 5-1. 4th stave, oboe and trombone, *Rising eels*]

The oboe part sometimes jumps with large intervals and has larger intervals at the end of the 11th stave; on the other hand, the trombone has rather smaller jumps.



[Fig. 5-2. 11th stave, oboe and trombone, *Rising eels*]

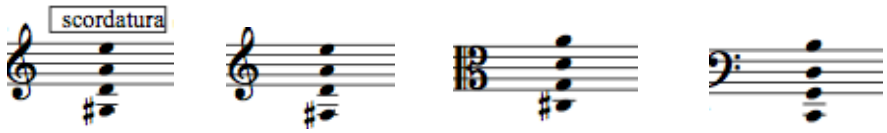
The wriggles and jumps alternate between the instruments until they are played together on the 18th stave. The trombone sustains a middle E and finally the oboe leaps to high pitches with multiphonics; the trombone signals the end of the multiphonics with a staccato attack.

There was only short period before the first concert, so the performers were still unfamiliar with the notation, and the piece was sometimes interrupted because of the need to change trombone mutes. I had not composed for trombone in my ensemble music, so I was interested to explore different mutes - straight mute (metal), straight mute (wood), whisper mute, wa-wa mute and plunger mute - and the different timbres they produce, but I had underestimated how long it would take to change mutes. The piece was better rehearsed for the festival performance, where it made the audience laugh and the 'rising eels' expression became popular during the festival, but I still want to work on the piece with performers who are more highly skilled in contemporary music.

6. *Crystallization* -for string quartet

Crystallization is the (natural or artificial) process of the formation of solid crystals precipitating from a solution or, more rarely, deposited directly from a gas. Crystallization is also a chemical solid-liquid separation technique, in which the mass transfer of a solute from the liquid solution to a pure solid crystalline phase occurs. The term 'crystallization process' denotes two major events, 'nucleation' - the step where the solute molecules dispersed in the solvent start to gather into clusters - and 'crystal growth' - the subsequent growth of the nuclei that succeed in achieving the critical cluster size. I wanted to represent these processes in my piece, and created two sections (bars 1-73, 74-131) as equivalents of the two events within the crystallization process.

I decided to re-tune one string on each instrument to create a larger number of natural harmonic pitches. The string quartet usually has open strings on pitches C, G, D, A, and E – rising perfect fifths – and I added another set of rising fifths – B, F♯, C♯, and G♯ – with B as the bottom string of the cello, F♯ the bottom string of violin II, C♯ the bottom string of the viola and G♯ the bottom string of violin I (see below). When using nine pitches, natural harmonics of these pitches become very varied and also bright. Together these nine pitches are used as a scale – C, C♯, D, E, F♯, G, G♯, A and B – and I also make a structure with two crossing-points which looks like a big crystal.

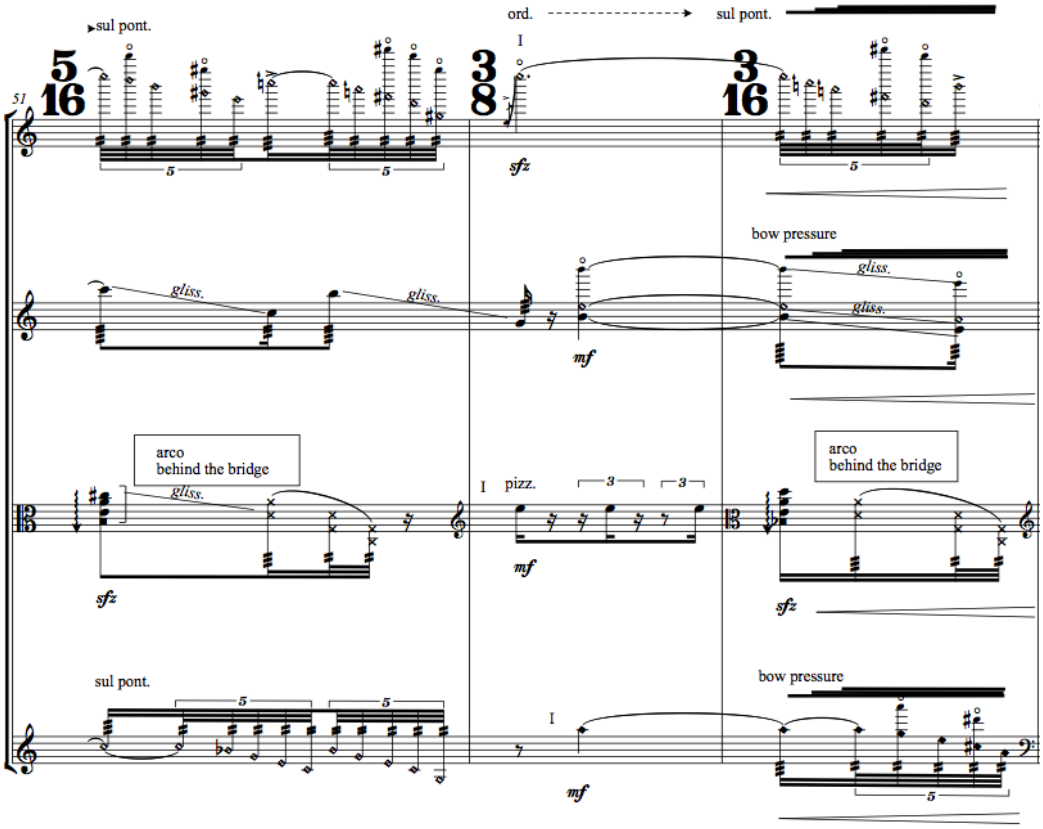


[Fig. 6-1. scordature for each string, *Crystallization*]

After that I made 14 groups labelled from A to N with these pitches and chose fundamental pitches for each section (see Example I, page 49). I also made a graph to show on which string each of the natural harmonic pitches occurred (see Example II, page 50). Patricia Strange and Allen Strange's book *The Contemporary Violin - Extended performance Techniques* was a very helpful guide to natural and stopped harmonics.

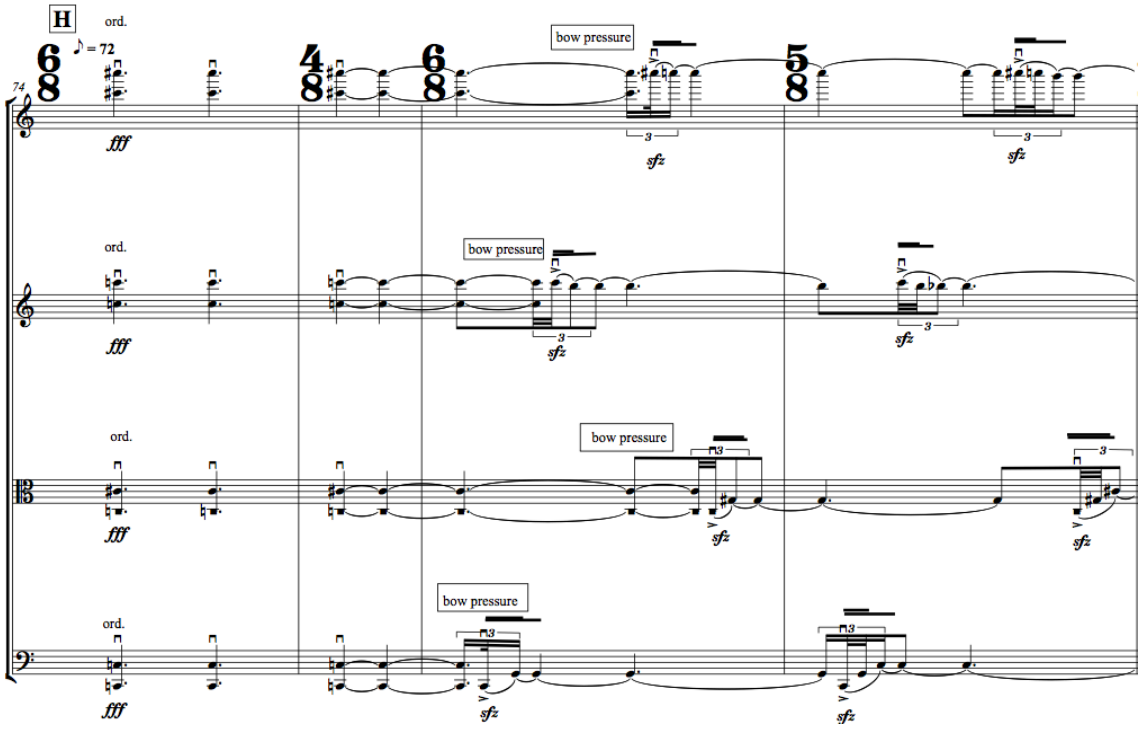
For sections A to C (bars 1- 43) in the first section, I use small fragments, made with harmonics and quaver note values. These are quite flexible in each instrument and sometimes played *tutti* with *sforzando;* each *tutti* represents an initial 'nuclears' in the crystallization process. Natural harmonics are added on the same strings, with longer harmonic *tremolo* to create a rich sound at low volume and to link together the groups of fragments to the next fragments. Next *battuta* are added, then *pizzicato* attacks on the lowest notes of the overtone scales. As the sound level drops at the end of section C the *pizzicati* become more prominent.

The next sections, D and E, are slow (♪= 54) and contrast with the previous sections. The fundamental pitch appears on violin I, played as triplets and repeating like echoes with the first and second bows. The triplets are taken up as rhythmic *pizzicati* for cello and as *pizzicato* chords. After that, the violin I part leaps to a high E and descends with *flautando* fingering so that some natural harmonics are produced; the effect is a spectral sound colour which also has some noise elements. At the end of section D, I also introduce extreme bow pressure for the violins, a technique which becomes more important in the next section.



[Fig. 6-2. bars 51-53, full score, *Crystallization*]

Section F is faster than the other sections (♪=90). Earlier material using natural harmonics recurs, now extended and continuing into the following section. The harmonics reduce and little by little normal fingering replaces *flautando* fingering, so that the sound gets louder; the use of extreme bow pressure also increases into the climax at section H (see below). My use of harmonics was particularly inspired by Jonathan Harvey's string writing in his *String Quartet* (1977).



[Fig. 6-3. bar 74, full score, *Crystallization*]

All the strings play fortissimo octave chords at the climax and then parts of scales, the violins descending and the viola and cello rising, with extra bow pressure. The notes of the scales increase and the bowing changes from *sul ponticello* to *ordinario* in section I*;* there is a gradual change from *arco sul tasto* to *pizzicato* for all but the viola which continues to play *arco* into section J. Sections J and K are slow (♪=54) and only the cello plays harmonics, sometimes higher than the violins' *sul ponticello,* which creates a timbral contrast. All the instruments play chords again at bar 110, moving quickly from *pp* to *ff.* Sections L and M start *ppp* with *staccato* accents. Finally all strings play *battuta* at bar 129 and, after a violin *glissando,* all the performers hold their position for at least 10 seconds to mark the ending of the piece.

7. Rococo Decorations for baroque flute, baroque cello and harpsichord

This piece was written for the *Spirituoso* project, a professional development scheme run by Sound and Music in collaboration with the Handel House Museum. There was no restriction in terms of style, and the aim was to produce a contemporary work in collaboration with the group, responding to their personality and the performance space of Handel House. I had a performance workshop with Spirituoso on 12th April and the premiere was on 11th November 2010. The instrumentation of Spirituoso was popular in the Baroque period in Europe but is less familiar today, especially in my country, Japan. We generally do not have a chance to study these instruments, so I hoped to learn about them through the workshop.

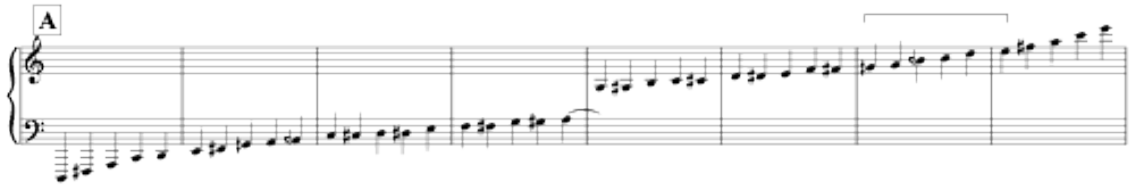
Historical instruments enable more artistically effective performances of music that predate the modern era, but the harpsichord was further developed in the 20th century and modern harpsichords have been used by contemporary composers. I was particularly impressed by Xenakis's *A l'Ile de Gorée* for harpsichord and chamber orchestra, which opens with a harpsichord solo. I had heard it some years ago in the Royal Festival Hall and it was one of the reasons I wanted to write for Spirituoso, even though their ensemble does not use a modern harpsichord.

On the other hand, I was also interested in tunings used by historically-informed performers, such as Kammerton (a'=465Hz or 466Hz) and Tiefkammerton (a'= 392Hz), and I wanted to use these different tunings as *scordatura*. I had thought the harpsichordist could change tuning but in the workshop I discovered it was impossible, so I decided to use *scordatura* only for the baroque cello. I re-tuned the C string to D, because I wanted to use the pitch D as a fundamental pitch of the opening section.

The title of the piece, *Rococo Decoration*, celebrates the style of 18th century French art and interior design. Rococo rooms were designed as total works of art with ornate furniture, small sculptures, ornamental mirrors and tapestries to complement architecture, reliefs and wall paintings (see below). I wanted somehow to represent this visual style through my music.

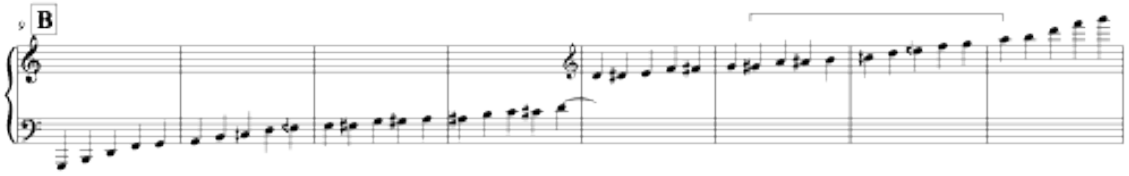
[Fig. 7-1. The Rococo Basilica at Ottobeuren, Bavaria]

The piece consists of five sections, A (bar 1-41), B (42-64), C (65-85), A' (86-98) and B' (99-123). The speed is different for each because I wanted to create different sorts of decorative figures with *glissandi* and scales. I focused on the parts of the overtone scale which also sound a little like a type of church mode (see below), from the central A to the D a perfect fourth higher from the A, and used six pitches from either side of these pitches.



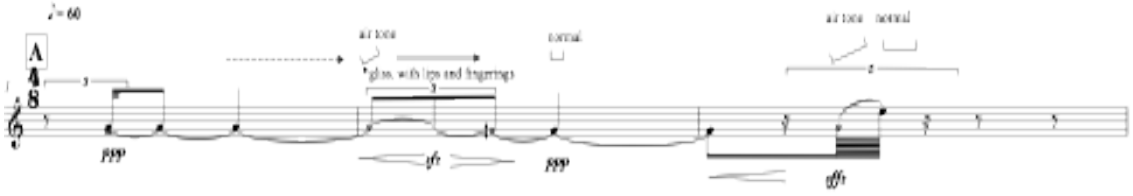
[Fig. 7-2. *Rococo Decorations*, basic scale for section A]

The basic scale is transferred to twelve fundamental pitches, each new scale also using more notes (see below). For instance, in the next scale with middle pitch D, I add a G and use ten notes on either side. This principle is used throughout *Rococo Decoration* to increase and expand the pitch material.



[Fig. 7-3. basic scale of section B, *Rococo Decorations*]

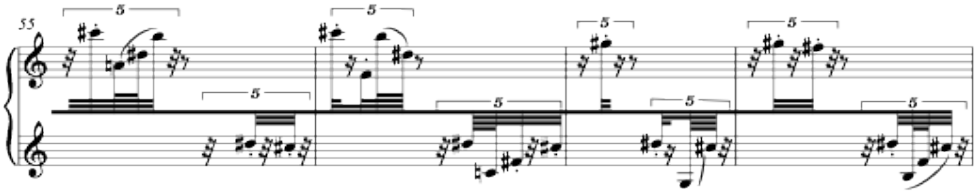
I considered how to represent the curved decoration of the Rococo at the beginning of the piece, and discovered the possibility of a curve *glissandi* with the air sound of the baroque flute. I devised a *glissando* notation to represent specific curves (see below). I also used harmonic trills and *tremoli* for the baroque flute and the baroque cello.



[Fig. 7-4. bars 1-3, Baroque cello, *Rococo Decorations*]

The harpsichord starts playing harmonics in bar 25, and these materials then change to trills, *tremoli* and arpeggios in order to create further decorative figures, with sharp curves in the flute harmonics and cello *glissandi* from bar 36. In practice, the microtonal harmonics did not work on the baroque flute but harmonics work very well on the baroque cello. The tempo changes at bar 42, further scales appear and the harpsichord writing turns around three or four notes to create a denser sound.

The middle section starts with *staccato* harpsichord and the tempo returns to ♪=60. I like the noise of the harpsichord articulation and use large intervals to create short decorative figures, all the instruments playing asymmetric rhythms (see below) which reflect the use of abstraction and asymmetry in Rococo design.



[Fig. 7-5. harpsichord, bars 55-58, *Rococo Decorations*]

[Fig. 7-6. Rococo designs]

After the middle section, I decided to return to ideas from the previous sections, although sometimes the instrumentation is changed, so the final two sections are marked A' and B', and finally the short scales of the baroque flute are extended to draw in all the notes of the basic scale from the opening sections.

I liked the richness of the ensemble sound and I thought some of the harpsichord writing was very effective, but I now find *Rococo Decorations* a little problematic because the materials tend to be undeveloped and lack variety. Each section is too short and the tempo changes were included largely to avoid boredom.

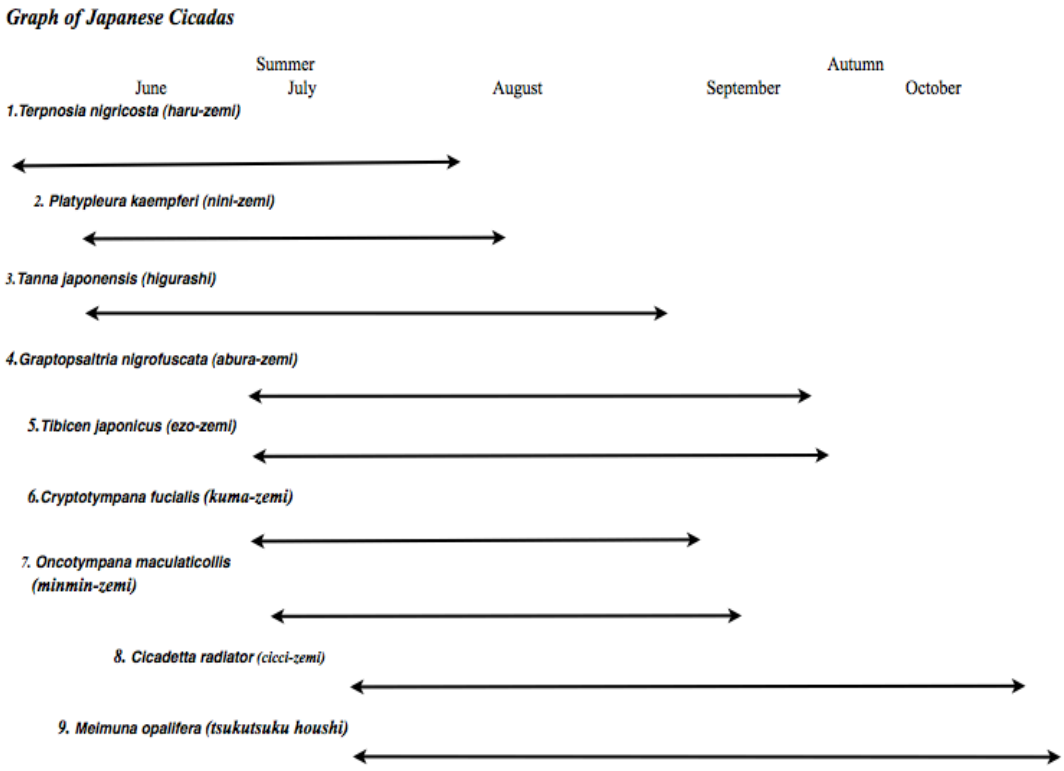
The Spirituoso ensemble does not usually play new music and they found it hard to count the changing time signatures, so I had to conduct the piece myself in the concert. I was very disappointed with this project and for a while lost motivation to compose after the piece. I feel it is important for composers to work with professional performers to improve our skills.

8. Semi-Shigure for singers (SSAATTBB)

This piece was written for the EXAUDI Vocal Ensemble Project, a professional scheme run by Sound and Music. I had workshops with the EXAUDI on 2nd November 2010 and 25th January 2011.

The Japanese expression 'Semi-Shigure' refers to the 'scattered shower' of the voices of cicadas. There are about thirty types of cicadas in Japan and they inhabit different areas. Each type has a different song and range of voice. In particular, one type exhibits the following special behaviour: if one individual starts singing, the others join in to sing together and although the resultant sounds are offensive to some ears to others they have great beauty. This *tutti* singing is what is traditionally understood by *Semi-Shigure*.
However, we generally hear many types of cicada song at the same time and some cicadas tend to sing individually, with one species having a very special voice with glissandi and microtone progression. The modern meaning of 'Semi-Shigure' refers to these various sounds being heard simultaneously.

Cicadas only survive for two weeks, and different species live during different parts of the year, so cicada song gradually changes towards autumn. I created a graph spanning the end of spring to the beginning of autumn showing how different types of cicada inhabit different periods (see below); this became the structure for my piece.

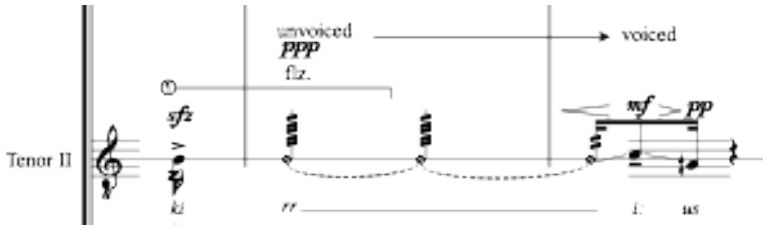


[Fig. 8-2. graph showing cicada life-spans from the end of spring to the beginning of autumn]

In representing the idea of the 'Semi-Shigure' with eight singers (SSAATTBB), I had to use many contemporary techniques and difficult vocal sounds, some of which I found described in Trevor Wishart's *Book of Lost Voices*. First of all, I divided the time periods into six sections, with overlapping songs of cicadas across the six minutes. I then distinguished different cicadas by using different colours on a paper. Next, I created pitches and sound techniques based on my aural analysis of cicada sounds. I added one more cicada, *kuroiwa tsukutsuku,* because it was similar to the voices of *tsukutsuku houshi* (cicada 9), and finally decided to base the music around the ten types of cicadas which can be heard in Tokyo. Initially I planned to vary these musical materials, but in the end, they mostly appear as repetitions.

To create dynamic contrasts I realised that I needed not only soft sounds with noises but also loud *tutti* sounds. I had heard a concert by EXAUDI and was very impressed by Xenakis's *Nuits* (1999), particularly the *tutti* passages where all twelve singers sang the same texts very powerfully. I decided to create a similar effect with the sound of *cicci-zemi* before the final section, contrasted with a solo for the second soprano just before the ending.

It was difficult to notate the cicada noise sounds by myself and some of the notations confused the performers at the first workshop. For instance, at the beginning of the piece I wanted unvoiced sounds with flutter-tongue but the singers showed me that it was possible for them to do this in three different ways - unvoiced, half voiced and voiced - so I made a gradual change from unvoiced to voiced (see below).



[Fig. 8-2. from the first bar of Tenor II, *Semi-Shigure*]

I notated unpitched noise sounds on a single-line stave and pitched parts (which also included microtones) on a five-line stave and, at the second workshop, the singers found the notations much more effective. In the middle section, however, the singers found it impossible to produce the sound which Wishart describes as 'sub-harmonics', which I had based on a cicada's voice, and we had to find an alternative.

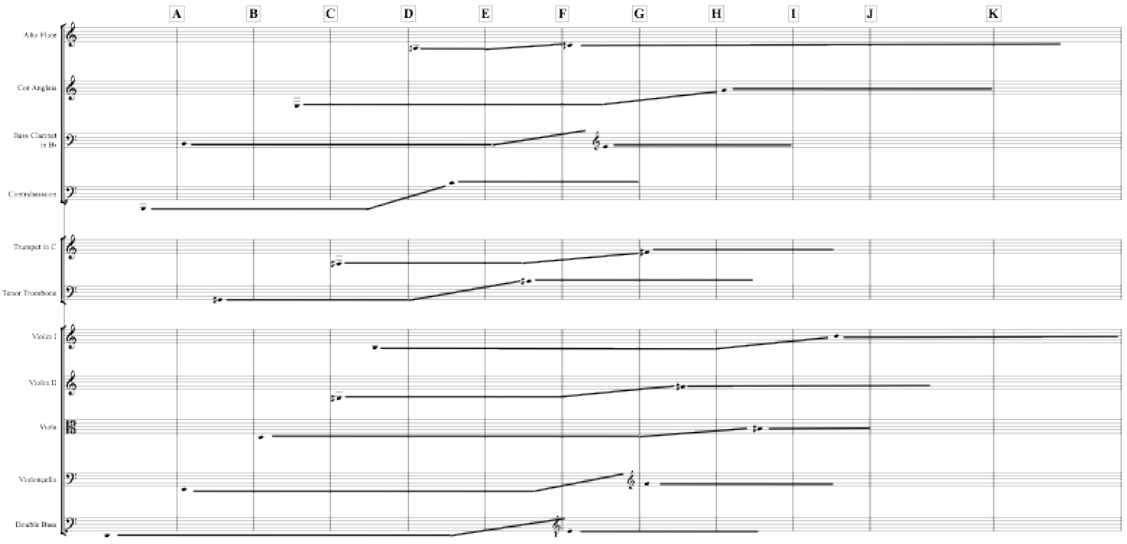
Between the workshops and the premiere I re-notated the score, doubling all the note values as the conductor had recommended. I also added an appendix which explained the techniques and

changed the sub-harmonics to ‘making noise with the throat’. I also stipulated that I wanted a fast, narrow vibrato rather than a slow, wide vibrato, except at the points marked *molto vibrato*.

The piece was premiered in an EXAUDI: Exposure concert as part of *Out Hear* at King’s Place on 3rd October 2011. In the rehearsal before the concert, the vocal techniques worked well, particularly those which required ‘making noise in the throat’, which were very close to the sounds I had imagined. (Eight months later, I finally found a name for this technique, when I met the baritone singer Frank Worner at the Tzlil Meudcan Festival in Israel and he told me that the sounds were called ‘under-tones’.)

9. The Enthalpy of Vaporization for chamber ensemble

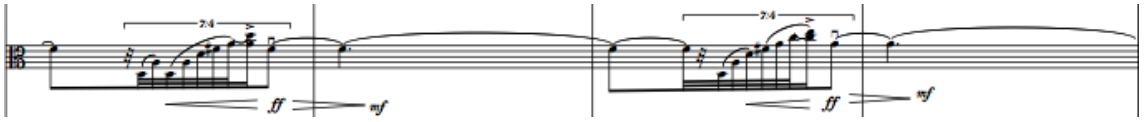
The enthalpy of vaporization is the energy required to transform a given quantity of a substance into a gas at a given pressure. It is often measured at the normal boiling point of a substance. I created a graph (see below) to illustrate how the number of instruments playing together increases until they reach a climax, which is just before boiling-point.



[Fig.-9-1. graph of the structure, *The Enthalpy of Vaporization*]

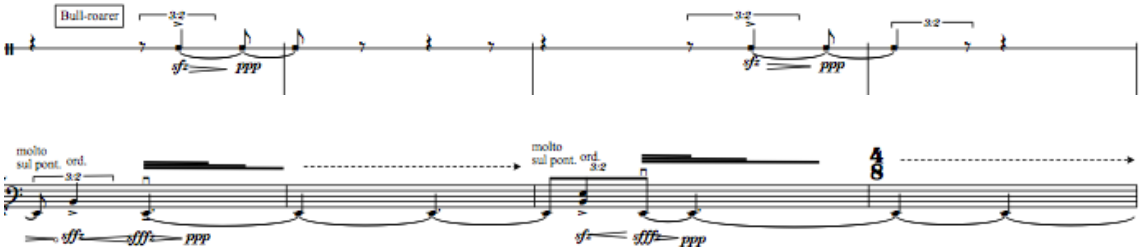
The instrumentation starts in the low register with pedal tones in the tenor trombone and with the double bass using bow pressure. The piano, bass drum and tam-tam are added next so that the range of the instruments gradually goes higher, and the number of the accompanying instruments increases. I wanted to vary the perspective of the instrumental sound, so I used many combinations of *sforzando*, *diminuendo*, *sffz>ppp,* etc. (although it is difficult for trombonist to vary dynamics on pedal notes).

Time-signatures and pulses represent given pressures, and the liquid-gas phase transformation is represented by changes in the string parts. The strings have odd-number tuplets: eleven for the violin I, nine for the violin II, seven for viola, five for cello and three for double bass. The strings change note on each tuplet beat; the action represents a simple physical model for the liquid-gas phase transformation, which is the energy required to free atomic nucleus from the liquid, and is equivalent to the energy needed to overcome the surface resistance of the liquid (see below). The rhythms are usually not played together and each instrument's shape occurs at a different point in each bar; I was curious to discover whether these small changes would be audible.



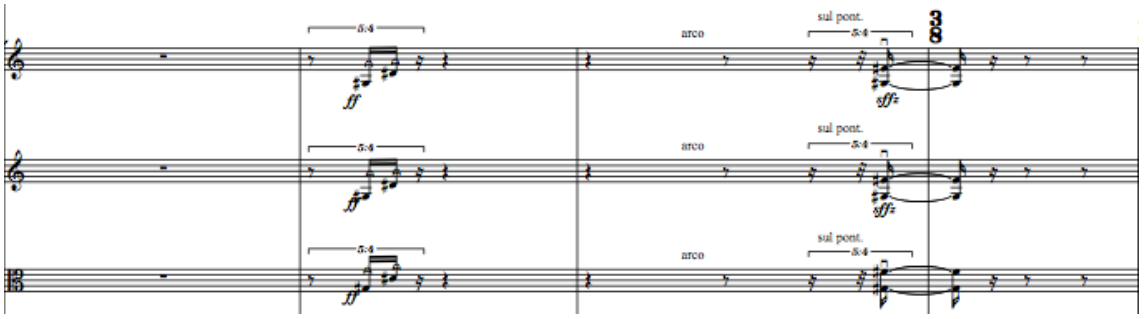
[Fig. 9-2. bars 69-73, viola part, *The Enthalpy of Vaporization*]

I particularly wanted to use the bull-roarer as a sound full of energy which could make noisy contrasts with the use of extreme bow pressure on the strings. The effect begins with the bull-roarer and the double bass (see below) and continues to the end of the climax in bar 84 between the bull-roarer and all the strings. (Unfortunately, the ensemble that gave the premiere did not have a bull-roarer so the percussionist and I tried using rubber mallets on the timpani to create a similar effect. The sound was softer than I wanted so it would be better to use the correct instrument in the future.)



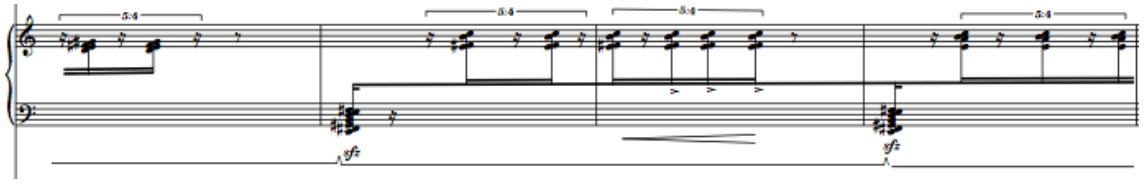
[Fig. 9-3. bars 5-8, percussion and double bass, *The Enthalpy of Vaporization*]

The piece is based on the fundamental pitch E and each instrument also has the fundamental pitch of a different overtone scale. The instrumentation tends to be based on instrumental doubling and I developed the musical materials to represent the energy of the liquid slowly moving as it is heated. The pitch E is usually sustained with long notes, contrasted with briefer figures such as these in the violins and viola (see next page).



[Fig. 9-4. bars 13-16, violins and viola, *The Enthalpy of Vaporization*]

The double bass player must sustain extreme bow pressure almost without a break, although there is some variation from *ordinario* to *molto sul ponticello* to create a fluid sound effect. The other instruments join in, climaxing in a very loud *tutti* with *accelerando* at bar 73. The piano has a series of chordal attacks based on the overtones of an E fundamental, stopping and starting again to represent gradual changes in pressure (see below).



[Fig. 9-5. bars 69-73 piano, *The Enthalpy of Vaporization*]

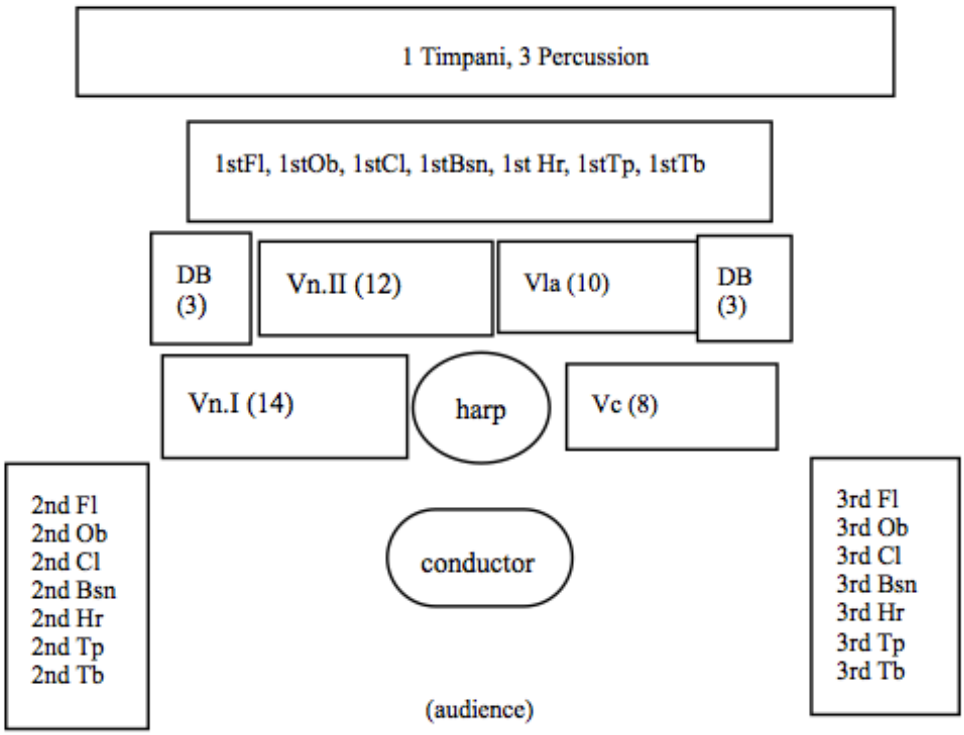
After that there is a shift to longer repetitions of phrases and the *tempo* changes to ♪ = 90 from bar 79 and the previous tension is released. At bar 83, the music is suddenly much quieter and the tempo returns to ♪ = 60, after which everything moves into the highest ranges, with air sounds for the flute, and harmonics in the strings. The instrumentation is gradually reduced until the end of the piece and the music fades out, leaving only violin harmonics, notes plucked inside the piano and the sound of a bow on the tam-tam.

The Enthalpy of Vaporization was selected for the International Composer Pyramid 2011 and was premiered at the Lille Conservatoire (France) on 10th December and at St Gregory's Centre for Music in Canterbury on 11th December by the ICP ensemble conducted by Philippe Nahon. The piece is nine minutes long but I edited it to six minutes for the project. Ten young composers and fifteen performers were selected for the project and it was very beneficial to exchange our knowledge of techniques in the international workshops.

10. Kaleidoscope for orchestra

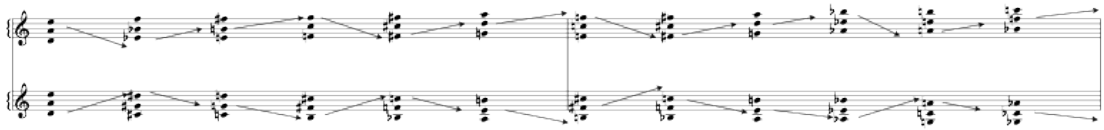
This piece was written for the Sound and Music 'Embedded' project with the BBC Symphony Orchestra, a chance to write a piece of orchestral music for the BBC Symphony Orchestra. Over the course of the project a few composers had the opportunity to try out material at various stages of the process and had input from a mentor, a conductor and the performers of the orchestra. I participated in workshops on 18th April and 2nd November 2011 and the piece was premiered by the BBC Symphony Orchestra, conducted by Garry Walker, on 17th February 2012.

I composed the piece around the idea of a kaleidoscope, inside which there are three mirrors. I had had the idea for a number of years and had made sketches for chamber orchestra, but I had abandoned these for various reasons, mostly to do with the instruments available and their limited ranges. I started writing the piece for the symphony orchestra at the beginning of 2011 and created five minutes for the first workshop. I wanted to use balconies on either side of the main stage, but the BBC Maida Vale studio only has a balcony above the audience seats so I divided the woodwinds and the brasses into three groups and set them up in the middle, left and right of the stage (see below). A harp is set up in the middle of the stage and sometimes becomes the principal instrument in the piece, as at the start where harp *arpeggios* and *bisbigliando* are set against *glissandi* in the strings.



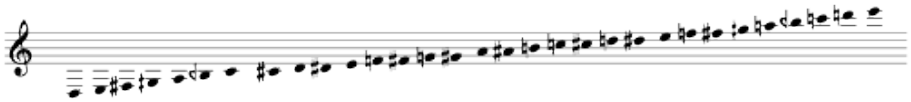
[Fig.10-1. orchestra layout, *Kaleidoscope*]

A symmetric harmonic progression expands during the first few minutes. As shown (see below), this symmetric pattern represents the reflective symmetry within a kaleidoscope.



[Fig. 10-2. harmonic progression I, *Kaleidoscope*]

Out of the materials of this first section I developed material for two further sections. In addition, I created scale progressions which combined the middle notes of a overtone scale and the symmetric scale (see below).

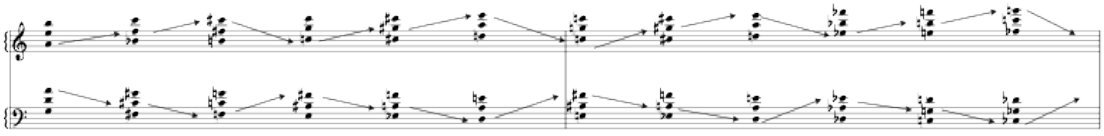


[Fig.10-3. A-based scale for woodwind, *Kaleidoscope*]

I had several meetings with the harpist, Louise Martin, and was surprised at the speediness of her pedal changes; this inspired me to create a beautiful ending with the pedal noises of the harp. I also regularly consulted Alfred Blatter's *Instrumentation and Orchestration (*1977), my bible since I started studying composition.

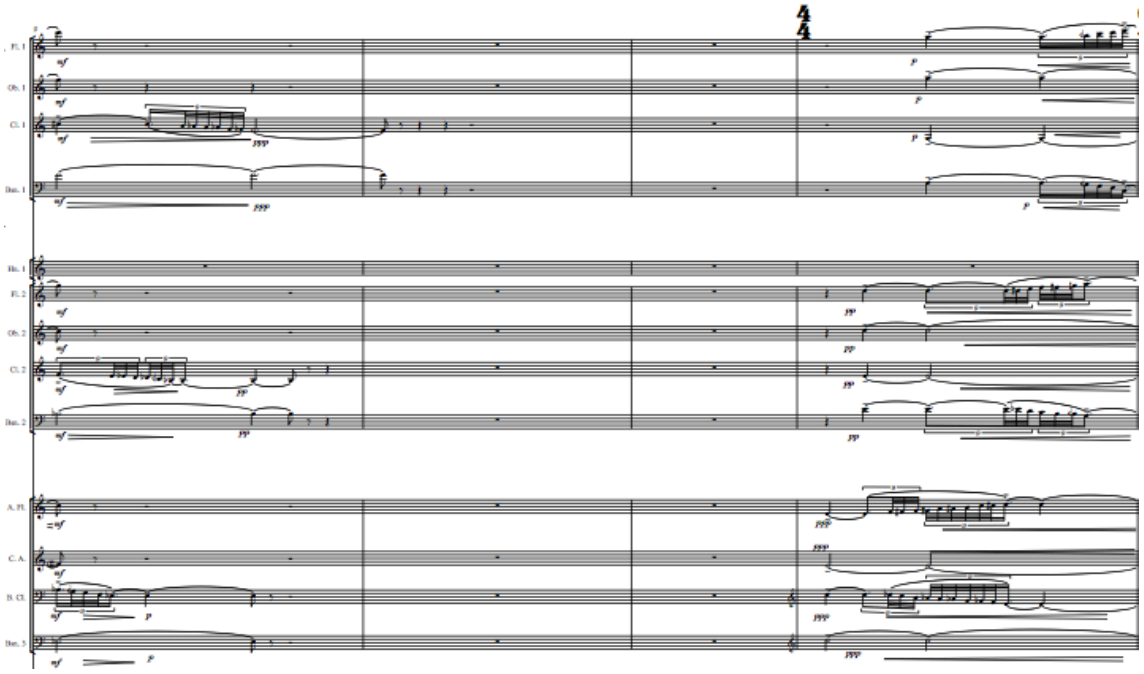
During the first workshop, I discovered that the layout was effective for some instruments, such as the brass, but not for others. The woodwind players seemed uncomfortable playing in an unfamiliar position, and it was also a little difficult to hear the harp because the orchestration was very dense. I needed to control the dynamics more carefully and consider how to use instrumental colour to achieve the three-dimensional effect I wanted for the piece.

After the workshop, we had feedback from the conductor, director and mentor. I was selected to go on to the second workshop with two others, but the conductor asked me to re-write the score doubling the note-values because it was difficult to read. I also decided to develop a new harmonic progression.



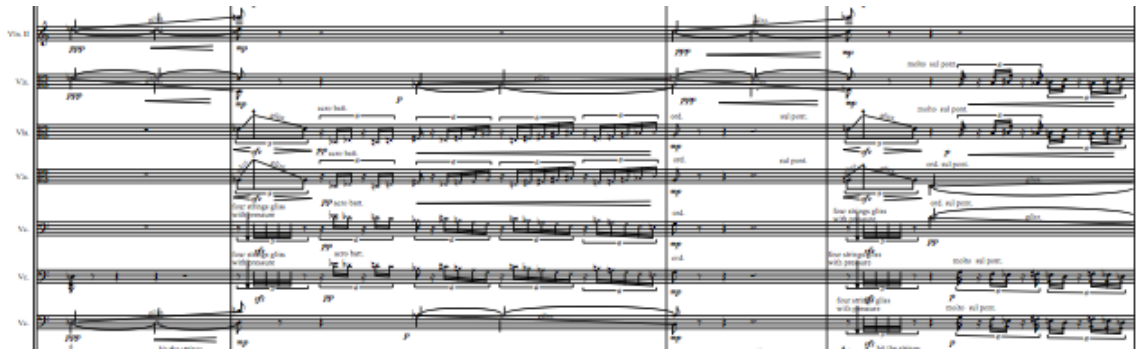
[Fig.10-4. harmonic progression II, *Kaleidoscope*]

Only some of the ideas proposed in the feedback fitted my style and so I made relatively few modifications apart from changing the harmonic progression and creating a two-beat delay in the woodwind passage shown below.



[Fig.10-5. bars 5-8, *Kaleidoscope*]

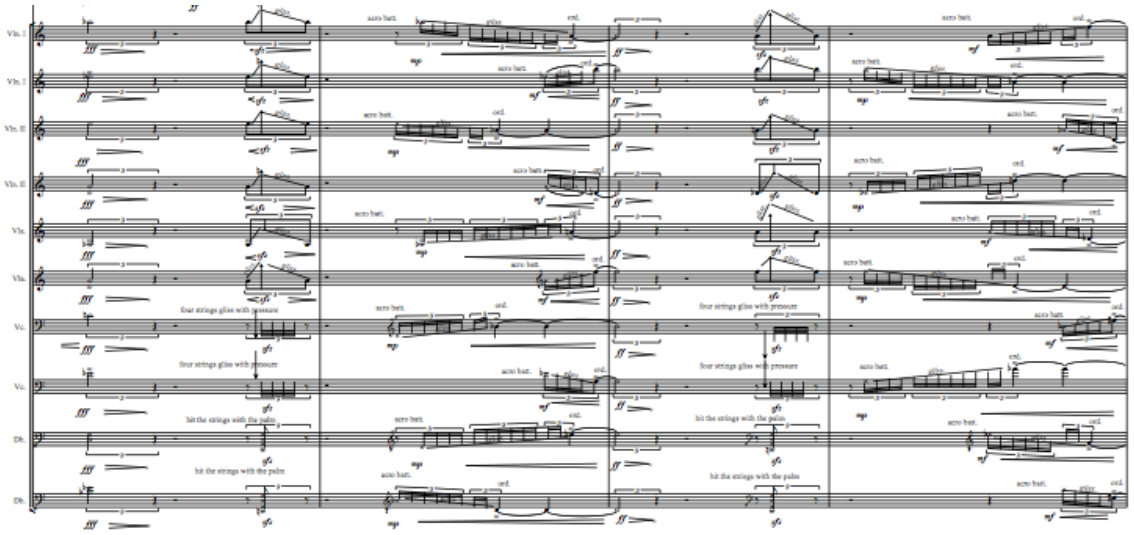
Before the second workshop I was nervous that the piece was under ten minutes and that the orchestration was not as effective as I had imagined, but the performers had become used to the unusual orchestral layout and found the double-value score much easier to read. The woodwind delay effect worked well but I could not hear the scales in the strings in the first section because of the *divisi* writing nor could I hear the harp part. After the workshop, I added more players to the string passages to create a louder sound.



[Fig.10-6. bars 25-28, *Kaleidoscope*]

I expanded the section featuring the brass, adding twelve bars to the beginning and intensifying the climax by introducing the instruments a beat apart. I also created two important new sections, the long string *glissandi* and woodwind scales which descend together at bar 37 and then return in the opposite direction in bar 115.

After a year's work on the piece there were three days of rehearsals before the concert. Extra string players were added to achieve the volume I wanted from the orchestra, and I also replaced *arco battuto* with staccato bowing to create a louder sound. The gaps between the three groups of musicians made it difficult for some players to see the conductor and so I asked for TV monitors to be set up on each side to avoid any delay.



[Fig.10-7. bars 106 -113, *Kaleidoscope*]

It was also difficult to hear the oboe multiphonics, but otherwise I was very happy with the orchestral sound. Some listeners told me that the orchestral detail was much clearer in the balcony seats than in the stalls. Watching the audience's attention shift from one orchestral group to another suggested that I had achieved the three-dimensional effect I wanted. The recording of the concert was broadcast on BBC Radio 3's Hear and Now on Saturday 12th May 2012.

11. Romeo and Juliet for piano duo

This piece was commissioned by duoDorT as part of their Quantulum project, in which they commissioned six composers working in different genres to experiment with piano and voice in a variety of contexts. They began with a residency and introductory performance at Aldeburgh in November 2011, followed by a series of performances combining all the new works. I composed the piece for them over five days at Aldeburgh and then changed some parts of the score later.

My idea was to write a piano duo incorporating Morse code. This can be transmitted in a number of ways: originally as electrical pulses along a telegraph wire, but also as an audio tone, a radio signal with short and long tones, or a mechanical or visual signalling device like an Aldis lamp or heliograph. A series of on-off tones, light or clicks can be understood by skilled listeners or observers without special equipment. Since the action of Morse code is similer to playing harmonics on a piano I decided to use harmonic techniques for the short pulses and normal piano for the long pulses.

I translated some dialogue from Shakespeare's *Romeo and Juliet* into Morse code, traditional love translated into digital love (see below). I originally wanted to use a dialogue from the beginning of the Act but the sentences were too long, so instead I chose a passage from the famous love scene in the Capulets' orchard (Act II, Scene II) and then created a piece with the rhythms from the code.

JULIET
Romeo!
.-. --- -- . --- | ..--.. |
ROMEO
My dear?
-- -.-- | -.. . .- .-. |
JULIET
At what o'clock to-morrow
.- - | .-- .... .- - | --- | -.-. .-.. --- -.-. -.- | - --- | -- --- .-. .-. --- .--
Shall I send to thee?
... .- .-.. .-.. | .. | ... . -. -.. | - --- | - .... . . |
ROMEO
At the hour of nine.
.- - | - .... . | .... --- ..- .-. | --- ..-. | -. .. -. . | ..--.. |
JULIET
I will not fail: 'tis twenty years till then.
.. | .-- .. .-.. .-.. | -. --- - | ..-. .- .. .-.. | -...- | | | - .. ... | - .-- . -. - -.-- | -.-- . .- .-. ... | - .. .-.. .-.. | - .... . -. | ..--.. |
I have forgot why I did call thee back.
.. | .... .- ...- . | ..-. --- .-. --. --- - | .-- .... -.-- | .. | -.. .. -.. | -.-. .- .-.. .-.. | - .... . . | -... .- -.-. -.- | ..--.. |

[Fig.11-1. *Romeo and Juliet*, Act II, Scene II, with Morse code translation]

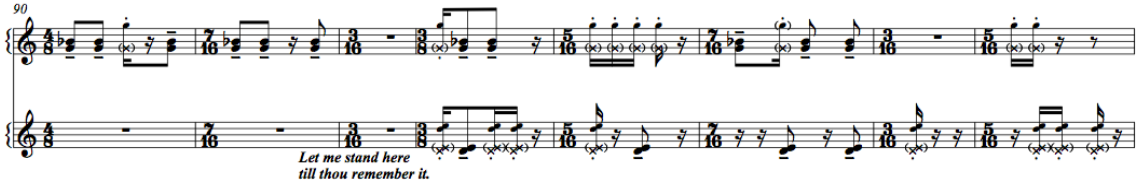
Morse code is transmitted according to the following rules (see below):

1. short mark, dot or 'dit' (·) — 'dot duration' is one unit long
2. longer mark, dash or 'dah' (–) — three units long
3. inter-element gap between the dots and dashes within a character — one dot duration or one unit long
4. short gap (between letters) — three units long
5. medium gap (between words) — seven units long

Using these rules I turned the code into musical notation. It was interesting to discover that playing in Morse code it takes many bars to play just one word. It was also quite difficult for the players to learn because the rhythms were different in each bar.

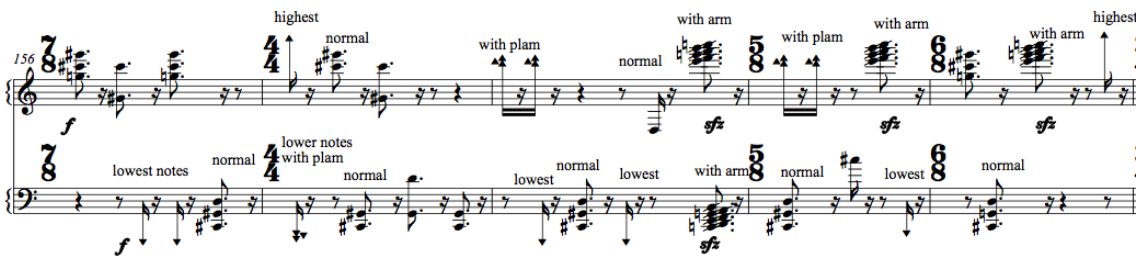
I began the piece for piano I with the F a perfect fourth above middle C, because the frequency of Morse code was usually 700 Hz; then piano II has the E, a major third up from middle C. The pianists needed to mark the positions of the harmonics on the strings inside the piano and practise touching the strings while they were still vibrating. Piano I plays Juliet's lines on the higher pitch while piano II plays Romeo's lines.

Piano I has to play double harmonics from bar 45 and because of hand-size intervals can be no larger than a semitone or major second; from bar 93 both pianists play double harmonics.



[Fig.11-2. bars 90-97, piano I and piano II, *Romeo and Juliet*]

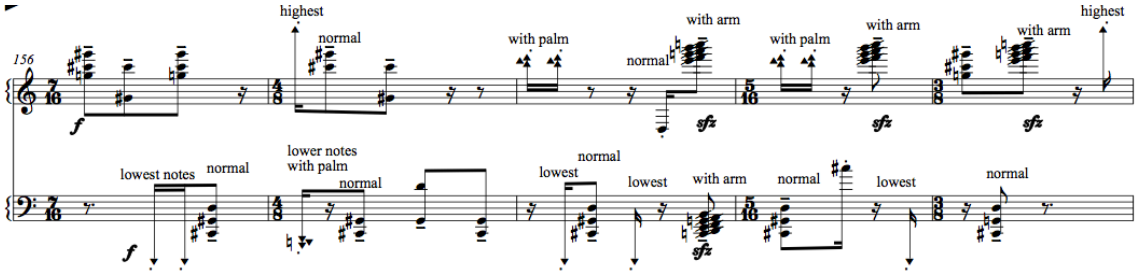
I was satisfied with the idea and the sound but felt the end of the piece needed more impact, so I added some other techniques such as playing with the palm and arm.



[Fig.11-3. bars 156-160, piano I and piano II, *Romeo and Juliet*]

Morse code speed was usually measured in words per minute (wpm) and characters take different amounts of time because they contain differing numbers of dots and dashes. I wanted my Shakespeare translation to be very fast and so the tempo is ♪= 200; eight pages of score last only two minutes.

duoDorT tried a few parts of the piece in our session at Aldeburgh, but although I liked the sound I was concerned about the harmonics because the pianists found it hard to consistently touch the strings at the right point. After the Aldeburgh session, I had to compose other pieces and came back to this piece again in February 2012. My supervisor suggested that my notation was difficult for performers to read, and he suggested changing the notation by halving note-values and removing many of the rests. I tried changing the first page of the score and sent it to the performers. As I expected, they preferred it; it was easier to read and to play faster.



[Fig. 11-4. bars 156-160, piano I and piano II, *Romeo and Juliet*]

duoDorT recorded this piece in June 2012 for a CD which also included the other composers in the Quantulum project.

12. The Butterfly Effect

for flute, clarinet, horn, trumpet, percussion, piano, violin, viola and cello

In chaos theory, the butterfly effect is the sensitive dependence on initial conditions, where a small change at one place in a nonlinear system can result in large differences to a later state. The name of the effect, coined by Edward Lorenz, is derived from the theoretical example of a hurricane's formation being contingent on whether or not a distant butterfly had flapped its wings several weeks before.

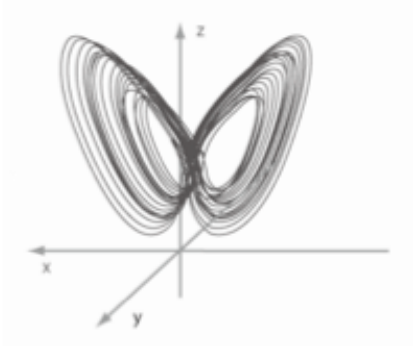
I was interested in the effect of the Lorenz Attractor (see below) and researched chaos theory, especially Gerhard Nierhaus's *Algorithmic Composition-Paradigms of Automated Music Generation*. Chaos theory was very influential in 20th century music and Iannis Xenakis in particular pioneered its application in computer-assisted composition. More recently, chaos theory has informed the composition of James Dillon's, *Nine Rivers,* a cycle of nine works interlinked by a series of "tropes" to create a vast musical environment with an overall duration of around three and a half hours.

$$\frac{dx}{dt} = -px + py$$

$$\frac{dy}{dt} = -xz + rx - y$$

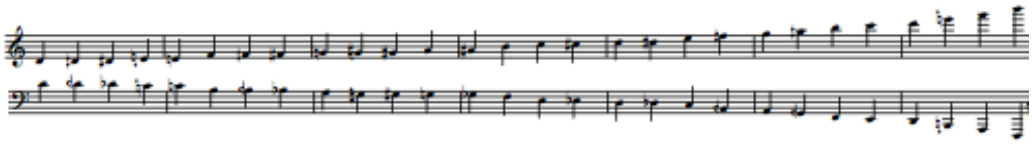
$$\frac{dz}{dt} = xy - bz$$

[Fig. 12-1. equation for the Lorenz Attractor]

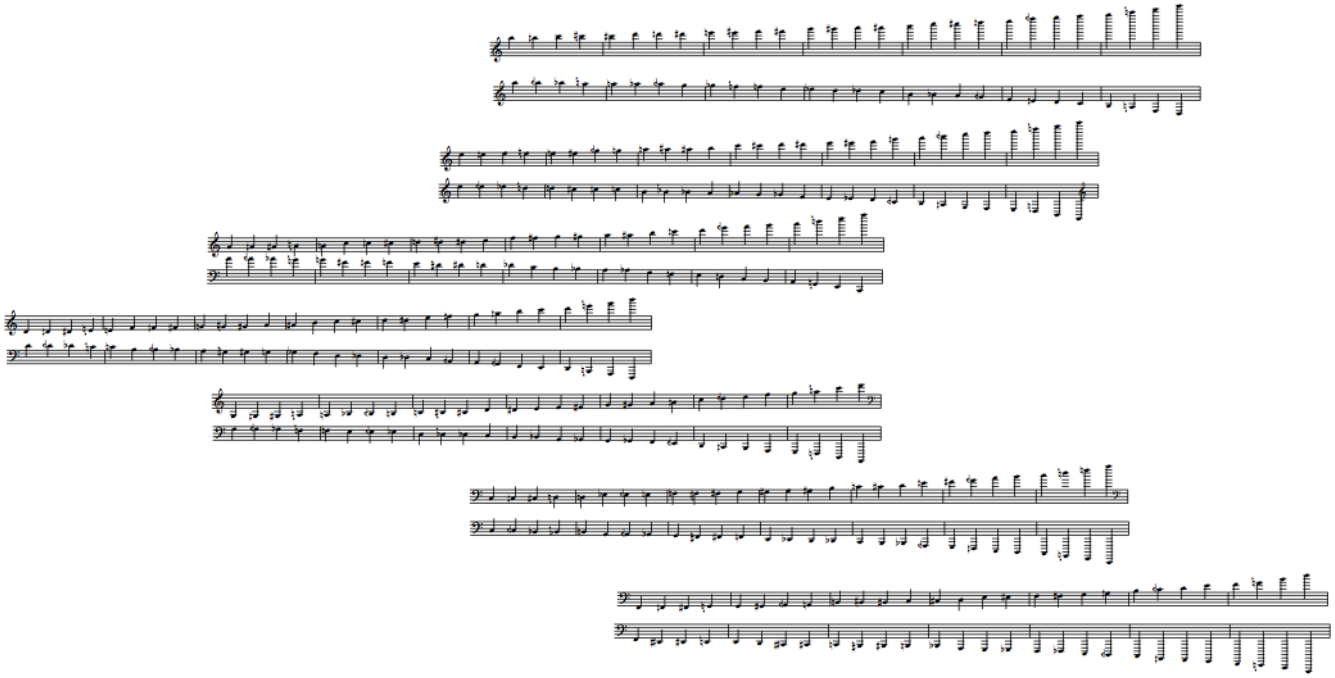


[Fig. 12-2. shape of the Lorenz Attractor]

I wanted to approach algorithmic composition through Max/MSP or SuperCollider but was unfamiliar with the software so I asked one of my colleagues to model the Lorenz equation so that I could listen to sound changes produced by varying different axes with a mouse in SuperCollider. However, the results tended to emerge as chromatic scales. I also tried to use the logistic equation, which represents a simple model of an ecosystem whose development is determined by a recurrent process. The sound was realised using Logic software but, although I experimented with both chromatic and microtonal scales, again the results were not as interesting as I had expected. Instead I decided to base the piece on the principal pitch D and developed a scale based on twenty-eight notes from an overtone scale (see next page), together with the same scale in contrary motion. Because I wanted to create string effects on open strings, I also transposed this scale a perfect fifth higher to A, E, B, and F♯, and fifth lower to G, C, F, and B.

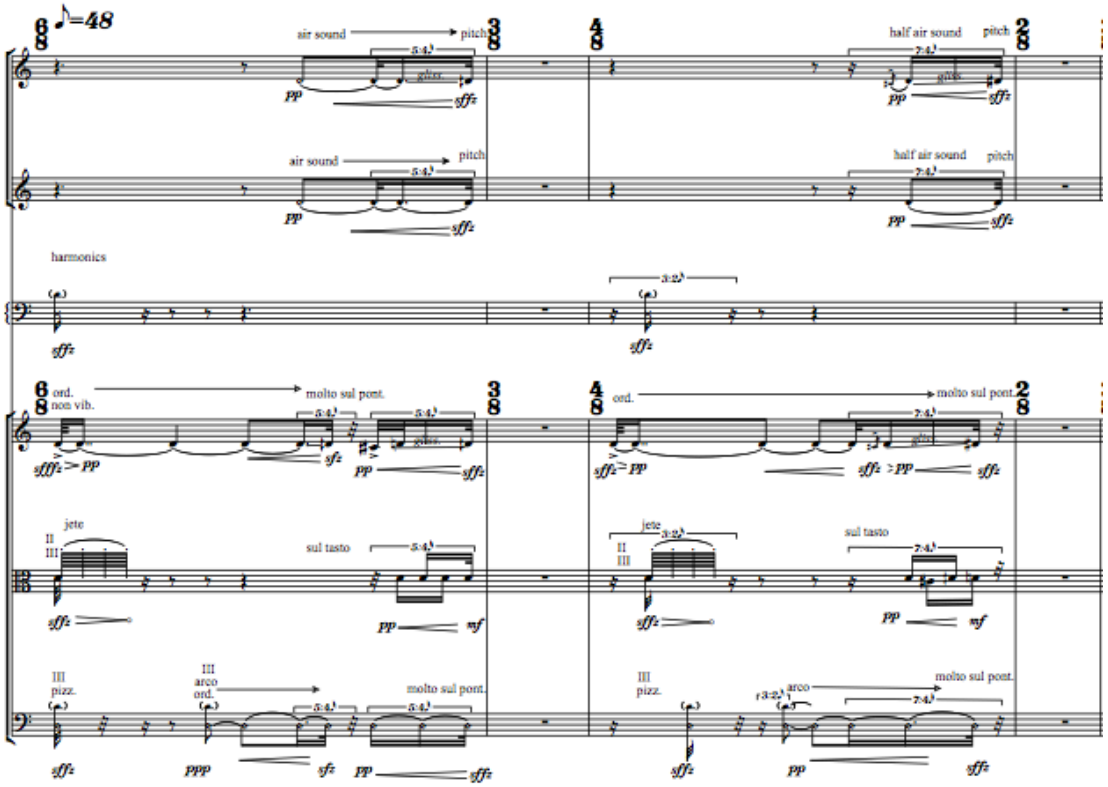


[Fig. 12-3. principal scale with fundamental pitch D, *The Butterfly Effect*



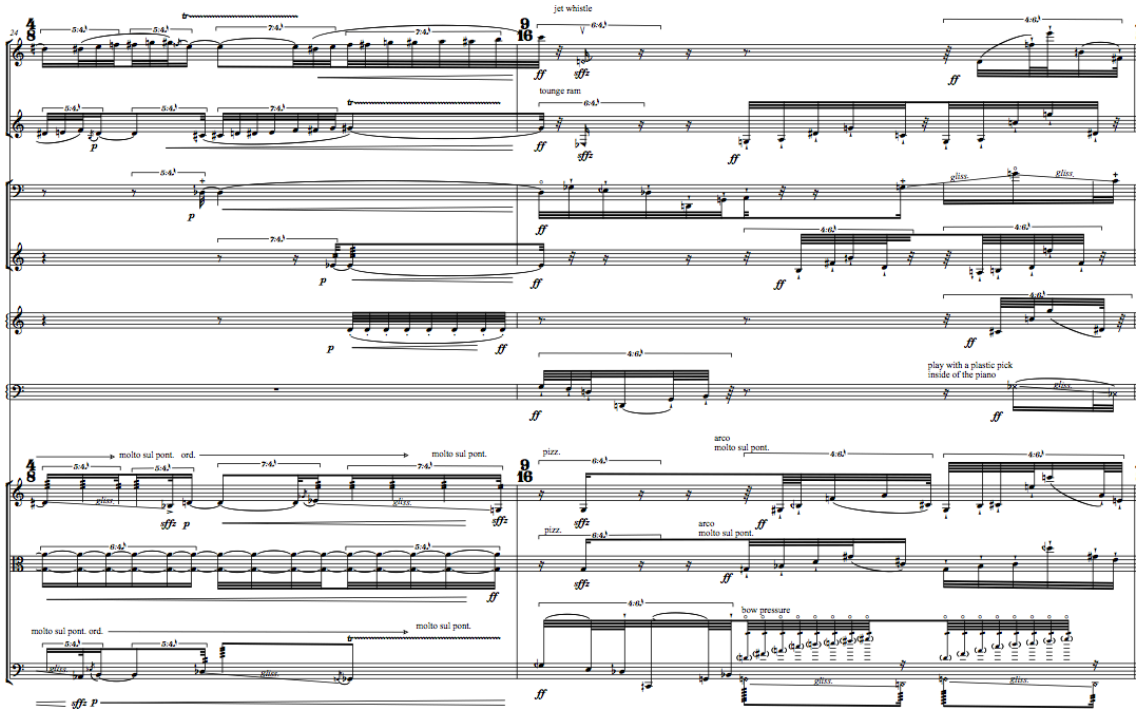
[Fig. 12-4. transposed scales, *The Butterfly Effect*]

I returned to the idea of the butterfly effect and considered how I could represent the flapping of butterfly wings. The piece consists of four sections and I decided to divide the instrumentation into groups. The piece starts out from D with instruments playing either D or notes close to D, the narrow intervals including microtones (see next page). Gradually the sound changes with slight rhythmic differences and the range of interval manipulation gradually increases.



[Fig. 12-5. bars 1-4, Flute, Clarinet, piano, violin, viola and cello, *The Butterfly Effect*]

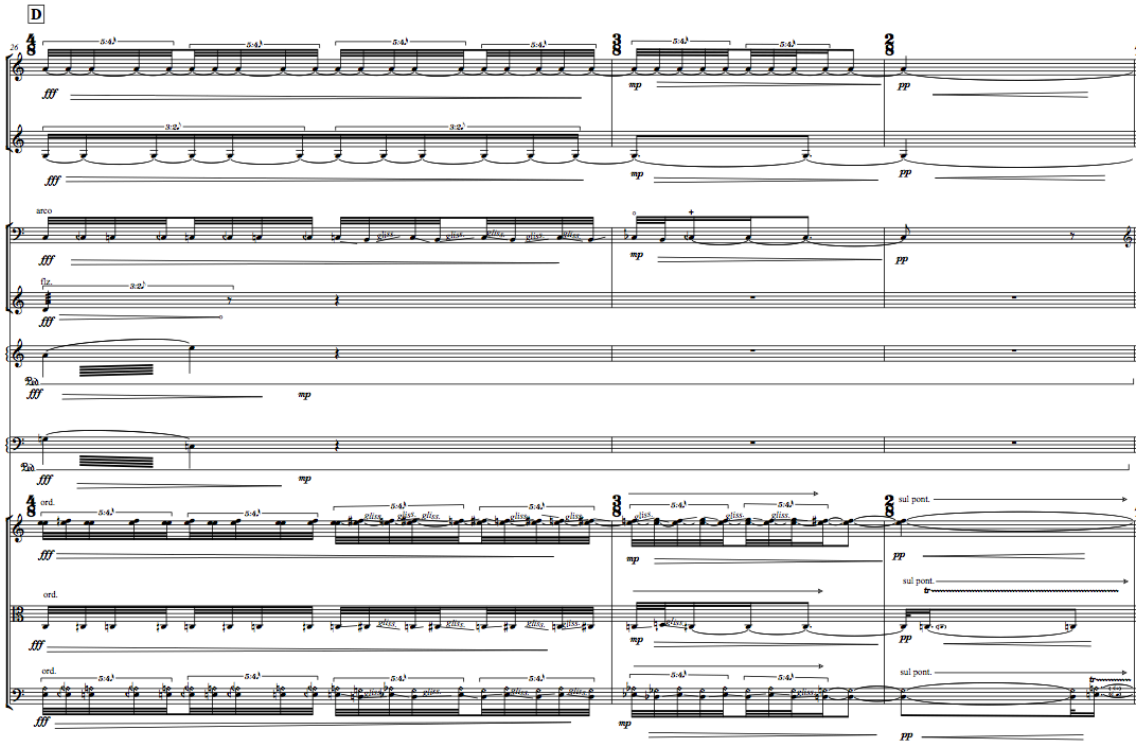
I then created a gesture with more complex rhythms which appear to suddenly interrupt the butterfly's fluid actions. This appears for the first time in bar 6, then recurs several times in the first section at greater length. This action is similar to the orbit of the Lorenz Attractor (see the previous page) and a large orbit-like figure appears three times, before longer rising and falling figures take over in bar 25.



[Fig. 12-6. bars 25-26, full score, *The Butterfly Effect*]

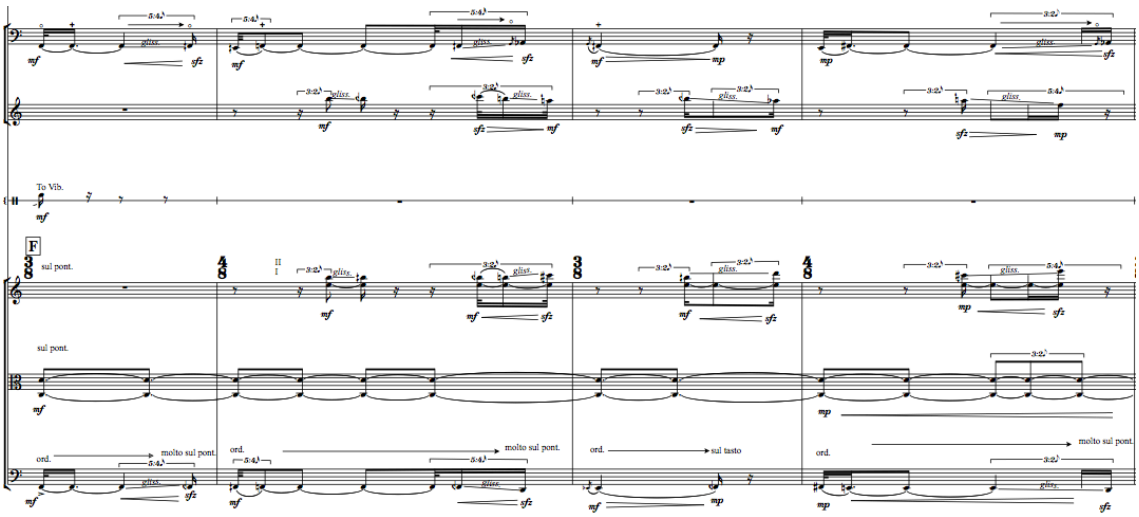
To generate further complexity, different rhythms are overlaid using notes chosen from the scales on D and G. I am able to vary the character of the sound depending on which notes I choose from the scale; when the pitches are around these fundamental pitches and the intervals between the notes are close, the resultant sounds are noisy, whereas when the pitches rise and the intervals become wider, the sounds become brighter.

Without a break, the second section starts with a *tutti* in bar 26 (see below), the first section where important contrasts are made between different instrumental groups. Woodwind multiphonics are combined with string harmonics and the section is further transformed from the sound world of the first section by the addition of brass *glissandi* and the piano.



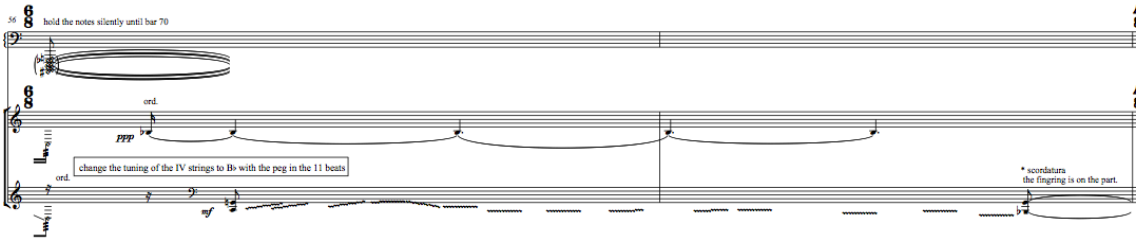
[Fig. 12-7. bar 26, full score, *The Butterfly Effect*]

In contrast to the first section, there is now more solo writing; for instance, a solo violin starts in bar 30, opposed by solo flute in bar 31, while the cello plays long bass notes. Thus, each instrument has a different function. In the next section the instrumentation changes to solo cello and clarinet, with the long notes played by the violin. Another change of function in bar 42 brings the horn and the cello together as one voice and the violin and the trumpet as the second voice (see next page).



[Fig. 12-8. bars 42-45, horn, trumpet, percussion, violin, viola and cello, *The Butterfly Effect*]

String harmonics and spectral sounds are repeated during two bars of 15/16, an expansion of bars 29 and 35, and this becomes the densest part of the piece. After that, the cello has to tune the C string down to B, and so I created a bridge for retuning the cello in bars 56 and 57 over 11 beats (see below). At the same time the pianist depresses the *sostenuto* pedal during the bridge and holds the notes which were the previous fundamental pitches A♯, B, C, D, E, F, G and A to create a resonance based on these notes until bar 70.



[Fig. 12-9. bars 56-57, piano, viola and cello, The bridge for the tuning of cello and holding if the piano pedal, *The Butterfly Effect*]

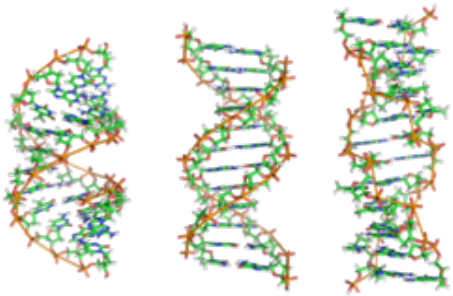
Finally woodwinds play more orbital figures and the brass play air flutter-tongues. The cello uses harmonics and the violin and the viola play *jéte* in the highest register, a combination of sounds which at the faster tempo is very effective.

The piece was selected for the Reading Session of the 46th International Summer Course for New Music at Darmstadt and was performed by the Ensemble Linea.

13. Double Helix - for solo flute

I was selected for the Tzlil Meudcan International Festival and Summer Course for Contemporary Music in Israel and completed this piece for solo flute in May 2012. The piece was premiered by Michael Schmid, the flautist of the Belgian ensemble Ictus, in the opening concert of the festival in the Felicja Blumental Music Center on 27th June 2012.

In molecular biology, the double helix is the structure formed by double-stranded molecules of nucleic acids such as DNA and RNA. Two complementary regions of nucleic acid molecules bind and form a double helical structure held together by base pairs. The double helix makes one complete turn about its axis. The frequency of twist depends largely on the stacking force that each base exerts on its neighbours in the chain.

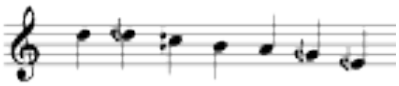


a ***b*** ***z***

[Fig. 13-1. the structure of a, b and z of the double helix]

I wanted to represent the image of the double helix in this piece for solo flute. It consists of three sections, the middle one slow, which are labelled ***a b*** and ***z***, like the structural features of the three major forms of DNA (see above).

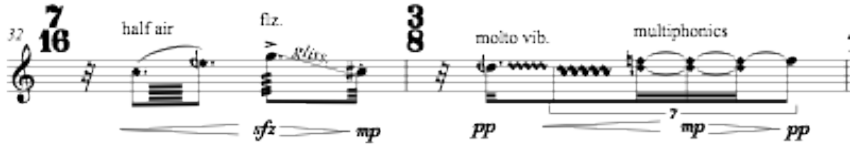
I used twenty-four pitches, including twelve quarter-tones, with D as the principal pitch because it is in a comfortable register to play, has many possible timbres and many fingering possibilities. I used a descending scale (see below), of increasing intervals from D:



[Fig 13-2. scale for the first section, *Double Helix*]

For the first section, I developed many types of vibrato on pitches spiralling around the axis pitch D. In the double helix the geometry of a base, or a base pair step, is characterised by six coordinates: shift, slide, rise, tilt, roll and twist, and so I employed many techniques including flutter-tongue, air sounds, lip glissando, bisbigliando fingerings and embouchure change, creating different kinds of sound colours to represent these coordinates.

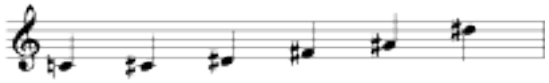
The ***a, b*** and ***z*** of the double helix diagram above are reflected in the structure of my piece. a is made from dense materials between the double lines and represented in my music by narrow intervals and *molto vibrato,* with different timbres produced by different kinds of techniques in each bar. I then created a spiral with one pitch and a neighbouring pitch as the start of the double helix, so that the flautist must produce double sounds with multiphonics or by combining instrument and voice (see below).



[Fig. 13-3. bar 32 and 33, *Double Helix*]

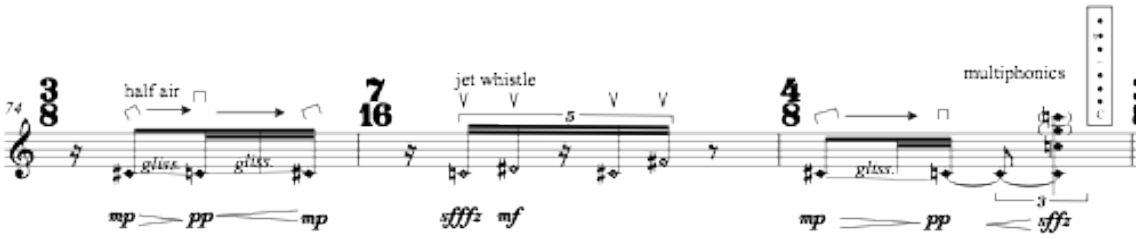
The difference between a spiral and a helix is that the helix has a third dimension. The idea of a third dimension connects this piece with my previous piece, *Kaleidoscope*, and it was interesting to try to find a similar effect with very reduced instrumentation. In *Double Helix* it is the use of dynamics which creates this third dimension.

For the second section, I wanted to make links between high notes and low notes and especially to use multiphonics and tongue ram. The tempo changed from ♪=72 to ♪= 48 and the lowest pitch is C, the last note of the principal scale of the first section. Because there are few quarter-tone fingerings in the low range of the flute, I had decided to use non-microtonal pitches in this section and the principal scale consists of six notes, the interval between each being a semitone wider than the one before (see below).



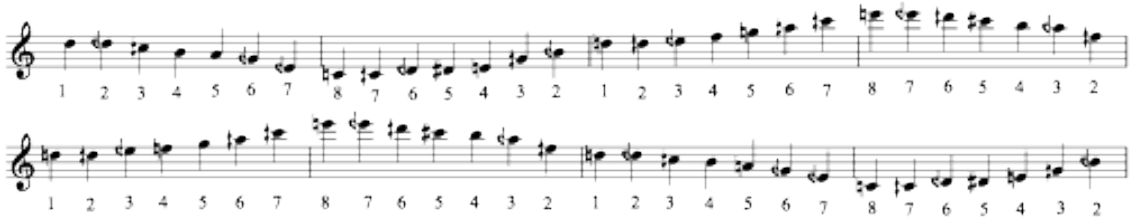
[Fig. 13-4. scale for the second section, *Double Helix]*

Structure ***b*** has a less thick structure than structure ***a*** (see the previous page) and there are nitrogenous bases between the double helix. I used noise effects, half air, jet whistle, tongue ram and slap keys, and four-note multiphonics to represent the nitrogenous bases.



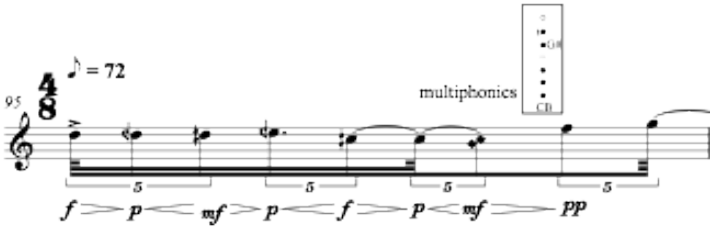
[Fig. 13-5. bars 74-76, *Double Helix*]

The third section is based on structure *z*, the thick structure which has elements of structure *a* and *b* (see the first page) so I used multiphonics again, both the double-note multiphonics of the first section and four-note multiphonics of the second section. The tempo is back to ♪=72 again and the same time signature 4/8 is continued, because I wanted to keep quintuplets and also wanted to change the value of notes in the rhythms. The double line of the two scales is symmetrical on the pitch D to form a double helix in the final section (see below).



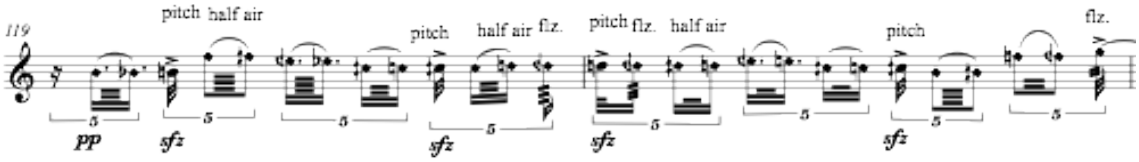
[Fig. 13-6. scales of the third section, *Double Helix*]

I decided on a duration-value for each pitch. For instance, pitch D is one quintuplet beat and D a quarter-tone lower is two quintuplet beats; so the further a pitch is from the initial D the longer it is. The numbers below the notes in the scale (see above) are the values of the notes in quintuplets. In addition multiphonics are sometimes added to pitches (see below).



[Fig. 13-7. bar 95, *Double Helix*]

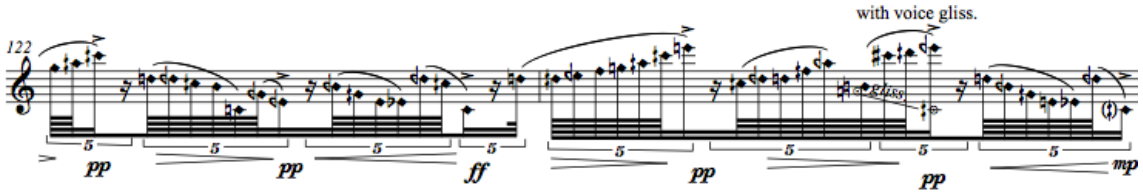
Then I used two notes from each scale so that the pitches formed a large double helix. Short grace-notes using pitches from the scales are gradually added and then *tremoli*.



[Fig. 13-8. bars 119-120, *Double Helix*]

At the end of the piece, I also used the scale from the second section with faster harmonics, but both my supervisor and Chaya Czernowin have suggested that the use of the scales in this section may need revision in order to maintain the energy of the music.

During sessions with Michael Schmid we found some problems with the multiphonics; some did not sound as notated and so he reinforced the sound with his voice. I used the voice to create interference between two notes and to create contrasts between the use of a loud and soft voice. I also added some additional passages using the voice in contrary motion to the main scales in the final sections.



[Fig. 13-9. bars 122-123, *Double Helix*]

Conclusion

This PhD submission has included various different types of compositional concepts drawn from natural phenomena, natural science, visual art and Japanese traditions. It was particularly during the writing of *Shade ←→ Light* that I began to consider compositional concepts more carefully, because in that piece I discovered how the underlying concept could inform many different aspects of the piece, such as the expanding pitch-structure, the use of complex rhythms in the middle section and the use of quarter-tones and sustained notes.

In *Sakura Variation* I used scordatura to create additional natural harmonic pitches. I also used playing techniques derived from Japanese traditional music, and based the use of quintuplet rhythms on the number of petals in a cherry blossom. Throughout the piece, most of the important notes are based on a traditional Japanese folk song. The string techniques would be developed in my subsequent string quartet.

In *Semi-Sigure* I wanted to recreate the sounds of scattered cicadas, and the musical materials came from the recordings of cicadas. The piece is like a set of variations because, although I used ten types of cicadas with different voices, the sound of each cicada tended to be similar. As a result my original plan to organise the sounds according to the sequence of seasons was modified to allow me to treat materials more freely.

These above concepts encouraged me both to be more imaginative and to derive compositional rules, based on underlying concepts, for choosing notes and musical materials. On the other hand, the rules were sometimes restrictive - for example, the use of scales in the alto flute duo *Sa-Ku-Ra* and the string quartet *Crystallization* - and I had to find other strategies to refresh my imagination. Nevertheless, finding concepts which can connect with musical materials remain important for me.

Through the thirteen pieces, I feel my ability to create varied and colourful sounds has improved, particularly through the use of extended instrumental techniques. I enjoy the contrast between overtones and contrary motion scales and feel this was especially successful in the final piece, *The Butterfly Effect*, where the use of spectral string sounds not only sounds interesting but also relates effectively to the concept.

Most of my pieces have achieved premieres and subsequent performances from performers who include the London Contemporary Orchestra, members of the BBC Scottish Symphony Orchestra, Anton Lukoszevieze, Catherine Pluygers and Alan Tomlinson, the Studio New Ensemble, the Arditti String Quartet, Spirituoso, EXAUDI, the International Composer Pyramid Ensemble, the BBC Symphony Orchestra, duo DorT, the Ensemble Linea and Michael Schmid, and one of my pieces, *Crystallization,* has been performed by different string quartets in

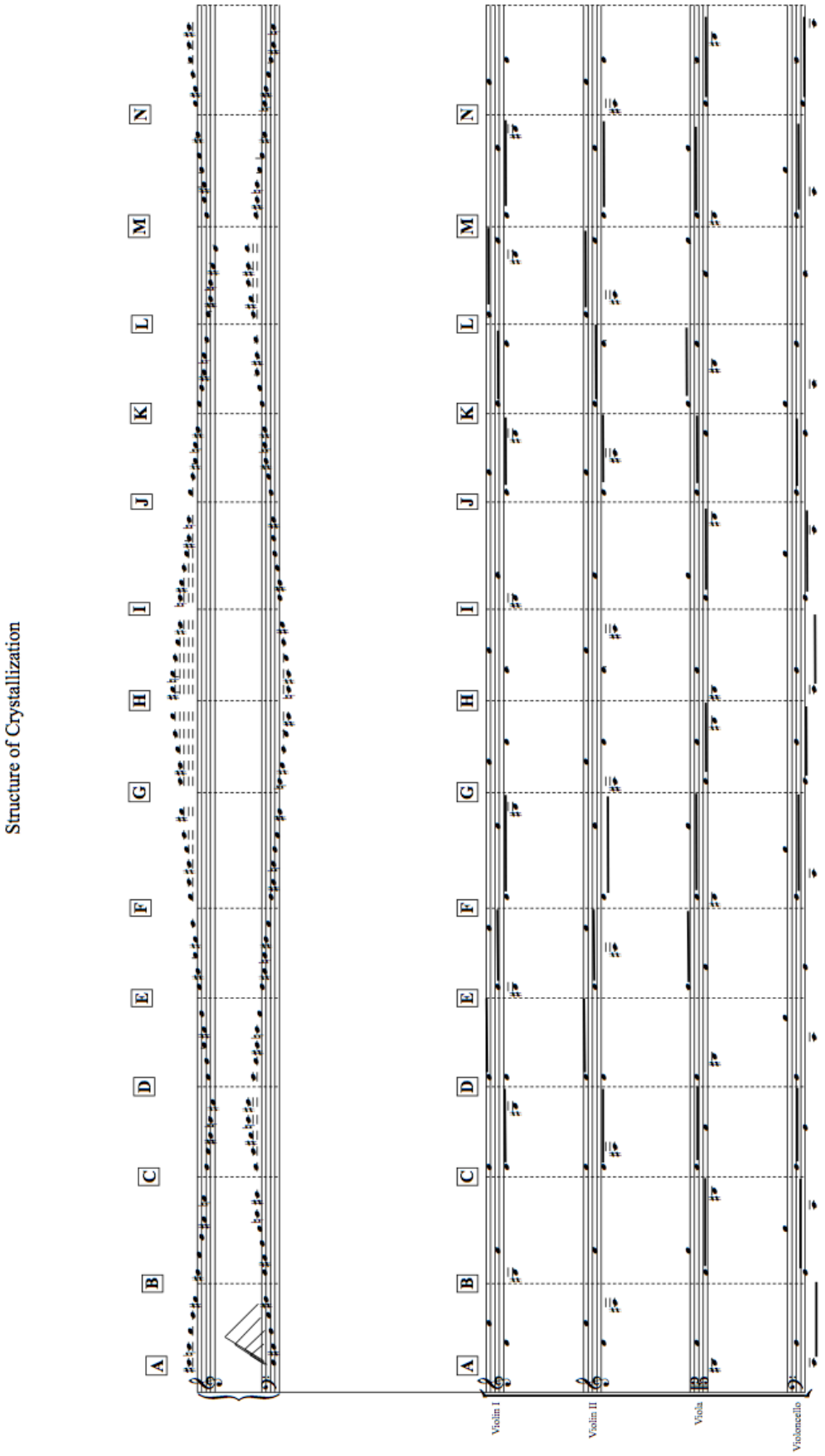
Moscow and London. I hope to have more performances in the future, but I have come to realise that, in using extended instrumental techniques, that I need to work with specialist new music performers. On a few occasions I have changed notations in response to requests from performers, but I am not comfortable with this.

I have always been interested in reading books and articles about topics beyond music and this has informed my choice of musical concepts. I am now interested in exploring ways in which a concept such as that in a *The Butterfly Effect* might be realised through algorithmic composition, and I also now want to investigate software which would be helpful during the creative process. In the future I also want to develop durational control in my composition, both from note to note and at a large structural level. I want to develop the contrast between simpler and more complex materials, in part, as I explained in the *Introduction*, in response to the work of composers such as Brian Ferneyhough, Michel Finnissy and James Dillon. I want to create music which expresses energy and excitement rather than just embodying an abstract schema, music with a real emotional impact realised through complex musical techniques.

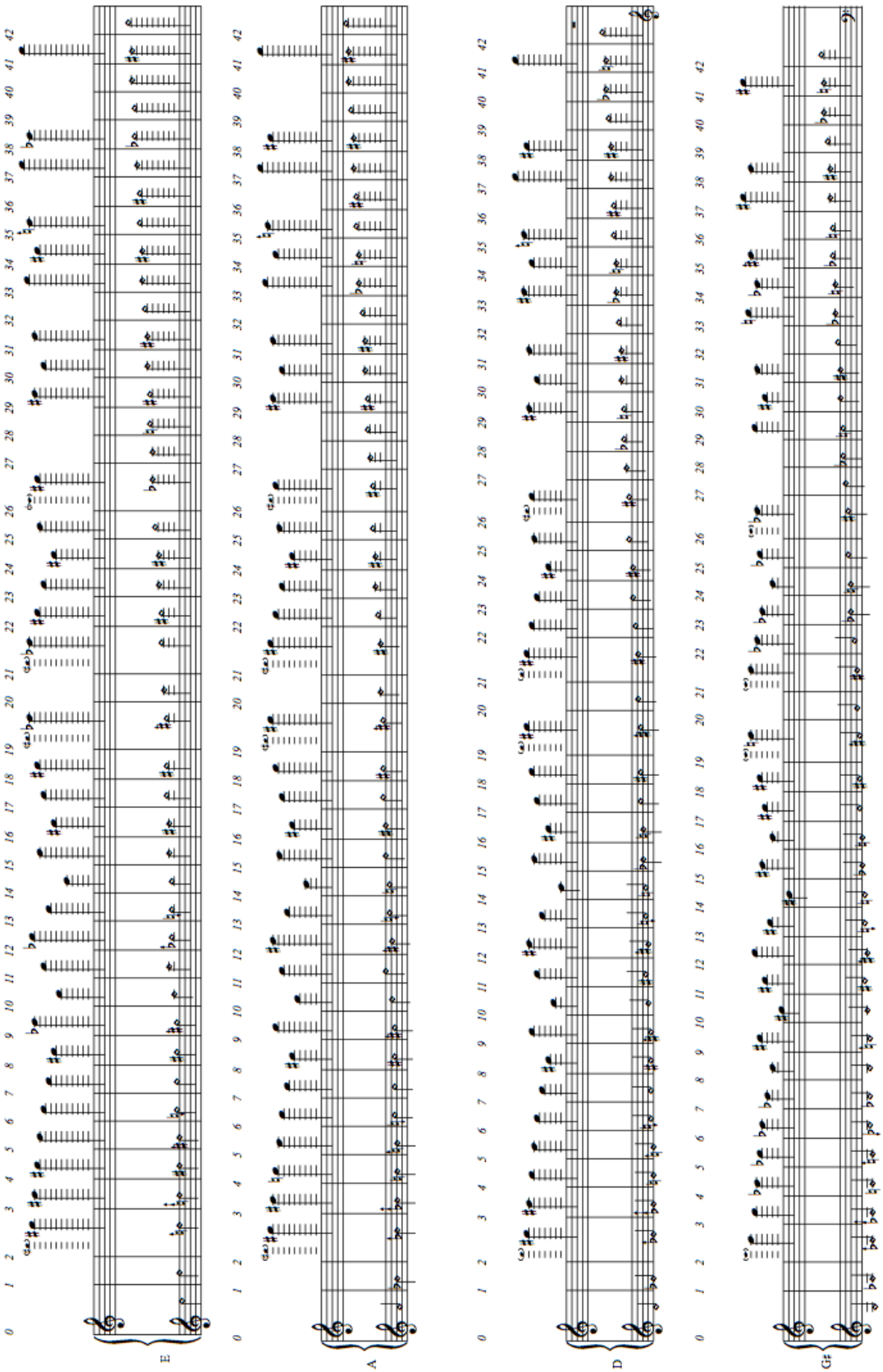
Yuko Ohara

September 2012

Musical Examples



[Example I, structure of *Crystallization*]



[Example II, harmonics of Violin, *Crystallization*]

Bibliography

Birtwistle, Harrison, *Clarinet Quintet,* Universal Edition, 1981.

Blatter, Alfread. *Instrumentation and Orchestration*, Second Edition, Schirmer Thomson Learmimg,1977.

Dillon, James, *Sgothan,* Hinrichsen Edition, Peters Edition Ltd., London. 1985.

Hespos, Has-Joachim, *Gelb*, hespos D27777 ganderkesee. verlagsnummer: H004 E, 1979.

Harvey, Jonathan, *String Quartet*, Faber Music Limited, 1977.

Inglefield, Ruth K. and Neill, Anne, *Writing for the pedal harp A Standardized Manual for Composers and Harpists,* Vanderbilt Music Company, The Second Edition, 2006

Glieick, James, *Chaos*, Published by Vintage. 1998.

Griséy, Gerard, *Periodes*, *Periodes per sette strumenti,* by BMG Ricordi Music Publishing S.p.A., 1974.

Lachenmann, Helmut, *Sakura Variation,* Breitkof & Härtel, 2000.

Levine, Carin, Christina Mitropoulos-Bott *The Techniques of Flute Playing,* Bärenreiter-Verlag Karl Vötterle GmbH & Co., 2002.

----------*The Techniques of Flute Playing II, Piccolo, Alto and Bass Flute,* Barenreiter-Verlag Karl Votterle GmbH & Co., 2004.

Macmillan, James, *Tuireadh* 1992, 1996 by Boosey & Hawkes Music Publishers Ltd.

Nicolet, Aurele, *Promusica Nova, Studies for Playing Avant-Garde Music for Flute*, Breitkopf & Härtel.

Nierhaus, Gerhard, *Algorithmic Composition-Paradigms of Automated Music Generation*, Springer-Verlag/ Wien printed in Germany., 2009.

Rehfeldt, Phillip, *New Directions for Clarinet,* 1994 Second edition published by University of California Press Reissued by Scarecrow Press, 2003.

Solomon, Samuel Z, *How to Write for Percussion, a comprehensive guide to percussion composition*, Samuel Z Solomon, 2002.

Sethares, William A., *Tuning, Timbre, Spectrum, Scale,* second edition 2005.

Smeyers, David, Beate Zelinsky, *Pro Musica Nova Studies for playing Contemporary Music for Clarinet*, Breitkopf & Hartel, Wiesbaden,1996.

Strange, Patricia and Allen Strange, *The Contemporary Violin – Extended performance Techniques,* University California, Ltd., 2001.

Veale, Peter, *The Techniques of Oboe Playing,* Bärenreiter-Verlag Karl Vötterle GmbH & Co.1994.

Wishart, Trevor, *On Sonic Art*, A New and Revised Edition Edited by Simon Emmerson, Taylor & Francis Group, LLC, 1996.

Xenakis, Ianiss, *Nuits pour douze voix mixtes,* editioned by Salabert in September 1999.