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Formula, moment, and IPS in Stockhausen's Evas Erstgeburt.

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FORMULA, MOMENT, AND IPS IN STOCKHAUSEN'S *EVAS ERSTGEBURT*

By

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DEDICATION

This thesis or dissertation is dedicated to my parents
Mr. Whaien Pan
and
Mrs. Michelle Pan
who have supported me during my educational studies.

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I would like to thank Dr. Rebecca Jemian for her patience and understanding during my work on this thesis. Dr. Jemian has worked with me arduously to get this thesis to its completed form. I would also like to thank Dr. Chris Brody for his encouraging words and enthusiasm throughout my two years of study at the University of Louisville. I would also like to thank Dr. Kirsten Carithers for her readiness to read my thesis and her course about “experimental” music. Without this course, I would be lost in trying to understand the musical climate that occurred throughout the mid-to-late 20th century. I would also like to acknowledge Dr. Rebecca Long for guiding me through my first year of graduate studies. Her course on Post-Tonal analysis and work with me helped in the creation of this thesis by instilling approaches to post-tonal music through our readings.

ABSTRACT

FORMULA, MOMENT, AND IPS IN STOCKHAUSEN'S *EVAS ERSTGEBURT*

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This analysis covers the form in Stockhausen's *Evas Erstgeburt*, the first act from his Monday opera, *Montag aus Licht.* It discusses the presence of Stockhausen's musical formula within this act and observes that his formula is integrated at several structural levels. This formula is a passage of music that determines the pitches, rhythms, and structure of all the music of Stockhausen's *Licht* cycle. This formula is a three-voice schema, and these three voices are named Michael, Eve, and Lucifer. While the formula creates landmarks in the music, which indicate towards form, a formula analysis is limited in describing the direction or role of the music in a section of music. Patricia Howland's Integrated Parametric Structures give a way to understand Stockhausen's music outside the formula perspective. These structures account for secondary parameters such as dynamics, articulation, register, and texture as crucial aspects to determine the amount of change between sections. These sets of labels stem from studies into segmentation, which deals with the grouping of certain notes into sets for an analysis.

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CHAPTER I: INTRODUCTION

Karlheinz Stockhausen developed and tailored multiple frameworks and devices such as moment form or formulaic writing to create new types of music. Alongside these new forms, he used serial processes to complement the music's structure. Through his serial process, Stockhausen was able to map out the extremities of music, which he described as the outer limits of human perception of certain aspects such as pitch, rhythm, and duration.[1] Stockhausen was a prolific speaker and frequently talked about his works in articles or interviews, and readers can learn about the composer's works from these sources. However, his descriptions and lectures usually feature general statements about his compositional process or philosophy, which may lack an investigation into the smaller details of the composer's work. Analysts such as David Lewin and John Dack have provided alternative methods for understanding Stockhausen's works. David Lewin's analyses centered around pitch class sets, in which he observed Stockhausen's use of a hexachord as pitch-class spaces that would transform into a different pitch space of hexachords. Dack's approach would analyze Stockhausen's sounds through Schaefferian theory, which focuses on perception of sound.[2] These writers offer ideas that can better describe the characteristics of Stockhausen's music. While these approaches

[1]Karlheinz Stockhausen, "Four Criteria of Electronic Music: with examples from '*Kontakte,*'" (Video, Oxford Union, 1972).

[2] The writings from these authors can be seen here: David Lewin, *Musical Form and Transformation: 4 Analytic Essays*, New Haven: Yale University Press, 1993; John Dack, "Strategies in the Analysis of Karlheinz Stockhausen's Kontakte für Elektronische Klänge, Klävier und Schlagzeug," *Journal of New Music Research* 27, no. 1-2 (1998): 84–119; Pierre Schaeffer, *Solfège de l'objet sonore*, Grand Prix de L'académie Charles-Cros: 1967-2005. Schaeffer's study focuses on the aspects and creation of sound. In this, he uses numerous audio clips to show that attack, duration, decay, pitch, and timbre affect each other.

may differ from Stockhausen's, both Lewin's analyses and Dack's analysis can be viewed as inspections of Stockhausen's ideas. In particular, these analyses can help in the understanding of Stockhausen's idea of moments, in which certain spans of music can be characterized by a distinguishable aspect.[3]

Stockhausen's works combine serialism with his concepts of form and sound.[4] In his composition *Momente* (1969), Stockhausen focuses on his idea of "moment." A moment is described by Stockhausen to be a section of music that is defined by its aspects: pitch, rhythm, or timbre.[5] He categorizes these aspects into groups and creates combinations with these groups. He names these groups with the letters, K, M, and D: K represents *klang* (noise), homophony, verticality, and periodic rhythms; M represents melody, heterophony, and asynchronous; and D represents measured duration, silence and polyphony.[6] *Momente* is created through varying combinations of these letters; each set of letters creates a moment. Moment forming is created by the combination of these moments and the degree of change between each moment.[7]

Alongside his concept of moments and moment form, Stockhausen composed with formulas. In *Mantra* (1970), Stockhausen created a small piece of music: a thirteen-note row over eight measures of music. This small formula is expanded to create the larger form of the composition of greater length. The thirteen notes of the row are expanded to create thirteen sections of the composition; therefore, this formula

[3] Karlheinz Stockhausen, "Lecture III: Moment-forming and integration (momente)," [sic] 1972.
[4] Stockhausen explains his shift of compositional style in an interview with Felder. David Felder and Karlheinz Stockhausen, "An interview with Karlheinz Stockhausen," *Perspectives of New Music* 16, no. 1 (1997): 94.
[5] Stockhausen, "Lecture III," 1972.
[6] Ibid.
[7] Ibid.

determines the structure of the music. This formula process can be combined with Stockhausen's idea of moments. Each of the thirteen sections can become a moment defined by a certain musical aspect. This combination of formula and moment is used in Stockhausen's subsequent work, *Licht,* an opera cycle of seven operas with an overarching formula structure.

Licht (*Seven days of the Week*), a monumental opera cycle that lasts more than twenty hours. The seven operas are named after each day of the week: *Montag* to *Sonntag*. Each opera derives its music from a "nuclear formula," which acts as the formal schema for the entire *Licht* cycle and dictates the structure, pitches, rhythms, tempos, articulations, and dynamics. Furthermore, this formula may exist in two distinct forms: the nuclear and superformula. The nuclear formula is the basic form of the formula, and it lacks the ornamentation or improvisations of the ornamented formula.[8] The formula represents the whole opera cycle, and each individual opera is a division of this cycle. These operas are sometimes referred to as "limbs" since they are parts of the larger whole, the *Licht* cycle.[9] Each of these opera limbs can be broken further into sub-limbs, which further breaks the music into smaller sections.[10] This paper focuses on *Evas Erstgeburt* (1988), the first act of the Monday opera (*Montag aus Licht)*.

In the formula, three voices represent the central figures of this opera cycle: Michael, Eve, and Lucifer.[11] These figures do not act like characters in traditional opera;

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[8] Jerome Kohl, "Into the Middleground," *Perspectives on New Music* 28, no.2 (1990): 273-274. The "kernel" that is frequently mentioned in Stockhausen's *Licht* formula is the smallest unit of the formula. Sometimes this is referred to as the nuclear formula (Kohl 267). Stockhausen also covers the idea of the formula and the kernel in an interview: Mya Tannenbaum, *Conversations with Stockhausen* (Clarendon Press: Oxford, 1987), 71.
[9] Ibid, 271 and 273.
[10] Ibid.
[11] Robin Maconie, *Other Planets: The Music of Karlheinz Stockhausen* (Oxford: Scarecrow Press, 2005), 409.

instead, they function more as manifestations of certain themes or ideas. In talking about these three, Stockhausen describes Michael as a combination of several people such as St. Michael and Michelangelo, and Michael acts as the opera's creator figure.[12] In opposition to Michael is Lucifer, who functions as a rebel and thinker. Lucifer likes complexity and rejects tradition.[13] Eve shares a namesake with Eve from the Abrahamic tradition. According to Maconie, she represents "the first woman (and seducer of man), evening, mother earth, a persona associated with continuity, changeability, temptation (carnal knowledge), and fecundity, but also honored as the sacred embodiment of motherhood."[14] These three main figures share their namesakes with their Biblical counterparts, and they dictate the music of the formula.

All three of these figures, Michael, Eve, and Lucifer, are present in the whole *Licht* cycle, and are referred to as formulas. They act as ideas such as structure throughout the individual operas. Just as the overarching organization of the operas is executed explicitly through the formula, the individual opera is also based on the formula; additionally, each scene has structural landmarks that spin out from the formula. The music between these landmarks—whether operas, acts, or scenes—remains flexible.

In the music, these figures are represented as musical ideas, and therefore, they are defined by certain intervals, rhythms, or gestures. Notably, the perfect intervals mostly occur in the Michael formula, and this formula mostly uses dotted rhythms.[15] The Eve formula is characterized by M3s, tritone intervals, and syncopated rhythms. The

[12] Robin Maconie, *Other Planets: The Music of Karlheinz Stockhausen* (Oxford: Scarecrow Press, 2005), 409.
[13] Ibid, 409.
[14] Ibid, 409.
[15] Kohl, "Into the Middleground" 271, 273.

Lucifer formula's unique interval is the rising m6, and this formula tends to use irrational divisions such as quintuplets, septuplets, or eleventuplets.[16]

Montag aus Licht (1988) is the Monday opera of this cycle. It contains three acts primarily focused on Eve. Before the first act, *Montags-Gruss* (Monday greeting) opens and introduces the first act, *Evas Erstgeburt*. The first act, *Evas Erstgeburt*, revolves around the births of seven animal children (*Tierknaben*) and seven dwarf children (*Heinzelmännchen*). These children are described as monstrous and awful singers. The character Lucifer rejects these children and commands that these children be rebirthed. At the end of this act, the children go back to the womb from which they originated. The second act, *Evas Zweitgeburt,* focuses on the births of seven boys named after the seven days of the week. The third act, *Evas Zauber* focuses on the abduction of several children from the second act by a female flautist.

The greeting and acts of *Montag aus Licht* comes on four notable CDs with recordings that contain recordings of the chorus, synthesizers, and recorded sound effects. These CDs contain the composer's realization of the works, and the recordings may be used in an actual performance. Each act and the greeting are recorded on separate CDs, and these CDs are numbered 36 according to the *Stockhausen-Verlag*.[17] each separate CD is assigned a letter from a-d. Therefore, the *Montag Gruss* is on disc 36a, *Evas Erstgeburt* is on disc 36b, *Evas Zweitgeburt* is on disc 36c; and *Evas Zauber* is on disc 36d.[18]

Evas Erstgeburt revolves around the numerous births of dwarf and animal children. This act has the following scenes: *In Hoffnung, Heinzelmännchen, Erste*

[16] Kohl, "Into the Middleground," 271-274.
[17] Karlheinz Stockhausen, *Montag aus Licht*, children's choir and *modern orchestra, Stockhausen-Verlag,* 1992. Liner notes.
[18] Ibid.

Geburts-Arie, Zweite Geburts- Arie, Knaben-Geschrei, Luzifers Zorn, and *Das Grusse Geweine*. A gigantic statue representing Eve gives birth to seven animal boys and seven *Heinzelmännchen* (dwarf children). As these children are born, they are nurtured by the women on the stage. However, due to the horrible singing of these children, Lucifer appears and forces the children back into the Eva statue's womb.[19] Each of these scenes' music and ideas are structured and conveyed by the formula.

In describing Stockhausen's formula process, Jerome Kohl discussed these ornamented formulas as acting as "middle-ground structures." These middleground structures are composed of smaller instances of the formula, and both levels of the formula can be composed of "moments." In Kohl's interview with Stockhausen, the composer referred to the parts of the music as moments.[20] Stockhausen would describe these moments as the persistence of an aspect or aspects. This moment will undergo a change, and the degree of change is important to Stockhausen's conception of moment.[21] When a parameter becomes changed, a new moment will begin or already has begun. Moments are defined by changes to musical parameters such as pitch, rhythm, duration, and dynamics, and in this Stockhausen defines two different types of changes: sudden or gradual.[22] These changes of musical parameters can inform when a new idea, section, or moment has occurred. While Stockhausen focused on the differences from one moment to another, a method for finding these changes is not thoroughly explained. Moments are defined by changes in a certain musical aspect, which acts as a wide net. While

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[19] Karlheinz Stockhausen, Preface to *Evas Erstgeburt* (Germany, Kürten, 1999), *xlvii-lvii*.
[20] Karlheinz Stockhausen and Jerome Kohl, "Stockhausen on Opera," *Perspectives of New Music* 23, no. 2 (Spring-Summer 1985): 24.
[21] Ibid, 25.
[22] Stockhausen, "Lecture III: Moment-forming and integration (momente)."

Stockhausen's descriptions of moments are broad, certain models can give a method for distinguishing moments.

To address the lack of vocabulary for analyzing post-WWII music, Patricia Howland proposes a model of "Integrated Parametric Structures" (IPS).[23] She observed that "segments" exist, but instead of being observed through a tonal system, one can observe qualities such as temporal density, spatial density, dynamics, register, and timbre.[24] Howland's main contribution creates labels for several IPS types: Tension/Release, Departure/Return, Symmetric, Directional, and Steady-State. Each of these IPSs categorizes one or more changes of sound between sections, which aid in identifying Stockhausen's idea of moments. Howland's IPS types can help identify sections or moments in *Evas Erstgeburt.*

Stockhausen combines both formulas and moments in *Evas Erstgeburt*. While these two concepts do not oppose each other, the level of interaction between the two devices may not always be clear. I argue that Stockhausen's formula usage is not strict, and his use of moments is as important to his formula. Although his processes are essential to the skeletal structure of the music, they do not always dictate the exact notes, rhythms, tempos, and dynamics in a passage or section. Firstly, this paper will investigate the formula's presence in these following scenes: *In Hoffnung, Heinzelmännchen, Erste Geburts-Arie, Zweite Geburts Arie, Knaben-Geschrei,* and *Luzifers Zorn.* Then, my paper

[23] Patricia Howland, "Formal Structures in Post-Tonal Music," *Music Theory Spectrum* 37 no. 1, (2015): 71.
[24] Ibid, 71.

will apply Howland's concept of IPS to observe possibilities of moments and observe the degree to which the formula informs the music's' moments.

CHAPTER II: NUCLEAR FORMULA

Stockhausen's *Licht* formula is a composed musical unit that determines the larger structures of the operas in his *Licht* cycle. This formula is divided into three separate voices: Michael, Eve, and Lucifer. The top voice contains the Michael formula; the middle voice has the Eve formula; the bottom voice is the Lucifer formula (example 1a).

Jerome Kohl, a prominent Stockhausen scholar, discusses the two types of *Licht* formulas – nuclear and superformula – in his article, "Into the Middleground: Formula Syntax in Stockhausen's *Licht.*" Examples 1a displays the formula in its nuclear form (otherwise known as the kernel form). The kernel form is the most basic version of the formula, it contains some of the pitches, rhythms, dynamics, and articulations that will be seen in the larger form of the opera. Its name is derived from Stockhausen's conceptualization of his formula. The nuclear formula is the smallest building-block of the whole opera cycle, and everything in the *Licht* opera cycle is based on the nuclear formula.[25]

The ornamented superformula form contrasts the kernel form; it is built upon the kernel form, but it has been elaborated with additional pitches, notes, and rhythms, and articulation. Example 2 shows the *Evas Erstgeburt* superformula, and in contrast to Monday section in the nuclear formula in example 1a, many additional notes reside in the superformula. In distinguishing the formulas, Jerome Kohl states that the superformula is "elaborated from the kernel by adding ornaments (*Akzidenzen*)" (example 2).[26] He further

[25] Kohl, "Into the Middleground," 265-267.
[26] Ibid, 267.

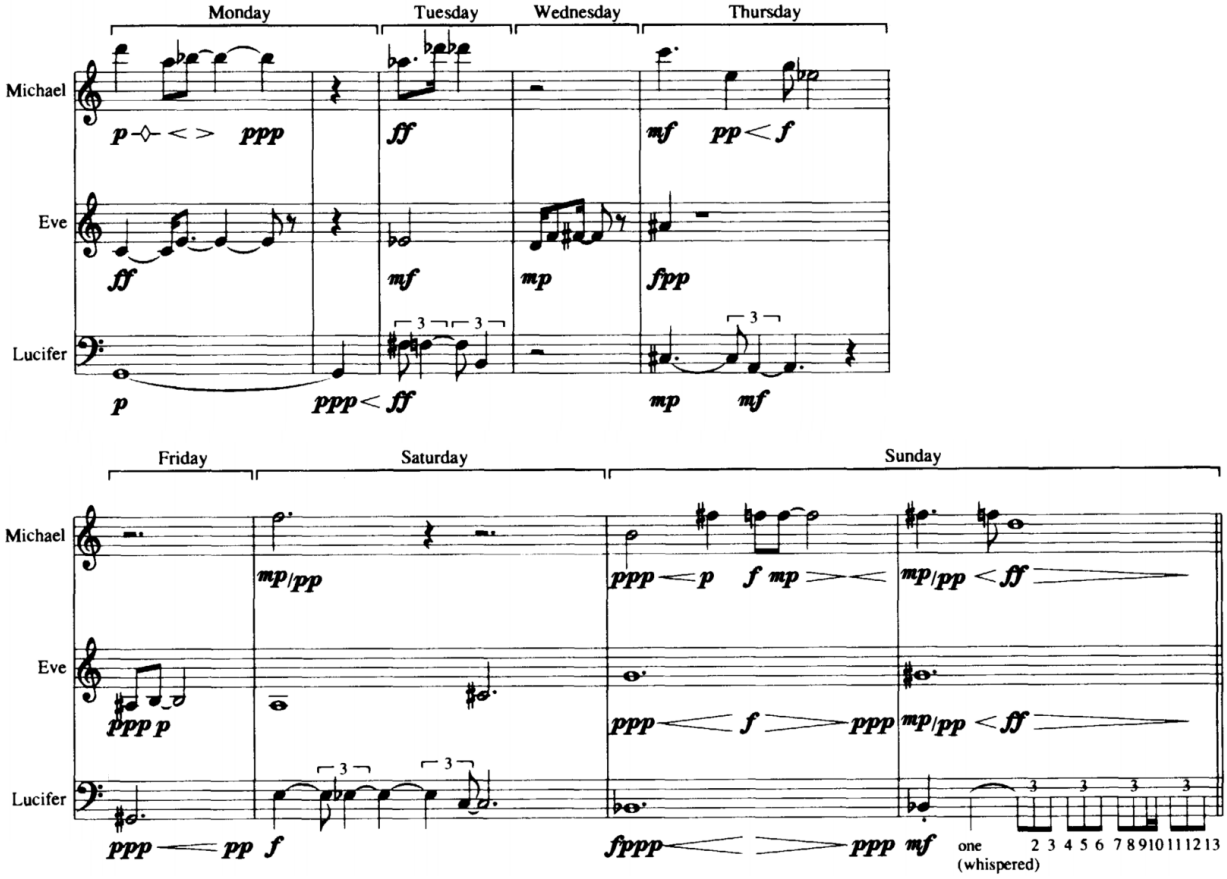
states that the opera's superformula sometimes has "coloration of the rests with soft noises" or "improvisations."[27] These instances Kohl mentions are meant to fill the space of duration in projecting the superformula over hours of music. For an example, in *Montag aus Licht,* a single note of the superformula may be held over fifteen to thirty minutes, but Stockhausen fills the duration span with additional music, which may be smaller and shorter instance of the superformula, "improvisations" or "colorations of rests with soft noises." Due to this, Kohl suggests that the kernel form is "less frequent."[28]

Jerome Kohl observes that cohesion is created through certain trichords in the nuclear formula. Firstly, although this formula seems set in a traditional three-voice division, the voices may overlap or borrow notes from each other. Notably, the Michael formula is a thirteen-note melody, while the Eve formula is a twelve-note melody, and the Lucifer formula is an eleven-note melody (example 1a).[29] He borrows Allen Forte's pitch-class set theory to analyze the formula's pitch content.[30] In this, Kohl observes the melodic pitches in and between each voice constructs a trichords with the prime form of [0 1 5], [0 3 4], or [0 1 4].[31] In this, the prime form is the most compact arrangement of pitches starting from a transposition of 0. Example 1a shows the nuclear formula of this piece. For the section of music labeled Monday, the Michael formula forms a [0 1 5]

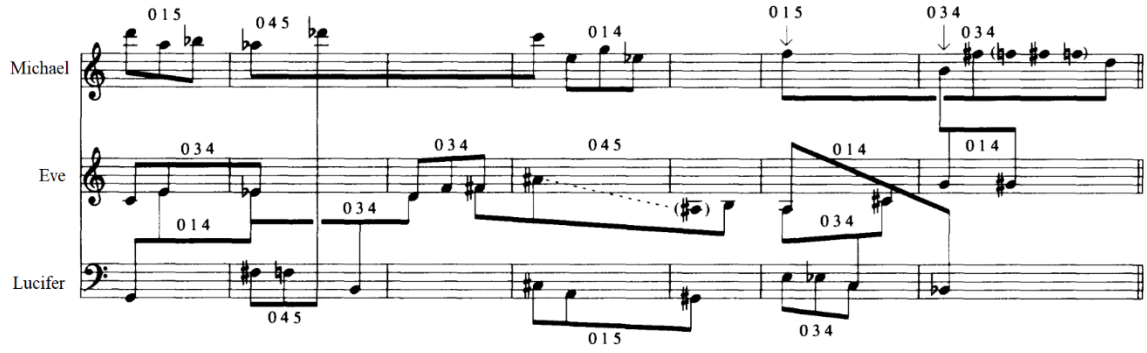
[27] Kohl, "Into the Middleground," 265-267.
[28] Ibid.
[29] Kohl, "Into the Middleground," 267.
[30] Allen Forte, *The Structure of Atonal Music,* (London: Yale University Press, 1973).
[31] Kohl, "Into the Middleground," 267.

trichord. Eve forms a [0 3 4] with the addition of the note from the Tuesday (*Dienstag*) opera. Lucifer borrows the E and E♭ from the Eve formula to generate a [0 1 4] (E♭ E G).

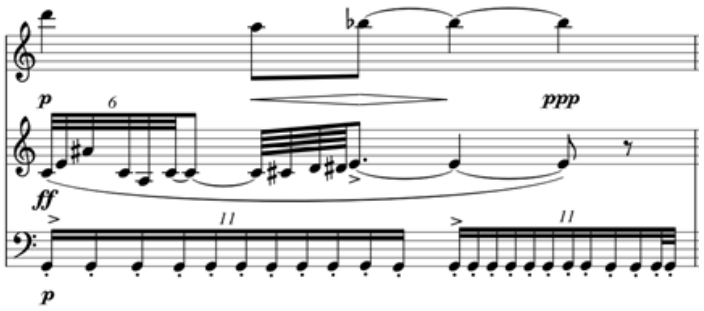
Example 1a: Nuclear Formula of *Licht* cycle[32]



Example 1b: Trichords and shared pitches in the Nuclear Formula



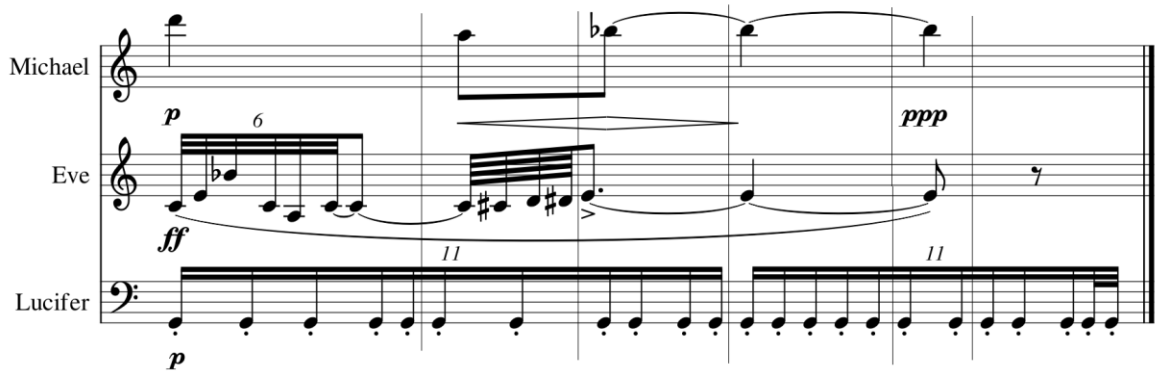
Example 2: Superformula for *Evas Erstgeburt* [33]



As the formula determines the whole structure of an opera act, similarly to the divisions of acts into individual scenes, the formula for an act can be divided into individual scenes. Example 3 divides the *Evas Erstgeburt* superformula into individual scenes with vertical lines. These notes can be found as structural notes within these scenes. These notes can exist as prolonged notes in one instrument voice or as smaller instances of a phrase. In example 4, synthesizer I contains the first note of the Michael formula in the first scene, *In Hoffnung*. This note is held for sixteen minutes until the next nuclear tone, A5, which arrives with the start of the next scene according to example 3. The second nuclear tone is held for around 14 minutes until the third note, B♭5, which occurs shortly after the beginning of scene three, *Erste Geburts-Arie*.

[32] Kohl, "Into the Middleground," 266.
[33] Stockhausen, Table of Contents in *Evas Erstgeburt*.

Example 3: Division of *Evas Erstgeburt*



Example 4: The Michael formula's appearance in *Evas Erstgeburt* in synthesizer I

Start of *In Hoffnung*	End of *In Hoffnung*	Start of *Erste Geburts-Arie*
Mm. 1	153	228

The durations of these nuclear tones may not seem to be neatly divided according to the note-values used. On his compositional process of his these operas, Stockhausen comments, "when I'm finished I see that my operas are at least one-third longer than what I originally planned, because during the work there is also the necessity of slowing down certain moments, leaving or making spaces longer, like so-called *ritardandos*, fermatas, etcetera."[34] Stockhausen may stretch or slow down certain passages, and although Stockhausen used a rigorous process, he gave himself and performers some

[34] Kohl, "Stockhausen on Opera," 31.

flexibility in the music. However, sustaining these nuclear tones is not the only instance of the nuclear formula or superformula. Smaller appearances of these formulae occur in the phrases of the scenes.

When selecting options for detecting these formula pitches and trichords, segmentation attempts to provide options in observing certain pitch-class sets. In his article, "Segmentation and Process in Post-Tonal Music," Christopher Hasty states, "[segmentation] refers more specifically to the selection of structurally relevant pitch components or pitch-class sets."[35] In this, Hasty discusses the multiple domains as deciding factors for grouping certain pitches such as dynamics, timbre, register, contour, or intervals. Each of these aspects is integral to Stockhausen's music as he emphasized the serialization of most sound characteristics. This chapter will analyze the music's use of the formula and detect its presence through these domains.

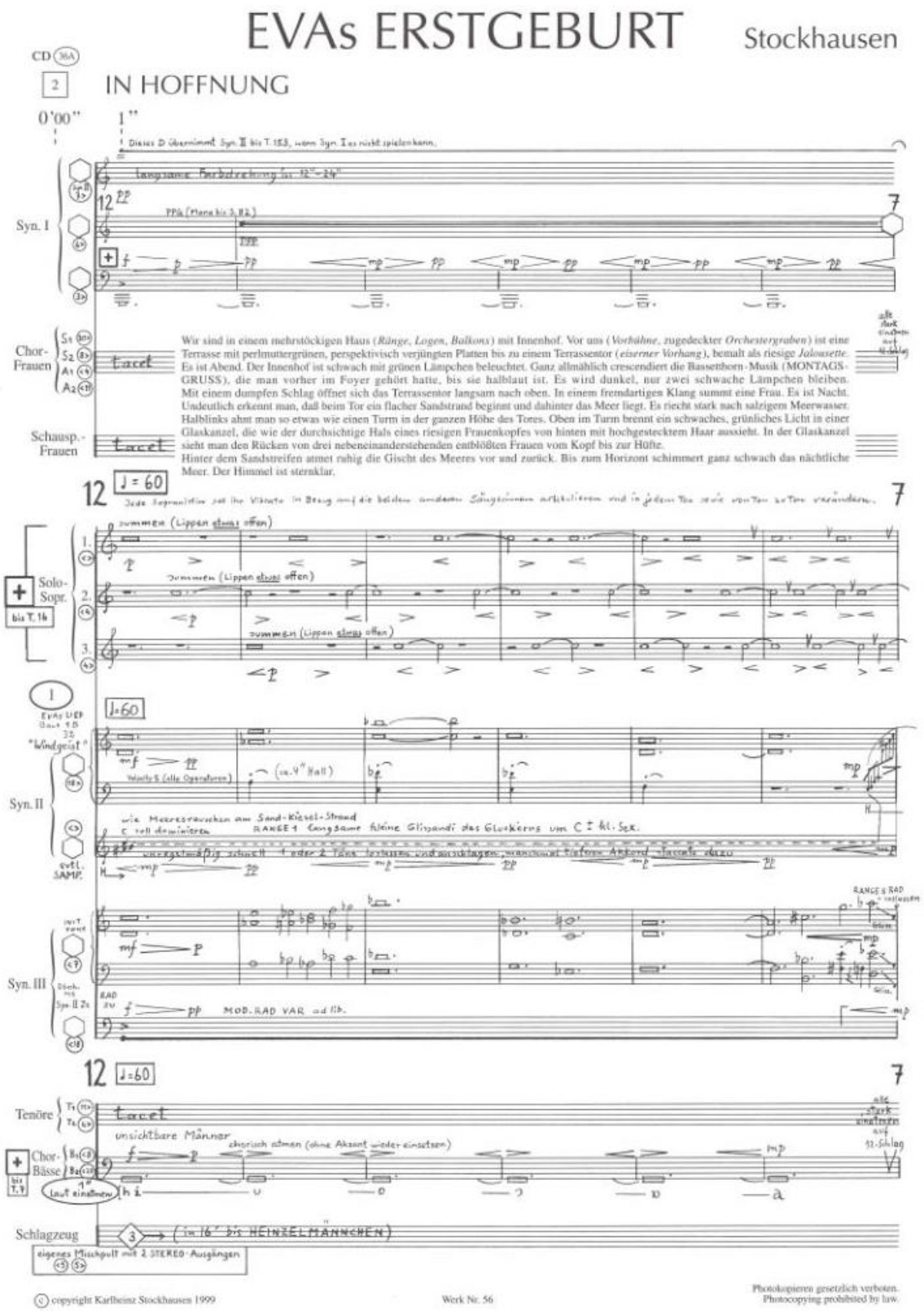
[35] Christopher Hasty, "Segmentation and Process in Post-Tonal Music," *Music Theory Spectrum* 3, (Spring 1981): 54.

IN HOFFNUNG

In Hoffnung, the first scene of *Evas Erstgeburt* in *Montag aus Licht*, comes after the *Montag Gruss* (Monday Greeting). Green lights (Eve's color) flood the theatre, and a flat beach near a starlit sea can be seen. A statue represents Eve in a pose sitting on the floor and leaning back in preparation for the numerous births during this act. Three solo sopranos stand near the statue and are prepared to wash the statue.

One can attempt to trace the formula in several parts in the score (example 5). *In Hoffnung*'s score is divided into three groups that can be attributed to the three figures of the opera: Michael, Eve, and Lucifer (example 3, on p. 13). The nuclear notes from the formula can be spotted in this opening section. In measure 1, D6 of the Michael formula can be seen in the top voice of synthesizer I, and it sustains this note for approximately sixteen minutes until the end of this scene. It changes to A5 before the next scene, *Heinzelmännchen*, and it is an instance of an audible prolongation of the nuclear tones. The *Eve* formula is featured in synthesizer I, the three solo sopranos, the "Windgeist" instrument in synthesizer II, and the top voice of synthesizer III. The Lucifer formula features in synthesizer I, synthesizer III, and bass chorus as well. The Lucifer formula primarily consists of one note for its kernel form, but his superformula form elaborates the note with an eleventuplet division (example 2, on p. 12).

Example 5: Opening of *In Hoffnung* mm. 1-6



In describing this scene's form, the score mentions that it features "nine periods" and states, "in the music of these nine periods, nine cycles can be heard, in which a musical formula grows and becomes increasingly alive."[36] This nine-cycle description is not specified or foretold by the nuclear or superformula. Rather than stemming from the formula, the selection of nine cycles in this scene probably reflects the nine-month gestation rather than a serial process.[37] Two notable sections precede the nine months of birthing (table 1). This table notes the CD track number, measure numbers, and time stamps to outline the sections in this scene. In this analysis, the CD track numbers originate from the *Montag aus Licht* score, and these numbers refer to the track list on the compact discs for this opera. In particular, since this comes after *Montags-Gruss, Evas Erstgeburt* is on the second disk, 36b, of compact CD collection. aid in a performance of this work. Much like rehearsal numbers, these numbers can be used to track possible sections in the music. Since these recordings are made by the composer, these recordings could be the composer's interpretation of the formula structure.[38]

Furthermore, tone scene recordings are included in these compact discs due to the difficulty of recording and mixing sounds. Tone scenes are instances of recorded sounds that feature in certain parts of the piece, and they may occur at the beginnings of a new section and may last till the end of the section.

On the score, the word, *Monat* (meaning month), appears in the top-right corners of the score to mark the start of a new cycle. In this scene, a *Monat* cycle usually consists

[36] Stockhausen, Preface to *Evas Erstgeburt*, *xlvii*.
[37] Maconie, *Other Planets*, 423.
[38] Stockhausen, Front matter to *Evas Erstgeburt.*

either of a few iterations of *Montag*'s *Evas Erstgeburt* formula or an iteration of the entire *Licht* formula.

Table 1: Track and *Monat* of *In Hoffnung*

Time	0'00	1'13''	2'25,6''	3'26,2''	4'34,7''	5'53''	7'17,'3''
CD Track	2	3	4	5	6	7	8
Measures	1	7	16	24	34	47	62
Monat			1	2	3	4	5

Time	8'51,1''	10'29,3''	12'19,9''	14'09'''
CD Track	9	10	11	12
Measures	78	95	113	133
Monat	6	7	8	9

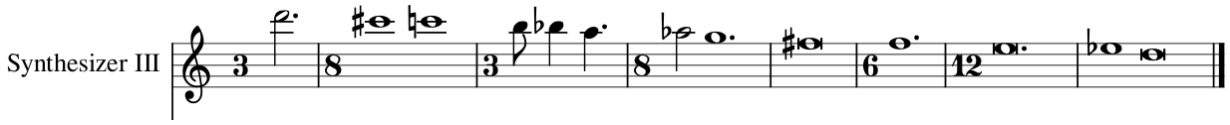
The beginning section that precedes the monthly cycles establishes the formulas in their respective parts, and it eventually leads into the nine-*Monat* cycle at m. 16. In this nine-*Monat* cycle, a growing musical formula can be seen in the gradual changes with each iteration of the cycle.[39] In *In Hoffnung*, the Michael formula does not initially start with its [0 1 5] trichord; instead, the scene begins with a Michael formula that uses a downwards chromatic line that slowly transforms into the Michael nuclear formula. The Eve formula contains multiple variations of the formula and gestures that are associated

[39] Stockhausen, Preface to *Evas Erstgeburt*, *xlvii*.

with Eve such as syncopated rhythm or glissandos. Lucifer formula remains consistent with its superformula by sustaining its pitch, but adds a few additional pitches.

To observe the process of the growing formula, this analysis shifts its attention to cycle 1 in m. 16. Synthesizer III, which is not usually associated with Michael, starts with the first note from the Michael formula and continues on with a distinctive chromatic descent. Through its shorter durations in the background of drone-like music, this part is distinct in register and duration. With the progression of each successive track and cycle, the music slowly forms into the *Licht* superformula. Example 6 shows the Michael formula in cycle 1, embellished with a chromatic descent.

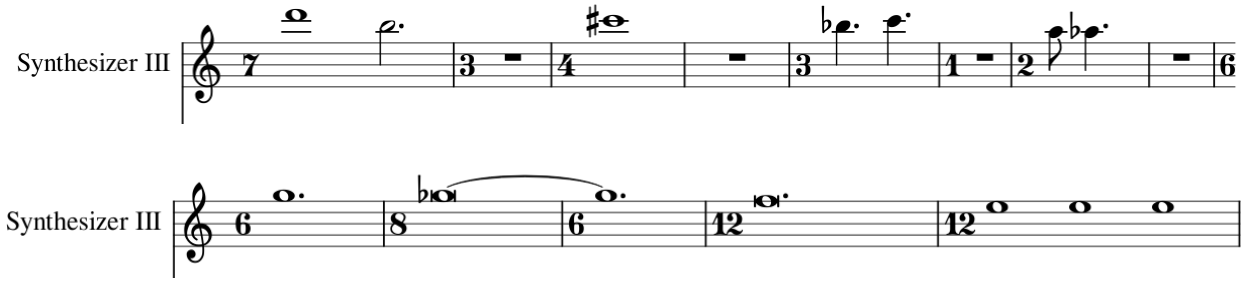
Example 6: Michael formula that starts as a chromatic descent, mm. 16-23



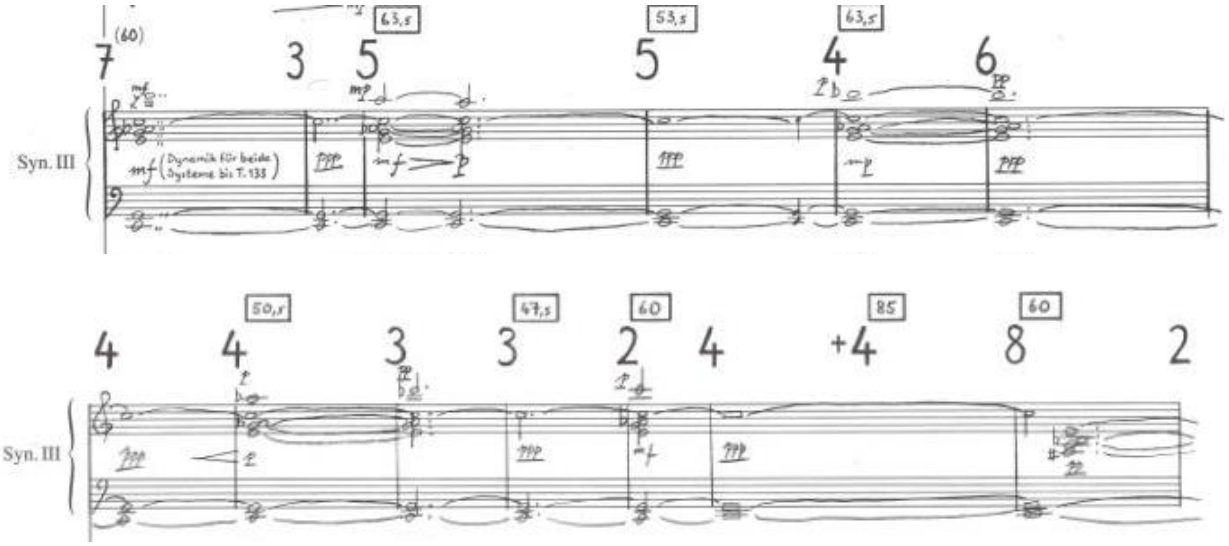
Synthesizer III starts on the same note (D6) in every cycle except one. The following pitches in each cycle slowly morph to resemble the Michael formula. In example 7a, cycle 3 has slightly changed note order to resemble the Michael formula. Example 7a shows synthesizer III sounding an incorrect trichord. In mm. 34-36, synthesizer III plays the trichord [D6-B5-C#6], which is different from the D6-A5-B♭5 trichord in the Michael formula. In terms of pitch content, the music is not a perfect match to the Michael formula, but in comparison to the chromatic descent in *Monat* 1, a closer match can be found through a contour. similar to this will eventually grow into a correct version of the Michael formula. Near the end of this scene, *Monat* 8 shows

synthesizer III using the [0 1 5] trichord from the Michael formula (example 7b). The Michael formula from the *Montag* limb grows into trichords, which can be identified with later formula limbs such as the [0 4 5] trichord formed from the two notes of the *Dienstag* formula and the first note of the *Donnerstag* formula [A♭5-D♭6-C6] (example 7b).

Example 7a: *Monat* 3, Synthesizer III top voice, mm. 34-41



Example 7b: *Monat* 8, Synthesizer III, mm. 113-125



I will refer back to table 1 and example 3 for my next analysis. The Eve and Lucifer formulas also undergo a cyclical *Monat* structure. The Lucifer formula primarily

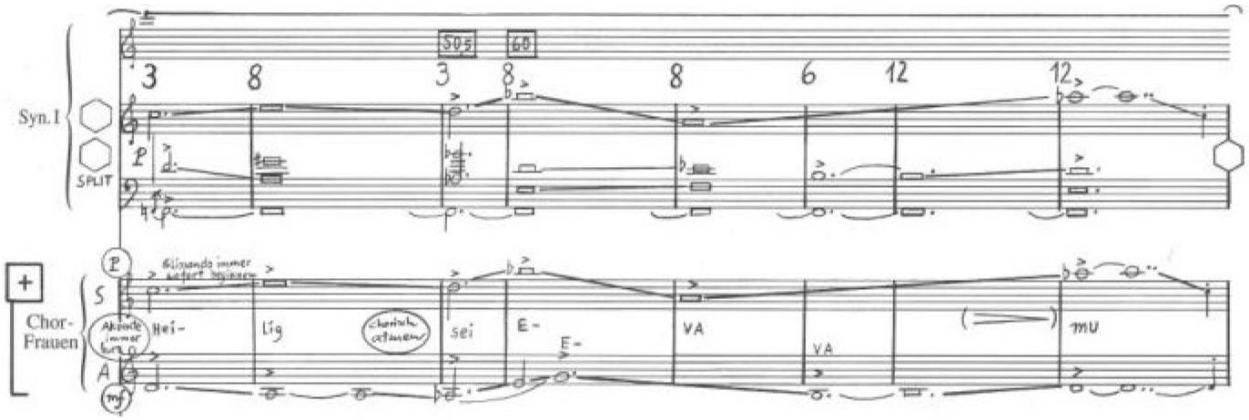
gravitates to its bass note, G2, which is the same note in the Lucifer superformula. Similarly to the sustained version of the Michael formula in the top voice of synthesizer I, the bass in synthesizer III sustains G2 throughout this scene. On a smaller level, the Lucifer superformula appears in full in this scene. As stated earlier, the Lucifer formula has eleven notes and each section in this scene can be related to a Lucifer nuclear tone (example 2, on p. 12). At m. 1, the bass sustains G2, which relates to the first note of the Lucifer superformula starting on *Montag*. In mm. 7-15, before cycle 1, the Lucifer formula moves to F#2. In *Monat* 1, the Lucifer formula moves to F2, and in *Monat* 2 it moves to B2. Each section in *In Hoffnung* adds to the Lucifer formula, which will lead to its completion to its eleven-note formula as seen in example 1.

The Eve formula exhibits a similar structure to the appearance of the Michael or Lucifer formulas. The first note, C5, sustains itself till the end of *In Hoffnung*. This note is an octave higher than the C4 in the Eve nuclear formula in example 1. The smaller appearances of the Eve formula occur at the start of a *Monat*. The Eve superformula's E5 occurs on the second section in mm. 7-15 before the first cycle.

The preceding paragraphs show that as the formula grows, Stockhausen also combines formulas to create different trichord or melodic connections. In example 8, a combination of formulas can be seen in synthesizer I. It sounds a melodic succession of pitches (C5-E5-D5-B♭5-A4-A♭5-C5). The starting melodic 3rd, C5 to E5 can be identified as part of the Eve formula. The appearance of note D6 does not fit with the notes of the Eve *Montag* superformula, but this pitch can be identified as part of the Michael formula. A trichord can be observed with the D6-B♭5-A5 from the Michael formula. While the kernel version of the Eve formula does not contain a B♭ following its

initial trichord, a B♭ does occur in the superformula version (example 2, on p. 12). This line continues on to A♭5 which is the next note of the Michael formula.

Example 8: Eve combines with Michael mm. 16-23



Alongside the formula process that grows, this scene's number of beats per measure also grows. The number of beats per measure within a *Monat* has slight invariance. Table 2 shows the beats per measure and invariance in each of the nine *Monate*. In this, each number to the right of the *Monat* number (M#) shows the number of beats per measure, and the order of beats per measure should be read from left-to-right. For example, Cycle 4 has the following beats per measures: 7 3 5 4 4 5 1 3 2 8 6 8 6 12 12. These measure numbers can be grouped into the following groups: (7 3 5), (4 4 3), (1 3), (2 8 6), and (8 6 12 12). Certain groups of beats frequently recur such as: (7 3 5), (4 4 3), (2 8 6) [and its variant (8 2 6)], and (8 6 12 12).

Table 2: *In Hoffnung* Number of beats per measure in the cycles

M1		3					8 (4+ | 4)*	3				8						8	6	12	12
M2	7							4	3						2	8	6		8	6	12	12
M3	7	3						4	3	1					2	8	6		8	6	12	12
M4	7	3	5				4	4	3	1	3				2	8	6		8	6	12	12
M5	7	3	5	5	4		4				3	2			8	2	6		8	6	12	12
M6	7	3	5	5	4	6	4	4			3	2			8	2	6		8	6	12	12
M7	7	3	5	5	4	6	4	4	3		3	2	8	8	8				8	6	12	12
M8	7	3	5	5	4	6	4	4	3		3	2	4	4	8	2	6	4	8	6	12	12
M9	4	6	5	5	4	6	4	4	3		3	2	8	8	2	8	6	4	8	6	12	12

M# = *Monat* number

NOTE: Read this table from left-to-right for the number of beats per measure. E.g., M1 has eight measures with the following beats per measure in sequential order: 3 8 3 8 8 6 12 12.

* Additionally, the parentheses show a possible re-distribution of beats per measure.

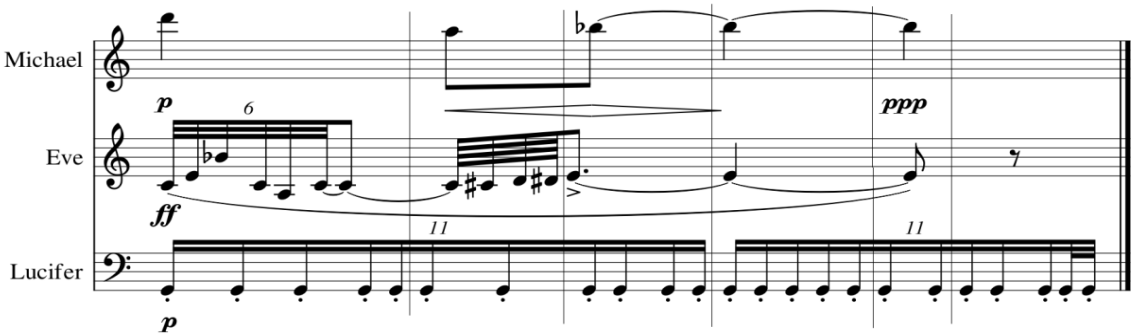
Referring to table 2, this analysis observes that the beats per measures that end each *Monat* are the same: (8 6 12 12). *Monate* 4 through 8 all start with (7 3 5), and near the latter half of these *Monate,* (2 8 6) or a variation (8 2 6) is frequently reused. In the overall progression of these *Monate,* the number of measures steadily increases. While most of the beats per measures are replicated, some discrepancies can be spotted in this table. Firstly in *Monat 1,* an eight beat per measure occurs in *Monat* 1. The placement of the (3 8 3) beat per measure sequence fits mostly with the sum of two measures of four beats per measure. Secondly, *Monat* 9 might have a different beat per measure for its first two measures. However, the sum of this measure, (4+6), is equal to 10, which is the same sum of the previous *Monate* (7+3). Lastly the (3 2 8 8) grouping in *Monate* 7 and 9 is not replicated in *Monat 8*. However, the durations and formula placement of the (3 2 4 4) beats per measure are similar to the (3 2 8 8) sections; therefore the (4 4) group can be seen as a halving of the beats per measure.

The *Licht* nuclear formula and superformula create the structure in *In Hoffnung*. The *Licht* superformula creates the structural pitches that are sustained in the opera's overall form, and it also creates the structure in *In Hoffnung*. Certain structural notes can be directly attributed to the *Licht* nuclear formula (example 1, on p. 11) or the *Montag* superformula (example 2, on p. 12). The following scenes will have either a similar cyclical form or a through-composed form. *Heinzelmännchen* is the next scene, and it will use a similar cyclical form.

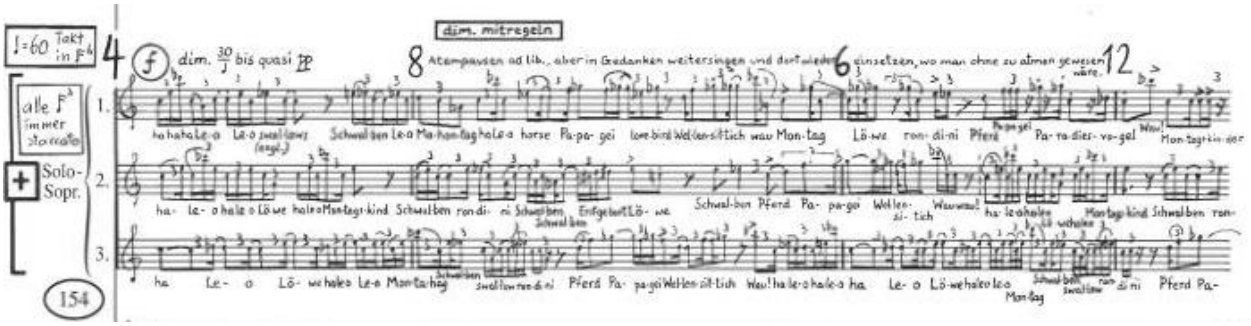
HEINZELMÄNNCHEN

After the nine cycles of gestation in *In Hoffnung*, Eve undergoes five labors and eventually gives birth to seven animal children and seven dwarf children in *Heinzelmännchen*. In this scene, the Michael drone in synthesizer I moves from D6 to A5. The Lucifer formula continues its drone mostly on bass note, G2. The Eve superformula features prominently in the three solo sopranos throughout this scene. The first birth arrives at the start of this scene, and a lion-child is born. The next three birthing labors are sectioned into consecutive and ascending half-step transpositions of these formulas. The second birthing labor and first transposition occurs on Eve superformula note, C#4. The third birthing labor and second transposition occurs on Eve superformula note, D4. The fourth birthing labor and third transposition occur on Eve superformula note, E♭4 (enharmonically D#4). The fifth and final birthing labor occurs on a different and final section. Example 9a shows the three solo sopranos using the Eve superformula at m. 154, and example 9b shows the superformula transposed up a half-step. This transposition repeats four times, and example 10 shows a reduction of this scene's form.

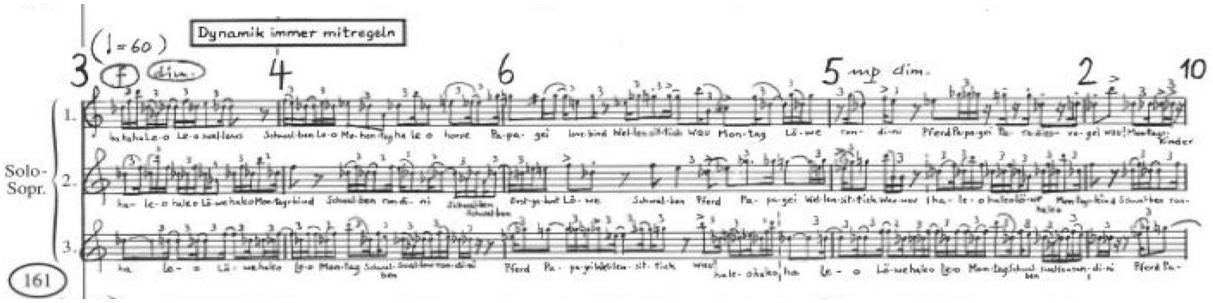
Example 3: (reprinted): Division of *Evas Erstgeburt*



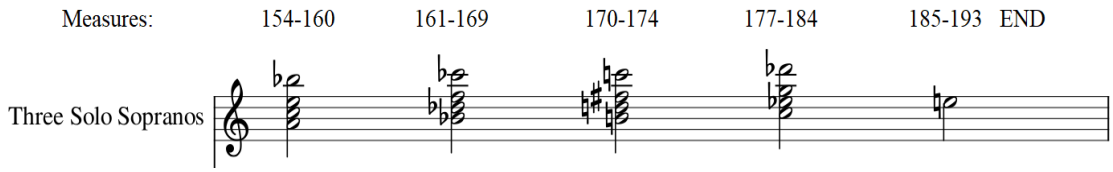
Example 9a: Eve superformula in *Heinzelmännchen* m. 154-157



Example 9b: *Heinzelmännchen* Eve Formula raised by a half-step m. 161-165



Example 10: Eve formula occurring structurally



The three voices sing various pitches seemingly outside the Eve formula. With C5 as 0, they sing [0 1 2 3 4 5 6 8 9 10]. The Eve formula consists of [0 4 10] in its overall form, and one of her superformulas has a chromatic run of C5, C#5, D5, and D#5 [0 1 2 3]; thus, the outside pitches are 5, 6, 8, and 9. Although 5, 6, 8, and 9 have no obvious trace to the formula, these notes can be deduced as further elaborations of the superformula. The trichord of the Eve formula [0 4 10] is written in each note of the chromatic ornamentation. Pitch classes 5 and 6 can be justified through extensions of this limb of the formula. Only pitch class 8 and 9 may be ambiguous. Pitch class 9 is A, which can correspond to the Michael formula's A, and it is part of the Eve superformula note, A. The note 8 can be considered the inverse interval of the M3 in the Eve formula or considered as an enharmonically spelled G# for the Eve formula on E.

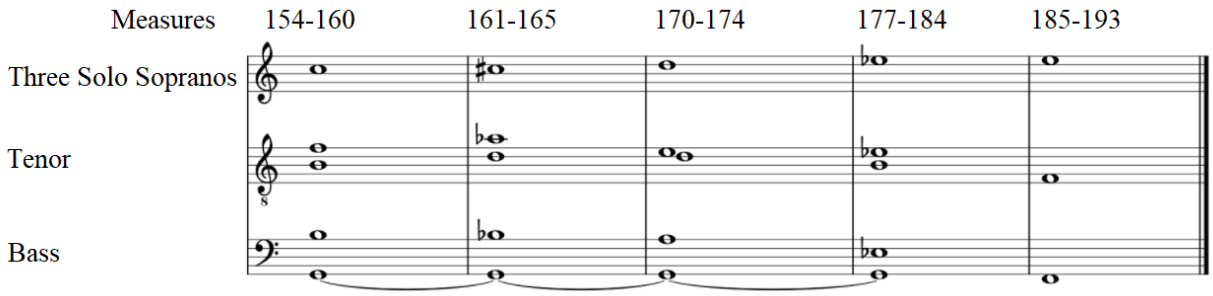
The three solo sopranos continue to sing the *Montag* Eve superformula. The supporting harmonies in the synthesizer, bass, or tenor sometimes use notes from the formula as well, although a direct connection with the formula is not clear. Example 11 shows a reduction of some of the drone pitches in this scene: the three solo sopranos in the top voice, tenor in the middle, and bass in the bottom. The three solo sopranos fulfill the superformula's chromatic step-wise transpositions. The bass maintains a G2 pitch, with additional notes that do not seem to be part of the formula: B3-B♭3-A3-E♭3. The

superformula for the *Montag* cycle shows that the Lucifer formula contains only an eleventuplet of note, G2. The superformula for the next two acts in the *Montag* opera explains these pitches.

The bass pitches can be found in the *Evas Zauber* superformula in the third act. These pitches can combine to create the same trichords found through *Montag* superformula. Sets [0 1 4] and its inversion [0 3 4] can be found with a combination of the bass notes, G2-B2-B♭2, which is the inversion of G2-G#2-B2. A-E♭-F can be seen as the same trichord as the starting notes [0 2 6] of the Eve superformula. However, some of the pitches used in these trichords are shared between formulas as well: B4 in the tenor and B3 in the bass in the first measure of the reduction; E♭ between the three solo sopranos (E♭5), tenor (E♭5), and bass (E♭3) in the fourth measure of the reduction, and F between the bass (F2) and tenor (F4) in the fifth system of the reduction. These formula trichords sometimes share their notes among the three figures. The E♭5 and E♭3 belongs to the Eve formula and is enharmonic to D#4 in the superformula. The B3 and is connected to the B2 in the Lucifer superformula. The F3 is to the F3 in the Lucifer *Evas Zauber* superformula. However, the tenor sings an F5 in the first system of this reduction. The previous scene, *In Hoffnung*, ended with a full rotation of the superformula, ending on *Sonntag*'s superformula. The Michael *Sonntag* superformula contains a B5 and F5. Therefore, the tenor of the first system is sustaining the *Sonntag* formula. The following

systems and tones can be seen borrowing the Eve *Sonntag* formula's G#/A♭, and the D can be seen in the *Sonntag* formula as well.

Example 11: Reduction of drone pitches in *Heinzelmännchen*



Alongside the use of the formula to inform its structure, *Heinzelmännchen* demonstrates the different speeds at which these formulas can be performed. Table 3 (on p. 31) shows a list of Stockhausen's notated measure groupings, and it separates each superformula section into three distinct measure groupings. Each structural superformula note has a set number of beats. The first section of *Heinzelmännchen* lasts for sixty beats. Soprano I has music that lasts for twenty beats; therefore, it repeats three times in a sixty-beat cycle. Soprano II has a cycle that lasts for thirty beats and repeats twice. Soprano III has a music cycle lasting twelve beats and repeats five times. The three solo soprano's cycle durations are divisions of sixty, and the music's beats per measure do not cleanly align with the three solo sopranos. The beats per measure listed for the first superformula section is divided into 4-8-6-12-10-14-6 beats (adding up to sixty beats). These divisions do not neatly fit with the soprano cycles of Eve formulas, but some math can be used to alter some of the measure divisions. The beats of the measures can be redistributed as 4-

8-6-(2+10)-10-14-6, with each number representing a single measure of varying beats. Table 3 shows some reoccurrence of beats patterns in these measures. Frequently, groupings of 10-10, 4-8-6-2, and 14-6 beats can be seen recurring at different parts of the superformula.

A new section of music breaks the regularity of the Eve formula in the three solo soprano sopranos, and it includes small snippets of the Eve formula. This grouping avoids the same periodic twenty-beat grouping usually found between the sections of the nuclear tones. While the cyclical process has been continuous, a short break lasting seventeen beats occurs between the D5 and E♭5 sections of the superformula. Stockhausen marks a measure grouping of 10-7 in the score. The measure of ten beats can be redistributed into 6-4. The first six beats have music for the three solo sopranos. This is paused for a recording, "tone scene 5," which lasts for four beats. Another set of music occurs and lasts seven beats. On the C5 of the Eve formula that starts *Heinzelmännchen*, the music presented lasts sixty beats. Consequently, the C#5 and D5 also last sixty beats.

Table 3: Beats per measure in *Heinzelmännchen*

Formula notes	Beats per measure						
C5	4	8	6	12 (-10) *			= 20
	12 (-2) *	10					= 20
	14	6					= 20
D♭5	3	4	6	5	2		= 20
	10	10					= 20
	13	7					= 20
D5	8	12					= 20
	10	10					= 20
	20						= 20
	10	7					= 17
E♭5	4	8	2	6			= 20
	16	4					= 20
	10	10					= 20
E5	4	8	8				= 20
	5	5	6	4	4	6	= 30

Formula note column shows the superformula note that the music is built. The numbers used are the beats per measure that are arranged into groups of 20. Nearly every superformula note in the chromatic run in the Eve formula is sixty beats long.
* This beat per measure of 12 is shared, but can be split into a 2 + 10 distribution.

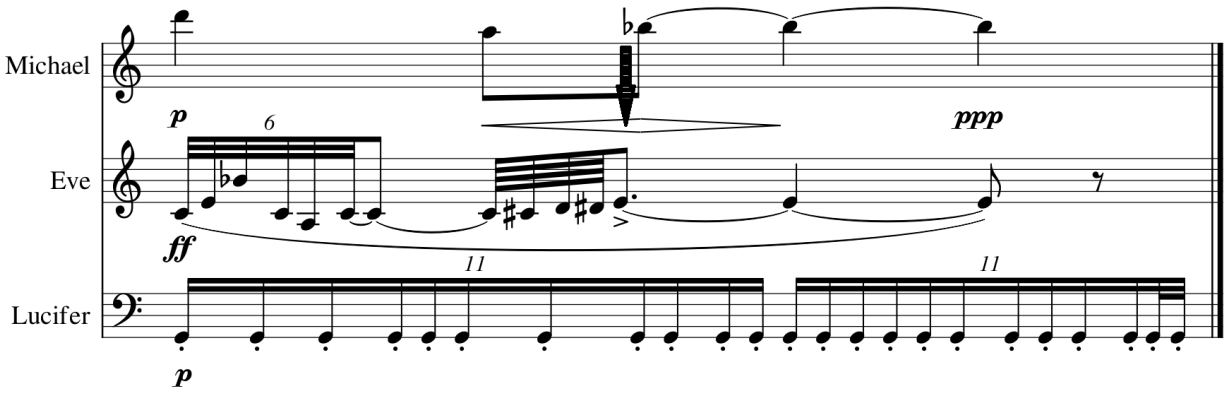
Aurally, one can consider this scene as a singular section. The cyclical process in this scene can be considered a single part of the act's overall structure. The music's texture and its use of the formula remains static, and the significant change is the chromatic transposition in accordance to the superformula chromatic ascent in the Eve formula. In the overall structure of the opera, this act depicts a singular idea: the numerous births of the *Heinzelmännchen* and animal children. This act's role and music could be considered as a collective whole as it reuses the same texture and process. However, a different reading observes that every note in this superformula Eve structure can be considered a section. Furthermore, each transposition of the Eve superformula can be divided into smaller units as well. This division will be revisited in chapter III in "*Heinzelmännchen* revisited."

After this rotational process, a short section of different music ends this scene. Lucifer makes a short appearance denouncing the children. With Lucifer's arrival, the three solo sopranos gasp and call his name, but Lucifer slinks back to the dark waters.

ERSTE GEBURTS-ARIE

This scene continues from the previous Eve superformula note, E4, from the previous scene, which was transposed to E5 (example 12). This scene arrives before the B♭5 in the Michael formula. In this scene, the three solo sopranos thank Eve for birthing her children, and solo soprano III eventually names the *Heinzelmännchen*. The women actors on the stage clothe and seat the *Heinzelmännchen* alongside the *Tierknaben* that were born from the previous scene. This scene lacks the cyclical process used in the previous two scenes and is through-composed. Texturally, the music focuses on the aria of the three solo sopranos. The other instruments and voices continue to accompany the sopranos with their formulas. Synthesizer II doubles solo soprano I; synthesizer I doubles solo soprano II; and synthesizer III doubles solo soprano III. Although the music still pulls its materials from the formula, this scene does not repeat musical materials in a similar fashion.

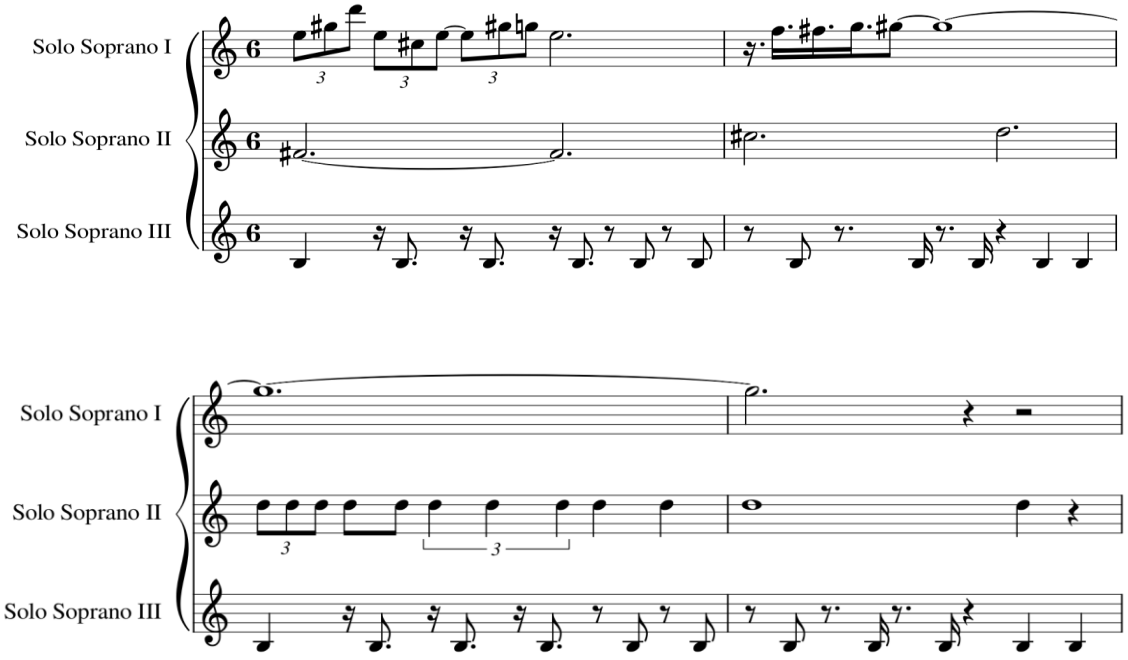
Example 12: *Erste Geburts-Arie* location in the superformula



Throughout this scene, the music continues to use the intervals, rhythms, and trichords that Jerome Kohl outlines.[40] At the beginning, the sustained Michael formula continues in synthesizer I with the sustained nuclear tone, A5. The three solo sopranos sing all three formulas—Michael, Eve, and Lucifer. These formulas are transposed by T4 (example 13). In the previous scenes, these three solo sopranos mostly sang the Eve formula, but now they borrow the Michael and Lucifer formula to re-establish the *Evas Erstgeburt* formula's presence in the music. Soprano I has an Eve superformula transposed by T4: [0 4 t] -> [4 8 2]. The Michael formula appears in soprano II, and it undergoes the same T4 transposition. The Michael formula's appearance might not be immediately understood, but the pitches, [F#4-C#5-D5], can be rearranged into a [0 1 5] set. The Lucifer formula also undergoes a T4 transposition with G moving to B.

[40] Kohl, "Into the Middleground," 270-271 and 273.

Example 13: The three solo sopranos singing the three formulas, mm. 194-197

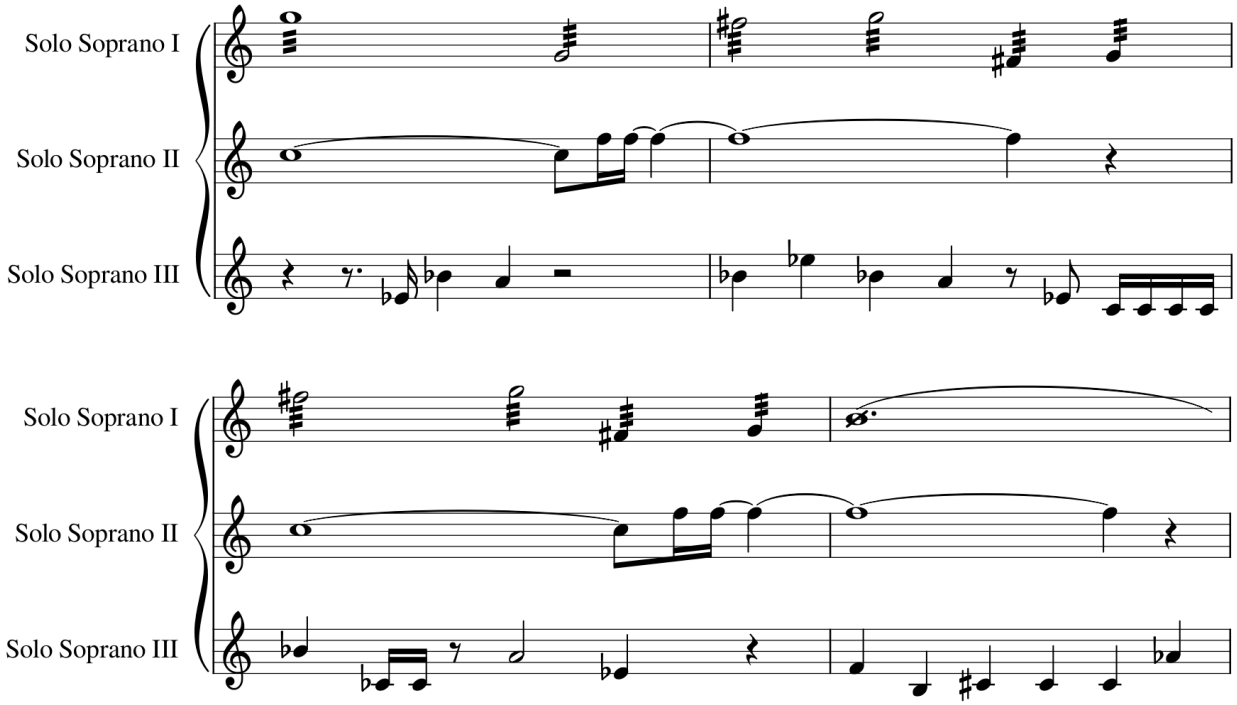


Pitch collections are not the only aspect associated with the three formulas. Similarly to the trichords in the nuclear formula, some rhythms represent Michael, Eve, and Lucifer in the formula. Short pulses and complex subdivisions are characteristic of the Lucifer formula. Syncopated rhythms represent Eve, and dotted rhythms represent Michael. However, not every instance of these types of rhythms should be immediately associated with a formula. For an example, soprano III, as shown in example 13, shows a few characteristics of the Lucifer formula. A two-measure pattern of eleven attacks reflects the eleventuplet in the Lucifer superformula. The slightly syncopated rhythm resembles the Eve formula, but the pitch content and number of attacks makes solo

soprano III's part lean towards a representation of Lucifer's *Evas Erstgeburt* superformula.

Throughout this scene, less clear iterations of the superformula are interspersed in the following sections in this scene. For instance, example 14 shows some of the difficulties of spotting the formulas in the three sopranos.

Example 14: The three sopranos, mm. 206-209



In example 14, some traces of the formula can be seen in the three sopranos. The soprano I pitches, [G5/G4-B4-F#5/F4], can be interpreted as a [0 1 5] set, a trichord harmony from Michael formula. The soprano II dyad, C5-F5, is a P4, an interval that Kohl attributes to the Michael formula.[41] The music in soprano III can be loosely traced

[41] Kohl, "Into the Middleground," 28.

to a combination of formulas. The ascending P5, E♭4-B♭4, in m. 206 is followed by a descending half-step, which can be traced to the intervals in the Michael formula. Measures 208-209 contain a transposition of the Lucifer formula. The rising 7th interval leading into m. 208 can be seen as part of the *Evas Zweitgeburt* superformula. The falling 7th can be traced to the Lucifer superformula in *Evas Zauber*. The half-step descent followed by an augmented 4th descent can be seen in the Lucifer *Dienstag* formula. Furthermore, [E♭4 B♭4 C♭4] in mm. 207-208 or [F5-C#5-C5] in m. 209 are [0 1 4] trichords. Tracing these pitches from soprano III to the formula eventually leads to a vague outline of the Lucifer superformula with the quarter notes [F4-B4-C#4] in solo soprano III's part in mm. 209. The F4 and B4 is from the *Dienstag* nuclear formula, and the C#4 comes from the *Donnerstag* nuclear formula (example 1 on p. 11).

While these outlines can be drawn, other formula aspects such as Michael's P4 interval in soprano II can be a weak connection to the superformula. Furthermore, depending on the selected pitches, the music in soprano III in example 14 can be arranged into portions of either the Michael or the Eve formulas. The M3s, C♭4-E♭4, creates an association to the Eve kernel in the *Montag* formula while the perfect interval, E♭4-B♭4, can be associated with the Michael formula. Additionally, these examinations do not show the connection between sections or the form of this through-composed aria. The formula can help with finding the durationally longer appearances of the formula in the synthesizer voice, which spans over several scenes, and it can also help detect the shorter appearances on the surface level. However, the formula's characteristics are not enough

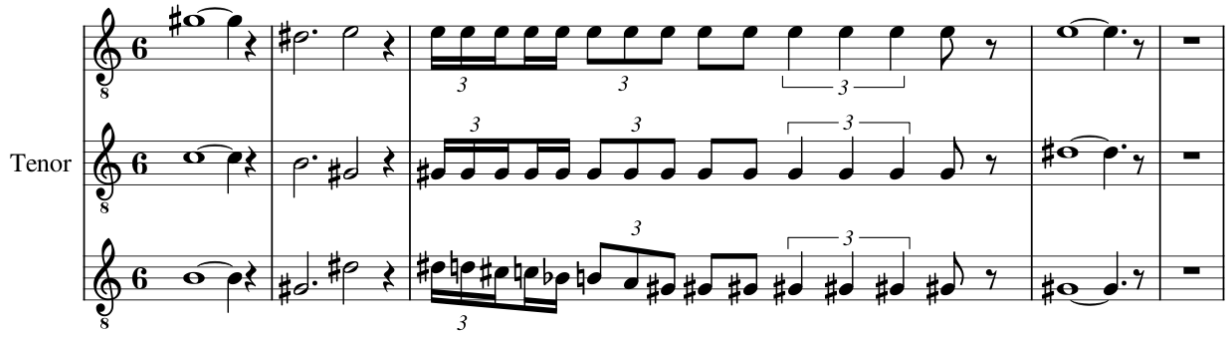
to supplant understanding of the music. An analysis of this piece's sections will be provided in chapter 3, "*Erste Geburts-Arie* revisited."

ZWEITE GEBURTS-ARIE

After the children are cleaned and named, three sailors arrive at the beach on boats loaded with food. They bow and greet the female chorus. The women chorus and sailors unload the food and celebrate the fourteen children's births. At the end of the scene, the sailors depart on their boats and join an invisible chorus.

This is the second aria in *Montag aus Licht*. Like *Erste Geburts-Arie, Zweite Geburts-Arie* lacks the same structure of the cyclical scenes. Upon arriving on this scene, the nuclear formula has reached all of its tones, and according to the formula, the rest of the music should structurally sustain the nuclear tones. *Zweite Geburts-Arie* primarily focuses on a group of three solo tenors (example 15). Unlike the previous aria, these three tenors sometimes exchange their spotlight with another group. These three tenors mostly sing trichords from the Michael formula, and the other parts accompany the tenors with harmonies derived from the nuclear formula. Rhythmically, the tenors sing small divisions, similarly to *Heinzelmännchen*.

Example 15: Three solo tenors in *Zweite Geburts-Arie*, mm. 256-259

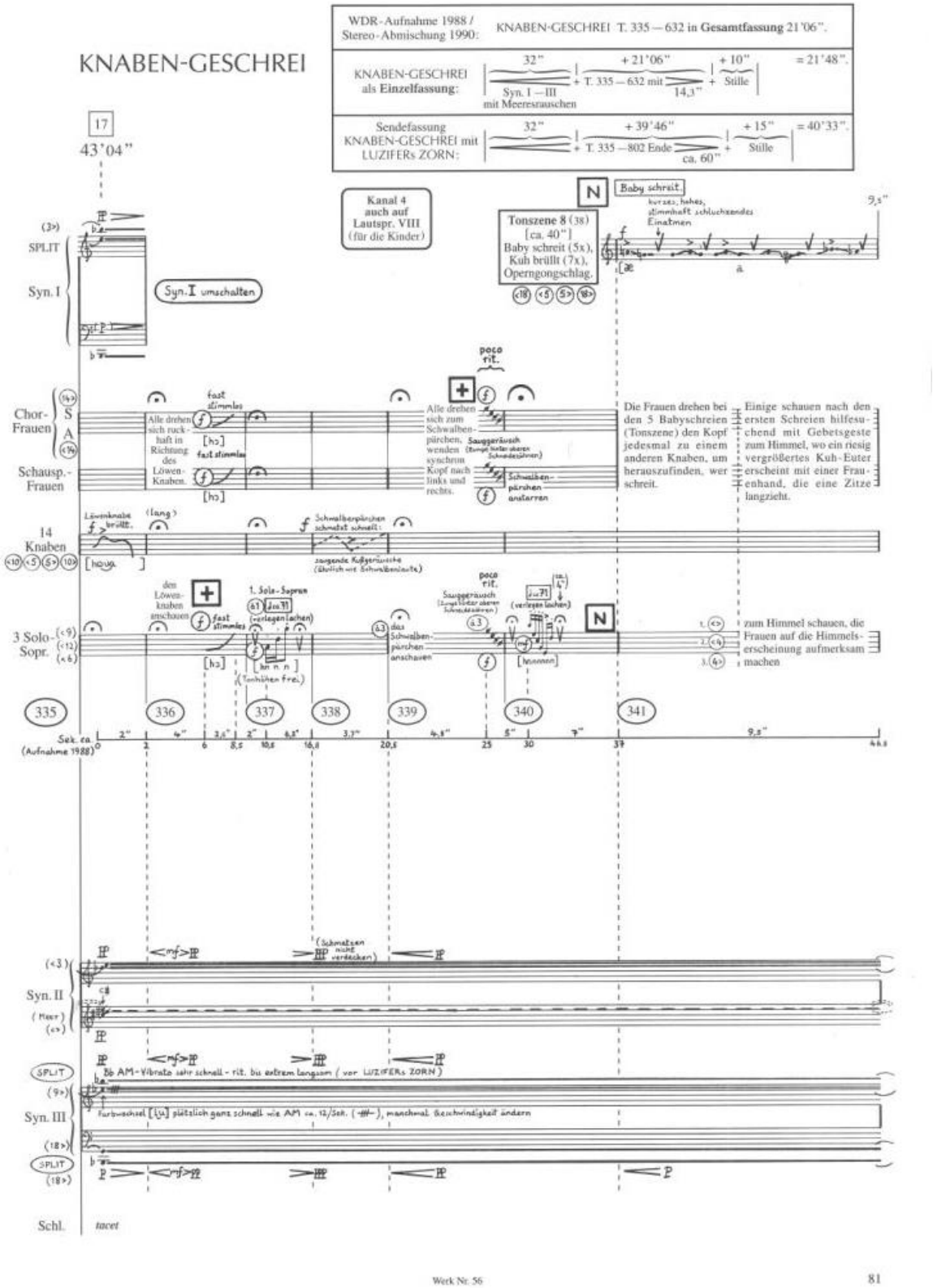


KNABEN GESCHREI

After the sailors set sail in *Zweite Geburts-Arie,* the next scene, *Knaben-Geschrei,* begins with the screaming of the children. To appease the children, a cow udder appears in the sky, and a woman's hand pulls down on the udder seven times. Twelve women scramble to each get a beach cart while the rest of the women feed the children with milk bottles. The women with the carts rush back to put the children into the carts. After this scramble, the ladies with their buggies align in a straight line, shout "Formation!", and begin a race in the next section. This whole section was recorded on one track on the CD, and the following section built on rotations is texturally different (m. 345). Due to the use of freely pitched and recorded sounds such as a cow's moo-ing, relating the sounds of this section to the formula can be obscure. Given the de-emphasis of pitch collections, other parameters can be examined for possible connections to the formula.

The opening section in this scene m. 335-344 encloses three notable sections. Throughout most of this section, the synthesizer I remains silent. Synthesizer II and synthesizer III sustain the same tones at the start of this scene. The first notable section is distinguished by the alternation of parts that occurs in mm. 335-341 (example 16). The three solo sopranos, chorus, and children begin to sing melodic figures with free-pitch. Example 17 shows the alternations among these three parts. The children sing an unpitched wave gesture, while the chorus sings an ascending glissando followed by a descending arpeggio of four notes. The sopranos sing freely-pitched ascending and descending arpeggios.

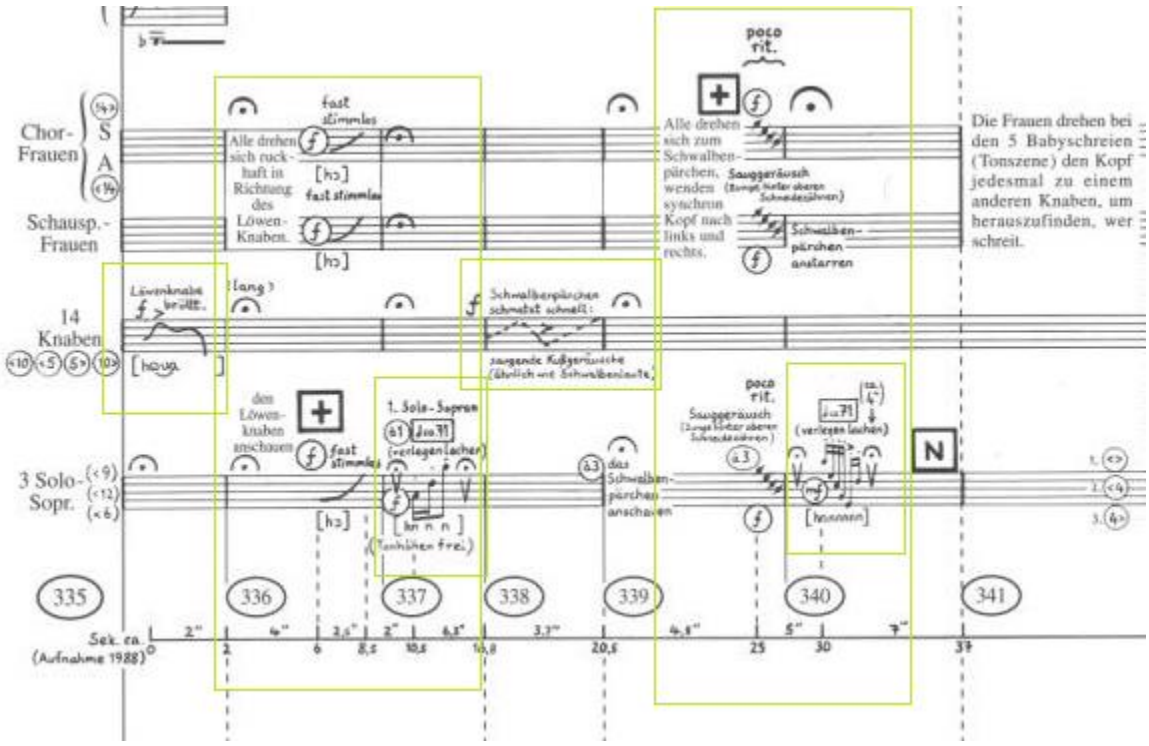
Example 16: Opening of *Knaben-Geschrei*, mm. 335-341



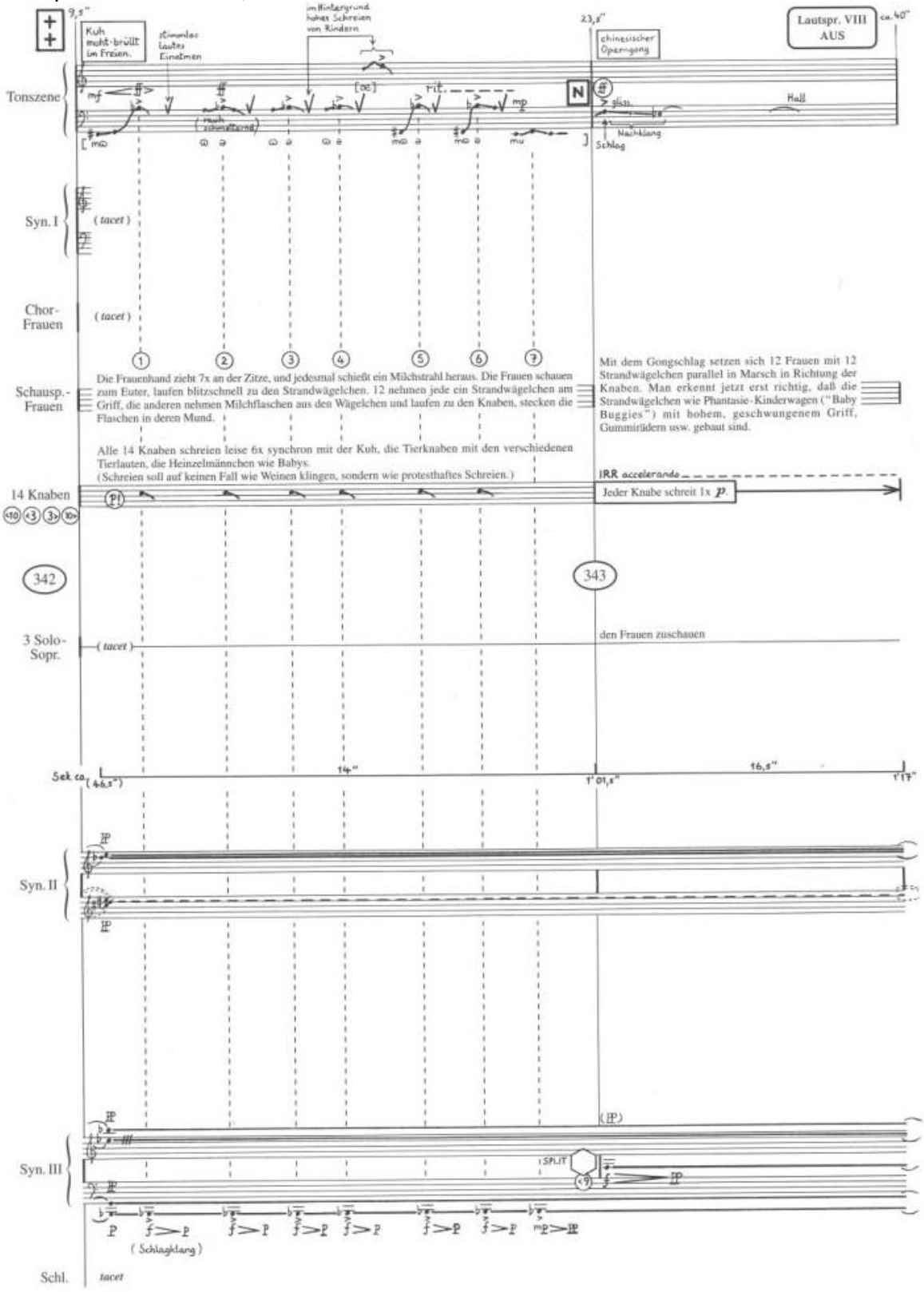
While these three vocal parts do not derive their pitches from the formulas, they still may be associated with the formula through certain characteristics. Glissandos are a notable characteristic of the Eve formulas, and the glissandos in mm. 335 and 337 are representative of Eve.[42] The arpeggios in mm. 337, 339 and 340 are not directly attributable to the Eve formula, and arpeggios are featured in the Lucifer formula as well. However, these arpeggios can be related to Eve if they are interpreted as glissandos with pointillistic articulation. The next section mm. 342-343 and 344 could have some association to the Eve formula through gestures such as glissandos and arpeggios, the absence of specific pitch or rhythmic connections to the Eve formula makes this reading tenuous.

[42] Kohl, "Into the Middleground," 273-274. Kohl associates glissandos as a characteristic of the Eve Formula.

Example 17: Alternation between the three vocal parts 335-340



Example 18: Cow scene, mm. 342-343



Following the music from mm. 335-341 (Example 18), the next part includes a solo tone scene that lasts for 30.5 seconds over two measures.[43] Most of the other parts are silent throughout this section with the exception of the synthesizers II and III, which sustain pitches. With the children pushed in carts by the women on stage, each of the three sopranos announces the word, "Formation!" The two sets of children, *Heinzelmännchen* and animal children, are separated into two groups. Stockhausen composes this section with what he calls a rotation of 35 cycles.[44] Throughout these rotations, a 4:3 polyrhythm occurs in a race on stage between the animal children's prams and the *Heinzelmännchen*'s prams. This polyrhythm is created when the *Tierknaben* ride over the perimeter of a large square on the floor (4), and the *Heinzelmännchen* ride over the perimeter of a triangle (3) on stage. However, these rotations are not always continuous. Sometimes, a section of music interjects itself into these processes, and Stockhausen names these interjections in the preface.[45] Table 4 lists the sections of the rotational process and the musical interjections as well as the tempos used in these rotations. This scene gradually increases in tempo with occasional losses of speed. Losses of speed happen after interjections or after the prams crash at the end of rotation 35.

The numbers used for tempos are derived from a log12 operation. For an example, twelve numbers are evenly distributed between 60 to 120. In his score, Stockhausen included the numbers: 40, 42.5, 45, 47.5, 50.5, 53.5, 56.5, **60**, 63.5 67, 71, 75.5, 80, 85, 90, 95, 101, 107, 113.5 **120**, 127, 134, 142, and 151. In the score

[43] The term, *Tonszene* (Tone scene), has not been used in the paper until now. *Tonszene* refers to a set of recordings that the synthesizer must play at a certain measure.
[44] In the score, the word "rotation" is used to outline the sections. Stockhausen's rotation in this case refers to the rotation of the prams as they move in triangular or square-like movement in this scene. Preface to *Evas Erstgeburt*, *lii*.
[45] Stockhausen, Preface to *Evas Erstgeburt*, *liii-liv*.

instructions, Stockhausen bolds the numbers 60 and 120 in this series to signal that he is building his tempo markings from the tempo of 60.[46]

[46] Stockhausen, Preface to *Evas Erstgeburt*, *lxxx*.

Table 4: *Knaben-Geschrei* rotation sections

Rotations	Duration in seconds	Tempo range	Measures	Beats per measure
1-4 (pause)	124.5	42.5, 45, 47.5, 50.5	356-371	6
5-6	51.5	53.5, 56.6,	372-379	6
Interjection (banana)	46.9	60, 63.5, 67	380-391	6
7-10	79	67, 71, 75, 40	392-403	6->3
Interjection (carrot)	60	42.5, 45, 47.5, 50.5	404-416	3->4
11-13	68.2	53.5, 56.5, 60	417-428	4->3
Interjection (statue)	40.6	63.5, 67, 71, 75.5	429-440	3->4
14-19	80.2	[80, 85], [90, 95], [101, 107], [113.5, 120], [127, 134], [142, 151]	441-488	4->3
Interjection (urination)	43.4	151	489-510	3
20-23	72.8	[80, 85, 90, 95, 101, 107]; [113.5 120, 127, 134, 142, 151, (53.5, 56.5)]; [60, 63.5, 67, 71, 75, 80, 85, 90, 95, 101, 107, 113.5, 120, 127, 134, 142, 151, 80]	511-554	3->2 mm. 535
24-35	108	80 (accel rot. 34-35) **	555-626	2

*Brackets group tempo per rotation
***Accelerando bis so schnell wie möglich* - Accelerate as soon as possible

This scene continues to use pitches from the transposed and un-transposed superformula; however, some difficulty may arise in tracing the pitches to the formulas. In rotation 1, certain tones can be seen as related to the formula. The F6 that sounds four measures prior to the start of this rotation is part of the Michael formula transposed up a m3. Similarly, the reoccurring B♭2 is derived from the G2 of the Lucifer formula transposed up a m3. The children's screaming can be grouped into trichords that can be traced to the formula. Four measures before the start of the first rotation, the children sing a [0 4 5] set. However, most of the sets that could be created by selecting melodic lines or verticality do not strongly resemble the trichords mentioned in Jerome Kohl's analysis.[47]

While the formula exists in these passages, it is frequently obscure or modified, which makes finding the formula difficult. However, these rotations share similar qualities such as contour and pitch content. For example (example 19), rotations 7-10 (mm. 388-403) share similarities in contour and pitch in the three solo sopranos. The intervals that are featured in these rotations are not the same in each rotation, but they are similar. I will be using contour labeling similar to Robert Morris's contour models for prime contours.[48] This model reduces certain contours into models through algorithm; however, given the simple contours of the soprano's part during this passage, not much explanation of Morris's model is needed. In this analysis, the lowest pitch in a single

[47] Kohl, "Into the Middleground," 270.
[48] Robert Morris, "New Directions in the Theory and Analysis of Musical Contour," *Music Theory Spectrum* 15, no. 2 (1993), 205-228.

rotation will be given the lowest number, 0. The highest pitch will be given the highest number, which will change depending on the number of different pitches.

To demonstrate the contour model, example 19 shows rotation 7-10. In rotation 7, solo soprano I starts with a [0 1 4] trichord in m. 388. It then sustains D#5 and moves to a dyad between D#5-B3-D#5 in m. 389-391. On rotation 8, similar leaps to those from rotation 7 are replicated, but the last interval reaches further, which is a slight modification from the previous rotation. Rotation 9 reverses the contour and adds a new note, G#5, at the last measure. Rotation 10 contains a similar contour to rotation 7 with a new set of notes and intervals. This sudden change in pitches and intervals sets rotation 10 apart from the previous rotations; however, they maintain a similarity through contour and rhythm. An application of Morris's contour model can be seen in table 5.

Example 19: Rotation 7-10, mm. 388-403

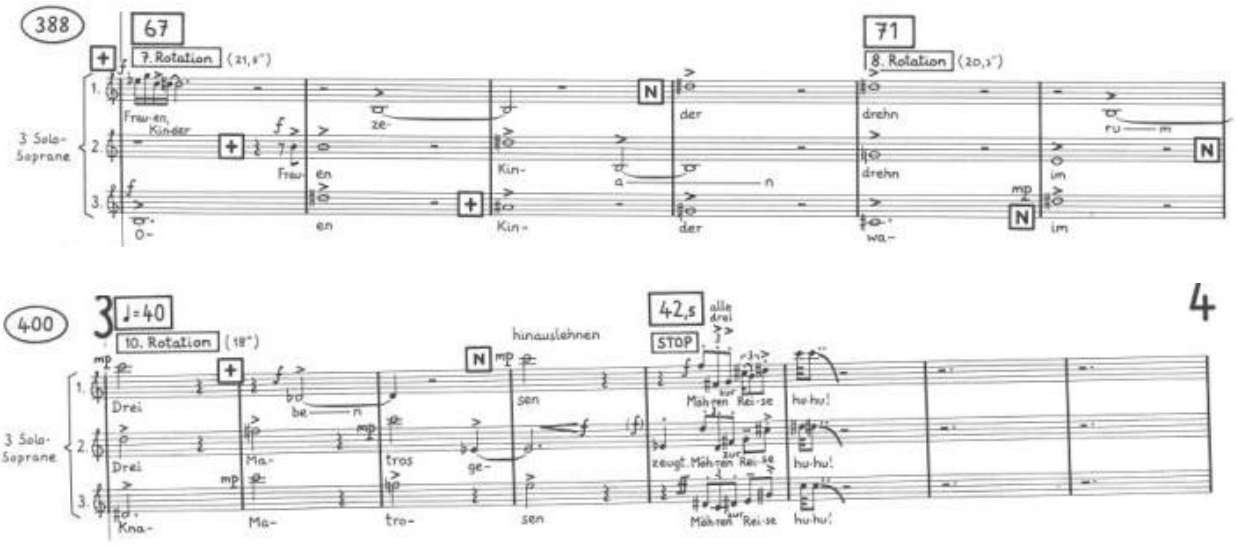


Table 5: Rotation 7-10, mm. 388-403

	Rotation	7	8	9	10
Soprano I	Contour	[101]	[102]	[201]	[101]
	Notes (in order)	D#5-B3-D#5	D#5-B3-B5	B5-D#4-G#5	C6-D♭4-C6
Soprano II	Contour	[120]	[210]	[1230]	[1230]
	Notes (in order)	B4-D#5-B3	G4-E4-B5-D#4	E5-F5-G#5-D#4	D5-F#5-C6-E4
Soprano III	Contour	[0321]	[0212]	[021]	[0321]
	Notes (in order)	B3-D#5-A#4-G#4	C#4-D#5-D#4-D#5	D#4-B5-F#5	D#4-C6-F5-E5

Table 5 notes the pitches and the contour used in these rotations. In soprano I, some pitch invariances occur, and some of the contours of the rotations share similarities. Soprano I's rotations 7 and 10 share the same contour. Rotation 8-9 could be seen as a palindromic contour. Throughout this passage from rotation 7-10, the soprano I's music repeats the same rhythm. Although rotation 7 uses a short embellishment of a [0 1 4] trichord, this trichord's duration signals its ornamental function. Although rotation 10 uses different beats per measure, the general rhythm is preserved.

In soprano II, some contours are related to each other. In rotation 7, a [1 2 0] contour begins this cycle. The following contour is quite different between [1 2 0] to [2 1 0], but some of the shared pitches such as the D# remain consistent. In cycle 8 and 9, and both cycles share the pitches E and D#, and similarly to soprano I, the contours appear symmetrical. The contour from rotation 9 is repeated in rotation 10; the only shared pitch is E♭4/D#4 as enharmonic spellings. Soprano III contains similar relations in contour between cycles. Rotations 9 and 10 are similar, and D# is commonly shared between all rotations in soprano III. These parts repeat the rhythmic placement of their pitches consistently around the same place in the measure. Rotation 7 and rotation 10 may differ because of entering and exiting this rotational group.

In synthesizer I, similar rotational music occurs; however, the music only fully rotates after two complete rotations of the other cycle. Therefore, the first rotation occurs on rotations 7-8, and the second occurs during rotations 9-10. The children sing in a 4:3

ratio of time. The pitches used can be analyzed as trichord combinations of [0 3 4] or [0 1 4].

The bass that represents Lucifer becomes more active during this scene. The bass sing notes with shorter durations and has a higher number of attacks with different pitches other than G2, which can be seen as ornamentation or trichords from the formula. Similarly to the other formulas, two levels of durations for Lucifer's formula durations can be observed. Similarly to *In Hoffnung*, the bass's Lucifer formula focuses itself around pitch G2. While other ornamental notes may create trichords or intervals that are relatable to the Lucifer formula, the centering of G2 maintains the sustain of this nuclear tone.

Some of the pitch associations from the formula can be confusing to apply to the Lucifer superformula. During this part, certain pitches are repeated during a rotation or a group of rotations. From the seemingly structural notes in the bass determined by the frequency of occurrence and duration, the bass notes, [E2 G#2 G2], (0 3 4) and [G2 G#2 B2] a (0 1 4], can be observed as trichords from the *Montag* superformula. However, the association of these notes to the formula can appear as arbitrary or loose.

LUZIFERS ZORN

After the terrible cries of the children in the previous scene, Lucifer arrives onto the scene as a mysterious entity with an “undefinable” form. Stockhausen refers to Lucifer’s physical appearance as a “polyp” and “black”" double-person. Two people, a bass and an actor, share a costume. The frontmost body is a bass singer that moves in “slow and stiff” movements. The actor is attached behind the costume of the bass with cloths connecting the two people. The actor moves erratically. This double-body is referred to as Luzipolyp in the score. Lucifer calls for the children to be reborn because he finds them hideous. In response, the sopranos and chorus stare at Lucifer with contempt.

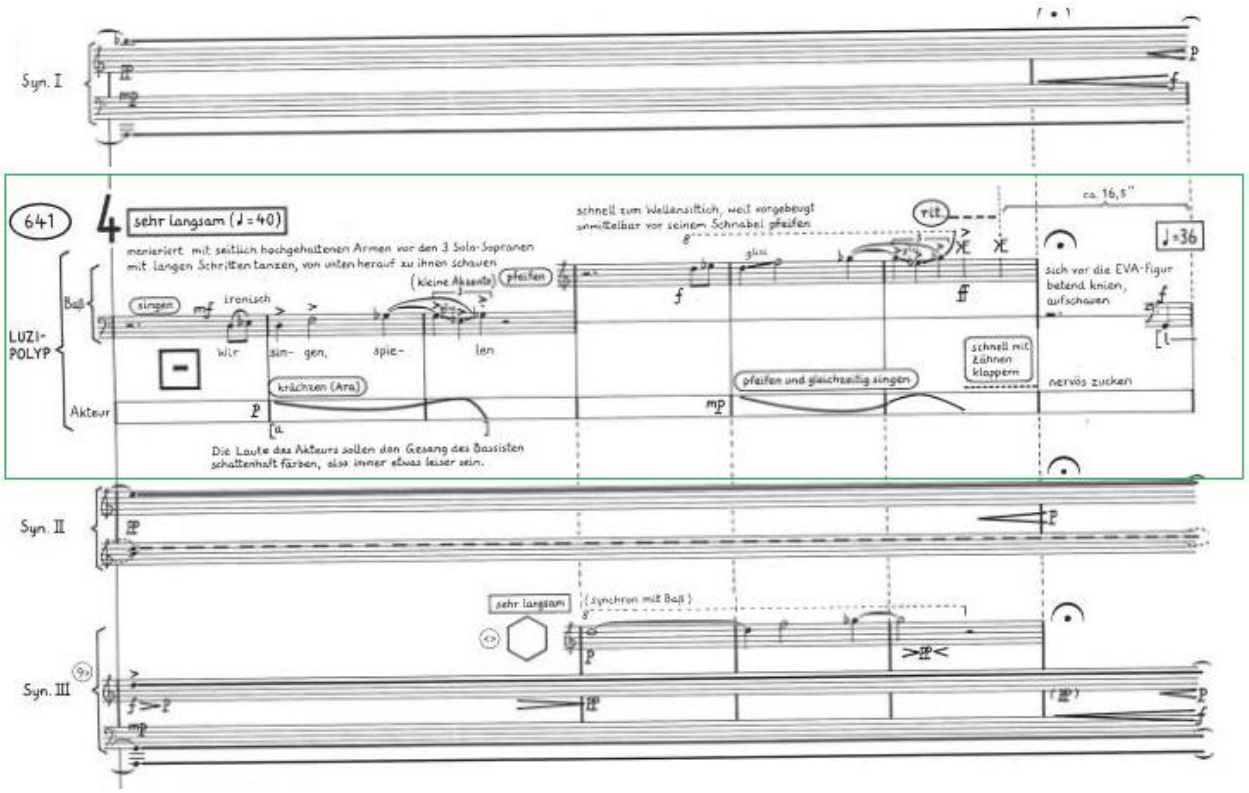
Luzifers Zorn continues to sustain the pitches in the Michael and Eve formulas; the Lucifer formula continues with its eleventuplet. The synthesizers sustain nuclear tones in synthesizers I, II. and III. The sopranos are mostly silent throughout most of this scene. During this scene, the Lucifer formula is the most active, and his music gradually becomes complex. Luzipolyp’s pitch and rhythm can be traced to the Lucifer superformula; however, most of these connections can be vague or loose. Some connections can be made with the ascending 7th in *Evas Zweitgeburt* and the trichords in *Evas Zauber.*

Each section starting the alphabet is marked by a syllable that uses the new alphabet letter. To announce the arrival of a new letter, Lucifer sustains the enunciation of two syllables: the alphabet letter’s consonant or vowel sound plus an -FA or -VA et. al. The -FA and -VA syllables can be associated with EVA, a variant of the name, Eve. In the score’s description, Lucifer sings through parts of the English alphabet; he goes

through letters A-K, O, and V-Z. Stockhausen created seventeen distinct sections for Lucifer, which is realized through a similar cyclical form in *Hoffnung* and *Knaben-Geschrei.* The cyclical process is preceded by music in mm. 633-647. Similarly to the *Knaben-Geschrei*, mm. 633-640 use glissando figures and arpeggiated free-pitches in the chorus, three sopranos, and Lucifer's part. The children are quiet during this section. The music from m. 641 to m. 647 begins the Lucifer solo with a melody built on a [0 1 4] trichord and its inverse [0 3 4] (example 21). Furthermore, glissandos are not a usual trait of the Lucifer formula; they are an Eve aspect. Lucifer might be borrowing these

glissandos as a way to "talk dirty" to the sopranos.[49] The start of Lucifer's alphabet process occurs in m. 648.

Example 20: Start of Lucifer's solo mm. 641-647

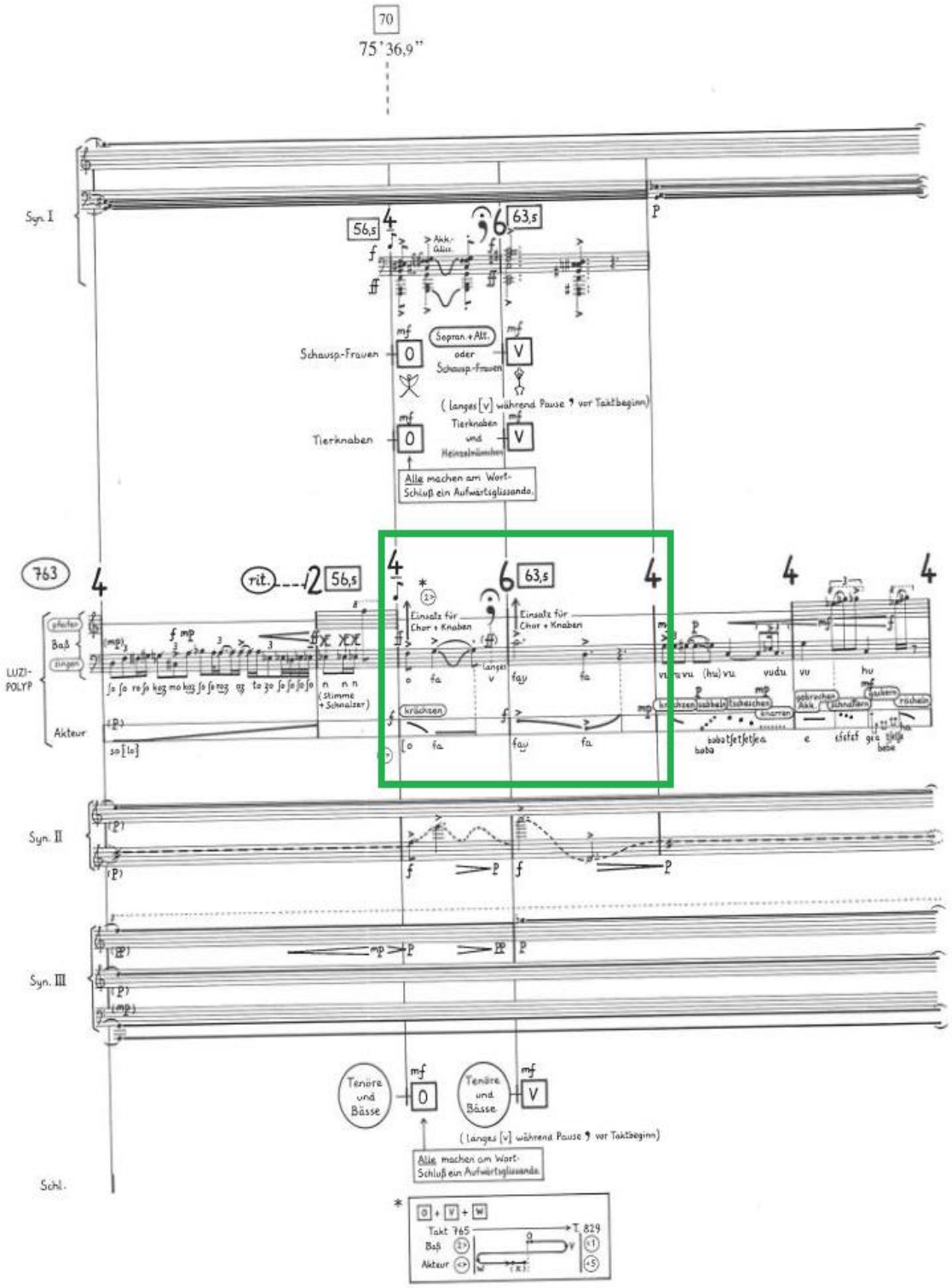


Letters A-K and O, Stockhausen ends each section with Lucifer's announcement of the letter, which is accompanied by the chorus's and three soprano's objection or disapproval of Lucifer's presence. Table 6 shows the organization of the letters. Most of Lucifer's announcements of the letters are signaled through rhythm and syllables. Firstly, these announcements are sung with slower and simpler rhythms (sometimes a quarter-note followed by a half-note). Although Lucifer makes the later letters slightly more

[49] Stockhausen, Preface to *Evas Erstgeburt, lvii.*

complex, the longer durations and fewer number of attacks per measure separate this announcement from the other parts of the music. Furthermore, in reading or listening to the libretto, certain consonants or vowels that are associated with a letter can be found throughout a section. For most of this process, the announcement of the letter occurs at the end of a section, but a swap of this order occurs in the letter announcement of letter V at m. 766. After ending section O after making a call of the letter, Lucifer immediately follows with an announcement of letter V (example 22). This reversal gives a palindromic construction to the whole scene as the rest of the scene shifts these signals to the start of a section.

Example 21: Beginning and end switch, letters O and V, mm.765-766



Endings from letters A-H are related to their letter-name pitches. Letter A is heard on letter-name pitch, A. Letter B is announced with pitch B♭; letter C with pitch C, et. al. (H occurs with pitch B natural). However, as the letter-name pitches are limited to seven to eight letters in traditional musical nomenclature, the later letters are assigned unused chromatic notes or a combination of pitches. In letter X (example 22), the pitches used for this letter is G3-B3. While the pitches may not be related by letter-pitch, the first two notes used are the same as rotation's A notes (example 23).

Example 22: Start of letter X mm. 778-80

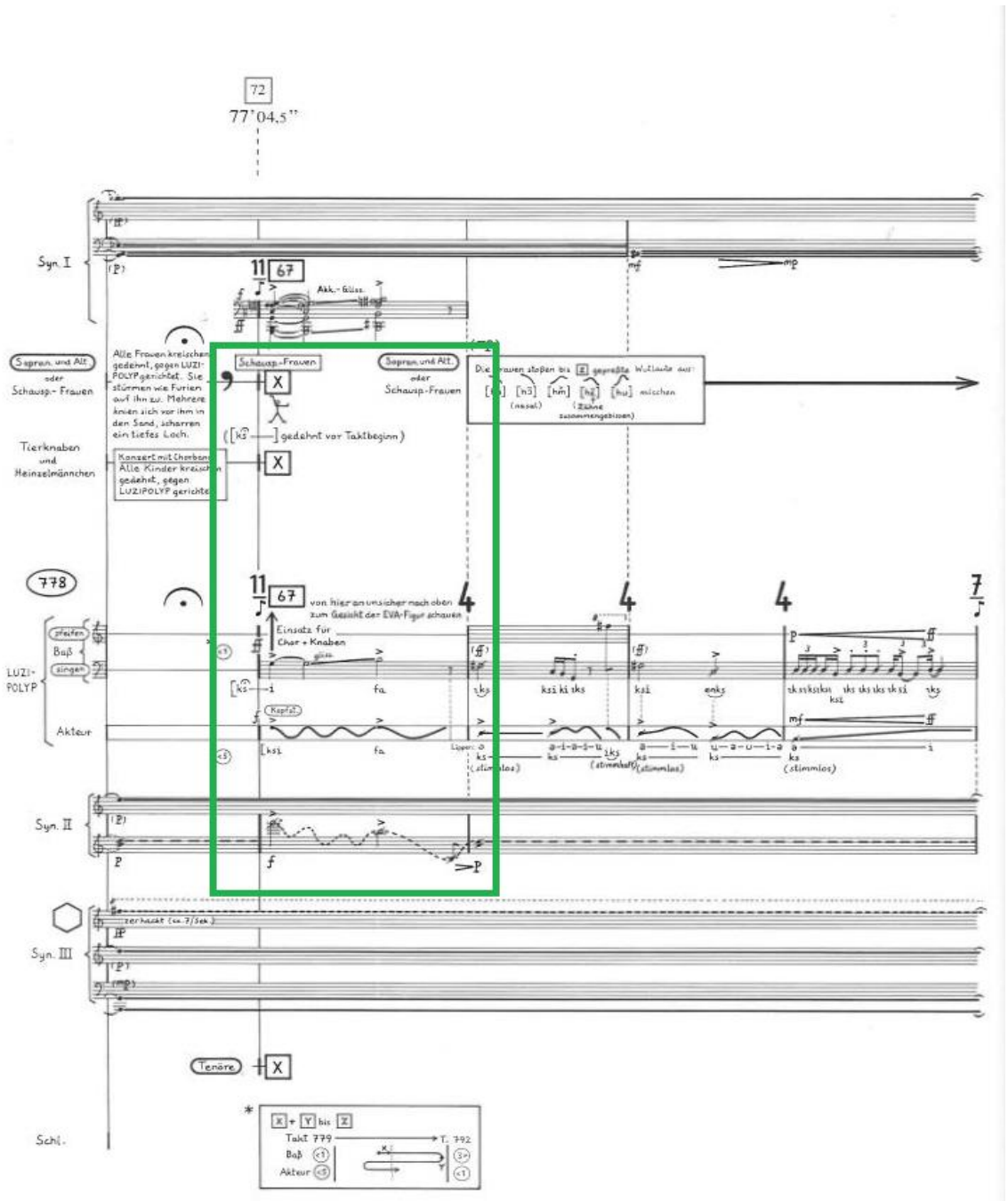


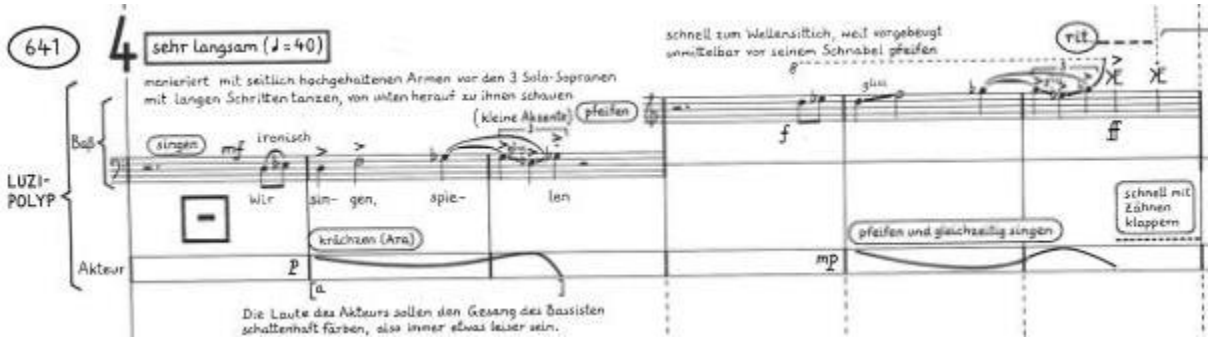
Table 6: Letters and placement

Letter	mm.	m.
A	648-51	651 - A-fa
B	652-664	664 - Be-fa
C	665-676	676 - Tʃe-fa
D	677-683	683 - De-fa
E	684-691	691 - E-fa
F	692-694	694 - Fɛ-fa
G	695-714	714 - Ge-fa
H	715-721	721 - He-fa
I	722-728	728 - I-fa
J	729-734	734 - Ji-fa
K	735-758	758 - Ka-fa
O	759-765	765 - O-fa
V	766-71	766 - (V)fau-fa
W	772-779	772 -(W)u-fa
X	780-783	780 - (X)ksi-fa
Y	784-792	784 - Yps-...fa *
Z	793	793 - (Z)tsvt-fa

(Letters in parentheses are not spelled out in the text, but the actual text has sounds that resemble the letter.)
* Many intermediary sounds occur but the beginnings and ends of this letter end with Yps-fa

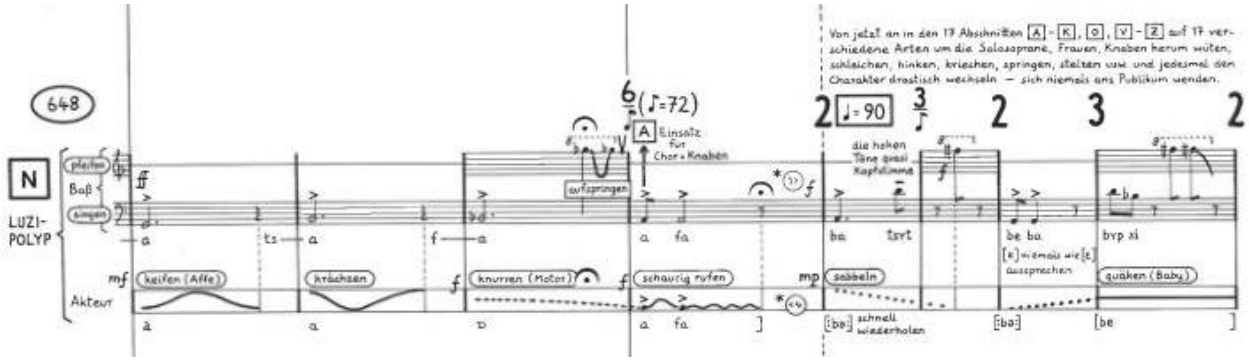
In terms of rhythm, the music uses smaller divisions of beats per measure to reflect the shorter durations of eleventuplets in the formula. In previous scenes, the music carries a slow-steady tempo with long durations and has fewer measures. Most of this rhythmic division and complexity comes from Lucifer's actor voice, who sings free-pitched passages with various short duration and high density of attacks. The erratic singing of this singer mimics the movement of the Luzipolyp. In the next section, mm. 641-647, the bass singer primarily sings pitched music with chords and intervals derived from the formula. The pitch content of this act is derived from the superformula; however, this connection is loose. A [0 3 4] (inverse of [0 1 4]) trichord melody can be interpreted from the pitches [D3-E♭3-D3-F3-G♭3], which creates a [0 1 4] with the D3-E♭3-G♭3 and a [0 3 4] with D3-F3-G♭3 (example 23).

Example 23: Start of Lucifer solo mm. 641-647



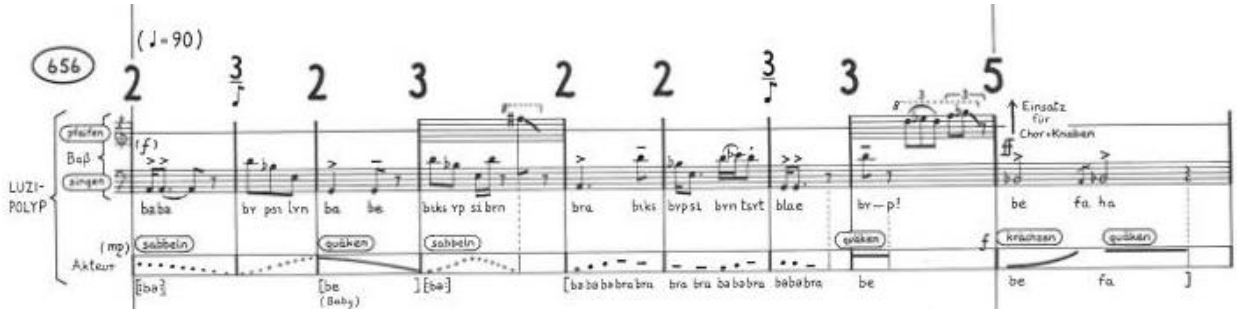
In terms of the formula content of the rotational process, the music will orbit around certain pitch collections and intervals, and the music maintains its tendency to increase in complexity. At section letter A, Lucifer's solo begins a melody that sings a [0 3 4] trichord [G3-B3-B♭3] with a single note being sung in each measure from m. 648 to m.651 (example 24).

Example 24: Start and end of letter A + beginning of B mm. 648-651



The start of letter B contains significantly more developed music at mm. 652-655 (example 25). It begins with a large leap of an 11th from A2-D4. The prominent trichord [0 3 4] occurs in the Lucifer superformula in *Evas Zauber* with the pitches [D4-F#4-G2]. Furthermore, the 7th interval between the F#-G in mm. 653-654 can be related to the Lucifer formula in *Evas Zweitgeburt*. The structural tone in both the start of Lucifer's entrance and the following letters, A and B remains to be G2. In the last measure of letter B, Lucifer sings on B♭2 on m. 664 and ends with the words be-fa-ha.

Example 25: Lucifer singing B mm. 656-664



CHAPTER III: IPS, MOMENTS, AND FORMULA

In *Evas Erstgeburt*, the nuclear formula and superformula inform much of the structure, organization, pitch, rhythm, and dynamics. On a smaller scale, while most of the musical content can be traced and derived from multiple manipulations of the formula, many additions to the music act as "ornamentation" or non-formula related material. Most of this analysis of *Licht's* nuclear formula and superformula in *Evas Erstgeburt* has focused on pitch sets, intervals, rhythm, and general form. Some formula aspects such as intervals or glissandos can appear as weak links or attributions to the formula. A repetitive or rotational process creates the form of *In Hoffnung, Heinzelmännchen, Knaben-Geschrei,* and *Luzifers Zorn*. The choices in the compositional process such as the number of cycles in *In Hoffnung*, the number of rotations in *Knaben-Geschrei*, and the alphabet process in *Luzifers Zorn* come from a decision outside the formula. Additionally, the ornamentation or non-formula material in the smaller sections of the music may follow and be understood by ideas outside the formula. Instead of solely relying on the formula to understand *Evas Erstgeburt,* a reading into Stockhausen's concept of moments will also prove useful in addressing organization in *Evas Erstgeburt*.

As stated before, moment and moment form should not be confused for each other. Moments are described as different sections of music that undergo a certain "degree of change" in certain musical aspects such as rhythm, pitch, range, dynamics, and articulation. Changes in the sets of these parameters can separate one instance

(moment) of music from another instance (moment).[50] Moments with long spans of music may have smaller moments nested within themselves. With the integration of the formula, these smaller moments can resemble a fractal division. “Moment-forming” is the realization of these moments as the central construction to a piece. This analysis will shift focus to several aspects of the music to distinguish moments through Patricia Howland’s integrated parametric structures (IPS).[51] Her IPSs describe the changes during a moment or between different moments. Howland states, “Smaller units called

[50] Stockhausen, “Lecture III: Moment-forming and integration (momente),” [sic].
[51] Howland, “Formal Structures in Post-Tonal Music,” 71.

'segments' combine to form a phrase-like unit that I will call an 'integrated parametric structure' or IPS."[52] She lists five main IPSs as crucial in her analysis:

1) Tension/Release: Derives its shape from a process of buildup and discharge of tension produced by increasing and decreasing values in parameters such as temporal density, spatial density, dynamics, and register.[53]
2) Departure/Return: Features an initial parametric state or process, a contrasting middle section, and a return to the initial condition.[54]
3) Symmetric IPS: "projects some type of mirror symmetry, often a retrograde structure"[55]
4) Directional IPS: "comprises an unidirectional series of parametric changes, that is, a process of either increasing or decreasing values in one or more parameters."[56]
5) Steady-State: "exhibits relative stasis in which either the parameters remain largely unchanged or such changes as occur tend to stay within a steady band of range of values; similarities among the internal parts of a steady-state IPS supply coherence."[57]

[52] Ibid, 71.
[53] Ibid, 75-78.
[54] Ibid, 78.
[55] Ibid, 78-80
[56] Ibid, 80-85
[57] Ibid, 86.

Although the segments in the music can be difficult to locate, some segmentation can be inferred through the formulas' structural scaffolding.[58] While the formulas' pitch sets, rhythms, and gestures (glissandos or dynamics) will aid in some of the segmentation, other aspects that can be called "secondary parameters" can help as well.[59] Secondary parameters can be described as aspects outside of pitch and rhythm such as density, spatial density, dynamics, register, and timbre. In certain places in the music where these formulas' connections seem loose or non-existent, manipulations of primary and secondary aspects fall in line with Stockhausen's ideas of moments (the degree of change between moments).

[58] Hasty, "Segmentation and Process in Post-Tonal Music," 73-4.
[59] Howland, "Formal Structures in Post-Tonal Music," 71.

IN HOFFNUNG REVISITED

In *In Hoffnung,* Stockhausen used the full nuclear formula and the *Montag* formula as pitch, structural, and rhythmic material. These formulas can be divided into smaller divisions such as trichords, and these smaller divisions are called limbs by the composer.[60] Despite its role of determining the structure of the opera, the formula may not serve as an adequate explanation for understanding the form or progress in a scene. Since each scene can have a unique approach to the formula, the scene's process should be taken into account alongside the formula.

In *Monat* 3 (example 26), the start of this scene is signaled by a sampled recording, a rooster's call in synthesizer III. In comparing this music to the previous cycle/month, the music features an increased attack frequency in the choir, a restart of synthesizer III's growing Michael formula, and the next note of the Eve superformula sustained in the three sopranos. During the sopranos' sustained A4, they sing the word, "*Luzefa*" in mm. 36-38. This word can be seen as a combination of the names, *Luzifer* (Luzi-/Luze-) and Eva (-fa), and its significance can be tied to the chorus's music. The complex rhythms are a signal of the Lucifer formula's presence, and they contain a sextuplet on beat 1, a triplet on the third beat, and a subdivided triplet plus two sixteenth notes on beat 7. This combination of Lucifer and Eve elements could foreshadow Lucifer's appearance later in the opera. After a short break in the sopranos and choir in m. 40, the sopranos sing "*Mondeva*" in m. 41 before another longer rest occurs. In mm. 42–46, the texture changes as the chorus returns to a drone-like sustained superformula; also, the three solo sopranos continue to sustain pitch A4 throughout mm. 42-44 as they

[60] Mya Tannenbaum, *Conversations with Stockhausen*, 71-72.

say the words "*Micheva*," a combination of Michael (Mich-) and Eva (-eva). The three solo sopranos' music changes when they sing the word "*Wasser*," which refers to this act's setting at a flat beach near a sea. In mm. 45-46, the three solo sopranos begin to rhythmically alternate between A4 and C5 in varying rhythmic divisions.

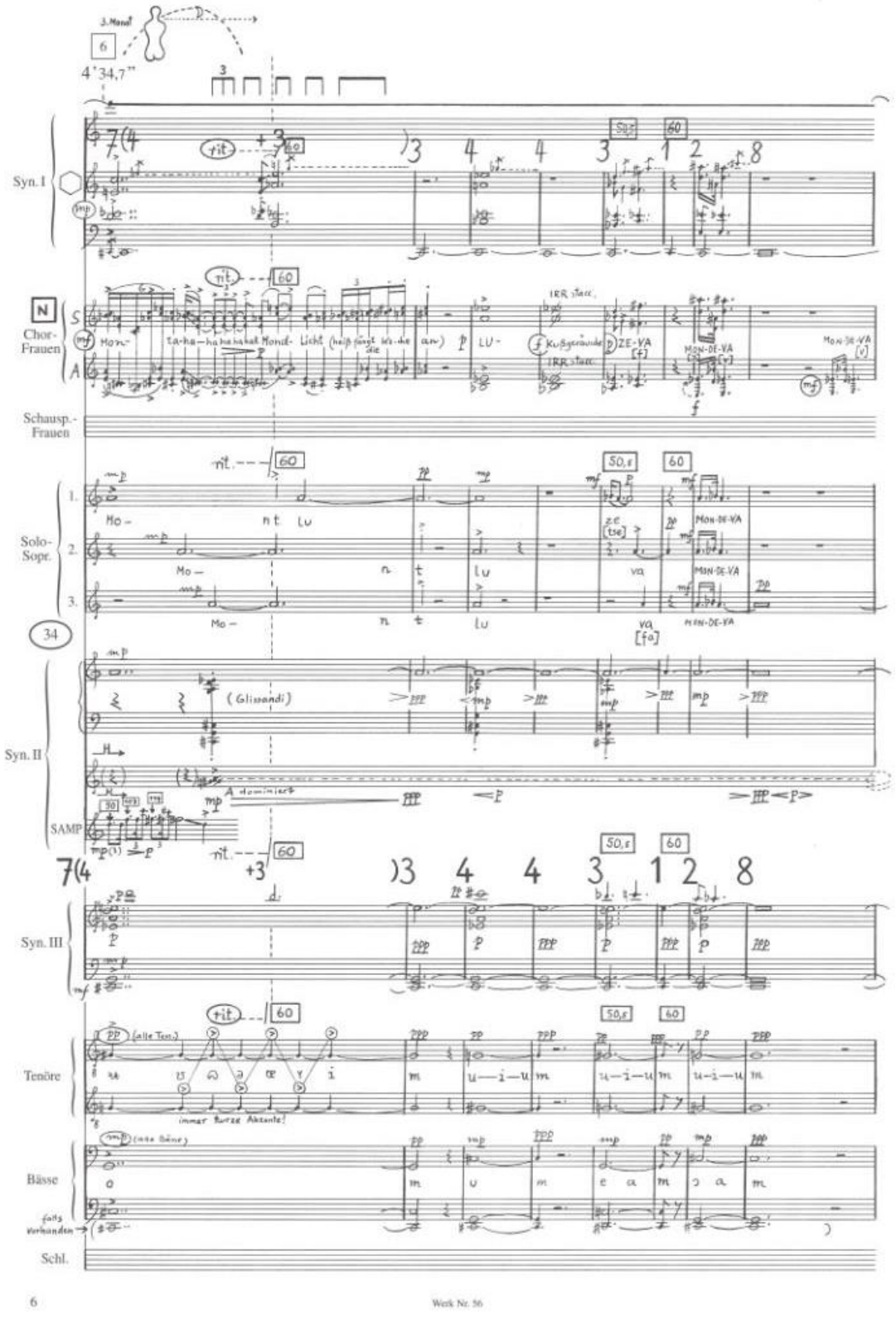
The breaks in the music and superformula can signal a segmentation of the *Licht* formula. *Monat* 3 can be divided into four sections. The following sections, *Luzefa* (mm. 34-39), *Mondeva* (40-41), *Micheva* (mm. 42-43), and *Wasser* (mm. 45-46), can be combined in different realizations. One interpretation sees each as separate sections. Each of these sections carries different parameters that change between each section; however, different parts of the formula appear to overlap with each other, which may cause issues in dividing this *Monat* into distinct "phrase-like units."[61] The chorus's complex rhythms start at m. 34, and the chorus pauses at m. 35. The subsequent music has longer durations and less rhythmic complexity. Measure 35 signals the end of one part of the formula; however, the trichord in synthesizer III's incorrect Michael formula in the highest voice [D6-B5-C#6]. The word, *Luzefa*, is sung by chorus in mm. 36-38. Identifying a section break at m. 35 would ignore the ongoing trichord in synthesizer III. However, since the possible trichord in mm. 34-36 has a pause in m. 35 as well, these measures can be observed as a dyad followed by a single note, C#6.

Another interpretation of *Monat* 3 splits the sections into two distinct portions, *Luzefa* plus *Mondeva* and *Micheva* plus *Wasser*, to create two sections. The soft but prominent synthesizer III that sounds the Michael formula can maintain continuity between the words *Luzefa* and *Mondeva.* The music's rest and fade in m. 41 signals an

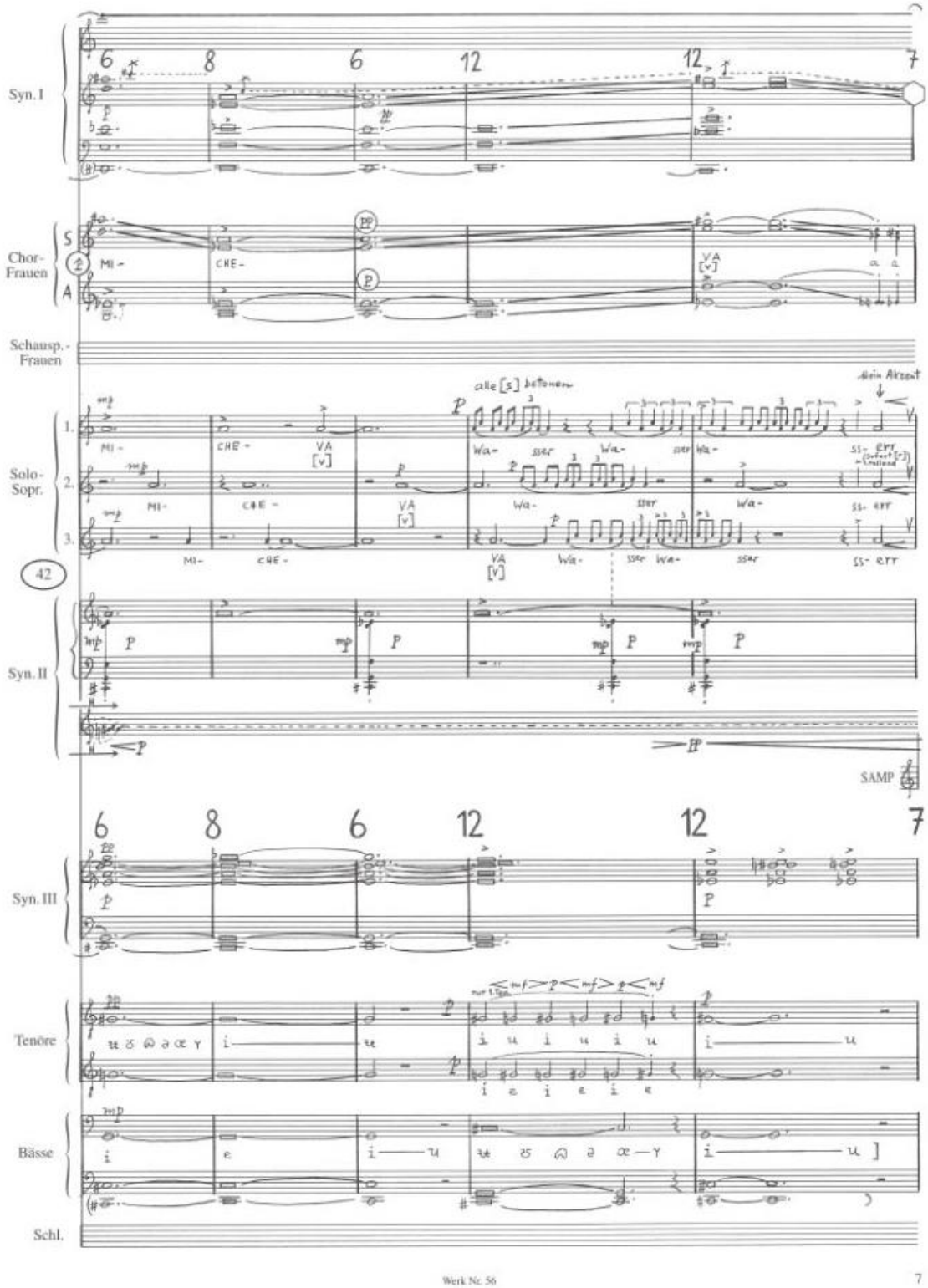
[61] Howland, 71.

end of the first section in a two-section interpretation. The second section occurs with the combination of *Micheva* and *Wasser*. The pitch, A4 is held throughout mm. 42-46, and the *Wasser* section just ornaments this A4 with a C5. The durations become smaller and the music accelerates from sustained whole-notes to eighth notes in the three solo sopranos in mm. 42-44, 16th notes, and triplet quarter notes in mm. 45-46.

Example 26a: *Monat* 3 mm. 34-46



Example 26b: *Monat* 3 mm. 34-46 (continued)

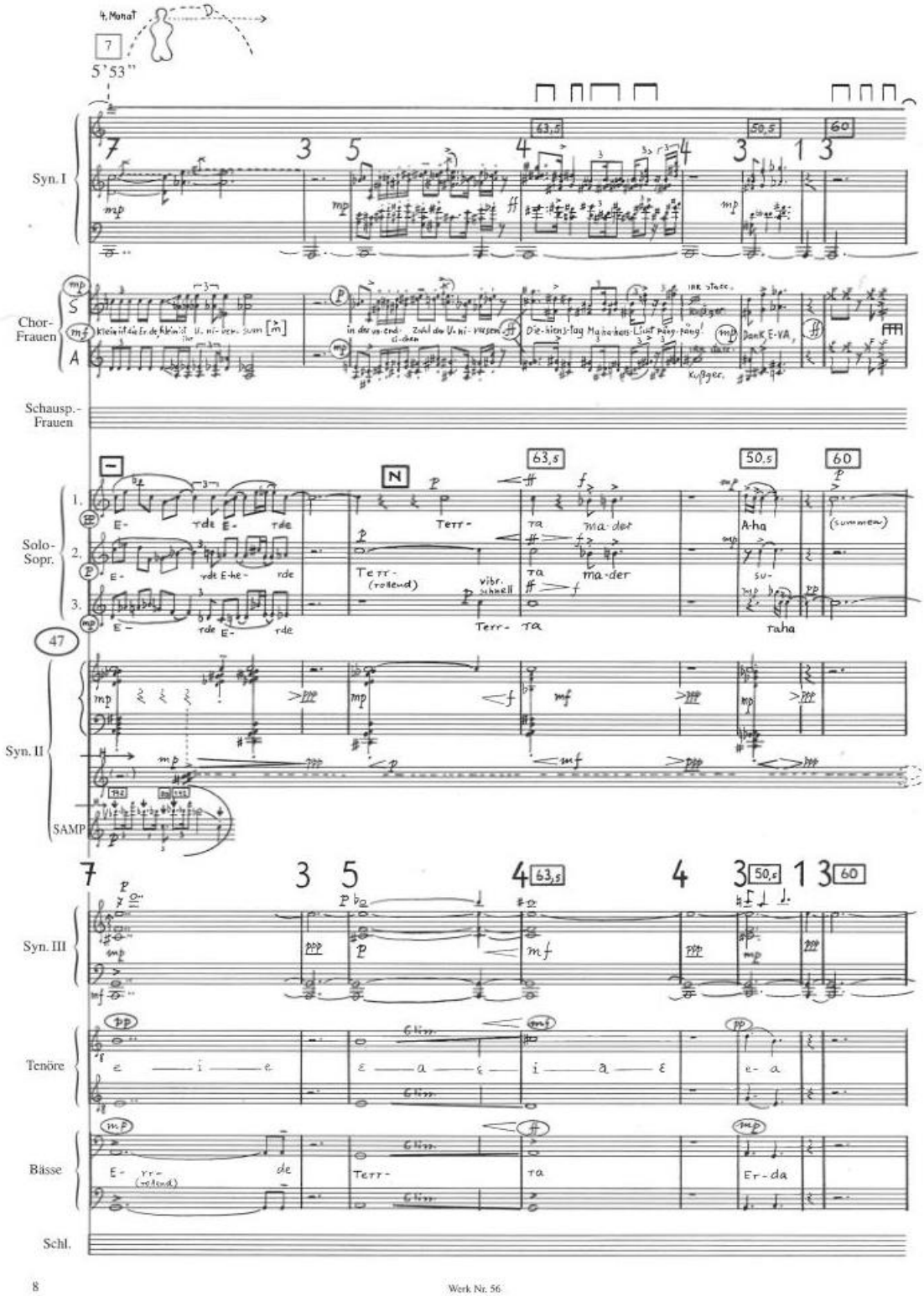


A Departure/Return IPS can be assigned to *Monat* 3; this will have an initial state, a departure, and then return to the initial state. The initial state is characterized by long sustained pitches and soft dynamics. Despite the rhythmic complexity and slight increase of dynamics in the chorus, most of the music sustains its texture of long durations and soft dynamics in the synthesizer III, bass, tenor, and three solo sopranos. The departure begins with the rhythmically dense music in the chorus. The loudest point occurs at m. 37, when the chorus suddenly rises to a *forte* dynamic, but this quickly subsides to a *piano* at the end of the measure. This fade in dynamics is the return to the initial state. Furthermore, this chorus serves more as an interruption as it sings the word, *Luzefa*, which can be interpreted as part of Lucifer's contrarian nature.

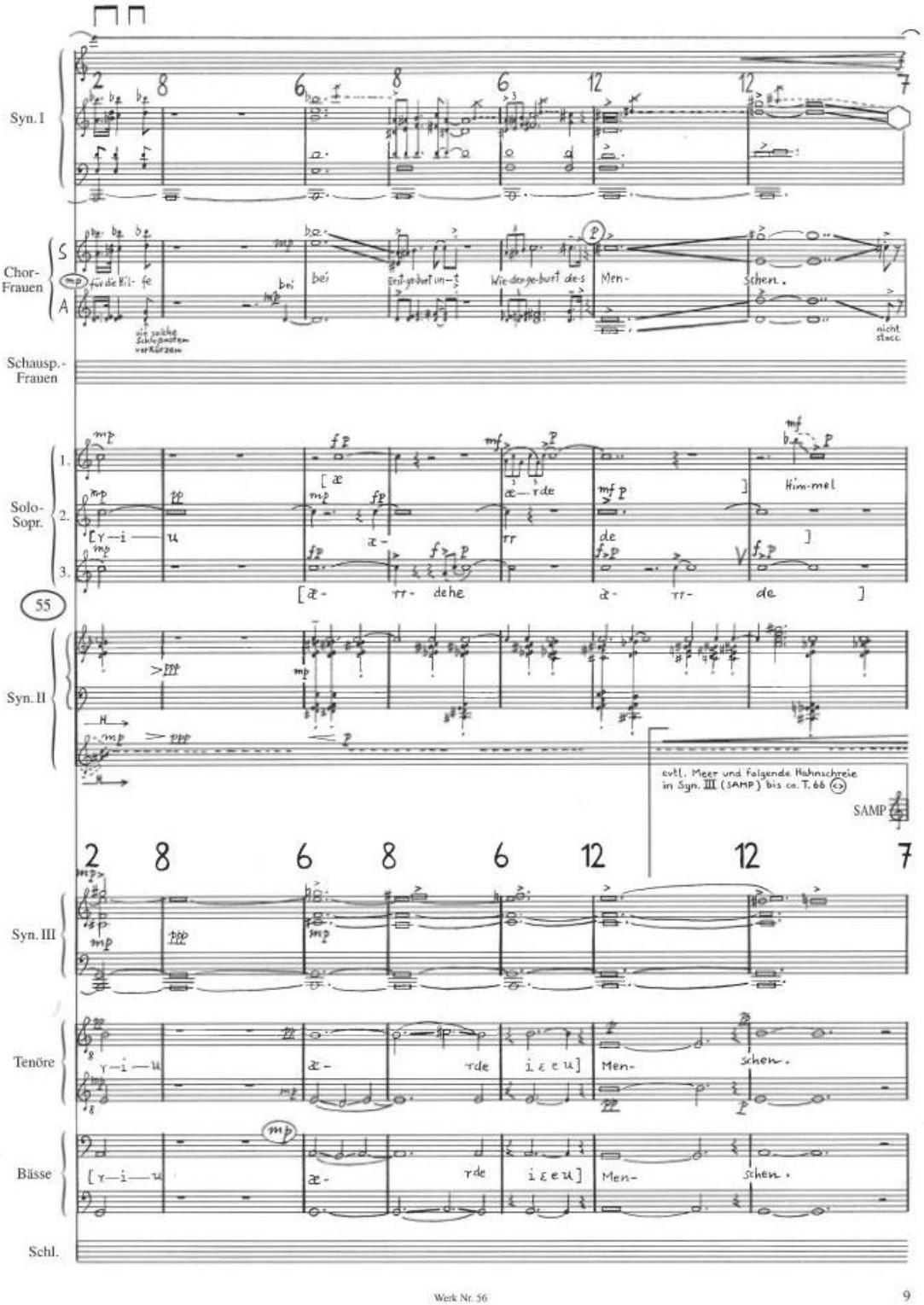
In *Monat* 4, (example 27), in mm. 47-61, the solo sopranos and chorus sing the Eve superformula, and the Michael formula continues in synthesizer III. The tenor and bass sing the Lucifer formula. The Eve formula in the solo soprano and chorus has many attacks, which increase the density of the music. A short pause occurs during m. 48, and the sopranos and chorus continue their high attack density. Both parts hit a high point in m. 50 at *fortissimo.* The music quickly subsides and undergoes a decrease in attack density in mm. 51-61. The last two measures of *Monat* 4 mimic *Monat* 3 with its twelve beats per measure and glissando in the chorus and synthesizer I. The longer note durations and glissando stretch the return to the initial state in preparation for *Monat* 5.

Monat 4 could be seen as a Tension/Release IPS. At the beginning of both *Monat* 3 and *Monat* 4, the music starts with a high-attack density of notes and rising volume in two parts: three solo sopranos and chorus. This density of attacks and volume subsides in a later half to a softer and less active section.

Example 27a: *Monat* 4, mm. 47-61

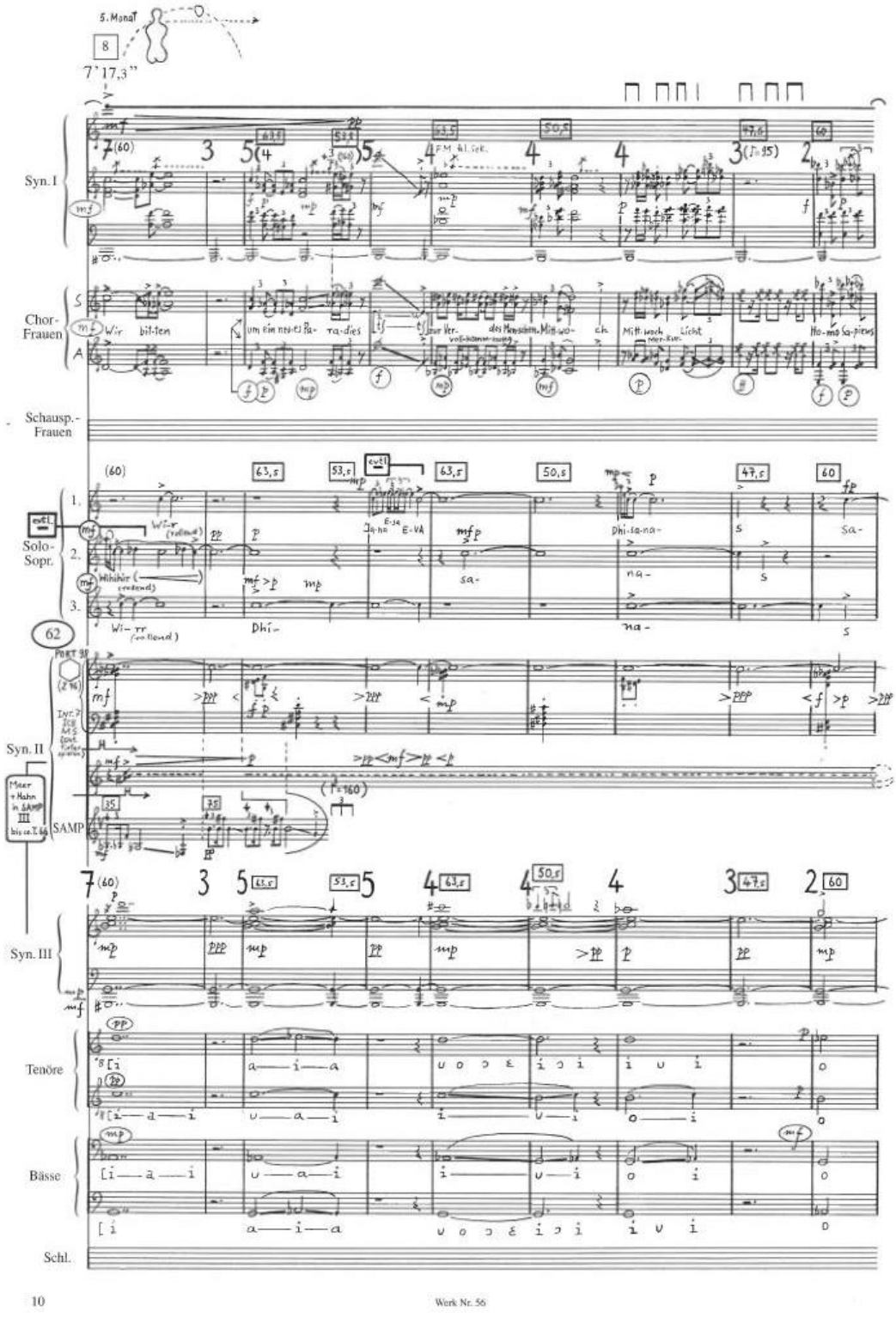


Example 27b: *Monat* 4, mm. 47-61 continued

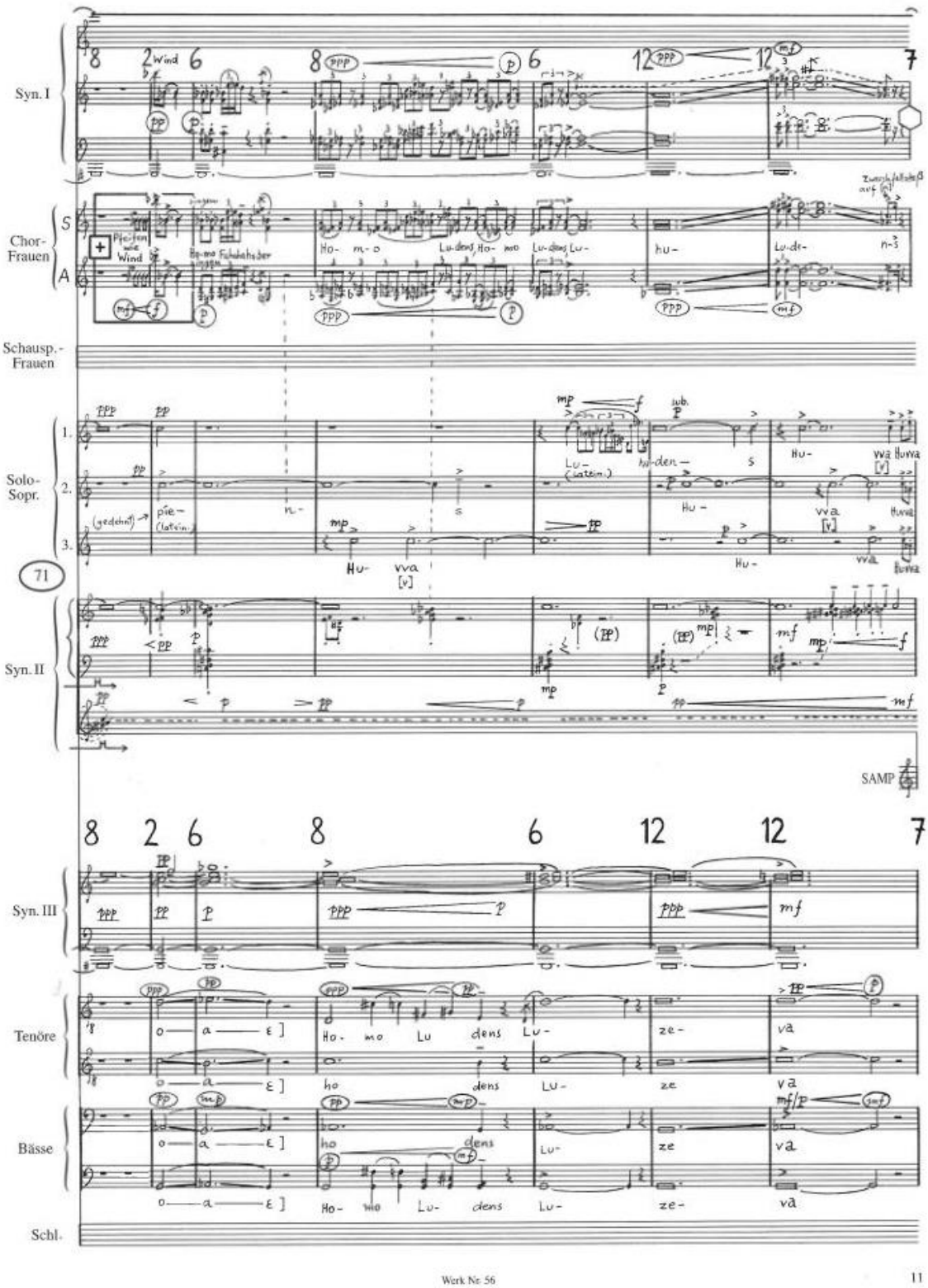


Monat 5 uses the same pitches and pitch sets as the previous *Monat* 4 and *Monat* 3; however, the music's attack density does not subside as quickly as in the previous two. Throughout mm. 62-77, the chorus maintains a mostly constant attack density. The volume throughout this section mimics the previous sections with build-ups to *forte* around the half-way point; in *Monat* 5, these build-ups occur in mm. 63-64 and 69-70. The volume subsides in m. 72 with multiple parts moving to a *pianississimo* volume. This reduction in volume is temporary as the music again ramps up in volume in all parts in m. 77. This process is different from the previous cycles because it has multiple long crescendos (example 28), whereas the previous cycles only had a single long crescendo in mm. 49 (example 27). The IPS for *Monat 5* could still be categorized as Tension/Release through the parameter of volume. Taking into account the progression of the *Monate*, *Monate* 3-5 can be considered a directional IPS. The music between these cycles gradually increases in liveliness through the appearance of greater volume and attack density as the formula becomes more realized. The following section, *Monate* 6-8, use similar IPS types to *Monate* 3-5 by adding more rhythmic activity and dynamic surges.

Example 28a: *Monat* 5, mm. 62-77



Example 28b: *Monat* 5, mm. 62-77 (continued)



The *Monat* formula process, in addition to the increase of rhythmic and dynamic energy, reflects the gestation period. *In Hoffnung*, as a whole, could be interpreted as a directional IPS. *Monat* 9 acts as the climax of the Directional IPS in this *Monat* cycle. By the last cycle, the full *Licht* formula is mostly realized as it uses nearly all of the *Licht* formula from *Montag* to *Sonntag*. *Monat* 9 maintains a high attack density in the chorus and synthesizer I. The volume reaches a *fortissimo* more frequently than some previous cycles. While the music's focus on the formula remains constant, the formula is not stable as it slowly transforms over time. The *Monat* cycle and the opera's superformula structure create a directional IPS as the crescendo from the formula becomes realized in the larger form. This scene's music and process conveys the growing activity of the gestational period as the children are ready to be birthed in the next scene.

HEINZELMÄNNCHEN REVISITED

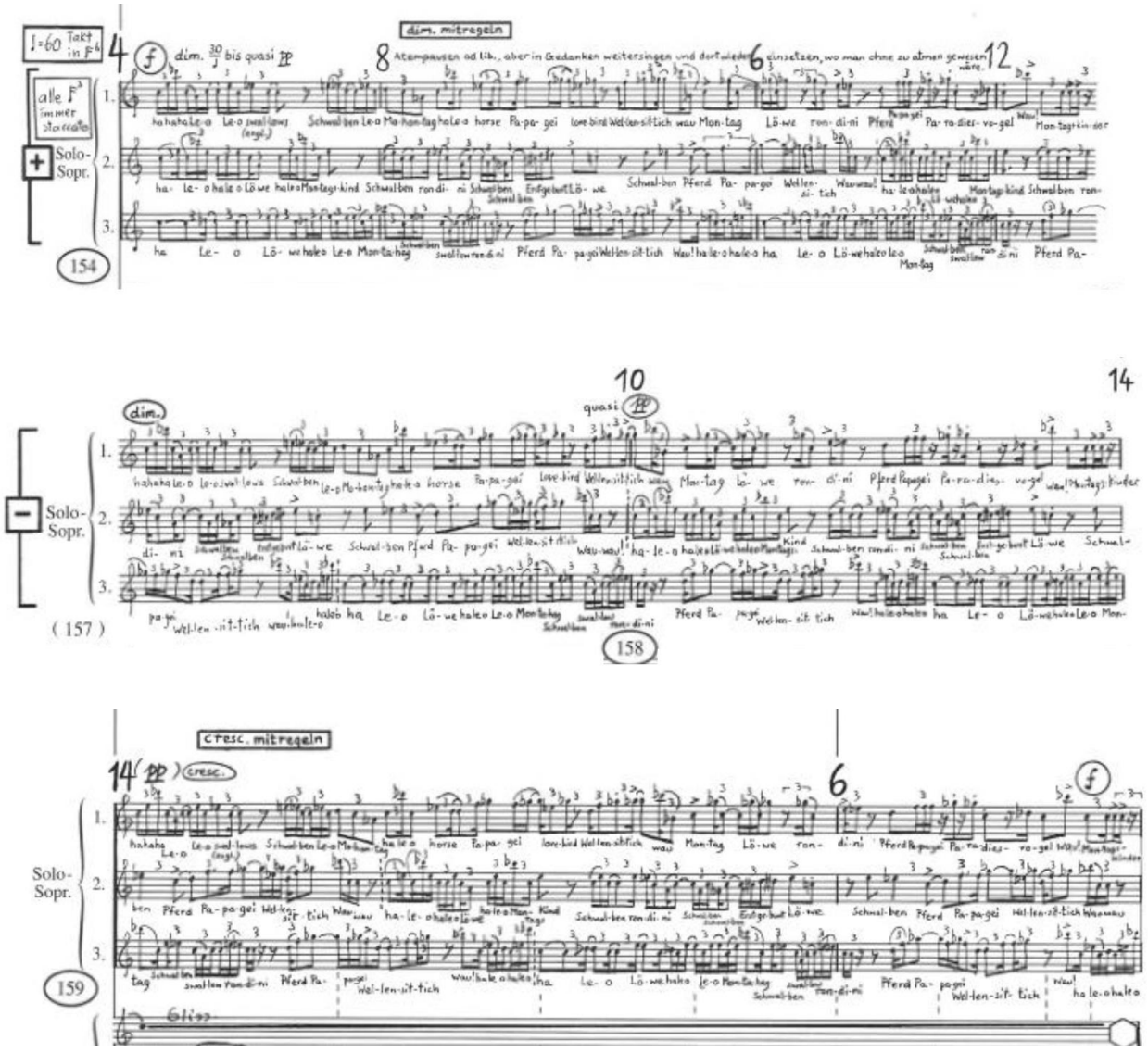
This scene's structure is defined by repetitions of the Eve superformula during each birthing, and each birth is accompanied by a tone scene. Since the musical material in terms of pitch and rhythm remains consistent throughout the music, a Steady-State IPS could be applied to these sections. However, this would ignore the tempo or volume changes that create separate sections.

On the first note of the Eve superformula, C5 (an octave higher than C4 from the original superformula), from m. 154 to m. 160, palindromic dynamics associated with the formula occur (example 29). In m. 154, several parts sound at *forte* or *fortissimo*. A decrescendo is also marked during this section, and it reaches its softest point after thirty beats or thirty seconds. The formula sounds at a *piano* or *pianissimo* volume on m. 158 for ten seconds. The next two measures last for 14 and 6 beats or seconds, and they begin a crescendo. This crescendo reaches a *forte* or *fortissimo* for all parts at the start of the next superformula note, D♭5. Through the divisions of this section on superformula note, C5 can be considered a Departure/Return. The music recedes to its original volume on reaching the next superformula section at D♭5.

While this palindromic structure is neatly divided into specific measure divisions, the three solo sopranos' structure does not determine the placement of the formula. The three solo sopranos repeat in twelve, fifteen, and twenty beats per cycle, respectively. The arrival of the decrescendo at the thirtieth beat after the superformula section on C5 only cleanly aligns with the fifteen beats per cycle of soprano II. This decrescendo would begin during the middle of soprano III's twelve-beats cycle and soprano I's twenty-beats cycle. The *pianissimo* at m. 158 at the fortieth beat of this section arrives as this section's

nadir. The *pianissimo* only aligns with the twenty beats per cycle of Soprano I. While one of the three solo sopranos may fit in the dynamic progression of this section of superformula C5, they do not inform the IPS. The dynamic changes and future tempo changes will determine the Departure/Return of this IPS as it overrides the formula's pitch structure.

Example 29: Three solo sopranos, mm. 154-160



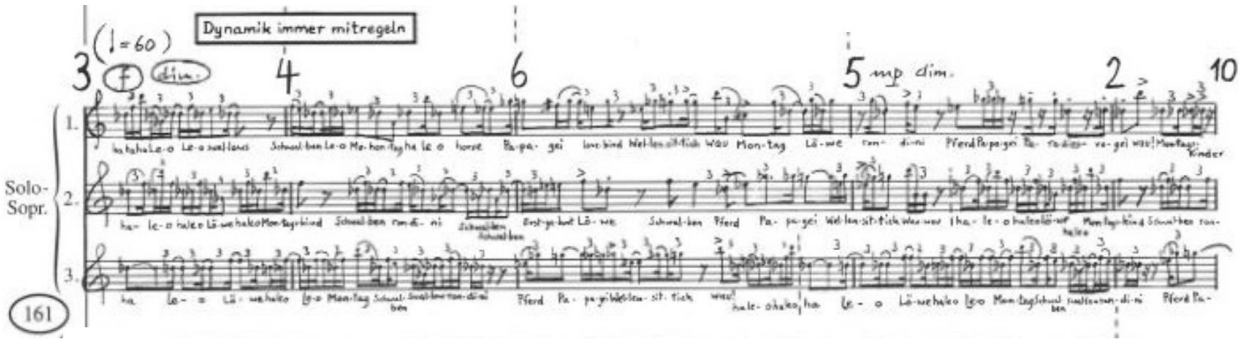
The second note, D♭4, of the superformula during mm. 161-169 has a similar volume progression, and it varies the tempo as well (example 30). The start of the nadir

portion of this superformula, D♭ begins at m. 165. A *ritardando* occurs in m. 166 and lasts for ten beats. According to Stockhausen's instructions, *ritardandos* must reduce the speed by half.[62] At m. 167, the music shifts tempo, and it takes 16th note as the beat at ninety beats per minute. The music in m. 167 becomes significantly slower and softer as it reaches its nadir again at the fortieth beat. This section occurs over twenty beats, and after twenty beats, this section will begin a gradual acceleration and crescendo at mm. 168-169. Upon reaching m. 169, the music returns to its original *forte* dynamic and to its tempo of 60.

Like the previous section, a departure from the original tempo marking occurs; however, the pitch content of the music is the same throughout this section. The pacing of division by beats remains consistent to the previous section. Twenty beats are given for the gradual descent in dynamics or tempo before reaching its nadir. Ten beats are taken at this climax before the following twenty beats will be a climb back to its original position. While the divisions of this progression may change, the occurrences of these dynamic markings remain consistent for even the third and fourth note of the superformula. The third and fourth superformula notes of this scene copy the beat organization of previous dynamic markings; however, a slight difference occurs with the peaks of the extremities of the sections.

[62] Stockhausen, Preface to *Evas Erstgeburt, lxxx.*

Example 30: Superformula on D♭, mm. 161-164

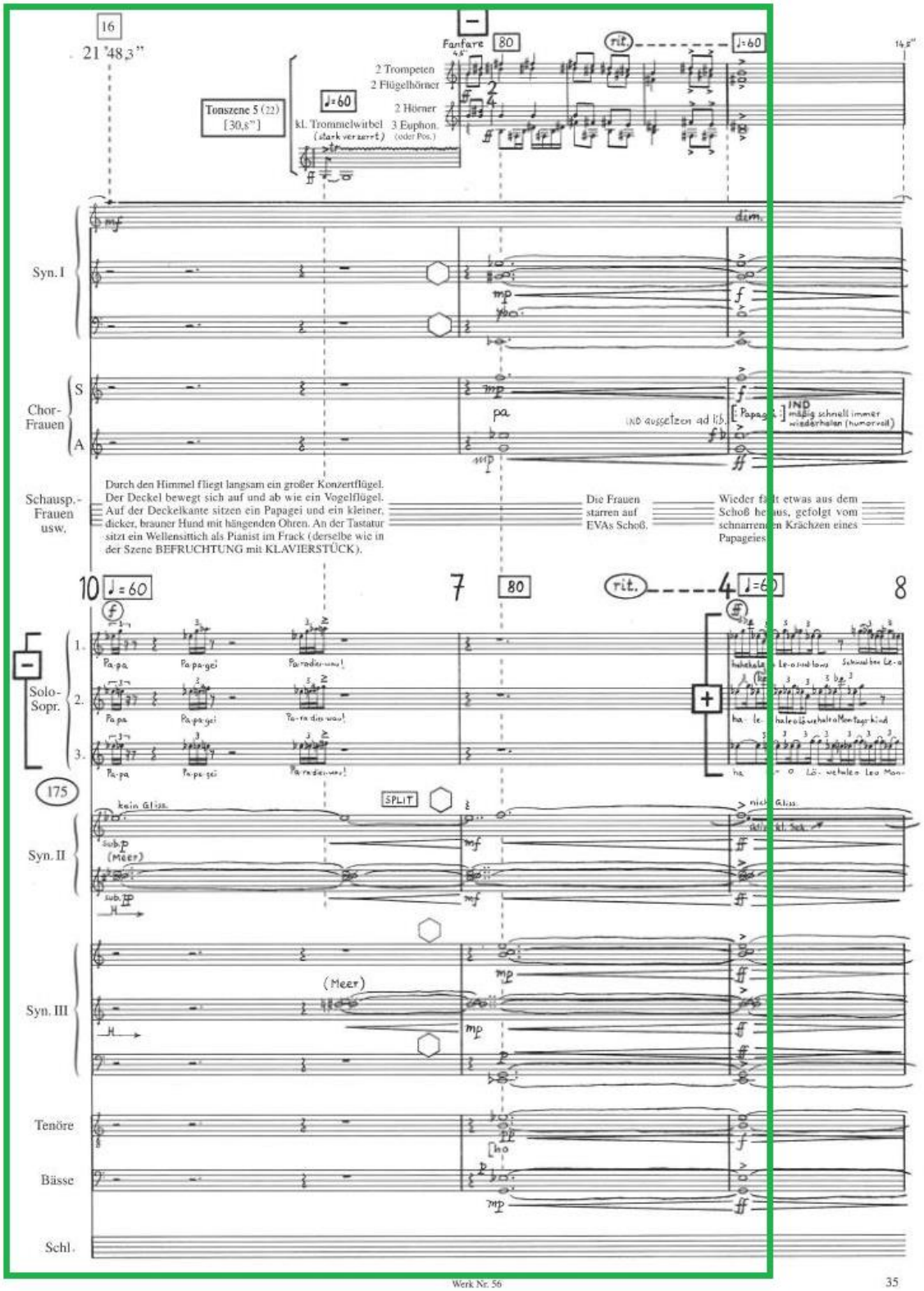


Both of these cycles can be labeled as Departure/Return IPS, and the music can be interpreted to reflect the events of the scene. In this case, the volume and tempo could signal the pace of the birthing process. The Eve statue starts with energy at a *forte* marking that will be needed for the birth. The decrescendos can represent Eve's depletion of energy as she rests between births. The music slows down during her rests, and the tempo and dynamic returns as she regains her energy. However, similarly to *In Hoffnung*, most of the music in this part remains the same. Only the tone scene that produce the sounds of the children differ notably from the previous superformula section in terms of pitch and rhythm. The music throughout the three solo sopranos can be seen as the same, but due to the secondary parameters, the music can be divided into three distinct sections. The beginning state of this music contains energy in volume and steady tempo. This state departs with the loss of volume and tempo, and it returns when the energy and tempo is restored. In terms of the overall progression, *Heinzelmännchen* could be seen as a directional IPS like *In Hoffnung*. However, since the music lacks the variation of pitch set and attack density between the cycles, register and dynamic range can represent the IPS of this scene. Each of the structural superformula notes transposes the same Eve

superformula by a half-step. Furthermore, the beginning dynamic of the first cycle is marked *forte*, but the last cycle ends in *fortissimo*.

Other modifications to the music occur to buffer the sections in the superformula. In mm. 175-176, the three solo sopranos have a small break in singing the Eve superformula. At this moment of the opera, a large concert grand piano flies through the sky with its lid acting like wings. A parrot (specifically a budgerigar) is seated at the chair as the piano's keyboardist. In the superformula plan, this occurrence of music does not appear; the purpose of this scene may not be clear through a formula perspective. However, in an IPS perspective, the music could be considered a Departure/Return. During this part, the music maintains a *forte*; however, a loss of the Eve superformula's high attack density drastically sets this music apart from the previous section. In this case, a Departure/Return IPS could be given if the initial parametric state of this music is the Eve superformula. If this interpretation is taken, then the contrasting section would be the music in mm. 175-176 as the focus on the Eve superformula is lost (example 31). This section can be interpreted as a slight reprieve from the numerous births up to this point in the scene.

Example 31: Slight interjection in the superformula process mm. 175-176



This Eve superformula process ends at m. 184. The music suddenly falls down to a lower dynamic throughout mm. 185-193. This section is separate from the superformula, but, like other parts of this opera, it contains music derived from the formula. In this part, a woman can be heard stating in Dutch, "My god, am I tired!"[63] The softer dynamics reflect this, but the music also sets up Lucifer's dark appearance as he slowly approaches the Eva statue and children. All the women turn towards Lucifer and shout his name, and in turn, Lucifer calls the children repulsive. The IPS of this scene might lack a good label as it is a sudden change and vastly different in terms of volume and attack density. This part can be seen as a Directional IPS in relation to the previous music in m. 174 or a Steady-State IPS. However, in describing the aspects of Directional IPS, Howland mentions a concept from Hasty's ideas of segmentation called "salience,"[64] which can be summarized as a process that increases or decreases these processes over time. In this case, the music undergoes a sudden change instead. The music lines up with Howland's idea of "replacement, a "type of IPS [that] closely resembles Stockhausen's idea of 'state' a formal unit in which there is 'no directed tendency of changes in any of the parameters.'"[65] In this case, no connection exists between the end of the superformula process at m. 174 and the start of this section in m. 175; therefore, due to the sudden change of state in the music, this section of music can be understood as a change of state and a Steady-State IPS.

[63] Stockhausen, Translation of performance instructions of *Evas Erstgeburt*, 7.
[64] Howland, "Formal Structures in Post-Tonal Music," 86.
[65] Ibid, 86.

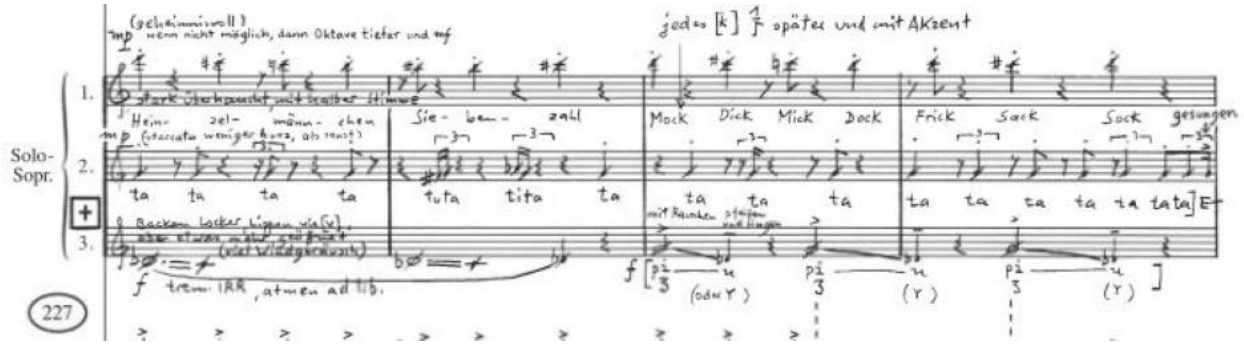
ERSTE GEBURTS-ARIE REVISTED

In the first birth aria, a formula analysis was able to describe some of the pitches and rhythms used in the music. Trichords such as the [0 1 5] and [0 1 4] (and their inverses [0 4 5] and [0 3 4] respectively) appeared throughout the music, and certain intervals such as the Eve ascending M3 also helped distinguish some formula segments in this scene. While these formula snippets can be observed, chapter 2 made no attempt to give a form analysis built on the formula. However, through secondary parameters and IPS, some semblance of form could be gathered from the music. As established in the previous chapter, the three solo sopranos are the most active in this scene and undergo the most changes in the music.

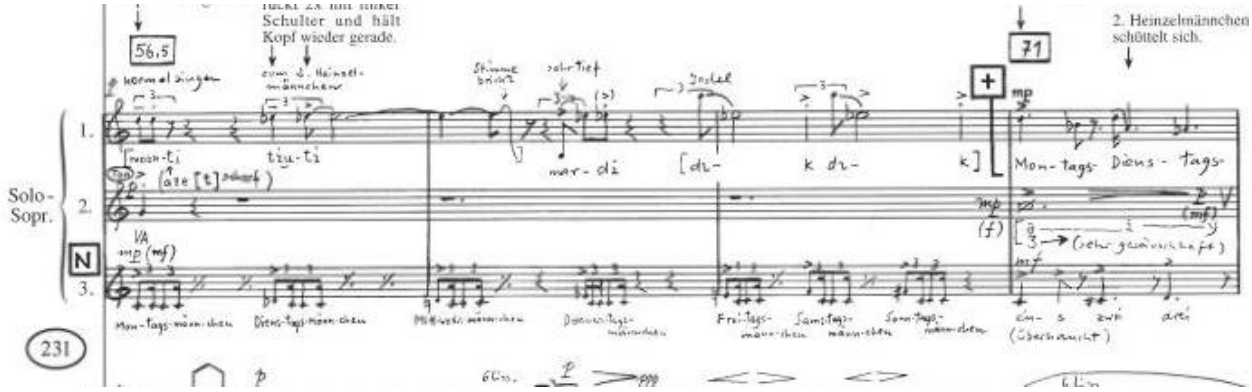
Table 7 provides a list of the sections in comparison to the CD audio track. Most of the time, the CD track provides a reliable mark that coincides with the sections in the music. However, two segments in this analysis do not agree with the CD's track division of the music. In mm. 231-233, this music is distinguished from music in mm. 226-230. In

these two sections, the music is separated by articulation and pitch collection (figure 32a/b)

Example 32a: Three solos sopranos, mm. 227-234



Example 32b: Three solos sopranos, mm. 227-234 (continued)



The music in example 32a and 32b is significantly different. Soprano I has a short detached chromatic scale descent in mm. 227-230. This voice changes to a different rhythm on 231-234 and a contour with leaps and an ascending half-step at the start. In the soprano II in mm. 227-230, the music sings short notes with varying entrances on syllable "ta," but in mm. 231-234, the soprano II is mostly silent. Soprano III begins singing with a tremolo on m. 227, but measure 231 contains music with a constant repetitive rhythm with pitches based on the superformula chromatic ascent. In the libretto, mm. 271-230 sets the naming of the *Heinzelmännchen* of this scene, in which they are named Mock,

Dick, Mick, Dock, Frick, Sack, and Sock, (which correspond to the days of the week: *Montag, Dienstag, Mittwoch,* etc.). The following section combines the days of the week and the end word of *-männchen.* Although the music is disconnected, the lyrics are connected by the naming of these *Heinzelmännchen.* Due to this, these two portions of music can be viewed as belonging to the same section. However, due to the multiple changes, this music could easily be seen as two Steady-State IPS that can be combined into one Steady-State IPS.

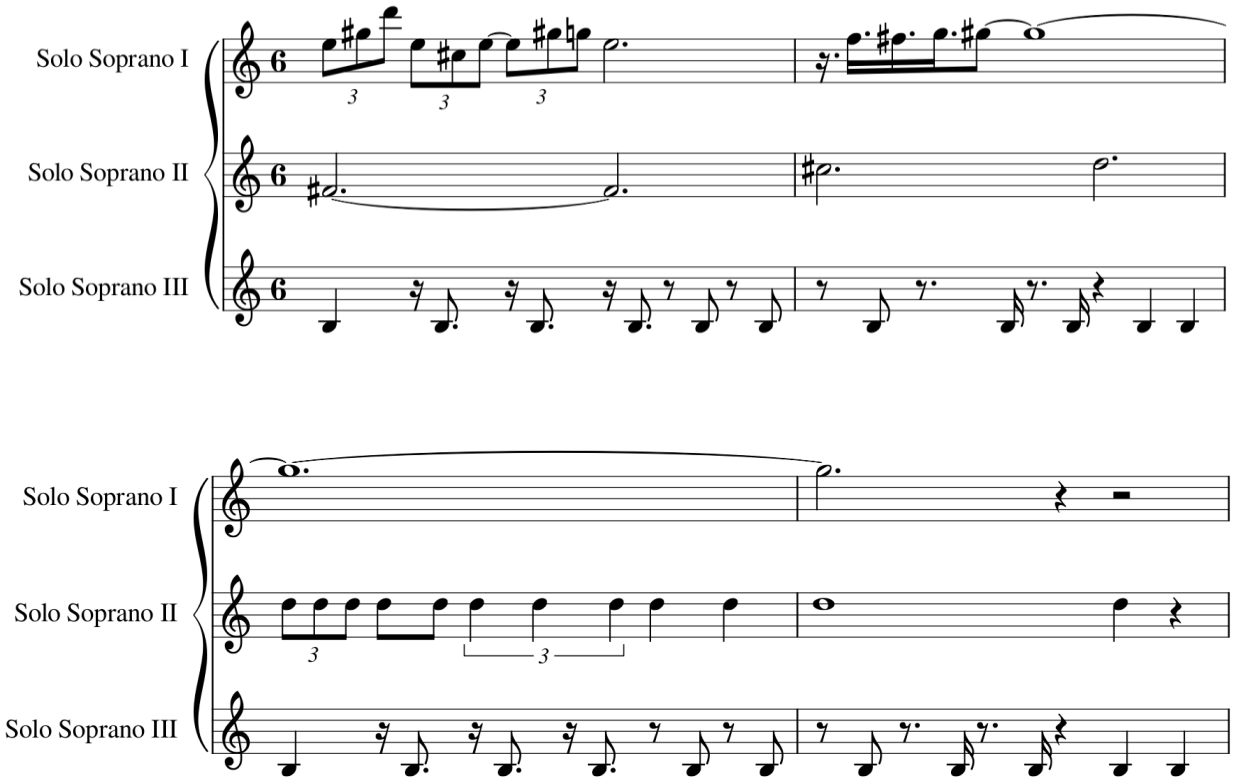
Table 7: Sections in *Erste Geburts-Arie*

Measure	CD Track
194-197	1 - m. 194
198-203	
204-210	2 - m. 204
211-215	3 - m. 211*
216-225	4 - m. 216
226-230	5 - m. 226
231-233	
234-242	6 - m. 234
243-254	7 - m. 243

* At 63.5 bpm, this recording is placed a beat before m. 211

This analysis places the second section on mm. 198-203 and disagrees with the CD track's placement of the second section (table 7). This part follows the scene's opening superformula. A tempo change occurs from a tempo marking of 60 to 63.5. At the start of this scene, the three solo sopranos sing an un-ornamented form of the formula, which switches to a new section that differs in pitch collection and rhythm (example 13 and 33).

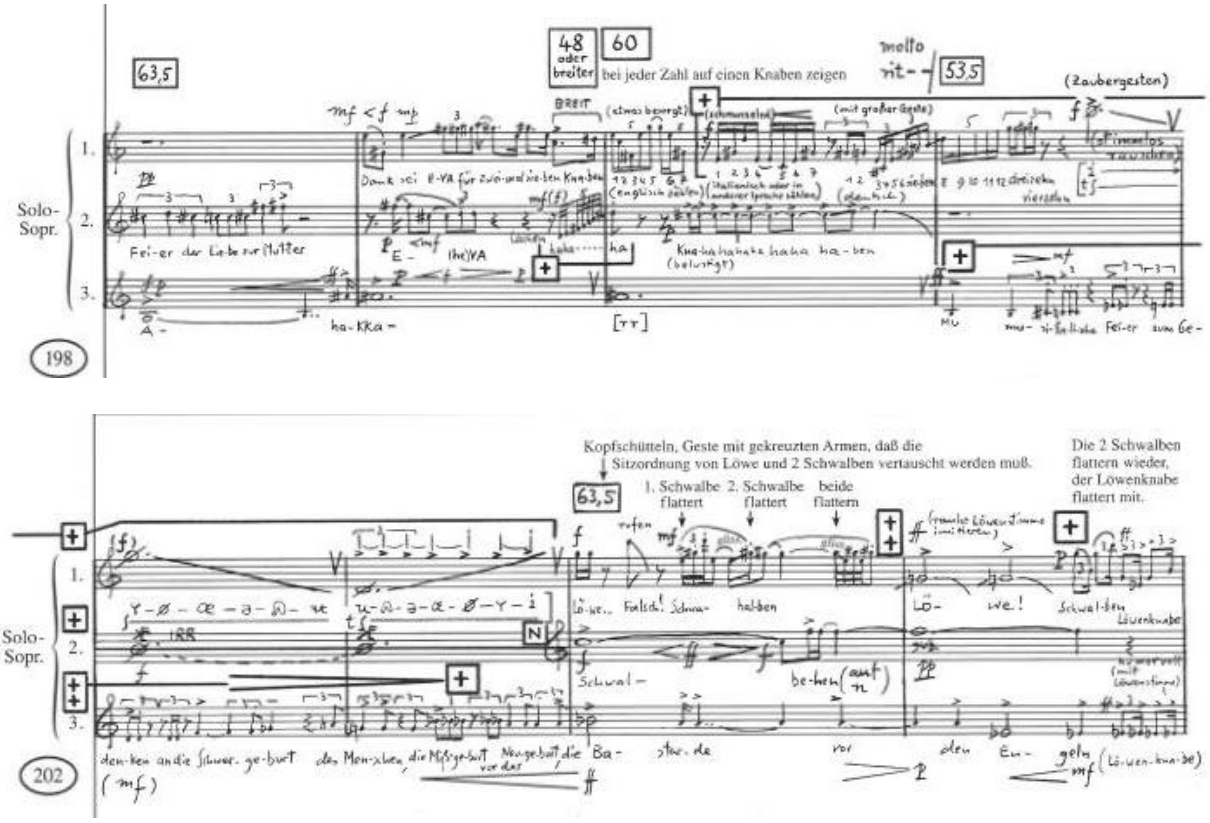
Example 13: Three Sopranos mm. 194-197 (reprinted)



\ While the music does have large differences in the notes selected in these three voices, certain interpretations can arise to give these two sections separate Steady-State labels. Following the CD track's interpretation, one would have to ignore the differences in tempo and attack density. However, both sections are connected by the same verse in the libretto, pitch collection, and rhythm. Furthermore, the superformula's appearance in mm. 194-197 restarts in mm. 200-201. Although the music does not use the exact same rhythms on a superficial level, the structural pitch collections and prolonged rhythms help connect this music to the previous section. This interpretation would make this section a long Steady-State IPS spanning mm. 194-203 for over a minute. In this analysis's interpretation, these two sections are separate, but they are connected by formula.

However, the passage's attack density and tempo get a significant increase to create a separate section. This increase in those two parameters would generate a directional IPS as the music begins to build more momentum through more frequent attacks.

Example 33: Music before track 2, mm. 198-205



Although reliance on the superformula can help detect beginnings and ends of certain sections, most of the music's structure does not reflect the superformula. Similarly to *Heinzelmännchen*, these formula figures do not neatly divide alongside these IPSs. An overlap of these serial forms can be seen in this opera. The three solo soprano sing and finish their formula parts at different rates. The libretto signals to the sections of the music but due to the continuous formula, the sectioning or moments of these scenes can

be difficult to see. In the first section of *Erste Geburts-Arie*, the three solo sopranos sing their first verse; the soprano I and II end their lines at similar times.

Due to the similarities of *Erste Geburts Arie* and *Zweite Geburts Arie*, this analysis will not cover *Zweite Geburts Arie.* The formula and moment aspect are similar because they both re-use their voice's respective figures: the sopranos and chorus primarily represent Eve and the tenors represent Michael. In this scene, moments can be created by an alternation of focus between voice parts or changes in articulation, dynamics, pitches, or dynamics.

KNABEN-GESCHREI REVISITED

In the previous chapter, the analysis of *Knaben-Geschrei* observed a short section preceding a 35-rotation cycle. The beginning can be understood in three sections: the alternation between the chorus, children and sopranos; the solo in the tone scene; and a return of the parts from the previous section. In terms of pitches and rhythm, this section had no direct connection to the formula. In the rotational process, connections to the formula could be made through certain pitch-class sets, but other parametric connections could be made through the changes between rotations. While these observations can connect the music cohesively, they can lack in explaining a role for these sections or changes in between sections.

The opening section can be divided into three parts and be viewed as three Steady-State IPSs. Measures 335-341 mostly features voices singing in alternation with underlying drones. In the next section, mm. 342-343, the cow moo introduces a new timbre. The chorus and children sing in synchronization with the cow moos, and a gong ends this scene. In terms of the texture, these two sections differ with the placement of the vocal parts. In the first section, these voices alternate with each other. During the cow moo tone scene, the chorus and children sing together instead. The voices in the third section, m. 344, are more closely aligned as the children sing their glissandos waves and the three solo sopranos sing the word “formation” three times. Parametrically, the music contains no drastic changes to dynamics or attack density. New timbres are introduced; however, the music overall lacks a change in any secondary parameters, and the pitches and rhythms are freely selected throughout this section. In the scene, the women chorus prepare the children to ride their buggies. At the sound of the gong, the women move

towards the children and load them into their carts. The announcement of "formation" organizes the actors to move in synchrony. Normally, this section could be seen as a single Steady-State IPS that encompasses three different Steady-State IPS. However, because the music goes from a monophonic/homophonic texture to a symphonic texture, it could be considered a Directional IPS. In this case, the music goes from unorganized sound to coordinated sound to reflect this scene's progression from scattered actors to formed groups.

A second look at table 4 shows that *Knaben-Geschrei* can be interpreted as a set of multiple Directional IPS, Steady-State IPS, or Tension/Release IPS. Generally, the gradually accelerating tempo indicates a Directional IPS; however, certain stops halt or stifle this advancement. The notable pauses are short pauses after rotation 4, 6, 10, 13, and 19. During these scenes, the women would stop the pram race and to do a certain action: feed the children, look and give praise to the Eve statue, or a short bathroom break and castration. On table 4, these occurrences are listed as interjections.

Table 4: *Knaben-Geschrei* rotation sections reprinted

Rotations	Duration in seconds	Tempo range	Measures	Beats per measure
1-4 (pause)	124.5	42.5, 45, 47.5, 50.5	356-371	6
5-6	51.5	53.5, 56.6,	372-379	6
Interjection (banana)	46.9	60, 63.5, 67	380-391 (4+4+4)	6
7-10	79	67, 71, 75, 40	392-403	6->3
Interjection (carrot)	60	42.5, 45, 47.5, 50.5	404-416	3->4
11-13	68.2	53.5, 56.5, 60	417-428	4->3
Interjection (statue)	40.6	63.5, 67, 71, 75.5	429-440	3->4
14-19	80.2	[80, 85], [90, 95], [101, 107], [113.5, 120], [127, 134], [142, 151]	441-488	4->3
Interjection (urination)	43.4	151	489-510	3
20-23	72.8	[80, 85, 90, 95, 101, 107]; [113.5 120, 127, 134, 142, 151, (53.5, 56.5)]; [60, 63.5, 67, 71, 75, 80, 85, 90, 95, 101, 107, 113.5, 120, 127, 134, 142, 151, 80]	511-554	3->2 mm. 535
24-35	108	80 (accel rot. 34-35)**	555-626	2

*Brackets group tempo per rotation

***Accelerando bis so schnell wie möglich* - Accelerate as soon as possible

IPS analysis can assign a function to these sections where the formula is less clear by explaining these interruptions in the rotational process. These interjections are marked by the word “stop” in the score, and they differentiate themselves through different melodies and parts. Examples 32a/b shows music from m. 429 to m. 440, which contains rotations 12-13 and the Eve statue interruption. This analysis observes that synthesizer III’s texture changes from a blocked chord to an arpeggio. Synthesizer I remains mostly the same. Both sections have synthesizers that contain twenty-four beats with dynamic markings that are the same, but reversed contour. Synthesizer I in rotation 11-12 ascends in contour, while the interruption descends. The three solo sopranos go from synchronous held durations to disjunct arpeggiated figures that resemble the Michael figure with different figures with a [2 0 1] contour and smaller rhythmic division. The *Tierknaben* halt from their chromatic octave ascent from rotation 11-13; giggles can be heard in place of this part. The bass maintains its solo complexity throughout its part. Texturally, the music of synthesizer I, bass, and part of the chorus remains the same, which connects this music to the previous section. However, the change in the other parts sets this music apart from the rotation. At this stop, the music continues its tempo acceleration. Dynamically, the music is not dissimilar, but the lesser amount of sounding parts takes away from some of the section’s overall volume.

In assigning IPSs to these sections, the rotation 11-13 section could be given a directional IPS as its tempo is constantly gaining through each rotation iteration. The IPS of the Eve statue stop could be called a Directional IPS as well, as its tempo increases throughout the music; however, as some parts halt their rotational process, this can be interpreted as a halt in the music’s process. However, the music maintains stasis in

certain parameters throughout the music, but one parameter, tempo, continues to climb. Contrary to the opera's plot at this point in the music, the stop for brief respite does not occur. This section can be interpreted as slowly enhancing the overall direction, excitement, and celebration that accompanies this scene.

Figure 34a: Rotation 12-13 and Statue stop, mm. 421-434

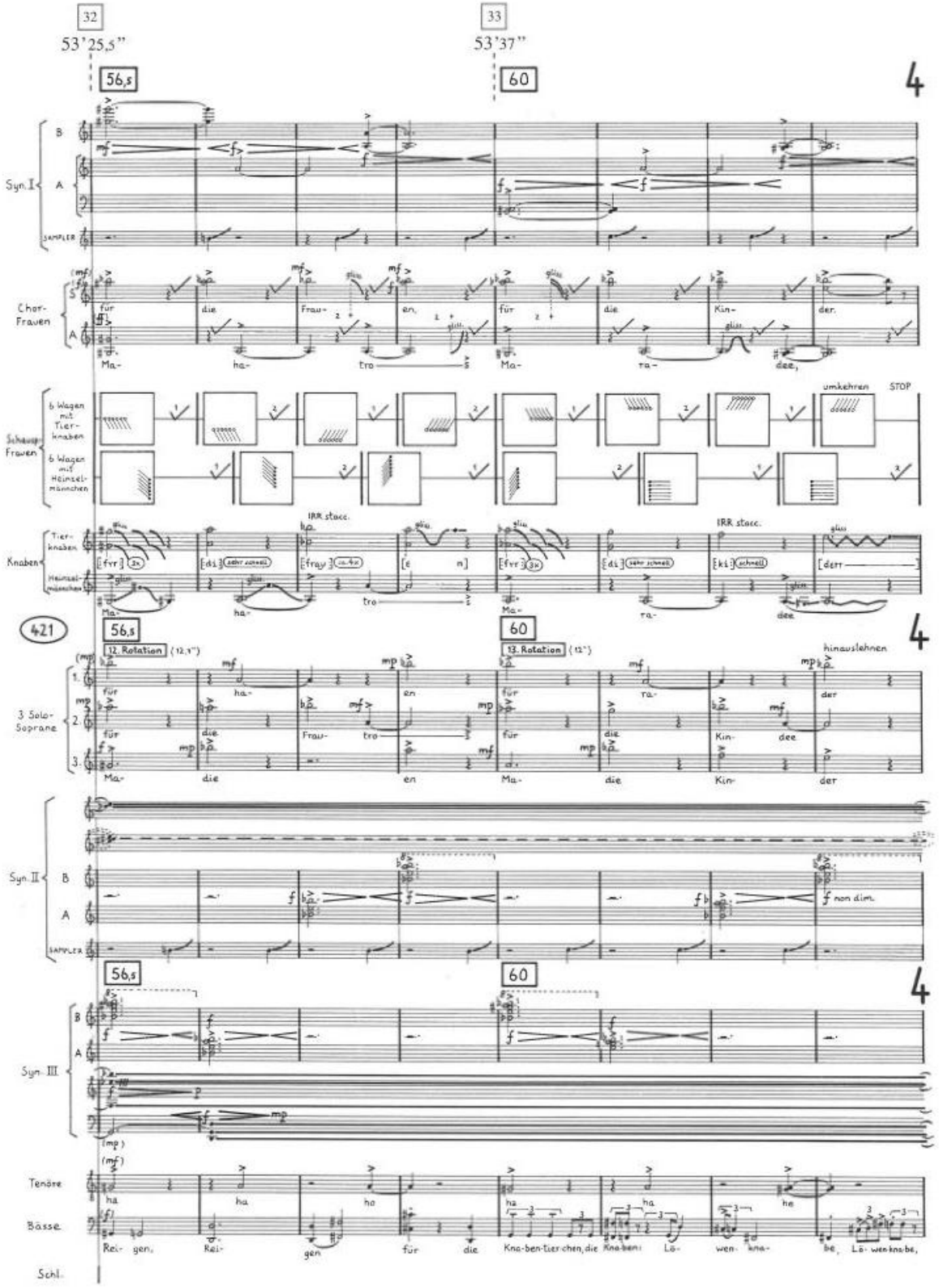
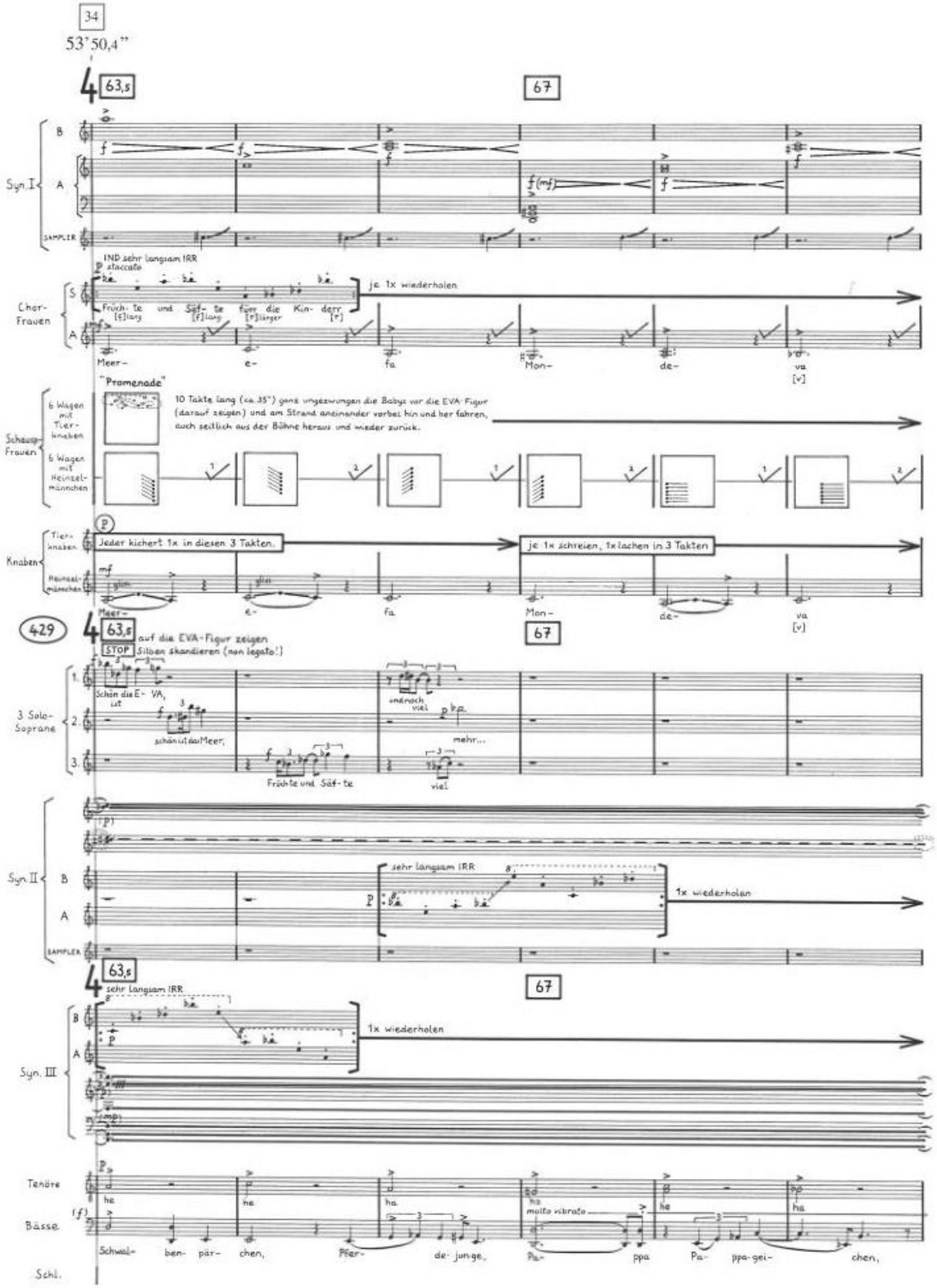


Figure 34b: Rotation 12+13 and Statue stop, mm. 421-434 (continued)



In this analysis thus far, IPS and secondary parameters serve to identify the moments in *Evas Erstgeburt.* In this scene, the formula is used in vague ways. While a formula approach can identify and connect certain rotations as being similar, this observation does not describe the differences between these sections. Furthermore, these rotations in the music can feel functionally lost as the music's connection to the formula can be general and vague. Instances of music that do not have a clear connection to the formula could be explained as ornamentation, but this is not an adequate explanation for the music or the idea of moment. IPSs explain the direction and role of a passage by identifying certain characteristics of the passage, and they are similar to moments. They both are based on the changes of parameters. Like moments, these IPSs can be seen as parts of the opera's structure.

LUZIFERS ZORN REVISITED

A formula analysis of *Luzifers Zorn* shows that the music can be derived from the *Licht* formula. This scene is cyclical, and it bases its cycles around the English alphabet. While an analysis can observe that these cycles borrow from the superformula's material, these connections may be obscure or vague. Instead of relating the music's content to the formula, this analysis will similarly approach this scene as a growing process similar to *In Hoffnung*.

The division of these sections occurs before or after Lucifer's announcement of alphabetical letters (table 8). Similarly to the growing processes of previous scenes, the music becomes gradually more complex or realized. At the start of the cycle, A-K, the announcement of letters comes at the end of the section and coincides with the chorus's and children's objections. At letter O, this announcement occurs at the end as well; however, the placement of the announcement is switched to the beginning during the announcement of letter V.

Similarly to cyclical types of rotations in *Knaben-Geschrei*, the music in *Luzifers Zorn* consists of transformations between sections of music. While the music in *Luzifers Zorn* slightly differs in superficial content such as intervals or pitches, its sections still carry commonalities that connect the sections. These connections may inform the IPS or IPSs of these letters. Table 8 lists characteristics that describe each cycle.

Table 8a: Sections of the letters and notable changes in *Luzifers Zorn*

Letter	Measures	Degree of change	Description
A	648-51	Start	36 bpm with long notes. Glissando figures that go up and down in frequency.
B	652-664	Drastic change	Addition of 7th leaps. The music becomes longer with more measures. Addition of different types of glissandos. Greater rhythmic division than letter A.
C	665-676	Small change	Similar to B with pitch sets and intervals. The actor's part includes faster turns in his part. The duration of this section is slightly shorter than B.
D	677-683	Significant change	Increased attack frequency in both parts. The bass includes a sextuplet and tremolo figure. Actor's part includes over 20 attacks in m. 677. Some shifts in pitch content change the melodic intervals in the bass part.
E	684-691	Significant change	Lesser attack frequency in the actor's part. Also, the actor changes their articulation of their notes to be longer. The solo bass sings a new figure of a pitch wave in m. 689. Pitch content similar to previous letters.
F	692-694	Small change	Significantly shorter duration than letter E. The actor's voice continues to sing longer duration notes.
G	695-714	Drastic change	Significantly longer section. Also increases the tempo from 90 bpm to 95 bpm. The pitch content is close to the previous letter. Further increased frequency of attacks and rhythmic activity in the bass's part. Actor's part incorporates downwards glissando figures.
H	715-721	Drastic change	A sudden slowing of tempo occurs right before the end of the letter "Gefa" at m. 713 to 63.5 bpm. The actor's sustained articulation of notes turns into glissando figures. The Bass slows down in frequency of attack, but still carries some rhythmic complexity.
I	722-728	Small change	Slower tempo, but similar to H.
J	729-734	Significant change	Addition of tongue clicking and clapping and shorter durations with the actor's rhythms.
K	735-758	Significant change	Longer duration overall. Increase of attacks in bass part, but long glissandos in the actor's part.
O	759-765	Significant change	Much shorter duration overall. Increase in attack rate. The actor's long glissando continues.
V	766-71	Drastic change	The Erratic Actor's contrasts from the smooth glissandos of the past sections. Decreased attack density in the bass singer.

Table 8b: Sections of the letters and notable changes in *Luzifers Zorn* (continued)

W	772-779	Drastic change	Entrance of tone scene 12. Lucifer only sings for two measures.
X	780-783	Drastic change	Return of Lucifer as the central focus. The actor sings glissandos that rapidly goes up and down in frequency. The attack density is low until m. 782, a measure before letter Y.
Y	784-792	Significant change	The actor sings mostly downward glissandos and detached articulation glissandos. Some glissandos are sung with an arch form. Lucifer starts subdividing his song into triplet 16th notes.
Z	793-797	Significant change	The triplet subdivision in Lucifer's bass voice continues, but it is sung in alternation with the *pfeifen* (pipe). The duration of the actor's notes becomes shorter. Glissandos in the previous section lasted at least two seconds. These glissandos last shorter than a second.

CHAPTER IV: CONCLUSION

In Stockhausen's *Licht* cycle, each opera's music is derived from a formula. This formula determines the work's overall structure, rhythm, pitch, dynamics, articulation and harmonies. The formula exists in two forms: nuclear formula and superformula. The nuclear formula is the smallest unit of the formula; it presents the structural pitches and rhythms of the formula. The nuclear formula expands to create the superformula, which is an ornamented version of the nuclear formula, containing many additional pitches, rhythms, articulations, and dynamics. *Licht*'s formula features three figures — Michael, Eve, and Lucifer — that represent certain ideas or themes in the opera. These figures frequently exist as characters in the opera, and they act as three distinct voices in the music. As musical ideas, each figure is assigned intervallic, rhythmic, and harmonic characteristics.

This analysis investigated the formula's involvement in *Evas Erstgeburt,* the first act from *Montag aus Licht*. This analysis attempted to parse the formula in the music through the recognition of trichords ([0 1 4] and [0 1 5]), intervals, and rhythms. This formula analysis reveals that the music's structure is informed by the characteristics in the superformula.

Evas Erstgeburt's structure uses the formula, but some sections of the music do not follow the formula. Features such as the nine-*Monat* cycle in *In Hoffnung*; the short break in *Heinzelmännchen;* the interjections in the rotational cycle in *Knaben-Geschrei*; and the alphabet figurations in *Luzifers Zorn* lack solid attribution to the superformula or nuclear formula. Furthermore, on a small scale, certain aspects such as pitch and rhythm lacked a solid connection to the formula. The cyclical scenes, *In Hoffnung*, *Knaben-*

Geschrei, and *Luzifers Zorn*, used music that could be associated with the formula, but certain modifications during the cyclical process could remove a clear association to the formula. For scenes that are more continuous, such as the *Erste Geburts-Arie*, the gradual changes are not present, and the music is more through-composed. However, the sections in a through-composed scene may appear to have little commonality with the formula. These non-formula sections of music can be explained by Stockhausen's ideas of moment and Patricia Howland's IPS model.

Patricia Howland's concept of Integrated Parametric Structures (IPS) is a model built around post-tonal music. It observes that "phrase-like" structures can be built through secondary parameters (timbre, register, dynamics, articulation, attack frequency, etc.). Furthermore, these IPSs carry a label that informs the music's function: Directional, Steady-State, Departure/Return, and Tension/Release. These IPS types can be frequently found in Stockhausen's music. The IPS type in Stockhausen's moment depends on the structural level of the musical sections that are observed. The whole progression of *In Hoffnung* is directional, but the eleven sections that comprise the whole may use different IPSs. Steady-State, Departure/Return, and Tension/Release frequently occur throughout this scene. Eleven sections comprise the parts of this scene, and the first two sections are introductory. The following section comprises nine sections, and each section after the first two introductory sections is referred to as a *Monat* (month). The nine *Monate* can be labeled with an IPS type, and furthermore, the music within these *Monate* can be divided into IPSs. This analysis observes that *In Hoffnung* is a directional IPS. Through the

structuring of the music through formula and non-formula methods, these moments can be found, and frequently, the formula can inform the ending of these moments.

In Stockhausen research, several notable scholars have covered the composer's composition process and philosophy through articles and interviews. Jerome Kohl, a prominent Stockhausen scholar, has researched and interviewed Stockhausen, regarding his compositional process and biography. Kohl has made analyses on the *Licht* opera cycle, and his analyses has been an immense resource to this paper. Jerome Kohl went for a "Middleground approach" in his analysis.[66] He analyzed mostly the large forms of the opera, and in an analysis of *Evas Erstgeburt*, Kohl's analysis of a "middleground" structure is present. However, if the formula is the basis for all the music in the *Licht* cycle, then the formula should be seen in the smallest level of the music: note-to-note. While this formula analysis was possible, it only helped slightly in realizing moments. The start of a formula or the repeat of a formula could signal to the start of a moment; however, the trichord connection to the formula was frequently vague.

Robin Maconie also has done biographical research on Stockhausen, and he has investigated the symbolism in Stockhausen's works, which has helped explain some of the seemingly non-formula sections or moments. These two resources have helped this paper's analysis with its information, but I was unable to find an analysis of the formula's presence on the smallest level in Stockhausen's *Licht* cycle.

The definition of moment was also vague. Stockhausen frequently emphasized the importance of the degree of change between moments. However, moments are sometimes described as stasis or discontinuity because moments can have as many similarities or

[66] Kohl, "Into the Middleground."

differences in comparing two moments. Howland's IPS and the formula helped in sectioning the music and showing relations between moments through secondary parameters. Howland's labels also explained the scene's progression.

This paper's research attempted to closely examine the formula's presence in the music, but this paper's analysis was not fully extensive. It only covered small portions of the scene's music and IPSs. Each scene has its own form, and each integrates the formula and moments differently to create segments and organization unique to the scene. Further avenues of research for this could be the use of statistics to calculate the prominence of the formula throughout the music. Even with Stockhausen's extensive serial process, this research did not map every possible connection according to the formula's parameters such as dynamics or rhythm.

The combination of formula analysis and IPS analysis yields an analysis of the smaller structures and of Stockhausen's conception of moment. Frequently, Stockhausen's music can appear rigid with its immense number of traits that are determined through serial composition. However, Stockhausen permits deviation and variation from his plan to set the music in *Licht.* While the formula serves Stockhausen to inform the music's pitches, rhythms, dynamics, articulations, etc., certain forms arise outside the formula that are informed by moments. While the music's form may be grasped through understanding of formula or moment, models such as Integrated Parametric Structures and other models may further approaches to understand Stockhausen's work outside the composer's word.

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