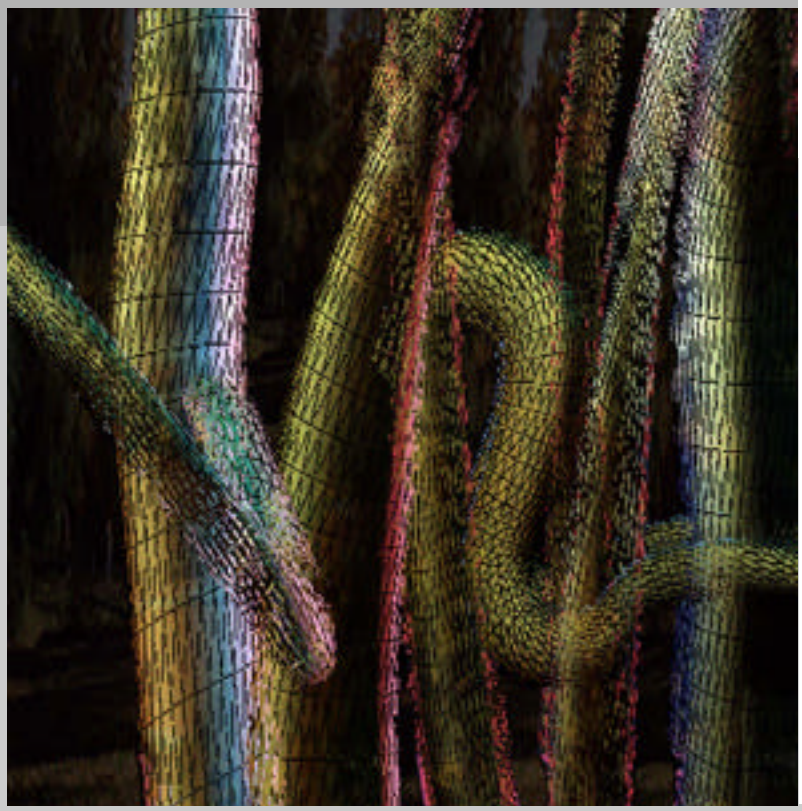
NEWSLETTER number. 6 volume 20 May/June 2000

Artists Using Science and Technology



# Artists Using Chance Operations

# Artists Using Chance Operations

Loren Means

In my last editorial I included an extensive excerpt from John Briggs' book Fractals. This time I'm going to present an extract from Dr. Leonard Shlain's *Art and Physics*:

"The American unleashing of the atomic bomb in 1945 ended the war and changed forever the fate of the planet. What began with Einstein doodling some calculations on paper napkins at outdoor cafe tables in Bern transmogrified into a stupendous burst of energy forty years later. This event ushered in a new paradigmatic era as well as a new physical one.

In Einstein's formulation of the special theory it was the field of light itself that determined the structure of space and time. Quantum physicists discovered that "things" constructed out of matter originate in fluctuation of insubstantial fields of energy. Since the field was made of nothing and was invisible, it had to remain a mental abstraction. Painters, too, began to explore the idea of art without an image. Though the great movement of abstract art began in 1910 with Kandinsky, it culminated in 1945 with Abstract Expressionism in New York. This tight-knit group of artists went further than previous abstract painters to create new images that spoke directly to the issues Einstein considered concerning our perceptions of space, time, and light

Jackson Pollock was the most revolutionary of these abstract painters. Among the several radical changes he introduced to art, one was to place the empty canvas on the floor instead of upright on an easel.

Because Pollock's finished works now hang on the walls of museums, viewers routinely orient each piece in conventional two-dimensional space: top and bottom, right and left. In creating his works, however, Pollock did not adhere to such a commonsense orientation. He was not interested in creating a "thing" that existed in the context of homogeneous space and linear time.

Unlike artists who had come before, Pollock wanted to translate the actual physical motion of the artist's wrist on to canvas. He therefore evolved an art form less concerned with portraying any image than with illustrating the unseen moment of the creative process... The process of painting itself became the subject matter of art.

Pollock described this process:

> My painting does not come from the easel...I prefer to tackle the hard wall or the floor...On the floor I am more at ease. I feel nearer, more a part of the painting, since this way I can walk around it, work from the four sides and literally be in the painting...
>
> I continue to get further away from the usual painter's tools such as easel, palette, brushes etc. I prefer sticks, trowels, knives and dripping fluid paint or a heavy impasto with sand, broken glass and other foreign matter added.
>
> When I am in my painting, I'm not aware of what I'm doing. It is only after a sort of "get acquainted period" that I see what I have been about. I have no fears about making changes, destroying the image, etc., because the painting has a life of its own. I try to let it come through. It is only when I lose contact with the painting that the result is a mess. Otherwise there is pure harmony, an easy give and take, and the painting comes out well.
>
> (Jose Arguelles, *The Transformative Vision*, Boulder: Shambhala, 1975, P. 253.)

In Pollock's most famous paintings there are no things, merely the expression of energy and tension. Typically, in his work there are no vectors of direction. His paintings are not changed very much if they are hung upside down.

They have no center or hierarchy of interest but instead give all areas of the picture equal importance. Pollock's canvases are uniformly filled from border to border, just as a field does not occupy a particular location but is ubiquitous in space. His works approximate the principle of the field as conceived in physics.

The space of Pollock's paintings meshes in a matrix with time. In his works, the paint itself flying through the air became a prolific metaphor. In all art previous to his, there had been a direct connection between the artist's intention and the effect when the brush was pressed against the canvas. This conversion of inner will into outer action expressed the essence of causality. The conscious mind directing the hand that holds the brush pressed against the canvas is the cause of the stroke; its imprint, the effect. By standing back and flinging paint instead of applying it, Pollock disconnected the artist from the canvas for the first time in Western art. For a brief moment as it traveled through space, paint arced in a fluid stream that was out of control.

As if in acknowledgment of the importance of this transitory moment in Pollock's creative process, more photographs have been made of this artist engaged in his paint- dance than of virtually any other artist in the act of creating a painting. Why is that? Why is Pollock's choreography more interesting than a photograph of anyone else involved in the creative process? Perhaps because a photograph captures the crucial unseen segment of Pollock's finished work, and complements

cover: Donnalee Dunne, *Intercession.*

(continued on page 13)

## Forum : Preview of Burning Man 2000

Ylem will host a preview presentation of Burning 2000 art. rning Man is a late summer outdoor festival of performance d installation art in the the Nevada desert, with attendance mbering almost 30,000. The speakers will discuss previous d forthcoming works of art for the festival. The festival enders are the presenters! Julie Holler writes, “It’s azing, seeing these complex structures and beautiful rks of art that may have taken a full year’s work to hieve... and at the end of the week are burned at the hands their creators.” Louis M. Brill, special event coordinator for m and Lady Bee, art curator of the Burning Man Festival ll introduce the presentation and the speakers:

Tim Black, creator of L2K – LED lighting circle

Michael Sturtz, facilitator at The Crucible will create at rning Man a temporary molten metal foundry

Jim Mason, artist in residence for Burning Man will create ageant puppet presentation of the stock market

Cassidy Curtis, inventor of the tele stereoscope, a unique reoscoptic viewing device will discuss and possibly monstrate viewing scope that will be exhibited at Burning an

Lisa Nigro, creator of the Flaming Metal Dragon. The ming Dragon in all its glory will be presented as a fire rformance installation.

(Due to ongoing activity of artists preparing their Festival installations, substitutions may occur).

Wednesday, July 19, 7:30 PM
McBean Theater
The Exploratorium
3601 Lyon St.
San Francisco, CA 94123

Information listed at
< http://www.ylem.org/NewSite/news/Forumtables.html>
learn more about Burning Man: www.burningman.com

Upcoming Forums:

September 20, Nature in Art: natural patterns and biological ideas as subjects for art.

November 15: On the Edge of Not Being Seen: Science imaging and what we can (or can’t) know.

2001—Ylem’s 20th Anniversary

Brainstorming about this is already going on. Anyone who wants to give ideas and help, contact Ylem’s president, Trudy Reagan: 650-856-9593,or email trudy at: trudy.myrrh@stanfordalumni.org

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# Earth Paintings, Chance, Links With Chaos Theory

Nora Raggio

1. *Earth Paintings*: a process

In 1995 I began a series of paintings which I called *Earth Paintings*. I make my work by painting with earth on paper,

Drenching paper in seawater

multimedia board, or canvas which has been soaked in seawater. I'm attracted by the interplay between my vision and the accidents that happen when sedimentary rock is washed in seawater.

In the beginning, I drench the blank surface (paper, multimedia board, canvas) in the ocean. The ocean waves surround my legs. As I wade in the ocean, I get a tangible feeling of the waves' whirl, current, pull, an echo, or reminder, of our Earth's rotation. There is a freshness to the sea that awakens my body. This experience primes me for the movement that will emerge in my work.

I walk out with the wet, primed paper/canvas, onto the Pescadero beach, a stage of sand and rock. The bluffs flanking the ocean yield a subtle, sensuous color. The limited cliff palette I use has a beckoning earthen grammar of white, iron-red sienna, bone gray, volcanic brown-black, with some surprising blue-gray. The blue-gray, I suspect, borrowed by the cliffs from the ocean over the time.

Pictures basking in the sun

I work with the cliffs' earth hues by letting my hand rub or slide the mud over the wet surface, allowing my awareness of the surrounding environment to guide me. My impulse is to integrate the apparent contradiction of the wet coexisting with the dry, of the ocean sculpting, eroding, washing the cliffs and the cliffs bounding, sucking up the ocean.

The pieces I have worked on with the soft clay on the sea-drenched surface, lie sunning on the beach, next to the cliffs and the ocean front. Occasionally, I will look for stones to keep my pieces from flying away with the wind. A convergence of natural forces comes into play in the creation of my work.

I enjoy the open-air workspace of the beach, my favorite earth painting beach being Pescadero, in Northern California. Curious seagulls land near my paintings. Perhaps they think it might be food. Locals walk by, some are interested and ask questions. A couple of Italian tourists, training in multimedia at nearby Silicon Valley, roam down the coast and by chance, run into me. “You know, this is the way our ancestors painted centuries ago, with color derived from hills, they made their own pigments!”

When the pieces have dried, I wade in the ocean and wash them. The ocean “develops” the pictures by cleansing the paper/canvas, making clear what was once covered by extra earth clumps and powder.

More recently, I have experimented with leaving the raw mud on the pieces, without washing. This results in increased opacity and translucency from the different densities of earth on the media.

2. Chance origins and other earth painting stories

I chanced on my first earth paintings in freshwater. Later, like fish swimming towards the ocean, I came to practice my earth painting series by the sea, mainly on Pescadero beach.

This is the story of how it all began. It was July 1995 and I was taking part in a painting workshop led by Marguerite Fletcher, who happened to bring with her a few books on Andy Goldsworthy. The workshop focused on water color painting, but leafing through the Goldsworthy's work engendered in me a yearning to be closer to nature, to work more collaboratively with the elements offered to us naturally, rather than to work with processed materials.

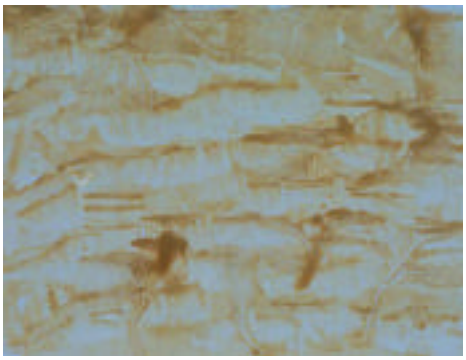
Later on that day, I started with watercolors on a small wooden dock jutting into a small lake at a ranch near Pescadero. The hot July California sun was beating down on me relentlessly, my body heating up like a ripe summer fruit. Without warning, and quite impulsively, I fell into the lake taking with me the two-by-four feet Lana aquarelle paper I was working on. I felt refreshed and curiously silted with the soft clay particles suspended in the lake. The piece of paper naturally soaked by the lake, taking suddenly a weight of its

n, invited me to plunge deeper . As I resurfaced near the re, I couldn't help but notice the warm gray color of the 's shore mud. I grabbed a handful, and when I stepped on dock again, I spread the silt softly over the drenched er, unintentionally making a “wood rubbing” with the wet h and the patterns of wood on the dock. There was nething about the utter sensuality of the process and the tle, natural markings that resulted on the drenched paper, ch kept me practicing this dive, drench, and mud eading, the whole afternoon and through next day, until the kshop ended.

ater, that same July, I visited Pescadero beach, on another nting workshop. I felt compelled to continue the eriment I had begun in freshwater--with seawater. Now, fortuitous secret about Pescadero beach is that the cliffs, de of sedimentary rock flanking the Pacific Ocean, provide most varied earth palette that can be found for miles und. As I mentioned earlier, the hues vary from off-white, eddish, to gray, to dark volcanic black. Those colors all live e, right by the shore, and moreover, they are not hard, but mbly and very soft when mixed with water. I experimented n the seawater and the earth palette on different media: er, canvas, multimedia board and so started my series *h Paintings*

wo distinct stories come to mind that illustrate how ironmental factors, the earth, wind, seawater, and sun, ract and collaborate with the “trance” process I've come to over and practice by the seashore.

One of my first and still one of my most valued pieces to erge from this collaboration with nature is a sienna red h piece that came to be quite by accident. I drenched a



Anastamotic Earth

e of heavy watercolor paper in the ocean and immediately ered it with a single earth color using a sponge brush. ead of leaving it to bake completely under the sun, I took ack to some very quiet, shallow waves by the tide pools. most amazing anastamotic forms emerged throughout piece. Anastamotic is perhaps a clever shorthand for a tern seen quite recurrently through nature. It is basically “branching” pattern seen in leaves and in tree branches, same branching pattern of rivulets becoming streams, n rivers, and finally the ocean. I was quite struck by how the simple process I practice could bring forth such a magnificent and delicate pattern.

A more recent story evokes the rather overwhelming power natural forces have on my pieces. Near the end of last year, when I was working by the shore on a triptych I later called *Earth Whale*, I noticed a rather unusual phenomenon at the beach. The tidal range was about half a mile wide, rather than the usual twelve to twenty-four feet at Pescadero. I was marveling at the depth of the tide “pendulum” when all of a sudden the three related pieces that were drying on the beach were swallowed up by an ocean wave and taken very quickly out to sea. Impulsively, I followed my three floating pieces. Wading breast-high into the ocean I retrieved them. The undertow had a tremendous pull and it was difficult getting back to the dry beach. Because of this “accident” the paper had taken on a wavelike character and the earth had been partially cleansed by the water into deep channels, giving the triptych a very vulnerable, poetic presence.

3. Links to chaos theory

I first became acquainted with chaos theory around 1995 when I read James Gleick's book, *Chaos-Making a New Science*, (Penguin, 1987), an accessible introduction to the complexities of chaos theory.

I find “strange attractors” and complex patterns evolving from the repetition of simple processes fascinating and see their effect in my art

The notion of strange attractors, as I understand it, relates to the fact that some patterns tend to certain (for lack of a better word) “gravitational” centers. For example, nightmares or dreams may, for a while, or with some periodicity, gravitate towards a theme, and revolve around “Goldberg variations” of this theme. It happens with relationships too: an interaction with one human being may bring out in oneself a very different pattern of interaction than with another human being, and the patterns that evolve with one human being tend to revolve around certain topical themes.

I would say that the strange attractor in my earth paintings involves being attracted to the same beach, Pescadero, again and again and interacting with that beach in special ways. The confluence of a repeated process, with repeated environmental elements and a geographical center for the process, results in the making of the series *Earth Paintings*.

The emergence of complex nature patterns through the repeated use of a simple algorithm, such as the famous Mandelbrot series, has a link to my art. The process I use at the beach is a simple one, as outlined in the first part of this essay. I drench the medium (paper, canvas) with seawater, rub patterns over the surface with wet earth, let the pieces dry for a while. Usually I wash the pieces off (or "develop" them) in the seawater and let them dry again in the sun. This process embues my work with a very natural, organic presence. xxxxxx

Nora Raggio nraggio@ispchannel.com

# Patterns of Matter: Exploring the Microscopic World

Andrew Haynes

Our physical surroundings reveal beauty where we least expect to find it. A closer look at everyday objects uncovers worlds within a few square millimeters. The microscope allows us to illuminate and appreciate the natural architecture in a few of its manifestations. By studying these minute landscapes we can see how the logic of matter forms our universe. This understanding is immensely useful to scientists yet also provides ample creative opportunities. For the past five years, I have been taking photomicrographs of these crystalline worlds. The images I choose to record are those that evoke a certain mood, resemble a particularly familiar object, or simply present an eye-catching image. The view through the eyepiece is rarely disappointing for no two formations are ever identical. Experimenting with the variables in the process yields a rich trove of visual finds.

Grant Elliot's *article The Art is in the Defec*t in Volume 19 #12 of the Ylem Newsletter explains how crystalline abnormalities occur in the manufacturing process. My approach is somewhat different in that I grow imperfect crystals intentionally for their visual impact. My photomicrographs differ from Dr. Elliot's in another important way. I use transmitted polarized light rather than reflected polarized light. The photographs are taken at relatively low magnification (10x-50x).

A polarized light microscope connected to a 35mm camera permits me to bring back images of this crystalline micro-architecture. Polarized light microscopes have two movable polarizing filters that can be positioned to create a specific optical effect. At right angles these filters block all non-refracted light. A specimen placed in this light path must bend the light so it can pass through the second filter. The light, slowed down and bent by its journey through the crystalline structure, finally reaches the camera.

Various solutions of reagent purity chemical compounds are used to form the crystal formations. A few drops of this solution on a glass slide will evaporate leaving a thin sheet a few microns thick. These small formations may be very heterogeneous. Small gradients in temperature or concentration may result in large well-defined specimens or clusters or both on the same slide. The slightest shift in the crystal's orientation to the light path results in a shift in the spectra passed to the eyepiece and film plane. Manipulating these variables allows the visual artist to produce a diverse group of images from just a few different chemicals.

Crystals formed under varying conditions behave accordingly. Low temperatures and medium concentrations yield mostly regular, well-defined formations. (fig 1)

Fig 1, to the right, depicts low temperature crystallization of Magnesium Nitrate. Note how the essential regularity of the growth is constantly changing. 20x magnification with dark field illumination.

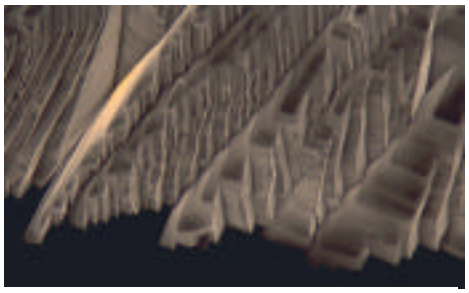


Figure 1: *Escalante* 16X20 Ilfachrome print (1996).

Note the repeating branching pattern as the crystal advances across the glass. The self-similarity of shapes at differing scales is characteristic of crystals and other fractal objects. The formation is also relatively thick as shown by the high relief. The same compound recrystallized at a higher temperature will lose its angular appearance and become more heterogeneous.

The over-stressed solid can no longer remain integral and cracks accordingly. These flawed formations are frequently more interesting visually than intact specimens. Examining these landscapes under the lens is like a treasure hunt where occasionally one stumbles over something really remarkable and unexpected. (fig 2.)

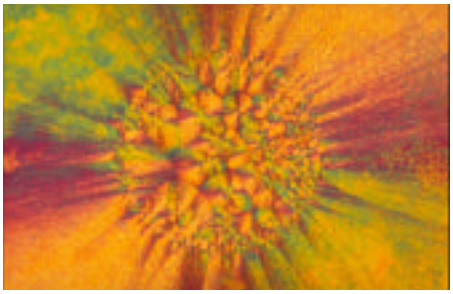


Fig 2 *Helios* 20x24 Ilfachrome print (1998).

Figure 2 is the result of the temperature (200 degrees C) fusion of magnesium and potassium compounds. Note the secondary crystal pattern as two layers intertwine to yield this portrait of an exploding sun. 25x magnification with 530 nm quartz compensator.

The unpredictable nature of this process offers the possibility of many different images

All of the crystals begin as "seeds," points of origin, footholds for the molecules to begin their assemblage. Something as minute as an imperfection of the slide or a speck of dust can provide the impetus for growth. As the growth process progresses, influencing factors shape the physical structure. The final formation is a record of the physical environment during the crystal's growth period. A "mature" crystal is like a tree's rings indicating different conditions during its life span.

Many of the crystals I grow are of hygroscopic (water acting) compounds. These crystals have particular interest ause of their short life spans. After formation, they quickly in pulling moisture from the air. Under the lens they appear sweat", beads of atmospheric moisture become visible on r surfaces. Gradually enough moisture accumulates and the nation begins to dissolve (fig. 3).

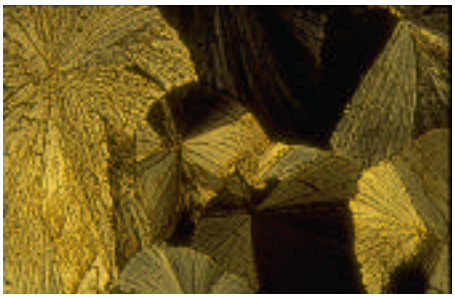


Fig 3 *The Big Thaw* 8x10 Ilfachrome print (1995).

Figure 3 shows a high temperature magnesium nitrate nation a few minutes after formation. Atmospheric sture has begun to return the chemical to solution. 25x gnification with dark field illumination.

As rapidly as it formed, the crystal disappears from sight. A cycle of sorts is played out in the space of a few minutes as se tiny gems grow from darkness and fade away soon after. ntinued re-crystallizations can be created on the same slide n each incarnation displaying a new yet familiar shape.

The hallmark of crystallography is multiple axes of symmetry. number and corresponding positions of these axes form the is of the seven different crystal systems. Textbook trations depict perfect specimens to facilitate teaching. If stals are grown in a tightly controlled environment, this fection may be achieved. In nature however, the perfect cimen is rarely if ever encountered. The chaotic, redictable and random events interact with the crystal's metrical habit to form the solid world around us.

The system encounters feedback as it progresses and small malies are amplified during subsequent iterations. Close allels can be seen between crystal formation and computer erated fractals. The computer repeatedly feeds variables k into a nonlinear equation to create a complex, repeating, lving structure. Crystalline growth follows its own internal c and is affected by environmental variables which determine inal form.

Aside from serving as models of physical science, the nations can be appreciated from a purely aesthetic ndpoint. Many have a strong resemblance to objects we erve every day (figures 4 and 5,).

Fig 4, next column, is an image of a medium temperature assium pthalate formation resembling a bird's beating wings t alights on the nest. It is under 40x magnification with dark d illumination.

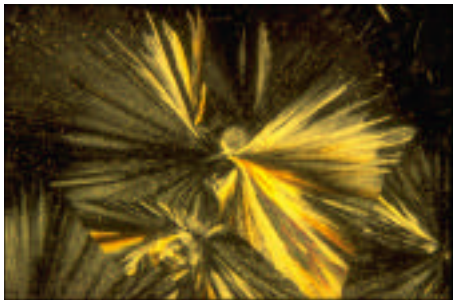


Fig 4 *The Nest* 5x7 Kodak C print (1996).

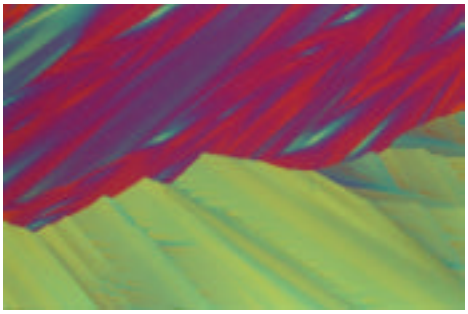


Fig 5 *Polar Mountains with Aurora Borealis* 20x30 Kodak C print (1996).

Fig 5 below shows the interface between a high temperature formation (characterized by the flowing blue and red) and a lower temperature formation.

Formations resembling geologic, plant and animal shapes are a real treat to encounter. While showing these images to others, I am pleased to see how people's imagination interprets each crystal. The abstract nature of the images often encourages free association in viewer's minds. The descriptions related by viewers are often completely different from my concept of the piece. Thus a single piece takes on new meaning with each person's observation. Each crystal is reinvented by every person who views it and chooses to interpret it in their own way.

I am continually intrigued by the world under the lens. In a space smaller than a human fingernail, one can observe mountains, life-forms and celestial objects. Observation of the growth process provides an inside view of nature's workings. Gentle manipulation of the growth process yields an infinite array of unique results. The randomness and unpredictability of dynamic systems are demonstrated in real time and in surreal color. The scientific world meets the aesthetic world in an ongoing ageless process of crystallization, dissolution and re-crystallization. The images bought back are a small snapshot of the infinite cycle of matter that forms our universe. XXXXXX

# Metaprogramming Emergent Graphics

Scott Draves

How can you write a computer program that doesn't get boring?

I have had that oh-my-god feeling while looking at computer generated graphics. Sometimes it even lasts more than a few seconds. How can that feeling be sustained?

Imagine you were given a limit of one megabyte disk storage for a digital artwork. How can you keep the user's attention? The beauty of any one clip of video or effect may entrance you, but without change - without evolution - we move on. Mere repetition of even the best content is tiring.

Randomization produces change, but a difference that makes no difference (in the sense of Gregory Bateson) doesn't count. For example, pure white noise is always different, but is boring because although technically it contains many bits of information, those bits have no meaning.

Software that produces random cut-up text (Note 1) shows real change, but it impresses only until the same words and patterns reappear again and again. Except for those few moments when we get lucky, the stars align, and magically the machine speaks to us. How often does that happen? Can we increase it? Is it possible to change coordinate systems to increase the likelihood of these lucky moments of beauty? Yes.

Any two artworks may be concatenated to form a larger work, but the information density remains unchanged unless there is a relationship between the works. The question is, how can we go super-linear? What kind of combination makes the whole greater than the sum of the parts?

Typical artificial life systems have a mapping from genotypes to phenotypes. I think of this mapping as a language - a mapping from programs to their meanings. There is a space of potential artificial creatures, each of which is a program describing that creature's virtual structure and behavior. For example, Tom Ray's Tierra is principally a metaprogram that executes the programs comprising the current population of the virtual universe.

A language can be defined either by an interpreter or a compiler. An interpreter is a metaprogram that reads a program as input, and traverses its structure and reduces it, performing the actions as it encounters them. A compiler is a metaprogram that reads a program, and translates it into the native language of the metaprogram. In practical programming terms, interpreters are slow to run and easy to write. Compilers produce fast programs, but themselves run slowly and are hard to write. A compiler accelerates execution of the genotypes by removing a layer of abstraction. The applicability of this essentially reductionist technique is a fascinating question. Can awareness be compiled?

With eye-candy software, the objective is to create visual effects that absorb human attention. They do so by producing novelty - a sequence of surprises - from a fixed program. The information and meaning that keeps your attention is decompressed by running the program. Iteration and recombination with the right language produces a diversity of effects and forms. The trick is finding the language in which beautiful things are easy to say. That is, to design a typewriter so that even a few thousand monkeys have a shot at producing real poetry.

## 1. Flame, Fuse, and Bomb

I build software that creates visual artworks and I freely distribute both the software and the resulting graphics by the internet (Note 3). This article describes three of these projects: Flame, Fuse, and Bomb. All three are iterated nonlinear systems in which higher-order patterns emerge.

They appeal to the sensuous eye, use natural colors, texture, and motion. They maximize user interest per byte of storage without exhibiting any practical value.

Bomb is a manifestation of the same vision that motivated my research in metaprogramming for graphics, which was about applying compiler generators to graphics. If the trick is to find the right language for mutation, then a tool for creating languages might be useful. There is an explosion of computation space opening up as price per flop approaches zero. These new spaces are a vacuum. The larger objective is to fill this these spaces with life.

Flame was written in 1993, and is a two-dimensional iterated function system fractal renderer (it draws a histogram of a strange attractor). The implementation is carefully designed to produce images without any artifacts, revealing as much as possible of the information contained in the attractor. The conversion of the histogram into pixels is properly anti-aliased spatially and temporally (motion blur). Was it to make it beautiful or accurate?

Figure 1 is an example of its output. (See also Figure 2, page 13, second column)

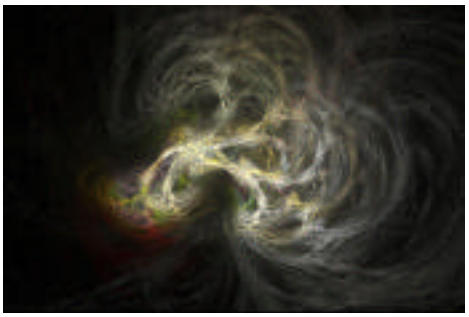


Figure 1: *Flame#165*, Scott Draves, 1993.

(Continued on page 11)

# In the Boundary of Function/Dysfunction

Donnalee Dunne

There is a space between what exists in the mind, and at exists in reality. This is the world of the computer artist e one who creates sculpture from electron beams; the one o paints with light. Artists have been drawn to the nputer by the brilliance of simple color married to the liance of light - as new and as exciting as stained glass in hic cathedrals. Ideally both must be viewed and erienced in context of that union. The radiance of the nputer screen is just as magical as the sunlight illuminating stained glass. We have embraced the computer and made vital part of our creativity.

We use the current technology in much the same manner t other technologies before it have been used by artists. ists have always worked creatively within the capabilities he medium. If paint just colored buildings , if bronze were y used for weapons and implements, if glass was used y for utilitarian objects, if computers were only used for okkeeping and memos, we would have little art today

Most artists push their media to the limits and beyond. It is part of what makes artists tick, and this is where the expected occurs. Perhaps it results from the computer's ess of being pushed beyond its resources, but here in the ndary of function and dysfunction, comes a magical gift. one who has worked in this medium very long has found v and then a marvelous rendering of the image that defies lanation.

I was a painter until ten years ago when I was introduced computer art software. I found an intelligent medium. I was cinated with the technology and felt I was experiencing a v art form akin to the Impressionists discovering the world painting outdoors with paint in tubes. For several years I d DOS-based programs - Crystal 3D and Lumena paint - ning on Targa 32+.I used a dual monitor setup with the nu on one screen and the image totally filling the second monitor.

Although my old, slow 286 with its 4 megs of RAM was moaned as a dinosaur, many times I felt so connected, as he mind of the computer was somehow reaching mine, I together we were creating images. I worked with the nd set of "seeing what the computer will give me today". I uld actually talk to it as if it understood.

But after a time I wanted to be in total control of what I was ating, so I worked countless hours, difficult hours, molding image to my satisfaction and purpose. Then, late at night, tired to go on, I moved the lights and camera for one last try. ally there it was. Something so wild, so far out, so wonderful.

I never could really explain *The Letter C*. What appeared on monitor was remote from any of the previous versions, and n not what I had told the machine to do. The computer had en me another present for all my effort.

When, in the fall of 1998, I switched to Windows programs PhotoShop 5.0 and Painter 5.0 on a Pentium computer, I nd that the best part of the change was the higher

*The Letter C*(1997), computer-generated print, 20" x 16"

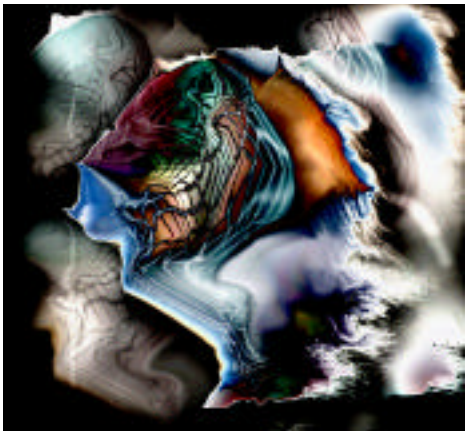
resolution available. I had waited almost ten years until I felt that the new software could do the same things the old Lumena did so well. Today I also use the program, 3D Studio Max, for some of the wire frame modeling.

The old dinosaur was my companion and when I so often asked it for more that it could give, it limped and cried and gave anyway. I would sit for hours waiting for an image to render line by line. There was a certain anticipated excitement in this process. There were times I could hardly wait for the last 3 or 4 inches to render to see if the image was acceptable. If the first rendering was anywhere close I would keep it. It became more difficult to reach that edge of the computer's capability with each upgrade, that space between where one's mind and the computer's meet. With today's speed and power, something is missed in the connective flow as we can reject hundreds of renderings in a short time until the one we like is given.

In 2D computer paint programs the activity is much the same as painting with physical oils or watercolor, with physical brushes. You stroke the canvas and get an instantaneous result. But the moment you apply a variable such as filters, one over another, the artist passes some of the control over to the computer. The artist can gain knowledge of what to expect from the programmed logarithms, but the results can be quite unpredictable. What you expect doesn't always happen.

In the process of creating *Egg Crystal* (page 9), I used several filters one after another. I have tried to replicate the filter effects since then but I never have quite gotten the same result again.

A move into three-dimensional space is an even deeper relationship with the computer's programming. The artist can learn how to construct an object, how to place that object into a scene, how to light that scene, where to position the camera, and what materials to use on the surfaces. The many coordinates are set, and the rendering begins. What now



*Egg Crystal* (1999), computer-generated print, 20" x 16"

appears on the screen is either not good, in that something needs to be reset, or pleasing, in that all is as expected.

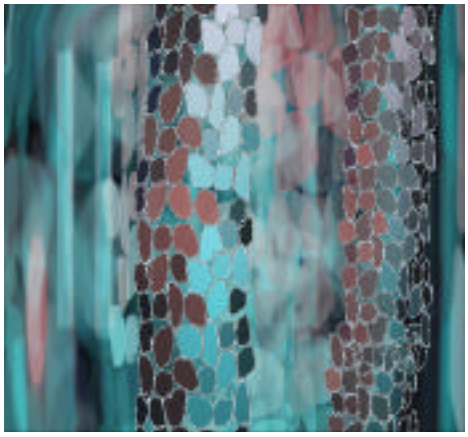
We have the choice of accepting or rejecting what is rendered, knowing that we set the parameters for what we see before us. This is the logic of the world of computer art. That if something doesn't render correctly it is human miscalculation. However, the unexplainable happens apart from logic.

It is said time and chance happen to all. The artist's task then is to evaluate that chance, to accept what the computer offers or to reject it. There is much to be learned from reconciling a mistake and knowing when to accept a gift. The computer can be very giving and it can be very unforgiving. From my past experiences the computer can be very preferential. Some people get marvelous results as soon as they sit down, and some struggle to the point of headaches.

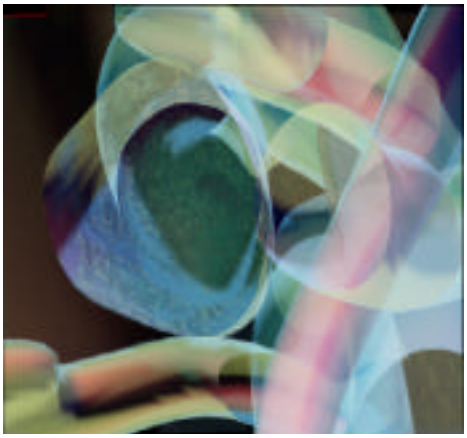
A few years ago, when I had the joy of watching the rendering in progress, I was able to stop the render at any time and leave what had been done on the screen. I would watch as the computer set the attributes of each polygon, slowly outlining each with the color and lighting effects to be rendered. Then, just as the last few polygons were being outlined, I would stop the rendering, and save the enhanced wire frame as an image. Then, I would let it finish. By having two versions, one the finished rendering and the other a colorful polygon line drawing, I was able to composite the final image in interesting ways.

In *Green Bark*, I put both the wire frame and the rendered image in buffers, and blended them using a high transparency brush. (Today, in Photoshop the same effects can be done in layers.) The same technique was used in *Top View*, with the addition, of a scanned image .

When I applied reflection mapping, the software saved the reflection it calculated into a accessible buffer. After final rendering of the image I would check the buffers to see how the reflection had been interpreted by the computer. Often I would find wildly beautiful imagery to keep, along with a lot of junk to toss out.



*Green Bark* (1996), computer-generated print, 20" x 16"



*Top View* (1996), computer-generated print, 20" x 16"

*Veil* (next page) was in part from a reflection map buffer. I loved the curtain effect, thanked the computer, and kept it. Today's fast machines have lessened the chances of a computer gift. Images render so quickly the slightest defect can be rejected and another version appear at the click of a switch.

The artist can have hundreds of variations quickly. But we now are seldom able to grab the process. The computer's workings, manipulations in progress are not as easily available as they were before. It can be faked with programs like 3D Max. The model can be rendered as a wire frame. But it is different. It now is simply rendering the lines of the model. Before, while the computer was working with those lines, I could save its “work in progress”.

However, one can still cause disturbances in the mechanics of the functions. Repetitions, over and over clicking on a tool can still stress the machine and cause malfunctions. It is easy to think it didn't “hear” us and click again, or on something else , all the while the computer is working on the original problem.

*Veil* (1997), computer-generated print, 20" x 16"

n the windows programs of today, the stressed computer ıply freezes and refuses to do anything, and the unsaved rk is lost. In the old DOS programs, the image would still ıain on the screen, as long as the second monitor was not ıt off. Then, when the computer was rebooted, the image uld still be there to capture.

The artist can still easily push the memory beyond capacity demanding more and more. If the machine does nething unexpected, the artist can discern what is of value. haps it's not really a gift, but a mistake. It is our choice. ıer way, we can toss it or embrace it. The machine is there olease. If it can't give what you are asking, or what it thinks ı are asking, it will give you something. The bottom line is, matter what the medium, it has always been the artist that ıws what works and what doesn't.

The question of value arises. Waiting for hours for one ıge, made it precious to me. I still have 8 or 9 year old ıges on 5 1/4" floppies, and although they are in a olution inadequate by today's standards, I hesitate to toss m away since they were so hard to make. Now only the ;t versions survive.

Computer art hasn't been around long enough to be truly ıluated. It has yet to stand the test of time. It has not ;ome an icon, but is still a phenomenon. It has yet to entify and justify itself.

The one thing a computer monitor lacks is surface. We rk with dots as Seurat, every pulse a point of light. We rk in the "space between" just behind the surface of the nitor glass. We work in the space between the physical t we can touch and the energy of light.

New technology tries to imitate the old, as Rome imitated the ek culture. We can make huge prints imitating oil on canvas t lack the individuality of the artist's stroke, that convey only illusion of surface texture. We can create virtual sculpture in erspace that lacks the solidity of real objects. Is the nputer only a tool? Or will there evolve a true art form ependent of the old technologies.

What computers do best is enhance reality, not replace it. The function of blending layers, compositing one reality into another or one perspective into another came into existence through computer technology. It gives the artist a wonderful tool to pull things into a scene and change the dimension of space.

Artists have always used the newest technology, from the discovery of paint, to bronze casting, to stained glass. But this is the first time their tools come with the ability to calculate. It is the first time that artists can feel as if those tools are creating with them. XXXXXX

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*Sun* (1999), computer-generated print, 20"x16"

It contains three innovations: 1) a set of seven special functions that increase the variety and character of the shapes, 2) it assigns brightness according to the logarithm of the density, rather than linearly, and 3) coloring is based on a third coordinate rather than density.

The logarithm is essential because the dynamic range of densities in the histogram is very large and has features at all scales (they follow a power law). That is, in one part of the image there may be adjacent pixels, one that was hit 3 times and the other 9 times by the dynamic system, and in another part of the image there are pixels that are hit 300,000 and 900,000 times. A logarithm is the natural way to exhibit both differences simultaneously. Without it some parts of the fractal are either excessively saturated or starved.

Despite appearances, Flame images depict strictly two-dimensional objects. There is an illusion of three dimensions due to the logarithm: if a dense part of the attractor overlaps a thinner part, the brightness of the sum is nearly that of the dense part, so it looks as if one part occludes another. The coloring algorithm works by adding a third dimension to the chaotic system. The third coordinate determines the color. This reveals the internal structure of the attractor.

The parameter space is a handful (2-5) of affine matrices (2x3) and the special function blending coefficients (7), for a total of 26-65 real dimensions. With so many dimensions and such a complex mapping it becomes almost impossible to design in that parameter space, instead you can explore it.

Flame is the last of a series of implementations of iterated function systems I did going back to 1986. Besides the batch renderer for linux that is available on my home page, Flame has been incorporated/ported into KPT5 (Kai's Power Tools), AfterEffects (by neosapien.net), the Gimp (a Photoshop-like program for Linux), and xscreensaver (the screen saver for linux).

Fuse was also created in 1993. It takes any collection of input images (typically photography of nature or people), and produces an output image that is a resampling of the input. It performs associative image reconstruction. It is a visual analog of travesty-style(1) automatic text cutup programs. I found that photos of body parts made excellent inputs. Figure 3 is a detail of Fuse images. It is from a combination of close-ups of the faces of myself and my friends. .

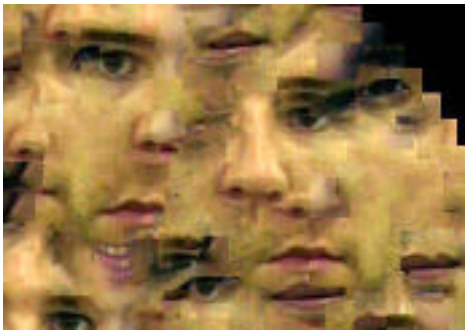

Figure 3: *Untitled,* Scott Draves, 1993.

The algorithm uses a Markov model of transitions between visual features in the input, and then feeds noise into the model to generate the output. The output image is built by copying samples of the input to overlapping destinations, where the sample is chosen (by associative search) to minimize the visual difference in the overlap areas. The search may be accelerated by starting the search with filtered low-resolution images, and finishing with full resolution. The fuse code has been rewritten a couple of times for different image formats (e.g. 8 bit and 32 bit), but has otherwise been pretty static.

Bomb began in 1995 and has been ongoing since then, though no new major modes have been added since about the end of 1998. Bomb is a software system that produces visual music. It creates a video stream that is fluid, textured, rhythmic, animated, and generally non-representational. It uses multilayered cellular automata, reaction-diffusion, an icon library, and a hodgepodge of special graphics hacks. It incorporates real-time versions of the Flame and Fuse algorithms as two of its modes. Three typical frames can be found in Figure 5.

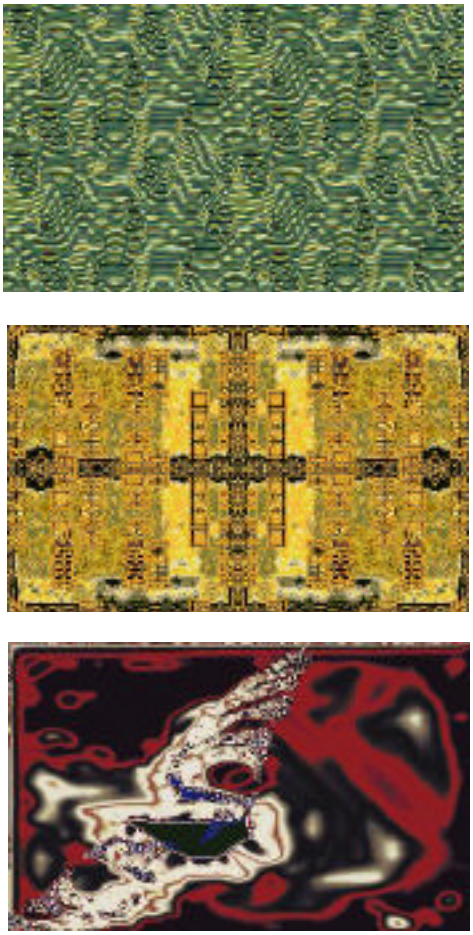

Figure 5: Bomb stills

The graphics may be influenced by an audio input. Control nes from the keyboard, a sequencer such as Cycling74's x, or Bomb has a self-play mode where it manipulates its n parameters and responds to the results. Bomb is a ch larger part of my life than other projects in terms of rs of labor and interaction, and is more closely related to taprogramming. Bomb has seen substantial growth and ut from other developers, including several complete ts.

Flame and Bomb both use color maps, that is, collections colors numbered 0 to 255. Personally I am not a big fan of usual saturated rainbow hued fractal and computer ors. In the spirit of open source, my colors are orithmically derived from photographs of natural scenery paintings by masters such as Monet, Van Gogh, and Klee. algorithm heuristically sorts colors from the image so that ors with adjacent indices are similar visually (global imization is impossible since it is the NP-complete eling salesperson problem (Note 2).

2. Metaprogramming

My research in metaprogramming aspires to enable grammers to manipulate real-time media streams in a ible, high-level way by treating the transformations of the eams as a language, and then applying the techniques of mpiler generation and partial evaluation to produce native e implementations of particular combinations of video ects. I started with the idea that partial evaluation could ke a powerful and portable interface to runtime code eration, and ended up focusing on extending compiler eration techniques to work with the packed bit-level resentations that are common in sound and video data.

For example, say you have an effect you want to apply to mage. Naturally there is a loop over all pixels in the image, some equation is applied to each neighborhood in the ge. The effect looks good, but gets boring after a while. add some options, or parameters to the effect, so now it ds your attention longer because you can vary the ameters, but the equation must now account for these ameters and do extra work decoding them. So the effect ws down.

More variety requires more parameters.

For example, consider a cellular automaton such as diffusion, which at each iteration each pixel is averaged with its ghbors. The iteration maybe altered by using differently ghted averages of the neighbors of each cell, e.g. S+E+W)/4 or (2N+2S+E+W+C)/7. The cellular automaton is specialized to compute just one kind of diffusion runs er than one that takes a vector with the five coefficients and compute many different kinds. There is a natural trade-off ween generality and performance.

So with more parameters the effect runs even more slowly - if it runs too slowly then it no longer appears animated and it dies. In the quest for infinite variety you may go as far as to add a parameter that is a language, so the effect becomes a meta-effect with a parameter that describes the actual effect. But that requires invoking the interpreter for each pixel of the image - and testing the parameters at each pixel has the same results since the parameters are fixed for the whole image.

Now the metaprogramming kicks in: it takes that pixel function and a particular parameter set and transforms them into native code that is then executed for each pixel. It factors out the repeated computation of decoding the parameters, leaving a residual program that is specialized to just one effect, but runs faster as a result.

3. Meaning

For me, it is certainly true that the only reason any algorithm is interesting is because of the image that it produces, but I produce more than images, I produce spaces of images. A program defines a mapping from parameter sets to images. The fundamental questions are, what fraction of the genotypes (parameter sets) are viable, and what is the diversity of the phenotypes (images)?

The flame images on my web page and that I use to make prints are just demos - my personal favorites. They are advertisements or bait, meant to draw attention into the core. Bomb is a visual parasite.(Note 4)

I feel rewarded when someone looks at one of my pictures, but I get a larger feeling when someone uses my software to create their own pictures. And best of all is when someone tinkering with the source code improves the program, then disseminates their new version.

It's difficult for me to lay claim to my images at all. They are all found objects. It is the nature of nonlinearity and emergence that something unexpected and unpredictable happens. When writing new modes for Bomb, or when picking new parameter sets for Flame, I work in a generate and test mode: try random parameter sets and save those that look good. I modify an existing programs, and keep the improvements.

Or in Bomb, I rarely knew in advance how a new cellular automaton would look. I just tried different combinations and equations until I found some that worked. This kind of creative process, generate and test, is the same as evolution itself, and I believe is the underlying mechanism of the more traditional "craft work" notion of creativity as well. Editing is a traditional form of creativity, and it too is based on generating a newer better smaller work from a larger, less well-structured body of text---the art of selection.

How do you choose your screen saver?

Why do you care?



(Continued on page 13)

(Continued from page 1)

the original painting by arresting for a moment in time the action that the finished work records."

(William Morrow, 1991, pp. 244-249.)

Although Leonard's book is now ten years old, I found similar concepts expressed in an interview,of. Benjamin Weil, the new curator of New Media Arts at the San Francisco Museum of Modern Art. He said, "to what extent do we consider a Pollock painting to be an object rather than the result of a 'process.' Pollock never really indicated whether the action of painting was more important than the actual result, or vice versa. What was preserved from Pollock was the end result of a process, which happens to be a painting."

(May 2000 issue of Artweek)

Donnalee Dunne was a graduate student when I stumbled across her work at Salongo Lee's MooBoo Gallery in Oakland, CA, in 1998. Now she teaches digital art at California State University at Fresno, and writes a column called Art in this Digital Age for the on-line magazine www.themestream.com.

Andrew Haynes makes his living as a scientist in Petaluma, CA. I encountered him and his crystal photographs at a couple of Ylem presentations, and was deeply impressed by his work. Andrew is the nephew of avant-garde music pioneer Ramon Sender.

Nora Raggio is a professional artist who lives in Palo Alto, CA, where I met her a an outdoor art show. I was first attracted to Nora's writing, but was transfixed by the work at her open studio last month. Nora's father runs a cultural center in Buenos Aires, Argentina.

Scott Draves works for a company in San Francisco's Media Gulch that does research into streaming media on the Web. He has his doctorate from Carnegie-Mellon University, and is representative of a generation of young, brilliant, intensely creative innovators. I ran across Scott's work when my son Daniel pulled me into his room to check out Scott's Web page. We looked up Scott's bio, and found out he lived right down the street from us. Next thing we were sharing sushi.

Leonard Shlain is a surgeon whose latest book is *The Alphabet Versus the Goddess*. He lectures frequently, and is well known in the San Francisco Bay Area as a generous patron of the arts. xxxxxx

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(continued from page 12)

Notes

1. A Burroughs-inspired text cutup technique (http://www.mt.cs.cmu.edu/htbin/ehn/conx2)

2. The traveling salesmen problem is: given a finite number of ``cities'' along with the cost of travel between each pair of them, find the cheapest way of visiting all the cities and returning to your starting point.

3. http://draves.org/art.html

4. Inside the Bomb (http://draves.org/bomb/inside_the_bomb.html)

shoutouts: jhno, nix, amacker, loren, imber.

By Scott Draves

spot@draves.org

Figure 2: Flame#191, Scott Draves, 1993.

Artists Using Science and Technology



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***, pronounced eye-lum, a Greek word for the xploding mass from hich the universe nerged.***

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