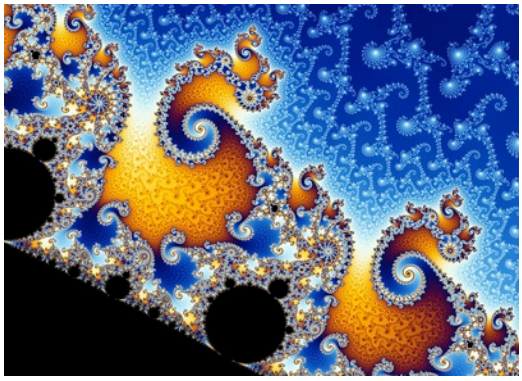
FRACTAL SYNCRETISM, THE ART OF FRANÇOIS MIGLIO, AND REFLECTIONS ON ARTS-INFORMED INQUIRY

UNION of MATRICES,
François Miglio, 1998



Computer-Generated Image:
The Mandelbrot Set

Abstract

Fractal Syncretism is a proposition that Art shares underlying commonalities and unities with the traditions and practices of the Sciences and the Sacred. Fractal Syncretism is proposed by contemporary French visual artist François Miglio, a native of Montpellier in southern France, whose visual art explores the infinite complexity, mystery and unity of nature through poetic fractal representation.

This paper discusses the origins, dynamics and evolution of François Miglio's creative process. We relate the artist's work to some of the recent scholarship on fractal forms, systems science and the integral worldview. We also contemplate a program that introduces the "new sciences" and arts-informed inquiry to the education enterprise at the primary, secondary and undergraduate university levels.

Keywords: art, art-informed inquiry, fractal syncretism, fractals, complexity, education

Fractal Syncretism: A Proposition

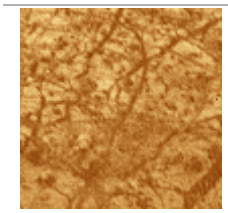
Fractal Syncretism proposes that Art, Spirit and Science, despite their differing criteria for Truth, are each an expression of the same exploration of the mystery of creation.
In this paper we discuss the origins, dynamics and evolution of François Miglio's creative process, and relate those to the author's research and the artist's work on the role of the fractal form in the evolution of consciousness. We explore the implications of the proposition and examine its own claim to an underlying aesthetic and unity of purpose and process. We also attempt to assess the validity of Fractal Syncretism in terms of recent scholarship in the social and systems sciences that addresses relationships between art, science, the sacred, consciousness, conscious evolution and living systems.

This presentation is accompanied by an exhibition of the artist's work at the 2006 ISSS Conference, Sonoma State University.

Origins, Dynamics & Evolution of Fractal Syncretism

The natural world, both organic and inorganic, is comprised of structures at every scale, from the subatomic, to the microscopic to the macroscopic to the cosmologic. Structures are assemblies of forms, and forms are assemblies of patterns. Patterns emerge from repetitive, iterative and recursive processes. Most, but not all, of the natural world is comprised of repetitive, iterative and recursive fractal forms.

Fractal Forms at Cosmic, Planetary and Personal Scales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	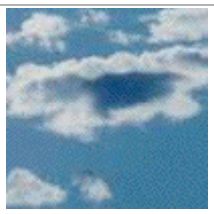		
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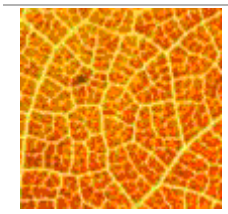
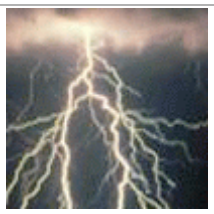
			
Leaf veins	Lightning	Cauliflowers	Mountains

Source: http://classes.yale.edu/fractals/

Source: www.onefourth.net/miglio

Fractal Syncretism and the art of François Miglio draw primary inspiration from the ubiquity of fractal forms throughout the natural world and from the universal archetype of the spiral.

Fractal Syncretism proposes a practice of art that is a reflection of the creative process itself. It suggests a unity of purpose among, and a serious dialogue between, the arts, sciences and spiritual traditions, postulating that the three axes of Art, Science and the Sacred, despite their differing criteria for Truth, are each an expression of the creative dynamics and mysteries of Creation.

François Miglio's ideas about Fractal Syncretism emerged and evolved through intensive art-informed appreciative inquiry over a period of years beginning in his late teens. His creative method is grounded in contemplation, reflection, intuition, dream-work, art practice, verse and collaboration. Without an academic background in systems theory or fractal geometry, in his late teen years Miglio recognized intuitively, from observation, that certain repetitive patterns were describing all of nature and its inherent unity. Over time, as a working artist, Miglio began to understand the repetitive patterns as fractal forms, and became conversant with the languages of fractal geometry, chaos theory, nonlinear dynamics, and computer-generated fractal images, although the latter have had only a tangential impact on his creative work.

Syncretism, from the Greek *synkretismos*, means a "union of communities." It attempts to reconcile disparate, even opposing beliefs, and to meld the practices of various schools of thought. Its objective is to promote dialogue among several discrete traditions, and thus assert an underlying unity. Mr. Miglio, unencumbered by the conventions of art practice in his native France, nor by market-oriented trends in the world of art, like Benoit Mandelbrot in the scientific world before him, spends considerable time each year in the San Francisco Bay Area practicing and exhibiting his art, since he finds greater creative stimulation, greater understanding of and receptivity to his work here than is found in France and other countries of the European Union.

Background & Influences on the Art of François Miglio

François Miglio was born in Montpellier, in the Languedoc region of the south of France, in early August 1958. His father was an officer in the French military and, with his family, was posted at various places in continental France and other countries of Europe. Between the ages six and ten, the family lived at Rennes in Brittany, and then moved to Brussels, Belgium where the pre-teen François discovered both Flemish and French painting. His family then was posted to the Rhone Valley near Valence where François began the formal study of agriculture, and where he immersed himself in the natural world by cycling alone in the French Alps and the Ardèche region.

During this experience, Francois discovered Le Palais Idéal Du Facteur Cheval, The Ideal Palace of the Postman Cheval, which he considers one of the best examples of "Art Brut," as described by Dubuffet, and to which he returned many times for inspiration. The Palais was built by the postman over a long period of time, and in many respects it resembles the work of Gaudi, containing many fractal aspects in its nonlinear form.

In his own words, François says that his experiences of the Palais du Facteur Cheval, in the village of Auterive, had major influences in his life and inspiration for his life's work. It was there that he decided that like this humble man, his dream was to become an artist, a painter, and a person who could bring happiness to others through his work. It was there in Auterive that François did his first painting at the age of 14 in the village where the Palace is located.

Le Palais Ideal du Facteur Cheval :: The Ideal Palace of the Postman Cheval
Source : http://photos.french-property.com/showphoto.php?photo=694&password=&sort=7&thecat=500

In 1976, at the age of 18, François's father accepted a new military posting at Sandhurst, the British Military Academy, where he was appointed as a professor. It was there, during visits with his family on holidays and over the summers, that François made the acquaintance of Marc Phillips, one of his father's students, and the future husband of Princess Anne, daughter of Queen Elizabeth II. He recalls that Mr. Phillips was not an exemplary student and that, to him, the Princess resembled a horse. One of his major discoveries during this period was that he decided against marrying a "princess."

During his visits with family in Britain, François explored the countryside in Scotland and Wales, discovering the work of the artist Constable. He also developed a "political and social consciousness" while working as a laborer on the major land estate of an aristocrat and member of the British Parliament, who was renowned for sponsoring the largest annual rally of vintage Rolls Royce automobiles in the U.K.

While visiting Britain, François experienced two transforming events through major disagreements with his father --- the first when he announced that he planned to become an artist, and the second when he refused to go into military service. While his parents were posted in Britain, François remained in Montpellier, living with his older brother, a medical student, to complete his high school studies in agriculture. After reluctantly serving eight months in the French military, François undertook business studies, and then worked at a pharmaceutical laboratory for eight years. He married at the age of 24, and is the father of two children, daughter Laurence now age 17, and son Hadrien now age 14, who is with his father for the ISSS Conference on his first visit to the U.S.

In 1991, at the age of 33, François decided to devote his full energies to the pursuit of art and to the restoration of an historic 17th century house he had purchased in the city of Beziers, along the Canal du Midi, southwest of Montpellier.

In 1998 Francois made his first visit to the United States to pursue his artistic vision in the San Francisco Bay Area. He felt, intuitively, that the Bay Area, as a vast "open system," receptive to new ideas, encouraging entrepreneurial risk-taking, unlike France and much of Europe, would be a far more compatible place for him to practice and evolve as an artist. While he continues to reside in and upgrade his home in Beziers, François spends at least five months of each year painting and exhibiting his work in the San Francisco Bay Area.

Mr. Miglio most recently has exhibited his major paintings in the San Francisco Bay Area at Stanford Art Spaces, Center for Integrated Systems, Stanford University (January 13 to March 9, 2006), and in San Francisco, at Artship Exhibitions, *The Sea: An Inward & Personal Response*, SomArts Cultural Center Main Gallery, March 2 to 22, 2006.

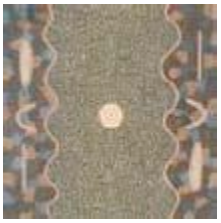
Previously Miglio has participated in solo and group exhibitions at the Department of Economics, University of California, Berkeley, the Vorpal Gallery in San Francisco, and in France at several galleries and universities.

Fractal Forms in Art Across the Millennia

From the earliest fossil and historical records of human evolution and later the development of civilizations, humans have explored territories in search of sustenance. Initially humans were intimately familiar and integrated with their environment in order to survive and thrive. In the aesthetics of early cultures one can observe an innate desire for the creation of beauty and novelty.

The fractal forms embedded in the natural world have always been represented in human cultural expression through drawings, engravings, sculpture, painting, music, song and dance.

Aboriginal Art. The indigenous peoples of the Australian continent used repetitive dots and symbols to represent their territory and cosmology. This art form dates back tens of thousands of years and survives today as cultural expression of aboriginal identity, culture and cosmology.



Renaissance Thought. Leonardo da Vinci contemplated nonlinear dynamical systems in drawings of turbulence and swirls.

Asian Representation. Much of the art of Asia represents the fractal forms embedded in nature, such as in this painting, "The Great Wave," by the 18th Century Japanese artist, Hokusai.

Source: Where otherwise unattributed : www.onefourth.net/miglio

Sacred Art. Across nearly all cultures and spiritual traditions, art celebrates the sacred in many manifest forms, much of which is fractal in nature, as is seen in this rose window, typical of Christian art, and also in the arabesques and repetitive patterns so predominant in Islamic and Hindu sacred art. The chants and dances of various spiritual traditions, both exoteric and esoteric, employ the repetitive self-similarity and repetition of the fractal form.

Modern American Art. The work of modern American artist Jackson Pollock has been described by critics in terms of a "radical aesthetic of centerlessness and incompletion." Pollock dripped paint from a can onto vast canvases rolled out across the floor of his barn. Although recognized as a crucial advancement in the evolution of modern art, the precise quality and significance of the patterns created by this unorthodox technique have remained controversial. Scientific analyses, using the mathematics of fractal analysis, have demonstrated that Pollock's patterns are fractal ---- "the fingerprint of Nature."

One of Pollock's Paintings
"Convergence: Number 10, 1952"
(The Albright-Know Gallery, USA)

Source: http://www.phys.unsw.edu.au/PHYSICS_!/FRACTAL_EXPRESSIONISM/fractal_taylor.html

REPRESENTATIONS OF THE ART OF FRANÇOIS MIGLIO & FRACTAL SYNCRETISM

Through the proposition of Fractal Syncretism, François Miglio attempts to fuse the fractal languages of Art, Science and Sacred. His paintings aspire to explore the unknown, the invisible and the infinitely complex. His perspectives are neither scientific, nor mystical. Rather, he speaks from the heart, the unconscious, and the conscious mind as an artist, utilizing neither scientific rationale, nor the language of religion, but rather his individual poetic intuition.

HOLISTIC VISION, 1995

The artist has chosen this double spiral that is omnipresent in his paintings because it becomes a sphere when contracted onto itself. Thus, the same symbol can evoke several dimensions.

GEMMATION, 1996

The majority of Miglio's paintings, specifically his theoretical paintings, are geometrically built with the double spiral or spiraled cones In this painting, he introduces the concept of parallel worlds, which in this instance are apparently unaware of each other, yet submit to the same laws to carry out cycles emerging and returning from chaos.

UNION OF MATRICES, 1998

Here also Miglio composes the geometrical construction of conical spindle spirals (lavender and clouds) emerging from the point of creation and fitting into a sphere. This painting is made up of only one half of this sphere. In this geometrical composition, the artist introduces the reality of a landscape, and the integration of the landscape becomes apparent.

TRYPTICH, 1995 - 1998

In this monumental work, comprised of three earlier works, the artist presents the expressions "point of creation" and "points of conjunction" that are perhaps best explained by the scientific term "strange attractor."

Holistic Vision

Union of Matrices

Gemmation

BUTTERFLY EFFECT, 1994

Similar to the Butterfly Effect of chaotic dynamical systems, as described by Edward Lorenz, the artist questions through this painting the creative strength of the work of art. One detail opens up into infinity, similar to the physical world where the beat of the butterfly's wing in South Asia can become a cyclone, a tornado, or a hurricane in North America, creating chaos in the established order.

MIRRORED BUTTERFLY EFFECT, 1994

The complete "butterfly effect" is achieved by placing a mirror to the left of the previous painting. This painting was inspired by the description of the turbulent mirror by J. Briggs referring to the mirror in Lewis Carroll's "Alice and Wonderland." The artist believes this mirror could be the bridge between the visible and the invisible.

PASSAGE, 1994

This painting is a metaphor for the cycle of life, the link between the elements: Air, Water and Fire, which also are the linkages between energy and matter.

These linkages are represented by the fractal symbol, the yellow double spiral. This double yellow spiral represents a fractal spiral that is a link between these different physical elements.

THE KISS OF LIGHT, 1997

In this work, through the representation of waves and using solar colors, the artist's intention is to establish linkages between energy and matter. He represents turbulence where "order" implicit in the form of waves turns to "chaos," and then re-emerges to order. The artist also demonstrates through the wave sequence his concept of "Fractal Syncretism" where the scientific/physical/rational elements coalesce with spiritual/sacred/eternal elements through poetic representation of fractal forms by the artist.

Through different levels of interpretations of his paintings, the artist intends to establish the relationship between the three distinct languages --- the intuitive, the rational and the spiritual.

The Intuitive Approach of Art. The poetic representation of the wave presents the artist's rendering of a reality that appears.

The Rational Approach of Science. The solar colors of the waves tend to provide a rational explanation for the transfer of solar energy to wind and then from wind to waves. This in turn demonstrates the influence of solar energy upon matter.

The Spiritual Approach of the Sacred. The engraved symbols throughout these paintings correlate to the repetitive language and the primary basis of the artist's personal meditation.

CONSCIENTIA, 2001

In this painting, the artist attempts to express the concept that the universe appears real to us only because we are aware of it and because we can express it.

The Artistic Vocabulary of François Miglio

At the heart of his work François Miglio aspires to create works of art that are transdisciplinary and transcultural, integrating artistic expression across time, space and cultures.

The method he uses is "dynamic representation," combining the nonlinear dynamic processes of intuition, curiosity and original poetic language that employs art as a means to explore reality in the natural world. He takes extensive risks in his work, refusing to conform to contemporary French and European norms and standards for "high art," which he believes are overly mercantilisitic and artisanal. The medium he employs in his work is oil pastel on paperboard attached to plywood. From simple sketches of geometric and fractal forms that emerge out of contemplation and dream work, percolating and evolving over time, the artist uses the meditative, recursive process of chiseling to render the colors and shapes that he draws into final forms. In parallel with the physical repetition of chiseling, a recursive process of meditation creates a reinforcing feedback loop that adds introspective depth to the work on paperboard, inspired by images of arabesques, mandalas and rose windows.

The artist is unable to separate the technical and physical processes of his creative expression from the introspective and inspirational processes. When the artist "feels" that the painting is complete, he then applies coats of varnish to the work, and attaches it to plywood for framing. The artist characterizes his landscape painting as akin to works of mosaic art, while his work with waves and dunes is more intuitive and abstract yet expressive of the patterns of the natural world which inspires them.

Some Observations from the Literature

In "An Inquiry into Paul Cézanne: The Role of the Artist in Studies of Perception and Consciousness," presented by Amy Ione at the 1999 *Cognitive Science Conference on Perception, Consciousness, and Art,* held at the Free University of Brussels, Center for Empirical Epistemology, and published in the *Journal of Consciousness Studies*, Vol. 7, No. 8/9 (2000), the author makes several observations that are directly relevant to an understanding of Miglio's creative process and the body of his work.

> "….as Paul Cézanne's work clearly demonstrates, an artist does not passively 'see,' so much as the artist relates to what he or she sees while painting --- and thus actively coordinates various areas of the brain while seeing and creating." (p. 58)
>
> "….visual artists spend years evaluating how to manipulate their tools so that they can convey what is of interest to them effectively --- and then more effectively. For painters this exploration is one that constantly brings sight, touch, cognition and emotions together as novel solutions are actively developed to encode information. Indeed, what makes powerful art exciting is that the solutions are not memorized models that have settled into our brains.
>
> To the contrary, history shows that the creative work artists produce includes an experientially created record that, among other things, precisely shows how artists have learned to expand their means of expression over and over again. Frequently and repeatedly, we find examples of perceptual and technical growth in a single artist when we examine the artist's oeuvre over the course of a productive lifetime. We also encounter evidence demonstrating how innovative artists break with learned conventions for seeing and representation." (p. 61)
>
> "…. as a painter Cézanne repeatedly combined his hands and his sensations with his eyes, brain, and mind to bring his unique vision onto the flat picture plane….At this point two ideas are important to keep in mind. First, since no one had ever painted his way before him, the complex painting techniques he developed to convey what he 'saw' were not prescribed methods others could teach him. Second, his paintings are concrete forms and were formed as a part of a dynamic, experiential and embodied activitiy. His canvases did not serve as a means to translate abstract ideas into an aesthetic form. Instead they recorded a process through which he (1) systematized the particular elements that came to define his style, (2) learned to coordinate what he saw with what his materials could do, (3) learned to push the materials to their limits, and (4) continually found ways to perceptually deepen all he wanted to express with paint. Thus, Cézanne's paintings record his way of combining constancy with a complex and vitally informed visual expression….." (p. 63)

These citations do not compare the work of Miglio with that of Paul Cézanne. Rather, they intend to demonstrate and re-emphasize the essential and critical components of the creative process that are involved in Miglio's work and the work of many other visual artists. Cézanne has stated "the eye educates itself by contact with nature." (p. 60). And he wrote to Emile Bernard, "I believe in the logical development of everything we see and feel through the study of nature and turn my attention to technical questions later." (p. 69). Miglio's postulation of Fractal Syncretism unites the natural world, the rational world, and the world of the sacred through deep observation, contemplation and poetic expression.

Concordance / Coherence / Connaissance

François Miglio has written this tale of Man contemplating the Universe to which he belongs.

Ce Chaos étrange
Regardant
Une étrange immobilité
De ce regard,
Des particules de lumière
Se mirent à rêver
A jouer,
A créer.
Bientôt les hommes
Vinrent contempler
Ce monde a leur image.
Dans ce monde
Un monde encore plus étrange
Leur apparut
Fait de formes semblables
Qui jouaient ensemble.
Les hommes se mirent
A rêver, à jouer avec elles.
Ainsi l'homme
Ouvrit la porte
Sur un mystère insondable,
Celui de la Création.

English Translation by François Miglio and Franco Giunta

This strange Chaos
Is observing
A strange immobility.
And from this perspective
Some particles of light
Begin to dream,
To play,
To create.
Soon Man
Goes out to contemplate
A world that looks like him.
In this world,
A world where more strangeness appears,
Is a composition of similar forms
Which play together.
Man begins to dream,
To play with the forms.
Thus, Man
Opens the door
To the deepest mytstery---
The mystery of creation.

The Prevalence of Patterns

Throughout the natural world, patterns are ubiquitous. The ability to recognize patterns, and the growing understanding of their coherence and meaning, are markers for the evolution of intelligence and consciousness among humankind.

Patterns represent the emergence of similar and self-similar forms from fields of information that David Bohm called "the implicate order." C.G. Jung, David Bohm, Ervin Laszlo, among many others in the fields of quantum dynamics and systems science, speak about the emergence of form and meaning, and their generative potential, by virtually all systems, as characteristics of their quest for expression and evolution. Erich Jantsch wrote in 1980,

> Science is about to recognize these principles as general laws of the dynamics of nature. Applied to humans and their systems of life, they appear therefore as principles of a profoundly natural way of life. (*The Self-Organizing Universe*, 8)

A defining feature of the emergence of form in any system is the dynamic of replication, or the system's ability to engage in autopoetic processes to reproduce its component parts. The dynamic of replication is the essential component of a complex system.

Fractal Forms

"*Frangere*" is the Latin infinitive meaning "to break." Its past perfect participle "*fractus*," broken or fractured, is the root for the noun and adjective "fractal," the term coined by Benoit Mandelbrot in 1975 to describe the recursive, self-similar forms and shapes he found embedded at all scales of magnification throughout nature.

In the field of mathematics, the first recognition of fractal form, The Cantor Set, emerged in 1877 from the work of Georg Cantor (1845-1918), who used the technique of constant subdivision of a straight line to illustrate the concept of an infinite set, thus developing a looping technique that is called a recursion. Other mathematicians whose theoretical work was influential in the evolution of the new branch of mathematics that would become fractal geometry include Helge von Koch (1870-1924) who created the recursive Koch curve in 1904, Giuseppe Peano (1858-1932) who was a founder of mathematical logic and set theory, and Felix Hausdorff (1868-1942) who developed the idea of fractal dimension while working with the Koch curve. Benoit Mandelbrot (b. 1928) was the first mathematician to illustrate graphically and visually the emerging principles of fractal geometry. By using computer graphics, Mandelbrot found that shapes formerly described by Cantor and Koch as "pathological" curves were not pathological at all, and that self-similar shapes were prevalent throughout nature: mountain ranges have peaks within peaks; trees consist of branches of branches; clouds have self-similar shapes within their formations; human and animal vascular, pneumatic, nervous and cellular systems each have self-similar foms at all scales.

Neither fractal geometry nor computer-generated fractal art are within the scope of this paper, nor do either relate directly to the art of Francois Miglio. However, the principles of fractal geometry have a bearing on several lines of our discussion. Following is a

summary of the five essential components of fractal geometry as discussed by systems scientist Ron Eglash (1999):

> **Recursion**: a circular process, or iterative feedback loop, in which the output at one state becomes the input for the next.
>
> **Scaling**: the concept of having similar shapes and patterns at different scales within a range of consideration.
>
> **Self-similarity**: exists in two domains, "exact" self-similarity, where all properties of the form are exactly self-similar at all scales, and "statistical" self-similarity, where self-similar forms exist at many or most, but not all levels of scale.
>
> **Infinity**: a mathematical principle that specifies recursion can occur forever, and which incorporates the element of dimension into the mathematical lexicon.
>
> **Fractional Dimension**: a theory of measurement governing fractals that allows dimensions to be fractions rather than whole numbers.

Fractal Forms in the Evolution of Consciousness

African Fractals: Modern Computing and Indigenous Design (1999), by Ron Eglash, is especially germane to the discussion of fractals in the context of evolution of consciousness. Eglash has found that despite the wide diversity of cultures in Africa, examples of self-similar fractal shapes and fractal forms are found in the architecture of indigenous settlements of people in virtually every corner and every culture of the continent. He describes and illustrates, among indigenous settlement architectures, rectangular fractals in northern Cameroon, circular clusters of fractals in much of southern Africa, and branching fractals in the street grids of many North African cities.

Eglash writes,

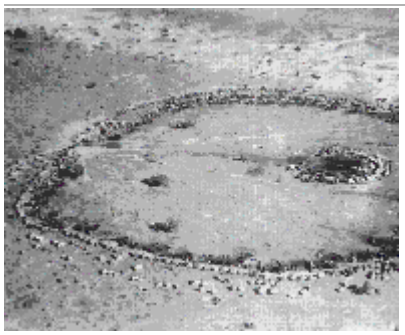
> "…we have seen that a wide variety of African settlement architectures can be characterized as fractals. Their physical construction makes use of scaling and iteration, and their self-similarity is clearly evident from comparison to fractal graphic representations." (38)

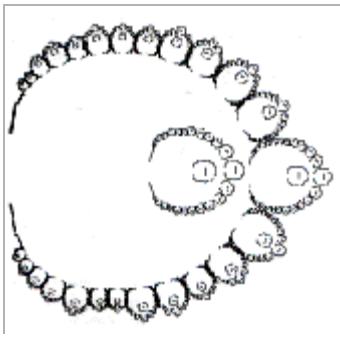
Eglash does not conclude that there is an explicit indigenous African knowledge of fractal geometry. However, he does suggest that fractal design in African settlement architecture is linked to "conscious knowledge systems that suggest some of the basic concepts of fractal geometry," and later in his book he presents "…more explicit expressions of this indigenous mathematics in astonishing variety and form." (38)

Eglash also posits that the prevalence of fractal patterns in African decorative arts are the result of an "intuitive esthetic." (38) He cites the sharp contrast between fractal settlement patterns in Africa and the Euclician-Cartesian geometric grids that are typical of European and Euro-American settlements.

Ba-Ili Settlements, Southern Zambia

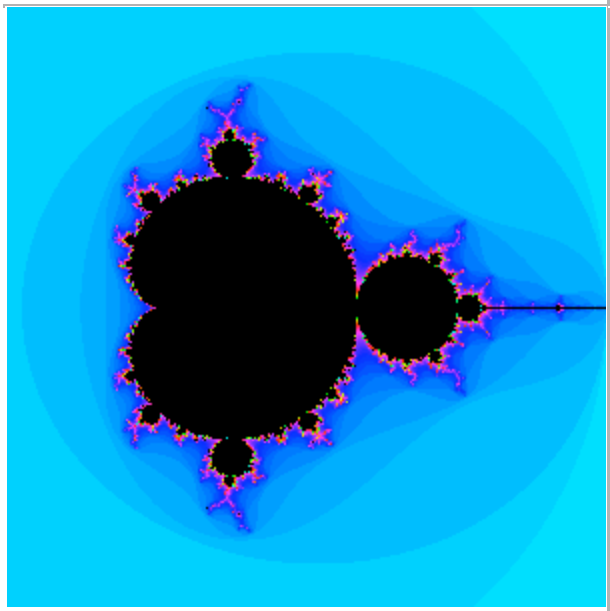
Eglash provides one of the most striking examples of African fractal architecture, in the Ba-Ili settlements of Southern Zambia. Each extended family's home is a ring-shaped livestock pen, with a gate on one end at the front of the pen. Near the gate are small storage buildings. Moving around the ring, the buildings become progressively larger dwellings, until the largest, the father's house, is opposite the gate at the back of the pen. At left is an aerial photograph of the settlement. At right is a schematic of the settlement. Note the striking resemblance to the fractal forms found in The Mandelbrot Set.





Source: http://classes.yale.edu/Fractals/Panorama/Architecture/AfricanArch/BaIla.html

Photo and Schematic of Indigenous Settlement Architecture in Africa
and the Fractal Forms found in the Mandelbrot Set.



Mandelbrot Set

Source: The Beauty of Chaos…500 images of the Mandelbrot Set, from:
http://i30www.ira.uka.de/~ukrueger/fractals/Welcome.html

Eglash's research began in the 1980s, as a graduate student at the University of California, Santa Cruz, while investigating settlement architecture in Central and West Africa. Aerial photographs of various settlement compounds revealed that many were composed of circular structures enclosed in other circles, or rectangles within rectangles, and that the compounds were likely to have street patterns in which broad avenues branched into very small footpaths.

As Eglash notes, at first he thought these phenomena had emerged from unconscious social dynamics. But during his fieldwork, he found that fractal designs also appear in a wide variety of intentional designs --- carving, hairstyling, metalwork, painting, textiles --- and that the recursive process of fractal algorithms are even employed in African quantitative systems.

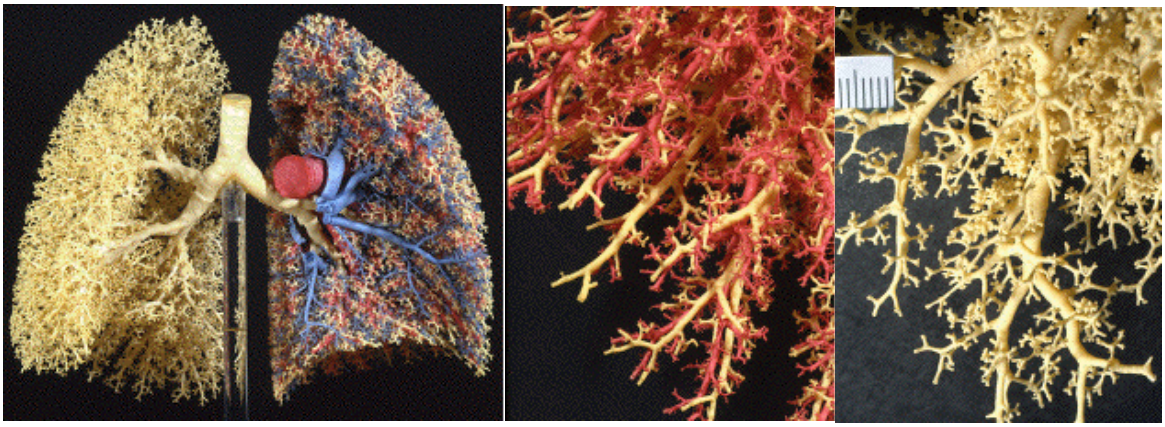
A Fulani wedding blanket from Mali.
Courtesy of Ron Eglash

Eglash adds that in the design rationales and cultural semantics of many African geometric figures, as well as in indigenous quantitative systems (additive progression, doubling sequences, binary recursion) and symbolic systems (iconic symbols for feedback loops, equiangular spirals, infinity), there are abstract ideas and formal structures that closely parallel some of the fundamental aspects of fractal geometry. These results, Eglash concludes, are congruent with recent developments in complex systems theory, which suggest that pre-modern, non-state societies were neither utterly anarchic, nor frozen in static order, but rather utilized an adaptive flexibility that capitalized on the nonlinear aspects of ecological dynamics.

Source: Summarized from Abdul Karim Bangura's Review of *African Fractals*, 5/29/06, http://africaunchained.blogspot.com/2006/05/african-fractals.html

Eglash sees similar recurring patterns on different scales in ivory sculptures, palace and village layouts, and braided hair designs. His argument for the ubiquity of fractals in African design and thought is provocative. It has generated much intellectual interest in the intuitive mathematical foundations of indigenous sub-Saharan African cultures, and has application to the teaching of history and mathematics in the U.S. educational system, in particular, in the context of African-American learning.

Human and Animal Physiology. A decade after Mandelbrot published theoretical speculations about the fractal nature of human physiology, theoretical biologists began to find fractal organization controlling structures throughout the entire body.



Source: http://classes.yale.edu/fractals/Panorama/Biology/Physiology/Physiology.html

The nature of the branching of blood vessels, from capillaries to aortas to veins, is fractal. The frequency spectrum of heartbeat timing follows fractal laws (called the His-Purkinje network), a labyrinth of branching pathways.

The respiratory system, in particular the lungs and bronchial tracts, are branching fractals, which need to pack the greatest amount of surface into the smallest available space.

The digestive system is fractal, containing undulations within undulations. The urinary collection system is fractal, as are such by-products as kidney stones, which like other crystalline lattices have exceptionally fractal shapes and dimensions.

The fractal structure nature has devised works so efficiently that, in most tissues, no cell is ever more than three or four cells away from a blood vessel.

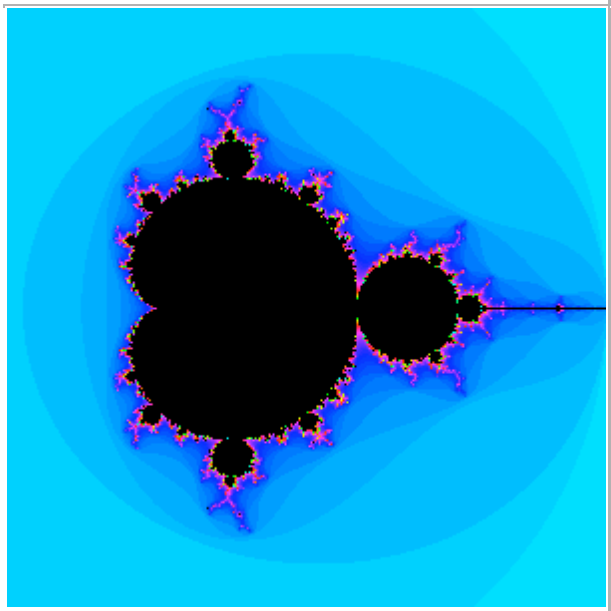
Like the simple algorithm that, on repetition, generates incredibly complex fractal images and structures, the DNA of human and animal genomes specifies repetitive processes for bifurcation, resulting in the development of all structures and organs of the body. Currently biologists are establishing that fractal scaling is not just common, but it is universal in morphogenesis.

In his book Chaos: Making a New Science, James Gleick discussed "fractal basin boundaries," the boundaries between one kind of steady-state system and another, where chaos often appears. He posited that theoretical physicists have demonstrated the **universality of fractal forms** by investigating fractal basin boundaries. In describing the study of fractal basin boundaries associated with phase transitions, in particular of magnetization and non-magnetization in materials, by Heinz-Otto Pietgen and Peter Richter, respectively a mathematician and a physicist at the University of Bremen, Gleick

reports that they found beautiful pictures of complexity---cauliflower shapes with progressively more tangled knobs and furrows.

Fractal Images of Cauliflower at Declining Scales, Source: http://www.fourmilab.ch/images/Romanesco/

Fractal Images of Cauliflower at Declining Scales, Source: http://www.fourmilab.ch/images/Romanesco/



The Mandelbrot Set

Gleick wrote,

> As [Pietgen and Richter] varied the parameters and increased their magnification of details, one picture seemed more and more random, until suddenly, unexpectedly, deep in the heart of a bewildering region, appeared a familiar oblate form, studded with buds: the Mandelbrot set. It was another signpost of universality. 'Perhaps we should believe in magic,' they wrote. (p. 236)

Fractal Aspects of Physical Brain Structure

Source: www.BrainConnection.com , Oakland, CA

The physical structure of the human brain, and of the brains of most other vertebrates, is entirely fractal in form, comprised of regular furrowed patterns and bifurcations, convoluted, wrinkled tissues that fold back upon themselves. As the seat of the mind, and potentially of consciousness, the brain presents a series of deep epistemological questions. Did the brain create or discover the mathematical rules on which it and the entire universe turn? What are the relationships of brain structure to brain function, to mind, and to consciousness? Understanding brain function and form, the nature of mind, and the origins and evolution of consciousness are among the most compelling issues facing the disciplines of biological, mathematical, neurological and physical sciences, the social sciences, and metaphysics.

Fractal Synchronicities in Non-Locality and Brain Function

The brain has been characterized as a "strange attractor" and strange attractors have been shown, mathematically, to be fractal in form. This author met artist Miglio through a series of synchronicities in 2003. While doing Internet research on fractals for a paper exploring the roles and effects of fractals in the evolution of consciousness, the author found the website www.onefourth.net/miglio and sent an email in hopes of establishing communication with the artist. After several months had passed without an answer to this query, François phoned the author to introduce himself, and to say that he was staying with friends near the author's home in the Oakland hills. We have been collaborating on various ideas and initiatives involving fractal art and science since then.

A parallel synchronicity occurred during the writing of this paper. In discussing his creative process, consisting of reflection, meditation and dream work, François described his intuition that the fractal nature of his art emerges from the fractal aspects of his brain, and the cross-fertilization of its left and right hemispheres. From the image shown above, it is clear that the physical structure of the human brain is fractal. The synchronicity involved here is that the author had written a paper on the fractal nature of consciousness, based on lucid dream work he was doing, for coursework in his PhD program at the California Institute of Integral Studies. Neither the artist nor the author had previous

knowledge that both had arrived at similar conclusions through deep dream work about the significance of fractal structure and dimension in creative and conscious activities.

Art and the Deep Structure of Creativity

"Intuition relates us to possible futures, the way memory relates us to the past, and awareness relates us to the here-now Present." -- Hermetic Saying

Avec ma memoire, je remonte le temps.	With my memory I return to the past.
Avec mon corps, je vis le present.	With my body I experience the present.
Avec mon imagination, j`esplore le futur.	With my imagination, I explore the future.
Verse: François Miglio, 20002	Translation : Franco Giunta, 2006

Art does not intend to demonstrate "Truth," although it does so in a remarkable number of instances. In his comprehensive study of the embedded relationships between art and the physical sciences, *Art and Physics: Parallel Visions in Space, Time & Light* (1991), Leonard Shlain, M.D., a resident of Mill Valley, Marin County, California, has suggested a more radical role: *that artists unerringly anticipated the major developments of science through history, and in particular anticipated all the elements of the "new" physics.* He proposes that the imagery of revolutionary artists "…contains crucial insights that underlie the conceptual framework of how society sees the world." (380) He demonstrates how the vision and imagery of the cubist, pointilliste and fauvre art movements, among others, have shone through in the advances of quantum physicists in the early 20th century, and he posits that the artists who gave form to these images could not possibly have had any knowledge of the physics that followed. Dr. Shlain asks,

> "…how is this [concordance between art and physics] possible? How could so many diverse artists through different centuries, virtually all of them unaware of what was about to happen in the field of physics, manage to bring forth so many innovative styles of art that spoke to the imminent re-visioning of physical reality in their times?" (380)

Citing the metaphysics of philosophers William James, who proposed the idea of "universal mind," and Teilhard de Chardin, who proposed a similar theory of a "membrane of consciousness" encircling the world, which he called the "noosphere," Shlain offers a model of human superconsciousness as an explanation to the question of how artists can incorporate into their work ideas that have not yet been discovered by physicists and that are not known by the general public.

In the Introduction to his seminal work *Mind and Nature: A Necessary Unity*, Gregory Bateson recalls a phrase he wrote in a letter to fellow Regents of the University of California:

> "Break the pattern which connects the items of learning and you necessarily destroy all quality." (1979, 7)

Bateson's idea is built on the premise and belief that "we" --- humans, primates, the other fauna, the flora, the sea, volcanoes and tectonic plates --- all are integral parts of a living world comprised of many embedded living systems. He believed that the loss by humankind (at least in the West) of the sense of ***aesthetic unity*** was a great

epistemological mistake (17). Gregory Bateson and Benoit Mandelbrot, whose work brought the fractal to general consciousness, were of the same generation and of the same intellectual milieu, working from different poles of the same continent, and using similar intellectual compasses for investigation --- erudition amplified by intuition. And both were similarly understood (more precisely, misunderstood) for their ontological questioning the conventional wisdom, their challenging of traditional assumptions and presumptions, and their raising new questions that had not been asked before.

Bateson posits that, "***Science probes; it does not prove***." His position is based on the premise that science is a predictive and perceptive endeavor, and since prediction and perception can never be absolutely valid, therefore science cannot prove generalizations definitively to arrive at a final truth. (26, 27, Emphasis added)

This argument, if one accepts it, provides one lens through which to view the propositions of Fractal Syncretism. It presupposes that science is a "way of perceiving and making…'sense' of our precepts," and that perception operates only upon difference. Bateson writes, "All receipt of information is necessarily the receipt of news of difference, and all perception of difference is limited by threshold. Differences that are too slight or too slowly presented are not perceivable." (27) Consequently, Bateson argues, since what science can perceive is always limited by threshold, "Knowledge at any given moment will be a function of the thresholds of our available means of perception." (27)

The implication is that the enterprise of Science, despite its self-described "objective" tools of quantity, measure, replication and falsification, is in many important respects as subjective an enterprise as are Art and Spirituality. Science itself has validated this conclusion. Through the subtleties of quantum dynamics, Bohm, Heisenberg, Schroedinger and many others after them have demonstrated with a great amount of probity that the act of observation affects the results of what is being observed.

In the Editor's Introduction to the re-issue of Bateson's *Mind and Nature*, as a part of the Series, Advances in Systems Theory, Complexity and the Human Sciences, Dr. Alfonso Montuori, faculty director of doctoral and master's programs at the California Institute of Integral Studies, and this author's faculty mentor, wrote,

> Gregory Bateson wanted us to have a better, more elegant understanding of, and approach to this probing, recognizing the constraints and possibilities required by that mental shift from proving to probing, from simple answers to complex questions. His creative inquiry led us to the nature of mind, the mind of nature, and the pattern that connects. (xviii).

We submit that the fractal form is an essential element in the pattern that connects, and that art-informed inquiry contributes some important insights to this enterprise of understanding.

Some Conclusions and Reflections

Seminal systems thinkers over the past three decades, many of whom are speakers at this conference, in particular Ralph Abraham, Fritjof Capra, Sally Goerner, Ervin Laszlo and Humberto Maturana, have contributed greatly to the literature of the patterns that connect, to the interconnectedness of all things, and to a broader and more general understanding of the systems principles that permeate reality.

The "New Sciences" speak to the interrelatedness of all systems, animate and inanimate, and to the underlying unity of all reality as realized through an understanding of fractal form and dimension that is the pattern of underlying unity. Integrative bioscience, chaos and complexity, nonlinear dynamical systems, neuroscience, quantum dynamics and nanoscience all point to a more exciting, fresher, more hopeful and more integral views of the world and of reality. In *Chaos and the Evolving Ecological Universe*, Sally Goerner writes, poetically,

> The new understanding denies dualism, the separation of human- and mind-based dimensions from physical dimensions. We are not a mystery *apart* from the world but part of the mystery *of* the world. So, while we have significantly demystified ourselves, we have also re-enchanted the world and our role in it. Creation is no longer an ancient, surrealistic event but an ongoing mystery unfolding day-to-day in physical reality. And true to religious description, the mystery is in us, of us and more than us all at the same time. Science --- our belief in here and now facts --- and spirituality --- our sense of more-to-it-than-this --- map to one physically real world. (154)

Fractal syncretism speaks to the ongoing mystery of creation, the ubiquitous unity found in the natural world, and it expresses these creative mysteries through original art.

Mike King, a faculty member at the London Metropolitan University, adds a metaphysical dimension to Sally Goerner's words, and a form of validation to the proposition of Fractal Syncretism in writing,

> "Science at its most abstract is neutral and value-free, but, as Einstein's thought shows, it is also to do with the beauty and grandeur of the world, in other words the deep structure of human experience…..Can we consider art as a discipline for the exploring the deep structure of experience?……
>
> The new metaphysics attempts in one way or another to say something about the deep structure of human experience. The reductionists would prefer to say the deep structure of the universe, and to leave out the subjective human element, but perhaps despite themselves the reductionists write endlessly about the human *implications* of their science. **It is my contention that all three of art, science, and religion deal with the deep structure of our experience, the fundamental givens of our world. Clearly they do it in different ways, but at the heart of the anthropic metaphysics is a willingness to cross traditional boundaries and seek common ground with other disciplines."**
> [Emphasis Added]
>
> Source: http://web.ukonline.co.uk/mr.king/index.html, "The New Metaphysics and the Deep Structure of Creativity and Cognition," presented by Mike King at the October 1999 Creativity and Cognition Conference, Loughborough University, U.K.

Reflections on Arts-Informed Inquiry

The Arts is a broad subdivision of culture, comprised of many expressive disciplines. In modern usage, it is a broader term than *art*, which usually means the visual arts, comprised of both fine art and crafts. A precise definition of the arts can be contentious, but the following areas of activity are usually included:

- Architecture
- Art & Visual arts
- Crafts
- Dance
- Design
- Drawing
- Film
- Literature
- Music
- Opera
- Painting
- Photography
- Poetry
- Sculpture
- Theatre & Performing Arts

Source: http://en.wikipedia.org/wiki/The_Arts

With this description in mind, some of the most interesting arts-informed inquiry today is occurring in the field of architecture, for example, in the work of Frank Gehry who uses topological and fractal forms in the design of his monumental museums, concert halls and galleries. For Redding, California, Spanish architect Santiago Calatrava designed a footbridge crossing the Sacramento River that is also a sundial, and that has placed this remote rural town on the map by creating a "community commons" around which residents and visitors alike congregate and celebrate.

In film, the work of Michael Moore ("Farenheit 9/11") and of Vice President Al Gore ("An Inconvenient Truth") have illuminated very serious democratic and environmental issues and raised consciousness and awareness across the political spectra in the United States and abroad.

In music and opera, the works of Berkeley composer John Adams, New York dramaturgist Tony Kushner, and San Francisco Symphony director Michael Tilson Thomas have raised consciousness broadly about the AIDS epidemic and mournfully commemorated the terrorist attacks of September 11, 2001.

Arts-informed inquiry has been the province of artists among the various art disciplines since at least the High Renaissance. Artists probe, as scientists do, to express what they see, sense and intuit in the world, and then to represent their impressions and interpretations in visual, performance and many other art forms.

As a recognized discipline, however, arts-informed inquiry (no matter how broadly viewed) has not, until fairly recently, been able to shed the objectified paradigms established for science-based inquiry, at least in the American context. Currently, there are formal arts-informed inquiry programs and courses of study at major Canadian and Australian universities, most notably at the University of Toronto, the University of British Columbia and the University of New South Wales. In the United States, arts-informed inquiry enjoys currency at some of the "avant-garde" graduate schools, such as

at the Saybrook Graduate School and the California Institute of Integral Studies in San Francisco, and at the New School University in New York City. An Internet search reveals a graduate level course offered during the Spring 2006 term at Harvard University by a professor in the law school, Arts-Informed Inquiry :: The Art Project in Science, Arts, Systems Thinking.

The work of Leonardo da Vinci represents an early epitome of arts-informed inquiry. His probing, and his rendering and interpretation of what he found, led to valuable insights, new methods, and ultimately to new disciplines in both the arts and the sciences. Leonardo da Vinci conceived of ideas vastly ahead of his own time --- conceptually inventing the helicopter, the tank, the use of concentrated solar power, the calculator, a rudimentary theory of plate tectonics, and the double hull, among others. In addition, he greatly advanced the state of knowledge in the fields of anatomy, astronomy, civil engineering, optics, and the study of water, hydrodynamics. Of his works, only a few paintings and sketches survive, together with his notebooks containing drawings, scientific diagrams and notes.

Fractal syncretism, in proposing an essential unity of generative purpose among the arts, the sciences and the spiritual traditions, is another expression of emergence, and of the same re-enchantment of the world that Sally Goerner speaks to.

Related Curricular Issues for American Education

Many academic studies have demonstrated that arts programs in the curricula of elementary, secondary and high schools help students hone critical thinking, writing, expressive, mathematical and social skills. Although funds to support arts curricula in public schools nationally and in California have decreased greatly over the past three decades, trends indicate a change in the understanding and recognition of the value of the arts in the overall development of student competencies. In California, the current Governor is proposing the addition of $600 million in funds to support arts curricula in public schools. This is very promising. The arts offer both school students and university investigators new lenses through which to inquire about the human condition, the nature of reality, and the meaning that most all of us seek. Teaching the principles of arts-informed inquiry should be a part of this overall educational enterprise.

However, it is in the area of science education, where much new effort and many new resources are being placed, that major deficiencies continue to exist. It is absolutely astonishing that, thirty years on, after acceptance of the validity of the "new sciences," core curricula addressing the new sciences are not to be found at the undergraduate level at even our most elite universities, not to mention in secondary and middle schools.

We are proposing an initiative, which can include contributions by many participants at this Conference, to develop new core science curricula that teach both classical science and the new sciences of complexity and systems in a highly integral way. After all, the new sciences do not replace classical science; rather, they expand upon their "here and now" foundations of classical science, to introduce subtlety, nuance and complexity into the educational enterprise and to expand the foundations of student understanding.

We envision this curricular initiative to embrace: primary education (grades 5-8), a highly receptive student cohort whose world views have not yet been entirely disenchanted by normative "training" in education; secondary education (grades 9-12) where teens can be reenchanted by new narratives of the cosmos, the environment and the nanosphere; undergraduate education (lower division core science distribution requirements) where students now are quite ill-equipped by the existing science curriculum to comprehend fully the dynamics of our complex world; and undergraduate and graduate science/math education programs whose students need to be fully prepared to teach the new sciences at primary and secondary levels. We also envision components of this initiative that include major emphases on the relatedness of the arts and of arts-informed inquiry.

Our hope is to engage the imagination of forward-thinking enterprises, such as the Bill & Melinda Gates Foundation, which is investing millions into educational change, as well as the National Science Foundation and the U.S. and California Departments of Education. The first phase of the enterprise will be curriculum development for each sector. The second phase would be longitudinal demonstration projects that measure fully both the quantitative and qualitative impacts of the new curricula. We encourage those interested in contributing and/or participating to contact Frank Giunta and Lezlie Kinyon.

Afterword: Mandelbrot, Milglio & Fractal Symmetries

Born in Poland to Lithuanian parents, Benoit Mandelbrot and his family moved to Paris in 1936. He studied under Gaston Julia and Pierre Fatou at the Ecole Polytechnique, and earned his doctorate in mathematical sciences at the University of Paris in 1952. After working for several years at the National Center for Scientific Research in France, and spending time in research in the U.S. as a visiting scholar at Cal Tech and Princeton's Institute for Advanced Study, Mandelbrot was appointed as a mathematician at IBM's Watson Research Center in New York, beginning in 1958.

Mandelbrot demonstrated the use of fractals as realistic and useful models of natural phenomena, including the structure of plants, blood vessels, brains and lungs, the shape of coastlines and the clustering of galaxies. He held the view that fractals were, in most ways, more intuitive and natural than the smooth, linear objects of traditional Euclidian geometry. From his groundbreaking work, the mathematical discipline of fractal geometry evolved, and in 1982, Mandelbrot published the results of his years of research as *The Fractal Geometry of Nature,* which introduced fractal geometry to both the scientific and the general audiences.

Certain symmetries emerge from the life experiences of the mathematician who discovered the embedded fractal and the artist who embeds the fractal form in all of his work. Both Mandelbrot and Miglio were nurtured in the modernist, mid-20th century French intelllectual milieu. Mandelbrot was introduced to science and mathematics by his mother, an M.D., and by two maternal uncles, both mathematicians. Miglio's early life experiences were influenced by his father, a career officer in the French military who was posted, with his family, at numerous locations around continental France, and at Sandhurst, the British Military Academy. By their own characterizations, both the mathematician and the artist work at highly intuitive levels. And both, generally, have rejected normative French and European intellectual traditions and conventions established for their respective disciplines in favor of the American flavor.

Mathematician Benoit Mandelbrot discovered the now-famous "Mandelbrot Set" while working in Paris and New York in 1958. In the same year, artist Francois Miglio was born in Montpellier in the south of France. Like Mandelbrot did before him, Miglio finds the more "open systems" of the U.S., and of the San Francisco Bay Area in particular, to be more fertile fields for the exploration and expression of his work, especially because of local attributes such as progressive democracy, the nourishment of risk-taking, sensitivity to and concerns about the quality of the environment and the sustainability of civilization, and, not least, because many of the seminal thinkers exploring complexity and systems science are to be found in the Western United States.

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About the Author

A resident of the Rockridge district of Oakland, California, **Frank Giunta** is a graduate of the University of Pennsylvania where he majored in literature and physics. He completed master's work in modern British literature (D.H. Lawrence) at San Francisco State University, and has completed coursework toward the PhD in Humanities at the California Institute of Integral Studies. He is currently working on his dissertation topic.

From 1983 to 1996 Frank managed the industry liaison, research support and research facilities programs for the College of Engineering at the University of California, Berkeley, from which he elected early retirement in 1996. Currently he serves as president of the board of directors of ARTSHIP Foundation, San Francisco, and does consulting nationally and internationally on knowledge-based and culturally-driven local economic development.

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Send email to the artist's internet address, and/or contact Frank Giunta who will know the artist's location and can transmit messages to him.