# WAYS OF INTEGRATING MUSICAL SYSTEMS:

# A PORTFOLIO OF COMPOSITIONS

by

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## Abstract

This portfolio comprises three compositions which chart the development of a unique method of integrating systems of organisation pertaining specifically to pitch and rhythm, with both small-scale and large-scale applications. An overview of the general principles behind these techniques is given, explaining their historical and scientific context. Detailed analysis, for the most part with reference to the latest two pieces, provides insight into the more complicated aspects of organisation, beginning with the creation of topographical pitch systems. Intervallic relationships are then extended to the field of rhythm by means of the harmonic series as an absolute reference point defining frequency ratios. By examining (theoretically) the interaction of combinations of different frequencies, new ways of defining and even quantifying consonance and dissonance are developed. This is followed by the extension of the technique to structural organisation. Explanation of approaches to timbre and texture are also given, and finally a wide range of influences, from throughout the canon of Western art music, are acknowledged and examined.

# Table of Contents

# List of Compositions

## Main Works:

| | |
|---|---|
| ***Orbis Mentis*** c. 15' (March 2008) | flute (doubling piccolo), oboe, clarinet, bassoon, horn, trumpet, trombone, 2 percussionists, piano, harp, 2 violins, viola, violoncello, double bass<br><br>Recorded by Birmingham Contemporary Music Group, conducted by Peter Wiegold, at the CBSO Centre, May 2008 |
| ***Awakening*** c. 7' (January 2009) | 2 pianos, harp and 2 percussionists<br><br>Performed and recorded by New Music Ensemble, conducted by Lee Differ, at the CBSO Centre, March 2009 |
| ***Ad Astra*** c. 10' (June 2009) | large string orchestra<br><br>Performed and recorded by Birmingham Philharmonic Orchestra, conducted by Michael Lloyd, at the Adrian Boult Hall, September 2009 |

## Appendix:

| | |
|---|---|
| ***Church Bells*** c. 10' (September 2007) | piano solo |

*N.B. Whilst the recordings of* Orbis Mentis *and* Church Bells *are, on the whole, accurate reflections of my intentions, those of* Ad Astra *and* Awakening *are not performance standard, but are included for reference purposes only.*

# List of Figures

# Ways of Integrating Musical Systems: A Portfolio of Compositions Commentary

## Introduction

The three pieces that comprise this portfolio represent the evolution of a set of ideas concerning the organisation of musical elements, the relationships between them, and the construction of pieces following on from these first two considerations. In this post-tonal era there have probably never been more widely diverging opinions on these matters; my approach, however, stands firmly on the shoulders of the Western art music tradition.

The principles of the tonal system are not dispensed with, but reinterpreted, extrapolated and reapplied; the fact that they have served Western art music for so long is evidence enough that these principles have a more universal value beyond the context of a particular era and location. The most general of these principles is that of motion, which is possible because of the functional harmonic system, which generates a metaphysical three-dimensional space; this facilitates motion from one area to another. Whilst the demise of tonality opened the way to exploration of stasis in music (not least by borrowing meditative Eastern musical features such as pedals/drones and ostinati), there are of course many ways of maintaining motion within the general context of atonality. The quandary posed by the disintegration of the long-established tonal system has yielded many results, from improvisatory/aleatoric music to music which is hyper-organised to the point where the composer is himself a slave of his systems and cannot make free choices within them. Systems of organisation are important in order to generate some form of logic in the music, but here they only provide the framework within which the music can take place; details are always freely chosen and combined. My primary concern has been finding ways of organising pitch, rhythm and structure into coherent, mutually supportive systems with their own logic, yet which is at least partially aurally discernible.

My search for unification and integration of what have been considered separate musical elements began with applying one underlying organisational principle to several levels and to different parameters, and later became the derivation of rhythm/duration and structure from pitch systems, reaching such close relationships between horizontal and vertical aspects that indeed they can be considered to be the same phenomenon on different levels.

All my pitch systems involve a hierarchy in some way; thus different pitches have certain roles, as in tonal music. Over the course of the compilation of this portfolio, the focus formerly afforded to pitch classes in the tonal system has shifted to register-specific pitches as a result of

the use of non-octaving scales. Register has become increasingly important, as has the role of intervals and their manipulation.

The systems do not govern the content of the music, but provide the space in which the drama takes place. Unlike the almost universally known tonal system, contemporary systems vary from piece to piece and no prior knowledge on the part of the listener can be assumed. Consequently I have found it necessary to spend the first section of a piece outlining the system in which it takes place, much in the way that a nineteenth century sonata structure establishes tonality and subject matter in the exposition, before the 'drama' takes place in the development. (It is also pertinent that early sonata-form put more emphasis on establishing tonal areas than on motivic and thematic material, which only later superseded tonal area in importance, eventually eclipsing it completely). The sonata principle is itself also important to my music. That the participating subjects contrast is inherent to the principle of motion, but more often than not, they are different derivations from the same source, a surface distinction which is removed during the course of the piece.

In tandem with principles borrowed from the tonal tradition, I have also employed a scientific approach to musical organisation, for which the harmonic series is a particularly important resource in quantifying dissonance and providing frequency ratios of intervals. By considering the behaviour of interacting pitches, new ways of thinking about harmony, rhythm, texture and structure can be developed. Actual scientific study of sound is not utilised, but rather concepts from theoretical acoustic behaviour are combined with more traditional methods of working.

## Pitch Systems

To expound upon this overview, it is useful to give primary consideration to pitch organisation, which, always of importance, comes to dominate the conception of a piece in my latest work. *Orbis Mentis* derives all systems of organisation from a number sequence, 21312132, beyond which there is no further relationship as each aspect was developed separately; pitches are organised into modes by considering each number of the sequence as a number of semitones. A series of small intervals is produced, which gives a non-octaving scale of pitches. From rotations of this series, portions adding up to 12 were selected to form modes, since they fit inside an octave. The hierarchy of this system is most basic; each mode contains a 'final' which acts like a tonic, and is therefore of elevated importance. Different modes are used in different sections, corresponding to different keys used in tonality. However, greater variety is produced by these modes because, in addition to moving onto different pitch levels, each has a different characteristic pattern of intervals, whose range extends to minor thirds as well as tones and semitones. Naturally they are all related because they derive from a common source, and portions that are similar in juxtaposed modes are utilised for the purpose of 'modulation'. This system of modes, however, does not have the sophistication of later pitch systems which have a deeper relationship with tonal space as a whole. Its major weakness is the lack of overall systematic harmonic organisation, since, just as the horizontal choice of pitches is free within the mode, so is the vertical; whilst within modes, the triadic characteristics/relationships form a coherent system, across modes there is a lack of continuity. Thematic material makes free use of the pitches available, necessarily displaying the intervallic characteristics of the prevailing mode, but is otherwise unrelated to the pitch system.

Pitch systems and thematic material become increasingly interrelated throughout my output. This is partly owing to the increasing necessity of describing the tonal space in which a piece takes place, and partly because of the increased sophistication of pitch systems in operation which allow greater variety of meaning/function to be attributed to pitches.

The system employed in *Awakening* is a register-specific arrangement of pitches derived from the Fibonacci sequence. It spans out from a central pitch, E, progressing again by realising each figure as a number of semitones, both ascending and descending. Thus the primary interval sequence in both directions produces the following pitches:

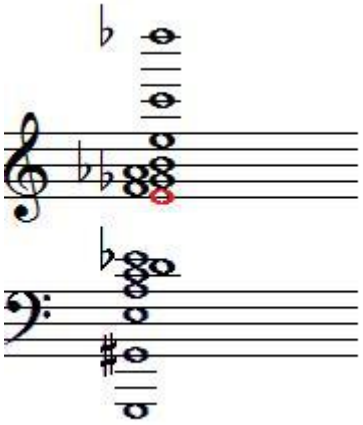
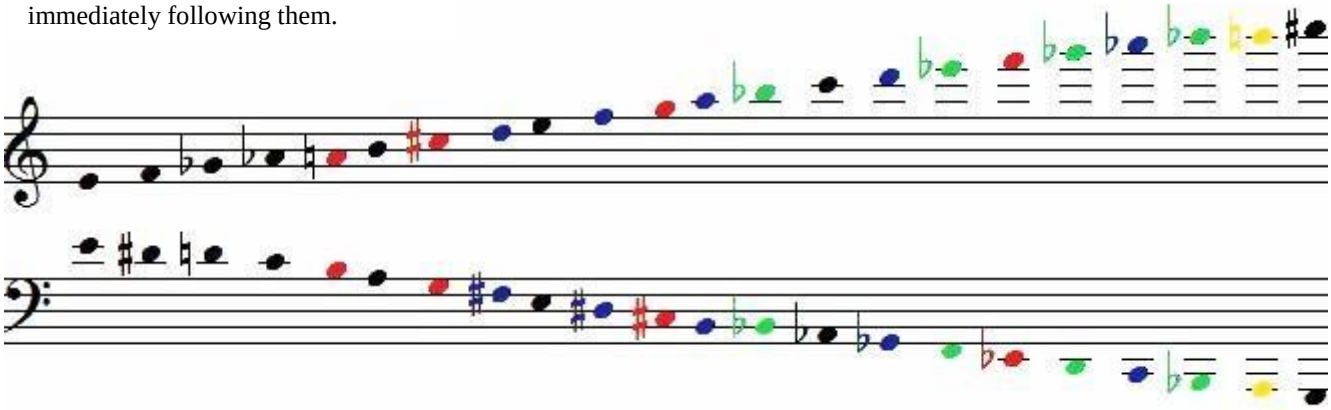


Fig. 1: Primary pitches in the pitch system of *Awakening*. Accidentals only apply to the pitches immediately following them; natural signs in other octaves are omitted for greater clarity. The central 'mirror line' pitch is highlighted.

These pitches constitute the primary pitches, which form the skeleton of melodic and harmonic language. If each interval is divided into its two constituent intervals (those preceding), a sequence of secondary pitches is produced. By dividing again, a sequence of tertiary pitches is produced, and so on and so forth, until a series of tones and semitones is reached:

Fig. 2: Pitch System of *Awakening*. Accidentals only apply to the pitches immediately following them.



Black = Primary pitches
Red = Secondary pitches
Blue = Tertiary pitches
Green = Fourth set of pitches
Yellow = Fifth set of pitches

This overall pattern, which is vertically symmetrical, thus produces a concentration of primary pitches in the centre which spread further and further apart as it extends outwards. This complex hierarchy generates a detailed and register-specific topography. The evolution of the pitch system is reflected in the opening section of the piece, beginning with an exchange of semitones in the piano parts. The semitone is both the smallest interval (found in the equal-temperament tuning system) and the most dissonant (a topic in its own right); here it acts as a tiny event which sets the whole piece into motion, from which pitch and rhythm grow organically. As the range extends, the primary intervals are always described first, and are then 'filled-in' by the

secondary, tertiary, etc. pitches. Inverting around a central pitch creates a tonal opposition, providing a force for motion in the system; this is clearly articulated by the inverse symmetrical developments either side of the 'mirror line'. Coincidently, the triadic features of the primary chords above and below the central pitch are E major and A minor respectively, which would in the tonal system also form a natural opposition in the form of a dominant and tonic respectively. In *Awakening* however, it is the top chord, the 'E major' which acts as a 'tonic', with the inverse in an undermining role. Modulation is effected by moving the centre point of the system around, always by primary intervals so that sequences of pitches common to the current and the next level can be used as 'pivotal' sequences, as in *Orbis Mentis*.

*Ad Astra* is also based on a register-specific multi-layered hierarchical system; the components can be interpreted more fluidly, however. At the focal point of the piece is a hugely dissonant chord spanning the whole range, which is made up of thirds in the repeating sequence minor-minor-major. The high degree of symmetry in this arrangement makes it possible to be interpreted as an aggregate of half-diminished ('Tristan') chords, of dominant seventh chords, or of overlapping dominant ninth chords. The multiplicity of constituent patterns is condensed to the opposition of the half-diminished aspect and the dominant-seventh aspect of the dominant-ninth 'whole'. The roots of each chord/level from both aspects are as follows:

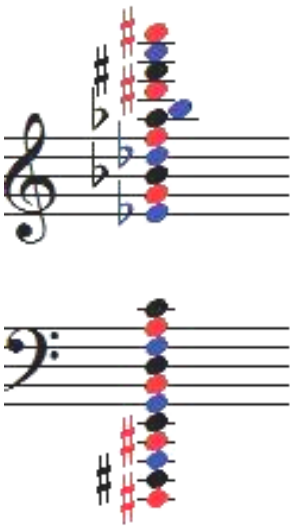
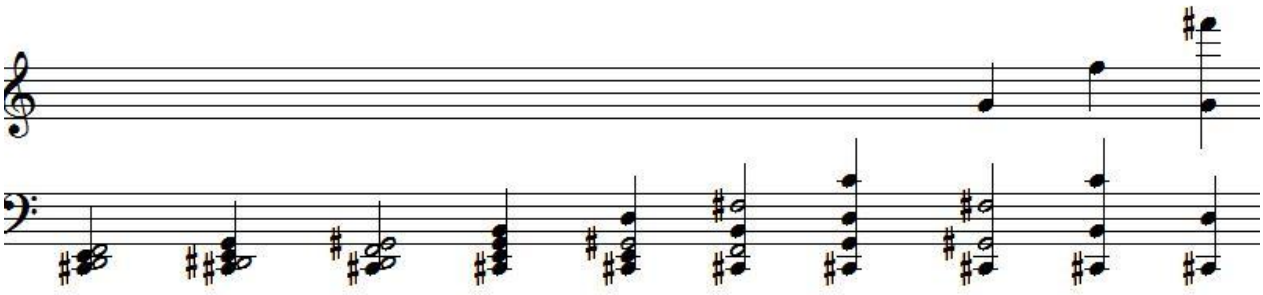


Fig. 3: Focal chord of *Ad Astra*. Roots of the half-diminished chords are shown in red; roots of the dominant seventh chords are shown in blue. (Non-root pitches in either interpretation are 'secondary' pitches.) Accidentals only apply to the pitches immediately following them.

Again, opposition within the pitch system is created by inversion, but here the two arrangements are not different sets of pitches, but different interpretations of the same pitches. However, the opposition of the 'themes' pertaining to each is further defined by using predominantly the half-diminished version in the lower register and the dominant seventh version in the upper, 'artificially' giving register a functional role. These areas overlap in order that

gradual metamorphosis from one theme to the other can occur, in tandem with an overall gradual ascent in register. Thematic material is derived from intervallic rotations in both directions either side of each of the half-diminished and dominant seventh chords (in isolation of the aggregate chord). The resulting chord sequences are naturally inversions of each other, but this relationship is obscured by the way in which the themes are derived from them: whilst the first type of music is (relatively) freely rhythmicised and ordered register-specific pitch organisation, the second is rhythmically defined but freely arranged vertically to produce quasi-modal/tonal aggregates (see bars 46-51).

Fig. 4: Chord rotations of the half-diminished aspect on C#. The first four chords form the basis of the line in the cellos in bars 11-18; thereafter motives from the next four chords are hidden within the texture. Black notes denote pitches present in the focal chord, whereas white notes denote chromatic, or tertiary, pitches. (Accidentals only apply to the pitches immediately following them.)

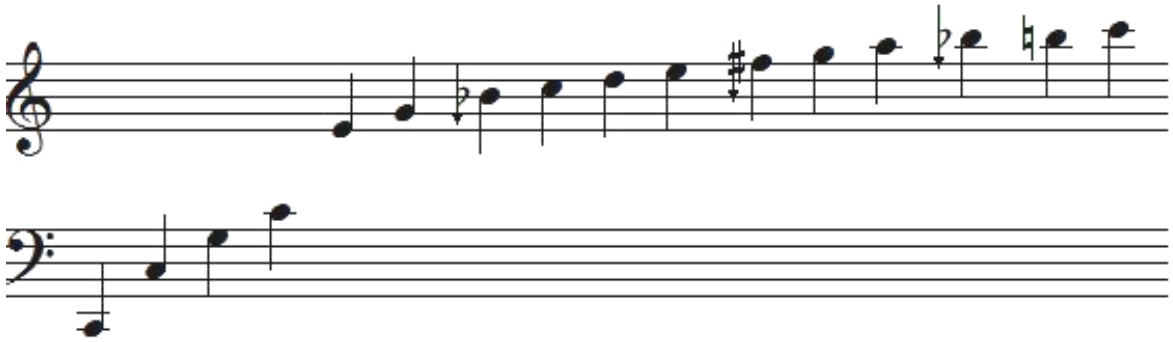


This sequence of intervallic rotations is produced by taking the previous chord, removing the first interval and adding the interval between the (previous) first and third pitches to the other end of the chord. The whole chord is then transposed to the same level as the first. Whilst the sequence derived from the half-diminished chord is built upwards, the other is built downwards, owing to the properties of those chords; it is not possible to extrapolate either of them backwards in the other direction. Beginning with the half-diminished aspect of the system, and thus the ascending sequence, the first section of *Ad Astra* opens up the tonal space from the bass.

## Rhythm from Pitch

The harmonic series plays an increasingly important role in my music as a means of defining consonance and dissonance, complementing other pitch systems in operation, whether in conjunction or in opposition. Consonance and dissonance have been central to music since venturing beyond monophony. They give music momentum; both must be present in a piece in order to reveal the other, and where two things exist in opposition, dialectic is created, which in turn generates motion. There exist well-established, if fluid, definitions of consonance and dissonance and rules of employment in the tonal tradition, but the two are relative places in a continuum. The harmonic series, as an absolute and scientific definition of pitch relationships, provides an 'order of consonance' of intervals (although this can only be applied with some approximation in equal-temperament). The basis for this lies in consideration of an interval as a frequency ratio rather than a number of semitones.

Fig. 5: The Harmonic Series.
Pitches are approximate.



Frequency ratio: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Given that pitch is produced by regular oscillations, it is clear that pitch depends on time and duration just as much as rhythm does. Therefore pitch can be considered as rhythm on a scale so minute that the human ear is not able to perceive the individual cycles; the overall effect is instead measured by secondary attributes that we refer to as harmony, timbre and texture. In a

consonant interval such as an octave, the cycles of the constituent pitches will frequently realign, as few cycles of each frequency are needed to complete the pattern[1]:

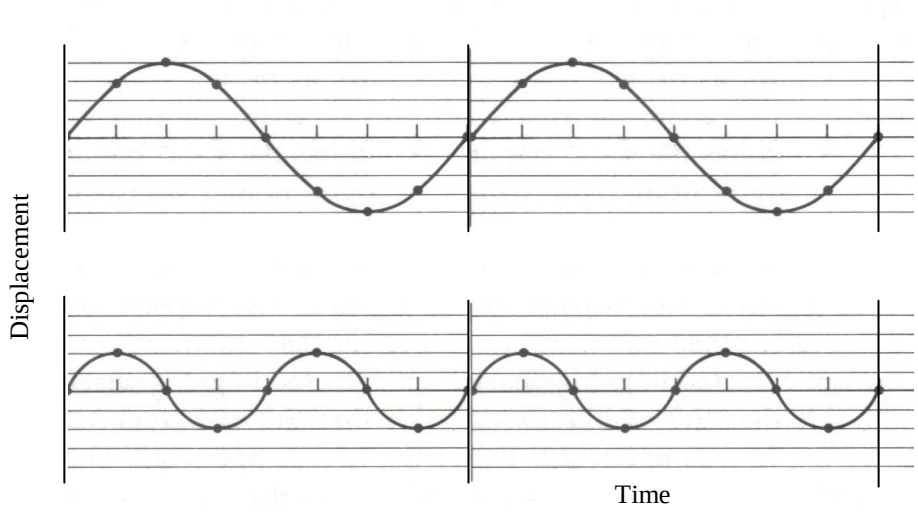



Fig. 6: Wave diagram for two waves of frequency ratio 1:2 (an octave). Vertical lines show points of realignment.

More complex frequency ratios take greater numbers of cycles to realign, producing more complicated resultant patterns. In a more dissonant interval such as a semitone, phasing between the constituent frequencies can be seen. With such similar frequencies, the resultant wave vibrates at a frequency equal to the average of the constituent frequencies, and the gradual phasing effect produces a slow pulsation of the amplitude, a phenomenon known as 'beats'.[2]

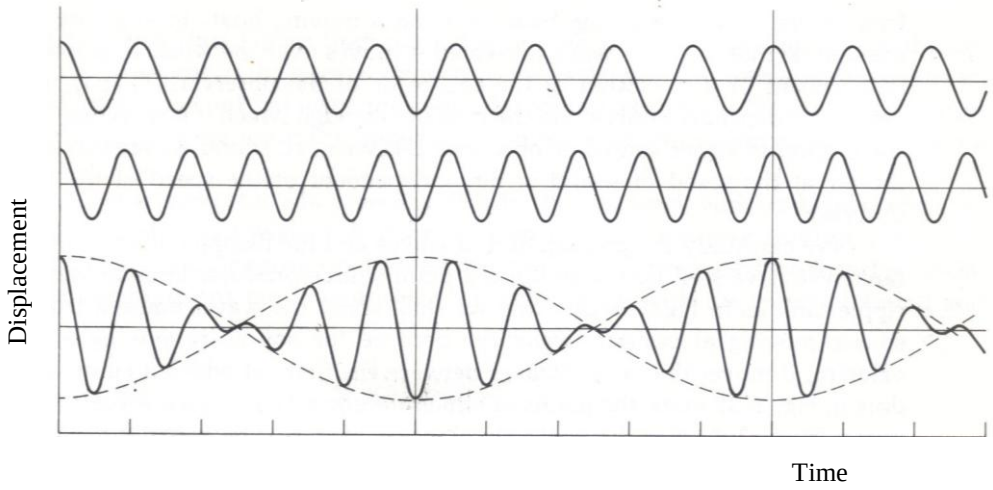
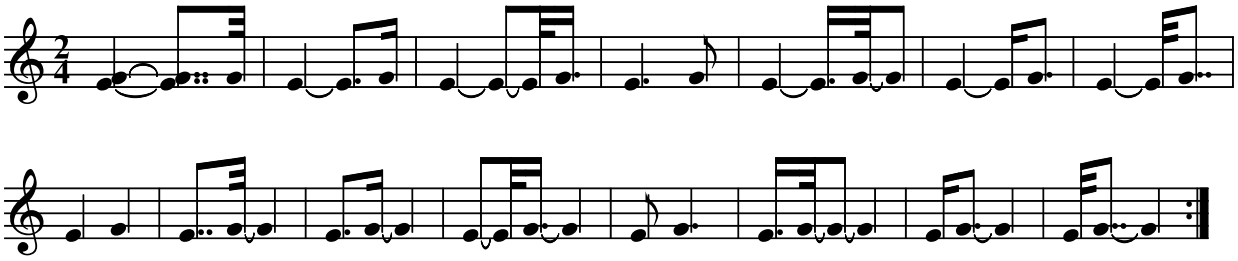



Fig. 7: Wave diagram for two waves of slightly different frequency (ratio 9:11) with their resultant pattern beneath.

[1] Diagram adapted from Richard Berg and David Stork, *The Physics of Sound* (New Jersey: Prentice-Hall, 1982), p. 49
[2] Ibid., p. 51

This latter effect distinguishes consonance from dissonance, and it can therefore be inferred from this that dissonance may be thought of as a rhythmic effect whereby constituents are slightly misaligned. If the oscillations are represented by pulses, the pattern can be notated conventionally for ease of analysis. The choice of rhythmic values is arbitrary, since it is only the proportion that matters; however it is useful to base patterns on the same sub-unit if they are to be compared.

Fig. 8: Sonority rhythm of a semitone. The frequencies of E and F are in the ratio 15:16, which means their durations are in the ratio 16:15. The sub-unit used here is the demisemiquaver.



I have termed these rhythmic patterns 'sonority rhythms', i.e. the rhythms of the sound. They quickly become very intricate as ratios become more complex or multiple ratios are used, providing an extensive rhythmic resource intrinsically related to the pitch material. This solves the problem of the unsatisfactorily arbitrary relationship that arises between pitch and rhythm when they are treated as they are in *Orbis Mentis*. Greater connections can be made between these properties by taking into account the fact that frequency increases on a logarithmic scale, whereas duration increases on a linear scale. *Awakening* and *Ad Astra* therefore base much of their rhythmic aspect on sonority rhythms pertaining to their respective pitch systems. In all three pieces, resources are used in a free manner; pitch sequences and rhythms are combined according to desired effect rather than by any form of serialisation, calculation or stochastic methods. This organic and flexible way of working allows for a great deal of creativity whilst ensuring that all aspects are related.

The effect of sonority rhythms varies with tempo, as at one extreme they are chords and at the other they are distinct rhythmic patterns, and in between they may be discernable as layers of regular pulsations at different speeds. Composite rhythms and layered patterns/textures have always been an interest (see appendix), and the extension of this phenomenon manifests itself neatly in the opening of *Awakening*. As previously mentioned, the pianos begin with an

exchange of semitones. The initial chord resonates in magnified form in the vibraphone and marimba, which use the same pitches repeatedly struck in the associated sonority rhythm at a tempo appropriate to the perception of the coexistence of differing rates of pulsation. This pitch/rhythm is further magnified in its application to the timing of the actual piano chords themselves (piano 2 gradually responds sooner and sooner after piano 1). As more intervals are introduced, the composite patterns follow them, until all the rhythms of the primary intervals have been presented. These patterns are then used in more expanded forms throughout the piece to determine rhythms of melodic lines, points of interjection and frameworks of more intricate lines. Relationship to metre is still free, and patterns do not necessarily start at a synchronised point, nor proceed the whole way through the cycle.

Once three or more pitches are involved in calculating sonority rhythms, the patterns become quite extensive and complex. The number of cycles a pattern takes to reach where it started gives some indication of the degree of dissonance in a chord. However, since the cycles pertain to the pitches themselves, and vary accordingly, it is easier to judge the relative dissonance of different patterns by considering the total number of 'sub-units' required to complete the pattern. Herein lies the potential to quantify the dissonance or consonance of a chord.

## Structure

Whilst sonority rhythms dominate the rhythmic details of *Awakening*, the structure is independent of them, comprising three sections which grow out of the nature of the pitch system. The first section defines the tonal space, gradually extending the vertical range in a horizontal manner. As the climactic conclusion of this section is approached, individual notes become ever closer together and texture thickens, producing a gradual transition (performing the function of modulation) to a predominance of vertical concerns in the second section, which conflates motives into chords and builds a longer line from these chords. As these two sections may be seen to correspond to the exposition of a sonata movement, so might the third section be seen as a development, for it is defined by a lively development of the elements presented in the first two sections, building to a full-scale argument. It is in this section that the pitch system itself moves to different levels. However, the main source of opposition here actually arises from *within* the pitch system, and the 'defeat' of the inverse by the original is what draws the piece to a close, coming to rest on the rhythmically magnified primary chord in which the F natural is noticeably absent. It is this pitch which, when sounded with the E at the outset, provided the source of momentum for the piece through its dissonance. Note that here the lower register only supplies pitches which support the primary chord in terms of the harmonic series; it has been 'overcome' by the upper half of the system and moulded in support of it. Thus the Fibonacci sequence-derived system sets up dissonance, causing motion, and the harmonic series provides consonance, and hence a path to resolution. In the coda, these two systems combine, compromising to create a mutually satisfying pitch arrangement. The structure can therefore be seen to arise from the interaction of elements of the pitch system.

*Ad Astra* elevates sonority rhythms to structural levels. By spreading out the sonority rhythm of the dominant ninth chord over ten minutes, the position of climaxes, section boundaries and phrase architecture is predetermined according to sub-patterns within the cycle. In sonority rhythms of multiple intervals, intermediate points, where portions of the pitches present coincide, form a substructure, producing a hierarchy of points which has parallels with earlier described pitch systems. Thus in addition to five layers of pulsations present in this particular pattern, there are also eight layers of 'coincidence pulsations':

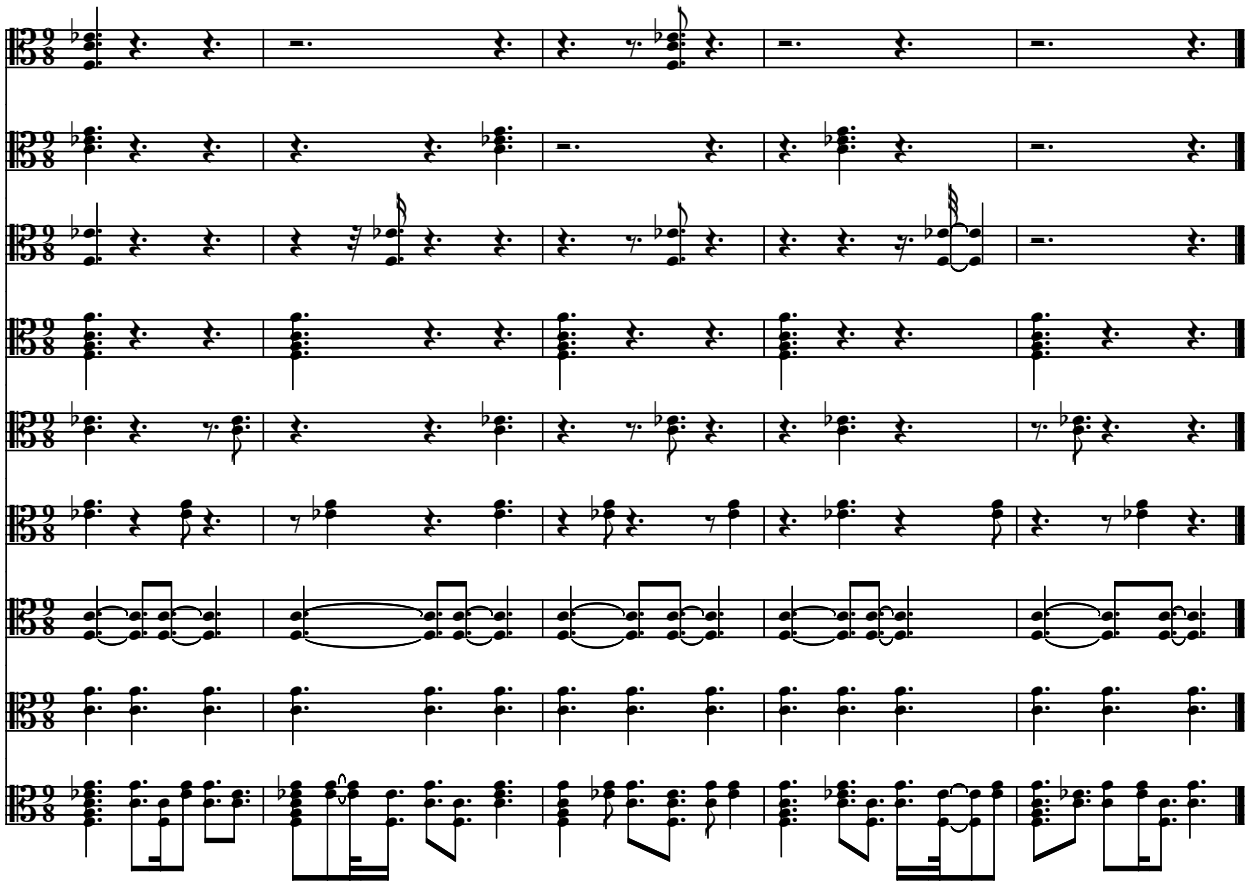


Fig. 9: The eight layers of sub-patterns found in the sonority rhythm of a dominant ninth chord. The resultant pattern of all coincidence pulses is shown on the bottom stave. Note that, with regard to non-retrogradable properties, it is only the attack points that have any importance; durations are an irrelevant necessity (much in the same way that in order to visualize a point, it must have magnitude).

The coincidence pulsation pattern is intricate enough in itself to be used in rhythmicising melodic line, and significantly shorter than the elaborate sonority rhythm of the dominant ninth chord; it is therefore preferable for use in the rhythmic detail of the piece. Notice that it is palindromic; this is a property common to all sonority rhythms. The individual patterns of coincidental points each have their own structural significance, in a hierarchy according to the number of pitches coinciding at that point. Thus points where four out of five pitches coincide correspond to climactic passages, points where three pitches coincide correspond to climaxes within passages of the second theme, and points where two pitches coincide define linear entries and subsections.

Other structural frameworks are overlaid with this, however. One is the division of the whole into three sections, in the ratio 3:3:4, the interval ratios of the half-diminished chord ascending, or the dominant seventh descending. These three sections present, develop and

conclude the material respectively. Another is the strategic position of important events in the unfolding of the discourse according to the golden ratio principle. Thus the main climax of the piece occurs around the golden section, and both the half golden section and the golden section of the golden section are consciously articulated. The point of symmetry (midpoint) is more subtly illustrated, falling on the climax of the second (central) appearance of the second theme.

These various structural plans sometimes coincide, and sometimes do not. The proximity of the climactic occurence of the climactic passage (the climax of the climaxes!) and the golden section (see fig. 10) not only extends the moment of tension but also parallels the behaviour of dissonant sonority rhythms, where points are slightly misaligned. If dissonance is (here) defined by the presence and frequency of beats (being greater where the frequency is lower), the pattern of beats itself may yield a general definition of the quality of dissonance. The loudest moment (greatest amplitude) in the wave cycle is where the peaks of the constituent waveforms coincide, and slightly either side of that point, where they almost coincide. Around the climax of *Ad Astra*, there occur two structural points which coincide (the beginning of the third section and a point where four pitches coincide) and another, the golden section, which happens slightly afterwards. Here I posit the concept of structural dissonance, which is nowhere more appropriate than at the climax, supporting the harmonic and rhythmic dissonance in the same passage.

Another element of disharmony on the structural level is found in the arrangement of musical material against the structural boundaries of the three main sections. These sections are marked, as mentioned previously, by the overall function of the musical content; the opening line gradually ascends through all the levels of the pitch system, describing the situation of the piece; the second section begins with the first full statement of the second musical idea and a heated discourse ensues; the final section is based on the retrograde inversion of the first section, which gives the impression of continuing in the same direction, yet with the opposite mood. Across these overall divisions, the two main ideas alternate according to the ‘points of coincidence’ structure.

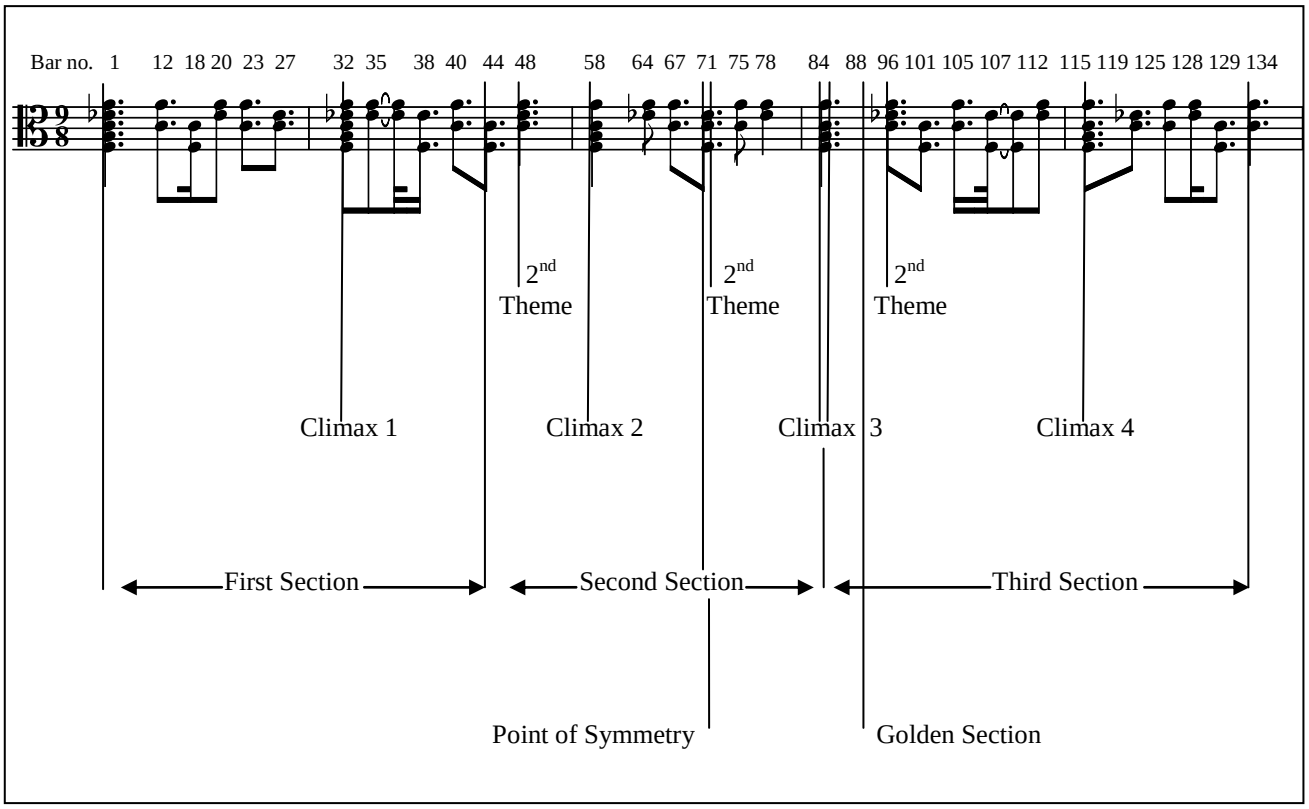



Fig. 10: Structure of *Ad Astra* as based on the coincidence pulsation pattern. Lines either side of a note-head refer to the same point.

Bars 115-8 contain the only passage in *Ad Astra* where sonority rhythms are directly used in a magnification role, as in *Awakening*; they serve to thicken the texture as well as obscure the beat, giving the impression of a fermata. The innocuous dominant ninth chord in bars 117-8 is of course the pattern from which the whole piece stems.

The coincidence pulsation pattern, as a derivation of the sonority rhythm, is also used to thicken the texture around the climactic points, but rather than single pulses, the individual units become small motives. The chords, being constructed from thirds as per the pitch system, are therefore not being magnified, using their own sonority rhythm, but artificially textured instead.

## Texture and Timbre

Just as pitch and rhythm can be seen as two extremes of the same phenomenon, texture and timbre can be considered as specific aspects of rhythm and harmony. There are limits on varying timbre as, depending on the instruments employed, it is often only variable in discreet units. Hence in *Orbis Mentis*, written for solo instruments of almost every kind, the timbral range is wide but links between instrumental timbres are harder to find; the timbre reflects the musical material in its colourful, abrupt juxtaposition. *Awakening* is more concerned with timbral exploration and attempts to link the (already similar) timbres by the use of extended piano techniques such as damping the strings[3] to produce a sound akin to the marimba and plucking the strings in the manner of a harp.[4] The high register of the piano is also linked to the vibraphone timbre.

A string ensemble has many more opportunities for gradation of timbre, and additionally texture can function as timbre because of the extraordinary ability of string instruments to blend together. Hence in *Ad Astra*, the full range of effects from harmonics, sordini, and sul tasto to sul ponticello, premuto and Bartók pizzicato is employed in order to provide a timbral dimension to an otherwise homogenous sound world. In fact, timbre is overtly functional in all three pieces; in *Orbis Mentis* and *Ad Astra* particular timbres are associated with particular musical ideas and moods, whilst in *Awakening* timbre aids differentiation of the roles of different layers in the texture. The pianos are the main protagonists, whilst the harp and percussion delineate turns of phrase, provide a commentary and grow out of the piano parts. Whilst the bulk of musical material is in the piano parts and the others are decorative and subsidiary to a degree, it would not be accurate to assert that the pianos constitute the foreground and the other parts, the background, for the harp and percussion parts sometimes act as foreground and sometimes as background, but never really fully as either.

Texture is at its most functional in *Awakening*, where it provides the most overt distinction between sections. It is less significant in *Orbis Mentis* despite the potential afforded by the ensemble, supporting the function of timbre but remaining most closely allied to the musical material itself, i.e. broken and abruptly juxtaposed. In *Ad Astra* texture functions in delineating the opposing musical ideas, as with timbre, but also most characteristically in illustrating structural high points.

[3] This did not happen properly in the performance recorded.
[4] This was omitted in the performance recorded.

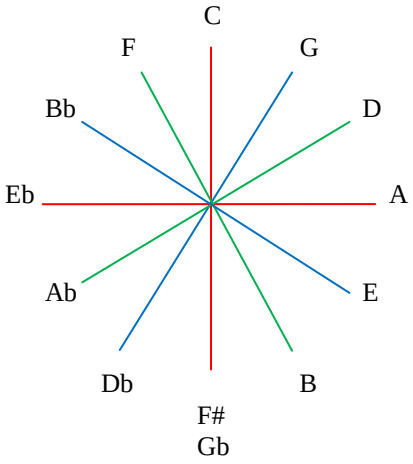
## Context

The ideas behind these three pieces draw inspiration from a wide range of influences from throughout the canon of Western art music, covering pitch systems, rhythmic organisation and structural foundations from both the tonal tradition and a range of twentieth century developments. Of primary concern were methods of organising pitch, avoiding recourse to the dodecaphonic technique, owing to its flattening out of harmonic space. Stravinsky's modal style is behind the derivation of the modes used in *Orbis Mentis*, whilst in places the triadic harmonies create a sound-world reminiscent of Messiaen. Both are reflected in the style of composition by block juxtaposition.

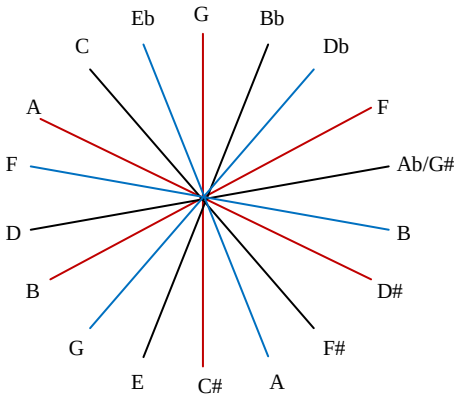
A greater source of inspiration for pitch organisation is found in Bartók's music. Whilst the Fibonacci chord of *Awakening* was derived from the method of intervallic rotations (essentially conflating the process into one non-transposed chord), the resulting Fibonacci pattern prompted investigation of Bartók's systems of organisation. The attraction of his pitch systems is that they use all twelve notes by extrapolating the principles of the tonal system: by extending the tonic, dominant and subdominant functions to all pitches via the circle of fifths. Thus he found a way of integrating all pitches into a system without renouncing functionality.

The focal chord in *Ad Astra* has its roots both in this aspect of Bartók's thinking and also in Mahlerian harmony. It is based on the extraordinarily dissonant chord that Mahler uses in his tenth symphony (e.g. first movement, bar 206), which consists of a dominant seventh chord plus two different 'Tristan' chords superimposed. This latter aspect, when extended over the whole range, produces a 'circle of thirds', which, when arranged in the same manner as the circle of fifths, produces the same tritonic oppositions and, indeed, three different axes. However, the nearest these axes come to Bartókian functionality is in the use of one axis as a tonic for one idea, and another axis as a tonic for the other idea. On lower levels a hierarchy is discernable but the functionality remains fluid.

Fig. 11: Comparison of Circle of Fifths and Circle of Thirds.




Bartók's Circle of Fifths.
Tonic axes are shown in red, Dominant in blue, and Subdominant in green.




Circle of Thirds from *Ad Astra*.
Tonic levels of half-diminished aspect shown in red;
Tonic levels of dominant seventh aspect shown in blue.

Late Mahler and late Beethoven have also had important influences on structure. *Ad Astra* draws on both in its episodic character, specifically the first movement of Mahler's Symphony no. 9 and the slow movement of Beethoven's String Quartet no. 15, both of which use double variation form. Whereas the themes in these pieces develop independently, the two themes in *Ad Astra* affect each other, in that first 'theme' gradually submits to the second, which takes over and 'converts' the first. Here a link can be seen with Brian Ferneyhough, who often employs 'two or more contrasted or innately contradictory elements [...] which engage in a process of transformation or erosion'.[5] Another similarity with Ferneyhough is found in the rhythmic aspect; just as sonority rhythms are created from the layering of regular pulses at different speeds, so are Ferneyhough's rhythms. The difference is that he produces rhythmic interest by removing some of the pulsations (and to my knowledge, he does not employ ratios of pulse speeds related to intervallic ratios), whereas my sonority rhythms are used at tempi slow enough to be distinguishable, the focus being on the patterns resulting from the superimposition.

Other structural influences include Mahler's use of a particular section of music to define structural boundaries in the finale of his sixth symphony; this formed the basis of the recurring climactic chords in *Ad Astra*, which occur at specific coincidental points in the structural rhythm. They divide the music solely according to this pattern, however, accentuating a structural precept

[5] Richard Toop, 'Ferneyhough, Brian', in *Oxford Music Online* http://www.oxfordmusiconline.com, (Accessed 6 April 2009)

apart from the larger structural design in operation. They are also integrated as a logical outcome of the surrounding music, rather than an abrupt interruption, thus functioning slightly differently.

The shadow of Boulez is clearly seen in the textures and instrumentation of *Awakening*; the influence of *Sur Incises* is especially strong. Aside from the employment of similar forces in similar roles, with a similar emphasis on timbral exploration, something of Boulez's relentless energy is also tangibly reflected. An important source of interest was the way in which Boulez developed the gestures of his piano piece *Incises* into a thirty-seven minute long composition involving nine instruments. Some of the general principles of his developmental methods found their way into *Ad Astra*, in particular the construction of larger phrases and sections from tiny gestures, or 'seeds'.[6] In *Sur Incises*, Boulez expands gestures from *Incises*, by (often varied) immediate repetition by other members of the ensemble, extending one gesture into several phrases constituting a section. Similar techniques can be found in *Ad Astra*, although there is less emphasis on gestures passing around the ensemble. Examples are ubiquitous; contrasting methods of employment of this device can be illustrated by comparison of bars 20-21 (cellos and violas), bar 35 and bars 42-3. However, the phrase construction in *Ad Astra* depends more on linking multiple *different* tiny gestures to form a longer line (each gesture corresponds to one of the members of the chord rotation series shown in fig. 4, page 6). The gestures purposely appear to grow out of each other in the opening bars (in part owing to their origin in the chord rotation series), but their development is more easily seen across phrases (for example compare the initial appearance of motives 1, 2 and 3 in bars 2, 3 and 4 respectively, and subsequent recurrences in bars 12 and 14 (cellos), 18-20 (cellos), 23-4 (violas) and 29-30 (second violins). As in *Sur Incises*, repetition is used both to insist (e.g. in climactic passages) and to fade away (e.g. bar 35). *Ad Astra* differs on the macro-scale however, by subverting this gestural detail to a larger, more remote structural framework.

A rather more unlikely influence is that of Mauricio Kagel, in particular his *Match* for two cellos and percussion. Whilst the idea of opposition within an ensemble has been around almost as long as ensembles have existed, the overtly theatrical aspect, referring to something outside the purely musical, caught my attention. A similar element of opposition is found in *Awakening*, where pianos I and II do not just embody the upper and lower aspects of the pitch system respectively, but are physically positioned opposite each other and engage in a musical duel. This is particularly apparent in bars 101-117. This utilisation of physical position and the spatial aspect of sound as functional, in support of the musical content, is further developed in *Ad Astra*:

[6] Pierre Boulez, *Eclat; Sur Incises*, Nieuw Ensemble; Soloists from Ensemble Intercontemporain, dir. Pierre Boulez; Film directed by Frank Schaeffer and Andy Sommer (Ideale Audience, DVD9DS15, 1994/2000), 'lesson'.

the two different ideas enter from opposite sides of the ensemble, and the gradual ascent and development of the main theme is coupled with an overall shift of focus from right to left across the ensemble. These spatial concerns draw on a characteristic of electroacoustic music, an even more remote influence.

One of the most important influences on my approach to composition is the work of Giacinto Scelsi and the spectralist composers, particularly Gérard Grisey and Tristan Murail. Their work effected a reconsideration of the nature of the elements of music, which we have so long considered to be wholly separate aspects, and their interrelationships. Whilst my music does not deal directly with sound spectra, several principles are borrowed, such as the consideration of the scientific activity behind music, the use of the harmonic series as an absolute reference point, and the quantification of the consonance or dissonance of pitch combinations. The spectralists make use of virtual fundamentals in defining and quantifying dissonance; this phenomenon is closely related to my own method, for a virtual fundamental is simply the frequency of a complete composite pattern, which is inversely proportional to the duration of the pattern; hence these two methods measure different properties of the same phenomenon. However, virtual fundamentals reflect the actual pitches of the constituents, not just the relationships between them, as the number of sub-units in a sonority rhythm does. This means that the same interval will give variable fundamental pitches according to which frequencies it uses, and so whilst useful in comparing intervals that contain one or more similar pitches, as an absolute measurement of a property of a relationship (or set of relationships), it has its shortcomings.

From this same perspective comes the recognition that harmony and timbre are aspects of the same phenomenon (which I have extended to pitch and rhythm). The richness and density of harmonies/textures in *Ad Astra* draws from this facet of spectralist music, whilst always remaining within the equal-tempered tuning system. More significantly, the scientific approach to pitch relationships provided the impetus to investigate sonority rhythms.

This reconsideration of pitch as a rhythmic phenomenon has strong parallels with Stockhausen's '21 octaves of musical time',[7] where he not only considers pitch as pulsed cycles, but, by using time as a common denominator, he places sound, rhythm and form on a continuum (much as, for example, X-rays, visible light and radio waves are all part of the electro-magnetic spectrum). Thus 'sound occurs when we perceive fast periods (between approximately 1/16000 and 1/16 of a second long), rhythm wherever we perceive moderate periods (between 1/16 and 8 seconds long) and form wherever we perceive slow periods (between about 4 seconds and 15

[7] Jonathan Cott (ed.), *Stockhausen: Conversations with the Composer* (London: Robson Books, 1974), p.189

minutes long)'.[8] Furthermore he notices that *each* of these 'sections' (not just pitch) can be divided in 7 or 8 octaves; that is, the ratio of each threshold to the one preceding is approximately 7 or 8 times the ratio 1:2, which therefore gives a range of approximately 21 octaves across the whole spectrum. *Ad Astra* does not go so far as to make particular quantitative links between different occurrences of the same pattern, since Stockhausen's theory was at the time of composition unknown to me. The objective was simply to use one pattern in all three areas, in an attempt to (covertly) unify what are usually thought of as separate parameters. In *Awakening*, the relationship between the pitches of the opening piano chords, the rhythm in the percussion and the rhythm of the piano chords is more easily apparent, at least on the score, but again these relationships are not specifically quantified (although their ratii can of course be calculated). Further work could be done in this area to investigate how such relationships could relate to Stockhausen's 'time octaves'.

[8] Karl Wörner, *Stockhausen: Life and Work* (London: Faber, 1973), trans. and ed. Bill Hopkins, p. 99

## Conclusion

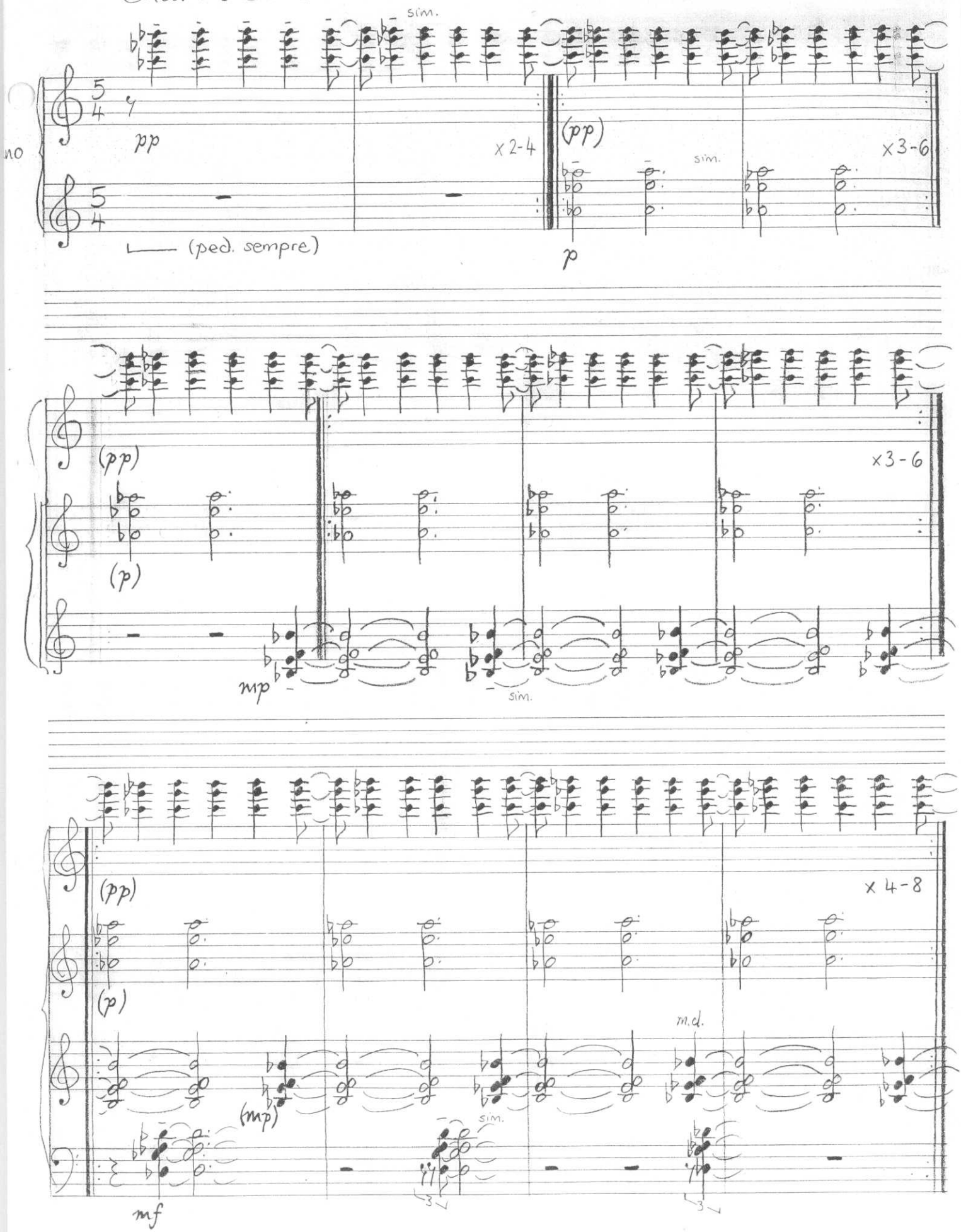
Despite certain systematic and scientific aspects, my music remains traditionally semantic and functional rather than phenomenological. Taking a scientific approach to pitch has not reduced music to a particular physical, acoustic activity, but has instead extended the creative resources available whilst continuing to strive for meaning in music via the phenomenon of harmonic space. There is much potential for further exploration of spectral techniques in conjunction with more traditional formal schema (rather than singular process), although it is important that all aspects of a piece are intrinsically related and mutually support each other, for without coherence, logic and meaning cannot be present (although this is perhaps largely irrelevant to the postmodern aesthetic). The three pieces of this portfolio explore ways in which musical elements can be moulded and organised without losing the overall dynamic of Western art music.

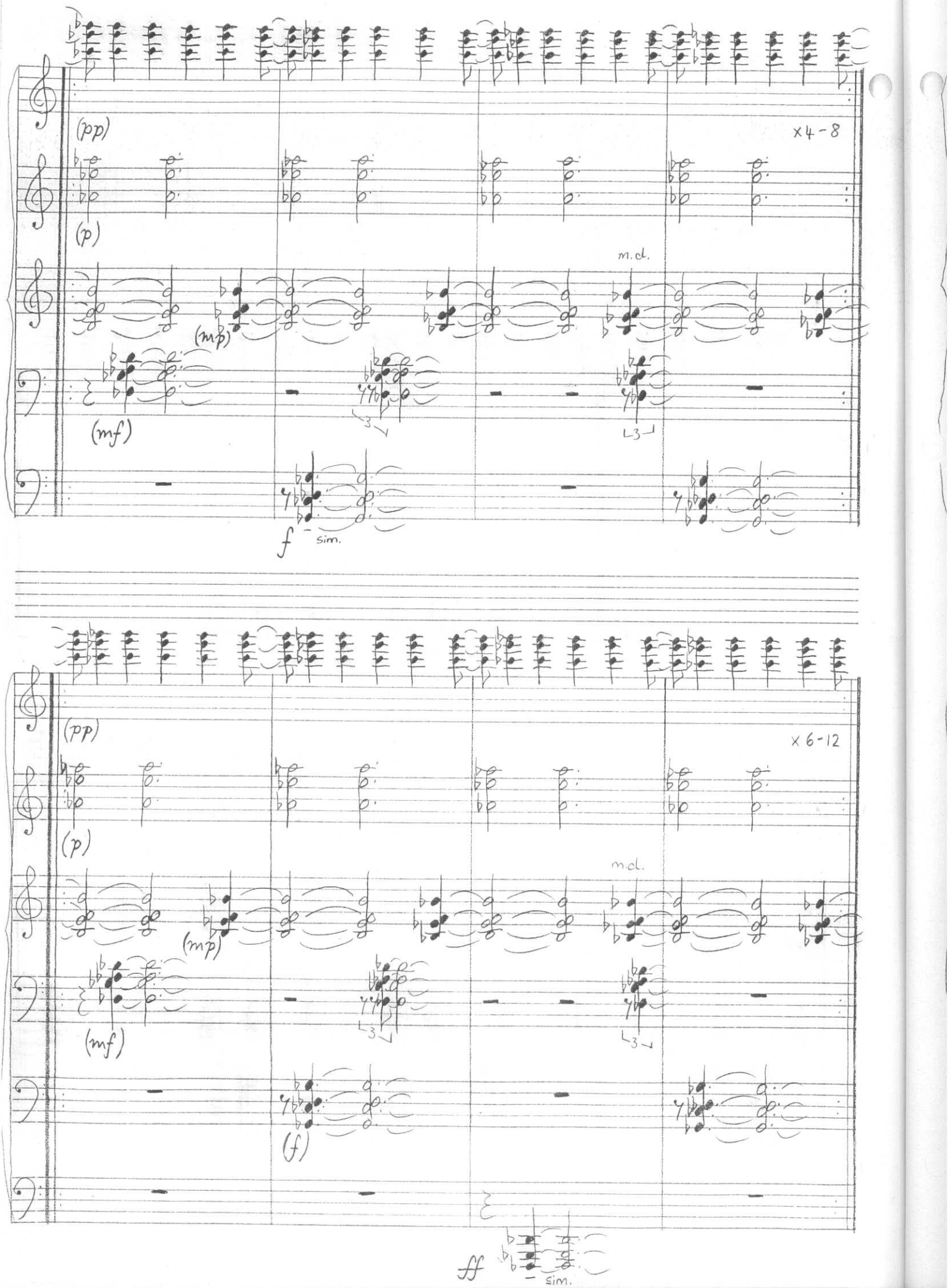
**Appendix**

- ***Church Bells*** (September 2007) for solo piano (see overleaf)

# Church Bells

OCTOBER 2007

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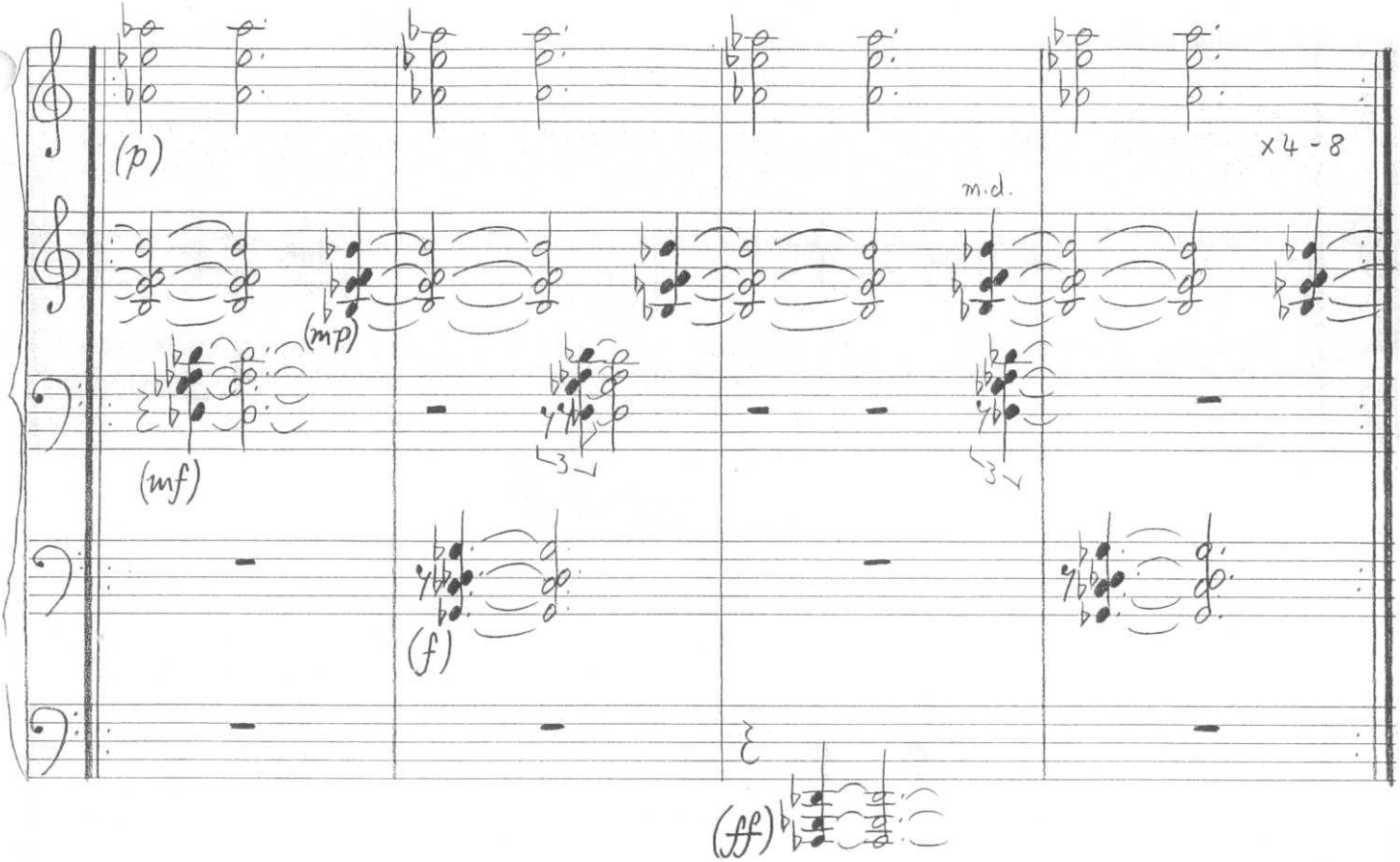
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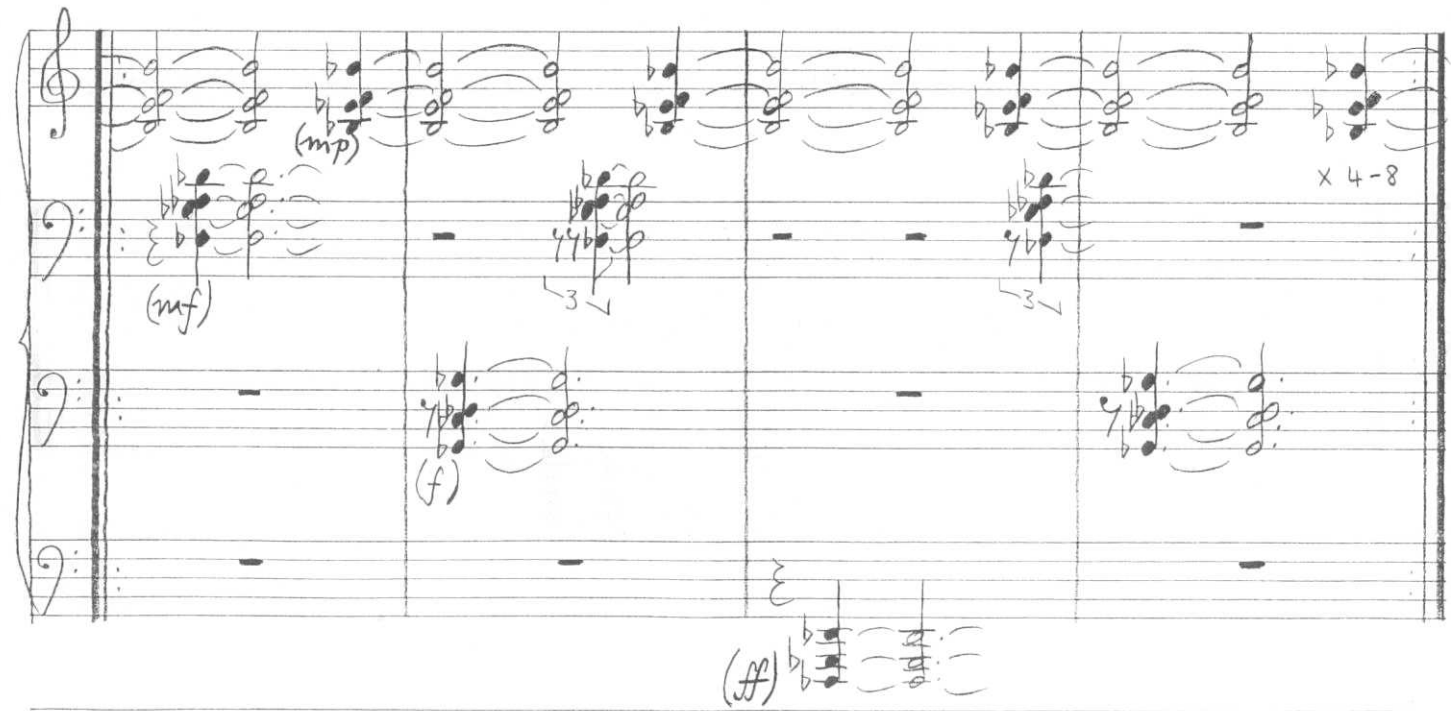
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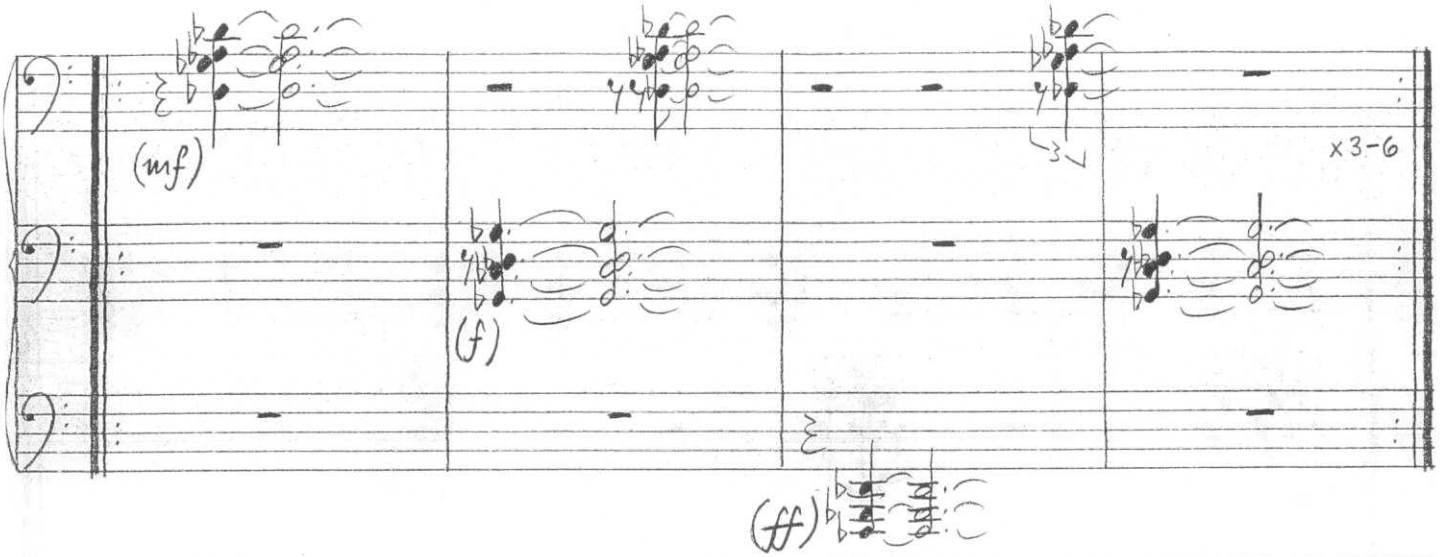
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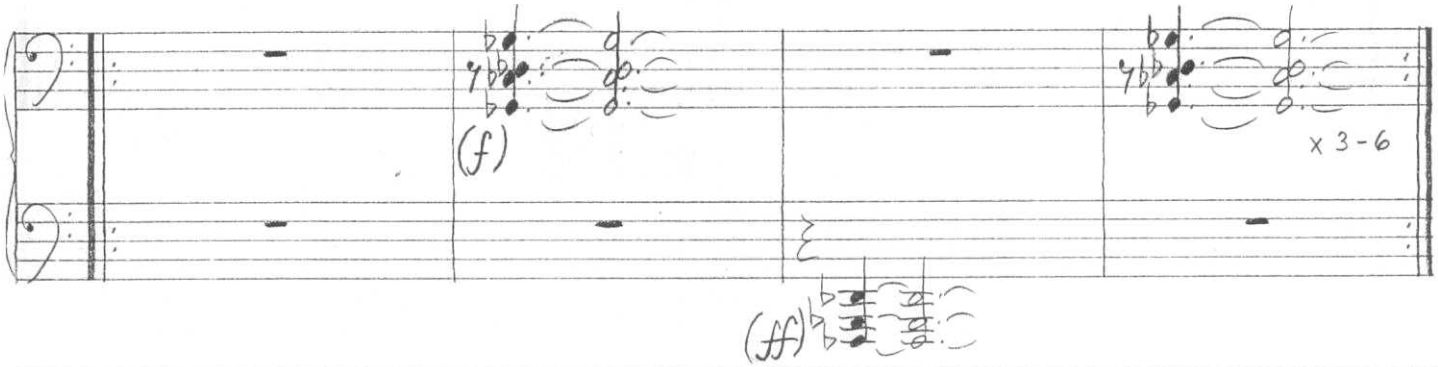
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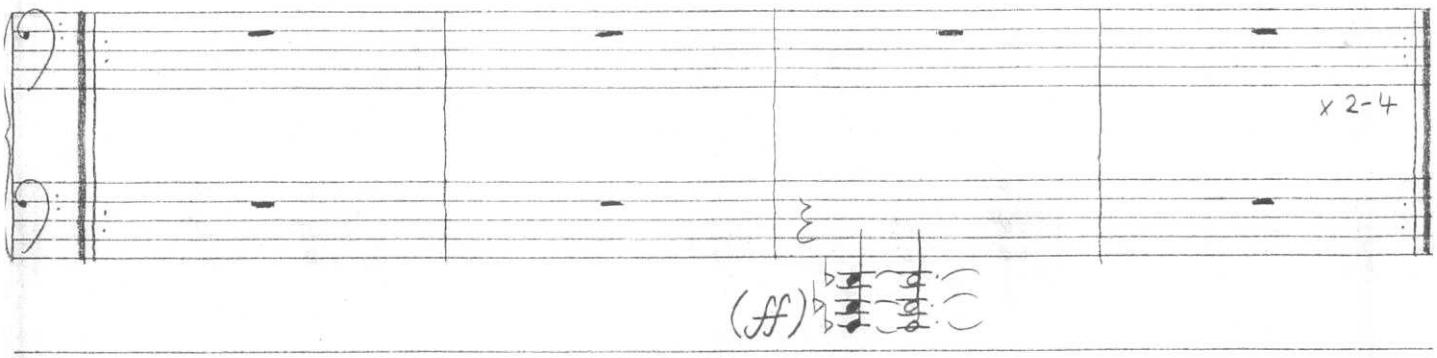
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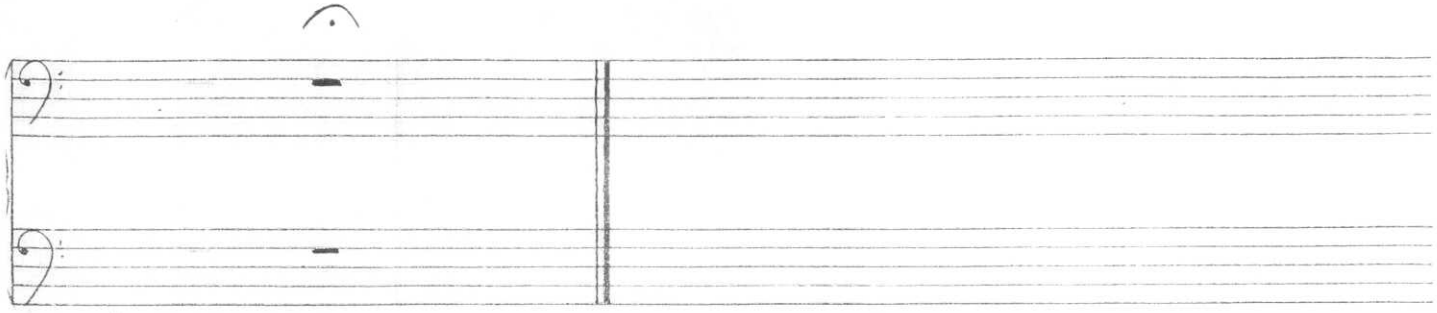
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