

SESSION THREE

Phenomeno-logical Garden:
A Work In Morpho-logical Process

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*"Every natural phenomenon, however simple, is really composite, and every visible action and effect is a summation of countless subordinate actions."*¹

*"Morphology is not only a study of material things and the forms of material things, but has its dynamical aspect, under which we deal with the interpretation, in terms of force, of the operations of energy."*²

*"I know that in the study of material things, number, order and position are the threefold clue to exact knowledge."*³

—D'Arcy Thompson, *On Growth and Form*

ABSTRACT

This paper was originally presented at the ACSA Eastern Central Regional Conference On Growth and Form: The Engineering of Nature. It presents an on-going architectural project that is exploring the morphological and integrative potential of fundamental processes that correlate with the world of natural phenomena. Through the emergent properties of "woven" flexible membranes (or networks) that perform as coordinated-modular-arrangements of basic elemental relationships, a variety of forms and installations have been fabricated and exhibited in several institutions. The evolving *Phenomenological Garden* project is a systematic investigation of the versatile and generative potential of these dynamic processes found throughout systems in nature, mathematics and music. As part of the Form Studies Unit in the School of Architecture at Carleton University, the work seeks to investigate how complex structures and forms are generated from initially random processes that evolve into morphologically rich integrated relationships.

INTRODUCTION

Through his definition of morphology and the "threefold clue" regarding the study of "material things" and their associated forms, D'Arcy Thompson offers us an insightful understanding of the intrinsic nature of the dynamic processes, or "operations of energy," that

exist throughout the physical world. These fundamental processes generate, and are themselves inherently composed of, very fertile, self-regulating and systematic procedures through which emerge the rich realm of natural phenomena and "material things." Therefore, as Thompson reminds us, an insightful comprehension can be achieved and, consequently, highly versatile working methods developed, through the understanding of how *number, order* and *position* are generated by, and interact within, these fluent "operations of energy."

The *Phenomenological Garden* project is a work-in-progress and in-process that has been inspired by these insights and the working procedures that they can reveal regarding nature's developmental processes. It seeks to explore the form and structure generating potential of these dynamic processes along with their elemental components, emergent integrative properties and pattern generating capabilities. A working process that would inherently incorporate *number, order* and *position* in the arrangement of its constituent parts, their integrative interactions, and in its developmental process, can generate *reciprocally related* organizational structure and form. Such a process offers great possibilities and directions to the study of morphology and to the field of architecture at a time when it is addressing the concepts and themes emerging out of our deeper understanding of the dynamic "operations of energy" in the physical world.

BACKGROUND

Throughout history, the theme of the nature of material things and their dynamics has been a source of inspiration for the creative work of many individuals. Titus Lucretius Carus' *De Rerum Natura* ("The Nature of Things") is a poetic meditation on this subject following the philosophical tradition of Epicureanism (342-270_{B.C.}). Lucretius begins his poem by invoking the goddess Venus, the mythological figure symbolizing the dynamic and creative power of the forces at work throughout nature. The work of Wallace Stevens and Pablo Neruda are more recent example of the poetic imagination inspired by nature's power.

Other individuals such as Pythagoras, Plato, Leonardo Da Vinci, Issac Newton, J. W. von Goethe, William Blake, G. W. Leibnitz, Ralph W. Emerson and Albert Einstein obsessively studied and contemplated on what the physicist Richard Feynman referred to as "the inconceiv-

able nature of nature." Throughout their work and insightful meditations we find a profound understanding and appreciation of the importance of Thompson's "threefold clue." *Number, order and position* are, of course, fundamental components in the emergence of a *relationship* between things.

We find dynamic forms and structures lurking within vastly differing scales of observation. Within the vast expanse of outer space, we encounter dynamically organized operations of light energy that remind us, through its spiral structure, of forms and patterns lurking within our immediate environment. The efficiency and incredible adaptability of this elemental form is further revealed through its use by nature in the highly versatile double-helix structure of DNA.

This interrelationship between scales and between matter, process, and form, found both in physics and in biology, is not just encountered within the realm of appearances. D'Arcy Thompson was well aware of this and describes the quest to understand this interrelationship as "the search for community of principles or the essential similitudes."⁴ Most essential regarding such a quest, the anthropologist Gregory Bateson reminds us, is "the discarding of magnitudes in favor of shapes, patterns, and relations."⁵ Evidently, within the realm of the organizing principles of integrated, highly adaptable and structured relationships, we encounter scaleless order or, perhaps more insightfully, a multitude of possible scales or magnitudes.

Concurrent with the publication of *On Growth and Form*, and as an interesting coincidence in history also related to this quest for "essential similitudes," a fundamental conceptual shift was already underway regarding our comprehension of the physical world and the principles involved in its structuring. Fundamentally, the nature of matter was revealed to consist of an irreconcilable yet intrinsic contradiction. At the heart of this paradox was the nature of form, structure, developmental organization, and emergent patterns. Measurable or numerically quantifiable form and position were inextricably linked and/or reciprocally related to the highly elusive behavior of the "operations of energy." Subsequently, it was revealed that through these highly complex processes emerge three-dimensional networks or patterns of probable or possible alternatives. According to the German physicist Werner Heisenberg:

*"The world thus appears as a complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole."*⁶

The intrinsic nature of this dynamic conception consists of the realization and comprehension of patterns as highly complex networks of organizational texture and potent energy. Understanding this inherent characteristic would provide the necessary insights into the new conceptualization. This contradictory nature of matter is a recurring theme that's encountered when contemplating the rela-

tionships between substance and form, subject and object, as well as unity and multiplicity. In the history of biology, this ancient dilemma is found to be inextricably associated with the understanding of the forms of living organisms and their growth or developmental processes. Both in physics and in biology, at the most elementary level, nature's processes are essentially the inter-relationships between things in a myriad of different orders of magnitude.

We are inextricably part of and surrounded by Heisenberg's encoded "tissue of events." The probing of the inherent nature of this fluently textured tissue, can lead to an insightful understanding of the nature of patterns and their correlation with matter, developmental processes, growth and form. In the words of Gregory Bateson:

*"We have been trained to think of patterns, with the exemption of those in music, as fixed affairs. It is easier and lazier that way but, of course, all nonsense. In truth, the right way to begin to think about the pattern which connects is to think of it as primarily (whatever that means) a dance of interacting parts and only pegged down by various sorts of physical limits and by those limits which organisms characteristically impose."*⁷

This dynamic conception envisions emergent networks as event-filled encoded records contain the richly in-forming and expressive potential of their generative processes. Modern computer visualization and simulation techniques are revealing new insights regarding the richness of these networks lurking within Heisenberg's "tissue of events" and Bateson's "dance of interacting parts." Fundamental insights are offered into the earlier developments regarding the nature of the physical world. Again, within the realm of complex phenomena, we encounter "objects" or confined spatial forms that "attract" or resolve the dynamic "operations of energy." The emergent spatially confined activity is the mediation or resolution of the conflicting interactions. These processes reveal a wealth of detail and Thompson's "essential similitudes" at almost infinite scales of organization. Here, again, *number, order and position* play a vital role and, revealed in greater depth, is the fundamental role of the relationships between interacting parts in different orders of magnitude along with their emergent patterns.

These dynamic patterns can be generated through vibrations in a liquid or a fine powder and when a dense liquid is evenly heated in a pan. In all of these examples, the dynamic events activated within the medium resolve themselves or eventually mediate into resonant, highly charged and encoded networks of energy. Within these potent patterns of phenomenal activity and their modular units, we encounter a correlation between "stable" form and dynamic inner structure.

WORK-IN-PROCESS

My work and research has been inspired by the broad implications of the developments described above. The initial stages of the work involved the use of a camera to generate a series of images titled *Multiples*. The resulting improvised multiple-exposure images would emerge from the purely visual intermingling or blending of a repeated image or module (see Fig. 1). Subsequently, a more physical, materially based and dynamic process was required and eventually conceived through the use of a potter's wheel and its rotary motion. Intrinsic forms lurking within the spinning wheel's spiral vortex were cast by securing a metal cylinder containing hot water and wax to the wheel. This process generated a series of forms reminiscent of seashells and biological shapes. Fig. 2 shows two views of two of these wax forms.

The potter's wheel was also used to spin a suspended cotton string into initially stable and sequential wave-formations that would eventually become turbulent at higher speeds. This project, titled *Ariadne's Thread/Rumi's Ocean*,⁸



Fig. 1. *Multiple #1*

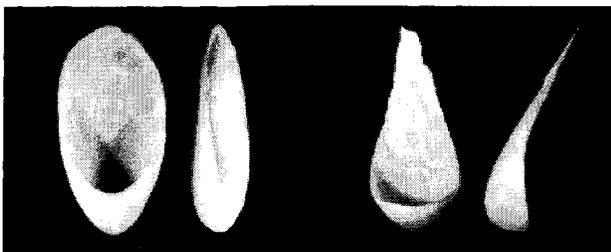


Fig. 2. *Wax Forms, 7" high x 3" wide.*



Fig. 3. *Manuel A. Báez, Ariadne's Thread/Rumi's Ocean,⁸ String & Potter's Wheel, 1993-present. Left & upper right: String Formations; lower right: Collaged Motion Drawings; middle: Calligraphic String Drawing; middle right: Multiple Exposure String Drawing or Ariadne's Ball of Thread.*

was inspired by scientific investigations of dynamic phenomena. It was recorded from different vantage points, generating a wealth of morphological formations, generative working procedures and insights into the correlation between reference frame and perception. Fig. 3 shows several of the forms generated by the spinning string. The whirling string shown on the left is spinning at a rate whereby it casts shadows of itself on its generated surface.

Through extensive research and analysis of the work generated from the projects described above, and the conceptual developments that inspired them, the dynamic versatility of several elemental relationships were explored by incorporating a flexible joint as part of the assembly. The joint consists of two bamboo dowels joined together with a rubber band, thus allowing for a high degree of flexibility. Through a variety of the *number, order and position* of several of these joints, very versatile modular units have been conceived and their form generating potential explored through the construction of modular membranes or fabrics. The flexibility of the joints and their three-dimensional relationships, both within an individual module and throughout the modular fabric, generates a wealth of forms and structures through the emergent transformative and organizing properties of the integrated assembly. These properties recall and re-generate the inherent properties of the natural phenomena that inspired their conception.

As illustrated in *On Growth and Form*, the underlying woven stress patterns found superimposed and interacting within the inner structure of bones, is a biological example of the way nature resolves a highly complex structural event. Thompson referred to these self-organizing stress fields and patterns as a "*diagram of forces*"⁹ generating the form of an object.

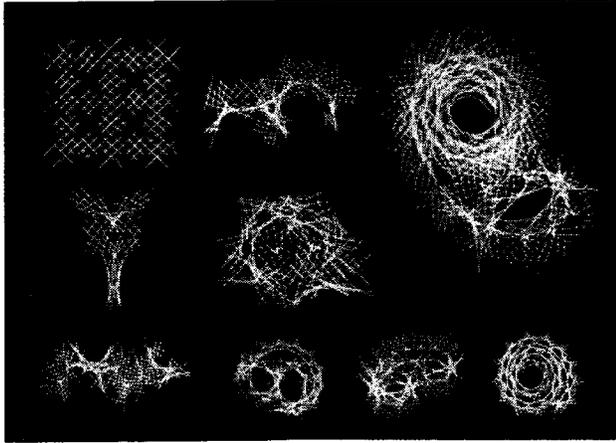


Fig. 4. Manuel A. Báez, *Suspended Animations*, 1994-present. *Form Studies with square module, 12" and 6" bamboo dowels joined together with rubber bands. Upper left-hand corner shows a portion of the fabric used throughout all fabrications.*

THE GARDEN

The most extensive exploration incorporated into the *Phenomenological Garden* project has been that of a square geometric relationship. Gradually, it became apparent that this is an extremely versatile relationship between joints. The modular fabric or membrane is constructed with 12" and 6" bamboo dowels and rubber bands. The upper left-hand corner of Fig. 4 shows the fabric along with several form studies. The upper right-hand corner shows an inherently coiling structure that's approximately 30 feet in length. Depending on how the fabric is probed and segmented into its inherent patterns, will determine the forms and structures that can be discovered and

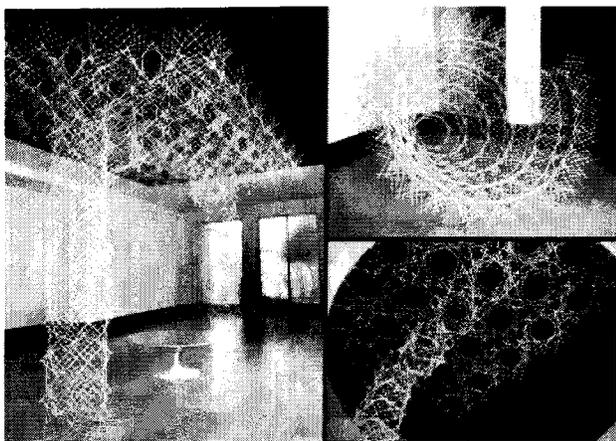


Fig. 5. Manuel A. Báez, *Phenomenological Garden*, Installation for the *Metaphoric Interweavings Symposium* at Cranbrook Academy of Art, 1998. *Upper right: 4' - 6" high sculptural form, lower right: reflected ceiling view of the installation.*

developed through the process.

As stated earlier, the three-dimensional joint relationship, as an integrated assembly, contains and/or is *in-formation*. What's revealed depends on the methods and/or means of inquiry. The encoded information or *potentiality* has a multitude of possible readings or interpretations. Through one's experience and familiarity with the working process, more expressive forms and intricate structures can be conceived. One literally feels the stresses being worked on and with, along with the inherent in-forming potential of the membrane. Sensually fluid curves begin to emerge as well as very organic or biological forms and structures. The experience is that of a process whereby one feels, follows, flows with, and guides the versatile form-generating properties of the dynamic relationship.

The sculptural forms shown in the upper right-hand corners of Figs. 4 and 5 are made from the same coiling structure. The inherent properties and versatility of this structure has been explored by uncoiling and re-arranging it into different formations. Again, the organic-looking forms and/or structures are all generated from the emergent properties of the assemblies and very clearly manifest D'Arcy Thompson's emphasis on the importance of *number, order* and *position* when it comes to natural phenomena and "*material things*".

Fig. 5 shows an installation done at Cranbrook Academy of Art in Bloomfield Hills, Michigan. By then, the fluent expressiveness of the fabric and working process, along with its possibly limitless capabilities, had become apparent. The installation was part of a symposium that I conceived and was invited to organize at Cranbrook Academy of Art for the Sybaris Gallery in Royal Oak, Michigan. The symposium, entitled *Metaphoric Interweavings*, explored the interrelationships (or "*essential similitudes*") between weaving, mu-



Fig. 6. Manuel A. Báez, *Phenomenological Garden*, Installation at the *Network Gallery* of Cranbrook Academy of Art, 1999. *Improvised sculptural weavings and freestanding structures constructed with the fabric shown in Fig. 4.*

sical composition and architecture through the use of a modular compositional process: artist Lissa Hunter lectured on her work, basketry and weaving; classical pianist Marina Korsakova-Kreyn gave a lecture/performance on the intricate structure of musical compositions by J. S. Bach; and professor of architecture Gulzar Haider lectured on the use of *mugarnnas* as modules in spatial transformations in Islamic architecture. *Mugarnnas* is a system of projecting niches used for spatial transition zones and for architectural decoration.

The installation in Fig. 5 initiated the *Phenomenological Garden* project. It was entirely constructed using the same square module and fabric shown in Fig. 4. Two supporting columns are gradually transformed into an intricately patterned ceiling structure. The majority of the patterns that emerged were unconsciously assembled and a rich variety of them are revealed as one walks around the installation or looks into the mirrored central table (Fig. 5 lower right). A different vantage point will reveal an entirely different pattern, at times familiar, but quite often completely unexpected.

As the project has evolved, the multiplicity of shadows cast by these constructions has become increasingly more relevant to the theme of the work. They have added another layer to the multiple readings and interpretations. Fig. 6 shows an installation at the Network Gallery of Cranbrook Academy of Art. The shadows played a major role in this installation along with the three-dimensional sculptural possibilities of the working process. A series of improvised sculptural weavings and freestanding structures cast their shadows on the walls and floor of the Gallery. Again, different vantage points reveal different aspects of the woven structures.

THE CROSSINGS WORKSHOP

The *Phenomenological Garden* is a project that has been evolving and will continue to do so as the explorations develop. Other modular joint relationships have been studied along with their emergent properties. Fig. 7 shows some of the work produced by students in my Crossings Workshop at Carleton University. The Workshop incorporates the educational potential of the research and work as a way of introducing the students to the rich potential of the working process and the developments that have inspired its conception.

The left side of Fig. 7 shows a structure by Mariam Shaker, constructed using a square module. By suspending it from the ceiling, the gradual effect of gravity is clearly demonstrated in the subtle, progressive undulations of the structure. To the middle and lower right of this structure are two different arrangements of the same structure by Diana Park, constructed with a seven-sided (heptagonal) module. In the upper right-hand corner, are two structures made with a square module. The one on the left is by Sherin Rizkallah and

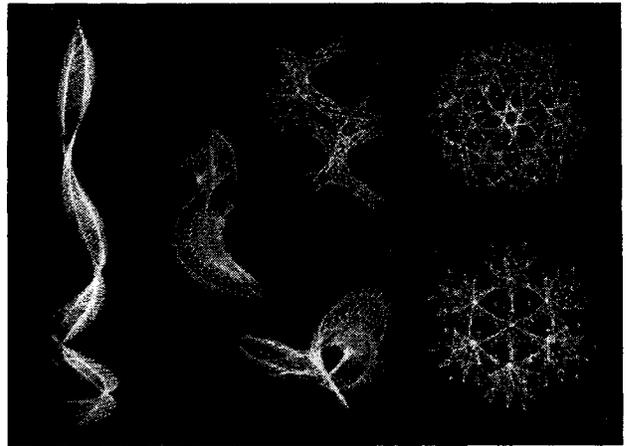


Fig. 7. *Crossings Workshop, Modular Form Studies. Works by Mariam Shaker, Diana Park, Sherin Rizkallah, Daniel Cronin and Sharif Kahn.*

on the right by Daniel Cronin. These two structures, along with Mariam Shaker's, clearly show the different possibilities contained within the same module. On the lower right-hand corner is a structure by Sharif Khan, constructed using a five-sided (pentagonal) module.

CONCLUSION

In the introduction to *On Growth and Form*, D'Arcy Thompson writes:

*"My sole purpose is to correlate with mathematical statement and physical law certain of the simpler outward phenomena of organic growth and structure or form, while all the while regarding the fabric of the organism, ex hypothesi, as a material and mechanical configuration. This is my purpose here. But I would not for the world be thought to believe that this is the only story which Life and her children have to tell. One does not come by studying living things for a lifetime to suppose that physics and chemistry can account for them all."*¹⁰

With these words Thompson reminds us of the mysterious and rich domain that lurks beyond the realm covered in his book. In the epilogue he describes "the threefold clue" as furnishing the "first outlines for a sketch of the Universe."¹¹ The simplicity of these "outlines" also provides a fundamental structure rich in its ability or potential to tell many different "stories." These basic "outlines" establish the groundwork or foundation for complex growth and diversity to emerge and flourish. This correlation between simplicity and complexity has been revealed to us periodically throughout history. D'Arcy Thompson is also reminding us that the way towards this mysteriously rich realm of diversity, as nature shows us, is through simple fundamental rules that eventually lead to a paradox of constrained and versatile freedom.

NOTES

1D'Arcy Wentworth Thompson, *On Growth and Form* (New York: Dover Books, 1992, p. 1028)

2Ibid., (p. 19)

3Ibid., (p. 1096)

4Ibid., (p. 9)

5Gregory Bateson, *Mind and Nature* (New York: Bantam Books, 1980, p. 11)

6Werner Heisenberg, *Physics and Philosophy* (NY: Harper Torchbooks, 1958, p. 107)

7Bateson, p. 13-14

8Ariadne is the mythological Greek guide to the labyrinth of chaos and the individual life. Jalai al-Din Rumi is the Great Persian mystic poet of the thirteenth century and the creator of the whirling, circular dance of the Mevlevi dervishes.

9Thompson, p. 16

10Ibid., p. 14

11Ibid., p. 1096

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