

# Biophotonics in the Rendering of a General Systems Language

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Keywords: art, biophotonics, genomics, modeling, simulation, systems theory

## Overview

My current foundry research methods combine a calculus of physics, grid computation (supercomputer) algorithms, systems modeling for simulation, and biochemistry, with classical foundry techniques. The aim of this fusion is a sculptural work in cast metal that gives haptic and visual channels for the audience to become aware of the protein dynamics that produce biophotonic light. This light is unique in that it occurs through the direct transduction of organismic motion into light, proposed via a symmetry in bonded electron orbitals.

The interface provided by the resultant sculptural form speaks to a concept of 'geometric syntax,' in this case connected to the relationships within genomics. Complementarily, patterns in language and genetic sequences can be analyzed using the same algorithm. The correlation suggests an early symmetry in the emergence of these systems.



*fig. 1 Biophoton sculpture*

Thus the aspects of such base geometric dynamics in proteins may create a way to model the emergent forms of a general systems dynamic. As these underlay the patterns of planetary ecology, they lay the foundations of food, medicine, genetics, and mythology. These are the cornerstones of our culture and its Arts.

The rhythm of these environmental phenomena gives rise to grammars of expression and speech. In reverence of nature's whole, or our own humanity, we use that speech to render stories. Inspired by these stories we explore

models of order; law and physics each their own evolution of mythology. These arts emerge a coherent whole that yet evokes reflection upon its emergent parts.

As each of these is underlain by a generally modeled system, I propose that 'geometric syntax' forms one of the components of a General Systems Language. I feel that the sculptural work proposed offers a way of interfacing 'geometric syntax.' Moreover, I feel that it does this via a sensory channel that is congruent to phenomena that it models.

The protein chosen for the sculptural work is the spinach plastocyanin that enacts photosynthesis. It is incorporated into this work with the collaboration of David LeBard. Further knowledge of this protein may allow us to consider energy creation via mechanisms as efficient and sustainable as one of the most well-coupled processes in nature.

The concept of a General Systems Language also allows us to consider how a culture can convey to its stakeholder citizens the genetic advancements that affect them - let alone conveying those advancements to another culture? The paper considers how stories and rituals passed down in the cultivation of food may represent one of the oldest systemic integrations of genetic knowledge.

## Foundry Research Methods

My process in this work has been driven by a re-envisioning of modern media practice. In this work I have chosen the role of digital technology to augment traditional methods of sculpture. It is the aim that this 'simple' work envision a future generations interactive sculpture. I feel that this choice will allow the underlying concepts in the work to be more clearly expressed when animation or interaction is deemed appropriate.

In preparation for producing work in classical metal foundry techniques I have begun with a conceptualization process that involved visionary meditation and scientific models, as well as modes more familiar to the arts. I began initially with rendering various images of a 'mythological biochemistry,' particularly the relationship of light to DNA. As I later came to research biochemistry, genetics and biophotonics (biochemical emissions of light) I discovered that the work was conceptually in-line with science. Moreover, I found that some of the visions seen could be physically operating, though if so were yet unmeasured.

Biophoton emissions, being the most mysterious aspect of the work, became the focus of development. These emissions are more prevalent in living organisms, and thus offer a unique manner by which to more deeply understand and express characteristics of life.

These are single-photon emissions that occur by the internal motion organic molecules. The atomic bonds in organic molecules are weaker than in metals, and the flexibility of the bonds is proposed to be integral in the biophoton emissions.

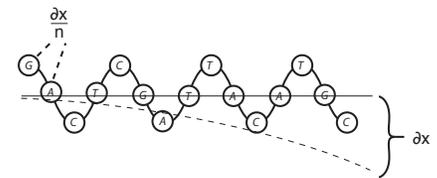


fig. 2 Cumulative bond flexibility

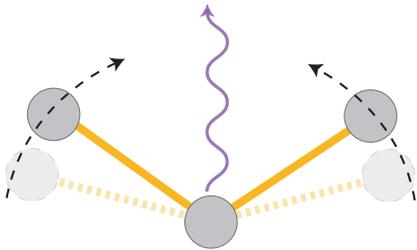


fig. 3 Emission correlation to bonding angle

Particularly, it is theorized that wave-function shape of electron orbitals can organize themselves in such a way that intra-molecular motion caused by thermodynamic forces is transduced into an ordered electromagnetic emission. Sometimes referred to as Photo-Quantum Effect, these photon emissions are not the result of stored chemical energy but proposed to be a transduction of thermomechanical energy.

Have a deeper understanding of these dynamics was deemed possible through computer simulation. The intent of this simulation was the produce 3D data that would be representative of the atomic structure that produced biophotons. The 3D data would then be converted into a file format appropriate for production on Rapid Prototyping (RP) machines - '3D printers.'

Preparation for this work involved a study of Calculus, in order to more easily understand the numerical data simulated. The simulation itself was carried out on a beowulf cluster using MPI - Message Passing Instruction set. This programming language is designed for parallel computation ("supercomputer") architecture that are now accessible via groups like Sun Microsystems, Google, etc. Such accessibility ensures that this manner of work will always be reasonable to execute. The complexity of algorithm design also required study of system theory and modeling in order to manage the organization of the target work.

David LeBard, PhD Candidate at Arizona State University, collaborated in to supply of his atomic simulation of the atomic dynamics of 1AG6: Spinach Plastocyanin. The collaboration is opportune not only due to his competency in the field and invigoration by the interdisciplinary process, but also because of the poetic role that the 1AG6 protein plays. The protein is the core mechanism for photosynthesis in spinach, which also has the highest quantum efficiency of any plant in converting light into energy. Shawn Lawson, Professor at Rensselaer Polytechnic Institute, also collaborated in the OpenGL renderings, and implementation of algorithms for converting the atomic simulation data into OBJ file format.

## Haptic Interface

The intention of producing sculptural work via these techniques is to enable new forms of interface. It is felt that haptic interfaces allow a level of understanding that is not possible via the abstract mechanisms of visual information. The simulation data conveys more than 3D positions - it models the movements of the protein. The movements are used to modify the 3D model, adding roughness to the areas that move the most.

The finished sculpture thus provides a haptic interface into the protein's dynamics. Being able to hold a physical form allows the body to have a relationship with the nature of the protein. The fingertips receive tactile information about the protein's movement, and integrate this awareness with the spatiality of the piece.

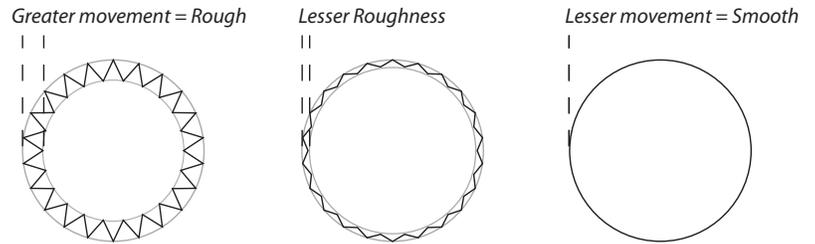


fig. 4 Relationship of Protein Movement to Surface Roughness

## Biophotonic & Genetic Operation

The aim of exercising our interface possibilities is to permit experience of the relationship between biophotons and the DNA. From this work it is proposed that previously labeled 'junk' DNA is architectural to gene functioning. The mass of genetic material could be considered like a woody trunk to the growing 'apical meristem' that are genes. Genes respond more quickly to the world around them, and are constantly varied as they learn and adapt to the momentary fluctuations of a changing climate as well as other events & cycles that is perhaps hundreds or thousands of years in duration. As these gene-level changes occur, a kind of resonance is sought with the architectural DNA, which has resulted from millions of years of developmental growth.

In this model, I propose that the genetic historical change in development, and explosive growth of complexity, was perhaps an 'investment in loss'. In a symbiotic manner, base organisms deciding to live with 'extra' DNA - like house guests, of house staff, of the parent organism / DNA. These 'extra' pieces, which did or do regulatory and administrative jobs, became the foundation and architecture for complex growth. As these foundations had to be capable of growth as well - a feedback mechanism came into being (or was simultaneous) that allowed feedback from the gene-DNA to reorder the architectural DNA elements.

I use the concept of the gene DNA being like a laser chamber, it forming a kind of cavity to build up waves of sufficient coherency. These waves may be biophoton emissions themselves, or another order of electromagnetic energy. In their escape from the gene 'chamber' they reflect & refract through the space capacitated within the helical twisting of the architectural DNA. All such wave introduced into the architectural DNA mix and form resonant modes. These modes exert pressure that reorders the architectural DNA occurs when the gene-wave is sufficiently coherent with existing functioning, yet inclusive of new dimensions of wave function.

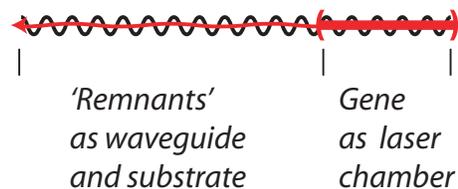


fig. 5 Biophotonic laser 'pumping' of genetic substrate

Thus, if gene material consistently maintains a structure that creates a wave that is not resonant with the architectural DNA, there is pressure from the architectural DNA (even as an anechoic pressure) to dissolve this non-resonance. If it persists then the pressure of the non-resonant wave upon the architectural DNA may cause a gradual realignment at the architectural level. As a metaphor, consider river sandbar evolution as the flow changes over decades and centuries. Non-resonant forms may be as depression, autism, cancers, Parkinson's, Alzheimer's, etc. - systemic illnesses, inclusive of consciousness, that have physical components.

The model of standing waves of light casts an interesting light upon the concept of “genetic memory” and “ancestral memory.” Such light may form patterns within patterns; beat sequences that arise from the waveforms of existing forms. These sequences could acquire rhythm and then change the codons around them to engender greater genomic complexity.

So perhaps architectural DNA has its ghettos. Its backwater streets. The edges of genetic-’tectonic’ shifting. The architectural component arose from an initial investment in loss and submission to greater symbiosis - dissolution of the genetic ego. Thereafter, those established elements have the poor knocking via their own gates, and must become their fore-bearers. Shamanic medicine-artists walk these streets, watching the swept patterns in the effluvium and sweeping their own - aimless wandering forms that may, with the whirlwind, eddy into coherence or break down a ruinous wall of genetic history. It seems to be difficult for the social organism to see its own toes when it’s so high up - like an antenna with no frame of reference to ‘read itself’ (and so the most grounded have the best reference).

### **Praxis**

Work by Reenan (1) on how genetics interacts with the nervous system may open the door to a body/nerve-to-RNA feedback loop. This is not to say a ‘conscious’ alteration, since there are several envelopes to cross from the thinking brain to the bio-mechanical processes that parlay with our genes. Yet, the mechanism is there and the science backs up what has been done throughout history, which is to promote the practice of holistic activities that encourage an integrated awareness of activity-alchemy, down to the cellular / luminescent level.

The article may help unfurl an awareness of the mystical practice of altering our own DNA. The conscious mind is one layer of filtration, or refinement / generalization, that is followed by the unconscious, then a habitual / cellular level (which may be protein-based), then the DNA. Bioelectric imbalances in the layer of the nervous system, which are treated by Tai Chi, Yoga, and others, are of an order of effect that is closely related to the cellular processes layer. The layer may recode RNA & protein, which ‘tests out’ changes in the system before they are encoded into DNA - generally considered to be a hard / long-term change. Doubtlessly this is due to the transmission of DNA characteristics through reproduction, thus DNA alterations set the trend of generations, and RNA becomes the vessel of an individual life.

Here again we can look to model the relationship of DNA to biophotonic light, with the capacitance of the latter being a mechanism for ‘genetic memory’ and ‘ancestral memory’ (which may or may not be thoroughly considered as each their own layer). Certainly, the manifestation of biophotonic capacitance in the DNA would be the non-linear organization of introns, exons, and other DNA material outside of what we define as the ‘gene.’ The biophotonic organization process may at work in the recently discovered Mendelian Inheritance Loophole (2), where genetic re-sequencing can occur the generation after a change has been introduced into the DNA.

The scenario would seem to illustrate the importance that holistic social awareness places on the interaction between child and grandparents - the un-metered awareness of the child tunes into the tempered / ripened genetic state of their elder, circumventing potential instabilities in the parent generation. The dynamic may also explain why people in some socio-environmental scenarios have relatively rapid generational / reproduction cycles - in the promotion of a more stable version of DNA than is maintained throughout the life of an individual under the stresses of their environment.

Overall, the line of thinking re-emphasizes the importance of holistic awareness practices. Special light is shed upon the spreading of holistic medical wisdom, such as is present in the system of Chinese Medicine, where the incorporation of Chi-focused energy work leads to metaphysical and poetic considerations of the subtle development of life. The practices taught by Chinese Medicine encompass a broad range of physiological, mental,

emotional and spiritual health, and the integration of these concepts in all acts of the Chinese Medicine practice likely promote coherence of the genetic process to the biophotonic level.

The connection of biophotonic light and consciousness via genetics creates an avenue for interesting poetics on the relationship of consciousness to gravity. Though our experience of light can be rendered in mundane manners, the phenomenology of light is still one in which even science is at a loss to encompass. Light has been considered to arise from symmetry in electromagnetic operation. Recent work (3) suggests that the natural beauty of light is more subtle than perfect symmetry, and instead arises from the 'shimmering' of vectors in the tensor field of spacetime (like waves upon a field of grain).

The delicate poetics proposed by this new model suggests that consciousness may have a massaging effect upon gravity through the torquing effect that DNA has upon quantum fields in the production of biophotonic light. It offers the idea that life is not a mechanism tuned toward pure luminescent coherence, functioning or not functioning, but rather a myriad of asymmetrical relationships each with their own uniquely beautiful state of balance. There is also the notion that the development of consciousness is in direct proportion to the topological nature of spacetime, and that a feedback mechanism between them could be represented.

### **Linear & Geometric Syntax**

To seek out feedback mechanisms between consciousness and the environment we may look to the physical mechanics involved in our biology. An interesting, though potentially unsurprising, correlation exists in the linearity of syntax in genetic and linguistic form. Algorithms used for natural language structure processing are the same as for gene sequences. If this correlation is anything other than superficially coincidental then it suggests a correlation between speech-structured thoughts and genetic development.

Since this structuralism is grammatical, both in language and in genes, then we could extrapolate a 'mad-lib' like grammatical framework for a story that is based upon a section of genetic code. Using this to craft a story, our aesthetic sense may pick out what element (plot or otherwise) may be 'missing' - revealing a genetic mechanism of which Genetics Science is unaware.

Implications would extend to biotechnology, painting a story for how unfamiliar genetic code will interact when brought together. Other echoing may exist for gene and drug interactions - and area where interactions are complex and difficult to predict / extrapolate. Rendering these chemical 'rules' as a story could allow a different mode of accessing the system dynamics that permits extrapolation via our own cognitive faculty - and facilitate additional rule formalism. Using the grammatical framework to craft multiple stories presenting a range of elements (different 'drop-in's of the 'mad-lib') would allow us to finer tune our sense of the dynamics via holographic and statistical models.

Similar 'modeling' occurs in literary works, such as the Bible, Lord of the Rings, and Hero of 1000 Faces, where rhythms that underlie the stories of many traditions are represented in a single work. Through these condensed works, the characteristics of specific cultural traditions become magnified through their comparison to a general reference. Literary analysis of genetics (or other systems) projected as story-structure iterations could offer a new way to investigate complex systems. The narrative / literary approach to may also allow for generalization of complex ecological genetics for easy conveyance at various scales - just as a story can be summarized or extrapolated upon by a storyteller.

The relationship between form and meaning draws attention again to the linearity of the systems. Our speech emerges in an order, always linear, but the meaning afforded by syntax may come in a myriad of configurations. Genetic and protein formations may offer deeper insight by which we can broaden our sense of 'linear' syntax.

We may look to DNA and proteins not only for the linearity of their coding, but also across the space that their atomic structure composes. A protein is not merely a linear sequence of atoms, but rather a complex configuration of bonding energy potentials arrayed in space. Moreover, changing in the geometry that atoms are arrayed produces photon emissions that are of significant order to affect the protein structure. The linear order of atoms is of no greater or less importance than the dynamics that are conducted across space.

From seeing the importance of spatial dynamics we can consider that a syntax must not be linear nor one-dimensional, but may more rightly be based upon the spread of relationships in the system. Given such geometric syntax is operative at the genetic level we may look to extrapolate its emergence into the ordering and operation of biological, ecological and planetary systems, as well as our own language.

### **Open Source Genetics**

Given that these syntactical relations are the result of atomic structure, we may find them at the root of general systems dynamics. Thus we may find them as patterns in ecology, food, medicine, genetics, and mythology. Our language and stories may therefore be congruent to the rhythms of the environment, as they would be embedded with the same general systems dynamics.

Here we can consider how to reflect our genetic and genomic novelties in ways that are more commonly relatable in the social practices we presently endeavour. At present, any understanding of genetics knowledge requires significant academic study, and is generally not meaningful to the untrained. This distancing creates an unsustainable practice, which then becomes a danger as we embark broadly upon genetic engineering.

In revealing dimensions of general system dynamics we can build bridges between our systems knowledge in any areas - regardless of whether they be in fields that are academically different, or culturally different. In doing we would begin to structure an 'open source' approach to genomic and systems knowledge that would be accessible to a person of any culture via their own language and environment. Thereby we may have route to stabilize our technological advancement in genetic engineering through gaining feedback from the true stakeholders: all humans (and we may begin to understand how to listen the rest of the stakeholders: the rest of organismic life)

Because the dynamics would be truly general we would see them have nascent presence anywhere in the universe. Individuals could thus have a bridge to experiences that are increasingly 'alien' to their own - yet be able to approach them through as much familiarity as necessary. The hope is that in constructing a General Systems Language we may reform our models of experience, learning and education such that humans may integrate the broaden swath of Information into a more succinct Knowledge.

My intention in using a sculptural approach to this work is to stimulate our sense of these dynamics via as many sensory channels as possible. I feel that haptic and proprioceptive feedback is underutilized when compared with the great amount of visual and auditory information that is available. My hope is that a nascent synesthesia exists within us all that may allow us to access deeper experience of the world through multi-sensory works.

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