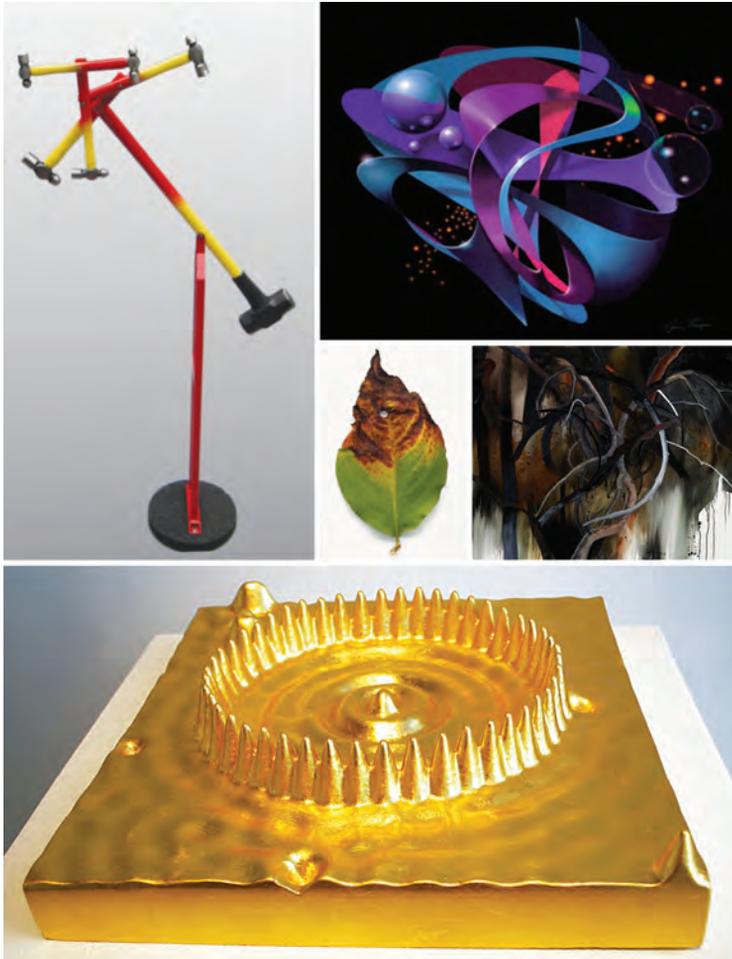


Art Inspired by Science

Imaging the Natural World



Robert Louis Chianese

Proceedings of the Pacific Division
American Association for the Advancement of Science
Volume 29, Part 2

Art Inspired by Science

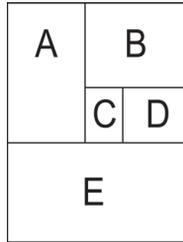
Imaging the Natural World

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Front Cover



- A. *Waltzing Hammers* Ken Patton
- B. *Formus* James Thompson
- C. *Loneliness* Liz Lee
- D. *Burn #6* Hiroko Yoshimoto
- E. *The Well (Quantum Corral)* Julian Voss-Andreae

Back Cover

Gallery photograph by Michael Crane

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Volume 29, Part 2

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Art Inspired by Science

Imaging the Natural World

A monograph on the science-based art exhibit presented on
the campus of Southern Oregon University as a cooperative project
between the Schneider Museum of Art and the
91st Annual Meeting of the Pacific Division of the
American Association for the Advancement of Science
June 12 – September 6, 2010

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AAAS, Pacific Division
Ashland, Oregon, U.S.A.



Robert Louis Chianese. Photo courtesy James Manley.

About the Author

Robert Louis Chianese, B. A. Rutgers (1964), M. A., Ph.D. Washington University, St. Louis (1971), is Emeritus Professor of English at California State University, Northridge where he taught courses on British and American literature, literature and art, literature and the environment, and men's literature. He headed the National Endowment for the Humanities Liberal Arts project at CSU Northridge, which devised an interdisciplinary, team-taught general education program. He has taught literature and the environment as a Fulbright Scholar and Senior Specialist in Bulgaria and China.

He is a Mitchell Laureate for an essay on sustainable societies and founder of The Sustainability Council of Ventura County, California. He is currently President of the Pacific Division of the American Association for the Advancement of Science (2011-2012) and head of its General and Interdisciplinary Studies section, for which he organizes symposia bringing together the humanities and sciences.

Now retired from teaching, he writes poetry, fiction, and dramatic works. He fishes Northern California rivers and the waters off Ventura where he and his wife, Paula, live and enjoy their two young grandchildren with adoring fascination.

CONTENTS

Preface ix

Science and Visual Arts ix

The Exhibit xii

Works 1

Collaborative Projects 1

Works Made by Individuals with Machines and Computers 5

Works Made by Individuals by Hand,
Representing Science or Mathematical Theory 10

Works Made by Individuals by Hand, Evoking Special
Objects or Phenomena Discovered by Science 20

Works Made by Individuals by Hand,
Depicting Features of the Natural World 26

Acknowledgements 34

Notes 34



Entrance to one of several art galleries on the Southern Oregon University Campus displaying artwork for the *Art Inspired by Science* exhibit. Photograph courtesy of Michael Crane.

PREFACE

Sponsored by the Pacific Division of the American Association for the Advancement of Science and hosted by Southern Oregon University, *Art Inspired by Science* solicited works based on science from artists throughout the United States. This seemed to offer little hindrance to artists, given the number and variety of artistic expressions we received. As modern science proposes ideas that have become “curiouser and curiouser,” many artists today regularly take their cues from it.

Each artist was asked to provide a statement that explains how the work incorporates science. These statements often become essential to understanding such a work, and I frequently borrow from these statements in quoted excerpts in the text. Schneider Museum of Art Director Michael Crane and I selected over thirty artists, whose works, along with the supplementary information, were on view in five galleries on the campus during the summer of 2010.

Three broad categories characterized the science-focused art: collaborative projects; works by individuals primarily made by computers and machines; and works by individuals primarily made by hand. The art can also be divided into categories by the particular aspect of science it depicts: science or mathematical theories or ideas; objects or phenomena discovered by science; and familiar features of the natural world.

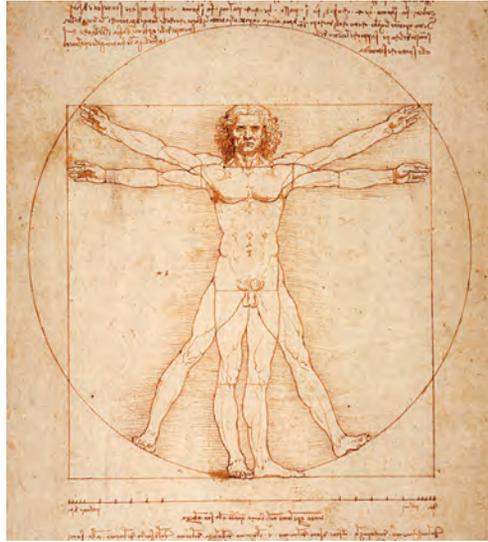
Such innovative and specialized art can please as much as it can puzzle and raise fundamental questions about what art is and is not. And artists may make claims about their science-inspired artistry that may be hard to accept. Some of those questions and claims are worth pondering in a discussion of both the science and the artistry of the particular works in the exhibit as well as the general relationship between science and visual art itself.

Science and Visual Arts

Science and the visual arts have had a long association. Ancient depictions of the world were not just fanciful illustrations but forms of pre-scientific inquiry about how the world works. Egyptian astronomers etched quasi-accurate star maps on the ceilings of tombs as early as 1470 BCE. For thousands of years, Arab, Chinese, and Greek healers portrayed their accumulating, often curious lore about the human body in diagrams, body maps, and even models that were used as tools of diagnosis. Medieval alchemy depended on elaborate illustrations of human actors to illustrate actual chemical transformations witnessed in the alchemist’s laboratory.

Leonardo da Vinci’s iconic drawing “The Vitruvian Man” (1492) depicts a fundamental principle of the Renaissance: the harmony between the world and human beings, the

macro and micro cosmos, with mankind the measure of all things. It is more than an illustration—it's a sci-art mathematical model that confirms a deeply-held theory about geometric order, the perfection of the world, and human concordance with all things.



Leonardo da Vinci *Vitruvian Man* 1492

Later, natural history illustrators, such as Mark Catesby (1682-1749), Pierre-Joseph Redouté (1759-1840), and John James Audubon (1785-1851), striving for accurate representations, nonetheless illustrated plants and animals with such deliberate artistry and individual style that their works fetch thousands of dollars from art collectors today. Audubon's four-volume *Birds of America* recently sold for \$11.5 million, a record price for *any* book. Such works transcend scientific illustration and become aesthetic icons of both the cultural history and natural history of their times.

Today, scientific illustration without deliberate artistic intent has become a subset of contemporary science itself, with whole institutes, schools, and associations devoted to the instruction of this visual ancillary to science. Masters degrees and advanced accreditation ensure a continuing tradition of depicting the seen and unseen world, obviously with the contemporary emphasis on accuracy over artistry. This, however, does not prevent the work of modern professional illustrators from winning art awards or gaining the admiration of collectors.

Furthermore, images derived from deep space telescopes, electron microscopy, and nanotechnology can become instant art, adorning the covers of science journals as ready-made examples of fantastic, abstract, or minimalist art—often with artful computer tweaking. The *Art Inspired by Science* exhibit had a gallery dedicated to the often dazzling covers of AAAS's *Science* magazine and another gallery dedicated to images of work in wildlife forensic photography.

Despite this long collaboration between them, science and visual arts have held his-

toric biases against each other—science judging fine art as useless and based on illusion, and the humanities and the arts expressing antagonism toward science because of its perceived reductive simplifications and its rigorous rationality, which necessarily exclude emotion and fantasy.

While both provide insight, sharpened awareness, and aids to reflection, their proximate and ultimate goals differ.

Art is primarily sensuous, whereas science is rational and argumentative: the one produces an expressive, evocative sample of the world, while the other a data-supported truth-claim. Artists want us to behold, respond, and appreciate; scientists want us to agree. Except for political art, art rarely argues; rather it offers a personal view of reality for us to question, admire, and respond to emotionally.

“Aesthetics” refers to feelings, emotional responses, and complex personal and cultural matters such as beauty and taste. While scientists can admire and talk about a “beautiful” theory because of its simplicity or symmetry, they apprehend it with an intellectual-contemplative outlook. “Beauty” in art, while a somewhat dated and ambiguous notion, refers to an emotional apprehension of the work, also perhaps due to its simplicity and symmetry, but again perceived through the senses in a highly emotional state. Whereas scientists actively seek to rid their hypotheses of emotional influences, artists work very hard to provoke emotional responses to their works.

The basic science product is a complex research paper for highly specialized colleagues in an esoteric language and using complex mathematics, often funded by a research grant. Popular and general science works synthesize and communicate science ideas to the public in more accessible language, offering phenomena to wonder at. The basic art product is a single work usually produced by a single artist, which attempts to be a “stand alone” expression of an individual. It may be complex in its imagery or form; nonetheless, it attempts to communicate its insights as directly as possible to a wide audience. Artists depend on the sale of these works to a general or special public as a means of making a living.

Science is progressive and the knowledge it acquires advances; art does not advance but instead restates basic human truths in new or traditional forms. In this exceptional case of art inspired by science, the artist may venture into unfamiliar areas of knowledge and theory for inspiration.

Scientists are both much more collaborative and competitive in their endeavors, often enlisting team efforts. Artists are more iconoclastic, and while they form schools and are often competitive, they openly borrow past and present traditions as forms of inspiration.

Scientists use math and language, and also visuals, but as illustrative aids that clarify. Artists use form and personal imagery as well as traditional and archetypal symbols as an end in themselves.

Scientists want to advance and refute understanding of existing theories and findings. Artists want to innovate and depart from existing modes of expression, while evoking older traditions.

However different, both the artist and scientist often start with the same fascination about the world, explore it, examine it with care, and get inspired and intrigued by its unending mysteries. They both offer their particular understanding or vision of it through an investigation of what's normally hard to see and then revise what they see as their investigation proceeds. They both ask profound questions which may forever elude human answers. In this particular category of art inspired by science, some artists borrow esoteric formulas to aid their investigations.

Both artists and scientists also speculate about alternative worlds and realities and try to reshape our world view and disturb our ordinary assumptions. And, they can both be fearless in the face of public or official opposition to what they present.

The Exhibit

In *Art Inspired by Science*, artists creatively engage, employ, and derive stimulus from science topics and disciplines—from astronomy and biology, to health, ecology, and physics, as well as from mathematics itself. Their efforts, whether scientifically accurate or not, offer many such moments of special awareness about the very profound questions for which science continues to seek answers—where did it all come from? what is its nature? how does it work? where is it going? how do we fit in? These are the questions that gave birth to the Arts, Humanities, and Sciences themselves as related forms of knowing. Contemporary academic institutions often separate these disciplines or, if they remain in the same “college,” they rarely share the same forum for their ideas or methods. True interdisciplinary collaborations are rare though they remain highly recommended forms of teaching and learning. They are somewhat realized in *Art Inspired by Science* by the happy though one-way reliance on science by the artist.

These artists, some of whom are scientists themselves, are very willing to let science lead them to new discoveries, new visions, and new forms of expression. Competition with science as a way of knowing seems irrelevant, the old antagonisms left by the wayside. In fact the artists seem driven by an excitement to see what science reveals and to show it to others, almost show it off. These artists are admiring companions to science and revel in its exotic insights and visions.

Moreover, it seems that these artists are willing to concede science's lead role in pushing human insight and vision into unforeseen territory; they attend to science to mine its riches. Perhaps scientific discovery in this view is far more exuberant, curious, and far-reaching than what art or humanities alone present these days, though the adjectives “experimental,” “innovative,” and “paradigm-shifting” characterize much of what art in all fields claims it is doing. It is not that tradition becomes irrelevant or abandoned, but that the creative energies of art seem stimulated so naturally by science. In fact, except for the use of some very unique

technologies, the art here employs fairly standard forms and materials—oil, watercolor, ink, pencil, paper, digital prints, and various sculptural materials such as steel, bronze, and gold. It is in the processes of making art that innovations abound. Computers, lab equipment, nanotechnology, and other means of making art are employed, though one artist returns to the earth, the fire-burnt earth itself, for the raw materials to produce her handmade images.

One effect of science-inspired art seems a drifting away from self-absorbed personalization, though a few artists let biology and medicine express their personal or family experience with disease. We expect such personal, almost confessional self-exploration in the arts but not here. While the artists often humanize the esoteric ideas of science, such as a “quantum corral,” they do not typically personalize them.

Instead there is a clear trend to non-exclusive reflections on the earth-bound and cosmic mysteries of the actual, the visible and the invisible, and the theoretical. It is as if the world of science supplies what the imagination of the artist had to dream up before. For many of these artists, it is not *my* awe but rather *our* awe at the world that science opens up to us. “How I see it” seems less important than how we all need to see and respond to it, sensuously and reverently. The artist serves as an impersonal guide to the miraculous. And while miracles here dwell mainly in the house of the actual, they still can evoke a spiritualized wonder, even at atmospheric effects, weather, ice thaw, the squiggles of a water flea, or the re-growth of a forest, and the ordinary becomes extraordinary.

Finally, in a different category are works dependent on mathematics, including geometry, esoteric equations, game theory, and numbers themselves—perhaps ten or more of them in this exhibit. It might seem that incorporating mathematics in art is a huge challenge, but it may also provide very wide latitude for invention; these artists took advantage of that possibility. They share the goal of making vividly manifest abstract natural processes and laws, and the invisible realities of the macro and micro dimensions. From a display of the cultural and scientific meaning of numbers themselves, to their use as keys to philosophical speculations about the nature of the universe and the unfolding patterns of change and transformation, these artists bring numbers and equations to physical, sensuous form. An award-winning piece depicts the resultant shape of a speculative equation about the quantum universe, as if art alone can illustrate the most ethereal realities posed by science.

This then seems to constitute the overriding purpose of art inspired by science in this exhibit—not announced nor required by the exhibit planners—to bring to aesthetic awareness the seen and unseen elements of the natural world for our contemplation and wonder. This sort of vision would seem to fulfill Ralph Waldo Emerson’s idea of how we make life itself valuable: “It seems as if the day was not wholly profane, in which we have given heed to some natural object” (“Nature” 1844). “Giving heed,” exclusive and careful heed, to natural objects would seem to serve as a fitting motto of art inspired by science. Such heed is in fact a high form of praise.

What follows are my explanatory and sometimes critical comments on works by artists in the exhibit.



PLATE 1. Brian Gillis and Mike Miller *Wunderkammer: An Expeditionary Journal 2009*

WORKS

Collaborative Projects

The team of **Brian Gillis** and **Mike Miller** assemble a collection of modern curiosities in the form of tabletop objects which record their process of collecting materials for a contemporary *Wunderkammer* or “Curiosity Cabinet.”

These cabinets of wonder and weirdness delighted Europeans in the 16th and 17th centuries with what Gillis and Miller describe as “idiosyncratic accumulations of unusual natural specimens, scientific contraptions, and rare and exotic works of art.” A curiosity cabinet would excite myriad reflections as each viewer found personal meaning in the odd assortments.

They entitle their project *An Expeditionary Journal 2009*, a physical record of an expedition of open inquiry without clear destination. Curiously though, the *Wunderkammer* on view left some viewers cold but intrigued others since it seemed to lack enough objects to arouse us. It featured miscellaneous plastic discs and planes strung into twisting lines, but which themselves seemed platforms to display or frame absent objects. Are we invited to project whatever excites our curiosity onto the translucent shapes in this tabletop cabinet? Much postmodern art invites such questions, and we have to ask if these artists have instructively fooled us into understanding our collaboration with the creation of meaning. This is a twenty-first century curiosity cabinet after all.

The eclectic materials, the seemingly casual method of displaying them, and emphasis on inquiry itself as a persistent human activity in all fields make *An Expeditionary Journal* a hybrid of science, art, and cultural history. The examination table of miscellaneous curiosities, like leftovers from a workshop of unknown purpose, throws us back to collecting itself as a way of understanding the impulse of both science and art to notice, admire, and accumulate all kinds of stuff for study and pleasure.

Another unique and collaborative project could be likened to a curiosity cabinet of sorts, one involving numbers. **Rochelle Newman** and **Maryanne Scatamacchia** team up to produce an ongoing catalogue of their creative play with the numbers zero through twelve. *Numerarium—The Nuance of Number 2009* is a mixed media assemblage comprised of drawings, paintings, collage, and computer-printed pages that are laminated and then assembled into a large, circular, table-top “artist book.”

Newman and Scatamacchia treat all uses and characteristics of numbers—their “mysterious, historical, practical, and artful aspects.” On a page featuring the



PLATE 2. Rochelle Newman and Maryanne Scatamacchia *Numerarium*—*The Nuance of Number* 2009

number “5,” we see pentagons, pentangles, finger numerology, and a military patch on a 5-part grid, plus Pythagorean claims about the power of 5. These random items on the page and the causal presentation allow us to imagine the artists’ spontaneous impulse to record an idea or image about a number and share it with each other and viewers of the project.

An “artist book” conceives of a book as a work of art in itself, not only by what it includes, or the fact that an artist made it, but also by its sculptural form, its materials, its bindings, and often its overall aesthetic design, texture, and sensuous “feel.” *Numerarium* gives the impression of an engineering production or a rotating shelf of scrapbooks rather than a fine art object. Its mathematically determined contents and form evoke the notion of a reference source, and an unwieldy one at that.

But when we examine individual pages we understand that this work collects the cultural dimensions of our most used numbers and, like *Wunderkammer*, becomes a conceptual work about curiosity, the process of inquiry, and the joy of ongoing discovery in the sciences, arts, and humanities. Numbers and pages here are the artifacts and the book a handy repository in art form.

Also employing numbers, but in a very different way, the team of artist **Luc Benard** and mathematician **Richard Palais** in their *Equation Series* (2007) present a computer-generated group of fractal images using complex numerical equations and specialized computer programs. This collaborative work fits into the computer art category as well. They capture the texture, look, and age of old hand-made draw-

ings through Photoshop fonts and colors, which they say “people find . . . aesthetically appealing completely independent of their source.” In these complex computer doodles, they perhaps unconsciously revisit Leonardo’s fascination with small elemental forms, such as his repeatedly drawn whorl. Here the Old Masters’ tradition of illustrating intriguing forms gets a contemporary twist: algebra run through computers produces meaningless but appealing designs—pure mathematics as abstract, faux-retro art.

This leads us to wonder what fantastical imagery may be latent in all sorts of numerical formulae when tweaked by computer-artist-mathematicians. This also evokes the questions of control and intention, with the artist more of a decorator or finisher than a purposeful maker. Their images seem to bring together the radical control of precise formulae with the expressive license of capricious ornamentation. Perhaps these designs evoke the ancient carpet weaver’s art above anything else.

Benard and Palais also submitted their award-winning digital image of a highly complex, computer-generated object with a very esoteric artist statement. Both image and explanation involve sophisticated mathematics, summarized imperfectly here. Entitled *Kuen’s Surface: A Meditation on Euclid, Lobachevsky, and Quantum Fields* (2009), it projects a “pseudospherical” object called a Kuen’s surface suspended over drawings of it on a table, plus the formula that produces it. Despite its intricacy, the curvy object follows Euclid’s axioms for plane geometry,



PLATE 3. Luc Benard and Richard Palais *Equation Series* 2007

except something called his “Parallel Postulate,” which posits that lines with a certain angle between them will never meet.

As their statement explains, a Kuen surface also can represent the relativistic mathematics of the structure of matter, where some parallel lines do meet—in another dimension we might say. Their image does seem other-worldly—a blown-glass enigma, beautiful and compelling when we ponder how equations can result in objects that happen to coincide with and embody fundamental aspects of matter. For it, they were awarded first place in the illustration category of the National Science Foundation and *Science Magazine*’s 2009 Scientific Visualization Challenge. This intentional image expresses the artistic power and range of computer-assisted art, an arresting, self-reflexive depiction of images and an object that forces us to meditate on the mathematical substructure of time, space, and matter itself.

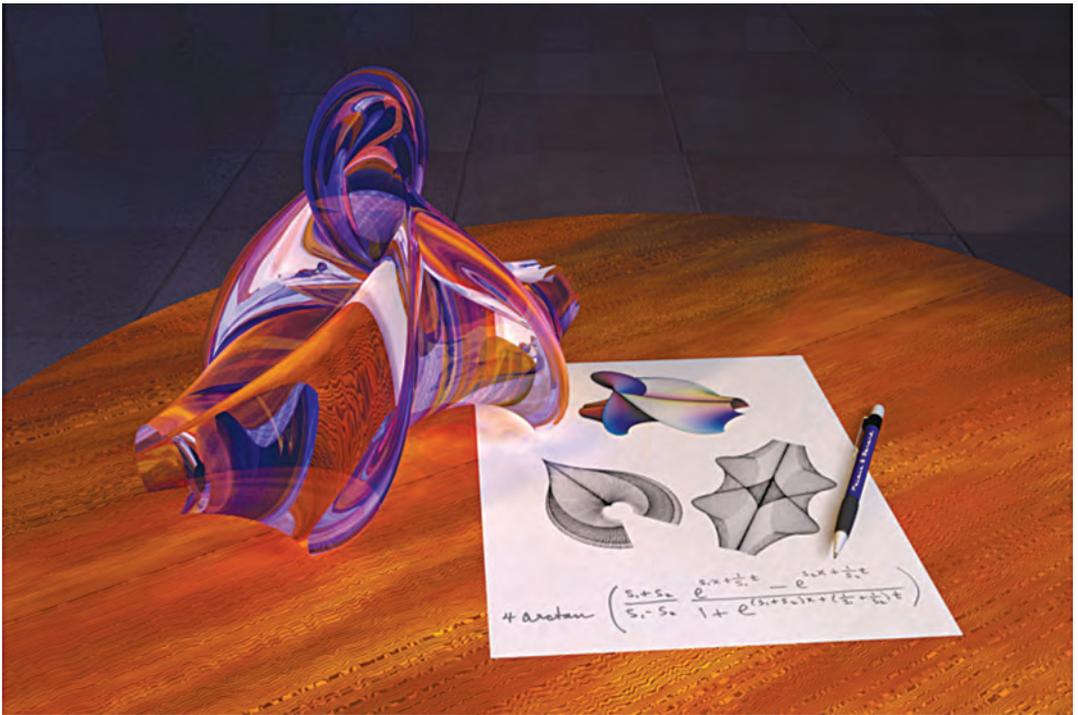


PLATE 4. Luc Benard and Richard Palais *Kuen’s Surface: A Meditation on Euclid, Lobachevsky, and Quantum Fields* 2009

Works Made by Individuals with Machines and Computers

Two other artists have a very different take on the growing interest in computer-generated art. **James Thompson** replaces a pencil with a computer drawing stylus and allows his hand to sketch free-form lines, which he then digitally modifies into an exotic, colorful shape. *Formus* (2001) entices us to guess which lines first graced the screen from his free-flowing hand and what surfaces, shapes, volumes, and colors the programming modified and added.



PLATE 5. James Thompson *Formus* 2001

Many works in this exhibit could call into question the age-old notion of art as a product of the human hand, but the assist Thompson's manual stylus gets from the computer could also pay homage to the hand/mind partnership of the visual artist as someone who still toys with lines, colors, tones, and volumes. But is this the visual equivalent of the computer-assisted digital piano, where harmonies and whole accompaniments can be dialed in to ramp up into some random, kitten-on-the-keys plunking? *Formus* prompts the inevitable question: what sort of art is this, something "man-made" or something "machine-made"?

The answer seems less problematic with **Carlos Sequin's** sculpture, *Aurora Australis* (2010). Sequin, a physicist, electrical engineer, and computer scientist, translates a source, here another sculptural form, into a mathematical formula. Then he programs the equation into a computer “so as to reproduce a shape close to the original, and then [I] play with some of the parameters, to find out what other pleasing shapes might be part of the same family.” This creative play ultimately results in the design for his own bronze sculptures.



PLATE 6. Carlo Sequin *Aurora Australis* 2010

Sequin’s “hybrid forms” of sci-art inventiveness seem very much a part of genuine art, no matter how “electronically-assisted” the final object might be. His digitalized interpolation of another form transcends the process of copying; it’s more like a musical variation, with the inner motif transfigured by calculations, and then, in this case, made solid.

Linda Lee Nicholas abandons conventional artist tools and materials—brushes, pencils, watercolors, washes, and oils—and uses laboratory instruments and ink instead. Despite the lab tool implements, her *Pink Algae in Moss* (2009) looks like a fairly conventional abstract watercolor. But she affixes a narrative to it that evokes the laboratory for her in a very personal way.

She wants her cool, almost cellular “biomorphic” imagery to reflect, she says, her preoccupation with “masses” diagnosed in her parents’ bodies. This leads her to reflect on growths and growth itself, how it starts, healthy and otherwise— “the connection germination has with conception, biology and nature represented as the cycles of birth and death.” She wants her ink drawings to ask at what point does seed growth and development turn diseased?



PLATE 7. Linda Lee Nicholas *Pink Algae in Moss* 2009

The titles she gives her images hardly suggest her intended meaning. The images are more like ink blot Rorschachs inviting individual interpretation. The title *Pink Algae in Moss* might indicate which life forms we might visualize in her abstract watercolor, but her references to her parents’ tumors and her “obsession” with “masses” in the body seem a privileged view of its content, only conveyed in her statements about the work. Her biographical approach to her art likely settles some of her apprehensions about her parents. And, art that consoles the artist—and perhaps some viewers—has a significant place in the history of art. If this is her deeply personal reading of her ink blots, so be it.

J'Sha claims that his images, which he derives from his own techno invention called nanoentonography, are the “world’s smallest pieces of flat artwork.” He explains that “At a mere 100 microns tall (1/10 of a millimeter) with features smaller than one micron, works like *Nanolite* are smaller than a speck of dust and 1/8 the width of a strand of hair.” Such technology is normally used to prevent the counterfeiting of products. But he uses it to shape these very small objects through a process he compares to time-consuming bronze casting. Even when photographed and enlarged via microscope for human sight, his work leads us to ponder the question of scale in art—is anything too small or large to be considered art? Must we be able to see it with our natural eyes for it to be art at all?



PLATE 8. **J'Sha** *Nanolite* 2010

J'Sha would obviously argue no, and whatever objects or actual “pieces” he fashions into simple designs do have material form and substance. *Nanolite* might be a crude landscape of a tree with clouds on a moonlit night. Obviously it would not matter precisely what he fabricates and photographs: his art depends primarily on scale. As he explains, “It’s 90% engineering and 10% artistic talent.” Perhaps that will be enough for some.

Micron-sized art seems no match for the much smaller atomic-level material that actual nanotechnology can “see,” with particles measured in a billionth (10^{-9}) of a meter. What kind of art can one derive from this? Amazing art we’d have to say.

Julian Voss-Andreae manages it by turning a quantum object into a foot-square tabletop sculpture.

He borrows experimental data from researchers studying “matter waves” as seen by a “scanning tunneling microscope.” This exposes some iron atoms scattered on a copper surface, which the scientists then move with the same microscope into a circle, called a “quantum corral.” Presumably just looking at an iron atom will



PLATE 9. Julian Voss-Andreae *The Well (Quantum Corral)* 2009

nudge it, though I am not sure what “tunneling” does to it.

From these data, Voss-Andreae creates a code for a milling machine to carve his work, called *The Well: Quantum Corral* (2009), out of a block of wood. He exaggerates the height and depth of the ring of iron atoms just to let us see them rising above what he calls this “tiny landscape” and then gilds it with gold leaf— “to evoke a sense of wonder.” As these iron atoms get transformed into gold leaf sculpture, Voss-Andreae seems to imitate an alchemist’s dream—turning base metals into gold.

This wondrous work gives us a palpable glimpse of the subatomic world, with all of its mysteries and fruitless speculation about how it “really is.” We’ve seen diagrams and illustrations and models of atoms yet we want to see and know what this world really looks like—it’s everywhere, at the basis of everything, and still we must talk about it as a cloaked chimera. Perhaps this is fundamentally what art does: it brings to physical, sensuous awareness the unseen and unseeable—dreams, fantasies as well as the worlds hidden in a grain of sand. It distorts as it reveals, exaggerates as it expresses, re-shapes as it orders, and forms what is often formless. That science and subatomic particle physics should provide the dream-world images for artists’ revelations does not seem to change much of what art does.

Works Made by Individuals by Hand, Representing Science or Mathematical Theory

Steve Zolin in *White Motionscape* (2007) attempts to eclipse the two-dimensional limits of flat surfaces by depicting imagery based on Einstein's curving space-time and Stephen Hawking's hypothetical donut-shaped universe. Zolin's painted surfaces all curve around each other and touch, constituting what he calls a "motionscape," the hypothetical curved shape of reality.



PLATE 10. Steve Zolin *White Motionscape* 2007

Zolin's mixed media art evokes the simplification of natural forms found in impressionist and cubist art. In *White Motionscape*, space-time itself takes up the frame in an abstract pattern of tangential surfaces. We are given a freeze-frame glimpse of the shape and movement and suggestive colors of space-time itself, something science and philosophy and art have been trying to characterize and represent for ages. Zolin's cool, dynamic, and pleasant-looking sample of reality will have to serve for the time being our appetite for seeing unseeable ultimates.

Hiroko Yoshimoto was specially featured in this exhibition for her wide range of science-inspirations and diverse works. A separate gallery was reserved for over a dozen of her productions in various media.

Her *Sengai Triad* (1986) series in traditional oils meditates on the three shapes of reality posed by the Zen Buddhist monk Sengai (1750-1837)—the circle,



PLATE 11. Hiroko Yoshimoto *Sengai Triad* 1986

square, and triangle (which also evoke the three religions in Japan at the time: Buddhism, Shintoism, and Confucianism). Sengai suggested that this triad of shapes constituted “the universe” or reality, and Yoshimoto deploys them in various configurations in three separate paintings.

Their lively colors, limited tonal range, and changing interrelationships instill a quiet reverie: but just how do these shifting geometric forms make up the universe, we ask. She explains she has painted over fifty of these large works as a series. What sort of enlightenment through art are we offered here? Perhaps out of chaos and disorder come the regular solids of orderly form—not randomness nor voids but substantial, patterned perfection symbolized by those familiar shapes governed by laws of interactive motion, a formal dance of the universe. A modern philosopher-scientist might want to claim that.

Western mathematician Fibonacci (c. 1170-c. 1250) brought Hindu-Arabic numbers to the west and popularized a number sequence that even today can characterize the accumulative process of natural growth. Each number in the series is the sum of the two previous numbers, which is not a doubling but a 1.6-fold increase. Yoshimoto graphs this popular progression not by presenting ever-larger shapes in her *Fibonacci II* wall hanging (2005) but by increasingly darkening Japanese washi paper squares. That darkening follows the Fibonacci series: the artist adds three drops of black ink to water for three squares, then four for the next five squares, five drops for eight squares, and so on. And since we stare directly at the



PLATE 12. Hiroko Yoshimoto *Fibonacci II* 2005



PLATE 13. Hiroko Yoshimoto *Wavy Lines II* 2009

whole transformation, this work leads us to contemplate any step on the way toward change by which all things evolve and the rate of transformation itself—gradual, ever increasing, but persistent. Her *Wavy Lines II* panels (2009) present colorful expression of all types of radiation—water, sound, heat, and sine/cosine waves. For the artist herself, painting these randomly layered lines sets up a rhythmic process until the lines “started to ‘oscillate’ and at the end, settled to create a vision that resembled water.” Invisible waveforms of life resolve themselves into water, in luminous blues and yellows with a dash of ochre, as if Yoshimoto, like an ancient philosopher-artist, discovers through painting itself that a single substance or vibration constitutes reality.

Flounder Lee also presents a work that visually records a process of constructing something. *1024 Points to Make a Hypercube* assembles photographs of six tosses of bits of material to represent the hypercube, which can have one dimension in time or many dimensions in space. The impossibility of graphing a hypercube in two-dimensional space is compensated somewhat by references to time elements—the changing outdoor light conditions in the photographed backgrounds and the sequence of time it took to toss the bits into the air.



PLATE 14. Flounder Lee *1024 Points to Make a Hypercube* n.d.

In this performance work, perhaps Lee could have folded the six panels into a cube, turning 2-D photography into 3-D sculpture, though still no closer to the 4th temporal dimension or endless spatial dimensions of the hypercube. These are creative strategies best left to the artist. Nonetheless, Lee adds the puzzling statement that the many tossed bits in their rise and fall create “amazing patterns by chance, maybe referencing quantum physics.” Conjoining the rigorous geometry of the hypercube and random quanta patterns would seem to make his work a fairly unscientific jumble. Artists must be careful to get the science right.

Inspired not just by science, Lee explains that he also evokes artist John Baldessari’s piece, “*Throwing 4 balls into the air to get a perfect square*” (1974), which his work visually imitates. Baldessari’s ball-tossing art plays with the notion of randomness and arbitrariness versus the strictness of geometric shapes and rules we devise to play such tossing games. In thirty-six tosses, Baldessari hardly gets close to the shape of a square; yet when we change our perspective we might discover one. If Lee’s work is ultimately about relativistic perspective, he needs to clue us in. Are we always going to play peek-a-boo with his evasive hypercube?

Here is a case where more elaborate explanation by the artist, not less, seems necessary—an aspect of science-themed art that seems inevitable due to its usual difficulty.

Tallmadge Doyle presents part of her series of aquatint etchings honoring Joannes Kepler, the 15th century German astronomer. Kepler tried to integrate both solid geometry and the ancient notion of four basic elements into his astronomical discoveries. Doyle’s *Kepler’s Cosmic Geometry* (2006) depicts planets that also embody the cube, the tetrahedron, the octahedron, and the icosahedron representing in that order Earth, Fire, Air, and Water as the “building blocks of creation.” This evokes the triangle, circle, and square of Sengai as elemental forms in Yoshimoto’s painting. Doyle also seems to allude to astral bodies in the luminous radiance of the objects, perhaps finally connecting essential solids, cosmic entities, and the four classical elements to the human body as well. Doyle’s colorful works express her respect and admiration for Kepler, his real discoveries, his pre-scientific theoretical assumptions, and his contribution to Newtonian and later science.

Steve Miller offers another visual homage to a scientist, a contemporary one, Nobel Prize winner Roderick MacKinnon, who in 2003 won the Chemistry award for discovering how inorganic ions flow across cell membranes.

Miller’s silk screens are multi-layered visual collages. His *Protein #409* (2007) superimposes cellular forms, molecular models, equations, and a helix or two over a diagram of what presumably constitutes the “proteomics” or model of a particular protein. Since some proteins change form with time, Miller presents what looks like an evolving, changing visual form (see image on page 16).

Here is a case where artistry transcends the illustrative dimensions of the



PLATE 15. Tallmadge Doyle *Kepler's Cosmic Geometry* 2006

work, with Miller able to create a dynamic visual image that evokes abstract drawing (and an artist such as Sam Francis) as well as biochemical illustration. Miller's direct borrowing of MacKinnon's work in this elaborate form suggests an aesthetic dimension of science itself in depicting molecular process.

Two other artists give us samples of natural forms using conventional materials and manual technique but in unique fashion. **Susan Knight** concentrates on the outlines of erratic swirls inscribed by flowing water, and **Kit Callahan** celebrates the pervasive shape of the ellipse. In their own ways, both artists seem to be searching for the essence of motion in the universe itself, much as Leonardo returned to sketching the swirl of water as if to unlock some fundamental but unseen secret to creation.

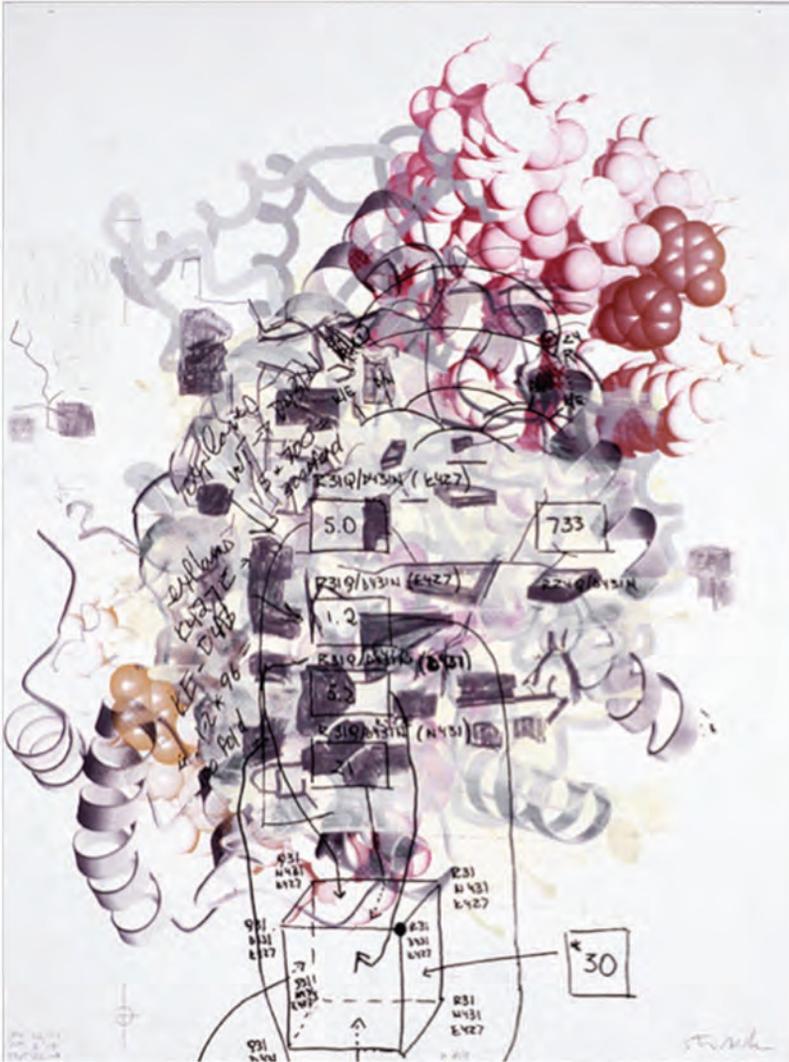


PLATE 16. Steve Miller *Protein #409* 2007

Knight's *Red Water Chaos* (2008) responds to researchers' discoveries that the microscopic spiny tail water flea causes the deterioration of Lake Michigan's food web. Her intricate cutout of paper, acrylic paint, and colored pencil presumably traces the aberrant, menacing meandering of the flea and its effect on the water which streams after it. The red path of the flea resembles a twisted, contorted artery, as if the invader has disturbed the healthy, graceful flow of water and the nutrient "blood" supply that keeps the lake alive.

This work of ecological protest does need the artist's explanatory statement, but when viewed along with her other works in the exhibit, such as *Water Action* (2008), where she shows the harmonious twists and turns of healthy water, the meaning of this chaotic water swirl becomes clearer.

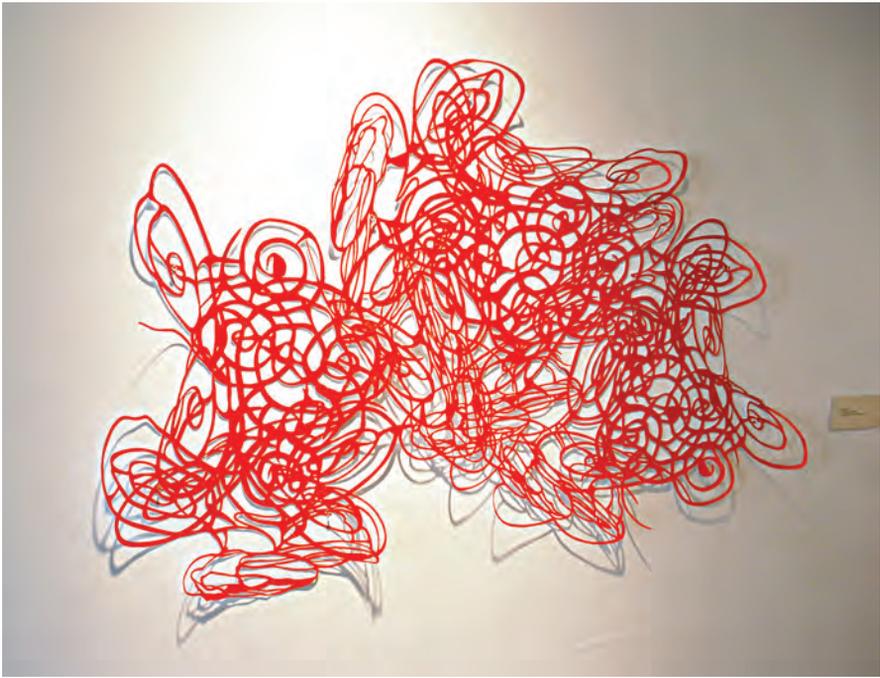


PLATE 17. Susan Knight *Red Water Chaos* 2008

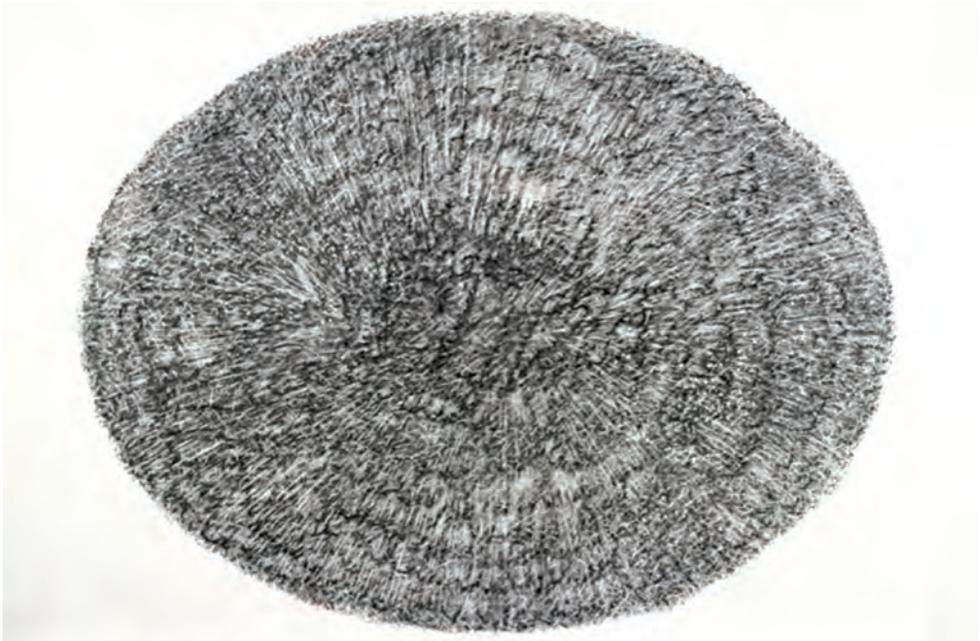


PLATE 18. Kit Callahan *Ellipse II* 2004

From her geologist father, Kit Callahan learned to trace all variety of ellipses by using a piece of string and two nails and simply changing their length and location. Since then, the ellipse in its infinite variety has become her artistic fascination, which she now draws freehand as in *Ellipse II* (2004). For her it creates “a personal elliptical space within the universal chaos,” and in its infinite possible shapes represents the “infinite space of the universe.” Here is another artist whose repeated attention, obsession almost, to a changeable shape wants it to unlock secrets of the cosmos itself.

Other basic principles get illustrated in **Ken Patton’s** kinetic sculpture *Waltzing Hammers* (2009). Its pendulum-swinging large hammer, topped by the interfering motion of smaller ones, not only demonstrates potential energy converting



PLATE 19. Ken Patton *Waltzing Hammers* 2009

into kinetic and then back again. It also shows how chaotic actions for a time upset the regularity of motion within a system, only to be dampened down into a more regular “waltz.” The ingenious structure reveals the dynamics of erratically moving systems, in and out of phase with themselves when swung, which then come into phase through inertia and the conservation of energy. Its simple design and ingeniously moving parts of metal, wood, and stone show how a science principle can become an elegant work of art, while it also helps engineer Patton explain to viewers the “fallacy of perpetual motion.”

Patricia Pease constructs strip quilts out of fabric that she intends to express string theory in physics. The individual ribbons of color that comprise *String Theory* (2007-08) can, as she explains, stand for the smallest units in matter, “vibrating one-dimensional energy strings.”



PLATE 20. Patricia Pease *String Theory* 2008

Her colorful quilt, in its vertical rows of narrow horizontal bands, evokes many other things—plowed fields, flags and banners, game boards, and townscapes

in naïve painting, for instance. This suggests that such strings, which theoretically can exist in nine dimensions, have a much more mundane reality. Without her title and statement one would not locate her work in the realms of Einstein's gravity theory and quantum mechanics. But since she pieces together a hodgepodge of fabric strips that result in something of a "crazy quilt," perhaps this can in two-dimensions symbolize the multi-dimensional realities implied by string-theory. However, the quilts give no clue to this by themselves and may actually deny the nine dimensions of string theory in their very colorful evocation of the traditional work of quilt makers.

Works Made by Individuals by Hand, Evoking Special Objects or Phenomena Discovered by Science

Seven artists focus on science discoveries that fascinate because of their radical forms and amazing processes, fundamental aspects of art production itself. Their works do more than illustrate; they express the artists's emotional curiosity, their almost playful enchantment with seen and unseen phenomena, which results in both naturalistic and abstract treatments.

(Myrrh) Trudy Reagan paints expressive abstract designs on forty-five inch diameter acrylic sheets to create her "Essential Mystery Series." For her the essential mysteries involve the impact of scale and number in forming reality, familiar scientific themes such as the energy-matter transformation, newer theoretical constructs such as synchronicity, emergence, and consilience, and the human mind in its free-roaming explorations.

In *Energy Becomes Matter* (2009) Reagan creates a root-like, disc-shaped labyrinth of irregular pathways or arteries, where color suggests the transformations of energy/matter into each other. The yellow center implies some sort of intensification, as if this process, emerging from the black void, begins in the fire-red furnace of the exterior and reaches a near-white hot apotheosis at the center. There's a hint of biological life in these twists and linkages of the transformation, but Reagan reminds us in her statement that we have put energy in the service of powerful weapons, so that viewers may see the entwining of energy/matter in this work as the explosive dynamic of both creation and destruction.

Terry Nathan's *Smoke Dance: Where Kant Meets Newton* (2008) may seem like a fairly ordinary though arresting photo of smoke whirls, except for the detail and minute scale of the whirls: they are very small structures within the smoke. What he has to say about them in his artist's statement gives his digital print new significance.

Like Trudy Reagan, Nathan concentrates on primal forms, with the smoke whiff representing for him the nexus of Kantian aesthetics and Newtonian mechan-



PLATE 21. (Myrrh) Trudy Reagan *Energy Becomes Matter* 1997



PLATE 22. Terry Nathan *Smoke Dance: Where Kant Meets Newton* 2008

ics, or the coming together of physical beauty and mathematical structures. This fusion defines the dance of smoke, so that, in its small, fleeting appearance, it represents “the sublime, the beautiful and the figurative, which are exemplified by symmetry, self-similarity, scale invariance, order and disorder.” Such an art-science fusion he finds in various natural and artistic forms, such as “rivers, weather systems, galaxies, and torso sculptures made in centuries past.” The smoke dance therefore is both a tiny symbolic icon and a material example of natural form itself.

Shoshanah Dubiner takes viewers into a cell in her *The Deep* (2007), a gouache on paper work, which playfully depicts the inner parts of the cell in story-book fashion. The cell contains a nucleus within the cytoplasm, and mitochondria, as well as some full-bodied, highly evolved creatures—berries and beasties fuming from deep-ocean like vents, all bombarded by sperm-like, jelly-fish radiances from a sunny cosmic energy source. In Dubiner’s portrayal, the cell ultimately contains these later-evolved critters within itself. While this fantasy cell of the deep ocean unfolds into myriad life forms, it also suggests that later biological development lies implicit in originating foundational cells. This is only metaphorically true, with millions of years and endless random events influencing the shape and variety of life forms, but Dubiner’s colors, luminous forms, and quasi-identifiable creatures compress time and let us wonder indeed how a cell ultimately does generate a large, familiar life form.



PLATE 23. Shoshanah Dubiner *The Deep* 2007

Colombe Leinau's topographic painting *Olympus Mons* (2005) reveals her sculptural background as she layers white-on-white acrylic to build up a representation of the Martian volcano. Somewhat suggestive of female anatomy in form and title, *Olympus Mons* extends beyond the surface of the painting. Leinau bends the canvas into a “wrap-around” to emphasize this bas-relief feature. The white surface of Leinau’s Mars erases its expected red coloring, as if to emphasize its sculptural, abstract purity.



PLATE 24. **Colombe Leinau** *Olympus Mons* 2005

Michael Koester turns what may be an actual worrisome “place” into an abstract digital print. *Nuclear Pool* (2007) portrays the nuclear fuel rods in a reactor’s pool of water as they produce the blue electromagnetic glow known as Cherenkov radiation. This bright, colorful square dotted with circles belies its high tech, intense origins and its potential for both beneficial and toxic outcomes. The minimalist print, once labeled, generates unresolved tensions as it evokes a refined aesthetic simplicity as well as the quite threatening depths of a nuclear pool.

Both **Harriet Rex Smith** and **Kathleen Caprario** independently produce fantasy works inspired by images from the Hubble telescope. Using the photographed swirls of distant galaxies, already enhanced and modified by astronomers, both Smith and Caprario modify them again to serve mythic and spiritual purposes.

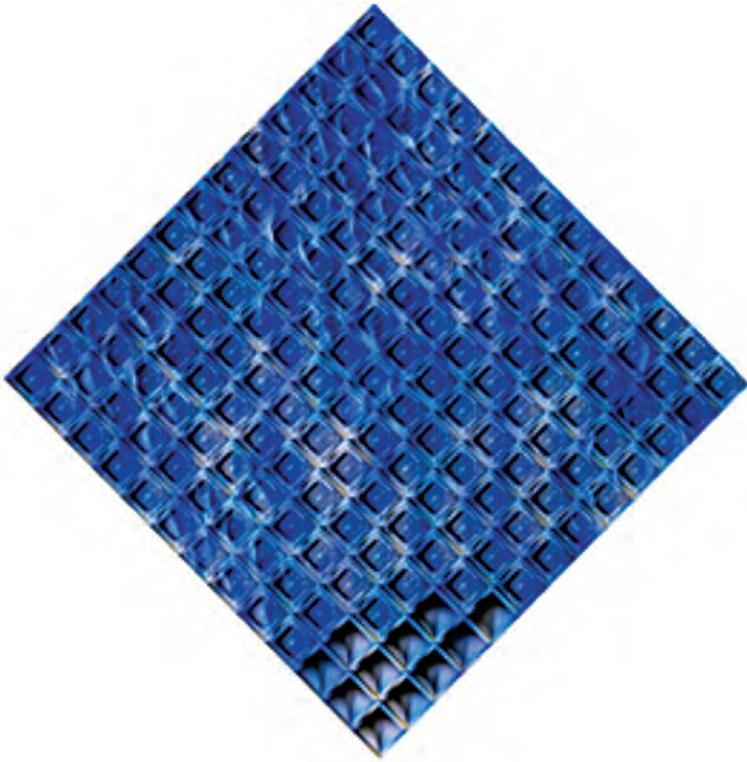


PLATE 25. Michael Koester *Nuclear Pool* 2010

In *Lagoon Nebula over Mt. Shasta* (2000) Smith connects the far distant galactic immensity of a nebula to a close up of a more familiar, somewhat large feature here on earth—a mountain in Northern California, Mt. Shasta, which can be seen with the naked eye from near the campus where the *Art Inspired by Science* exhibit was hung. Smith’s watercolor attempts to align and integrate the two radically different objects to convey a single idea: “the quantum physics idea of ‘entanglement’ and the holistic view of ‘oneness.’” The rather esoteric concept of entanglement posits an interaction between particles even if they are a galaxy apart. For Smith it is the conjoining of cosmic vastness with the concrete local at human scale that generates a sense of wonder and oneness, connecting us and familiar landscapes with the myriad stars.

Kathleen Caprario also transforms images of galaxies into spiritual icons. Her oil, *The Enchantment* (2009), gives the wispy, outer space Hubble photograph a ghostly enhancement of shapes and forms emerging from the blur of stars (see image on page 26). Are these the gods of the cosmic dance, or embodied energies of space/time, or familiar earthly effects of the sun through clouds, or just far away wisps of light and matter? She wants us to see all sorts of connections in this image: “the relationship of self to the greater, macro environment.”

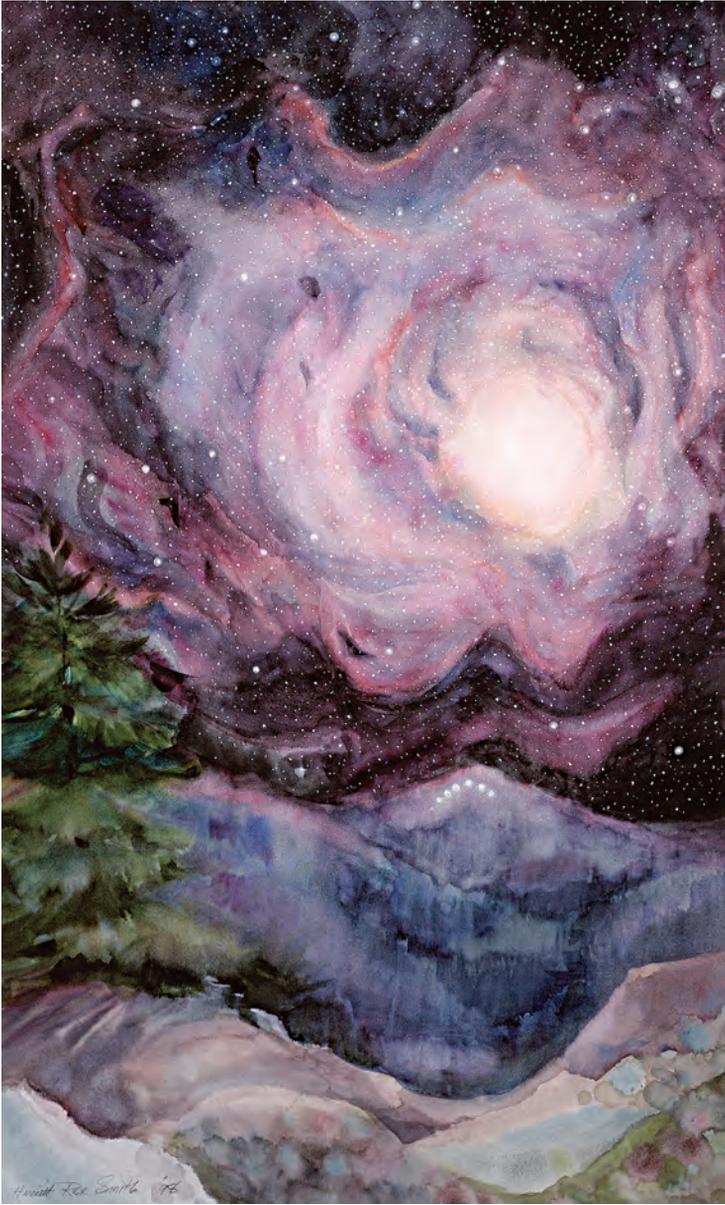


PLATE 26. Harriet Rex Smith *Laguna Nebula over Mt. Shasta* 2000



PLATE 27. Kathleen Caprario *The Enchantment* 2007

Works Made by Individuals by Hand, Depicting Features of the Natural World

In this group of works, the artists represent somewhat familiar objects in unique and creative ways, so that to label them scientific “illustrations” would mislead: the works and statements here seem focused on the natural world as we know it, yet we are led to see and interpret aspects of it in novel ways.

Paula Fong in her watercolor *Stonecrop* (2008) gets closest to science illustration: her small swatch of a water bank displays mosses, lichens, and flowers growing on a rock. Fong carefully paints them so that we can identify their species and imbues the whole scene with subdued tones that convey the shadowy coolness and



PLATE 28. Paula Fong *Stonecrop* 2008

dampness of this less than conventionally beautiful and appreciated environment.

In *Old Growth* (2010) **John Sollinger** also treats a humble patch of landscape, the messy base or “duff” of a western cedar tree littered with needles, leaves, and supporting lichens and mosses. This attention to nature’s scatter gets enhanced through the materials used to compose this quasi-mosaic: stained glass and southwest Oregon sand. Perhaps disregarded as debris and low life forms, these elements of *Old Growth* point to a different kind of grandeur on the ground, matched by the nearly invisible old tree, but immediate and as everlasting as the tree, and given the title, to be equally revered.



PLATE 29. John Sollinger *Old Growth* 2010

Carol Ovenburg also paints a spot of forest floor, quite abstract and barely recognizable within her grid, as she attempts to capture the ever-changing ecological process of growth, death, and renewal, which she wants her painting to order. Each section of the grid in *Spring Thaw* (2009) seems to become its own work of art, where organic forms transform as they thaw and seem to acquire living connections. She even recycles her paintings the way nature recycles natural elements and asserts that viewers’ own neurobiology gets changed from witnessing her works.

Liz Lee collects and scans actual leaves then modifies the images to create a flat contemplative, almost stark space around them. She wants any one leaf in her “New Leaf Series” to symbolize aspects of the human condition: “happiness, depression, instinct and obsession.” Her digital leaf print *Loneliness* (2008)



PLATE 30. Carol Ovenburg *Spring Thaw* 2009



PLATE 31. Liz Lee *Loneliness* 2009

provokes ambiguous reflections about growth and loss and the potential for outside interference—the hole—to change our outlook on life. However, part of the leaf is still green and its life cycle might suggest an ongoing, evolving encounter with both isolation and connection to others. Such reflections may draw our attention to any natural object as an aid to free-ranging contemplation as in Zen Buddhism, but Lee’s modified leaf and title seem to direct our thoughts in a more defined way.

Laurie Rawlins in her painting *Crepuscular Rays* (2010) captures those sun rays that appear to emanate from one point in the sky, usually behind clouds at dawn or dusk, the “crepuscular” (or “obscured”) hours. Growing out of her study of optics in nature, her paintings of light are, she says, “not illustrations, but impressions of optical phenomena.” The impressionism she employs to capture these rays seems more focused on the effects of light on sky, land, and water, rather than on the viewer’s subjective vision. Her layered blues, whites, golds, and the variegated colors of water, all crossed by the vertical yellow rays, convey a scene of freshness and calm after storm, not really characteristic of the dazzling sky heroics in most sunray phenomena. To that extent, *Crepuscular Rays* does impart Rawlins’ subjec-



PLATE 32. Laurie Rawlins *Crepuscular Rays* 2010

tive impression of the glittering aspect of this kind of light show.

Clay Lohmann quilts human body parts and anatomy in *Quilt 1* (2008), inspired, he says, by life drawing and by famous anatomy illustrators from Vesalius to Henry Van Dyke Carter. The quilted cloth images give a decorative aspect to the foot bones, chest and face muscles, and leg veins, emphasized by the addition of abstract designs and flower ornamentation, as if the human figure is stepping out for a fancy undress jaunt, with perhaps the sun and moon accompanying him. The quilt itself evokes a folksy world where anything but human anatomy would normally adorn it, and implies a look below the surface of ordinary patterns. The hint



PLATE 33 Clay Lohmann *Quilt 1* 2008

of patchwork in the lower right can suggest the patchwork assembly of the human body fabric as well.

Kathryn Cellerini's take on the body is a bit more disturbing and personal. In a multi-part installation, she creates sculptures of viscera (her own she says) from mulberry paper stamped with carved wood blocks and water-based inks, which she stains and massages with tea, and then sows with embroidery thread. The results appear a bit too real for some squeamish viewers. By now, though, many will have seen the Body Worlds exhibits of artist/anatomist Gunther von Hagens and the “plastinized” form of actual bodies engaged in everyday activities, so the shock of Cellerini's paper organs should not be so great. However, to their realistic aspect, Cellerini's adds that these viscera represent her own internal organs in potential stages of disease and health due to a chronic digestive disease. For her, these and other pieces “symbolize my physical and emotional struggles to process, repair, and heal.” This artist therefore bares herself in uncommon and somewhat shocking ways.



PLATE 34. Kathryn Cellerini *Reparations I, II, III* 2010

Hiroko Yoshimoto, who had a separate gallery of works in the *Art Inspired by Science* exhibit, made the earth-toned, exotic imagery of her *Burn #6* from *Rising from the Ashes Series* (2009) with charcoal and ashes from actual fires in Ventura and Santa Barbara Counties, California. She hints at phoenix-like new growth in the tangle of burnt twigs and branches. Primordial and menacing in its aspect, the jumble of tree



PLATE 35. Hiroko Yoshimoto *Burn #6* from *Rising from the Ashes Series* 2009

parts evokes living organs of the earth itself, exposed in their damaged state but capable of re-growth. *Burn #6* expresses the dark beauty of destructiveness, with the promise of renewal.

Yoshimoto not only employed materials from fires for this art, but also won a grant from the Ventura County Arts Council and James Irvine Foundation to promote fire prevention through a series of public talks by fire officials that featured 15 large drawings and paintings she made for this project. Her art from the earth ultimately serves the earth in both its nature-based origins and ecological purpose.

These artists, realistically depicting features of the natural world, still have a wide latitude of expression as the natural takes on new beauty, solemnity, power, and danger in their science-inspired visions.

ACKNOWLEDGEMENTS

In the initial planning stages for this exhibit, I was greatly aided by fellow members of the AAAS, Pacific Division Executive Committee, Professor John Hafernik of San Francisco State University and Professor Alissa Arp of Southern Oregon University. Professor Roger Christianson of Southern Oregon University, the AAAS, Pacific Division Executive Director, provided key guidance to facilitate university involvement with the exhibit and the conference panel about it. He also set up and designed this monograph. I express my deep gratitude to each of them.

In selecting artists and works, collaboration with Director Michael Crane of the Schneider Museum of Art at Southern Oregon University was indispensable. He was the primary liaison with artists submitting works. He and his staff have my profound thanks for the imaginative and accessible displaying of the works in five galleries around the SOU campus throughout the summer of 2010. I am also grateful for his helpful review of the early manuscript and for crucial clarifications of the Notes to the works below. And many thanks go to my former student and English professor, Amy Madsen, who proofed a later version. Any errors are my sole responsibility.

NOTES

PLATE 1. Brain Gillis and Mike Miller, *Wunderkammer: An Expeditionary Journal 2009*; 8' x 8' tables with 3-D printed ABS plastic, laser-cut plexiglas, laser-etched graphite-coated arches paper, laser-etched acrylic paint-coated arches paper, wood, fiberboard, styrofoam, and steel with digitally produced images and objects. Exhibit photograph by Michael Crane.

PLATE 2. Rochelle Newman and Maryanne Scatamacchia, *Numerarium—The Nuance of Number 2009*, mixed media sculpture and flat book with eleven laminated binders (8.5 x 11 x 3) and pages; 3-ring binder with letter size pages with drawing, painting, computer printing.

PLATE 3. Luc Benard and Richard Palais, *Equation Series, 2007*, 24 x 36. These fractal images were produced by using various equations as input in Stephen Ferguson's Flarium24 Windows program, using 40 iterations and the filter: $rr+=\text{atan}(\text{fabs}(\text{dzy}/\text{dzx})) * \text{atan}(\text{fabs}(\text{dzy})) * 2$. They were then assembled in Photoshop using fonts and coloration to mimic the old technical drawings of Leonardo da Vinci.

PLATE 4. Luc Benard and Richard Palais, *Kuen's Surface: A Meditation on Euclid, Lobachevsky, and Quantum Fields*, 2009, digital print generated by a formula of the Sine-Gordon Equation, 24 x 36. This image was awarded first place in the Illustration category of the NSF/*Science Magazine* 2009 Scientific Visualization Challenge.

PLATE 5. James Thompson, *Formus*, 2001, digital print of drawing with computer-generated complements, 16 x 16.

PLATE 6. Carlo Sequin, *Aurora Australis*, 2010, bronze, from another's sculpture converted into a mathematical formula, manipulated and generating the form of this sculpture, 16 inches tall.

PLATE 7. Linda Lee Nicholas, *Pink Algae in Moss*, 2009, ink on paper, 12.5 x 13.5.

PLATE 8. J'Sha, *Nanolite*, 2010, nanoentomography image, viewed in microscope, 100 microns tall (0.1 mm).

PLATE 9. Julian Voss-Andreae, *The Well (Quantum Corral)*, 2009, gilded wood, image generated by scanning tunneling microscope, 12 x 12. Exhibit photograph by Michael Crane.

PLATE 10. Steve Zolin, *White Motionscape*, 2007, mixed media on paper, 18 x 24.

PLATE 11. Hiroko Yoshimoto, *Sengai Triad*, 1986, mixed media on canvas, 36 x 45.

PLATE 12. Hiroko Yoshimoto, *Fibonacci II*, 2005, wall hanging of rice paper squares, sumi ink, 72 x 48.

PLATE 13. Hiroko Yoshimoto, *Wavy Lines II*, 2009, oil on panel, 96 x 120.

PLATE 14. Flounder Lee, *1024 Points to Make a Hypercube*, n.d., inkjet print on drawing paper, 22 x 26.

PLATE 15. Tallmadge Doyle, *Kepler's Cosmic Geometry*, 2006, etching, aquatint, 20 x 30.

PLATE 16. Steve Miller, *Protein #409*, 2007, mixed media silkscreen on paper, 30 x 40. Exhibit photograph by Michael Crane.

PLATE 17. Susan Knight, *Red Water Chaos*, 2008, cut paper, acrylic paper, colored pencil, dimensions variable. Exhibit photograph by Michael Crane.

PLATE 18. Kit Callahan, *Ellipse II*, 2004, graphite on paper, 84 x 100.

PLATE 19. Ken Patton, *Waltzing Hammers*, 2009, mixed media kinetic sculpture, 70 x 20 x 6.

- PLATE 20. Patricia Pease, *String Theory*, 2008, fiber, 39 x 41.
- PLATE 21. (Myrrh) Trudy Reagan, *Energy Becomes Matter*, 1997, digital print, round and covered with acrylic plastic, 24-inch diameter.
- PLATE 22. Terry Nathan, *Smoke Dance: Where Kant Meets Newton*, 2008, photo.
- PLATE 23. Shoshanah Dubiner, *The Deep*, 2007, gouache on paper, 18 x 24.
- PLATE 24. Colombe Leinau, *Olympus Mons*, 2005, acrylic on canvas, 28 x 28 x 1.5.
- PLATE 25. Michael Koester, *Nuclear Pool*, 2010, mixed media digital print with electronics.
- PLATE 26. Harriet Rex Smith, *Laguna Nebula over Mt. Shasta*, 2000, watercolor, 40 x 60. Photograph of painting by Robert Jaffe.
- PLATE 27. Kathleen Caprario, *The Enchantment*, 2007, oil, wax on wood panel, 30 x 30 x 1.5.
- PLATE 28. Paula Fong, *Stonecrop*, 2008, watercolor, 12 x 20.
- PLATE 29. John Sollinger, *Old Growth*, 2010, stained glass, native sand on panel, 20 x 16.
- PLATE 30. Carol Ovenburg, *Spring Thaw*, 2009, oil on canvas on panel, nine 16-inch square panels.
- PLATE 31. Liz Lee, *Loneliness*, 2009, digital image, archival ink-jet print on photo rag, 16 x 20.
- PLATE 32. Laurie Rawlins, *Crepuscular Rays*, 2010, oil on canvas, 48 x 48.
- PLATE 33. Clay Lohmann, *Quilt 1*, 2008, machine and hand embroidery on new and used cotton, 78 x 72.
- PLATE 34. Kathryn Cellerini, *Reparations I, II, III*, 2010, three, suspended mixed media constructions of woodcut and linocut on unryu and mulberry papers, tea, pins, embroidery thread, sewing thread, and beeswax. Each piece approximately 18 inches high, installed dimensions variable.
- PLATE 35. Hiroko Yoshimoto, *Burn #6* from *Rising from the Ashes Series*, 2009, acrylic, charcoal from burn sites, pastel on paper, 48 x 60.

