

**THE COMPOSITIONAL PROCEDURES USED IN JOHN CAGE'S
*SIX SHORT INVENTIONS, FIRST CONSTRUCTION (IN METAL),
AND SPONTANEOUS EARTH***

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With a lack of interest in John Cage's early works, this study sheds light on the way in which these three early works are composed. In this study, the development of Cage's square-root or micro-macrocosmic form is explored and then traced from the forms genesis to later modifications of the form.

The centerpiece of the article is a description of the techniques used to create *First Construction (in Metal).* Using Cage's correspondence with Pierre Boulez as a starting point, the organizational tools and methods are uncovered and traced throughout the piece. *Six Short Inventions* is found to be an embryonic piece that holds traces of many of the techniques that come into existence in *First Construction (in Metal).* *Spontaneous Earth* is used to follow the maturation of these techniques in Cage's hands.

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AND SPONTANEOUS EARTH***

BY

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Abstract

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To My Father, My Mother and Jill

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Introduction

The following is a discussion of three works by John Cage: *Six Short Inventions* [1934], *First Construction (In Metal)* [1939], and *Spontaneous Earth* [1944]. I will attempt to retrace the methods that Cage used during the composition of these three pieces. Through this recreation, I should unearth a continuous evolution of compositional procedures. These three works were not completely new efforts; instead each built on techniques that Cage had used previously.

First Construction (in Metal) has historical significance because it is credited as John Cage's first composition utilizing a "micro-macrocosmic" structure. This structure will be defined later in this paper. During the early portion of this study, the following questions came to mind. Are the ideas that Cage was using for his compositional processes new or were they rooted in previous sources? Also, were these ideas carried into later works?

After the initial study of the *First Construction (in Metal)*, I wanted to determine whether or not these techniques had origins in other places. For this purpose, I chose *Six Short Inventions* [1934]. The decision was made based on information I found during a cursory study of one movement. The hope was that some compositional ideas from this work would influence Cage's later works, especially the *First Construction (in Metal)*.

Five years separate *Six Short Inventions* and the *First Construction (in Metal)*. *Spontaneous Earth* was chosen from a list of works written in 1944, five years after the *First Construction (in Metal)*. I attempted to find compositional similarities between *Six Short Inventions*, *First Construction (in Metal)*, and *Spontaneous Earth*.

Cage himself grouped his compositions from 1934 to 1944 together in “Notes on Compositions I.”¹ Cage created five separate categories: compositions that keep repetitions of individual tones as far apart as possible (1933-34); compositions with fixed rhythmic pattern (1935-38); music for dance, film, and theatre (1935-); compositions with a hierarchical structure (1939-1956); and intentionally expressive compositions (1938-51).²

Background

Six Short Inventions, *First Construction (in Metal)*, and *Spontaneous Earth* were all written during a time period that has been neglected by many in Cage scholarship. An example of the treatment of this period can be seen in one of the few surveys of Cage's entire compositional output, *The Music of John Cage* by James Pritchett.³ Pritchett attempts to create a broad overview of Cage's output, providing analysis and further commentary on specific works scattered throughout Cage's career. David Patterson, in his dissertation "Appraising the Catchwords, c. 1942 - 1959: John Cage's Asian-Derived Rhetoric and the Historical Reference of Black Mountain College," states that Pritchett's survey claims to be complete.⁴ However, Patterson points out several problems with Pritchett's survey. "His [Pritchett's] focus is essentially the Cage of c. 1951-1992, [and Pritchett] needlessly devalues the approximately seventy extant non-chance works

¹ John Cage, "Notes on Compositions I (1933 - 1948)," in *John Cage: Writer* (New York: Limelight Editions, 1993).

² Ibid., 5

³ James Pritchett, *The Music of John Cage*, (New York: Cambridge University Press, 1993).

⁴ David Wayne Patterson, "Appraising the Catchwords, c. 1942 - 1959: John Cage's Asian-Derived Rhetoric and the Historical Reference of Black Mountain College," (Ph. D. diss., Columbia University, 1996), 16.

composed between 1933 and 1951 as little more than a preliminary warm-up."⁵ All three works considered in this paper fall into this "warm-up" period.

The beginning of Cage's compositional career, c. 1933-1938, has been the most ignored by scholars. Very few studies of these works have been undertaken. In fact, Pritchett calls these works both "impractical"⁶ and "only of passing interest."⁷ Even later works, such as *Spontaneous Earth*, written for prepared piano, do not escape criticism by Pritchett. Pritchett finds fault with these prepared piano works because they were written primarily for dance⁸. He states that works like *Spontaneous Earth* are "workaday affairs"⁹ and that the compositions themselves "tend to be less distinctive."¹⁰ Once again, Patterson points to flaws in Pritchett's treatment of these prepared piano works:

In one particular eerie moment ... he [Pritchett] accuses the third of the *Three Dances* for two prepared pianos [1944-1945] of having, among other things, 'too many notes.'¹¹

The survey neglects the era from 1933 to 1944, making Pritchett's survey incomplete.

These missing years are the years during which *Six Short Inventions*, *First Construction (in Metal)*, and *Spontaneous Earth* were all written.

The following statement, by Peter Gena, summarizes the treatment of the Cage's output from 1933-1951:

In the early period (up to 1951) masterpieces in the tradition of 'classical' American experimentalists were produced. The *Sonatas and Interludes* (1946-1948) for prepared piano becoming a fixture of the repertoire.¹²

⁵ Ibid., 16 - 17.

⁶ Pritchett, *The Music of John Cage*, 8.

⁷ Ibid., 6.

⁸ Patterson, 17.

⁹ James Pritchett, *The Music of John Cage*, 26.

¹⁰ Ibid., 25.

¹¹ Patterson, 18.

¹² Peter Gena, "John Cage the Composer," in *A John Cage Reader in Celebration of his Seventieth Birthday*, Peter Gena, Jonathan Brant, and Don Gillespie ed., (New York: C. F. Peters Corporation, 1982), 2.

The period of Cage's compositions before 1951 is termed "early." Traditionally, student or immature works usually represents the early period of a composer's output. These early works are generally not representative of the composer's later output and contain little or no importance for scholars. Gena names *Sonatas and Interludes* as the most important work of this early period; in fact, it is the only work that is mentioned from this period. *Sonatas and Interludes*, not completed until 1948, was written four years later than *Spontaneous Earth*. Gena overlooks all of the works that are considered in this study. In summary, Peter Gena, James Pritchett, and many other Cage scholars have ignored this "early" period of Cage. However, through this study, the compositional methods used in later Cage works will be able to be traced back to *Six Short Inventions*, *First Construction (in Metal)*, and *Spontaneous Earth*.

Six Short Inventions

Six Short Inventions [1934] is based on Cage's own work *Solo Obbligato Accompaniment of 2 Voices in Canon* written in the previous year.¹³ Cage considered these works as part of a larger work: *Solo with Obbligato Accompaniment of Two Voices in Canon, and Six Short Inventions on the Subjects of the Solo*.¹⁴ The work was originally written for three unspecified instruments. Later, with the help of David Tudor, the work was orchestrated in 1958, for Alto Flute, B^b clarinet, B^b Trumpet, Violin, 2 Violas, and Cello.¹⁵ The orchestrated version of the score, published in 1963 by Henmar Press, is the version that will be used in this study. However, the orchestration of the

¹³ John Cage, "Notes on Compositions I", 5.

¹⁴ John Cage, *Six Short Inventions*, (New York: Henmar Press, 1963) preface.

¹⁵ Ibid.

work will be ignored in this analysis due to the orchestrations inconsistencies with the original compositional plan. Each movement of *Six Short Inventions* was created by taking a subject from the opening measures of the *Solo with Obligato Accompaniment*.

Paul Griffiths, in his survey *Cage*, states:

The first compositional method that Cage introduced was a simple non-serial control of chromatic polyphony, employed in three works of 1933-34: the *Sonata for 2 Voices*, the *Composition for Three Voices*, and the *Solo with Obligato Accompaniment* (also three part).¹⁶

The method used for this part of Cage's compositional process was analyzed by Deborah Campana in her article "Sound, Rhythm, Structure: John Cage's Compositional Process Before Chance."¹⁷ Cage's method of composing *Solo with Obligato Accompaniment* is the formation of a twenty-five-note pitch cycle. Within these pitch cycles, all twenty-five notes must occur before one of them can be repeated.¹⁸ John Cage described this process during an interview with Daniel Charles: "I had already written pieces with several voices that relied on a gamut of 25 half tones. I particularly watched for non-repetition."¹⁹

Campana continues her analysis by identifying a set of horizontal and vertical checkpoints that create a guide for the compositional process.²⁰ "The vertical alignment of the melodic lines was governed by Cage's desire for dissonant harmonies and by his intent to keep the repetition of pitches occurring in simultaneously sounding pitch cycles apart from each other."²¹ The horizontal checkpoints to which Campana refers were created through the use of the twenty-five-note cycle.

¹⁶ Griffiths, 1.

¹⁷ Deborah Campana, "Sound, Rhythm, Structure: John Cage's Compositional Process Before Chance," *Interface: Journal of New Music Research* 18, no. 4 (1989): 225.

¹⁸ *Ibid.*, 225.

¹⁹ John Cage, *For The Birds*, interview by Daniel Charles, Tom Gara and John Cage editors, (New York: Marion Bergers Publishers, 1995), 72.

²⁰ Campana, 228.

²¹ *Ibid.*

Pitch Organization

According to Thomas Hines in his article “Then Not Yet ‘Cage’: The Los Angeles Years 1912-1938”, *Six Short Inventions* is the strongest piece surviving from Cage's studies with pianist Richard Bühlig.²² In 1932, the two met when Cage, seeking a performer for his housewife lecture series, approached Bühlig. Cage wanted Bühlig to give a performance of Schoenberg's Opus 11, for which Bühlig had given the U.S. premiere.²³ Instead, Bühlig began giving the young Cage lessons in composition. From these studies, Cage learned Bühlig's compositional technique. Hines described this technique as “composing in two high octaves and two low octaves with a middle octave shared by both; no tones could be repeated within any of the three octaves until all of the tones had been used in each respective range.”²⁴ However, this technique also has seeds in other another location. In Henry Cowell's book *New Musical Resources*, originally published in 1930, Cowell devoted an entire chapter to dissonant counterpoint.²⁵ Here Cowell discusses the music of Schoenberg, Webern, Hindemith, and Ruggles.²⁶ During an in-depth discussion of the techniques of Charles Ruggles, Cowell states that Ruggles, used a technique in which “...the same note is repeated in a melody before enough notes have intervened to remove the impression of the original note...”²⁷ Ruggles technique is similar to that used by Bühlig.

Cage modified this technique to meet his compositional needs. Cage later detailed how he controlled the chromatic polyphony by striving “...to maintain very great

²² Thomas S. Hines, "Then Not Yet 'Cage': The Los Angeles Years, 1912-1938," in *John Cage Composed in America*, Majorie Perloff and Charles Junkerman ed., (Chicago: The University of Chicago Press, 1994), 91.

²³ Ibid.

²⁴ Ibid.

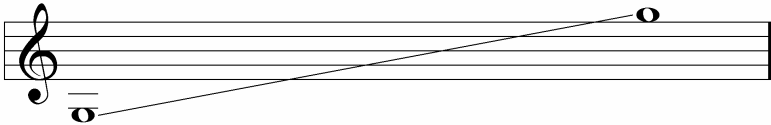
²⁵ Henry Cowell, *New Musical Resources*, (New York: Something Else Press, 1969), 35.

²⁶ Ibid., 40.

distances between repetitions of each given pitch; I considered the octave of note 'x' as a different note 'y', and not just as the octave of that note 'x'...”²⁸

Every pitch in *Six Short Inventions* falls into a two octave span beginning on the G below middle C.

Figure 1 Range of Twenty-Five-Note Row



Each note in the two-octave-chromatic span is included in the twenty-five-note cycles. In each cycle, the pitches may appear in any order, and this order is varied throughout the many appearances of the cycle. The first instrumental part of the first movement of *Six Short Inventions* is comprised of two statements of the twenty-five-note cycle.

Example 1 *Six Short Inventions*, Movement 1, Instrument 1, mm 1-12²⁹



²⁷ Ibid., 41-42.

²⁸ Cage, *For The Birds*, 72.

²⁹ Cage, *Six Short Inventions*, 1.

Example 2 Six Short Inventions, Movement 1, Instrument 1, mm 13-end³⁰

The two statements of the twenty-five-note cycles, Examples 1 and 2, are seemingly unrelated beyond the pitch content. Cage did not use any of the traditional serial techniques -- transposition, inversion, or retrograde -- to modify subsequent instances of the cycle. Instead, each time a twenty-five-note cycle occurs, he used a completely new form of the cycle, always attempting to place repetitions of the same note as far apart as possible.

Campana states that each "repetition of a particular pitch [is] to occur as far as possible from any other statement of that exact pitch (but not its octave duplicate)." Through this compositional constraint, two separate streams of twenty-five-note cycles appear. The first type of twenty-five-note cycle is in Example 2. The second type is found in Example 3.

Example 3 Six Short Inventions, Movement 1, mm 3-7³¹

³⁰ Cage, *For the Birds*, 72.

In Example 3, the twenty-five-note cycle is found in the pitches of the ensemble, rather than just the pitches of a single instrument. The two streams of the twenty-five-note cycle overlap. For example, the twenty-five-note cycle shown in Example 1 appears here, but it is incomplete. Appendices A and B list all the twenty-five-note cycles found in each of the movements of *Six Short Inventions*. Via these appendices, the overlap of these cycles can be seen clearly.

Cage admitted "that his plan was not carried out rigorously..."³² For instance, if this plan were rigorously followed the first five movements would each have 150 notes -- six instances of the twenty-five-note cycle. However, the actual note count ranges from 139 notes to the expected 150 notes. Table 1 shows the number of notes found in each movement.

Table 1 Number of Notes in Movements 1 -5

Movement	No. of Notes
1	150
2	146
3	148
4	150
5	139

Note from Table 1 that only two movements have the expected number of notes. This expected note count should, when divided equally between all of the individual instruments, yield parts that contain 50 notes, or two twenty-five-note cycles per movement. Table 2 shows the number of notes played by each instrument in the first five movements.

³¹ Cage, *Six Short Inventions*, 1.

³² Griffiths, 10.

Table 2 Number of Notes For Each Instrument

Movement	Instrument	No. of Notes
1	1	50
	2	50
	3	50
2	1	50
	2	49
	3	47
3	1	50
	2	48
	3	50
4	1	50
	2	50
	3	50
5	1	44
	2	45
	3	50

Only 10 of the 15 instrumental parts contain the expected number of notes. If the two movements that contain the correct number of notes are removed from this calculation, only 4 of the 9 remaining instrumental parts contain 50 notes per movement.

In movement 4, a movement that contains the expected number of notes, additional deviations from the expected plan can be seen. The first twenty-five notes of the ensemble should produce a complete twenty-five-note cycle. However, as can be seen in Example 4, the expected plan is not fulfilled.

Example 4 *Six Short Inventions*, Movement 4, mm 1-3³³

The image shows a musical score for three instruments (Inst. 1, 2, and 3) in Movement 4 of *Six Short Inventions*. The score is written in treble clef with a key signature of one flat (B-flat). The notes are numbered to show a cycle of 25 notes. The numbers are: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25. The notes are distributed across the three instruments as follows:

- Inst. 1: 24, 25, 19, 18, 16, 10, 1
- Inst. 2: 13, 8, 3, 12, 14, 20, 23, 11
- Inst. 3: 2, 7, 9, 5, 17, 22, 15, 6, 13, 21

The pitches B^b (3) and C (16) do appear in Example 4. However, these pitches do not appear within the first twenty-five notes of the movement. The B^b does not occur until the end of measure 3, and the C does not appear until measure 4. Also, the E^b (20) occurs in part 3 only after the G (12) has reappeared.

Structure

The number of twenty-five-note cycles yields the structure of *Six Short*

Inventions.

Table 3 *Six Short Inventions* Structure

Entire Work Movements # of cycles	Six Short Inventions																																										
	1						2						3						4						5						6						Coda						
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1+

Using a pitch based organizational structure for this work would not have been uncommon for Cage during this period.³⁴ It was not until later that Cage used duration and rhythm, instead of pitch, to structure his works.³⁵

Table 3 has similarities to the “micro-macrocosmic” or “square root” structure. Later, Cage used this structure almost exclusively for a fifteen-year period. The following is a brief explanation of the square root form given by Cage; a more in-depth explanation will occur in the section of the paper devoted to the *First Construction (in Metal)*. Cage states:

The fact of the identity of the number of measures and the number of parts, or, in other words, the existence of the square root of the whole...one wants to reflect the large in the small and the small in the large.³⁶

³³ Cage, *Six Short Inventions*, 4.

³⁴ Cage, *For The Birds*, 72.

³⁵ Christopher Schultis, *Silencing the Sounded Self: John Cage and the American Experimental Tradition*, (York, PA: Northeastern University Press, 1998), 89.

³⁶ John Cage, "A Composer's Confessions," in *John Cage Writer*, (New York, Limelight Editions, 1993), 35.

Six Short Inventions predates the first use of the micro-macrocosmic form in the *First Construction (in Metal)* from 1939. However, the structure of the work displays some of the basic concepts of the micro-macrocosmic structure. The small parts are related to each other, each part containing the same twenty-five-note cycle, each with a different ordering of pitches. Each large section (movements) contains six small structural units (twenty-five-note cycles).

The structure found in Table 3 requires that each movement contain six instances of the twenty-five-note cycle. There are two different methods that can be used to obtain six cycles. The first method uses only the twenty-five-note cycles found in the individual instruments.

Figure 2 Twenty-five-note Cycles within each instrument, Movement 3

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrument 1	Row 1							Row 2								
Instrument 2	Row 1							Row 2								
Instrument 3	Row 1							Row 2								

The second method uses the six instances found in the ensemble as a whole.

Figure 3 Twenty-five-note Cycles within the ensemble, Movement 3

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrument 1	Row 1			Row 2		Row 3		Row 4			Row 5		Row 6			
Instrument 2																
Instrument 3																

■ Used by more than one row

Figures 2 and 3 show the two different methods of calculating the twenty-five-note pitch cycles for Movement 3. Charts for each of the movements can be found in Appendices 1 and 2.

All movements except the sixth and final movement contain six instances of the twenty-five-note cycle. In the sixth movement, there are six instances of the twenty-five-note cycle plus a coda that contains an additional twenty-five-note cycle and a few additional notes. This coda acts as an ending for both this movement, and because of its

placement at the end of the work, for the entire work. The coda for *Six Short Inventions* can be found in its entirety in Example 5.

Example 5 *Six Short Inventions, Movement 6, mm 17-32*³⁷

The musical score for Example 5, *Six Short Inventions, Movement 6, mm 17-32*, is presented in three systems. Each system contains three staves labeled Inst. 1, Inst. 2, and Inst. 3. The music is written in 4/4 time and features a variety of rhythmic patterns, including eighth and sixteenth notes, rests, and dynamic markings. The first system shows the initial entry of the instruments. The second system continues the development of the themes. The third system concludes the piece with a final cadence and a double bar line.

James Pritchett, while discussing the *First Construction (in Metal)*, says that Cage added a coda "to the end of the piece, for reasons that are not clear."³⁸ Cage's use of a coda that disrupts the integrity of a structure is not uncommon. In the other works analyzed in this study codas are also found. The coda is composed using the same techniques as the rest of the work. The coda allows the technique one final statement. It finishes with an

³⁷ Cage, *Six Short Inventions*, 7.

incomplete statement of the twenty-five-note cycle. This may be Cage's way of expressing the fact that this technique has not exhausted all of its possibilities. By labeling Example 5 a coda, the sixth movement would then contain six instances of the twenty-five-note cycles. Table 3, discussed earlier, already labels measures 17-32 of Movement 6 as a coda.

Governing Number

The number six begins to emerge as an important factor in many aspects of the construction of *Six Short Inventions*. There are six movements in *Six Short Inventions*. In each movement, two sets of six instances of the twenty-five-note cycle are present: six within the individual instruments (two in each instrument), and six within the ensemble.

Six Short Inventions is an "early" work for John Cage. The work contains certain elements that Cage revisits in later works such as the *First Construction (in Metal)*. The compositional elements discussed above are developed and solidified into materials that Cage uses for many years. This work is not, as Pritchett claims, "of only passing interest."³⁹

First Construction (in Metal)

By stating, "In using a modest array of basic elements the *First Construction (in Metal)* does not depart from earlier work ..."⁴⁰, Paul Griffiths is pointing out that the *First Construction (in Metal)* has roots in earlier Cage works such as *Six Short Inventions*. *First Construction (in Metal)* was written for six percussionists, each with a different set of instruments. The instrument list for each player is given in Figure 7.

³⁸ Pritchett, *The Music of John Cage*, 18 - 19.

Much of the current information about the *First Construction (in Metal)* has been taken from several letters written between John Cage and Pierre Boulez. In this correspondence, Cage wrote a detailed description of some of the compositional processes used in the creation of *First Construction (in Metal)*. Cage sent these descriptions in response to the following inquiry from Boulez:

I will play some of your records (they were particularly struck by *First Construction (in Metal)*). In order to present these discs in a precise manner, I should like to be able to say exactly what instruments and rhythmic construction you used ... you must send me the exact nomenclature of all the instruments you used.⁴¹

The replies, sent by Cage, discuss not only the instrumentation but the compositional procedures used throughout the *First Construction (in Metal)*. All of the information taken from these Boulez-Cage correspondences refers back to this initial query by Boulez.

Rhythmic Organization

One of the most prominent compositional procedures used in the *First Construction (in Metal)* was the organizational methods used for the work's rhythmic motives.

Rhythmic Motive Circles

Cage discussed the organization of these rhythmic motives in a letter to Boulez:

...there are 16 rhythmic motives divided 4,4,4,4 conceived as a circular series. When you are on one, you can go 12341 or retrograde. You can repeat (e.g. 11223443322 etc.) but you can not go 2 - 4 or 1 -3.⁴²

³⁹ Ibid., 17.

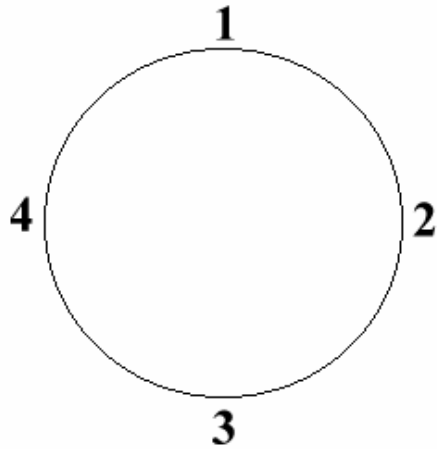
⁴⁰ Griffiths, 10-11.

⁴¹ Jean-Jaques Nattiez, ed., trans. Robert Samuels, *The Boulez-Cage Correspondence*, (New York: Cambridge University Press, 1993), 44.

⁴² Ibid., 49.

Cage described both the way in which the motives are organized and the way in which they are manipulated. Figure 4 illustrates the circular series that Cage described above.

Figure 4 Circle Series



The circle is used as the visual representation of the arrangement of the motives. The numbers in Figure 4 represent the locations along the circle where the rhythmic motives are placed. Cage can move from motive to motive by travelling around the circumference of the circle. As described in the letter, 1 can go to 2 or 4, but not 3.

Sixteen recurring rhythmic motives can be found in the *First Construction (in Metal)*. These motives are then divided into four groups of four motives each. In this analysis, these groups will be labeled Rhythm Circles A – D. These rhythmic motives remain unchanged for each of the percussionists. Example 6 shows the first rhythm circle ‘A’.

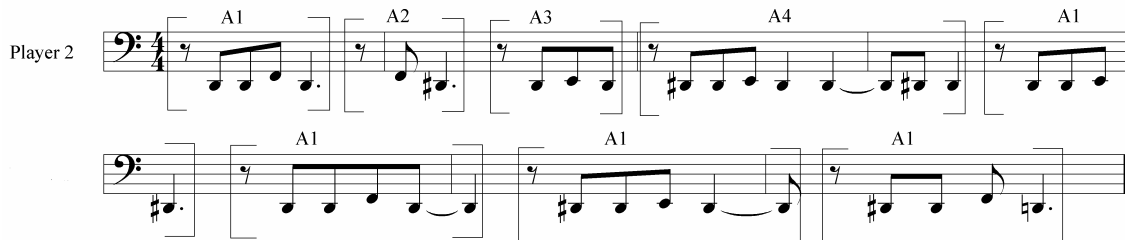
Example 6 A Rhythm Circle



Example 6 contains the four rhythmic motives needed to complete Rhythm Circle ‘A’. Each motive is labeled with a letter and a number. The letter refers to the rhythm circle and the number gives the location of the motive within the circle, as found in Figure 4.

This will be the method used to label the rhythmic circles in this analysis. With Rhythmic Circle ‘A’ complete, Cage was then able to traverse the circle creating passages similar to Example 7.

Example 7 Player 2, mm 1 - 6⁴³



In Example 7, the manner that the ‘A’ rhythmic motives appear (A₁-A₂-A₃-A₄-A₁-A₁-A₁) is consistent with the rules specified by Cage.

Cage does not limit himself to just sixteen basic rhythmic motives; he develops the ‘A’ motive group, creating “composite” motives. These composite motives contain characteristics of two or more motives from the ‘A’ rhythm circle. Example 8 contains the composite motives of the ‘A’ rhythm circle.

Example 8 Rhythm Circle A Composite Motive



Each of the composite motives that are found in Example 8 have characteristics that are related to the motives in Rhythm Circle A. The first composite motive has the same overall duration as A₃, but has a similar structure and the same number of attacks as motive A₂. The second composite motive has the same number of attacks as A₃, but the same duration as A₂. The third composite motive has the same number of attacks as A₁. The fourth composite motive does not share a duration with any of the other ‘A’ motives,

⁴³ John Cage, *First Construction (in Metal)* (New York: Henmar Press Inc., 1962), 1.

but this motive is the A_1 with an additional eighth note added to the final attack of the motive. The final composite motive has the duration of A_3 , but has the same number of attacks as A_2 . The creation of these composite motives does not create a consistent process of transformations. Instead, each of these composite motives is created in a different manner.

These composite motives are inserted into the *First Construction (in Metal)* as replacements for members of the A rhythm circle. At times, these composite rhythms are inserted between members of the motive group; sometimes the motives are repeated by themselves, and sometimes they are used in combination with other 'A' composite motives. Examples 9 through 11 show each of these three possibilities respectively.

Example 9 Player 3, mm 12 - 16⁴⁴



Example 10 Player 4, mm 17 - 20⁴⁵



Example 11 Player 2, mm 21 - 22⁴⁶



Figure 5 describes all four rhythm circles, giving each member motive and any composite motives that appear for each of the circles.

⁴⁴ Ibid., 2.

⁴⁵ Ibid.

⁴⁶ Ibid., 2-3.

Figure 5 Sixteen Rhythm Circles and Composite Motives

Rhythm Circle A



Composite A



Rhythm Circle B



Rhythm Circle C



Rhythm Circle D



Composite D



The B composite motives are constructed by deconstructing the B₂ motive. The first composite motive begins at the fourth eighth note of the B₂ motive. The second composite motive starts at the beginning of the B₂ motive and continues to the fifth eighth note. The D composite motive is taken from the D₁ motive. Both of these motives

have the same duration, however the third eighth note is changed to a rest and the fourth eighth note is tied to the fifth. There does not appear to be any governing method for the replacement of a Rhythm Circle motive with a Composite Motive

Tremolo Motive

Long Tremolos

Not all of the rhythm segments in the *First Construction (in Metal)* are included in the motives found in Figure 5. There are several rhythmic segments that do not belong to any of the rhythm circles. The most basic of these motives are long held tremolos. These tremolos are played by each of the percussionists. The *First Construction (in Metal)* begins with Example 12. The example contains tremolos being played on a thundersheet in all parts except Player 2.

Example 12 Ensemble, mm 1- 4⁴⁷

Player 2, whose battery does not include a thundersheet, is still able to produce this tremolo motive. To create this effect, the pianist is required to sweep a gong mallet over

⁴⁷ Ibid., 1.

the bass strings of the piano. This effect is notated in the same manner as a long tremolo and at times appears together with other performers playing the thundersheet.

Example 13 Players 1 and 2, mm 117 - 121⁴⁸

Player 1

Player 2

Sweep on the bass strings w/ gong mallet

All of the sounds found in Examples 12 and 13 create a backdrop of noise without any discrete attacks. This motive will be labeled TREM in this analysis.

Ratio Motives

Sub-classes of the TREM motive also appear in the *First Construction (in Metal)*.

The first subclass, the ratio motives, are comprised of a series of attacks of equal duration, usually greater than a quarter note. The label for these motives is the ratio between the number of attacks and the duration of all the attacks in whole notes.

Example 14 Players 1 and 4, mm 133 - 135⁴⁹

Player 1

Player 4

2:1

4:1

8:3

In Example 14, Player 1 is playing 2:1 and 4:1, while Player 4 is playing an 8:3 ratio motive. Because the motive contains a set of attacks with equal durations, the motives are non-retrogradable. Non-retrogradable rhythms are the same when read either forward or backward. These ratio motives are a sub-class of the TREM motives because

decelerating a tremolo can form a ratio motive. The decelerated TREM motive would form a series of attacks with equal duration.

Example 15 Players 1, 4, 5, mm 8 - 9⁵⁰

Player 1

Player 4

Player 5

In Example 15 there are two attacks to one whole note, so the ratio is 2:1.

Example 16 Player 5, mm 74 - 80⁵¹

Player 5

In Example 16, there are eight attacks within the time of seven whole notes creating a ratio of 8:7. These ratio motives are at times played simultaneously, with different ratio values for each percussionist.

At times, the players only highlight the attack points of the ratio motives.

⁴⁸ Ibid., 11-12.

⁴⁹ Ibid., 13.

⁵⁰ Ibid., 1.

⁵¹ Ibid., 8.

Example 17 Ensemble, mm 101 - 112⁵²

The musical score for Example 17 Ensemble, mm 101 - 112, is presented in two systems. The first system is marked with a 2:1 ratio, and the second system is marked with an 8:7 ratio. The score is in 4/4 time and features six staves labeled Player 1 through Player 6. Player 1 is a percussionist with a rest. Player 2 is a bassist playing a ratio motive. Players 3, 4, 5, and 6 are percussionists punctuating Player 2's attacks.

In Example 17, Player 2 is playing a ratio motive (2:1) and (8:7), while Percussionists 3 through 6 are punctuating the attacks of Player 2. Later, Player 5 joins in performing the same ratio motive as Player 2.

Non-retrogradable Rhythms

The second sub-class of the TREM motives are also a sub-class of the ratio motives. These new categories of motives, like the ratio motives, are non-retrogradable

⁵² Ibid., 10-11.

and have a duration longer than a quarter note. However, the duration of the attacks does not maintain a constant value. In the analysis, this motive category is labeled NR. The first example of a NR (non-retrogradable rhythm) can be found in measure 56, Player 5.

Example 18 Player 5, mm 56-58⁵³



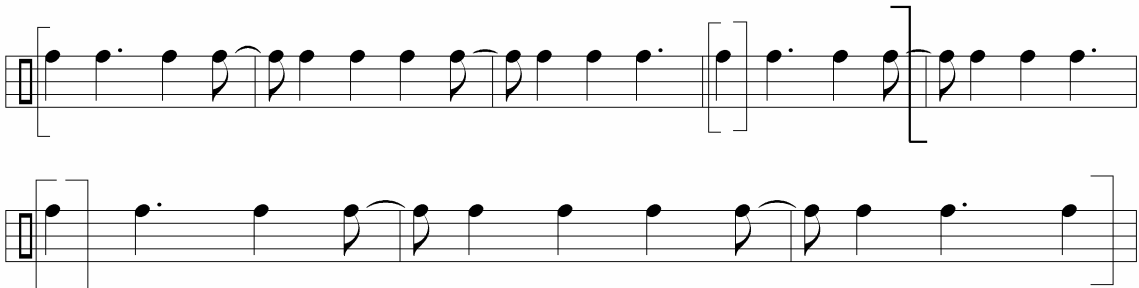
The center measure of Example 18 is a NR rhythmic motive that returns at measure 166, Player 5, and at measure 237, Player 4. Example 18 is non-retrogradable and all of the durations are greater than a quarter note. However, unlike the ratio motive groups, the durations of the notes are not all equal. Another example of a recurring non-retrogradable rhythm can be found in Example 19.

Example 19 Player 6, mm 232-233⁵⁴



These non-retrogradable rhythmic motives can appear by themselves, as found in Examples 18 and 19, or they can appear in succession, as found in Example 20.

Example 20 Player 6, mm 165-172⁵⁵



⁵³ Ibid., 6.

⁵⁴ Ibid., 22.

⁵⁵ Ibid., 16-17.

In Example 20, the NR motives are lined up one after the other. In fact, the motives share a single note, which becomes both the end of one motive and the beginning of the next. In addition, when these motives are placed in a group of three, the entire passage becomes non-retrogradable. In the example this is shown by the larger bracket.

Non-classifiable Motives

There are a few additional motives found in the *First Construction (in Metal)* that do not fit into a rhythm circle or any of the sub-classes of the tremolo motives. One of the most unusual of these uncategorized motives can be found in Example 21.

Example 21 Player 1, mm 53 - 56⁵⁶



The reason this rhythmic motive is unusual is that it appears twice, first at measure 53, and then again at measure 244. The motive is comprised of two parts that are arranged to create an ABA form. Because of the form of this motive, it is similar to the non-retrogradeable motives. The motive itself is retrogradeable, but the manner in which the motive segments are grouped (ABA) is not. The rest of the uncategorized rhythmic motives are short segments that do not repeat.

In Appendix C, Cage's use of the rhythm circles and the additional rhythmic motives are shown within the structure of the score. Pritchett points out that by using this rich palette of rhythmic material, Cage was able to create a "continuity of irregular patterns with fairly little repetition," or at the other extreme, a single motive, or a group of 2 or 3 motives may repeat.⁵⁷

⁵⁶ Ibid., 6-7.

⁵⁷ Pritchett, *The Music of John Cage*, 19.

Sound Circles

In Cage's letters to Boulez, Cage presented a plan for his use of instrumentation similar to the plan he used for rhythm. Cage stated that "there are 16 instruments for each player...and the relationships between the instruments (in the method) are similar to those between rhythms (circle-series)."⁵⁸ If this statement is correct, each player should have four groups of four instruments, and these groups should be arranged into circles similar to the rhythm circles. The use of the term instrument, in this case, refers to each item that is struck by a performer. For instance, Player 5 uses eight anvils, which would be considered eight instruments. In this analysis, the term instrument as used by Cage will be replaced by sound to alleviate any confusion with the later use of the word

In several articles and interviews, Cage discussed some of the inconsistencies specifically related to the instrumentation between this compositional plan and the final score of the *First Construction (in Metal)*. In an interview with B. Michael Williams, Cage stated several inconsistencies in the number of sounds. Cage said that some of the performers did not have the 'correct' number of instruments, "because we didn't have the number. It would have been right, compositionally, for there to be 16, it seemed to me, but we couldn't have 16 in one case, I think there were only 3 Temple Gongs and I couldn't get another."⁵⁹ In his article "Composition as Process," Cage also mentioned this inconsistency. "I had known all along that one of the players used 3 Japanese temple gongs rather than 4, but the fact that only three of these relatively rare instruments were

⁵⁸ Nattiez, 49.

⁵⁹ B. Michael Williams, "The Early Percussion Music of John Cage, 1935 – 1943," *Percussive Notes* 31 no. 6 (August 1993): 62.

available to me..."⁶⁰ So, Cage's decision to use only three Japanese Temple Gongs was a practical decision that interferes with the compositional plan.

Another difference between the compositional plan and the score is Cage's addition of the thundersheets. Cage states in "Composition as Process" that, "the addition of metal thundersheets for background noise bringing the number 16, for those who enjoyed it, to 17."⁶¹ The omission of the thundersheets from the compositional plan gives additional weight to the omission of the thundersheet tremolos from the rhythmic circles discussed earlier. Extending this idea, any sound that plays only consistent tremolos should also be omitted from inclusion into one of the sound (instrument) circles. Because of this, the sleigh bells played by Player 3 would also be omitted. Cage felt that a larger error occurred with his use of mallets. Again in "Composition as Process" he said, "playing cowbells first with rubber and then with metal multiplied by two the number of sounds actually used."⁶² So, in his count of 16 sounds, Cage ignored the changes of timbre due to changes in mallet choice.

Despite the inconsistencies discussed above, James Pritchett, in *The Music of John Cage*, was able to determine the 16 sounds used by two of the percussionists. Player 1 has 16 sounds found in the number of orchestra bells, after the omission of the thundersheet, and Player 5 has 8 anvils, 4 Chinese cymbals and 4 Turkish cymbals, and by omitting the thundersheet a total of 16.⁶³ There are two shortcomings of Pritchett's limited discussion of the instrumentation. First, Players 1 and 5 are only two of the six

⁶⁰ John Cage, "Composition as Process," in *Silence* (Hanover New Hampshire: Wesleyan University Press, 1973), 24.

⁶¹ *Ibid.*, 24-25.

⁶² *Ibid.*, 24.

⁶³ Pritchett, *The Music of John Cage*, 18.

parts. Second, Pritchett never mentions grouping these sounds into circles, similar to the rhythm circles, or how the circles are used in the *First Construction (in Metal)*.

Defining the Sound Circles

Using the information provided by Pritchett as a springboard, the remaining sound circles can be recreated. With the omission of the thundersheet, Player 1 plays 16 circles can be recreated. With the omission of the thundersheet, Player 1 plays 16 pitches, as was mentioned by Pritchett. The 16 pitches can be arranged into four groups of four. Example 22 shows the sounds used by Player 1 in the order in which they appear.

Example 22 Player 1, Sound Circles, Order of Appearance

Player 1

1.W 1.X 1.Y 1.Z

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

The sound elements in the previous example and all succeeding ones are labeled first by the player of the sound, then by the circle in which the sound appears (W - Z), and finally by the location of the sound on the circle (1 – 4). The sounds, like the rhythms, are placed on a circle similar to the one found in Figure 4. For example, the first sound from the first sound circle for Player 1 is labeled 1.W.1. An interesting aspect of these four sound circles is that they comprise a 4-note chromatic set. The sound circles, found in Example 22, can be lined up to form a chromatic scale from the D above middle C to the F an octave above, as seen in Example 23.

Example 23 Player 1, Sound Circles, Chromatic Order

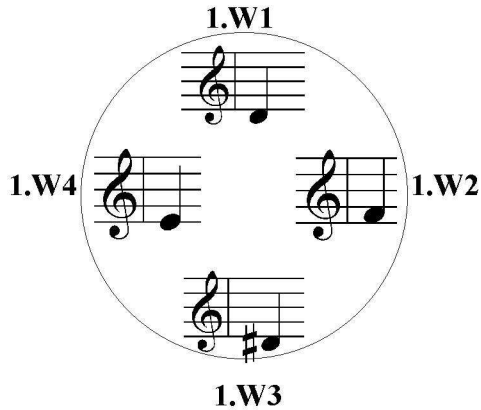
Player 1

1.W 1.X 1.Y 1.Z

1 3 4 2 1 3 4 2 1 3 4 2 1 3 4 2

The sounds in each of these groups can be placed onto the circle found in Figure 4.

Figure 6 Sound Circle W for Player 1



The result is a sound circle that appears in Figure 6.

Example 24 Player 1, mm 13 -16⁶⁴

Player 1

Example 25 Player 1, mm 72-75⁶⁵

Player 1

In Examples 24 and 25, Cage used only pitches from sound circle 1.W. The pitches for these examples were chosen using the same rules that governed the choice of rhythmic motives from the rhythm.

The sound circles comprising Player 1's set-up are typical of the methodology Cage used to create the rest of the sound circles. At the same time, the sound circles used by Player 5 can be used as a guideline to help determine the sound circles for the remaining parts, although, almost all the other parts contain fluctuations from this basic structure. Figure 7 catalogs all of the sounds used by each player and places them into the

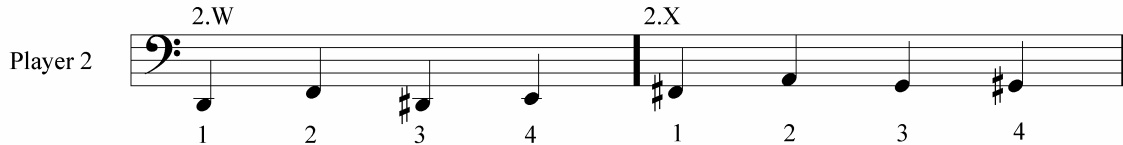
⁶⁴ Cage, *First Construction (in Metal)*, 2.

⁶⁵ *Ibid.*, 7-8.

appropriate sound circles. It should be noted, as Cage discussed, that there are a few discrepancies in the number of sounds and sound circles present in each part.

Player 2, like Player 1, performs 16 sounds. The first two sound circles are comprised of pitches that are played normally in the lower portion of the piano.

Example 26 Player 2, Sound Circles W and X



Like those of Player 1, these circles contain four chromatic pitches, and these two sets are related to each other by a half step. An example of these sounds within the *First Construction (in Metal)* can be found in Example 27.

Example 27 Player 2, mm 10 - 12⁶⁶



The other two sound circles for Player 2, use extended piano techniques. Grouping 2.Y consists of glissandi produced by an assistant sliding a metal rod along the piano strings while the pianist plays a tremolo. Cage, in "Composition as Process," stated that the "siren like piano trills which sound as one were counted as two."⁶⁷ However, by including the duration and the direction of the glissandi, four separate sounds can be identified. All the sounds in the 2.Y circle are present in Example 28.

⁶⁶ Ibid., 1-2.

⁶⁷ Cage, "Composition as Process," 24.

Example 28 Player 2, mm 56 -64⁶⁸

There are two motives in which the assistant is directed to move the metal bar in either direction. 2.Y.1 and 2.Y.2 both have a duration of 4 beats, while 2.Y.3 and 2.Y.4 both have a duration of 6 beats. All four of these motives appear in Example 28. This sound circle is the only one, which takes into account the duration of the sounds in addition to their pitch and timbre content. Using of wavering harmonics creates the fourth sound circle for Player 2, 2.Z. This sound circle can be found in Example 29.

Example 29 Player 2, mm 101 - 104⁶⁹

The sound elements used to create this circle are the same pitch elements as Group 2.W; however, the assistant is altering the sound by manipulating the piano strings.

Player 5 has 16 sounds at his disposal. An unusual aspect of this performer's setup is that in the 1962 score for *First Construction (in Metal)*, the instrumentation list states that only four muted anvils are needed⁷⁰ instead of the eight that are required in the notation. In a letter to Boulez, Cage stated that eight anvils are needed. This information supports the listing found in the note to the score.⁷¹

⁶⁸ Cage, *First Construction (in Metal)*, 6-7.

⁶⁹ Ibid., 10.

⁷⁰ Ibid., Note.

⁷¹ Nattiez, 50.

The remaining players 3,4, and 6 vary from the compositional plan. Player 3 and Player 6 both produce only 12 sounds, and these sounds are divided into three sound circles rather than four. Percussionist 4 has only 15 sounds due to the missing Japanese temple gong. In this case, the Japanese temple gongs form a sound circle containing only three elements. Figure 7 shows all sound circles for each player in the *First Construction (in Metal)*.

Figure 7 Sound Circles for All Players

Player 1: 16 Orchestra Bells (omit Thundersheet)

Orchestra Bells

Player 2: Piano (omit the sweep of bass strings)

Piano (normal)

Player 3: 12 Oxen Bells (omit Thundersheet and Sleigh Bells)

12 Oxen Bells

Player 4: 4 Brake Drums, 8 Cowbells, 3 Japanese Temple Gongs (omit Thundersheet)

4 Brake Drums 8 Cowbells 3 Japanese temple gongs

Player 5: 4 Turkish Cymbals, 8 Anvils, 4 Chinese Cymbals (omit Thundersheet)

4 Turkish Cymbals 8 Anvils 4 Chinese Cymbals

Player 6: 4 Muted Gongs, Water Gong, Gong, Tam-Tam

4 Muted Gongs Water Gong Gong / Tam-Tam

Center Edge Lower Raise Center Edge Center Edge

The identification of these sound circles within the score can be found in Appendix C.

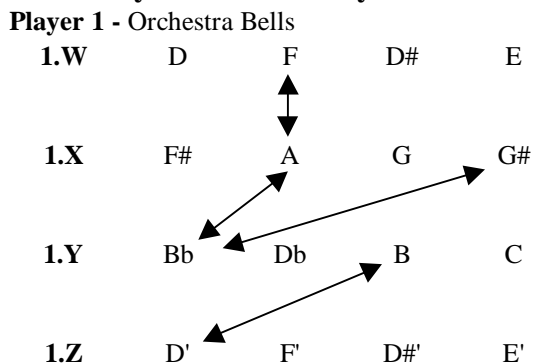
Gateway Sounds

With the sound circles defined, Cage needed a method to move from one circle to another. For this purpose, Cage created a series of “gateway” sounds. In Example 30, the A above middle C in the 1.X circle becomes the gateway for Player 1 to move to circle 1.Y and the B^b a half-step above.

Example 30 Player 1, mm 29 - 36⁷²

Figure 8 contains the four sound circles for Player 1. The arrows between the sounds designate a gateway sound. The direction of the arrows signifies the direction that the gateway was used in the *First Construction (in Metal)*.

Figure 8 Gateway Pitches for Player 1



Each of the gateways between the sound circles of Player 1 travel in both directions. However, not all of the gateway sounds are able to function in both directions. For an example of a single direction gateway and for a list of all of the gateway sounds, refer to

⁷² Cage, *First Construction (in Metal)*, 6-7.

Table 4. This table contains all of the sound circles in the *First Construction (in Metal)* and shows the gateway pitches for each of the possible transitions between circles.

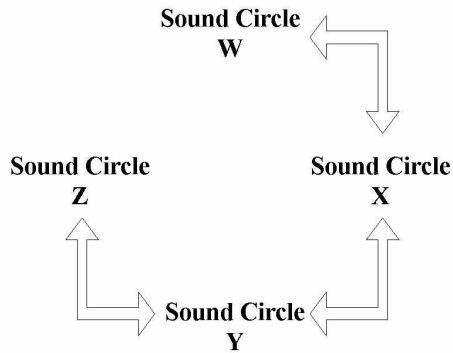
Table 4 Gateway Pitches for All Sound Circles

Player 1 - Orchestra Bells					Player 2 - Piano						
W	D	F	D#	E	Normal	W	D	F	D#	E	
		↑						↗			
X	F#	A	G	G#	Normal	X	F#	A	G	G#	
		↓						↖			
Y	Bb	Db	B	C	Gliss	Y	Down 4	Up 4	Down 6	Up 6	
		↘									
Z	D'	F'	D#'	E'	Harmonics	Z	D	F	D#	E	
		↗									
Player 3 - Oxen Bells					Player 4						
W	D	E	F	G	Brake Drums	W	D	G	E	F	
	↑										
X	A	B	C	D'	Cowbell	X	A	D	B	C	
	↓										
Y	E'	A'	F'	G'	Cowbell	Y	E	A'	F	G	
		↘									
		↗			Japanese TG	Z	A	C	B		
Player 5					Player 6						
Turk. Cymbal	W	E	A	F	G	Mute Gongs	W	E	A	F	G
				↗							
Anvil	X	D	G	E	F	Water Gong	X	Center	Edge	Lower	Raise
				↖							
Anvil	Y	A	D'	B	C	Tam-Tam / Gong	Y	Tam Center	Gong Edge	Gong Center	Tam Edge
				↖							
Chin. Cymbal	Z	G	C	A	B						

Meta-Circle

Note that not all of the circles have gateway sounds to one another. Cage places the circles into a meta-circle as shown in Figure 9. He uses a similar method to traverse this meta-circle as the one used to traverse the other circles in the *First Construction (in Metal)*.

Figure 9 Meta-Sound Circle (Sound Circles within a Circle)



Sound circle W leads only to sound circle X, which can travel either to sound circle Y or back to sound circle W. However, Circle Z can not travel to Circle W, instead it is forced to pass through sound circles Y and X to reach Circle W. The movement around this meta-sound circle is highlighted in Example 31; the 1.Z circle moves only to the 1.Y circle, which leads to either the 1.Z or 1.X circles.

Example 31 Player 1, mm 54 - 60⁷³

With gateways between the circles in place, Cage could move throughout the entire expanse of the sound materials. Cage linked his use of circles to the serial procedures of Schoenberg. "I tended to put these motives in circles and permit them to go around in a circle and not to cross the circle, an idea that came from 12-tone music."⁷⁴ Also, the circles are related to the linear twenty-five-note technique used in *Six Short Inventions*. Both the techniques utilize a set group of musical elements. These elements are then

⁷³ Ibid., 6.

⁷⁴ Williams, "The Early Percussion Music," 62.

cycled through creating the patterns of pitches or rhythms. The difference between the two methods is that the number of pitches that can be chosen dwindles in *Six Short Inventions* as the cycle is used. All but one element of the circle are available to the composer at any given time.

Structure

In reviewing the Cage repertory between 1935 and 1945, B. Michael Williams points out that Cage composed 15 works for percussion.⁷⁵ Williams has been able to place the percussion works into four categories based on the compositional procedure used by Cage: fixed rhythmic structures repeated throughout; icti-control, i.e. predetermined number of attacks per phrase; free-style; and square root or micro-macrocosmic form.⁷⁶ *First Construction (in Metal)* falls into the last category of works. The micro-macrocosmic structure "became the logical outgrowth of [Cage's] predilection for non-traditional sound sources and rhythmic development and therefore the most important feature of his work at this time."⁷⁷

Pritchett has also investigated the structure of *First Construction (in Metal)*.

The structure of the *First Construction (in Metal)* is based on a single number series that controls both the lengths of phrases in terms of measures and lengths of sections in terms of phrase group units.⁷⁸

Although, the square root form has its roots in earlier works such as *Six Short Inventions*, the *First Construction (in Metal)* solidifies this structure, which is used almost exclusively in Cage's concert works from 1939 - 1956.⁷⁹

⁷⁵ B. Michael Williams, "John Cage: Professor, Maestro, Percussionist, Composer," *Percussive Notes*, 36, no. 4 (August 1998), 55.

⁷⁶ *Ibid.*, 59.

⁷⁷ Campana, 238.

⁷⁸ Pritchett, *The Music of John Cage*, 16.

⁷⁹ *Ibid.*

Micro-Macrocosmic Form

Micro-macrocosmic form, or square root form, is a structure based on the division of the whole into equal parts. Cage described this structure in the following way.

...The idea now described, independently conceived, concerns itself with phraseology of a composition having a definite beginning and an end. I call this principle micro-macrocosmic because the small parts are related to each other in the same way as the large parts.⁸⁰

These parts are then grouped into sections, and the ratios of these sections are transferred down through the levels of the hierarchy.

The following is an example of a simple micro-macrocosmic form based on the number 5; divided into two phrases in the proportions of 3:2.

Table 5 Simple Micro-macrocosmic Form

Whole Work (25 measures)																			
Macro Unit 1 (3 Micro Units)										Macro Unit 2 (2 Micro Units)									
Micro 1 (5 mm)			Micro 2 (5 mm)			Micro 3 (5 mm)				Micro 4 (5 mm)			Micro 5 (5 mm)						
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

The measures, listed on the bottom row, are grouped into units of five, each representing a micro unit. These groups of five are then divided into units of three measures and two measures. These sub-groupings form the macro level of the structure (line 2). The name square root form is derived from the fact that there are five groups of five measures and hence twenty-five total measures, or 5^2 .

Cage's move to percussion ensemble caused a shift away from the pitch based methods that he learned from Schoenberg⁸¹ to those based on rhythm. The important factor is, as Gaston Slyvestre states, "Cage busied himself in developing ... a single common denominator existing between the components of music, sound and silence, in

⁸⁰ Cage, "A Composer's Confessions," 35

⁸¹ Cage, *For the Birds*, 72.

other words: duration.”⁸² Cage puts it this way: “I only truly detached myself from Schoenberg's techniques on the structural character of tonality once I began to work with percussion. Structure then became rhythmic; it was no longer a tonal structure in Schoenberg's sense.”⁸³

In letters to Boulez, Cage explained that the *First Construction (in Metal)* “is written in 4/4 (four measures, three measures, two measures, three measures, four measures) the whole lot 16 times.”⁸⁴

Table 6 Micro-Macrocosmic Structure

Macro Unit	4				3			2		3			4				Coda
Micro Unit	1	2	3	4	1	2	3	1	2	1	2	3	1	2	3	4	
mm	1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	

In the note for the *First Construction (in Metal)*, Cage explains the structure of the work in the following manner: “The rhythmic structure is 4-3-2-3-4 (16 x 16) with a coda of 9 measures (2-3-4).”⁸⁵ Each of the micro units contains 16 measures, split into groups of 4-3-2-3-4. Like *Six Short Inventions*, Cage attaches a coda that lies outside of the 4-3-2-3-4 structure. The coda is formed from the same compositional techniques that were used throughout the rest of the work and acts as a final statement of these techniques.

Structural Changes

The structure of the work is highlighted for the performers and listeners in many different ways. The micro sections, for example, are separated from one another by double bars. Zooming out to the 5 macro levels of the piece, there are several ways that

⁸² Gaston Slyvestre, trans. Daniel Charles, Notes for John Cage, *Works for Percussion*, Quatuor Hélios, Wergo wer6203-2, 11.

⁸³ Cage, *For the Birds*, 72-73.

⁸⁴ Nattiez, 49.

⁸⁵ Cage, *First Construction (in Metal)*, note.

Cage highlighted the changes of the macro level sections. For example, the macro sections begin with changes in tempo.⁸⁶

Table 7 Large Structural Unit Tempo Changes

Macro Unit	Measure Number	Rehearsal Letter	Tempo Change
4	1		96
3	66	D	A Little Faster
2	113	G	Suddenly as fast as D
3	145	I	A Little Faster
4	193	L	Faster
Coda	257	P	Slowing down very much to the end

The tempo increases until it reaches the coda, at which point the work starts a ritardando until the end.

Changes in the orchestration also delineate changes in the macro level sections.

One orchestration change is the number of instruments used at either side of these structural changes. Table 8 gives a list of the number of instruments playing during each change in the macro form. The “From” column gives the number of players used before the double bar, while the “To” column gives the number of players used after the double bar.

Table 8 Change in Number of Instruments

Macro Unit	Measure Number	Number of Instruments Playing	
		From	To
4	1	--	--
3	66	5	1
2	113	4	2
3	145	5	4
4	193	5	6
Coda	257	6	6

⁸⁶ Pritchett, *The Music of John Cage*, 19.

All entrances except the entrance into the coda had changes in the number of instruments performing. The most noticeable of these changes can be found between the first two macro sections. Moving from 5 instruments to just a single set of Oxen Bells creates a striking change in the number of instruments in the ensemble. The last three changes do not offer such significant differentiation between sections.

Another way that Cage used the orchestration to delineate macro level change is by altering the timbre of the ensemble. Table 9 shows the changes in instrumentation that occur at the changes of macro-level units. These timbre shifts occur when a player changes from one instrument to another at these macro-level changes. For instance, at the first macro level change Player 4 is playing the Temple Gongs and moves to the Thunder Sheet.

Table 9 Changes in Ensemble Timbre

Macro Unit	Measure Number	Instrumentation		
		Player	From	To
4	1		--	--
3	66	4 5 6	Temple Gong Anvil Tam-Tam	Thunder Sheet Turkish Cymbal Muted Gong
2	113	1 4 5	Piano Normale Brake Drums Turkish Cymbal	Piano Tremolo Cowbells Anvil
3	145	2 6	Piano Tremolo Muted Gong	Piano Normale Water Gong
4	193	2 6	Piano Tremolo Water Gong	Piano Normale Tam-Tam
Coda	257		--	--

At each macro level change, except when entering the Coda, at least two performers are scored with a change in instrumentation. This is enough of a change to create a contrast in the timbre between these macro sections.

Form

Along with this micro-macrocosmic structure, Cage described a form that overlays the entire work. Within one of his letters to Boulez, Cage states the following:

The rhythmic structure is 4,3,2,3,4 (16 x 16). You can see the first number (4) equals the number of figures that follow it. This first number is divided 1,1,1,1 and first 1 present the ideas that are developed in 3, then those in 2, etc.⁸⁷

While the micro-macrocosmic structure determines where the percussionists play, the form helps determine what they play. In the note that precedes the score for *First Construction (in Metal)*, Cage also discussed the way in which this form develops, as "an exposition, (1-1-1-1) followed by development (3-2-3-4) and an extension (2-3-4)."⁸⁸

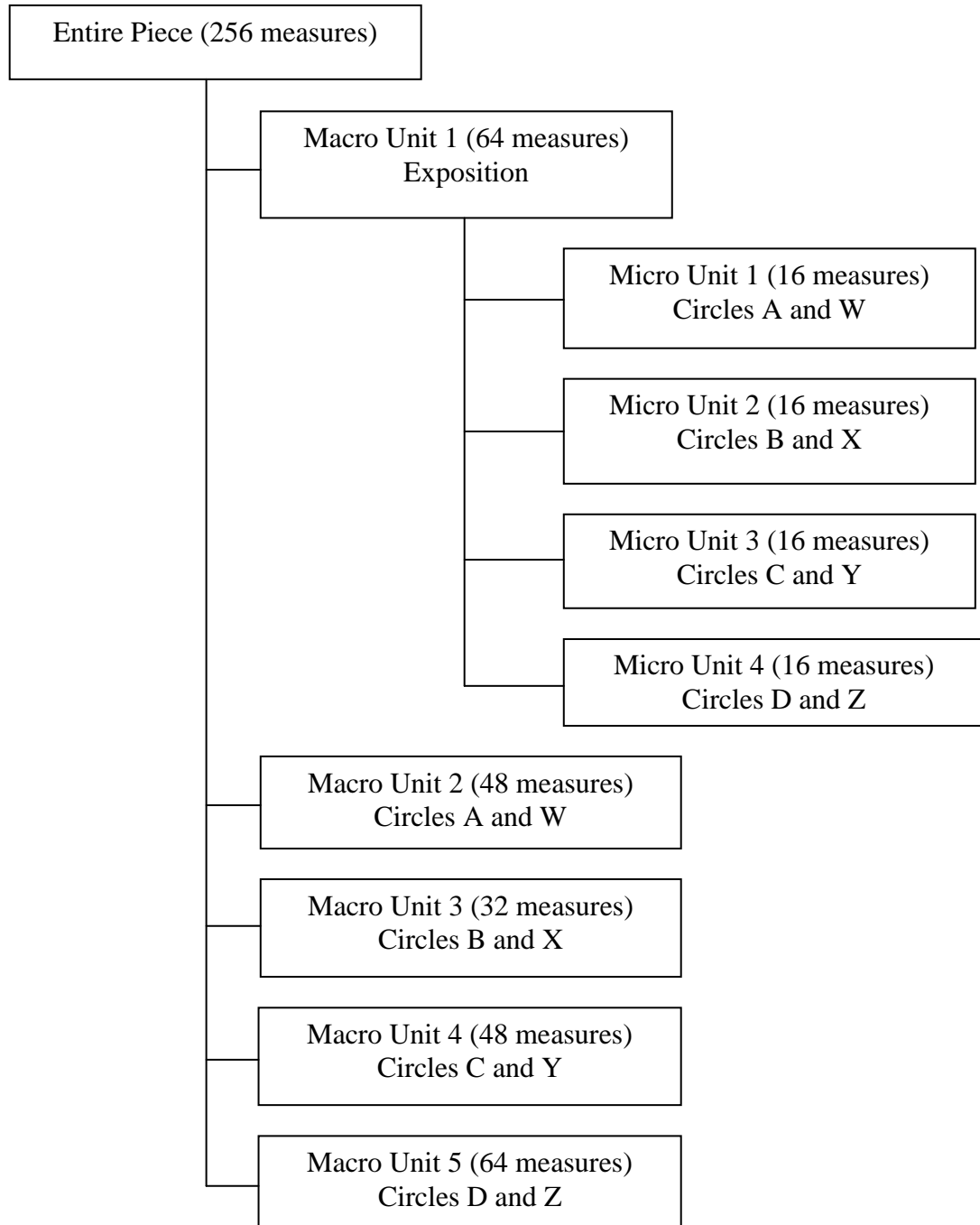
When combining these two descriptions, the following can be deduced. The first macrocosmic unit of four is split into four units of 16 measures each. These units act as the exposition, each presenting one rhythm circle and one sound circle. The following macro structural units (3-2-3-4) act as development sections, each focusing on the corresponding circles that appear in the exposition.⁸⁹ This idea is presented in a more clearly in Figure 10.

⁸⁷ Nattiez, 49.

⁸⁸ Cage, *First Construction (in Metal)*, note.

⁸⁹ Cage, "Composition as Process," 23-24.

Figure 10 Graphical Representation of Micro-Macrocosmic Structure



For example, the first exposition section and the first development section both contain the same rhythm and sound circles.

As Appendix C shows the first micro-unit within the first macro-unit (the first unit of the exposition), starting at measure 1, contains only rhythm circle A and only

sound circle W. Similarly, in the second macro-unit (first unit of the development section), measure 65, the only circles that appear are A and W. The third micro-unit of the exposition; starting at measure 32, is expected to add rhythm circle C to the already present circles A and B. However, rhythm circle C appears first in measure 28, acting as a pick up to the third micro unit. The same holds true for the sound circles; sound circle Y is added to the already established W and X however, sound circle Y does not appear until measure 32, as expected. The introduction of a circle with each exposition unit parallels the addition of the circle in the development part of the composition. The coda, beginning at measure 257, is predominately rhythmically constructed of long values that are mostly greater than a half note. Only Player 1 is playing a different rhythm. Player 1 is performing rhythm circle D, the last rhythm circle. Like the micro-macrocosmic structure, Cage's use of form has ties to earlier works. Cage has discussed this form's link with the past. "You know that with exposition and development (without recapitulation) and with the form (climax, apotheosis (?)) Etc., this construction is 19th century."⁹⁰

Governing Number

The *First Construction (in Metal)*, like *Six Short Inventions*, focuses on a single number. In *Six Short Inventions* the number is six; for the *First Construction (in Metal)* it is sixteen. There are sixteen measures in each of the sixteen structural units.⁹¹ Cage mentioned the importance of the number 16 in his letter to Boulez. "...there are 16 instruments for each player, (fixation on the number 16)."⁹² There are also 16 sounds and

⁹⁰ Nattiez, 50.

⁹¹ Williams, "John Cage, Professor," 57.

⁹² Nattiez, 49.

16 motives, each divided into groups of four.⁹³ There are sixteen different instruments in the work. Cage's use of "instrument" during his discussion of the sound circles does not correspond to the use of the term instrument in this discussion. In this discussion the term instrument refers to each individual sounding body, i.e. each brake drum. Cage, however, uses the term to refer to all of the brake drums as a single instrument. Table 10 is a list all of the instruments that are included to reach this value.

Table 10 Sixteen Ensemble Instruments

<u>Player</u>	<u>Instruments</u>	<u>No.</u>	<u>Excluded</u>
Player 1	Orchestra Bells	1	Thundersheet
Player 2	Piano {Normal, Gliss, Harmonics }	3	Bass string sweep
Player 3	Oxen Bells, Sleigh Bells	2	Thundersheet
Player 4	Brake Drums, Cowbells, Japanese Temple Gongs	3	Thundersheet
Player 5	Turkish Cymbal, Anvil, Chinese Cymbal	3	Thundersheet
Player 6	Muted Gongs, Water Gong, Tam-Tam, Gong	4	Thundersheet
Total		16	

Cage also mentioned in his letter to Boulez that there was a correlation between the number 16 and the choice of mallets. "The number 16 occurs in some cases in considering changing the method of striking (difference in sonority)."⁹⁴ I could not find any correlation between the number 16 and the mallets used by the percussionists.

Many of the elements used by Cage during the composition of the *First Construction (in Metal)* had roots in early works such as *Six Short Inventions*. One of these elements is basing many of the compositional elements on a single referential number. In this case, the most important use of this referential number can be found in the construction of the square root form. Cage referred to this in "A Composer's Confessions:" "my *First Construction (in Metal)*, which embodies the principles of

⁹³ Cage, "Composition as Process," 23.

rhythm structure to which ten years later I still adhere..."⁹⁵ For the means of filling this structure, Cage devised the sound and rhythm circles. These circles can be compared to the linear ordering of materials found in *Six Short Inventions*. These ideas and innovations did not stop with the *First Construction (in Metal)*, instead, Cage carried these ideas into later works, both improving and reusing the ideas.

Spontaneous Earth

Spontaneous Earth [1944], written five years after *First Construction (in Metal)*, expands on the compositional ideas found in the *First Construction (in Metal)*. This piece, along with many others written for prepared piano during 1944, was originally written to accompany a Merce Cunningham dance.⁹⁶

Structure

Spontaneous Earth uses a square root structure similar to that which Cage used in the *First Construction (in Metal)*. For *Spontaneous Earth*, the structure is based on the number nine, which was split into the proportions, 3 - 2 - 2 - 2. Cage varies the basic square root structure for *Spontaneous Earth* by adding a new level of structure. This new level of structure was added between the previous small (micro) and large (macro) groups. The names of these levels (small, medium, and large) are taken from Cage's "Lecture on Nothing."⁹⁷

⁹⁴ Nattiez, 50.

⁹⁵ Cage, "A Composer's Confession," 34-35.

⁹⁶ John Cage, *Spontaneous Earth*, (New York: Henmar Press, Inc., 1977), cover page.

⁹⁷ James Pritchett, "The Development of Chance Techniques in the Music of John Cage, 1950-1956," Ph. D. diss., (New York University, 1988), 15.

Table 11 Spontaneous Earth Micro-macrocosmic Structure (partial)

Large (partial) - 3 of the 9 total units		
Medium		
Small	Small	Small

Table 11 diagrams just the first large (macro) section of the structure. All the boxes in Table 11 (except the large) represent entire structural units. A structural unit is comprised of nine smaller units that are grouped into the proportions (3-2-2-2). Table 12 below explains the relationship between these structural levels in a different manner.

Table 12 Duration of Units at Various Levels

Level	Duration of Unit (in measures)	Number of Units (in First Large Unit)
Macro (Large)	9	First section (3) of (3-2-2-2)
Middle	3	1 cycle
Micro (Small)	1	3 cycles

Appendix D shows the structural changes that take place over the entire work.

Small Level

The micro-macrocosmic structure is highlighted through several different techniques. The first micro unit of the structure is shown in Example 32.

Example 32 Spontaneous Earth, mm 1-9⁹⁸

This small section is divided into nine units of one measure each. These units are grouped into the 3-2-2-2 proportions. The brackets found in Example 32 give these sub-groups. Cage highlights these sub-groups through the rhythm of the right hand, ending each unit with a rest. In the case of the first two sub-groups, the rest is succeeded by a pick-up eighth note that leads into the next section. The third unit ends with a full quarter note rest. Cage then marks the end of this small structural unit with a double bar, as the ends of all of the small units are marked.

Medium Level

The medium structural level contains nine units of three measures each, or twenty-seven measures. These three-measure units are sub-divided into the groups of 9-6-6-6 thereby keeping the 3-2-2-2 proportions laid out in the structure. Example 33 shows the entire first medium level unit with the sub-divisions of that group given in brackets.

⁹⁸ Cage, *Spontaneous Earth*, 1.

Example 33 Spontaneous Earth, mm 1-27⁹⁹

The first system of musical notation consists of two staves. The upper staff is in bass clef with a key signature of one flat (B-flat). It contains a melodic line with eighth and quarter notes, including rests. The lower staff is in bass clef and contains a rhythmic accompaniment of eighth notes with sharp and flat accidentals. An octave sign (8) is placed below the first few notes of the lower staff.

The second system of musical notation consists of two staves. The upper staff continues the melodic line from the first system, featuring a half note and a quarter note. The lower staff continues the rhythmic accompaniment. A vertical bar line is present at the end of the system.

The third system of musical notation consists of two staves. The upper staff features a melodic line with a half note and a quarter note. The lower staff continues the rhythmic accompaniment. A vertical bar line is present at the end of the system.

The fourth system of musical notation consists of two staves. The upper staff features a melodic line with eighth and quarter notes. The lower staff continues the rhythmic accompaniment. A vertical bar line is present at the end of the system. The text *una corda* is written below the lower staff.

The fifth system of musical notation consists of two staves. The upper staff features a melodic line with quarter and half notes. The lower staff continues the rhythmic accompaniment. A vertical bar line is present at the end of the system. A dashed line is drawn below the lower staff.

⁹⁹ Ibid.

This middle level unit is sub-divided in a similar manner to the first small level unit found in Example 32. The beginnings of the sub-divisions of the medium level are given by double bars and texture changes. In example 33, the first section of this middle unit lasts nine measures; this coincides with the placement of the double bar that also marks the end of the first small unit. The second medium unit has a duration of six measures and begins at measure 16. At this point, the pattern in the left hand changes for the first time. The final two groups in this medium level are separated by changes in texture, with an *una corda* marking at measure 22. Finally, the end of this medium level unit is marked by a double bar after measure 27.

Large Level

The large structural units have a unit size of nine measures, these are divided in the same proportions as the other structural levels. In Example 33, three of these nine measure groupings can be seen. These units constitute the first phrase of the large unit. This phrase contains three small structural units that are delineated by the double bars.

Modifications of the Structure

The 3-2-2-2 proportions of the micro-macrocosmic structure are used throughout most of the work. However, there are several places where Cage alters the basic proportions of the sub-groups. The first example of this is in the small unit of the first large unit, starting at measure 19 in Example 34. This small section is sub-divided into three sections (3-3-3) instead of the usual four and is perceivable through changes in the left hand. The brackets in Example 34 show the three sub-divisions of this small unit.

Example 34 Spontaneous Earth, mm 19 - 27¹⁰⁰

The musical score for Example 34, 'Spontaneous Earth', measures 19-27, is presented in two systems. The first system (measures 19-23) features a right hand with a melodic line of eighth and quarter notes and a left hand with a steady eighth-note accompaniment. A 'una corda' marking is indicated at the end of the first system. The second system (measures 24-27) continues the accompaniment in the left hand, while the right hand has rests in measures 24 and 25, followed by a whole note in measure 26 and a whole rest in measure 27.

The division of this sub-section is given by either long notes or rests. The first sub-division, measures 19 to 21, ends with a whole note and rests are found in measures 24 and 25 dividing the second and third sections. This is not the only location where the proportions of the small level sub-divisions are changed from the expected 3-2-2-2 to 3-3-3. There are three small units that are modified in this manner: units 3, 5, and 8.

Example 34 is the third small unit. Small unit 6 is altered differently from the three small units mentioned above. The same proportions exist as in normal section grouping (one 3 and three 2's); however, these groupings are reordered into 2-2-3-2.

The changes in the proportions of the small unit sub-division are used by Cage to highlight changes in the large (macro) level units. The first two altered structural units, 3 and 5, mark the end of a large (macro) section, and small section 8 marks the beginning of the final large unit at measure 64. Table 13 below shows each small unit and the

¹⁰⁰ Ibid.

proportions in which it is sub-divided. This structural information is given along with the measures that contain the small unit and the melodic material contained within each unit.

Table 13 *Spontaneous Earth* Large and Small Unit Sub-divisions

Large (3-2-2-2)	Small	Measures	Structure
1	1	1-9	3-2-2-2
	2	10-18	3-2-2-2
	3	19-27	3-3-3
2	4	28-36	3-2-2-2
	5	37-45	3-3-3
3	6	46-54	2-2-3-2
	7	55-63	3-2-2-2
4	8	64-72	3-3-3
	9	73-81	3-2-2-2
Coda		82	

The altered sections mark the beginning or ending of a large unit and that there is one alteration per each large unit.

Once again, as found in both *Six Short Inventions* and *First Construction (in Metal)*, a coda was added to the work. This coda is not part of the structural plan, it is not included in the 3-2-2-2 structure, just as the codas of the two previous works were not part of their respective structures. Unlike the previous codas, the coda for *Spontaneous Earth* does not contain a final statement of the pitch or rhythmic material. This coda is a single note.

Motives

Motive Organization

The micro-macrocosmic structure created the structure of the piece, a different method was needed to control the motives of the piece. These small level units can be further grouped into two motivic categories, α and β .

Table 14 *Spontaneous Earth* Small Unit Motive Categories

Large (3-2-2-2)	Small	Measures	Type (α or β)
1	1	1-9	α
	2	10-18	α
	3	19-27	α
2	4	28-36	β
	5	37-45	α
3	6	46-54	β
	7	55-63	α
4	8	64-72	α
	9	73-81	α
Coda		82	α

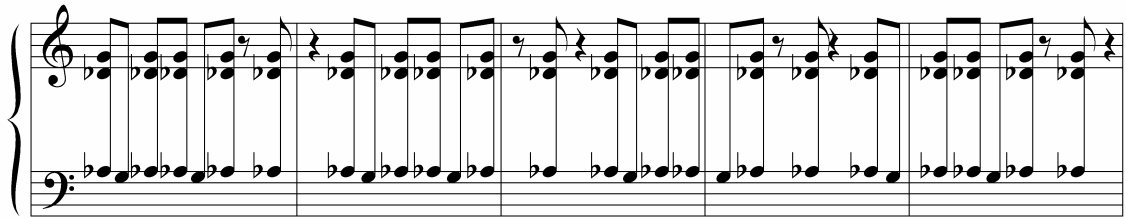
These motive groups are shown for each small structural unit in Table 14. The α group, found in Example 35, is the most prevalent within the piece. Seven of the nine small level units are part of this category. These α motives are not duplications of each other, instead all of the motives have similar shapes and rhythmic and melodic materials. Example 35 is only one example of how this motive appears in *Spontaneous Earth*.

Example 35 *Spontaneous Earth*, Grouping α , mm 1-9¹⁰¹

¹⁰¹ Ibid.

Example 35 is the first small unit, a typical example of the α group. There are two remaining small units not grouped in the α motive group. These motives can be grouped together to form the β motive group. Example 36 shows a typical example of this motive group.

Example 36 *Spontaneous Earth*, Grouping β , mm 28-32¹⁰²



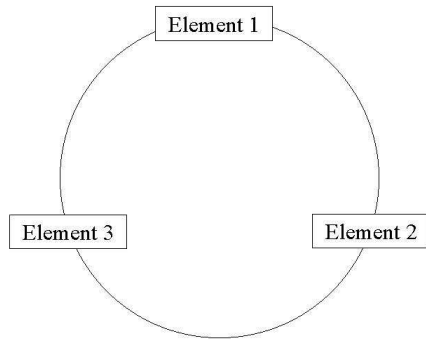
An interesting thing to note about the placement of these β sections is that they highlight large unit changes. Both of these sections appear at the beginning of the second and third large units. Hence, changes in motivic groups, like changes in the small units structure, are used to inform the performer/listener of changes in the larger structural units.

Pitch Circles

The pitch choices in *Spontaneous Earth* can be organized into circles similar to those used in the *First Construction (in Metal)*. In *Spontaneous Earth*, however, there are only three pitches found in each circle, unlike the four-element circles found in the *First Construction (in Metal)*. A generic circle that is used to create these pitch circles is given in Figure 11.

¹⁰² Ibid.

Figure 11 Circle for *Spontaneous Earth*



This three-element circle gives every element the ability to travel to both of the other elements. Therefore, there is no need for the compositional rule that forbids motion across the circle, as found in the *First Construction (in Metal)*. This three-motive circle may not seem necessary. If all of the motives move freely to one another, the placement of the motives on a circle is unnecessary since there is no need for the composer to cross the circle. But, to the author, the compositional process of moving around the circle is still evident in the plan of the work.

The first of these pitch circles is found in the right-hand of the α motivic group.

Figure 12 Pitch Circle, α Motive, Right Hand

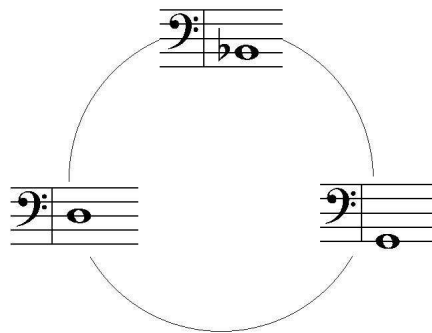


Figure 12 can be traversed to create the musical fragment found in Example 37.

Example 37 *Spontaneous Earth*, mm 15-18, right hand only¹⁰³



This circle is explored in the same manner as that Figure 12, creating the left-hand part for the α motive group.

Governing Number

Like six in *Six Short Inventions* and sixteen in the *First Construction (in Metal)*, the micro-macrocosmic structure of *Spontaneous Earth* is built on the reference number nine. Each of the structural units contain nine smaller units. The square root of the reference number forms the number of structural levels (small, medium, large). The number three is also used for the number of elements found in the pitch circles in Figures 12 and 13.

The types of sounds used in *Spontaneous Earth* and in the *First Construction (in Metal)* are very similar and create an additional connection between the two pieces. After 1944, Cage moved away from the percussion ensemble to prepared piano. There were several reasons for Cage's move to this new instrument. First, the resulting sounds of the instruments are similar; the sound of the prepared piano can evoke images of a percussion ensemble. Also, there were social factors involved in this change of instrumentation. Cage stated that "because in the bustle of New York 'everyone was busy with his own schedule...it was easier to work alone at the prepared piano than it was to organize a group of people to play percussion instruments."¹⁰⁵

¹⁰⁵ David Revill, *The Roaring Silence John Cage: a Life*, (New York: Arcade Publishing, Inc., 1992), 84.

Conclusion

These three works, *Six Short Inventions*, *First Construction (in Metal)*, and *Spontaneous Earth*, show an evolution of certain compositional techniques that create a connection between all three of these works.

All three works have a structure based on a single number. The composer in both the overall structure and also the structure of the sub-sections themselves uses this number. *Six Short Inventions* has a structure based on the number six: there are six movements, each having six cycles of the twenty-five note row. The structure used in this piece was transformed into the micro-macrocosmic structure first used in the *First Construction (in Metal)*. Where, the number sixteen becomes the basis for the structure of the entire work. Cage expanded the micro-macrocosmic structure in *Spontaneous Earth*. In this work, a middle level was added to the structure based on the number nine. One should note, that this brings the number of structural levels to three or the square root of nine.

In the three works discussed in this paper, the compositional methods used to fill the structure are similar. In all cases, Cage created a technique to spin out pitch material, and in the case of the *First Construction (in Metal)*, rhythmic material as well. The technique Cage used changed from the subtractive, linear technique of *Six Short Inventions* to the circles found in *First Construction (in Metal)* and *Spontaneous Earth*. The technique of *Six Short Inventions* has Cage choosing notes from a twenty-five-note pitch cycle, removing the notes from the collection as they are used, and starting over when the collection is empty. At this point, the process begins again, creating a cycle of pitches. The technique of *First Construction (in Metal)* and *Spontaneous Earth* is based

on a circle in which Cage can freely move around the circumference of the circle while choosing notes and rhythms. The two techniques are similar because both of the methods can produce a large amount of material quickly and easily. They also produce a repeating collection of pitches and motives.

Also, the referential number that determines the structure of these three works also determines other compositional decisions. For the *First Construction (in Metal)* and *Spontaneous Earth*, the number determines the number of sound or rhythm elements. In both cases, the circles are comprised of the square root of the basic number.

The compositional ideas described in this paper find their way from these “early works” into many of Cage's compositions that follow. Without this period of works, which have been deemed by some scholars as “work-day affairs”¹⁰⁶ and “impractical,”¹⁰⁷ many of the later works may not have appeared as they are today.

¹⁰⁶ Pritchett, 25.

¹⁰⁷ *Ibid.*, 8.

Appendix A

Six Short Inventions

Tone Rows By Instrument

■ Used by more than one row

Movement 1

	mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrument 1		Row 1											Row 2				
Instrument 2		Row 1											Row 2				
Instrument 3		Row 1											Row 2				

Movement 2

	mm	1	2	3	4	5	6	7	8	9	10	11	12	13	
Instrument 1		Row 1							Row 2						
Instrument 2		Row 1								Row 2					
Instrument 3		Row 1								Row 2					

Movement 3

	mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrument 1		Row 1									Row 2						
Instrument 2		Row 1										Row 2					
Instrument 3		Row 1									Row 2						

Movement 4

	mm	1	2	3	4	5	6	7	8	9	10	
Instrument 1		Row 1						Row 2				
Instrument 2		Row 1						Row 2				
Instrument 3		Row 1						Row 2				

Movement 5

	mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Instrument 1		Row 1									Row 2				
Instrument 2		Row 1									Row 2 (borrows from inst. 1 & 3)				
Instrument 3		Row 1									Row 2				

Movement 6

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrument 1	Row 1											Row 2				
Instrument 2	Row 1											Row 2				
Instrument 3	Row 1											Row 2				

mm	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Instrument 1	Row 3			Row 3										Coda		
Instrument 2	Row 3										Coda					
Instrument 3	Row 3										Coda					

mm	33	34	35	36
Instrument 1				
Instrument 2				
Instrument 3				

Appendix B

Six Short Inventions

Tone Rows by Ensemble

■ Used by more than one row

Movement 1

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Instrument 1	Row 1			Row 2			Row 3			Row 4			Row 5			Row 6		
Instrument 2																		
Instrument 3																		

Movement 2

mm	1	2	3	4	5	6	7	8	9	10	11	12	13					
Instrument 1	Row 1			Row 2			Row 3			Row 4			Row 5			Row 6		
Instrument 2																		
Instrument 3																		

Movement 3

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Instrument 1	Row 1			Row 2			Row 3			Row 4			Row 5			Row 6		
Instrument 2				■														
Instrument 3																		

Movement 4

mm	1	2	3	4	5	6	7	8	9	10								
Instrument 1	Row 1			Row 2			Row 3			Row 4			Row 5			Row 6		
Instrument 2							■											
Instrument 3				■														

Movement 5

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14				
Instrument 1	Row 1			Row 2			Row 3			Row 4			Row 5			Row 6		
Instrument 2				■			■						■					
Instrument 3							■						■					

Movement 6

mm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrument 1	Row 1				Row 2			Row 3				Row 4		Row 5		
Instrument 2																
Instrument 3																

mm	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Instrument 1	Row 6			Row 7			Row 8			Row 9		Row 10			Coda	
Instrument 2																
Instrument 3																

mm	33	34	35	36
Instrument 1				
Instrument 2				
Instrument 3				

112 **2**

128

Player	F 4	3	2	3	4	G 4	3	2	3	4
1							Thundersheet Trem.		Orch. Bells A X	Orch. Bells A X
2		Piano 2:1 Z	Piano 2:1 Z	Piano NR Z	Piano NR Z		Piano Trem.	Piano Trem.	Piano Trem.	Piano Trem.
3		Oxen Bells 2:1 W	Oxen Bells 2:1 W	Oxen Bells NR W	Oxen Bells NR W			Oxen Bells A W	Oxen Bells A WX	Oxen Bells B WX
4		Brake Drums 2:1 W	Brake Drums 2:1 W	Brake Drums NR W	Brake Drums NR W		Cowbells B X	Cowbells B X	Cowbells B X	Cowbells B X
5		Turk.Cymbal 2:1 W	Turk.Cymbal 2:1 W	Turk.Cymbal NR W	Turk.Cymbal NR W	Anvil A X	Anvil B X	Anvil B X	Anvil B X	Anvil B X
6	Muted Gong A W	Muted Gong 2:1 W	Muted Gong 2:1 W	Muted Gong NR W	Muted Gong NR W	Muted Gong A W		Muted Gong A W	Muted Gong A W	Muted Gong A W

144 **3**

160

Player	H 4	3	2	3	4	I 4	3	2	3	4
1		Orch. Bells 2:1 X		Orch. Bells 8:3 X	Orch. Bells B X	Orch. Bells C X	Orch. Bells C Y	Orch. Bells C XY		Thundersheet Trem.
2	Piano Trem.	Piano Trem.	Piano Trem.	Piano Trem.		Piano A WX	Piano A WX	Piano A WX	Piano A WX	Piano A WX
3		Oxen Bells B W		Oxen Bells B W	Oxen Bells B W					
4	Cowbells A X	Cowbells 8:3 X	Cowbells B X	Cowbells A X	Cowbells A X	Cowbells B Y	Cowbells B Y	Cowbells B XY	Cowbells B XY	Cowbells B XY
5	Anvil B X	Anvil B X	Anvil B X	Turk.Cymbal 2:1 W	Turk.Cymbal C W	Turk.Cymbal C W	Turk.Cymbal C W	Turk.Cymbal C W	Turk.Cymbal C W	Anvil C X C XY
6		Muted Gong A W		Muted Gong B W	Muted Gong A W				Water Gong NR X	Water Gong NR X

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192

Player	J 4	3	2	3	4	K 4	3	2	3	4
1	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.
2	Piano A WX	Piano Trem. Y	Piano Trem. Y	Piano Trem. Y			Piano Trem.		Piano Trem.	
3		Oxen Bells B W	Oxen Bells B W	Oxen Bells B W	Oxen Bells B W	Oxen Bells A W	Oxen Bells C W		Thundersheet Trem.	Thundersheet Trem.
4	Cowbells B XY		Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.
5	Turk.Cymbal 1:4 W	Anvil C X	Anvil C X	Turk.Cymbal W		Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.	Thundersheet Trem.
6	Water Gong 1:4 X	Water Gong NR X	Water Gong NR X	Water Gong NR X	Water Gong Trem. X	Water Gong Trem. X		Water Gong Trem. X		Water Gong Trem. X

Bibliography

- Cage, John. "A Composer's Confessions." In *John Cage: Writer*. New York: Limelight Editions, 1993.
- _____. "Composition as Process". In *Silence*. Hanover, New Hampshire: Wesleyan University Press, 1973.
- _____. *First Construction (in Metal)*. New York: Henmar Press Inc., 1962.
- _____. *For the Birds*. Interviewed by Daniel Charles. Edited by John Cage and Tom Gara. New York: Marion Bergers Publishers, 1995.
- _____. "Notes on Compositions I (1935 - 48)." In *John Cage: Writer*. New York: Limelight Editions, 1993.
- _____. *Six Short Inventions*. New York: Henmar Press Inc., 1963.
- _____. *Spontaneous Earth*. New York: Henmar Press, Inc., 1977.
- Campana, Deborah. "Sound, Rhythm, Structure: John Cage's Compositional Process Before Chance". *Interface: Journal of New Music Research* 18, no. 4 (1989); 223-241.
- Cowell, Henry. *New Musical Resources*. New York: Something Else Press, 1969.
- Gena, Peter. "John Cage the Composer". In *A John Cage Reader in Celebration of his Seventieth Birthday*. Edited by Peter Gena, Jonathan Brent, and Don Gillespie. New York: C.F. Peters Corp, 1982.
- Griffiths, Paul. *Cage*. New York: Oxford University Press, 1981.
- Hines, Thomas S. "'Then Not Cage': The Los Angeles Years, 1912 - 1938". In *John Cage Composed in America*. Edited by Majorie Perloff and Charles Junkermann. Chicago: The University of Chicago Press, 1994.
- Nattiez, Jean-Jacques, ed. *The Boulez - Cage Correspondence*. Translated by Robert Samuels. New York: Cambridge University Press, 1993.
- Patterson, David Wayne. "Appraising the CatchWords, c. 1942-1959: John Cage's Asian-Derived Rhetoric and the Historical Reference of Black Mountain College." Ph.D. diss., Columbia University, 1996.

- Pritchett, James. "The Development of Chance Techniques in the Music of John Cage, 1950-1956". Ph.D. diss., New York University, 1988.
- _____. *The Music of John Cage*. New York: Cambridge University Press, 1993.
- Revill, David. *The Roaring Silence John Cage: a Life*. New York: Arcade Publishing, Inc., 1992.
- Schultis, Christopher. *Silencing the Sounded Self: "John Cage and the American Experimental Tradition"*. York, PA: Northeastern University Press, 1998.
- Slyvestre, Gaston. Translated by David Chales. Notes for John Cage. *Works For Percussion*. Quatuor Hélios. Wergo wer6203-2.
- Williams, B. Michael. "The Early Percussion Music of John Cage, 1935 - 1943". *Percussive Notes* 31, no. 6 (August 1993): 60-67.
- _____. "John Cage: Professor, Maestro, Percussionist, Composer". *Percussive Notes* 36, no. 4 (August 1998): 55-61.

Curriculum Vitae

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Education

- D.M.A. expected May 2004, Music Composition, University of Illinois at Urbana-Champaign 1998 - Present
A.B.D. Dissertation Defense completed May 15, 2003
Secondary Area of Concentration: Computer Science
Graduate Instructors: Zack Browning, Sever Tipei, Eric Lund, Stan Link, David Patterson, William Brooks, Warren Burt
Doctoral Projects:
Reconstruction: Recreating the Compositional Processes used by John Cage in First Construction (in Metal), Six Short Inventions, and Spontaneous Earth
An analysis of the rhythmic and motivic processes developed by Cage during the composition of these three works
A Framework for the Development of Computer-Assisted Composition
The development of a programming framework (in Smalltalk) for use in the creation of new composition software systems
- M.M., Music Composition, Crane School of Music, State University of New York at Potsdam 1997
Awards: Graduated with Distinction (GPA 4.0)
Composition Instructors: Paul Steinberg, Andrew E. Simpson
- B.S., Music Education, West Chester University, West Chester, PA 1995
Awards: Graduated Cum Laude (GPA 3.4)
Composition Instructors: Robert Maggio, Larry Nelson

Current and Previous Employment

- Instructor, Introduction to Music Composition (Music 145b, Fall), Unit One, University of Illinois at Urbana-Champaign 2001 – Present
Design a music composition class for non-majors with experience ranging from no music-reading ability to many years of private lessons.
Lead a discussion oriented class through the music of the last century.
Plan, coach, and evaluate composition and performance oriented projects.
Create a course packet with reading and listening materials.
Organize a concert showcasing students' works.

- Instructor, Electronic Composition (Music 145b, Spring), Unit One, University of Illinois at Urbana-Champaign
 Design an electronic music composition class for non-majors.
 Maintain and update an electronic music studio containing several Macintosh computers, synthesizers, and digital recording equipment.
 Provide instruction on the use of studio equipment.
 Plan, coach, and evaluate composition projects.
 Organize a CD project showcasing student works.
- Instructor, Theory of Popular Music (Music 145c, Fall and Spring), Unit One, University of Illinois at Urbana-Champaign
 Design a class on the theory and history of popular music for non-music majors.
 Design assignments and projects that allow the students to create and learn about popular music through composition and analysis.
 Teach non-majors basic music reading skills.
- Unit One Core Staff Member, Unit One, University of Illinois at Urbana-Champaign 2001 – Present
Unit One is a living and learning community in Allen Hall at the University of Illinois focusing on creating a small liberal arts environment within the larger university system.
 Participate in weekly staff meetings that design and plan future Unit One events and policies.
 Plan and participate in orientation weekend for incoming freshmen.
 Aid students in the creation of programs to be presented to a campus-wide audience.
 Maintain and administer the Unit One Electronic Music Studio containing a wide range of computer and midi equipment.
 Administer focus groups and other information gathering sessions with the students.
 Participate in committees for hiring resident directors, student planners and additional Unit One staff.
- Instructor, Private Saxophone Lessons (Music 145jg), Unit One, University of Illinois at Urbana-Champaign 2002 – Present
 Provide instruction for a small studio of non-major saxophonists.
- Web Designer, Composition-Theory Department, School of Music, University of Illinois at Urbana-Champaign 2002
 Design and create the main web site for the composition-theory division at the University of Illinois.
 Solicit and organize materials from faculty members and present them in a web-friendly manner.
- Teaching Assistant, School of Music, University of Illinois at Urbana-Champaign 2000 – 2001
 Music Theory 1 & 3 (Music 101 & 103)
 Lecture class of approximately 100 students.
 Provide one-on-one tutoring.
 Hold discussion section of 10-20 students once a week.
 Create homework solutions.
 Grade and evaluate homework.
 Aural Skills 1 & 3 (Music 111 & 113)
 Hold a discussion section of 10-20 students twice a week.
 Provide one-on-one instruction.
 Prepare and administer sight-singing and dictation tests.

System Administrator, Computer Music Project, Experimental Music Studios, School of Music, University of Illinois at Urbana-Champaign Maintained UNIX Network containing three separate operating systems (NeXT, SGI, and Linux) and Macintosh computers. Updated and maintained web pages for both the Computer Music Project and the Experimental Music Studios. Created and maintained user accounts for all classes held within the Computer Music Project. Provided one-on-one instruction to users on the operation of UNIX. Provided assistance to researchers working on various projects within the Computer Music Project.	1999 – 2000
Local Area Network Administrator and Business Systems Analyst, American International Group (Wilmington, DE) Maintained a network of computers running Windows NT, Windows 95, and Windows 3.1. Created and documented procedures for new and current software. Created new database and administrative software for use by staff. Provided one-on-one computer assistance and support to approximately 100 users.	1997 – 1998
Sound Engineer, Crane School of Music, State University of New York at Potsdam Recorded and edited sound materials for musical and non-musical events. Operated and transported audio mixers and various recording equipment within a concert environment.	1996 – 1997

Performances (complete list of works included)

<i>Candidates, George I – vs. – the Very Bad Man From the East, and Bushisms</i> performed as part of <i>Op-Rock Explosion</i> , Allen Hall, University of Illinois at Urbana-Champaign.	December 2003
<i>Subtraction with MD</i> performed at the MAVrick Festival 2003, School of Music, University of Illinois at Urbana-Champaign.	July 2003
<i>ENVolve.1.22.03.01, Anatomically Speaking, and Lavender Mist</i> performed during the Computer Fear Movie Festival, University of Illinois at Urbana- Champaign.	April 2003
<i>George I –vs.- the Very Bad Man From the East</i> performed as an installation during a MAVrick Ensemble concert, Ukrainian Museum of Modern Art, Chicago, Illinois.	February 2003
<i>George I –vs.- the Very Bad Man From the East</i> performed as an installation, School of Music, University of Illinois at Urbana-Champaign.	December 2002
<i>ENVolve.2.*</i> and <i>George I –vs.- the Very Bad Man from the East</i> performed as part of <i>A Night in the Cornfield</i> , Allen Hall, University of Illinois at Urbana- Champaign.	December 2002
<i>Ann Street</i> and <i>Bushisms and Other Things</i> performed during the MAVrick Festival 2002, Urbana, Illinois.	June 2002
<i>ENVolve.2.*</i> performed as an installation at the 2002 SEAMUS Conference, University of Iowa, Iowa City, Iowa	April 2002
<i>Ann Street</i> performed during the <i>New Music of the Twenty-first Century Festival</i> , School of Music, University of Illinois at Urbana-Champaign.	February 2002
<i>ENVolve.1.*, Dance of the Forever Encircling Politicians, Lavender Mist</i> performed during Art Fantastic, Allen Hall, University of Illinois at Urbana- Champaign.	November 2001
<i>ENVolve.1.22.03.01</i> included on the CD <i>Origins</i> from the Experimental Music Studio, University of Illinois at Urbana-Champaign.	August 2001

<i>ENVolve.1.*</i> included in an installation of Manifold Art at the University of Massachusetts Art Gallery, University of Massachusetts.	August 2001
<i>Anatomically Speaking, Dance of the Forever Encircling Politicians,</i> and <i>ENVolve.1.*</i> performed during the 7-11 Festival of New Music, School of Music, University of Illinois at Urbana-Champaign.	June 2001
<i>Subconscious Persuasion</i> performed during <i>Interactronic</i> , an evening of interactive electronic works, Canopy Club, Urbana, Illinois.	April 2001
<i>Journeys I – “Illinois”</i> performed during the <i>New Music of the Twenty-first Century Festival</i> , School of Music, University of Illinois at Urbana-Champaign.	February 2001
<i>Journeys I – “Illinois”</i> performed during a salon held by Peter Tambroni., Chicago, Illinois.	February 2001
<i>ODB4</i> , performed during 2000 Midwest Composers Symposium, School of Music, University of Illinois at Urbana-Champaign by University of Illinois Percussion Ensemble.	November 2000
<i>Journeys I - “Illinois”</i> performed during the Masters Recital of Peter Tambroni on double bass, School of Music, University of Illinois at Urbana-Champaign.	April 2000
<i>Solo for 5</i> , a collaboration with choreographer Jessica Swoper, performed at <i>An Evening of Collaborations</i> , Department of Dance, University of Illinois at Urbana-Champaign.	April 2000
<i>Trio Square</i> performed during the <i>Early Music of the Twenty-First Century Festival</i> , School of Music, University of Illinois at Urbana-Champaign by University of Illinois New Music Ensemble.	March 2000
<i>Trio Square</i> performed during 1999 Midwest Composers Symposium, School of Music, University of Michigan by the University of Michigan New Music Ensemble.	October 1999
Masters Recital, an hour of performances of music written at the Crane School of Music, State University of New York at Potsdam, works included: <i>achieving the Togethercoloured instant, Anatomically Speaking, Filtra, Four Short Pieces for Clarinet, Lavender Mist, Le petit tourbillon d’eau, Two Opposing Forces, Simset.</i>	April 1997
<i>Choose Your Own Adventure</i> co-written with Jon Doyle, performed during a composition recital of the music of Jon Doyle, Crane School of Music, State University of New York at Potsdam.	March 1997
<i>Le petit tourbillon d’eau</i> performed during a <i>Concert of Student Works</i> , Crane School of Music, State University of New York at Potsdam.	November 1996
<i>Songs for Winds no. 2</i> performed during a recital by Kim Guessford, Elizabethtown College, Elizabethtown Pennsylvania.	March 1996
<i>Songs for Winds no. 1</i> performed during West Chester Senior Recital, Swope Hall, West Chester University, West Chester, Pennsylvania.	August 1995
<i>Gabriel’s Message</i> performed by the St. Marks Lutheran Church Choir, Wilmington, Delaware.	December 1993

Performing Experience

Promoted and organized <i>Op-Rock Explosion</i> , a "happening" at Allen Hall, University of Illinois at Urbana-Champaign containing student works from the Music 145 class and others.	December 2003
Promoted and organized <i>A Night in the Cornfield</i> , a "happening" at Allen Hall, University of Illinois at Urbana-Champaign containing student works from the Music 145 class and others.	December 2002
<i>Variations I –</i> by John Cage (electronic realization), MAVrick Ensemble, Ukrainian Museum of Modern Art, Chicago, Illinois.	December 2002
Promoted and organized <i>Art Fantastic</i> , a "happening" at Allen Hall, University of Illinois at Urbana-Champaign containing student works from the Music 145 class and others.	November 2001

<i>Solo for 5</i> (saxophone) performed at <i>An Evening of Collaborations</i> , Department of Dance, University of Illinois at Urbana-Champaign.	April 2000
<i>Speech</i> (radio 2) by John Cage, performed during <i>The Changing Sound Worlds of John Cage</i> , Krannert Art Museum, University of Illinois Urbana-Champaign.	November 1999
Arranged, organized, and promoted an hour recital of own compositions.	April 1997
<i>Choose Your Own Adventure</i> (saxophone) and <i>An Essay on John Cage</i> (Speech and Movements) by Jon Doyle, performed during the composition recital of Jon Doyle, Crane School of Music, SUNY Potsdam.	March 1997
Senior Recital (saxophone) performed an hour long solo recital containing several works including my own work, <i>Songs for Winds no. 1</i> for Soprano Saxophone and Piano.	August 1995
Performed in various ensembles at West Chester University including West Chester University Concert Band, Symphonic Band, New Music Ensemble, Saxophone Ensemble, Statesmen Jazz Band, and Masterworks Chorus (oboe, clarinet, saxophone, bassoon, percussion, and voice).	1991-1995
Freelance Jazz Ensemble (saxophone): Organized, rehearsed, and promoted a Jazz Combo playing in the Wilmington, DE area.	1992-1995
<i>Take Me Along</i> (clarinet and saxophone), Pit Orchestra, Kennet Square High School (Kennet Square, PA).	December 1994
<i>Music Man</i> (bass guitar), Pit Orchestra, Mount Pleasant High School (Wilmington, DE).	April 1993
<i>Bye, Bye, Birdie</i> (electric guitar), Pit Orchestra, Brandywine Community Theater (Wilmington, DE).	March 1993

Additional Teaching Experience

Five classroom lectures on “Software Design and Programming in C++” given in Advanced Computer Sonification (Music 403), School of Music, University of Illinois at Urbana-Champaign.	Spring 2000
Six classroom lectures on “Basic C++ Programming” given in Computer Music (Music 404), School of Music, University of Illinois at Urbana-Champaign.	Fall 1999
Development of a website for Music 315 (Music of the 20 th Century) with Professor David Patterson, University of Illinois at Urbana-Champaign.	1999 - 2000
A week-long seminar on the use of composition within elementary classrooms for sophomore and junior music education students, Crane School of Music, State University of New York at Potsdam.	Spring 1997
Arden Community Recreational Association Day Camp, Sports and Music Director, teaching both outdoor activities and a small jazz combo, Arden, DE.	Summer 1995
Private saxophone lessons to middle and high school level students.	1992 – 1994
Student Teaching Experience Secondary Level, Kennet High School, Kennet School District, Kennet Square, PA. Kenneth Hoch, Co-operative Teacher.	Fall 1994
Student Teaching Experience Elementary Level, Sabold Elementary School, Springfield School District, Springfield, PA. Lorma Crow, Co-operative Teacher.	Fall 1994
Saxophone instructor at Mount Pleasant High School for the concert and jazz bands, Wilmington, Delaware.	1992

Honors and Activities

<i>List of Teaching Assistants Rated as Excellent by their Students – Rated Outstanding</i>	Fall 2003
Ranked in the top ten percent of all Teaching Assistants throughout the University of Illinois for Music 145 B and 145 C.	
Member of the School of Music Computer Advisory Committee	2003 – 2004

<i>List of Teaching Assistants Rated as Excellent by their Students</i>	Spring 2003
For Music 145	
Treasurer, Group for New Music Student Organization	2002 – 2003
<i>List of Teaching Assistants Rated as Excellent by their Students – Rated</i>	Fall 2001
<i>Outstanding</i>	
Ranked in the top ten percent of all Teaching Assistants throughout the University of Illinois for Music 103 and 113.	
<i>List of Teaching Assistants Rated as Excellent by their Students – Rated</i>	Fall 2000
<i>Outstanding</i>	
Ranked in the top ten percent of all Teaching Assistants throughout the University of Illinois for Music 101 and 111.	
Graduated with Distinction (GPA 4.0) from Crane School of Music, SUNY Potsdam.	1997
Inducted into Pi Kappa Lambda, Zeta Mu Chapter, Music Honors Fraternity, Crane School of Music, SUNY Potsdam.	1997
Graduated Cum Laude (GPA 3.4) from West Chester University.	1995

List of Works

Name	Year	Instrumentation
Candidates	2003	Four Politicos, Signs, and Referee
Channel Music	2003	Wind Ensemble
George I – vs. – The Very Bad Man From the East	2002	Video and Sound Installation
Bushisms and Other Things	2002	Video and Sound Installation
ENVolve.2	2002	Electronic Tape
Journeys III – “Wedding Day”	2002	Viola and Double Bass
Subtraction for MD	2002	Piano
Ann Street Revisited	2001	B ^b Soprano Clarinet
Subconscious Persuasion	2001	Politician and MAX/MSP
birds(2000	3 Female Voices, Cello, and Percussion
Dance of the Encircling Politicians	2000	Electronic Tape
ENVolve.1	2000	Electronic Tape
Pakilawa	2000	12 Instruments (mixed variety)
Solo	2000	5 Unnamed Instruments
Journeys II - "Kim's Wedding"	1999	Cello
Journeys I - "Illinois"	1999	Double Bass
odb4	1999	Percussion Quartet
Trio Square	1999	Flute, Clarinet, and Bassoon
Coffee Talk	1998	Found Percussion
Evening Song	1998	String Quartet
4 Short Pieces for Clarinet	1997	B ^b Clarinet and Effects Processor
Anatomically Speaking	1997	Electronic Tape
Insurrection of the Mind	1997	Wind Ensemble
Two Opposing Forces	1997	Electronic Tape
achieving the Togethercoloured instant	1996	Baritone (Voice) and Piano
Filtra	1996	2 Percussionists and Electronic Tape
Le petit tourbillon d'eau	1996	Flute
Lavender Mist	1996	Electronic Tape
SIMSET	1996	B ^b Clarinet and Bass Clarinet
Contend, O Lord	1993	Voice and Piano
Soldier	1993	2 Trumpets, Euphonium, Tuba, and Percussion
Gabriel's Message	1992	SATB Choir
Songs for Winds No.1	1992	Soprano Sax and Piano
Songs for Winds No.2	1992	French Horn and Piano