

VISUAL ART MADE MUSICAL:
ISSUES OF SHAPE, PROPORTION AND
LARGE-SCALE FORM IN *ESCHER SKETCHES*

by

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ABSTRACT OF THE DISSERTATION

Visual Art Made Musical:
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This dissertation examines the relationship between the orchestral work, *Escher Sketches*, and the two graphic prints by M.C. Escher on which its music is based, *Regular Division of the Plane I* and *Regular Division of the Plane VI*. Chapter 1 provides background information on the two visual works and, generally, on Escher's work with the "regular division of the plane." Chapter 2 discusses how *Escher Sketches*, a 12-tone piece, utilizes a regular division of the octave in the construction of the prime row forms behind its two movements. Chapter 3 and Chapter 4 explain how Movement I, "Birds and Fish," and Movement II, "Lizards," share structural similarities with Escher's prints at the background, middleground and foreground levels of the music.

Dedication

This dissertation is dedicated with love and respect to my mother, Nancy Graffius Gage, and my father, Leonard Patrick Gage. When I was very young my parents instilled in me a love for learning, an appreciation for art, and a healthy respect for the hard work required to be successful. I hope one day to be as great a teacher as my mother, who is both strong and kind, and as great a lover of music as my scientist father, who approaches each concert he attends with unbridled enthusiasm.

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Introduction

The graphic artist... is like a blackbird singing at the top of a tree. He repeats his song over and over again, and it is complete in each print that he makes.¹

The above quote from Dutch graphic artist M.C. Escher (1898-1972) describes the art or, more precisely, the craft of printmaking. Escher sees the production of prints as being fundamentally different from other visual arts like sculpture or painting. The painter or the collector of paintings has only a singular, unique object that represents a given work. The graphic artist, however, can create a multitude of prints using one unique plate or lithograph stone.² Each of these prints is the artwork; all of these prints are the artwork. The craft of printmaking then, it follows, is not unlike the craft of musical composition; music can be printed and disseminated widely as with a lithograph, and a composer may produce a single score which allows for a multitude of live performances. M.C. Escher understands the similarity between these two crafts, and his relationship with the world of music goes far deeper than his merely seeing himself as a “blackbird.” The artist felt an intimate connection to music and musicians throughout his career. Douglas R. Hofstadter, in his foreword to the 2004 edition of Doris Schattschneider’s book, *M.C. Escher: Visions of Symmetry*, writes, “Not only was Bach, like Escher, fascinated by patterns created through repetition, but Escher, in return, revered Bach’s music and was deeply inspired by it over his entire lifetime.”³ Hofstadter himself explored parallels between Escher and Bach, as well as similarities in their creative processes and

¹ M.C. Escher, “The Regular Division of the Plane” (Utrecht, 1958), in M.C. Escher: His Life and Complete Graphic Work (New York: Harry N. Abrams, Inc., 1982), p. 155.

² Ibid., p. 155.

³ Douglas R. Hofstadter, foreword to Doris Schattschneider, M.C. Escher: Visions of Symmetry (New York: Harry N. Abrams, Inc., 2004), p. viii.

sensibilities, in his seminal 1979 book, *Gödel, Escher, Bach: an Eternal Golden Braid*.

Escher's love for Bach and the repetition and ornamentation of Baroque music is well

documented. In a 1965 speech while receiving the Culture Prize of the City of

Hilversum, Escher offered these words of explanation for his requesting the inclusion of one of Bach's *Goldberg Variations* on the day's program:

Bach's music may perhaps provide the occasion to say a few words about my work. I had better not expound on the affinity I seem to have discovered between the canon in polyphonic music and the regular division of a plane into figures with identical forms, no matter how striking it is to me that the Baroque composers have performed manipulations with sounds similar to the ones I love to do with visual images. Allow me to say only that Father Bach has been a strong inspiration to me, and that many a print reached definite form in my mind while I was listening to the lucid, logical language he speaks, while I was drinking the clear wine he pours.⁴

This statement makes explicit Bach's influence on Escher, but also gives the reader a glimpse into what Escher found so compelling, and familiar, about Baroque musical texture; he seemed to appreciate the high degree of organization and structure, as well as the complex imitative polyphony. In the Baroque composers, and particularly Bach, Escher found kindred spirits.

It is without question that M.C. Escher was influenced by polyphonic music, and that his visual art, with its repeated patterns and interlocking, contrasting shapes, is imitative in a musical way, but does it seem possible that this cross-disciplinary influence could run the other direction? Could one imagine a musical composition inspired by Escher's visual art? On the surface, it seems impossible to effectively reproduce any visual work through music. Music is fundamentally an abstract art form, while visual art often uses literal or representational imagery to reflect realities in the natural world. Even Escher's most abstract, geometric imagery seems to have a "concrete" existence.

⁴ M.C. Escher, *Escher on Escher: Exploring the Infinite*; trans. Karin Ford (New York: Harry N. Abrams, Inc., 1989), pp. 20-21.

Many musicians in the past have responded to the challenge of approaching visual art by creating music that reflects only the simple, emotional essence of a given artwork.

Mussorgsky's "Pictures at an Exhibition," for one, employs separate sections with a variety of moods to represent contrasting sketches by visual artist Viktor Hartmann. This approach, although responsible for the creation of well-regarded music throughout history, is highly subjective. Other composers have taken a vastly different approach, one where the structural elements, not the emotions, of a visual work provide fodder for the creation of music. In 1436, Guillaume Dufay wrote music for the dedication of the cathedral at Florence. His piece was based on the supposed dimensions of Solomon's Temple of biblical lore, the building that stands as the model for hundreds of years of church construction. Dufay made the visual musical not by culling some emotional essence from the architecture, but by incorporating the dimensions of the temple into the background structure of his composition.⁵ The resulting motet, *Nuper rosarum flores*, is similar to Solomon's Temple at a fundamental level, even if the abstract surface of Dufay's music bears no relationship to the physical surface of any building. The visual-musical relationship here is more empirical and less subjective than it is with Mussorgsky.

Escher Sketches (2008) for orchestra has at its core a Dufay-like translation of visual dimensions into musical realities. The work is based not on a mythical temple, though, but on M.C. Escher's visual art; specifically, *Escher Sketches* renders in musical form certain structural elements of two woodcut prints from 1957, *Regular Division of*

⁵ Craig Wright, "Dufay's 'Nuper rosarum flores', King Solomon's Temple, and the Veneration of the Virgin," *Journal of the American Musicological Society* 47 (October 1994), pp. 395-427, argues convincingly for this reading of the Dufay motet, an interpretation completely at odds with Charles Warren's 1973 study claiming the composition was based on the dimensions of the Florence cathedral dome.

the Plane I and Regular Division of the Plane VI. The orchestra piece demonstrates fundamental similarities with the Escher woodcuts at the background, middleground and foreground, or musical surface, levels.

1 Escher's Regular Division of the Plane

In 1957, M.C. Escher was commissioned by a Dutch group called the De Roos Foundation to write an essay on his “division of the plane” works. The piece, published in book form in 1958 as *Regelmatige vlakverdeling* (“The Regular Division of the Plane”), included six new woodcuts by the artist designed to demonstrate concepts in the text. Early in the book, Escher supplies the following definition of the phrase, “regular division of the plane”:

A plane, which should be considered limitless on all sides, can be filled with or divided into similar geometric figures that border each other on all sides without leaving any ‘empty spaces.’ This can be carried on to infinity according to a limited number of systems.⁶

The six prints in the book reflect a diversity of content, style and expression, but they do share one common element – they are all black and white. Escher explains that “it is the contrast that we are after,”⁷ and with that contrast the artist creates a powerful tension. Escher continues, “There is no ‘black’ on its own, or ‘white’ either. They only manifest themselves together and by means of each other. We only assign them a value by comparing them with each other.”⁸ In addition to their two-tone structure, all of the “regular division” woodcuts also share a strong foundation in mathematics, specifically in geometry and in crystallography, the geometry of crystals. The study of crystals reveals the complex systems of shapes that can fill a plane.⁹ Escher is comfortable with the mathematical implications of his work; he writes, “For me it remains an open question

⁶ Escher, “Regular Division of the Plane,” pp. 156-157.

⁷ Escher, *Escher on Escher*, p. 16.

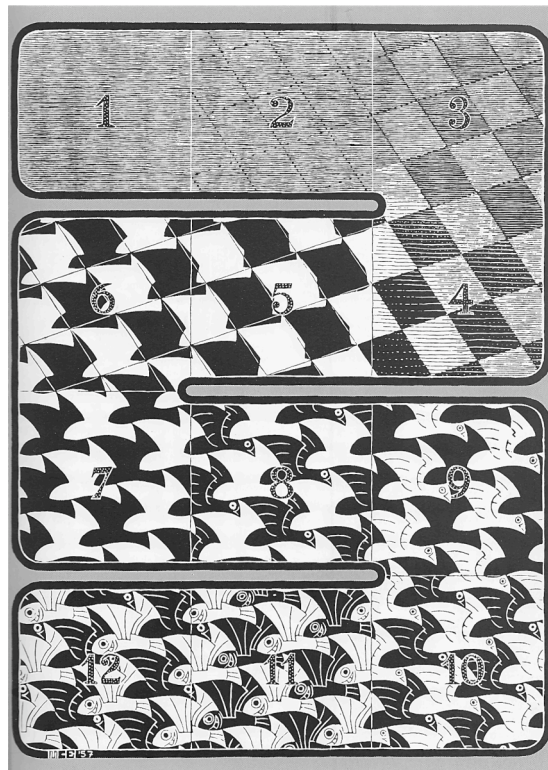
⁸ *Ibid.*, p. 17.

⁹ Escher, “Regular Division of the Plane,” p. 156.

whether the play of white and black figures as shown in the six woodcuts of this book pertains to the realm of mathematics or to that of art.”¹⁰

1.1 *Regular Division of the Plane I*

The first print example in *Regelmatige vlakverdeling* is a woodcut that features a progression of twelve square, numbered panels. They are organized much like a board game, with a winding path for the intended viewer:



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www.mcescher.com

This work, entitled *Regular Division of the Plane I* (Appendix A), is designed to tell a story. Escher states:

¹⁰ Ibid., p. 155.

...in the developing pattern of a regular division of the plane the images are *side by side* and the time factor is shifted to the movement the observer's eye makes in following the sequence from picture to picture.¹¹

Regular Division I is also concerned with black versus white contrast, and the print includes prominent gray sections. Not only is the opening square of Escher's progression solid gray, but the entire winding path is also resting on a gray background. In 1951, the artist wonders:

Isn't it really an utterly illogical way of acting to start from the one extreme at our disposal: the white paper? Wouldn't it be more valid, at least theoretically, to take the average between the two extremes as starting point: that is, paper in a shade of gray?¹²

Escher continues by suggesting that the graphic artist try "setting his prints in a gray border. By doing this, he would give a suggestion to the observer, 'Remember, it is true that the paper on which I printed was white, but gray is still my starting point'."¹³

Finally, one may wonder how Escher chose birds and fish as the animal subjects for this woodcut. The answer, quite simply, is that he chose to return to thematic material that he had explored six years earlier, in 1951's *Predestination (Topsy-Turvy World)*. This lithograph features the same interlocking bird and flying fish shapes as *Regular Division I*, but something surprising occurs as the birds and fish separate and fly closer to the viewer – the flying fish attack and kill the birds. This "topsy-turvy" outcome inverts the accepted idea of the predator/prey relationship between fish and birds, and also provides an explanation for the facial expressions on the animals in the 1957 woodcut. The birds have startled or frightened expression on their faces, with their eyes large and bulging. The fish, by contrast, have wide, toothy grins. When the animals finally meet in

¹¹ Ibid., p. 158.

¹² Escher, *Escher on Escher*, p. 17.

¹³ Ibid., p. 18.

the twelfth panel of *Regular Division I*, the teeth of the fish are resting directly upon the down-turned necks of the birds. While it is a bloodless, geometric kill, the violent irony of *Predestination* remains intact.

1.2 *Regular Division of the Plane VI*

Woodcut VI in *Regelmatige vlakverdeling* is inhabited by a different set of creatures – black and white lizards:



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www.mcescher.com

While there is only one species of animal in *Regular Division of the Plane VI* (Appendix B), Escher builds contrast into the work by varying the size of the many lizards. Specifically, he begins on top with one large creature and gradually increases the number as he moves down the page. Escher himself provides a brief and compelling overview:

Just as I started in woodcut I with a ‘story’ in pictures, I now end in woodcut VI with another example of what may be considered as dynamic progression. In this case there is no developmental process of contrast and shape, but a halving or a doubling, a diminution or an enlargement, a division or a multiplication depending on whether the print is read from the top downwards or from the foot upwards. Whichever description we choose, it is the case that ‘something happens’ in a vertical direction. Two limits can clearly be distinguished: at the top the plane is limited by the ‘singleness’ of one reptilian creature, which spans the entire width of the print like a roof; at the bottom the design is concluded in a horizontal line by the ‘multiplicity’ of a theoretically infinite number of infinitely small creatures.¹⁴

It should be noted that while size is an important element of contrast in this work, Escher continues here to play the tones of black and white off of each other. In a nod to continuity, the “pile” of lizards is also centered atop a gray background that closely resembles the first panel of *Regular Division of the Plane I*.

¹⁴ Escher, “Regular Division of the Plane,” p. 168.

2 *Escher Sketches* for Orchestra

M.C. Escher is known for creating visual works that stretch the norms of proportion and perspective until the rules of the physical world seem to snap. While this style often lends a playful tone to his prints, particularly those that feature “optical illusions,” Escher’s art is grounded in a complex and careful kind of mathematics. His work with the “regular division of the plane” has a particularly mathematical bent, as geometric shapes are “tiled” together into interlocking patterns. This tiling, or tessellation, suggests a parallel in the world of musical composition. Music often features both repeated patterns and a complex counterpoint between similar and divergent shapes. Even the idea of a plane that is regularly divided can find a manifestation in music. The plane, a blank canvas for visual imagery, is akin to the musical octave, a hollow acoustic repository and the “space” in which a chromatic aggregate resides. The concept of a “regular division of the octave” is, in fact, what drives the underlying harmonic structure of *Escher Sketches*

2.1 Construction of Basic Row Forms

Escher Sketches is dodecaphonic, a work of 12-tone serialism, and both of its movements have at their foundation a basic row of twelve ordered pitch-classes. Both Movement I, “Birds and Fish,” and Movement II, “Lizards,” utilize tone rows that explore, through pitch-class ordering and intervallic content, the concept of “regular division of the octave.” That is to say, these collections feature intervals that can be stacked atop each other to fill a single octave without, in Escher’s words, “leaving any ‘empty spaces’.” On the surface this may seem an unremarkable claim, as five of the six intervals between a

semitone and a tritone share this characteristic;¹⁵ the systematic application of these interval-classes within the structure of the *Escher Sketches* rows, however, shows an exploration of not only these “even” intervals but also of how they may be combined into trichords and tetrachords that are transposed and “tiled” together to create a 12-tone aggregate. The aggregate then becomes another plane, vastly larger and more abstract than a single acoustic octave, where tessellations of similarly sized and shaped interval structures may reside.

The prime row form in Movement I, “Birds and Fish,” is presented as an ordered sequence of Arabic numerals below, with 0 signifying pitch-class “C” and the remaining eleven numbers organized using modulo 12, or mod 12. “t” therefore is 10, and “e” is 11:

9 3 4 6 1 7 8 t 5 e 0 2

The above row finds its first expression in “Birds and Fish” (abbreviated BF) with the following pitch-classes:

A D# E F# C# G G# A# F B C D

These pitch-classes can be found split between the double bass and cello in mm.7-18 of Movement I. This BF row reflects the regular division of the octave in both its intervallic content and in the manner that it may be segmented. The row is organized into three similar tetrachords, beginning on pitch-classes 9, 1, and 5:

9 3 4 6
1 7 8 t
5 e 0 2

¹⁵ The only interval in that range with a semitone size that does not divide evenly into twelve semitones is the “perfect fourth,” comprised of five semitones. Of course, no interval larger than the tritone, save the octave itself, can be multiplied into a single octave.

By taking a closer look at the first of these tetrachords, we find that its structure is suggestive of intervals that evenly divide the acoustic octave. Using set theory, the ordered tetrachord [9-3-4-6] would be analyzed as prime-form tetrachord $\{0, 1, 3, 6\}$. This prime set is unordered and left-packed, and the intervals between the leftmost element and the remaining elements are, respectively, a semitone (0-1), three semitones (0-3), and six semitones (0-6). The intervals between consecutive elements in the prime-form tetrachord are, from left to right, a semitone (0-1), two semitones (1-3), and three semitones (3-6). Each of these component intervals divide evenly into the octave, with one semitone as the foundation interval in a chromatic scale, two semitones in a whole-tone scale, three semitones in a “diminished seventh chord,” and six semitones in a tritone. These intervals are also interrelated, as a tritone can be divided evenly by one, two or three semitones. In context within *Escher Sketches*, this first tetrachord is ordered, and its ordering has significance: The first dyad in the “Bird and Fish” row, 9-3, opens the tetrachord and the greater row with a tritone, the largest interval that can divide an octave and the “outside” interval of prime-form tetrachord $\{0, 1, 3, 6\}$; this is followed by dyad 3-4, the smallest interval that can divide the octave, and finally by dyad 4-6, a whole-tone interval. The only component tetrachord interval-class thus far ignored is the five-semitone span between the second and fourth elements in the prime-form set $\{1-6\}$. While this interval does not appear between consecutive elements in the ordered tetrachord, it does appear as the interval between the first and third elements (9-4). This five-semitone interval-class also plays a vital role in the intervallic relationship between the three tetrachords in the BF row. The second and third tetrachords are transpositions of the first, following prime-form $\{0,1,3,6\}$ and featuring identical ordering. When these

smaller collections are tiled together to create an aggregate, the distance between the final element of each tetrachord and the transposition that follows is this five-semitone interval-class. In other words, the transition from the first tetrachord to the second is accomplished through the interval-class of five semitones between pitch-classes 6 and 1. Similarly, the transition from tetrachord two to three spans the five-semitone interval-class between pitch-classes t and 5.

In the BF row, the concept of the “regular division of the octave” plays a role not only in the intervallic structure of the three tetrachords and in the interval-classes that separate them, but also in the transposition level as the row moves from one tetrachord to another. The component tetrachords in the row have been shown to have similar interval-content and order. One could claim that a tetrachord reference set has been established as a consistent ordering of prime-form $\{0,1,3,6\}$. That reference set, to which all three tetrachords in the BF row conform, would be [6-0-1-3]. These three tetrachords are written again below, beginning, respectively, with pitch-classes 9, 1, and 5:

9	3	4	6
1	7	8	t
5	e	0	2

This demonstrates that the first complete tetrachord is transposed up by an interval of four semitones to generate the second, and the second is transposed up the same four-semitone interval to create the third tetrachord. The resulting transposition levels, with four semitones or a “major third” between them, outline the pitches of an ascending “augmented triad” built on pitch-class 9 (shown in bold above). This transposition-level trichord, articulating prime-form $\{0, 4, 8\}$, is itself another equal division of the acoustic octave.

The second movement of *Escher Sketches* is titled “Lizards.” While this section features a pitch-class row that is different than the “Birds and Fish” collection, the “Lizards” row is also designed to explore the idea of “regular division of the octave.” The prime form of this row is presented below, again in mod 12 with 0 signifying pitch-class “C”:

9 5 1 0 8 4 3 e 7 6 2 t

The above row finds its first expression in “Lizards” (abbreviated as L) with the following pitches:

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

This pitch-class collection appears in Movement II beginning with the double bass “A” in m.2, and the row serves as a organizing structural principle through m.158. Like the BF collection, the L row reflects the regular division of the octave in both its intervallic content and in the manner that it may be segmented. The row is organized into four similar trichords, beginning on pitch-classes 9, 0, 3 and 6:

9 5 1
0 8 4
3 e 7
6 2 t

This row reflects the regular division of the octave in its intervallic content, its segmentation, and in the transposition levels within its segmentation. The first trichord, (9-5-1), is a vestige of the BF row, as its pitch-classes are the opening elements of the three BF tetrachords. This similarity engenders an organic relationship between the prime row forms featured in the two movements of *Escher Sketches*. Set theory would treat this first L trichord as prime-form {0, 4, 8}, a collection which evenly divides the

octave. As the L row moves through three additional trichords, each one is a transposition of this first, “augmented” trichord. The complete row is dominated by interval-class 4 (intervals of four or eight semitones), a natural result of having {0, 4, 8} as the foundation for all four component trichords. The other interval-class represented consistently is 1, as the gap between tiled trichords is either one or eleven semitones. Each of the component trichords is also transposed up from the previous collection by the same three-semitone interval. This operation places the initial trichord members into an ascending “diminished seventh chord,” which is shown in bold above. This set, prime-form {0, 3, 6, 9}, is yet another regular division of the acoustic octave.

3 Movement I, “Birds and Fish”

The first movement of *Escher Sketches*, “Birds and Fish” (Appendix D), is based on the progressive visual transformation in Escher’s *Regular Division of the Plane I*. From the construction of its prime row through the harmonic and rhythmic structure of its background, middleground and foreground textures, Movement I parallels the metamorphosis in Escher’s woodcut.

3.1 Background Structure

As Schoenberg’s 12-tone system has evolved through the 20th and 21st Centuries, many composers have sought ways to apply his principles to elements of music other than pitch. One such approach is the "total serialism" first practiced by, among others, Europeans Messiaen, Stockhausen and Boulez, where duration is serialized and linked with pitch-class. Babbitt has expanded upon this approach in America by introducing the "time-point" system, where durational intervals are associated not with pitch-class, but with interval-class; Charles Wuorinen has further refined this method by using Babbitt’s time-points to determine the large-scale structure of his compositions. Wuorinen generates background, structural material through the time-point process and then, within those large-scale forms, “nests” middleground and even foreground, or surface, iterations of that self-same time-point structure. This particular approach, effective in building organic relationships between large and small-scale forms within music, is employed consistently in the compositional process of *Escher Sketches*.

In the first movement of *Escher Sketches*, “Birds and Fish,” the prime row form provides the background time-structure for the music. The eight-minute movement

contains 504 quarter-note beats, which are divided into 12 component sections that correspond in duration to the interval-classes between the elements in the prime row. Each interval-class semitone is represented by 12 quarter-note beats. For example, pitch-class 9 to pitch-class 3 spans an interval-class of six semitones. Six semitones multiplied by twelve beats results in a 72-beat duration for initial pitch-class 9. The chart below presents the entire BF row, with durational values assigned to each interval-class. The total of the listed beat durations comprises the full, 504-beat length of Movement I:

“Birds and Fish” Ordered Row [9 3 4 6 1 7 8 t 5 e 0 2]

9	→	3	=	interval-class 6	=	72 beats
3	→	4	=	interval-class 1	=	12 beats
4	→	6	=	interval-class 2	=	24 beats
6	→	1	=	interval-class 5	=	60 beats
1	→	7	=	interval-class 6	=	72 beats
7	→	8	=	interval-class 1	=	12 beats
8	→	t	=	interval-class 2	=	24 beats
t	→	5	=	interval-class 5	=	60 beats
5	→	e	=	interval-class 6	=	72 beats
e	→	0	=	interval-class 1	=	12 beats
0	→	2	=	interval-class 2	=	24 beats
2	→	(9)	=	interval-class 5	=	60 beats

The above beat durations reflect the length of time for which the first pitch-class of the arrowed pairs is “active.” This means that the given pitch-class is the central organizing element within the background architecture during that span of time, with middleground and foreground musical structures controlled by, and “attached to,” this pitch-class. Although the active pitch-class determines musical activity during its span within every

structural level of the composition, there may be lengthy periods of time within this span where the pitch-class itself is not articulated on the musical surface.

In order to establish a fundamental relationship between the two movements of the composition at the level of background structure, the “Lizards” Row is also included as a layer of the background structure in the “Birds and Fish” movement. The L row is presented below, along with its component durational values:

“Lizards” Ordered Row [9 5 1 0 8 4 3 e 7 6 2 t]

9	→	5	= interval-class 4	= 48 beats
5	→	1	= interval-class 4	= 48 beats
1	→	0	= interval-class 1	= 12 beats
0	→	8	= interval-class 4	= 48 beats
8	→	4	= interval-class 4	= 48 beats
4	→	3	= interval-class 1	= 12 beats
3	→	e	= interval-class 4	= 48 beats
e	→	7	= interval-class 4	= 48 beats
7	→	6	= interval-class 1	= 12 beats
6	→	2	= interval-class 4	= 48 beats
2	→	t	= interval-class 4	= 48 beats
t	→	(9)	= interval-class 1	= 12 beats

The above “Lizards” rhythmic structure conforms to the same 1:12 ratio of interval-class semitones to quarter-note beats as does the “Birds and Fish” structure. However, due to varying intervallic content between the two prime rows, the total length of the L rhythmic structure is 72 beats shorter than the 504 total beats in the BF span. With both structures beginning simultaneously at the top of the movement, the L background material would abruptly end as the middleground and foreground elements of the BF structure are reaching a point of great rhythmic density. In order to prolong the L row material and to

complement this building density, another iteration of the L rhythmic structure is imposed upon the remaining 72 beats. This compressed structure, shown in the chart below, replaces the 1:12 ratio with a 1:2 ratio of interval-class semitones to quarter-note beats:

“Lizards” Ordered Row (72 beats)			
9	→	5	= interval-class 4 = 8 beats
5	→	1	= interval-class 4 = 8 beats
1	→	0	= interval-class 1 = 2 beats
0	→	8	= interval-class 4 = 8 beats
8	→	4	= interval-class 4 = 8 beats
4	→	3	= interval-class 1 = 2 beats
3	→	e	= interval-class 4 = 8 beats
e	→	7	= interval-class 4 = 8 beats
7	→	6	= interval-class 1 = 2 beats
6	→	2	= interval-class 4 = 8 beats
2	→	t	= interval-class 4 = 8 beats
t	→	(9)	= interval-class 1 = 2 beats

The background time-point structure of the “Birds and Fish” movement, then, comprises one iteration of BF (1:12) against two iterations of L (1:12, then 1:2). The opening of this movement can be seen below with only the BF and L background layers isolated:

The image displays a musical score for the opening of the "Birds and Fish" movement, showing two layers: BF (Background Fish) and L (Background Lizards). The score is divided into two systems, A and B.

System A: The BF layer (top staff) is marked with a 72-beat duration. The L layer (bottom staff) is marked with a 48-beat duration. The BF layer contains a series of quarter notes, while the L layer contains a series of eighth notes. A box labeled 'A' is placed above the BF staff.

System B: The BF layer (top staff) is marked with a 12-beat duration. The L layer (bottom staff) is marked with a 24-beat duration. The BF layer contains a series of quarter notes, while the L layer contains a series of eighth notes. A box labeled 'B' is placed above the BF staff.

The score is written in 4/4 time. The BF layer is in treble clef, and the L layer is in bass clef. The key signature is one flat (B-flat).

While the above example presents the first 23 measures of solely the background pitch-classes for “Birds and Fish,” these elements are “active” for their duration, finding expression in middleground and foreground structures and in the musical surface itself. This can be seen by comparing the above background chart with the orchestral score. For example, the A appearing in m.1 of both the BF and L backgrounds is brought to life on the musical surface by the first and second violins. The cello gives voice to the F in m.9 and the D-sharp in m.15, the latter arriving a beat later in the orchestra than it does in the background layer.¹⁶ At rehearsal “B” (m.19) the cello again contributes a background pitch-class with the occurrence of the E, and the instrument revisits the “active” background F in m.21 before the background C-sharp is introduced a few beats early in m.22 by the double bass.

3.2 Middle/Foreground Structure

While the influence of Escher’s visual style can be seen in the background structure of Movement I, where interval-class and row segmentation work towards a “regular division of the octave,” it is in the middleground and foreground texture of “Bird and Fish” that a more concrete relationship between visual art and music may be seen. Escher’s *Regular Division of the Plane I* depicts a series of twelve panels that undergo a gradual transformation or metamorphosis as they carve a winding trail through two-dimensional space. A simple gray square in panel #1 becomes interlocking black and white shapes, black and white birds, black and white fish, and, finally at panel #12, interlocking birds and fish. The evolution that occurs over the course of the artwork seems to suggest not

¹⁶ The articulation of background, middleground, and even foreground pitch-classes on the musical surface will occasionally stray slightly from a given time-point. These adjustments, made for the aesthetic purposes of gesture or phrase, never displace a time-point enough to distort the underlying structure and its inherent harmonic relationships.

only visual or thematic development, but also development over the course of time.

Regular Division of the Plane I, like most music, has a beginning, a middle, and an end. Escher adds this third, temporal dimension to the two-dimensional visual imagery on the page, thereby creating a work that is infinitely more complex and “musical.”

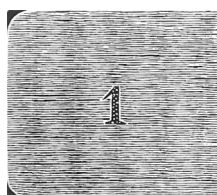
How does Escher prescribe which path the eyes should take through this visual work? The answer is simple; the artist has literally numbered the panels in the work from 1 to 12. While those Arabic numerals printed atop the imagery provide clear evidence that Escher wishes his audience to view this work as a progression beginning at the upper-left corner, even those numbers may be unnecessary. Anyone from the artist’s Dutch homeland, or neighboring countries, would naturally approach a page of text or prose at the upper-left corner, follow it to the right, and expect to continue to the bottom of the page. Here Escher has designed a cognitive experience for his audience that closely mimics the way they approach text, and, additionally, one that presents the well-worn evolutionary tale of “something emerging from nothing” as animals gradually materialize from within a gray haze. Just as Escher’s numbered temporal map invites its viewer along a well-lighted path, the clarity of his work’s relationship with time provides the outside composer a “way in” to this hazy realm.

The “Birds and Fish” movement from *Escher Sketches* is designed to reproduce, in a representational way, the visual structure and content of Escher’s *Regular Division of the Plane I*. The construction of the two 12-tone rows involved in the movement has been covered above, as has the large-scale time-point expression of those row forms. The intersection of the BF and L time-points generates a harmonic field that serves as a backdrop, or canvas, for the middleground and foreground textures of the movement, but

the “Lizards” row remains solely in the background layer. This row foreshadows Movement II, but it does not find further expression in the middleground or foreground of Movement I.

While the “active” pitch-classes within the background harmonic field find expression in the musical surface of “Birds and Fish,” the background time-point structure does not appear in its complete form within middleground or foreground textures. In other words, there are not complete, proportional time-point rows nested within time-points in the background structure. Instead, Escher’s woodcut provides the inspiration for the middleground and foreground structure. As *Regular Division of the Plane I* does with its winding path, the 504 quarter-note beats of Movement I are divided into twelve equal, 42-beat sections. These musical “panels” serve both to parallel the squares in Escher’s artwork and to serve as repositories for musical information. A careful look at the surface layer of Movement I reveals its middleground and foreground structures and the relationship those structures have with Escher’s woodcut.

Part One of “Birds and Fish” finds its inspiration in the first four panels of *Regular Division of the Plane I*. Over the course of this portion of the visual progression, alternating black and white parallelograms emerge from a gray mist. Escher begins with #1, so labeled by the artist, a panel located at the top left of the print:



Of the above square Escher writes, “The beginning is gray.”¹⁷ This statement may seem gratuitous, but the key to his explanation is the word “beginning.” Escher regards this initial panel as the first step in a grand journey, one where gray, neither black nor white, is charged with tension and creative potential. For here, “gray” is the blank canvas. Escher continues, “Is it not feasible to accept ‘gray’ not merely in a static sense... but also in a dynamic sense, as the origin of the contrast between white and black developing from it?”¹⁸ The gray in the above panel is accomplished by the alternation of very small black and white lines and requires viewers to use their eyes to “mix” the resulting color. Panel #1 corresponds to mm. 1-6 of Movement I, where an A-E perfect fifth in the upper strings suggests the panel’s undifferentiated, formless imagery. A is the first pitch-class in the standard (S) form of the BF row and E is the first pitch-class in the retrograde inverse (RI) form of the BF row, although only these initial pitches appear. The suggestion of S and RI is a deliberate foreshadowing of music that will occur at two important moments later in Movement I. Namely at Panel #7, where middleground S and RI will suggest bird and fish shapes for the first time, and at Panel #12, the denouement of Escher’s visual metamorphosis where foreground musical detail attached to S and RI will represent detailed birds and fish. The A-E fifth in Panel #1, then, is the structural ancestor of the creatures in Panels 7 – 12. Having the initial elements of S and RI isolated as a simultaneity for the first panel, without the remaining pitch-classes of the row, emphasizes the primordial nature of Panel #1 and provides an appropriate sound in the “perfect fifth.” The hollow, open sound of the fifth seems to suggest Escher’s gray canvas, with its world of potential yet to be realized. The focused and hollow fifth is

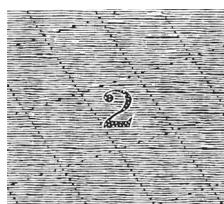
¹⁷ Escher, “Regular Division of the Plane,” p. 157.

¹⁸ Ibid., p. 157.

paired with sustained suspended cymbal and tam-tam, both utilizing gradual dynamic shaping in contributing to the gray “haze.”

Escher’s Panel #2 breaks the gray tension and sets the viewer on a course to realize the great potential inherent within the first panel. In the artist’s words:

Two systems of straight, parallel lines emerge from the indeterminate gray mists. They form the guidelines for the division of the plane. The distance between them and the angles at which they intersect reveal something of the character of the figures that will grow out of them later:¹⁹



The Panel #2 music begins at rehearsal letter A and extends to m.18. Here, the S and RI row forms that were only begun in Panel #1 are presented in their complete form in the cello and double bass. Their durational values are derived by time-point technique, but not as proportional time-points nested onto background pitch-classes. Rather, these middleground row forms are fit snugly into the 42-beat panel, with their time-point structure adjusted accordingly. As would be expected, the time-point durations are diminished from the background lengths by a factor of twelve. So, one semitone in interval-class is represented by 1 quarter-note beat. The 42 beats of middleground structure for BF row form S is shown below:

¹⁹ Ibid., p. 157.

“Birds and Fish” Middleground Row (42 beats)

9 → 3 = interval-class 6 = 6 beats
 3 → 4 = interval-class 1 = 1 beats
 4 → 6 = interval-class 2 = 2 beats
 6 → 1 = interval-class 5 = 5 beats
 1 → 7 = interval-class 6 = 6 beats
 7 → 8 = interval-class 1 = 1 beats
 8 → t = interval-class 2 = 2 beats
 t → 5 = interval-class 5 = 5 beats
 5 → e = interval-class 6 = 6 beats
 e → 0 = interval-class 1 = 1 beats
 0 → 2 = interval-class 2 = 2 beats
 2 → (9) = interval-class 5 = 5 beats

Set against the above pitch-classes and their corresponding time-point durations is the retrograde inverse form of the BF row (4-6-7-1-8-t-e-5-0-2-3-9). This RI row form contains pitch-class order and time-point structure that is distinct from the S form. Below are the strings (double bass at pitch) in the first seven measures of rehearsal A, with three structural staves printed below. The two middleground staves and one background staff are not part of the actual surface texture of the composition:

A

Violin I

Violin II *pp*

Cello *pp*

Double Bass *f*

Middleground S

First Tetrachord

Second Tetrachord (first three members)

Middleground RI

First Tetrachord

Second Tetrachord (first three members)

Background

Lizard Background
Pitch-Class #2

The fifths in the violins are a prolongation of the gray haze from Panel #1, and the pitch material in the cello and double bass is culled from the middleground S and RI time-point rows printed below the music. The two row forms are not kept distinct melodically, as pitch-class material is spread between the two lower strings.²⁰ The only background layer pitch-class that happens to begin during this excerpt, the “Lizard” row’s F, is expressed precisely on its time-point by the cello.

In Panel #3, Escher’s parallelograms begin to take on a black and white alternation through the mist as it lifts. The artist writes, “Visual delimitation or bordering is achieved... by the effect of the contrast between planes of different shades”:²¹



This panel corresponds with rehearsal B, or mm.19-30 in the score. Musical vestiges of Panels #1 and #2 remain, in both the upper string fifth – the haze – and the repeated middleground material from Panel #2 – the intersecting lines. In fact, with the exception of a few moments where new background pitch-classes alter the harmonic field, the cello and double bass essentially repeat at rehearsal B what had been performed at rehearsal A. The strophic repetition throughout Movement I lends a sense of “theme and variations” to “Birds and Fish.” The elaboration at letter B, the sense of increasing contrast as the parallelograms darken to black or lighten to white, comes solely from the viola, which

²⁰ The 5/4 downbeat in the above musical example is the time-point for the fourth pitch-class of both middleground rows. The cello and double bass “trade” row forms at this moment, thereby blending S and RI to the point where C-sharp is only articulated once between the two instruments.

²¹ Escher, “Regular Division of the Plane,” p. 157.

joins the texture to contribute the movement's first patches of foreground material. The viola is charged with adding increasing detail, and the instrument does so by mapping tetrachords onto pitch-classes in the existing middleground S and RI rows. Tetrachords are affixed to only every other middleground pitch-class as the definition of the black and white has yet to fully sharpen. The tetrachords themselves are always transpositions of the signature, component tetrachord of the BF row, tetrachord reference set [6-0-1-3]. To reiterate, this set is the consistent, "Birds and Fish" ordering of prime-form {0,1,3,6}. In addition, when the viola tetrachords are mapped, they are done so with equal durational values spread over the span of the host middleground time-point. The effect, then, is a complete texture consisting of multiple layers of rhythmic structure that alternate between proportional, time-point renderings and equal spacing in time. There is a 504-beat movement with background time-points generated from the BF and L prime rows. Stacked atop those time-points are twelve ferociously-regular, 42-beat panels. Within each panel are middleground row forms generated with time-points. Now, beginning at rehearsal B, there are evenly spaced tetrachords layered within those middleground time-points. This four-level alternation allows "Birds and Fish" to simultaneously exploit the interval-class proportions inherent within the BF row and the regular, path-of-squares structure of Escher's vision. The formal tension created by these oppositional time systems in the music is also a reflection upon humankind's desire to control or contain nature, a theme suggested by *Regular Division I* and many works in Escher's oeuvre.

By returning to the score and looking carefully at rehearsal B, one can see the first instance where background, middleground and foreground forces collide. Below are the first three measures of the orchestral score at rehearsal B. This example includes the

middle/foreground structural staves at the bottom, but omits all background structural staves:

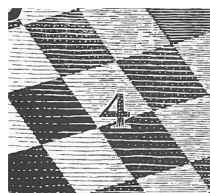
The musical score excerpt shows the following staves and annotations:

- Percussion II:** Measure 19 starts with a triangle articulation and a box labeled 'B'.
- Violin I & II:** Play a sustained chord marked *pp*.
- Viola:** Enters in measure 19 with a melodic line marked *f*.
- Cello & Double Bass:** Play a sustained chord marked *f*.
- Middle/Foreground S:** Labeled '(bare)' at the beginning and end of the excerpt.
- Middle/Foreground RI:** Labeled '(bare)' at the beginning and end of the excerpt.
- Structural Annotations:**
 - Foreground Tetrachord:** Indicated by brackets above the S and RI staves, corresponding to specific pitch classes.
 - Middleground Tetrachord (first three members):** Indicated by brackets below the S and RI staves, spanning across measures.

In the above excerpt, middle and foreground structural material is included in its pure form on the bottom two staves. Brackets along the bottom of each staff refer to middleground tetrachords, while brackets above each staff indicate foreground tetrachords attached to every other pitch in the middleground rows. In the S row, the initial pitch-class and third pitch-class remain unembellished, while the second pitch-class is adorned with a foreground tetrachord in equal duration values. The set of pitch-classes attached to the D-sharp, [3-9-t-0], conform to the BF tetrachord reference set [6-0-1-3]. For RI, the first and third pitch-classes receive foreground tetrachords while the second pitch-class remains bare. While all of this new foreground material is covered by the viola, the instrument avoids doubling pitch-classes already sounding in other

instruments.²² This leads to a viola line that is less rhythmically active, but more lyrical, than might be expected. This newfound trio of double bass, cello and viola is still accompanied by the quiet haze of the violins, and now a triangle. This percussion entrance is of note as, though the triangle is metal and sustaining like the suspended cymbal and tam-tam heard earlier, the triangle has a more distinct, articulate pitch and attack. This expansion of percussion timbre mimics the sharpening lines and clearer forms at this stage in Escher's visual progression.

Panel #4 finds the black and white alternation of the parallelograms becoming clearer and more focused as the gray mist completely fades away. Escher states that he aims to achieve “maximum contrast” by the end of this fourth panel:²³



The musical phrase, beginning at rehearsal C and spanning mm.31-42, acknowledges both the lingering haze and the sharpening texture beneath. As the mist is almost gone, the hazy upper strings are reduced by half and the A-E fifth is carried only by violin II. The fifth is also transferred up an octave to represent the thinning of the mist. This leaves violin I free to join the viola in attaching additional foreground tetrachords onto the middleground pitch-classes in the cello and double bass. These transpositions are no longer mapped onto every other note, but rather onto three out of every four, providing

²² The technique of local duplicate pitch-classes being “cancelled” is utilized throughout both movements of *Escher Sketches*. Unwanted octaves are thereby avoided, and there is greater pitch-class “turnover” within the local harmonic field.

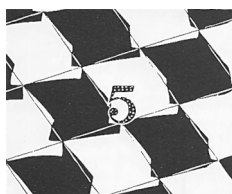
²³ Escher, “Regular Division of the Plane,” p. 157.

increased density and detail within the texture. As Escher's panel continues to sharpen in focus, violin I gradually introduces pizzicato articulation, a sound that shares the distinct attack of the triangle but lacks the hazy sustain. At m.42, the music reaches its first important transition. The "gray" ends abruptly as violin II abandons the A-E fifth, and the remaining strings contribute aggressive, simultaneous pizzicato octaves. This places the listener at the left edge of Escher's fourth panel, where, for a brief instant, there are perfect parallelograms free from the mist. This startling shift marks the transition from the first to the second section of "Birds and Fish," a change accomplished as the eye and ear cross from panel #4 to panel #5.

Part Two of "Birds and Fish" corresponds to Escher's fifth, sixth and seventh panels, and the surface texture is concerned with entirely new things. *Escher Sketches* resets, as does the woodcut, at the clean left edge of panel #4. This new zero point knows nothing of a lifting mist or of perfect parallelograms, but rather treats this moment as the starting point for a new evolutionary process. There are literally no parallelograms in the second part of *Regular Division of the Plane I*, but there is gradual transformation, a "morphing," from the idea of parallelograms to the idea of animal shapes. Escher states, "The straight lines of the borders between white and black in section 4 change gradually in section 5 and 6. They become increasingly bent and broken; where 'white' advances, 'black' automatically recedes."²⁴ By the end of Part Two, Panel #7, there will be abstract shapes that are almost birds and fish, and the orchestration will expand to include nearly every member of the *Escher Sketches* orchestra.

²⁴ Ibid., p. 158.

Part Two of “Birds and Fish” begins with Panel #5 (rehearsal D, mm.43-51), where the parallelograms first begin to rotate and distort, breaking the clean, intersecting lines that had been in place from Panel #2:



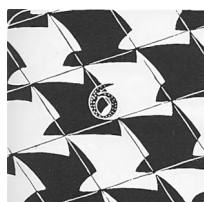
This distortion, or shifting, of the black and white shapes is accomplished musically by utilizing the same middleground 12-tone row from Section 1, but rotating it to begin with the second pitch-class in its order. This transformation will naturally alter the interval-class order within each row form and, consequently, the time-point durations expressed. These rotated forms of the rows are labeled below as 2S and 2RI:

BF Row S [9 3 4 6 1 7 8 t 5 e 0 2]
 rotates to
 BF Row 2S [3 4 6 1 7 8 t 5 e 0 2 9]
 which generates
 BF Row 2RI [9 4 6 7 1 8 t e 5 0 2 3]

BF row 2S has been rotated to begin with its second pitch-class and end with what is traditionally its first pitch-class. Once this transformation is performed, 2S becomes the new “standard,” and the RI form must be generated from this new ordered row. 2RI is then, really, RI of 2S. Another important characteristic of Escher’s Panel #5 is the lack of haze. This feature finds a musical parallel as the surface texture resets to include only

background and middleground pitch material. The full string section shares pitch-classes culled from middleground 2S and 2RI, and there are no foreground tetrachords.

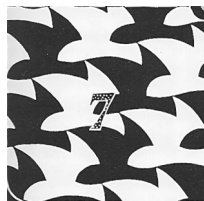
Escher's Panel #6 (rehearsal E, mm.52-63) sees further shifting of the interlocking black and white shapes:



What had been parallelograms have become so distorted that they are barely recognizable for their previous shapes. In fact, Escher even includes diagonal “guide lines” to remind the viewer of his earlier imagery, and perhaps to make explicit the extent of the transformation that has occurred. During the accompanying musical phrase, middleground BF row form S is also further rotated, now beginning with its third pitch-class. This operation generates row 3S, [4-6-1-7-8-t-5-e-0-2-9-3], and, in the process, row 3RI, [5-e-6-8-9-3-t-0-1-7-2-4]. These middleground forms are distributed through the strings and, in addition, the low brass, low woodwinds, pitched percussion (chimes), and clarinet. The tuba, contrabassoon and tam-tam enter on two occasions to punctuate the arrival of background pitch-classes. The entrance of the winds and brass expands the tone color of the musical surface texture and, in so doing, moves the listener away from the geometric abstraction of the first half of *Regular Division of the Plane I* and towards its more representational second half, populated by highly detailed animals.

Panel #7, which corresponds to the musical phrase at rehearsal letter F (mm.64-75), sees no further rotation of the black and white shapes. Instead, the forms stay in

place and their contour completes its metamorphosis into that of a bird or fish. Escher writes, “In this section the gradual growth of the figures has come to an end. They have achieved their definitive form and will retain it to the end of the strip”:²⁵



Absent still are the detailed markings required to identify any one of the objects as a flying fish or as a bird in flight, but their shape alone is evidence that they are either one or the other. Escher states that:

...an attempt was made to create a form in which the observer can recognize familiar elements. I assume that he will have a vague impression of something floating, with a body and two partially overlapping wings or fins; probably, therefore, a bird or a fish.²⁶

The middleground row forms at Panel #7 do not rotate any further, staying locked at 3S and 3RI. These two row forms, by virtue of their being active at the first appearance of birds and fish, now take on a special significance. BF row 3S will be associated, from Panel #7 on, with black birds flying towards the right (BBR). Alternately, 3RI will henceforth be associated with white fish flying towards the left (WFL). In fact, 3S and 3RI will be two of only four pitch-class rows that will appear in the middleground structure during the remaining panels. The other two, 3R and 3I, will be discussed shortly. All four of these rows are taken from the 3S form of the BF row, either in standard form, retrograde, inversion, or retrograde inversion. Below is a traditional 12 x

²⁵ Ibid., p. 158.

²⁶ Ibid., p. 158.

12 matrix with these four pitch-class rows running along the top, horizontal edge and the far left vertical edge:

	3S →												← 3R											
3I ↓	4	6	1	7	8	t	5	e	0	2	9	3	2	4	e	5	6	8	3	9	t	0	7	1
	7	9	4	t	e	1	8	2	3	5	0	6	1	3	t	4	5	7	2	8	9	e	6	0
	0	2	9	3	4	6	1	7	8	t	5	e	t	0	7	1	2	4	e	5	6	8	3	9
	3	5	0	6	7	9	4	t	e	1	8	2	9	e	6	0	1	3	t	4	5	7	2	8
	8	t	5	e	0	2	9	3	4	6	1	7	6	8	3	9	t	0	7	1	2	4	e	5
	e	1	8	2	3	5	0	6	7	9	4	t	5	7	2	8	9	e	6	0	1	3	t	4
3RI ↑	5	7	2	8	9	e	6	0	1	3	t	4												

All middleground row forms utilized in the remainder of “Birds and Fish” will originate from either the top or left edges of this matrix. Foreground tetrachord transpositions will begin with a pitch-class on an outside row or column and move in towards the center. However Panel #7, like Panel #6, does not contain any foreground tetrachords. Panel #7 utilizes solely 3S and 3RI, but, unlike Panel #6, it includes the addition of the upper brass and upper woodwinds to complete the *Escher Sketches* instrumentation.

Part Three of the “Birds and Fish” movement of *Escher Sketches* begins with Panel #8 and continues to the end of Escher’s zigzagging path. Panels 8 – 12 are an exploration of the myriad ways that a visual plane can be filled with interlocking images of birds and/or fish. These panels serve as the culmination of Escher’s vision. Part One brought abstract geometric shapes out of the haze, Part Two altered those shapes to make them more organic than geometric, and now Part Three delivers the flesh and blood of

birds and fish in flight. Part Three is unique for that fact that it is populated by actual creatures, with detailed eyes, mouths, and wings or fins. Panel #8, the musical phrase that corresponds with the opening of Part Three, resides at rehearsal G, mm.76-87.

Escher writes that, "...uncertainty ends as soon as the black silhouettes are filled with a few detail lines. It leaves no room for doubt: there are black birds flying against a white background".²⁷



Just as Escher adds life-like detail to his black birds with contrasting white lines, *Escher Sketches* adds foreground tetrachords to the middleground row (3S) associated with those birds. 3S (BBR) is one of the two middleground rows that carried over from Panel #7. The other is 3RI (WFL). 3S represents the black birds flying right (BBR) in the middleground layer of the music, but foreground material must be added to account for the fine white detail. Foreground detail here takes the form of tetrachords mapped onto pitch-classes in the 3S row. Unlike in Panels 3 and 4, however, where some middleground pitches were left “bare,” Panel #8 sees a foreground tetrachord attached to every pitch-class in the row. Each of these tetrachords features the same prime-form, {0,1,3,6}, and ordered reference set, [3-1-6-0], as the opening tetrachord of 3S. Meanwhile, the WFL, or white fish flying left, are visual background here, serving as the “negative space” between the detailed black birds. Therefore, the WFL music remains strictly middleground, 3RI with no foreground embellishment. The middle/foreground

²⁷ Ibid., p. 158.

texture of panel #8 can be seen below, in the first four measures of rehearsal G. These bars are structural and not part of the finished musical surface:

The bottom staff contains the first tetrachord of middleground 3RI, marked with a slur; those pitch-classes are performed in unison by the tuba and cello. The top staff has the first tetrachord of middleground 3S with stems down and slurred, and those pitch-classes appear in the bass clarinet and viola. Stems up in the upper staff are the foreground tetrachords, marked with dotted slurs, which are attached to each of the 3S pitch-classes. Labels above the staff indicate the upper-woodwind instruments to which particular foreground pitch-classes are assigned. These upper register lines are reinforced and echoed by the xylophone, a dry “wooden” mallet percussion instrument introduced with the detailed bird music.

In Escher’s Section #9, white birds suddenly appear. He explains, “When we move the detail lines from the black to the white motifs, the representation appears in reverse and white birds can be seen against a black background.”²⁸

²⁸ Ibid., p. 158.



The visual foreground/background relationship here is reversed, or inverted, from the previous panel, and the music at rehearsal H (mm.88-99) follows suit. White becomes black, black becomes white, and nothing else changes. 3-Standard (3S, BBR) flips to 3-Inverse (3I, WBR), and 3-Retrograde-Inverse (3RI, WFL) flips to 3-Retrograde (3R, BFL). Accordingly, the harmonic field consists of middleground 3R without embellishment and middleground 3I with foreground tetrachords decorating each pitch-class. 3R is articulated by the trombone and 3I by the double bass. The 3I foreground tetrachords are shared by the bass clarinet, bassoon, contrabassoon, and the marimba, which has replaced the xylophone as the “wooden” keyboard instrument.

Panel #10 sees the avian density double as Escher adds white bird detail to what had been the black visual background in Panel #9:



This section is, then, the first one in Part Three of “Birds and Fish” that has no fish, even as shapes in the visual background. This is also the first “animal” panel in *Regular Division of the Plane I* that has no background to speak of. Escher’s square has wall-to-wall birds, a step he explains is necessary in the progression of the work: “A completely regular division of the plane in the sense I mean comes about only when the function of

an ‘object’ can be attributed to *each* of the congruent figures.”²⁹ Without any fish in this section there are no animals traveling towards the left, and therefore no place for retrograde row forms within the music. The accompanying texture at rehearsal letter I (mm.100-111) features middleground 3S and 3I, with foreground tetrachords mapped onto every pitch-class of both. The Panel #10 music is a combination of half of the harmonic field from Panel #8 and half from Panel #9, a fact that should be transparent to the listener. The upper woodwinds and xylophone reprise their music from rehearsal G while the lower woodwinds and marimba repeat their music from rehearsal H. This foreground “bird detail music” for the black (BBR) and the white (WBR) interlocks rhythmically and registrally, much as the birds do in the visual work.

The eleventh section of Escher’s *Regular Division of the Plane I* marks a startling shift in visual detail. While the fundamental black and white shapes remain as consistent as they have been since Panel #7, Panel #11 introduces flying fish detail on animals all traveling towards the left. Escher writes, “The white and the black marks that we read as birds can also be seen as something else. If we shift the eye and the mouth from right to left and turn the wing into a fin, the birds become fish.”³⁰



This visual manipulation engenders a “through the looking glass” effect as birds change to fish instantaneously at the seam between Panels 10 and 11, resulting in some startling

²⁹ Ibid., p. 158.

³⁰ Ibid., p. 158.

two-headed “fish-birds” positioned atop the dividing line. The music at rehearsal J (mm.112-123) does a similar about-face, as the two “fish” middleground rows from Panels 8 and 9 (WFL and BFL) return simultaneously, this time with foreground embellishment mapped onto every single pitch-class. Panel #11 is the retrograde of Panel #10, both visually and in regards to row form structure. The harmonic field for the initial four measures of rehearsal J is presented below, in its structural form:

The top staff (BFL) has middleground 3R with stems down, containing pitch-classes covered by the trombone. Stems up are the foreground tetrachords mapped onto 3R, with pitch-classes distributed to the trumpet and chimes. The bottom staff (WBL) displays middleground 3RI with stems down, featuring pitch-classes covered by the tuba, and foreground tetrachords stems up, which are shared by the horn and the vibraphone. For the fish, the music shifts away from xylophone and marimba to metal, sustaining keyboard percussion instruments like chimes and vibraphone.

Panel #12 is the culmination of Escher’s vision for *Regular Division of the Plane I*. All of the thematic and visual concepts that the artist has established over the course of his winding path meld into one unified expression in this final panel. Escher states:

Finally it is of course also possible to unite the two types of animals in a single division of the plane. In the solution put forward here, black birds fly to the right and white fish swim to the left....³¹



In the above square, a mere twelfth of the total piece, Escher manages to synthesize every one of the important oppositional binaries heretofore established by his woodcut. Left is set against right, white is set against black, and fish are set against birds. Lest one claim that fish versus birds is not a proper binary, recall that these animals are established by the artist as opponents in the natural world. As steeped in irony and humor as it may be, the “universe” of Escher’s sketch is one of fish predator set against bird prey. The tension inherent in these clashes of direction, tone, species and fate are translated into music at rehearsal K (mm.124-135). Panel #12 shares the same middleground music structure as #7, the panel directly above it in the zigzag. In both cases, 3S (BBR) is set against 3RI (WFL). Whereas #7 has no foreground detail, though, this final section has a tetrachord mapped onto each and every middleground pitch-class. The harmonic field that results, along with the time-point rhythmic structure generated by its interval-classes, is the most varied and complex thus far exhibited in “Birds and Fish.” The row form structure of the first four measures of rehearsal K is shown below:

³¹ Ibid., p. 158.

The 42-beat phrase at rehearsal K is as much a musical denouement as Panel #12 is a visual one. A forward row is set against one that is retrograde, a standard row is set against an inverted one, upper register instruments are set against lower, and metal keyboard instruments are set against “wooden.” All the while, separate from the above graph, the background pitch-class structure concludes its slow march in dramatic fashion in the lower woodwinds, and a solitary triangle contributes an eighth-note pattern, as even and relentless as Escher’s twelve panels.

4 Movement II, “Lizards”

The second movement of *Escher Sketches*, “Lizards,” is based on M.C. Escher’s *Regular Division of the Plane VI*, with its shrinking and multiplying collection of lizards. From the construction of its basic standard row through the harmonic and rhythmic structure of its background, middleground and foreground textures, Movement II parallels the architecture of Escher’s woodcut.

4.1 Background Structure

“Lizards,” features two distinct musical background structures. The first harkens back to Movement I, and provides an organic link between the piece’s two movements, by imposing a single expression of the standard BF row over the entire 10-minute length of “Lizards.” The appearances made by these background pitch-classes on the musical surface are easily recognizable as the only twelve chime notes in Movement II.

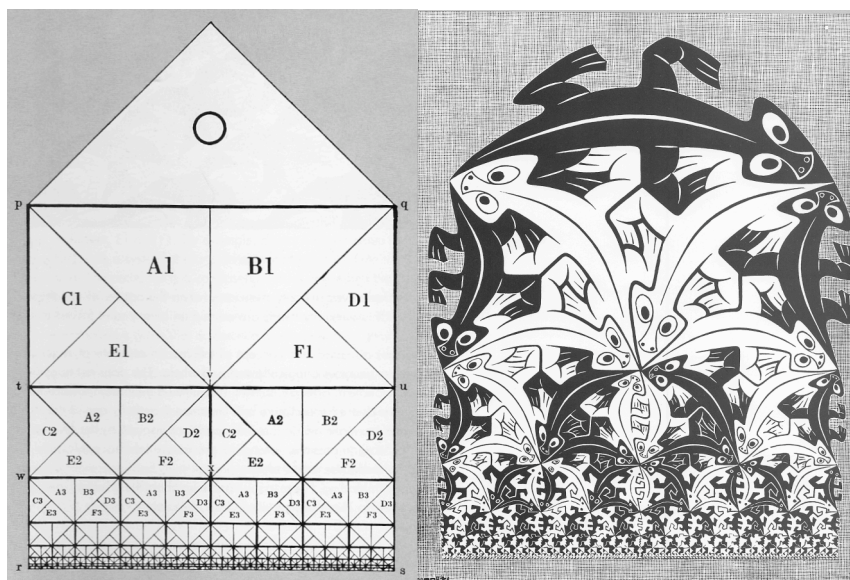
Orchestral chimes are an instrument that figures prominently in the “Birds and Fish” movement, so the instrumental expression of the BF row here also serves to reference a timbre from the earlier movement. The first of the twelve chimes appears on the downbeat of measure 2, and the durations assigned to that chime, and each successive one, is based on time-point structuring determined by interval-class. This is the same technique that was used to determine the rhythmic structure of the BF row and the two expressions of the L row within the background of “Bird and Fish.”

The other background structure at play in Movement II directly reflects the “lizard multiplication” in Escher’s *Regular Division of the Plane VI*. Although both movements of *Escher Sketches* employ 12-tone techniques and time-point structuring, the application

of these processes between the first and second movements is as different as are the two visual works. Unlike *Regular Division I*, this woodcut provides no numbered path for its viewer, although it seems natural that the eye would scan the work from top to bottom as if the print itself were a page of text or music. This way of viewing *Regular Division VI* is at the heart of the background structure of the “Lizards” movement.

For the music to begin at the top of the woodcut and reflect the proliferation of lizards moving downward, it must parallel Escher’s imagery in two fundamental ways. First, there must be a sense of multiplication. One black lizard at the top connects to two white lizards, which each separately connect to a black and a white lizard, and so on. The music accomplishes this by adding new or restructured pitch-class row forms as the music progresses. The second fundamental characteristic of *Regular Division VI* is the sense of “diminution.” As Escher adds more and more shapes to his page of finite width, those shapes must become progressively smaller in order to fit. In the music, this diminution is rhythmic, with shorter row form expressions and note durations as the piece moves forward. As Escher’s work develops from one large lizard to an infinite number of infinitely small lizards, the second movement of *Escher Sketches* accelerates accordingly.

The structure and pace of the “Lizards” musical acceleration are taken from the print itself. This particular woodcut is complex, with lizards of irregular shape and size interlocked together. Escher, perhaps recognizing this complexity, created a diagram of the skeletal structure of *Regular Division VI* to be included in *Regelmatige vlakverdeling* (Appendix C). Below, this graphic “blueprint” is placed next to the finished woodcut:



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Triangle “O” corresponds with the large lizard on top, triangles “A1” and “B1” correspond with the next smallest pair of white lizards, and so on. While the relative location of each creature is clearly communicated in the diagram on the above left, Escher does not include any information about the tone, black or white, or the direction of each lizard. Escher scholar Doris Schattschneider analyzes the blueprint geometrically, and she accounts for some of the information that the artist excludes:

The algorithm... is this: to produce smaller triangles adjacent to a given right triangle, reflect the triangle across its hypotenuse and split the image into two congruent right triangles. (This shows, by the way, that the two newly created triangles are scaled by $1/\sqrt{2}$; Escher’s “halving” refers to area, not scale.) A far more complex algorithm is needed for Escher’s lizards to occupy the diminishing triangular spaces successively. ...each large lizard must be turned (pivoted about the point where it touches elbows with two other lizards), shrunk to fit the smaller adjacent compartment, and then turned over (reflected) to bend in the right direction.³²

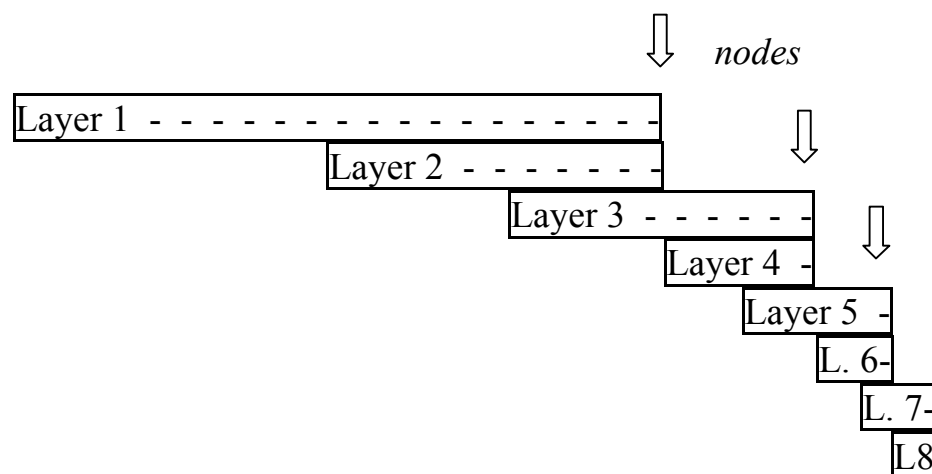
Schattschneider’s analysis, taken alongside Escher’s diagram, provides a clear picture of the background structure of *Regular Division VI*, and of the “Lizards” movement.

³² Schattschneider, *Visions of Symmetry*, p. 252

The musical background of Movement II is based on the shrinking and rotating square and diamond shapes in Escher's blueprint. The first section of "Lizards," called Layer 1, comprises the top diamond of the diagram, or the area that includes triangles "O," "A1," and "B1." This layer takes up the first 672 quarter-note beats of the music, approximately half of the ten-minute movement. Layer 2 of "Lizards" corresponds with the two adjacent squares that begin at the base of triangle "O." The left square includes triangles "A1," "C1," and "E1," and the right square includes triangles "B1," "D1," and "F1." Because these squares begin immediately below triangle "O," and share triangles with the Layer 1 diamond, the Layer 2 music begins 336 quarter-note beats, or halfway, into Layer 1.

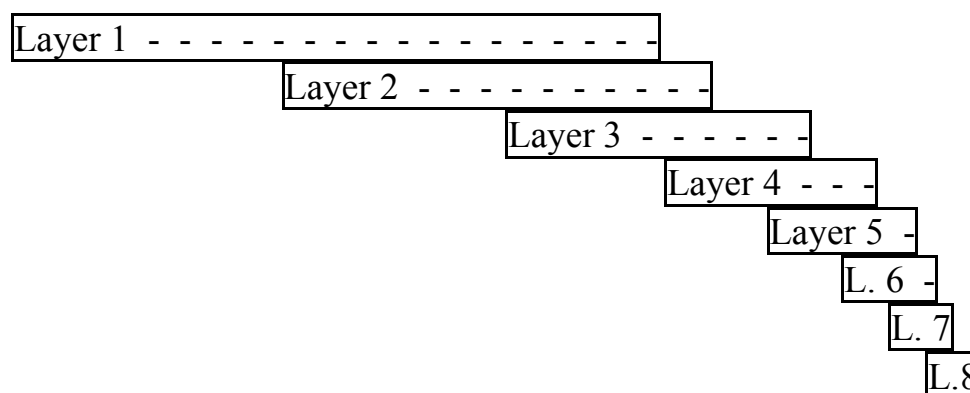
The relationship between the starting points of Layers 1 and 2 can be confirmed by looking at Escher's diagram, as can the fact that the two layers end together, at the horizontal line between points "t" and "u." It is at this point that the background structure of *Escher Sketches* departs slightly from *Regular Division VI*. As more layers are added to the musical architecture, the even-numbered layers are not half the length of the preceding odd-numbered layer. Every layer begins halfway through the previous one, but there is an even proportional diminution imposed as new layers are added. The ratio of diminution is $\sqrt{2}:1$, or approximately 1.4:1, which is taken from Escher's ratio of scale, triangle down to triangle, discussed above by Schattschneider. Therefore Layer 2 is not half the length of Layer 1, or 336 beats, but rather 480 beats, as 672:480 fits the ratio of 1.4:1. This pattern of each layer beginning halfway through the previous one and being $1/\sqrt{2}$ shorter continues throughout the remainder of the musical background structure. So Layer 3, the two diamonds topped by "E1" and "F1," commences halfway

through Layer 2 and lasts for 342 beats. Layer 4, consisting of four squares, lasts for 244 beats, and so on. To demonstrate, the diagram below shows a background structure for musical layers that would precisely match the proportional structure of Escher's woodcut. This graph simply extracts the height of each of Escher's layers and stacks them horizontally:



Each layer after Layer 1 is either half the length or the same length as the previous layer, and how pairs of layers end at the same time. Also evident are the “nodes” in the Escher print, where three layers are simultaneously either ending or beginning. There are three such nodal points marked by arrows in the above diagram, the first being the point where Layer 1 ends, Layer 2 ends, and Layer 4 begins. This particular node resides at horizontal line “t” through “u” in Escher's blueprint. Every horizontal line below that in the blueprint is another node.

In contrast, the schematic below presents the “lizard layers” in the musical background of *Escher Sketches*, Movement II:



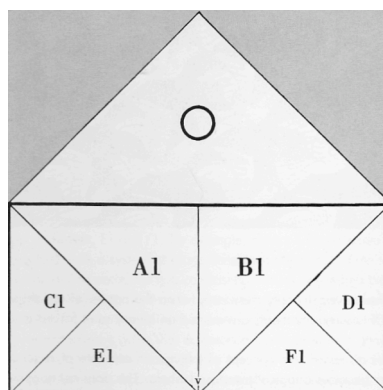
Although each layer begins halfway through the previous one, because each successive layer is $1/\sqrt{2}$ shorter, there are no “nodes.” There is never a point when any layer either begins or ends simultaneously with another. This background structure will express an evenly proportional acceleration when any musical material is mapped consistently onto it.

The accelerating “lizard layers” that comprise the background of Movement II do not gain any musical significance, however, until they are filled with background, middleground, and foreground harmonic and rhythmic information. The first background material mapped onto each of the layers is a single 12-tone row form. In the case of Layer 1, the single row is the standard form of the prime “Lizards” row, also known as L row. This set is written below, segmented into its four component trichords:

[9-5-1, 0-8-4, 3-e-7, 6-2-t]

This row form is mapped onto Layer 1, not with time-point durational values as in Movement I, but with even durations. The 672 quarter-note beats of Layer 1 are divided into 56-beat units, each one assigned to an element within the prime row.

This above process is repeated for Layer 2, with two important distinctions. First, as earlier discussed, Layer 2 is $1/\sqrt{2}$ the length of Layer 1. Therefore, the durational units for this layer will be shorter. The 480 quarter-note beats of Layer 2 divide evenly into twelve 40-beat units. The other distinction between the first two layers of the background is that each durational unit in Layer 2 is assigned to elements from two different row forms. These two forms represent squares “A1” and “B1” in M.C. Escher’s blueprint. Below are the Layer 1 and 2 sections of Escher’s diagram, with diamond “O” overlapping with the “A1” and “B1” squares:



Visually, it is clear that the top diamond and the lower squares share a similar architecture. Half of their area is made up of one right triangle, and the other half contains two equal right triangles. The diamond and squares only differ in scale and in orientation. The squares are, in essence, a smaller replica of the top diamond that is rotated 45° clockwise, with “A1,” or counterclockwise, with “B1.” In Movement II, this physical rotation finds musical expression as Layer 2 features two “rotated” versions of the Layer 1 row. These rotations are not of a complete pitch-class row, however, as it was when BF row forms were rotated in Movement I to represent shifting parallelograms. In Movement II, each row’s component trichords are rotated both internally and from a

positional standpoint within the larger row. In addition, this transformation works in both a “clockwise” and “counterclockwise” direction, paralleling Escher’s print. This process as it is applied to Layer 1 and Layer 2 in “Lizards” can be seen below:

“O” Diamond Background Row [9-5-1, 0-8-4, 3-e-7, 6-2-t]

“O” Row rotated clockwise to become

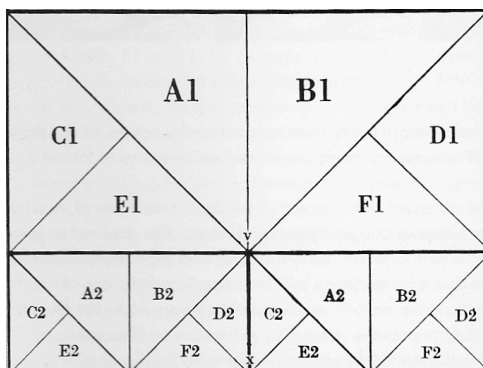
“A1” Square Background Row [t-6-2, 1-9-5, 4-0-8, 7-3-e]

“O” Row rotated counterclockwise to become

“B1” Square Background Row [8-4-0, e-7-3, 2-t-6, 5-1-9]

In the “A1” row, the last trichord of the “O” row (6-2-t), has been rotated to become the first trichord, and the remaining trichords have been shifted back accordingly. In addition, the trichord itself has been reordered, with its third and final pitch-class rotated to the first position (t-6-2). This process is duplicated to generate the remainder of the “A1” row. For “B1,” this rotation technique is applied in the opposite direction, with the “O” row trichords and their component pitch-classes shifting forward.

The remaining lizard layers are filled with row form material in a way that continues this organic relationship with Escher’s woodcut. The section below includes the squares and diamonds that comprise Layers 2, 3 and 4:



Halfway through Layer 2, the “A1” and “B1” squares, the two diamonds of Layer 3 begin. These are labeled in Escher’s diagram as “E1” and “F1.” The accompanying music takes the Layer 2 row forms, makes them $1/\sqrt{2}$ shorter, and continues the clockwise and counterclockwise rotation of the trichords and their positions. In other words, the “A1” and “B1” rows undergo rotation and diminution to become the “E1” and “F1” rows. The two Layer 3 diamonds are then split into the four squares of Layer 4, the two “A2” shapes and the two “B2” shapes in Escher’s blueprint. This process leads to the simultaneous expression of four distinct row forms in Layer 4 while Layers 2 and 3 are still extant. As more layers enter in Movement II, the rhythmic texture and the harmonic field become more dense and active, in accordance with Escher’s lizards as they multiply towards infinity.

4.2 Middle/Foreground Structure

The background structure of Movement II, “Lizards,” mimics the creatures in Escher’s *Regular Division of the Plane VI* through the diminution and multiplication of its background row forms. The middleground and foreground structure of Movement II is mapped onto these background layers, thereby reinforcing and rearticulating the acceleration. The middleground of “Lizards” breaks each background row form into two hexachords and then imposes an accelerating structure onto each. Serving as a microcosm of the increase in density over the entire movement, these structures map an increasing number of pitch-classes onto each successive pitch-class of every background hexachord. The progressive number of mapped pitch-classes over the course of each

hexachord is based on the concept, fundamental to the creation of the prime BF and L rows, of the “regular division of the octave.”

The first pitch-class, or element, of each background hexachord is left untouched to reflect the primacy of the unison, and, by extension, the octave. Mapped as a transposition onto the second pitch-class is a tritone that divides the duration of element two in half, in precisely the way that six semitones—{0, 6}—does the octave. The third pitch-class receives an “augmented triad” spread evenly across its span, a three-part division of the octave—{0, 4, 8}. A “diminished seventh chord” is transposed onto element three—{0, 3, 6, 9}—and a whole-tone set onto element four—{0, 2, 4, 6, 8, t}. The sixth and final pitch-class of each background hexachord receives a chromatic scale spread evenly over its duration—{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, t, e}. Below is a chart of this process as it is applied to the first six pitch-classes of background Layer 1. The background hexachord runs down the left vertical column, its pitch-classes in bold, and the middleground mappings extend horizontally to the right of each background pitch-class:

Layer 1 Background (Standard L Row, first hexachord)

pc 9 – 56b (beats)
pc 5 – 28b – **pc e** – 28b
pc 1 – 18.66b – **pc 5** – 18.66b – **pc 9** – 18.66b
pc 0 – 14b – **pc 3** – 14b – **pc 6** – 14b – **pc 9** – 14b
pc 8 – 9.33b – **pc t** – 9.33b – **pc 0** – 9.33b – **pc 2** – 9.33b –
pc 4 – 9.33b – **pc 6** – 9.33b
pc 4 – 4.66b – **pc 5** – 4.66b – **pc 6** – 4.66b – **pc 7** – 4.66b –
pc 8 – 4.66b – **pc 9** – 4.66b – **pc t** – 4.66b – **pc e** – 4.66b –
pc 0 – 4.66b – **pc 1** – 4.66b – **pc 2** – 4.66b – **pc 3** – 4.66b –

Element five, pc 8 above, is presented below as a musical example, where the whole-tone pitch-classes are spaced evenly between pc 8 and pc 4. This is a portion of middleground structure from the movement and not part of the musical surface:

Whole-Tone Hexachord
Member #1

Member #2

#1

#2

#3

#4

Layer 1, Background Pitch-Class #5

#5

#6

Background Pitch-Class #6

This progressive division of the 56-beat background units is repeated for the second hexachord of Layer 1 and for both hexachords in the background row of each successive, shorter layer. As the lizard layers shrink and the harmonic field is more densely populated, there are more instances of local duplicate pitch-classes. As in Movement I, a pitch-class introduced in proximity to a duplicate from a layer that is more background will be “cancelled” by the earlier pitch-class. The mounting harmonic density expressed over the span of Movement II requires that these cancellations be systematically localized to an increasingly smaller time region. From the beginning of “Lizards” to rehearsal “D,” duplicates sounding within a range of ten bars are rare and are cancelled on an individual basis. From rehearsal “D” to “K,” duplicates are cancelled if they occur within five bars of a pitch-class from an earlier layer. From “K” on, duplicates are cancelled within one bar, and the extreme density from rehearsal “O” to the end allows for duplicates even within a single measure.

The foreground structure of “Lizards” features characteristics on the musical surface that match both the acceleration and the “regular division of the octave” found in

the background and middleground levels. One such characteristic is the movement's use of un-pitched percussion. Over the course of the first hexachord of background Layer 1, the "O" triangle or the large black lizard in M.C. Escher's print, there is a rhythmic acceleration in the unpitched percussion. The rhythmic values are a composite of the background and middleground pitch-class attack points over the entire movement, scaled down proportionally to fit within the first half of Layer 1. The resulting rhythmic string contains an increase in the density of attacks, as the rhythms are an amalgam of every large-scale acceleration within "Lizards." These unpitched attack points are further treated as "regular divisions of the beat," as quarter-note beats with increasing internal density are featured. During the portion of the rhythm composite that corresponds with Layers 1 and 2, single bass drum quarter notes are attached to the un-pitched attack points. This is, perhaps, the rhythmic version of an open plane or octave. When the composite pattern reaches Layers 3 and 4, the attack points are further decorated with an anvil performing pairs of eighth notes—rhythmic tritones. Layers 5 and 6 in the rhythmic string find triplets integrated into the texture, and Layers 7 and 8 find the addition of sixteenth notes. All of these collections of duration values "divide" the quarter-note beat, and, in that way, share characteristics with Escher's tessellations that divide the visual plane. Below are two measures from Movement II, mm. 53-54, that feature two, three, and four-part divisions of the quarter-note:

53

(snare drum)

Perc. II mf

(brake drum)

Perc. III mf f mf

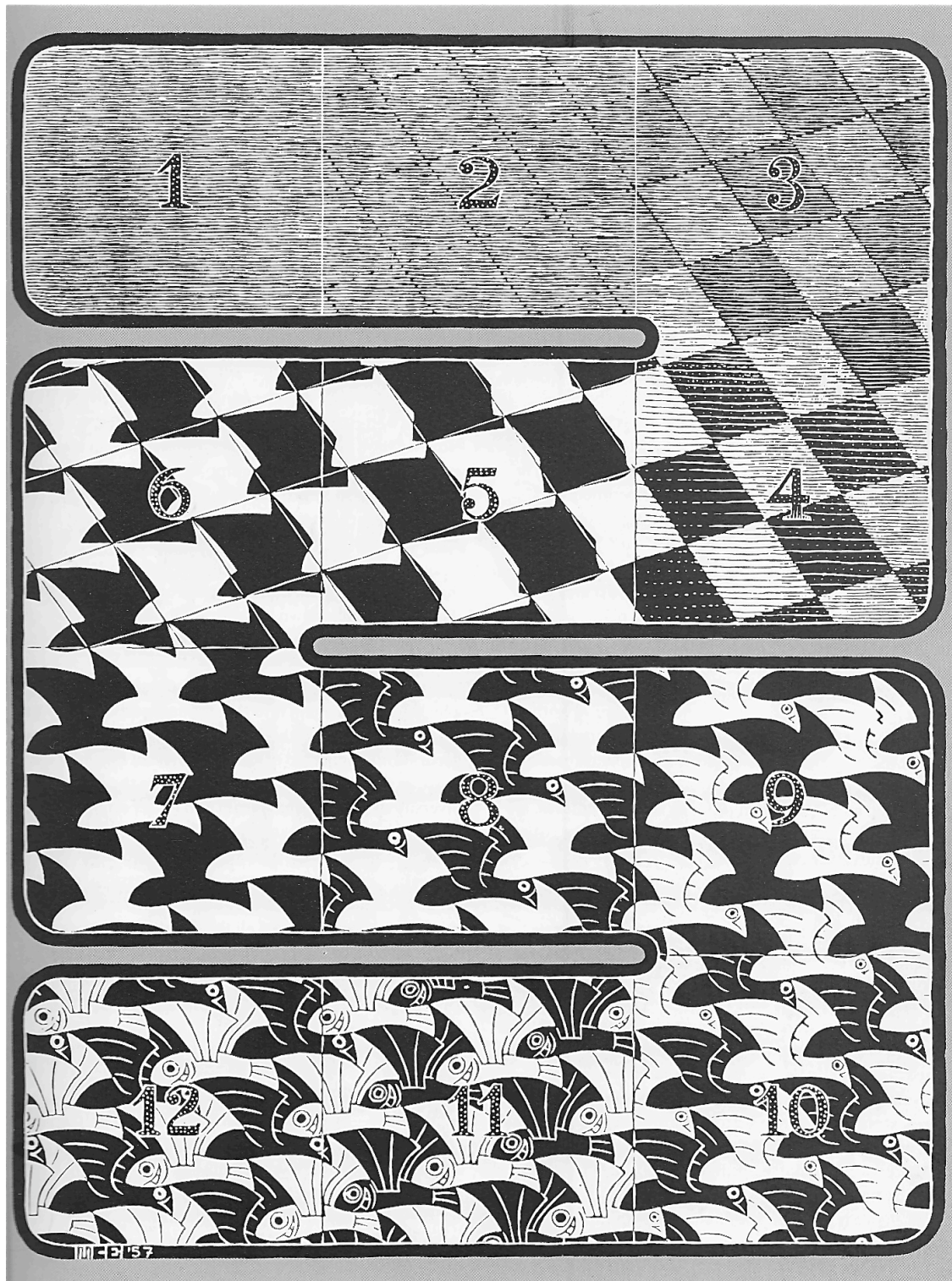
(timpani)

Perc. IV f

The foreground rhythmic mapping during this first portion of the “Lizards” movement continues throughout, with “regular divisions” of not just the quarter-note, but the half-note and whole-note as well.

It should be noted that the acceleration structure of Movement II does not extend fully to the end of the music. The musical surface continues after the acceleration has come to an abrupt end at the downbeat of m. 285. At this juncture, the audience is again faced with the violin A-E fifth that opened “Birds and Fish” and “Lizards.” This is the gray background included with all of Escher’s *Regelmatige vlakverdeling* woodcuts. Until one final, sudden orchestra octave brings all of *Escher Sketches* to a close, the audience is left to ponder, after all of the complex black and white imagery, M.C. Escher’s blank, gray canvas.

Appendix A – Regular Division of the Plane I



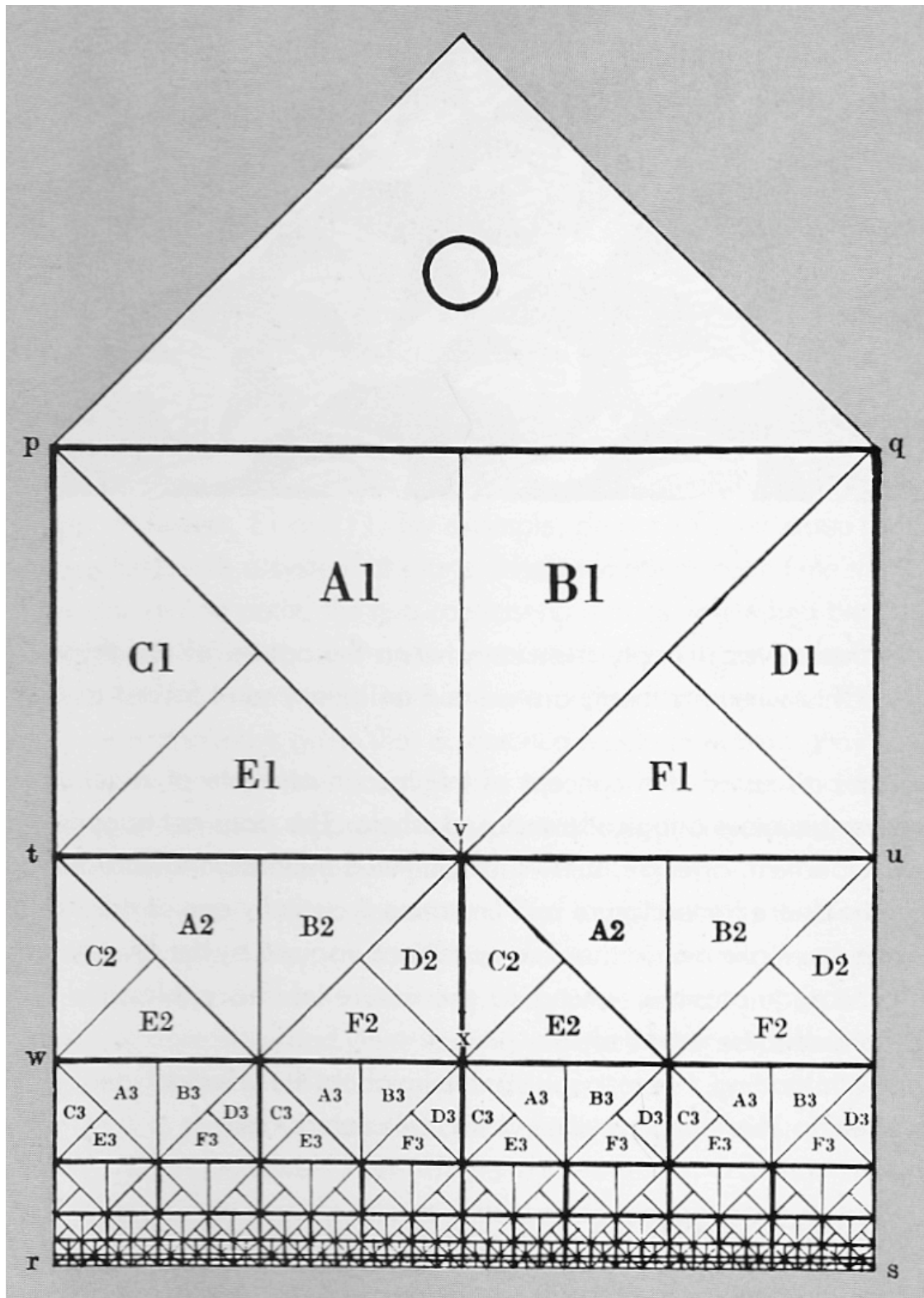
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Appendix B – *Regular Division of the Plane VI*



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Appendix C – Structural Diagram, *Regular Division VI*



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Appendix D - *Escher Sketches* Movement I, “Birds and Fish”

C Score

Darren Gage

The musical score is for 'The Firebird' by Igor Stravinsky, specifically the section from measures 1 to 18. The score is written for a full orchestra, including Percussion I, Percussion III, Violin I, Violin II, Viola, and Cello/Double Bass. The tempo is marked as ♩ = 66. The score includes dynamic markings (pp, mp, mf, f) and articulation (suspended cymbal, triangle). The score is divided into two systems, A and B, with measures 7 and 18 marked as the start of each system. The score is written in 2/4 time and features a variety of musical notations, including staccato, accents, and slurs.

43

Perc. I

Perc. II

Vln. I

Vln. II

Vla.

Vcl.

Dbl. Bass

to marimba

f

fp

ff

pp

pizz

arco

F

62

Picc. *mf* *f* *mf* *f*

Fl. *mf* *f* *mf* *f*

Ob. *mf* *f* *mf* *f*

Cl. *f* *mf* *f*

B. Cl. *f* *f*

Bass. *f* *f*

Cont. Bass. *p*

Hn. *f* *p* *f* *p*

Trpt. *f* *p* *f* *p*

Trmb. *f* *f*

Tuba *p* *f* *p*

Perc. I *pp* *mf* *f* *p* to xylophone

Perc. III *mf* *mf*

Perc. IV *mf* *f*

Vln. I *mf* *f*

Vln. II *f*

Vla. *f*

Vcl. *f*

Dbl. Bass *p* *f* *p* *f* *p*

72 80

Picc. *mf* *fp* *mf*

Fl. *mf* *fp* *mf*

Ob. *mf* *f* *mf*

Cl. *mf* *f* *mf*

B.Cl. *mf* *f* *mf*

Bass. *mf* *f*

Cont. Bass. *mf*

Hn. *mf* *p*

Trpt. *mf* *p*

Trmb. *mf* *f*

Tuba *mf* *p*

Perc. I 72 *mf* *p* xylophone *mf*

Perc. III *mf*

Perc. IV *mf*

Vln. I 72 *mf* *fp*

Vln. II *f*

Vla. *f* *mf*

Vcl. *f* *mf*

Dbl. Bass *mf* *p*

(8th)

Picc.

Fl.

Ob.

Cl.

B. Cl.

Tuba

Perc. I

Vla.

Vcl.

H

88 (8th)

Picc.

Fl.

Ob.

Cl.

B. Cl.

Bass

Cont. Bass

Trmb.

Perc. I

Perc. II

Perc. III

Dbl. Bass

p

p

p

p

mp

mp

mp

mp

mp

mp

mf

mf

marimba

to vibraphone

95

1

8^{va}

Picc. *mf*

Fl. *mf*

Ob. *mf*

Cl. *mf*

B. Cl. *mf*

Bass. *mf*

Cont. Bass. *mf*

Trmb. *mf*

Perc. I *mf*

Perc. II *mf*

Vln. II *mf*

Dbl. Bass *mf*

xylophone *mf*

(8^{va})

102

Picc.

Fl.

Ob.

Cl.

B. Cl.

Bass.

Cont. Bass.

Perc. I

Perc. II

Vln. II

Dbl. Bass

The image shows a page of a musical score for percussion instruments, specifically measures 116 through 120. The instruments listed on the left are Horn (Hn.), Trumpet (Trpt.), Trombone (Tmb.), Tuba, Percussion I (Perc. I), Percussion III (Perc. III), and Percussion IV (Perc. IV). The score is written in 2/4 time and features various musical notations including notes, rests, and dynamic markings such as *mp* (mezzo-piano), *mf* (mezzo-forte), *f* (forte), and *fp* (fortissimo). There are also articulation marks like accents and slurs. The Percussion I part includes a section marked 'suspended cymbal' with a *p* (piano) dynamic. The Percussion III and IV parts have a triplet of eighth notes marked with a '3' above them. The overall layout is clean and professional, typical of a printed musical score.

K

123

Picc. *f* *ff*

Fl. *f* *ff*

Ob. *ff*

Cl. *ff*

B. Cl.

Bass.

Cont. Bass.

Hn. *ff*

Trpt. *ff*

Trmb. *ff*

Tuba *ff*

Perc. I *ff* xylophone *ff*

Perc. II *ff* triangle *ff*

Perc. III *ff* one pedal

Perc. IV *ff*

Vln. I *ff*

Vln. II *ff*

Vla. *ff*

Vcl. *ff*

Dbl. Bass *ff*

pizz

(8^{va})

130

Picc.

Fl.

Ob.

Cl.

B.Cl.

Bass.

Cont. Bass.

Hn.

Trpt.

Trmb.

Tuba.

Perc. I

Perc. II

Perc. III

Perc. IV

Vln. I

Vln. II

Vla.

Vcl.

Dbl. Bass

fp

pizz *pizz* *pizz* *arco* *fp*

pizz *pizz* *pizz* *arco*

pizz *pizz* *pizz* *arco*

Attaca Movement II, "Lizards"

Appendix E - Escher Sketches Movement II, "Lizards"

C Score

Darren Gage

♩ = 66

Percussion I *bass drum* *f*

Percussion II *tam-tam* *f*

Percussion III *chimes* *f* *large guiro* *p < f*

Percussion IV *timpani* *mp*

Violin I *7 seconds* *p*

Violin II *7 seconds* *p*

Double Bass *mp*

8

Perc. I

Perc. II *large woodblock* *f* *tam-tam* *f*

Perc. III *cricket* *mf* *f*

Perc. IV *mp*

Vln. I

Vln. II

Vla. *mp*

Vcl. *mp*

Dbl. Bass

13

Picc. *mp* *mf*

Fl. *mp* *mf*

Ob. *mp* *mf*

Cl. *mp* *mf*

B. Cl. *mp* *mf*

Bass. *mp* *mf*

Cont. Bass.

Hn. *mp* *mf*

Trpt. *mp* *mf*

Trmb. *mp* *mf*

Tuba *mp* *mf*

Perc. I 13 *f*

Perc. II *f*

Perc. IV *f*

Vln. I *mp*

Vln. II *mp*

Vla.

Vcl. *pizz*

Dbl. Bass *mp* *mf* *f*

A. $\bullet = 132$

19

Picc. *fp*

Fl. *f*

Ob. *fp*

Cl. *f*

B. Cl. *f*

Bass. *fp*

Cont. Bass. *f*

Hn. *f*

Trpt. *fp*

Trmb. *f*

Tuba *f*

Perc. I 19 *ratchet* *f* *ff* *bass drum* *f*

Perc. II *crotales* *f* *large woodblock* *f* *slapstick* *f* *bowed tam tam* *p* *f*

Perc. III *vibraphone* *f* *cricket* *mf* *f* *mf* *f*

Perc. IV *f*

Vln. I 19 *fp*

Vln. II *fp*

Vla. *fp*

Vcl. *f* *pizz* *pizz*

Db. Bass *fp*

26

Picc. *f* *ff*

Fl. *fp*

Ob. *fp*

Cl. *fp* *fp* *fp*

B. Cl. *fp*

Bass. *fp*

Cont. Bass. *f* *ff*

Hn. *fp*

Trpt. *fp* *sfzp*

Trmb. *fp*

Perc. I *f*

Perc. II *f* *vibraphone*

Perc. III *f* *anvil* *brake drum* *anvil* *f*

Perc. IV *fp*

Vln. I *fp*

Vln. II *fp*

Vla. *fp*

Vcl. *fp* *arco*

Dbl. Bass *fp*

34 (8th)

Picc. *ff* *mf* *f* *mf* *mf*

Fl. *fp* *f* *mf*

Ob. *fp* *f* *mf*

Cl. *fp* *f* *mf* *mf* *f*

B. Cl. *fp* *f* *mf* *f*

Bass. *fp* *f* *mf*

Cont. Bass. *ff* *mf* *f* *mf* *mf*

Hr. *fp* *f* *mf* *f*

Trpt. *fp* *f* *mf*

Trmb. *fp* *f* *f* *mf*

Tuba *fp* *f* *f*

Perc. I 34 *p* *f* *mf*

Perc. II *f* *mf*

Perc. III *f* *mf*

Perc. IV *fp* *f* *f* *f*

Vln. I 34 *fp* *ff* *mf* *pizz* *pizz*

Vln. II *fp* *ff* *mf* *pizz* *pizz*

Vla. *fp* *ff* *f* *pizz* *pizz*

Vcl. *fp* *ff* *mf* *pizz* *pizz*

Dbl. Bass. *fp* *f* *ff* *mf* *pizz* *pizz*

suspended cymbal *p* *f* *mf*

to chimes

snare drum *mf*

slapstick *f* *f*

timpani *f*

42 (8th)

Picc. *f* *mf* *ff* *f*
 Fl. *mf* *f*
 Ob. *fp* *f*
 Cl. *mf* *mf* *f* *mf* *f*
 B. Cl. *mf* *f* *mf* *mf* *f* *mf*
 Bass. *f*
 Cont. Bass. *f* *mf* *ff* *f*
 Hn. *mf* *f* *mf* *mf*
 Trpt. *fp* *f* *mf*
 Trmb. *mf* *f*
 Tuba *mf*
 Perc. I 42 *chimes* *f*
 Perc. II *f* *mf*
 Perc. III *mf*
 Vln. I *pizz* *f* *pizz* *f*
 Vln. II *mf* *pizz* *f* *pizz* *pizz*
 Vla. *mf* *mf* *f* *mf* *pizz* *pizz*
 Vcl. *arco* *f* *mf* *pizz*
 Dbl. Bass *fp* *f* *mf*

C

(8^{me})

49

Picc. *mf* *f* *mf*

Fl. *mf* *f* *mf*

Ob. *mf* *f* *mf*

Cl. *mf* *f* *mf*

B. Cl. *mf* *f* *mf*

Bass. *mf* *f* *mf*

Cont. Bass. *mf* *f* *mf*

Hr. *mf* *f* *mf*

Trpt. *mf* *f* *mf*

Trmb. *mf* *f* *mf*

Tuba *f* *mf*

Perc. I *f* *tam-tam* *f*

Perc. II *mf* *f* *mf*

Perc. III *mf* *f* *mf*

Perc. IV *f* *f*

Vln. I *mf* *pizz* *f* *arco* *mf*

Vln. II *arco* *mf* *f* *mf*

Vla. *mf* *f* *mf*

Vcl. *mf* *pizz* *f* *arco* *mf*

Dbl. Bass *fp* *f* *mf*

56 (8^{va})

Picc. *ff*

Fl. *mf* *f*

Ob. *mf* *f*

Cl. *mf* *f*

B. Cl. *mf* *f*

Bass. *mf* *f*

Cont. Bass. *ff*

Hr. *mf* *f*

Trpt. *mf* *f*

Trmb. *mf* *f*

Tuba *mf* *f*

Perc. I *f* *to tam-tam* *tam-tam* *f*

Perc. II *mf* *f*

Perc. III *mf* *f* *ff* *f* *ff* *f*

Perc. IV *f* *ff*

Vln. I *mf* *f*

Vln. II *f*

Vla. *mf* *pizz*

Vcl. *mf* *f* *pizz*

Dbl. Bass *mf* *f* *pizz*

64 (8^{va})

Picc. *ff*

Fl. *ff*

Ob. *ff*

Cl. *ff*

B. Cl. *ff*

Bass. *ff*

Cont. Bass. *ff*

Hr. *ff*

Trpt. *ff* *f* *ff*

Trmb. *ff*

Tuba *ff*

Perc. I *ff* *ff* *f* *ff*

Perc. II *ff*

Perc. III *f* *ff*

Perc. IV *ff*

Vln. I *ff* *fp*

Vln. II *ff* *fp*

Vla. *arco* *ff* *pizz* *f*

Vcl. *arco* *ff* *pizz* *f*

Dbl. Bass *ff* *f*

bass drum

chimes

to xylophone

D

70

Picc. *pp* *mf* *p*

Fl. *pp* *mf* *p*

Ob. *pp* *mf* *p*

Cl. *pp* *mf* *p*

B. Cl. *pp* *mf* *p*

Bass. *pp* *mf* *p*

Cont. Bass. *pp* *mf* *p*

Hr. *pp* *mf* *p*

Trpt. *pp* *mf* *p*

Trmb. *pp* *mf* *p*

Tuba *pp* *mf* *p*

Perc. I *xylophone* *f* *ff* *pp* *to tam-tam*

Perc. II *marimba* *f* *ff* *pp* *to slapstick*

Perc. IV *f*

Vln. I *pp* *fp*

Vln. II *pp* *fp*

Vla. *pizz* *f*

Vcl. *pizz* *f*

Dbl. Bass *pizz* *f*

E

78

Picc. *mf*

Cont. Bass. *mf*

Trpt. *f* *mf* *f*

Tuba *f* *mf* *f*

Perc. I *tam-tam* *mf*

Perc. II *slapstick* *f*

Perc. III *large guiro* *mf < f*

Perc. IV *f*

Vln. I *fp*

Vln. II *fp*

Vla. *pizz* *f*

Vcl. *pizz* *f*

Dbl. Bass *pizz* *f*

xylophone *f*

marimba *f*

gong

85

Picc. *pp* *f*

Fl. *pp* *f*

Ob. *pp* *f*

Cl. *pp* *f*

B. Cl. *pp* *f*

Bass. *pp* *f*

Cont. Bass. *pp* *f*

Hr. *pp* *f*

Trpt. *f*

Trmb. *pp* *f*

Tuba *f*

Perc. I *mf* *f*

Perc. II *mf* *f*

Perc. IV *p* *f*

Vln. I *fp* *fp* *fp*

Vln. II *fp* *fp* *fp*

Vla. *f* *p* *f*

Vcl. *f* *pizz* *p* *f* *pizz*

Dbl. Bass *f* *pizz* *p* *f* *pizz*

93

Picc. *f*

Fl. *f*

Ob. *f*

Cl. *f*

B.Cl. *f*

Bass. *f*

Cont. Bass. *f*

Hr. *f* *mf* *f*

Trpt. *f* *mf* *f*

Trmb. *f* *mf* *f*

Tuba *f* *mf* *f*

Perc. I *f* *triangle* *mf*

Perc. II *f*

Perc. III *cricket* *mf < f*

Perc. IV *chimes* *f*

Vln. I *f* *mp* *f*

Vln. II *f* *mp* *f*

Vla. *p* *f* *mp* *f*

Vcl. *p* *f* *pizz* *mp* *mf* *f*

Dbl. Bass *p* *f* *pizz* *mp* *mf* *f*

F

102

Picc. *f*

Cont. Bass.

103

Hn. *f*

Trpt. *f*

Trmb. *f*

Tuba *f*

Perc. I *f* triangle *mf* ratchet *f*

Perc. II *mf* crotales *f* tam-tam *f*

Perc. III *mf* vibraphone

Perc. IV *mf* glockenspiel *f* slapstick

Vln. I *f* *p* *f* *pizz* *f*

Vln. II *f* *p* *f* *pizz* *f*

Vla. *f* *p* *f* *pizz* *f*

Vcl. *f* *pizz* *p* *f* *pizz* *f*

Dbl. Bass *f* *pizz* *p* *f* *pizz* *f*

G

111

Hn. *mf* *f*

Trpt. *mf* *f*

Trmb. *mf* *f*

Tuba *mf* *f*

Perc. I *f* triangle *mf* *f* ratchet *mf* *f* ratchet *mf* *f*

Perc. II *mf* crotales *f* large woodblock

Perc. III *mf* vibraphone *mf* *f* cricket *f* brake drum *f*

Perc. IV *mf* glockenspiel *f* slapstick

Vln. I *f* *pizz*

Vln. II *f* *pizz*

Vla. *f* *pizz*

Vcl. *f* *pizz*

Dbl. Bass *f* *pizz*

120

Picc. *mf*

Cont. Bass.

Hr. *mf* *f* *mf* *f*

Trpt. *mf* *f* *mf* *f*

Trmb. *mf* *f* *mf* *f*

Tuba *mf* *f* *mf* *f*

Perc. I 120 *to tam-tam* *mf* *tam-tam* *to rachel*

Perc. II *slapstick* *f*

Perc. III *anvil* *f*

Perc. IV

Vln. I 120 *pizz* *mf* *pizz* *sim.* *f* *pizz*

Vln. II *pizz* *mf* *pizz* *sim.* *f* *pizz* *sim.* *pizz*

Vla. *pizz* *mf* *pizz* *sim.* *f* *pizz* *sim.* *pizz*

Vcl. *pizz* *mf* *pizz* *sim.* *f* *pizz* *sim.* *pizz*

Dbl. Bass *pizz* *mf* *pizz* *sim.* *f* *pizz* *sim.* *pizz*

128 H

Fl. *mf*

Ob. *mf*

Cl. *mf*

B. Cl. *mf*

Bass. *mf*

Perc. II *mf* *vibraphone*

Perc. III *mf* *anvil*

Vln. I *mf* *arco* *pizz* *arco* *pizz* *arco*

Vln. II *mf* *arco* *pizz* *arco*

Vla. *mf* *arco*

Vcl. *mf* *arco*

Dbl. Bass *mf* *pizz* *pizz* *pizz*

137

1

Picc. *mf*

Fl. *mf*

Ob. *f*

Cl. *f* *mf*

B. Cl. *f*

Bass. *f*

Cont. Bass.

Perc. I 137 *ratchet* *ff* *mf*

Perc. II *tam-tam* *mf* *vibraphone* *mf*

Perc. III *f*

Perc. IV *chimes* *mf*

Vln. I 137 *pizz* *f* *mf*

Vln. II *f*

Vla. *f* *pizz* *mf* *pizz* *pizz*

Vcl. *f*

Dbl. Bass. *pizz* *mf* *pizz* *pizz* *pizz*

This image shows a page of a musical score, likely for a symphony orchestra. The score is written for multiple instruments, including Flute (Fl.), Oboe (Ob.), Clarinet (Cl.), Bass Clarinet (B.Cl.), Bassoon (Bass.), Contrabassoon (Cont. Bass.), Horn (Hn.), Trumpet (Trpt.), Percussion I (Perc. I), Percussion II (Perc. II), Percussion III (Perc. III), Percussion IV (Perc. IV), Violin I (Vln. I), Violin II (Vln. II), Viola (Vla.), Violoncello (Vcl.), and Double Bass (Dbl. Bass). The score is written in 4/4 time and includes various musical notations such as notes, rests, and dynamic markings like 'f' (forte) and 'mp' (mezzo-piano). The page number '144' is visible at the top left.

[illegible]

180 K

LS^{mf}

Picc. *mf* *f* *mf* *mp* *mf*

Fl. *mf* *f* *mf* *mp* *mf*

Ob. *mf* *f* *mf* *mp* *mf* *mp*

B. Cl. *mf* *f* *mf* *mp* *mf* *mp*

Bass. *mf* *f* *mf* *mp* *mf* *mp*

Hr. *mf* *f* *mf* *mp* *mf* *mp*

Trpt. *mf* *f* *mf* *mp* *mf* *mp*

Tuba *mf* *f* *mf* *mp* *mf* *mp*

Perc. I *mf* *mp* *mf*

Perc. II *mf* *mp*

Perc. III *to large guiro* *mf* *mp* *large guiro* *f*

Perc. IV *to small woodblock* *small woodblock* *mf*

188 (15^{ma})

Picc. 

Fl. 

Ob. 

B. Cl. 

Bass. 

Hr. 

Trpt. 

Tuba 

Perc. I 
mp *mf* *f*

Perc. II 
f *mf* *to chimes*

Perc. III 
mf *f*

Perc. IV 
mp *mf*

Dbl. Bass 

196 (15^{ma})

L

Picc. *f*

Fl. *f*

Ob. *f*

B. Cl. *f*

Bass. *f*

Cont. Bass. *f*

Hr. *f*

Trpt. *mf*

Tuba *mf*

Perc. I *f* *mp*

Perc. II *to marimba*

Perc. III *chimes* *to anvil* *anvil* *f* *mp*

Perc. IV *timpani* *f* *mp*

Vln. I *fp*

Vln. II *fp*

Vla. *pizz* *f*

Vcl. *pizz* *f* *mp*

Dbl. Bass *pizz* *f* *mp*

204

Picc. $\sharp\text{O.}$ pp

Fl. $\sharp\text{O.}$ pp

Ob. O. pp

Cl. O. pp

B. Cl. O. pp

Bass. O. pp

Cont. Bass. O. pp

Hn. 204 O. pp

Trpt. f

Trmb. O. pp

Tuba f

Perc. I 204 (S^{mb}) xylophone f ff

Perc. II marimba f ff

Perc. III mf crotales f ff

Perc. IV timpani f ff

Vln. I 204 (S^{mb})

Vln. II

Vla. $pizz$ mp f ff $pizz$

Vcl. $pizz$ f ff $pizz$

Dbl. Bass. f ff $pizz$

211

Picc. *mf* *p* *p* *mf*

Fl. *mf* *p* *p*

Ob. *mf* *p* *p* *mf*

Cl. *mf* *p* *p*

B. Cl. *mf* *p* *p* *mf*

Bass. *mf* *p* *p* *mf*

Cont. Bass. *mf* *p* *p*

Hn. *mf* *p* *p* *mf*

Trmb. *mf* *p*

Perc. I *mf* *mp* *p* *mf*

Perc. III *mp* *p* *mf*

Perc. IV *p* *mf*

Vln. I *pp* *mf* *mp*

Vln. II *pp* *mf* *mp*

Vla. *mp* *mf* *arco*

Vcl. *mp* *mf* *pizz* *arco*

Dbl. Bass *mp* *mf* *p*

M

217

Picc. *mp*

Fl. *mp*

Ob. *mp*

Cl. *mp*

B. Cl. *mp*

Bass. *mp*

Cont. Bass. *mp*

Hn. *mp* *fp*

Trpt. *mp* *fp*

Tuba *mp*

Perc. IV *mf*

Vln. I *mf*

Vln. II *mf*

Vla. *mf*

Vcl. *mf*

Dbl. Bass *pizz* *mf* *arco* *p* *pizz* *mf*

224

Picc. *mf*

Fl. *mf*

Ob. *mf*

Cl. *mf*

B. Cl. *mf*

Bass. *mf*

Hn. 224

Trpt.

Tuba

Perc. II *mf*

Perc. IV *f*

Vln. I 224 *8va*

Vln. II 224 *8va*

Vla. *pizz*

Vcl. *pizz*

Dbl. Bass *mf* *f*

233

N

Picc. *mf* *p > pp*

Fl. *p > pp*

Ob. *p > pp*

Cl. *p > pp*

B. Cl.

Bass.

Hr. *p* *mp* *p* *mp*

Trpt. *p* *mp* *p* *mp*

Trmb. *p* *mp* *p <* *mp*

Tuba *p* *mp* *p* *mp*

Perc. II

Perc. III *anvil* *>* *>*

Perc. IV *chimes* *f*

Vln. I *(5th)* *p* *pizz* *mp* *p*

Vln. II *(5th)* *p* *pizz* *mp* *p*

Vla. *p* *pizz* *mp* *p*

Vcl. *p* *pizz* *mp* *p*

Dbl. Bass *p* *mp* *p* *pizz* *mp*

[illegible]

254

Picc. *ff* *p* *mp* *mf* *fp*

Fl. *ff* *p* *mp* *mf* *fp*

Ob. *p* *mp* *mf* *fp*

Cl. *mf* *fp*

B. Cl. *mp* *mf* *fp*

Bass. *ff* *p* *mp* *mf* *fp*

Cont. Bass. *p* *fp*

Hn. *p* *mp* *mf* *fp*

Trpt. *p* *mp* *mf* *fp*

Trmb. *mf* *fp*

Tuba *f* *f*

Perc. I *to suspended cymbal*

Perc. II *to marimba*

Perc. III *to vibraphone*

Perc. IV *chimes*

Vln. I *pizz* *mp* *mf*

Vln. II *pizz* *mp* *mf*

Vla. *pizz* *mp* *f* *arco* *pizz*

Vcl. *pizz* *mp* *f* *arco* *pizz*

Dbl. Bass *pizz* *mp* *mf* *f* *pizz*

264

Picc. *mf* *mp*

Fl. *mf* *mp*

Ob. *mf* *mp*

Cl. *mf* *mp*

B. Cl. *mf* *mp*

Bass. *mf* *mp*

Cont. Bass. *mf* *mp*

Hr. *mf* *mp*

Trpt. *mf* *mp*

Trmb. *mf* *mp*

Tuba *mf* *mp*

Perc. I *p* *mf* *mp*

Perc. II *marimba* *mf* *mp*

Perc. III *vibraphone* *mf* *mp*

Vln. I *mf* *mp* *8va*

Vln. II *mf* *mp* *8va*

Vla. *pizz* *mf* *mp*

Vcl. *pizz* *arco* *mf* *mp*

Dbl. Bass. *pizz* *arco* *mf* *mp*

[illegible]

Picc. *mp* *f* *ff* *8va*
 Fl. *mp* *f* *ff*
 Ob. *mp* *f* *ff*
 Cl. *mp* *f* *ff*
 B. Cl. *mp* *f* *ff*
 Bass. *mp* *f* *ff*
 Cont. Bass. *mp* *f* *ff*
 Hn. *ff*
 Trpt. *ff*
 Trmb. *ff*
 Tuba *ff*
 Perc. I *ff* *p* *ff* *to snare drum*
 Perc. II *ff*
 Perc. III *ff*
 Perc. IV *ff*
 Vln. I *ff* *8va*
 Vln. II *ff* *8va*
 Vla. *mp* *ff*
 Vcl. *mp* *ff*
 Dbl. Bass *mp* *ff*

(*pp*)

281

Picc.

Fl.

Ob.

Cl.

B. Cl.

Bass.

Cont. Bass.

Hr.

Trpt.

Trmb.

Tuba

Perc. I

Perc. II

Perc. III

Perc. IV

Vln. I

Vln. II

Vla.

Vcl.

Dbl. Bass

snare drum

f

fp

p

287

Picc. *f*

Fl.

Ob.

Cl.

B. Cl.

Bass.

Cont. Bass.

Hr. *f*

Trpt.

Trmb.

Tuba

Perc. I *f* bass drum xylophone

Perc. II *f* tam-tam bowed tam tam *p* *f*

Perc. III cricket *f*

Perc. IV small woodblock

Vln. I *f*

Vln. II *f*

Vla.

Vcl.

Dbl. Bass *f*

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Rutgers University – New Brunswick, NJ <i>MA in Music Theory and Composition</i>	2000
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PROFESSIONAL EXPERIENCE

New Jersey Arts Collective – Belleville, NJ <i>Co-Founder and Artistic Director</i>	2000 – Present
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William Paterson University – Wayne, NJ <i>Adjunct Instructor of Music</i>	2002 – Present
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PERFORMANCES and LECTURES

Compositions Premiered by:

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