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**THE SEVEN PREREQUISITES FOR LIFE**

**BY**

**JONATHAN SEAN KARAFIN**

THESIS

Submitted in Partial Fulfillment of the Requirements for the Degree of

**Master of Fine Art in Imaging Arts**

Rochester Institute of Technology  
College of Imaging Arts & Sciences

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Willie Osterman, Committee Chair Date

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Therese Mulligan, Committee Advisor Date

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Jessica Lieberman, Committee Advisor Date

August 16, 2009

## ACKNOWLEDGEMENTS

Collaboration with the Rochester community has been an integral component of the successful installation of this work—support which has led to the creation of the first ever fully living sculptural art in the world. In addition, this artistic endeavor has resulted in the formation of a local youth program, developed in conjunction with the now-defunct Rochester After School Academy (Figure 1), in hopes of improving the city's 39% high school graduation rate.

The month-long summer program aspired to teach 11-14 year olds from the city school district advanced principles of both the arts and sciences. Students in this program learned about fuel cell design, and assisted in both creating and installing the final sculptural work at Rochester's Police Headquarters in the Public Safety Building. This facility was chosen in order to help strengthen the relationship between the young students and the police department, with the ultimate hope of creating a brighter outlook and future for the youth of Rochester.

Most importantly, I must thank Jen Liberatore, my love, for her continued help and support through years of sleepless nights on a closet floor, and yet somehow is still with me today. She still has many pairs of jeans stained with methylene blue, bruises and burns from the construction of the sculpture, but still loves me as on the day we first met. Perhaps she is as crazy as me. I am lucky to have found her among the confusion of the universe.

In addition, the mentorship of my advisors Willie Osterman, Therese Mulligan, Jessica Lieberman, Duane Palyka and Elliott Rubenstein was essential to my success. I

am grateful for their continued support of my increasingly eccentric ideas, for nearly bailing me out of jail, for keeping me alive, helping me to flourish as an artist and scientist, and never giving up on me.

The cooperation of the Rochester Institute of Technology, and the City of Rochester including the Rochester Police Department and the Rochester Fire Department, was vital to the success of this sculpture.

I thank Marge Lancer and Furaha Moye for giving me this opportunity to work with the City of Rochester, and believing in me.



Figure 1. Group photograph with students from the Rochester After School Academy.

## THE SEVEN PREREQUISITES FOR LIFE

By

**Jonathan Sean Karafin**

B.F.A., Film, Photography, Visual Arts, Ithaca College, 2004

M.F.A., Computer Animation: Imaging Arts and Sciences, Rochester Institute of Technology, 2008

### ABSTRACT

*The Seven Prerequisites for Life* is a biological sculpture presenting all of the main functions of a natural organism: growth, evolution, metabolism, response, reproduction, order, and regulation. Exhibited in Rochester, New York in December 2007, this sculpture has attained recognition in local news media and the internationally syndicated *Ripley's Believe It or Not* for its innovation in the field of art-science integration.

My thesis explores artistic motivations behind this endeavor, traversing from early fascination with magic through more mature investigations into the relationship between the fine arts, sciences, and mathematics. Intertwined with my enduring attraction to photography is the belief that this artistic discipline is—more so than any other—the exploitation of physical and chemical phenomena to complete artistic studies of one's surroundings.

The outcome of my investigation into the relationships between scientific phenomena and the fine arts may be observed in my installation, which reflects the many scientific and mathematic principles incorporated in its creation. Also intrinsic to its manifestation are the concepts of zero-point energy and the body as a source of light. Self-guided studies into quantum theory and metaphysics have led me to the awareness that all organisms are vessels of light, both absorbing and emitting it as an essential life

function. This underlying concept has guided me to create a synthetic being of energy in the universe's image.

## FOREWORD

Over a year has passed since I first exhibited *The Seven Prerequisites for Life*. Only now can I pause and reflect honestly upon the sculpture, my motivation to create it, and the many hardships I faced in the process. At the time I was near-homeless and broke, having foregone food and shelter to pay for community programming and sculptural supplies. I substituted excessive amounts of caffeine for sleep, risking my personal health and safety to accomplish a feat I had been told was impossible. Yet despite all of this, I regret nothing.

My thesis serves as a documentation of my struggles and sacrifices: one that I hope may one day bring positive change to the world.

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## 1. INTRODUCTION

My most recent endeavor in the fine arts surrounded the three-year design and production of a living sculpture entitled *The Seven Prerequisites for Life*. In this project, I employed numerous mathematical, scientific, and artistic principles, creating a “being of light” that embodied metaphysical philosophies surrounding the relationship between quantum energy and the living body.

The sculpture took the form of a 25-foot tree assembled from PVC piping and over 25,000 other hand-fabricated articles. Hundreds of slender plastic branches led to light-capturing leaves made from solar panels and fruit constructed of microbial fuel cells. An interlinked vascular system, composed of a potassium ferricyanide solution, was pumped to the canopy where it dispersed and rained down upon itself. Although the sculpture could not remain exhibited for long enough to do so, its continuous operation would have caused the gradual growth of yellow crystals on the exterior, signifying its age and health.

In its completed form, the final structure demonstrated the major attributes of a living organism:

- *Growth*: Given sufficient time, the sculpture would increase in size from the shell of yellow crystals that accumulated on the outside.
- *Evolution*: The living fuel cells evolved over time based upon the varying conditions that the sculpture provided for them.

- *Metabolism:* Baker's yeast within the microbial fuel cells metabolized and transformed simple glucose into pure electricity.
- *Response:* Bright green lights at the apex of the sculpture illuminated in the presence of enough food and solar power; as these resources were consumed, the lights dimmed to conserve energy.
- *Reproduction:* The yeast within the fuel cells reproduced, multiplying in number as it transformed food into energy.
- *Order:* The structure of the sculpture reflected the numerous geometric and mathematical principles applied in its design.
- *Regulation:* Specially designed circuits and batteries within the sculpture controlled the flow of electricity so that precisely enough was distributed to pumps and other components.

The sculpture's novelty and scale attracted the attention of several media outlets and other publications. It was a subject in an edition of the internationally syndicated comic *Ripley's Believe It or Not*, published in 200 newspapers across 42 countries (Figure 2). I was also invited to give a lecture as a Special Guest Artist at the New York Federation of Solid Waste Management and Recycling annual trade show and conference, one of the largest national meetings of its type. In addition, the sculpture was featured on local news networks (ABC, NBC, FOX) and written about in a front-page article of the *Rochester Democrat & Chronicle* and the *Philadelphia Intelligencer* (Figures 3 and 4). It was also online on websites including: [ripleys.com](http://ripleys.com), [yahoo.com](http://yahoo.com), [IGlobalCast.com](http://IGlobalCast.com), [inform.com](http://inform.com), [rochesterhomepage.net](http://rochesterhomepage.net), [democratandchronicle.com](http://democratandchronicle.com),

nakedrepublic.com, topix.com, articleon.com, and newstin.com. However, while the sculpture was praised and respected by many, it was equally maligned and detested by others—interpersonal conflicts with city officials hindered every step of the building process and ultimately prevented the sculpture from attaining its most complete form.

**Ripley's** → **Believe It or Not!**



**LIVING YEAST CULTURES GENERATED ELECTRICITY FOR THE LIGHTS, SOUND AND MOTION OF JON KARAFIN'S 26-FOOT-TALL, 2-TON BIOMECHANICAL SCULPTURE IN ROCHESTER, N.Y., IN DECEMBER 2007 ✓**



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Figure 2. *Ripley's Believe It or Not!* publication.<sup>1</sup>

<sup>1</sup> Graziano, "Living Yeast Cultures."

This affair is causing pain all around. Page D 5

Sunday, March 20, 2006

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The network has picked a darkly compelling subject for its first original miniseries: the story of the Green River serial killer who posed as a woman in the Seattle area in the 1980s and '90s. Based on the book, "Chasing the Devil," it stars Erin Gray as the police detective later sheriff, and two transgender women who became involved with tracking the killer, and fought an on-again/off-again court case, played by Amy Davidson. We've had previous miniseries with the killer who targets transsexuals and prostitutes.

**What in the world?**  
Believe it or not, this all makes very logical sense to Jon Karafin, its creator. And — oh, yes — it's actually functional.

By STACY BRIGGS  
THE INTELLIGENCER

**T**o the left, art. To the right, science. And that's Jon Karafin, Harbor-Horseshoe High School Class of 2000, standing where the science and art meet.

His interest in science watching, the reality hit?

For several months during the summer, fall and early winter of 2005, he occupied the public safety building in Rutherford, N.J., mostly through the microscope, creating an object the likes of which has never been seen before. Snowflakes. Crystals. The 21-year-old Karafin — an artist by education, a scientist by choice — spent at least 12 hours a day, every day, for six months, assembling the masterpiece there.

Luminescence captured, nearly informed the creation and the culture that the project involved "bioluminescent phenomena involving culture and form, which utilizes scientific and contemporary disciplines to reveal scientific and aesthetic facets of the creation."

"Although, 'when people read that,' Karafin says, 'most of the facts, they really had no clue.'"

"Simply put, he defines his work — an experimental microbial fuel cell — as the world's first "living sculpture."

"It has the most important for life: growth, evolution, energy response, reproduction, order and regulation," says Karafin. "And these are very specific, scientific terms. You're creating an organic sculpture that lives, a synthetic organism that follows these regulations. It's physically alive. It diffuses from a plant in that it's man-made. But it's a plant that creates light and grows crystals.

"The sculpture itself is physically alive. There are microorganisms — common baker's yeast, a single-cell fungus — that live inside those cells, draw their sugars with all the colors, and they're able, basically, when they eat sugar, to create electricity so when the happens within the structure, it's going to produce its own energy and it also grows over time — as it draws down from the top, it has a cylindrical stem and it forms crystals."

And it should grow forever as long as it's pumped into it.

Karafin, who earned four degrees — film, photo, visual art and audio production from the top, it has a cylindrical stem and it forms crystals."

See DREAM, Page D 2

**On the long run,** Jon Karafin says he hopes the kind of technology that generated this "living sculpture" — a microbial fuel cell — could be used to produce larger amounts of energy that could power things such as vehicles.




**Jon Karafin**

Figure 3. Philadelphia Intelligencer publication, page D-1.<sup>2</sup>

<sup>2</sup> Briggs, "Pipe Dream," sec. D.

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An H-H grad stands where art and science intersect. **D 1**



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## Dream

Continued from Page D 1

action — from Ithaca (N.Y.) College, in following that up with two master's degrees — photog-

replay and 3-D animation — at Rochester Institute of Technology.

And this knowledge of fuel cells he has?

Mostly self-taught.

Late last year, he told the Rochester Democrat and Chronicle he's interested in the aesthetics of organic structure and the parallels between man-made objects and living organisms, and he really wishes scientists would look at organic things more creatively and that artists would pay more attention to science.

"They can co-exist, but there's a hesitance to allow that to happen," he says. "I look at science as where you find pure art."

It began with an idea and grew — somewhat exponentially.

"The idea itself was to create a living being of light and to create a living sculpture — to make something that was self-sustaining," he says. "Why? Well, it had never been done before, and it was something I actually had been designing for quite some time. I was at a point where I said I either do this or it's always going to be just a sketch."

Two years ago, he began building a prototype in Rubbermaid containers in his kitchen. When it became successful, he moved it to studio space at the Rochester Contemporary Art Center.

Along the way, he sought the

## THE HELPING HANDS ARE YOUNG ONES

Jonathan Karafin did have some assistance in creating his living sculpture.

Area-city youngsters from the Rochester After School Academy where he taught a class for Megan Lanning, who originally had been hired to serve as videographer for the city — gave him a hand, particularly during the summer, on their own time.

Karafin says from were the only ones "who believed in what I was trying to do."

And a few of them approached the creatively extinct "Innocence" has a very high crime rate and there's just a 30 percent graduation rate for the city schools," he says. "I had no idea just how powerful that art, I really need to help the students." So I designed a

class with art and science.

"I had the idea to bring to the city to do something ... for the kids there. One of these didn't even know how many minutes were in an hour. I think I was asking them, 'I need you.' You know, these are great kids."

"Every one of the students had a terrible childhood story to tell that I just couldn't believe. This wasn't one isolated incident. It was every student. And they were able to cope with it. They would tell me, 'It's what I live with, for me, it was like a slap in the face. Yes, it was culture shock.'"

He says he would love to continue working with the city's children, but the funding for after-school programs has been extremely, effective this summer.

help of scientists.

And, finally, when he told them his scientific method, "they kind of cringed," he says. "They would say, 'It's a wonderful idea ... but we don't think you can do it. If it were possible, someone would have done it already.'"

Here's how it works in the Cliff Notes version for most of us:

The sculpture stands 25 feet tall, contains more than 25,000 hand-lubricated pipes, and includes 980 mechanical fuel cells, another 2 to 3 miles of clear tubing, and about 200 gallons of water and chemicals that is suspended in mid-air, as well as solar panels, and it weighs between 2,000 and 4,000 pounds.

"Think elephants," says Karafin. "And it's in the shape of a hexagon. The number six is integrated into the sculpture. The place where it converges — like the stump of a tree, if you will — is 18 inches wide, whereas at the top — where the fuel cells are — extends more than 10 feet wide."

It took more than six months and more than 3,000 man-hours to build.

"When I was working on the project, I was living off the kindness of others," he says. "Some nights, I'd sleep in the car. Some nights, I'd sleep in the studio. Some nights, I'd sleep on a

couch. My comfort was not my interest. My interest was completing the project."

Each fuel cell has two chambers — one filled with a solution of water, yeast and methylene blue, the other filled with water and potassium ferricyanide. He says the chambers are separated by a membrane that allows only protons — and not the electrons — to pass through.

When the yeast is fed sugar, the cell is able to create an electrical flow that can be used to power lights emitting diodes and water pumps. The pumps then send more chemical solution over the top of the sculpture, where drain heads are situated.

The process is aided by solar panels and the flow of chemical solution should eventually create crystals, as well as sound.

"The entire sculpture is geometrically tuned to produce sound," says Karafin. "It's just like a pipe organ — the longer the tube, the lower the sound."

How about reducing all this to its lowest common denominator?

"It's a hybrid of alternative energy technology," he says. "It's meant as a piece of art that can demonstrate what green technology can do."

That's pretty heavy stuff from a free thinker — no kidding, you say — who patched the solar panels, the chemicals, the pipes and other raw materials out of his own pockets.

But now you see it, and now you don't.

By agreement with the city, he had to disassemble the structure



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Figure 4. Philadelphia Intelligencer publication, page D-2.<sup>3</sup>

<sup>3</sup> Briggs, "Pipe Dream," sec. D.

## 2. MOTIVATION AND THEORY

### *2a. Introduction*

Magic is the performance of science: a wonderful skill and craft that transcends the borders between spectacle, art, and technology. Unlike most, I have always taken pleasure in uncovering the technical genius underlying the inexplicable. As a child I read every magic handbook in the library, gradually inducing one grievous consequence—attaining this knowledge ended the illusion. I saw great magicians such as Blackstone and Copperfield perform, hoping to recreate the bliss that had captivated me as a child. However, my growing understanding of magic came with a downside: each trick I witnessed had to be more amazing than the last in order to satiate my addiction. Even the tricks of Blackstone and Copperfield were ultimately not enough.

Realizing I was no closer to attaining true magic, I eventually lost interest in sleight-of-hand and card tricks. I refocused on inventive hands-on projects, in which I transformed ordinary objects into magical apparatuses where illusion occurred through secret mechanical and technological means. My parents despondently watched their electronics fall victim to investigative scrutiny and transformation into the bits and pieces of “magical relics” that would provide raw materials for my inventions. Although closer to alchemy than wizardry, my sculptural abilities and technical proficiency blossomed with each refined gimmick.

When first considering a career in art, I found inspiration in a different sort of magic: the unknowns and mysteries of science. This initially led to formal technical

studies within the fine arts through sketching landscapes, architectures, and people with meticulous accuracy. I became fascinated by the geometric patterns of organic material, driven by the discovery that mathematical calculations could rationally describe much of what appeared to be disorder within the universe. I also gained a particularly keen interest in photography: I found the field to rely strongly upon the use of mechanical, physical, and chemical processes as a means of understanding and describing the innumerable secrets of the world.

My interest in experiencing the unknown—the unexplainable—is an intense search for real magic. This prompted me to delve into both traditional scientific studies and metaphysical concepts, balancing on the border between science and philosophy—paradoxically increasing my understanding of the universe in the process. The compelling ideas I stumbled upon in my quest for the incomprehensible were incorporated in both my past and present work. My obsession began with the opposition between the factual and the spiritual, ultimately ending in a visual juxtaposition between science and art.

### *2b. Conceptualizing the Sculpture*

My decision to complete a sculptural work for my thesis project came from a desire to expand upon the photographic concept of art-science integration, and apply it to a different medium. The finished product was a novel artistic representation of the relationship between art and science, previously expressed through photography. Art and science have evolved complementarily, emerging together in various forms since antiquity. Photography is possibly the most well-known product of this relationship.



However, rather than simply use the medium to express an artistic concept, I instead chose to convey one of its underlying principles, the idea of art-science hybridization, through a different outlet. My sculpture was a tangible continuation of this convergence, and I kept the concept in mind while designing and building the project. This combined approach was especially apparent in the sculpture's creative use of technological and scientific devices.

The sculpture's treelike form arose from my long-term studies into mathematical, scientific, and metaphysical theories. Among these was the as yet unproven idea that humans and other organisms receive energy from the entire universe, and redistribute it equally far. I envisioned my sculpture as a synthetic being of light that would communicate this concept to my audience. The treelike shape was chosen because of the especially powerful connection with light that photosynthesis grants these organisms. Use of light-harvesting solar panels in the sculpture further reinforced this association. Through purposeful combinations of art and science, I aimed to both describe the known universe, and emphasize its magic.

### *2c. Interdependence of Early Photography and Science*

While art and science have traditionally been addressed as separate disciplines, photography represents the most notable example of these disparate fields intersecting in ways beneficial to both. Photography has provided science with a means of accurately depicting reality, oftentimes capturing images that the human eye cannot view. Conversely, scientific phenomena have long been a source of subject and inspiration for

photographers. In my thesis project, I intended to convey the spirit of mutual innovation demonstrated in early photography.

Photographers in the 19<sup>th</sup> century were quick to realize the potential benefit that their new medium brought to science. A crucial requirement for performing scientific work was the ability to permanently record detailed, accurate information about the study material so the correct conclusions could be drawn, and the work shared with other scientists. However, written descriptions and prints of hand-drawn images were of somewhat limited use, and the discovery of photographic processes was much appreciated.

Perhaps of special importance for scientific advancement was the photograph's detailed capture of subjects escaping the unaided human eye. For example, the existence of bacteria had been recognized since Antony van Leeuwenhoek observed them under a microscope in 1683.<sup>4</sup> However, the advent of photomicrography during the second half of the 19<sup>th</sup> century greatly increased interest in these organisms. Because of their bizarre morphologies, bacteria had been especially difficult to reproduce in drawings, and the use of photography greatly advanced the study of bacterial illness in both medical and epidemiological fields.<sup>5</sup> Anna Atkins, author of the first photograph-illustrated book, *British Algae: Cyanotype Impressions* (Figure 5), also acknowledged the difficulty of sketching minute, unusual organisms, and valued the capabilities that the recently developed cyanotype process afforded her.<sup>6</sup>

---

<sup>4</sup> Perry and Staley, *Microbiology: Dynamics and Diversity*, 31.

<sup>5</sup> Tucker, *Nature Exposed*, 159-60.

<sup>6</sup> Peres and Malin, "Science as Art," 493.



Figure 5. Excerpt from *British Algae: Cyanotype Impressions*.  
Source: New York Public Library, photo by Anna Atkins.

Astronomers also became exceedingly aware of the benefits photography offered their field. Although the early daguerreotype process was found to be unreliable for producing detailed images of even the moon or sun, later techniques proved to be more effective. Warren De la Rue, one of the most prominent astrophotographers of the era, used a specialized photohéliographe to create detailed albumin silver prints of the moon (Figure 6). Most notably, he captured a series of photographs of a solar eclipse on July 18, 1860, proving that red flames appearing around the moon during the eclipse were actually of solar origin.<sup>7</sup> Daguerreotypes showed insufficient detail of the phenomenon for the same conclusion to be drawn, and were considered inferior in that respect.<sup>8</sup> As

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<sup>7</sup> Bocard, "Astronomy," 89.

<sup>8</sup> Thomas, "Capturing Light: Photographing the Universe," 189-90.

photographic technology continued to advance through the mid 19<sup>th</sup> century onward, its value to astronomers continued to grow.



Figure 6. Albumen silver stereogram of the moon.  
Source: Flickr, photo by Warren De la Rue.

These two examples demonstrate how innovations in early photography, themselves brought about by technological advances, furthered scientific progress in a symbiotic feedback loop. My installation work similarly sought to use artistic and scientific methods, exploring metaphysical concepts at the edge of human understanding, while sparking the audience's interest in empirical science. While I intended to portray a spiritual "being of light," this goal was only realized through the use of fuel cells, complex chemical reactions, and similar technical implements.

### *2d. Energy Photography*

While photography has had an undeniably powerful influence on science to this day, there exists a parallel body of work investigating how newly discovered scientific phenomena may be used in fine arts. My interest in this area focuses on nontraditional

energy sources (i.e. outside the visual light range) and how they can be permanently fixed in a photograph.

One newer branch of photography concerns artistic images created from non-visual portions of the electromagnetic spectrum. Only certain types of energy are useful for this purpose—radio and microwaves are generally too weak to be captured in a photograph, while gamma rays are so powerful they pass through nearly all materials, making their imaging difficult. However, photographic images have been created from the remaining infrared, ultraviolet, and X-ray regions of the spectrum.

Soon after their discovery at the end of the 19<sup>th</sup> century, X-rays were recognized as an emerging artistic medium. Goby published the first X-ray photographs of flowers in 1913, and floral radiography, as it is called, remains popular to this day.<sup>9</sup> Nick Veasey is among the most prominent artists currently exploring this medium (Figure 7). He has been featured in numerous exhibitions, and has published a book of his X-ray photographic art, showing skillfully orchestrated images of subjects as diverse as insects, musical instruments, computer hardware, and a bus full of people.<sup>10</sup> However, the potential health risk from ionizing radiation exposure, and the difficulty of obtaining a setup to perform this type of work, have likely limited the prevalence of artistic x-ray photography. Infrared and ultraviolet photography, in comparison, are relatively simple to perform and are widely used for a number of purposes.

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<sup>9</sup> Raikes, “Floral Radiography,” 1150.

<sup>10</sup> Veasey, “Nick Veasey: X-Ray Photographer.”

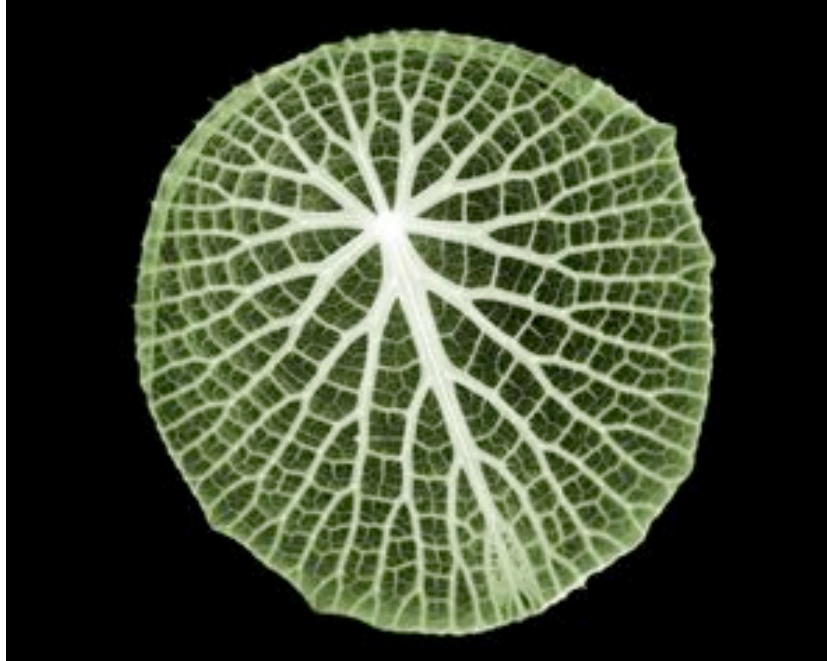


Figure 7. *Victoria Water Lily Leaf*.  
Source: NickVeasey.com, photo by Nick Veasey.

Kirlian photography is another form of image taken without the aid of visible light. In this technique, discovered by Semyon and Valentina Kirlian in 1939, an object is placed on a photographic plate and subjected to high voltage; the resulting photon emission forms a corona of radiating color around the object.<sup>11</sup> The technique can be safely used on people, capturing ethereal images of their hands or fingertips (Figure 8). Two groups of thought exist regarding the source of this phenomenon. The first holds Kirlian discharge to be explainable purely through empirical means, while the second attributes the images to a psychic aura surrounding the object.<sup>12</sup> Regardless of the origin of these images, however, their aesthetic appeal is evident.

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<sup>11</sup> Ray, *Scientific Photography and Applied Imaging*, 431.

<sup>12</sup> Woodhouse, *Paradigm Wars*, 194-95.

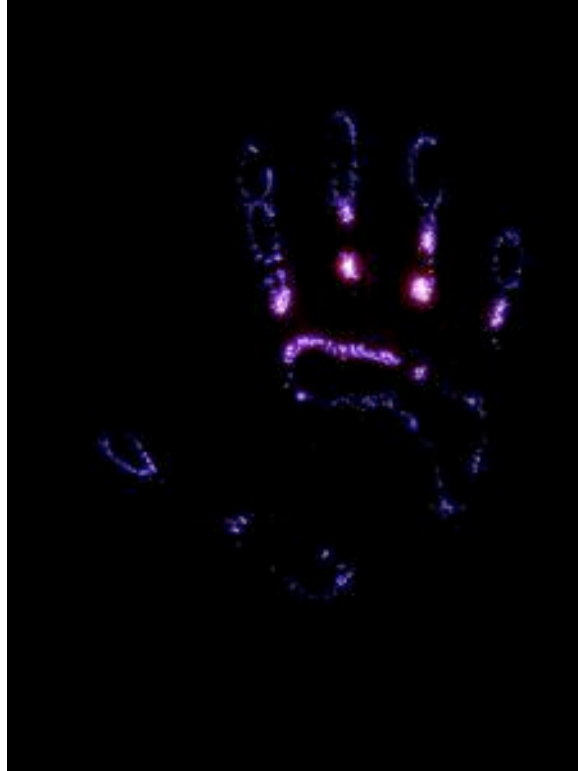


Figure 8. Kirlian photograph of a human hand.  
Source: Wikimedia Commons, photo by “C4r0.”

Through revealing the unseen energy permeating the universe, these photographic techniques highlight its ubiquity and importance. Although not apparent to the human eye, these forces surround us and quietly exert their influence upon our lives. My installation work reflected an interest in such invisible forms of energy, and used technological means to transform them into forms perceptible to my audience.

### *2e. Sculptural Inspiration*

Although much of the inspiration for *The Seven Prerequisites for Life* came from art-science hybridization as expressed in photography, a number of sculptural works also provided a theoretical and practical basis for the project. The gradual, dynamic way it

metamorphosed and interacted with its environment was founded upon a history of sculptures demonstrating similar behavior.

The solar panels and fuel cells in *The Seven Prerequisites for Life* generated energy so the sculpture could grow and evolve as its environment changed. While installed, it reacted to stimuli such as variable sunlight and the amount of glucose available to feed the yeast in the fuel cells. Some of this response was immediately noticeable—the lights at the apex of the sculpture dimmed with insufficient power, and the blue fuel cell chambers lost color as their sugars were depleted. Other effects, such as the crystal matrix developing over the sculpture, would not be noticeable for weeks.

Gradual maturation of artistic works has been exemplified in many other forms. For example, bonsai and topiary both have a long historical tradition, where the artist requires little more than aesthetic sense and horticultural skills to maintain the art as it slowly grows into new and more complex forms. The earliest known example of this type of work dates back to Roman times.<sup>13</sup>

Earthworks, or Earth Art, of the 1960s was a more recent application of this concept. Artists working in this genre converted natural botanical and geological materials into manmade sculptural art. The traditional concept of sculpture inverted so the work was no longer placed in a landscape—the landscape instead was the form of the artist's creation.

One of the more prominent artists participating in the Earth Art movement is David Nash. Nash began creating elaborate sculptural works from trees in the 1970s. With the passage of time as a defining factor, it ultimately took over 30 years for many of

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<sup>13</sup> Bowe, *Gardens of the Roman World*, 51.



his sculptures to develop and blossom into the shapes originally envisioned. One of his most famous works is *Ash Dome*, a cluster of ash trees trained to grow as a vaulted ceiling covering a section of woodland in North Wales (Figure 9).<sup>14</sup>



Figure 9. *Ash Dome*. Source: Coetir Mynydd.

Axel Erlandson also created sculptural works from trees, applying unconventional horticultural practices to graft tree sections together where they would not join naturally. The limbs and branches were then guided to intersect in unusual ways, forming beautiful geometric patterns unlike anything seen in the natural world.<sup>15</sup> For both Nash and Erlandson, nature represented an outlet through which biology merged with art to form a vibrant and active product evolving over a period of time.

While the treelike structure and continuous growth of my thesis project were reminiscent of Earth Art, its extensive use of synthetic materials distanced it from this movement. I aimed to use natural materials wherever possible, but the project depended

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<sup>14</sup> Grande, “Real Living Art.”

<sup>15</sup> Wikipedia contributors, “Living Sculpture.”

equally on manmade technological components such as fuel cells and solar panels.

Incorporation of these elements placed my sculpture within a subgenre known as the Art of Alternative Energy.

Artists pursuing this multimedia field create pieces such as interactive solar panel sculptures, wind-driven creatures, and sustainable architecture, requiring collaboration with scientists and engineers.<sup>16</sup> These works employ renewable resources such as solar, wind, geothermal, and hydroelectric power to generate electricity, and their aesthetic appeal stimulates the audience's interest in alternative energy.

Sarah Hall and Laurie Chetwood are two of the most relevant artists working in this field. Hall uses solar cells as an integral component of her large-scale stained glass window and sculptural compositions. She intends to advance awareness of solar energy through her photovoltaic glass art, and states that “incorporating colour, light and art with solar energy inspires us to think about our future in a new context.”<sup>17</sup> Architect Chetwood is a self-taught artist and scientist who creates kinetic motion sculptures, powering them with embedded fuel cells and other renewable energy sources.<sup>18</sup> Chetwood's most inspirational work to me is *London Oasis*, a towering outdoor installation of solar panels and wind energy producing daytime shade and calming nighttime lights for passersby in an urban park (Figure 10).<sup>19</sup>

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<sup>16</sup> Wikipedia contributors, “Renewable Energy Sculpture.”

<sup>17</sup> Hall, “Architectural Stained Glass Design.”

<sup>18</sup> Wikipedia contributors, “Renewable Energy Sculpture.”

<sup>19</sup> Lippincott, “London Oasis.”



Figure 10. *London Oasis*. Source: Land+Living.

*The Seven Prerequisites for Life* expands upon the concepts and physical features introduced in *London Oasis*, while maintaining notable differences in the creative approach. Whereas a predetermined architectural design guided the construction of *London Oasis*, I allowed theoretical and artistic function to take precedence over form. Scientific, numerological, and metaphysical theory guided the development of my sculpture, and its final shape, size, and scale were based upon my discoveries.

#### *2f. The Pursuit of True Magic*

I have had a longstanding interest in magic that has intensely impacted my past and current artistic pursuits. This is more logical than one might expect at first, especially when one comes to the realization that magic can be considered an art form in its own right. This unique field combines inventive craftsmanship and performance art with the ultimate goal of exposing the audience to pure amazement and wonder, if only for a brief and fleeting moment.

My childhood interest in performing sleight-of-hand tricks waned as my knowledge of the secrets behind most parlor tricks grew and their novelty disappeared. However, other magicians have been able to maintain their interest in the field through finding magic in more unexpected and enduring sources. Barry Gordemer, a professional magician for more than 15 years, believes that the real sorcery comes from within the human mind:

Back in my performing days, I loved to watch faces in the audience just as the trick reached the “tah-daaaaah” moment. For one instant, one nanosecond, you could see in their eyes that they actually, truly believed in magic. There'd be a moment of silence too small to measure, then applause—small at first then louder—as the sense of wonder dissolved. I'll never forget those moments. I'm convinced people want to believe in the impossible. They want miracles, no matter how small.<sup>20</sup>

The showmanship associated with magic performance is what keeps seasoned professionals interested in the field. Nearly all parlor tricks are surprisingly simple once their secret is known. Consequently, the greatest magicians of all time are known perhaps more for the finesse of their performance than for their ability to successfully complete a trick. Anyone can pick up a book and learn to perform the classic feats of Harry Houdini and Dai Vernon. However, it takes a true virtuoso to elicit the audience reaction that Gordemer describes. Thus the creative nature of magic lies within the self-expression the performer must master in order to effectively interact with the audience. In essence, the successful magician has evolved from one who follows a paint-by-numbers set of instructions to become a true artist.

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<sup>20</sup> Gordemer, “The Magic of the Human Mind.”

Although my chosen profession has taken a markedly different path, I possess this same desire to use my creative abilities to mystify my audience. In that sense, I liken myself more to the illusionist and endurance artist David Blaine, who has the following opinion about his field:

All my work is about honesty. Magic card tricks—we have to get beyond that. If magic is just magicians doing card tricks to impress other magicians—I'm not interested in that anymore. I don't want magic that looks real. What I want are real things that feel like magic.<sup>21</sup>

Similar to Blaine, I believe that magic can come from the exploitation of natural events to evoke an emotional response from my audience. Viewers of some of my installation work may have already experienced some of the acoustical, mathematical, and biological phenomena contained within on a purely independent basis. However, combining them in creative and novel ways amplifies their effectiveness, allowing me to manipulate space in order to produce a targeted emotion of my choosing.

### *2g. Zero-Point Energy*

In my pursuit of true magic, I have been drawn both to the detached rationality of modern science and to more metaphysical concepts attempting to explain the basic nature of reality and its relationship to the universe. Discoveries in these areas alter understanding of our surroundings, which in turn can be represented through artistic form. This holds true for me, and many of the recurring themes in my work revolve

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<sup>21</sup> Gopnik, “The Real Work: Modern Magic.”

around the metaphysical applications of quantum mechanics and a concept known as the zero-point field.

Doctors, authors, scientists, and artists, including Arthur C. Clarke, Bernie Siegel, Larry Dossey, Lynne McTaggart and Masaru Emoto, argue for the philosophical significance of the zero-point field. As a simple metaphor for the concept, imagine that you are bungee jumping. You fall at an increasing velocity until the cord stretches and sends you rushing back upwards. The moment where you remain motionless at the bottom of your descent, and it seems that you are neither falling nor rising, is where the figurative zero-point field resides.<sup>22</sup>

To provide a more technical definition, zero-point is a term used to describe the tiny amount of energy possessed by a theoretical “particle in a box” at its lowest quantum state. Since this particle is confined to a limited area, you can be certain of its location to some extent. Thus the Heisenberg uncertainty principle—that knowledge about position and momentum are inversely related—holds that it must have kinetic energy. In other words, because you are not completely unsure of where this particle is, you cannot say with absolute certainty that it has no momentum. The movements of zero-point energy are theoretically observable at absolute zero, representing the most minuscule, wavelike oscillations of all atoms and molecules around their equilibrium position.<sup>23</sup>

The metaphysical value of the zero-point field is to serve as an eternal, unchanging energy that exists in every atom in the universe at all points in space-time. Thus it serves as a unifying force to connect all matter, where quantum waves convey information and create a permanent memory of the universe's history. Such an immense

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<sup>22</sup> McTaggart, *The Field*, 23.

<sup>23</sup> Atkins and de Paula, *Physical Chemistry*, 338-39.

field of energy offers a possible explanation for some of the most profound human experiences, from alternative medicine to extra-sensory perception and the collective unconscious, as well as providing a scientific representation of a spiritual life force. In addition, there is a modest amount of evidence suggesting that zero-point energy can be extracted from matter and may someday be a viable form of renewable energy.<sup>24</sup>

The harnessable quantum energy of the zero-point field was the basis for constructing several crystal radios as preliminary research for my thesis project. I began constructing RF detectors using crystals and magnetic coils to pull radio frequencies from the atmosphere and create both voltage and sound without any external power source. This made me think about the relation of the body to these crystal radios, where the physical self was essentially an antenna to produce electricity based on proximity to the RF detector. In a more general sense, it also prompted me to investigate the ability of the human body to harness and transmit energy of multiple types, including electromagnetic and acoustical.

## *2h. Nature and the Human Body*

A major metaphysical consequence of the zero-point field is the intrinsic interconnectedness existing between seemingly disparate entities, particularly the natural world and the human body. For example, an electromagnetic discordance has been observed in the earth's atmosphere between the positively charged ionosphere and the negatively charged planetary surface. Known as the Schumann resonances, these

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<sup>24</sup> Anderson, "Zero-Point Energy."

extremely low frequency reverberations (7.83, 14.3, 20.8, 27.3, and 33.8 Hz) are perpetuated globally by lightning discharge.<sup>25</sup> This phenomenon by itself is quite fascinating, but its meaningfulness compounds when one considers that the Schumann resonances bear an extraordinary resemblance to the pattern of alpha brain waves. Some scientists believe that these frequencies can serve as a natural “tuning fork” to calm and organize improperly synchronized human biorhythms.<sup>26</sup> Conversely, the human brain can also be seen as creating sound energy in the form of the so-called Schumann resonances.

In addition to producing acoustical energy, evidence exists suggesting the human body emits electromagnetic radiation in the form of light. German researcher Fritz-Albert Popp investigated this radical concept in the 1970s, although his contemporaries dismissed it as an impossibility. In a comprehensive series of experiments using a photomultiplier, a recording device so sensitive it could individual photons, he observed organisms as diverse as mold, salamanders, and humans producing a stream of light at a 380 nanometer frequency—precisely on the edge between the visible and ultraviolet ranges of the electromagnetic spectrum.<sup>27</sup>

Subsequently, other experimenters have corroborated Popp's observations and the phenomenon has been formally termed “ultraweak photon emission” or “biophoton emission.” This discovery lends scientific support to many forms of alternative healing based upon self-regulation of the body, including acupuncture, homeopathy, and various electromagnetic therapies.<sup>28</sup> Dr. Gary Schwartz has observed that light is inseparably linked with the body’s healing process. He has produced over 5,000 biophoton images of

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<sup>25</sup> Wikipedia contributors, “Schumann Resonances.”

<sup>26</sup> Pastl-Dickenson, “The Discovery of Schumann Resonance.”

<sup>27</sup> McTaggart, *The Field*, 41-48.

<sup>28</sup> Bischof, “Humans Emit Biophotons.”



plants and other living matter, observing that photon production dramatically increases in injured tissue as it attempts to regrow.<sup>29</sup> Schwartz finds the outcome transcendent, exclaiming:

Can you imagine what happens to your mind after you have witnessed, over and over, the invisible glow of matter? You become forever aware of the invisible energy of everything. You cannot see a rose or walk past a tree without remembering that it is glowing and pulsing with life and vitality.<sup>30</sup>

Humans and all other living things emit an incredible and unexpected amount of energy; interpreting the meaning of this natural flow is essential to understanding the world around us. I choose to incorporate acoustical phenomena and light into my work because I believe it heightens the audience's ability to connect and interact on a more primal level, even if the impact remains purely in the subconscious. Both my preliminary and thesis work use these theories as a unifying concept of the universe.

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<sup>29</sup> Schwartz and Simon, *The Energy Healing Experiments*, 124-25.

<sup>30</sup> *Ibid.*, 127.

### 3. UNITED IN RESONANCE

#### *3a. Description*

Once while on a long drive, a vivid image flashed through my mind—the formation of the universe. Intricate, newly created sine waves whirled and resonated in unfamiliar colors that I barely comprehended. I came to the abrupt conclusion that all universal matter is linked together by these oscillations—an extensive matrix of energy exchange. Acoustical vibration is the remnant of this most ancient explosion, which created all particles that we now observe as light. The concept of creating light through acoustical vibration was the basis for my walkthrough, exhibited in the spring of 2005.

The installation took the basic form of an expansive, darkened hexagonal enclosure in which the audience was invited to traverse and explore. On the ceiling, a lattice of interlaced light emitting diodes (LEDs) surrounded a single near-ultraviolet light at the apex of this room. Seven powerful subsonic emission devices were placed in the enclosure: the first six at each of the corners and the remaining one in the center. These devices created thunderous acoustic outbursts of ambient sounds recorded at churches and other spiritual locations. Most of the output frequencies were far too low for the ear to detect, but both direct interaction with human brain waves and the faint sensation of vibrational energy remained, creating a sense of presence and reverence within the space.

As viewers traveled through the enclosure, electrical sensors detected their every movement along with natural light and temperature fluctuations. All environmental

variations were captured and used to activate optical “Theremins”—electronic musical instruments popularized by the undulating, high-pitched sine wave tones they provided in classic sci-fi films. These devices modified the subsonic frequencies emanating from each corner to produce echoing, reverberant pockets of interacting waveforms that encompassed the viewer from all angles.

While the acoustical effects alone were enough to captivate the audience, they were also tools used to create the intricate, glimmering light patterns that were the main focus of the installation. Each and every sound within the enclosure illuminated a corresponding overhead LED; when a viewer entered, the accumulating interference between the many acoustical elements quickly transformed the enclosure into a fluctuating sea of luminescence and metamorphosing colors (Figures 11-14).

Upon entering the installation, viewers were immediately taken aback by the temporary darkness and disoriented by the intermittently flickering lights. Once acclimated to the foreign environment, they became part of a newly formed universe—forming an intense connection with the erratic patterns similar to that of children discovering fireflies for the first time. A sense of contemplation, inspiration, and tranquility replaced the initial bewilderment first encountered within the installation.

This seamless coalescence was a compelling representation of the profound relationships between acoustical vibration and light energy, thus exemplifying the metaphysical concepts implied by zero-point energy and the quantum field. Although the participants could not fully comprehend what the glimmering lights intended to communicate, they still departed with a more thorough understanding of the universe. The installation presented an “inner eye” view of the world, where the complexities of

the unknown unite in an endless spiral of energy transfer to create a single expression of individual enlightenment and discovery.



Figure 11. *United in Resonance*; pulsing lights created from sound.



Figure 12. *United in Resonance*; pulsing lights created from sound.

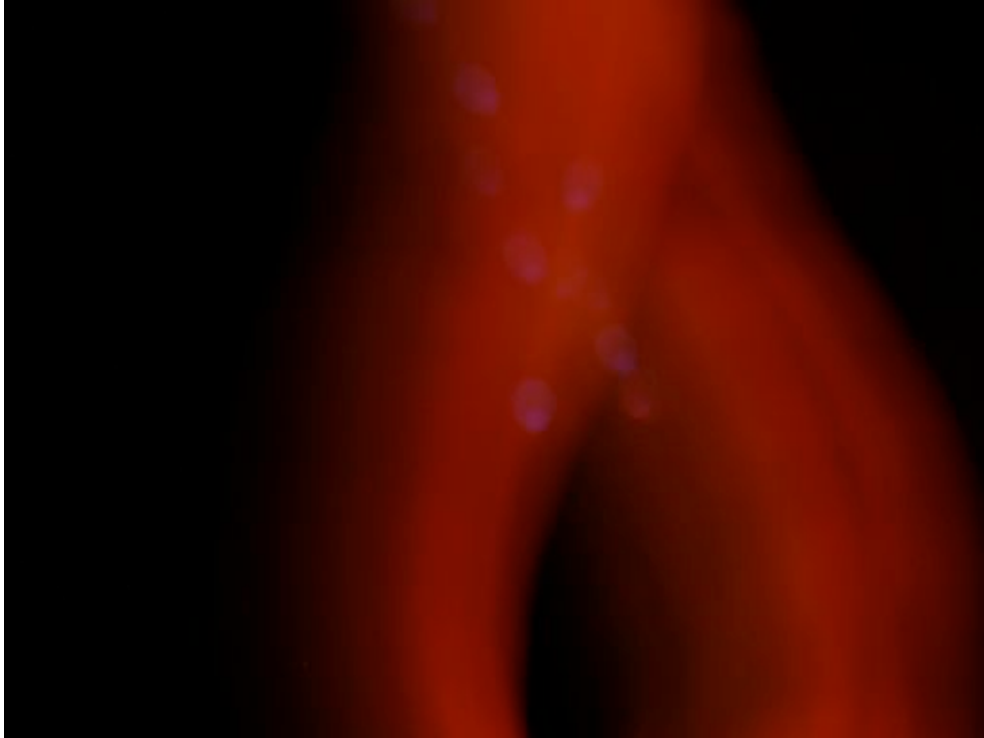


Figure 13. *United in Resonance*; pulsing lights created from sound.

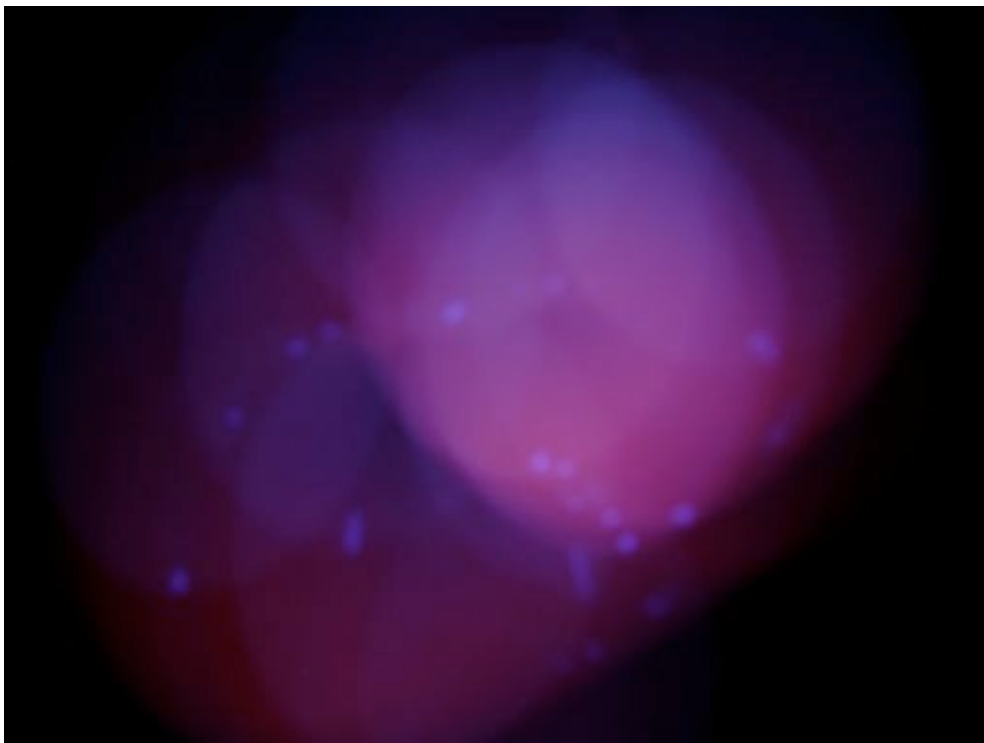


Figure 14. *United in Resonance*; pulsing lights created from sound.

#### **4. THE SEVEN PREREQUISITES FOR LIFE**

##### *4a. Description*

The most far-reaching implication of zero-point field theory is that the body serves as an organic channel through which all manners of natural and quantum energy may pass. I expanded upon this basic concept and attempted to create a physical representation of light in the universe's image. The culmination of this effort, a sculpture entitled *The Seven Prerequisites for Life*, was unveiled on December 7, 2007 in the City of Rochester Public Safety Building (Figure 15). This sculpture took the basic form of a 25-foot plastic tree with leaves and fruit fashioned from solar panels and fuel cells; a large basin at the bottom was intended to pump nutrient-rich water to the apex where the sculpture rained down upon itself and promoted its own growth. It employed numerous mathematical, scientific, and metaphysical principles to simulate the basic biological functions of a natural organism.



Figure 15. *The Seven Prerequisites for Life*; wide view of sculpture.



*4b. The Fuel to Maintain Life*

In its fully realized state, *The Seven Prerequisites for Life* exhibited all of the main functions of a biological organism: eating, breathing, reproducing, and growing just as plant or animal life (Figure 16). My work prior to this thesis utilized only nonliving components to portray the unifying energy permeating the universe. In order to tackle this shortcoming, I made exceptional efforts to incorporate organic material whenever possible. The result was the employment of 360 microbial fuel cells, powered by common baker's yeast, to create the electricity needed to drive electrical processes in the sculpture. These fuel cells were essentially the fruit of the tree, suspended in a dense cluster above the narrow trunk by slender white branches.

The microbial fuel cells were a type of electrochemical cell—large-scale batteries divided into a negative anode chamber and a positive cathode chamber. Metabolism of the yeast in the anode, accompanied by a chemical dye known as methylene blue, released billions of protons and electrons that diffused to the cathode. There they reacted with a dissolved mixture of the yellow salt potassium ferricyanide and formed water. While the protons escaped from the anode through a special polymer membrane that connected the two halves of the cell, the electrons were forced through a wire that followed the same path. The movement of these electrons created a current that was captured as electricity.<sup>31</sup> In order for the fuel cell to operate, the yeast had to be kept healthy and fed a constant supply of glucose. Therefore, the sculpture was alive in a very literal sense.

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<sup>31</sup> Harris, *Quantitative Chemical Analysis*, 287-90.



Figure 16. *The Seven Prerequisites for Life*; view of sculpture's circulatory system.

#### *4c. A Being of Light*

The organization of the sculpture allowed all wavelengths of light to be created within itself through the process of additive coloration. The main focal points of the sculpture were the stunning green lights at the apex (Figure 17). As the yeast developed and multiplied within the microbial fuel cells, their energy drove the irradiance of these lights. When the green lights shone, they fell upon a red solution of potassium ferricyanide and cobalt solution of methylene blue—required for the operation of the fuel cells. Thus the three primary colors of light were represented within the structure of the organism, combining to form all other colors in the visible spectrum.



Figure 17. *The Seven Prerequisites for Life*; view of electrical light produced through biological processes.

#### *4d. The Number Six*

The living sculpture exhibited intricate geometric patterns that reflected the fundamental physical and mathematical principles governing them. The treelike structure of the organism was designed to explore ancient and contemporary scientific discoveries, and also to remain perfectly balanced despite its staggering height and span. In this sense, geometry took precedence over the artistic process; math determined the sculpture's shape, size, and scale, allowing it to develop more organically (Figure 18).



Figure 18. *The Seven Prerequisites for Life*; view of organic forms determined using mathematic principles.

The number six was consequential in the sculpture's geometric and mathematical design. Investigating millennia of numerological knowledge led me to the conclusion that the number six provided the stability and support needed for the structure to remain upright despite its size. “Six” has the rare quality of being a “perfect” number—it is equal to the sum of its divisors. Between zero and one thousand, there are only three perfect numbers: 6, 28, and 496.<sup>32</sup> The hexagonal structure of the sculpture was conceptualized with the “ideal” numerological identity of “six” in mind.

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<sup>32</sup> Ouaknin, *The Mystery of Numbers*, 222.



Figure 19. *The Seven Prerequisites for Life*; side view of hexagonal fuel cells.

While I deliberately incorporated the number “six” into initial designs, it assumed greater consequence as the installation took physical form. When viewed from above, the sculpture assumed a virtually circular shape due to the numerous fuel cells distributed evenly around the perimeter (Figure 19). There are 360 degrees in a circle, and 360 fuel cells were required to generate the amount of energy for the sculpture’s operation ( $60 \times 6$ ) (Figure 20). Fluid containing spent fuel cell material was pumped to the apex of the sculpture and expelled onto a hexagonal web of fabric. There it formed six-sided monoclinic crystals of evaporated potassium ferricyanide. Over time, these crystals were intended to grow larger and more well-defined. However, and for reasons I will soon discuss, these crystals never matured so my thesis project was unable to progress as planned from theory to practice.

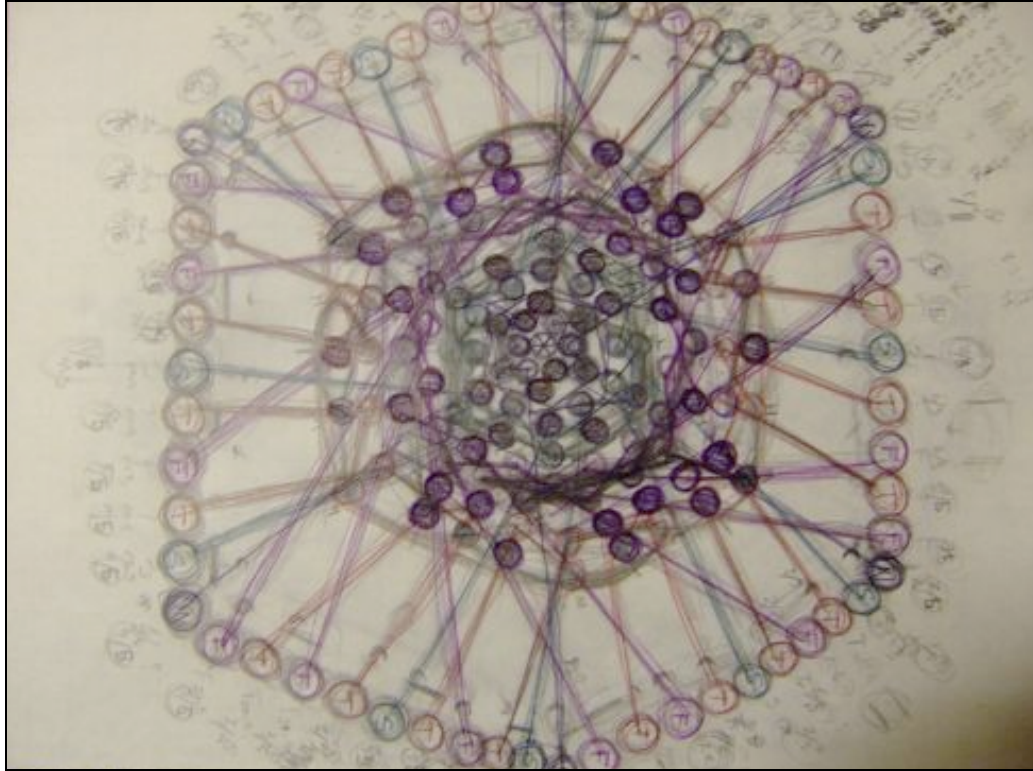


Figure 20. *The Seven Prerequisites for Life*; topographical sketch showing repetition of the number six.

#### *4e. The Resonating Universe*

The trunk of the tree, connecting the root-like base to the fuel cell branches, was composed of pipes cut to an exact length and woven throughout the sculpture in such a manner they produce the resonant frequencies of the Earth when they vibrate. Known as the Schumann resonances, these inaudibly low frequencies are the primary electromagnetic background observed in the space between the Earth and the ionosphere.<sup>33</sup> In order to accomplish this, PVC piping required specific lengths to produce these frequencies.

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<sup>33</sup> Wikipedia contributors, “Schumann Resonances.”

The following calculation was used to fashion individual pipes:

$$Freq = \frac{.389KV}{L^2}$$
$$K = \frac{1}{4} \sqrt{id^2 + od^2}$$

where  $V$  = velocity of sound in the pipe,  $id$  = inner diameter of the pipe,  $od$  = outer diameter of the pipe, and  $L$  = length of the pipe.



Figure 21. *The Seven Prerequisites for Life*; view of PVC pipe drums at sculpture base.

To provide the source for the Schumann resonances, PVC pipes with lengths up to several hundred feet were intertwined at exact angles to create the bodies of low-frequency drums. The ends of the pipes, when covered with elastic sheets, formed drum heads that were arranged around the base of the sculpture in a circular pattern

(Figure 21). When fuel cell liquid pumped to the apex of the sculpture cascaded to the bottom, it would have struck these drumheads and emitted the Schumann frequencies. However, like the yellow crystals mentioned earlier, this was another aspect of my installation that never reached fruition due to the inevitable institutional conflicts and forced setbacks faced during the building process of the sculpture.

#### *4f. Ideals vs. Reality*

Perhaps just as interesting as the concepts and theories interwoven into my thesis project was the human aspect of its creation. As my ideas progressed from blueprints and sketches to physical reality, it became clear that my artistic vision far surpassed the physical strength and endurance needed to fully complete the project. However, I refused to compromise my ideals and the sculpture continued to grow taller and more complex, regardless of my ability to keep up with the daily leakages, electrical failures, and collapses threatening its condition.

My desperation to complete my project within the confines of a civic space led to conflict with city officials. As the exhibition deadline loomed, I resorted to using increasingly odorous chemicals and loud tools in what was a private workspace for many. Obviously, those who had authorized my use of the Public Safety Building had not envisioned this level of disruption. In short time, I began to hear hushed conversations about the “anthrax bomb” I was building and other similarly exasperating comments. Caring more about working than enlightening those who were unable to understand my sculpture, I ignored the gossip and continued my reckless 24/7 schedule. The city’s Fire



Chief came to detest me, as the structure's towering height began to interfere with smoke detectors near the ceiling of the Public Safety Building. This resulted in a series of late night alarms where a firefighting crew was dispatched to the building, only to find one confused artist and an absence of fire.

These events set the stage for the climactic incident where I attempted the use of roofing tar indoors to waterproof the basin beneath my sculpture. From my perspective, this was a necessary evil—the basin's gradual leakage required constant mopping and threatened to damage the floor of the foyer. However, the other inhabitants of the building disagreed, calling 911 to complain of headaches and a nauseating odor. The fire department showed up, at which point the Chief verbally assaulted me using words that I will not repeat here. Other officials within the city government, who had already demonstrated their disdain for the project, issued a stop-work order forcing me to halt all construction and barring me from entering the Public Safety Building.

Skipping the tortuous and political details of how this situation was resolved, I was eventually allowed to continue my efforts with the understanding I was to follow strict rules and notification procedures in my future use of chemicals. The sculpture was also to be dismantled immediately following its December 7<sup>th</sup> exhibition date. Although this was far better than being shut down entirely, it was impossible to finish the project on time.

*4g. Imperfect Outcomes and Lessons Learned*

The thesis exhibition ended up being an unexpected success, as the sculpture illuminated for the few hours in which groups of visitors entered and exited the Public Safety Building. Even more unbelievably, I was able to give a coherent speech and converse intelligently with my audience despite having not slept or eaten in over four days. However, as a result of the turmoil and uncertainty in the weeks leading up to the exhibition opening, not all aspects of the project lived up to the theory first conceived.

Even with all of the things that went well, there are still many aspects of the project I wished had been more successful. For example, the special low voltage pumps I had purchased to carry fuel cell liquid to the top of the sculpture were not nearly as durable as expected—very shortly before the exhibition I discovered that they could only run for about fifteen minutes before burning out (although proving that the sculpture could produce voltage in excess). I stubbornly kept troubleshooting the issue and nearly sacrificed each pump on display. Fortunately, my girlfriend convinced me to reserve the last one and operate it as a demonstration at the exhibition. This was unquestionably the wisest thing to do given the circumstances, but since the pump was not constantly running, there was little liquid to fall upon the drumheads at the base. The silent yet thunderous vibrations of the Schumann resonance only lasted for a moment at the exhibition before the final pump shut off forever.

But perhaps most importantly, the yellow crystals that were to gradually form on the sculpture over weeks or months were only given a few short hours to grow. They barely had time to form a thin sheen before de-installation of the sculpture began on the

morning of December 8<sup>th</sup>. This is possibly the most regrettable aspect of the project, as the crystal growth was intended as a central feature of the sculpture, and, in my opinion, one of the most intriguing features of its organic “life.”

From this experience, I learned the choice of exhibition location can have a strong impact on an artist’s work. The Public Safety Building was a beautiful and expansive location in which to display my sculpture. However, the people that I associated with on a daily basis had, for the most part, little artistic or intellectual interest, and the overall impression of being an unwelcome intruder impacted negatively on my creative process. Perhaps as a partial result, the building was also not the ideal location to be using the chemicals and other hazardous materials required for the sculpture. Although these elements were necessary for completion of the project, in retrospect, I should have taken more responsibility in communicating to all necessary parties what I was doing on a daily basis. Nonetheless, I am still proud of my thesis project and its attempts to unify art, science, and the metaphysical in new and remarkable ways.

## 5. CONCLUSION

Innovative combinations of art, science, and technology allowed me to briefly engage in a magical world where ordinary exploration led to the unexpected and mystifying. While this “magic” was strongly founded within physical and natural law, I veiled technological and scientific components from my audience, leaving them with a primal sense of awe and curiosity. The culmination of my investigations reflected a matured and developed interest in confronting the unexplainable; I became a participant in the scientific paradigm that produced true magic.

The zero-point field is the key to comprehending universal energy and its existence within all of creation. If organic materials emit light and the field communicates within these frequencies, then light is the means of understanding the universe and the mind; somewhere in between is an interaction that unites the self with that same discourse. Thus I am light and thrive in this universe due to the existence of this relationship.

The ability of the universe’s energy to transcend the zero-point field and interact with the human body has been the ultimate guide for my thesis endeavor. We are quite literally creatures of light. My goal has been to reproduce this essence through an sentient entity—a living work of art that needs no outside source of energy to survive.

I have created a being of light in the universe’s image.

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