

## Mathematical Sequences and Artists' Books

Susan Happersett

Jersey City, NJ

E-mail: [fibonaccisusan@yahoo.com](mailto:fibonaccisusan@yahoo.com)

### Abstract

I discuss three different drawing techniques developed throughout the course of my artistic practice: counted marking drawings, chaos drawings and circle curve drawings. By using a series of drawings as a single work of art, I will create linear sequential artists' books based on fractals, growth patterns, and numeric sequences. A linear sequential artwork consists of series of images that display in a specific order from beginning to end.

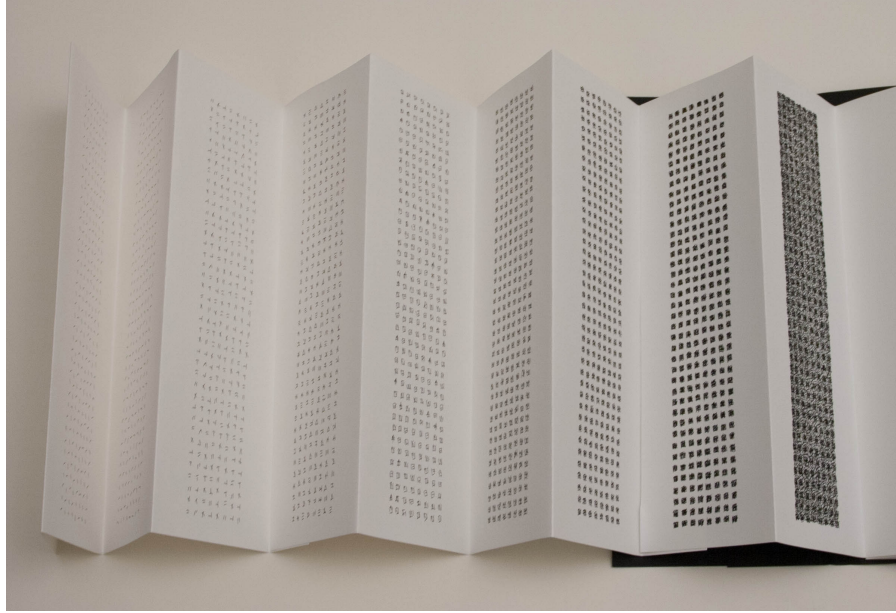
### Artists' Books

Many mathematical sequences, series, and formulae can be visually expressed using linear progressions. By creating a series of drawings to be viewed together, artists can elaborate on the sequential nature of these topics. Artists' books are a good vehicle to explore these relationships. I define artists' books as works of art where the artist has selected to present content in the form of a book. There are many possible forms that can be used to go beyond a basic codex: accordions, scrolls, pamphlets and books with multiple signatures. The nature of book forms allows artists to present multiple images coherently in a single work.

### Counted Marking Drawings

First, I will explain how I create my counted marking drawings. I work within a grid and predetermine the number of gestural marks within each grid square based on a mathematical sequence. Many of these drawings are based on the Fibonacci sequence. The Fibonacci sequence is a recursive sequence where the first two terms are 1 and 1, and each consecutive term is the sum of the two previous terms. The number of marks per grid square are counted out to reflect the growth of Fibonacci numbers. The accumulation of the strokes is a visual representation of how the sequence grows.

When I begin planning the grids I need to not only think about the growth pattern within each drawing, I also need to consider how the pattern can be carried out throughout the entire book. I want there to be a consistency between the micro aesthetic of the individual page and the macro aesthetic of the entire book. Figure 1 shows a one-of-a-kind accordion book based on these principles. In this case, all grid cells on a page show the same Fibonacci number and the sequence progresses from page to page. As a book, it shows the first nine terms of the Fibonacci sequence on nine connected pages.

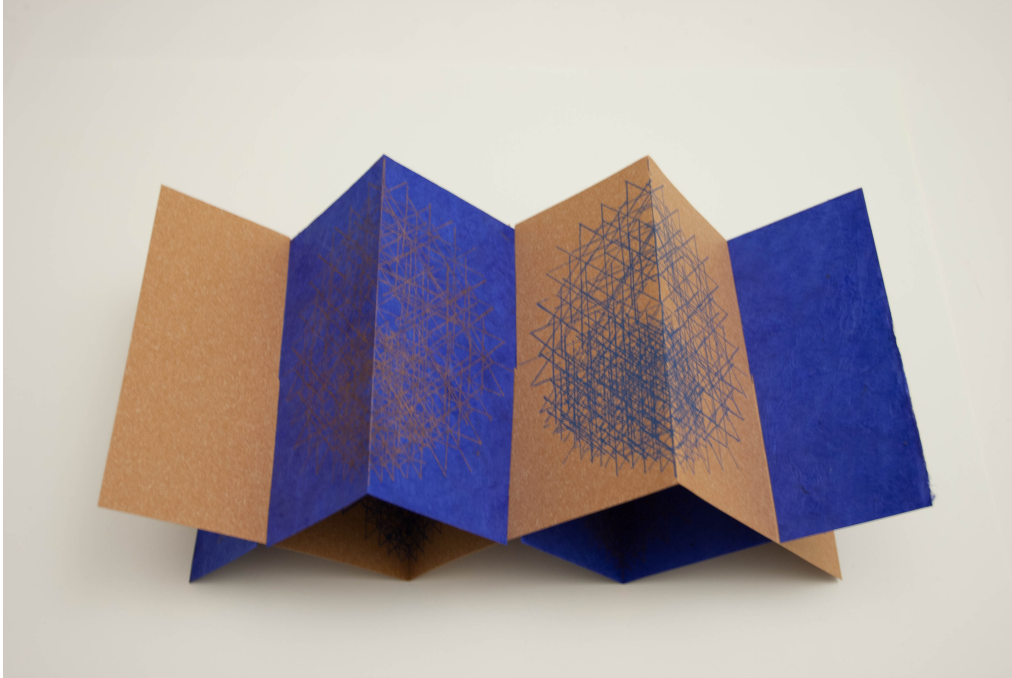


**Figure 1:** *Counted markings explore Fibonacci sequence*

### Chaos Drawings

I have also done work that relates to the chaos theory, using a series of 8-spoked fractal stencils. With the small margin of error in the stencils combined with the multiple iterations, I illustrate the order and pattern within a seemingly chaotic mass of lines. I spent many months making a stop motion video of the creation of a chaos drawing. To take a picture for the next frame of the movie, I had to step away from the drawing after every line. This pause in drawing made me look at the work in progress and I realized that the drawing was visually interesting in its intermediate forms, as well as in the completed product. I decided to make a book where you could see the drawing at different stages.

I created a series of hand-drawn books, but my most recent chaos-related project is a letter-pressed edition named *Box of Chaos* (see Figure 2) [1]. *Box of Chaos* consists of four folded paper structures illustrating eight phases of chaos. In Phase I there is a skeletal drawing of the fractal where the pattern is easy to recognize. In each subsequent phase there is more concentration of lines. Finally, in Phase VIII it is difficult to see the initial structure. In order to create a linear sequence of these drawings, I needed a plan that would clearly show the growth of the figure. So all of the drawings have three iterations of the initial eight-spoked fractal. For Phase I only one of the spokes has the 4th iteration completed. Phase II is the same as Phase I but the two adjacent spokes have the 4th iteration complete. Each consecutive phase has one more spoke with the 4th iteration of the pattern until finally Phase VIII has the complete cycle with four iterations of the pattern complete.



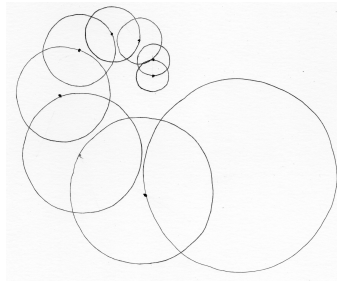
**Figure 2:** *Box of Chaos - Phase 1 and 2*

### Circle Curve Drawings

The third—and most recent type—of drawing is my circle curves. This work examines the ratio relationships of the Fibonacci numbers in 2-D space. I draw circles where their areas are in a sequence corresponding to the Fibonacci numbers. The area of the first circle determines the area for all of the circles in the drawing. The first and second circles are the same, and the third circle has an area of twice the first circle. The fourth circle has an area three times the first. The fifth circle has an area of five times the first. The sixth circle has an area eight times the first. This continues in the Fibonacci sequence. Using a system of overlapping and rotating 137.5 degrees these circles form an interesting spiral. The basic structure of a spiral drawing can be seen in Figure 3.

The number of circles of each size drawn is determined by the radius of the first circle. It is the closest integer to ten times the radius in inches, multiplied by the square root of the Fibonacci number that relates to the circle in the sequence. For example, if the smallest circle has a radius of  $\frac{1}{2}$  inch, then there are five circles drawn between the first and second circle (Fibonacci 1 and 1) and between second and third circle (Fibonacci 1 and 2). Between the third and fourth circle (Fibonacci 2 and 3) I will draw seven circles. This is the closest integer to 10 times  $\frac{1}{2}$  times the square root of 2. The next set of circles, between Fibonacci 3 and Fibonacci 5 will have nine circles.

My hand-drawn book *Fibonacci Double Spirals* (Figure 4) provides a view of how these drawings develop. Each page has a large completed turquoise spiral as the back ground. The first page only shows this background spiral. On the second page I have drawn just the first circle of a second smaller spiral in blue. The third page has the first two circles. Each consecutive page has one more circle until nine circles are complete and the spiral pattern is clearly developed.



**Figure 3:** *Basic Spiral*



**Figure 4:** *Fibonacci Double Spirals*

### **Conclusion**

Although I use distinctly different techniques for each of these works there is consistency in proceeding from drawings to artist's books. My drawing processes determine the pages of each book starting with initial structure through numerous stages to a final completed cycle. I use multiple images to present a cohesive work that conveys a mathematical theme. Each page of each book is planned to be part of a series, where the order of the pages is significant to the sequential format of the book.

### **References**

- [1] Susan Happersett, *Box of Growth*, 2013, Purgatory Pie Press, New York.