

Propagating Organization: An Enquiry

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Our broad aim is to understand propagating organization as exemplified by the vast organization of the coevolving biosphere.

The cell operates as an information processing unit, receiving information from its environment, propagating that information through complex molecular networks, and using the information stored in its DNA and cell-molecular systems to mount the appropriate response

We are looking for a new language and new concepts to deal with info and the propagation of organization in biology based on Kauffman's book Investigation

Kauffman argues that organisms are emergent causal agents in their own right in their selective environments and that biology cannot be derived from physics. You could use physics to explain how the heart operates but could not predict that the organ of the heart would emerge to pump blood from physics.

We argue that Shannon information does not apply to the evolution of the biosphere because one cannot prestate all possible Darwinian preadaptations or the ensemble of possibilities and hence their entropy cannot be calculated.

According to the Shannon definition of information a structured set of numbers like the set of even numbers has less information than a set of random numbers because one can predict the sequence of even numbers. By this argument a random soup of organic chemicals has more information than a structured biotic agent. The biotic agent has more meaning than the soup, however. The living organism with more structure and more organization has less Shannon information. This is counterintuitive to a biologist's understanding of a living organism. We therefore conclude that the use of Shannon information to describe a biotic system would not be valid. Shannon information for a biotic system is simply a category error.

A living organism has meaning because it is an autonomous agent acting on its own behalf. A random soup of organic chemicals has no meaning and no organization. We may therefore conclude the meaning of life is organization—organization that propagates.

The Relativity of Information

We have argued that Shannon conception of information is not directly suited to describe the information of autonomous agents that propagate their organization. We have defined a new form of information, instructional or biotic information such as the constraints in a cell that direct the flow of free energy to do work.

You may legitimately ask the question “isn’t information just information?”, i.e., an invariant like the speed of light. Our response to this question is no, it is relative. Instructional or biotic information is a useful definition for biotic systems just as Shannon information was useful for telecommunication channel engineering.

Work is the constrained release of energy into a few degrees of freedom. But where do the constraints themselves come from –as in the example of a cylinder and piston that confine the expansion of the working gas in the head of the cylinder to yield the translational motion of the piston, hence the release of energy into a few degrees of freedom—one finds that it typically takes work to construct the constraints. Thus we arrive at the first surprise - it takes constraints on the release of energy for work to happen, but work for the constraints themselves to come into existence. This circle of work and constraint shall turn out to be part of our theory of propagating organization.

Presaging DNA Schrödinger correctly predicted that the order of life had to be coded in an aperiodic solid crystal which can contain a wide variety of microconstraints, or micro boundary conditions, that help cause a wide variety of different events to happen in the cell or organism.

Thus, we starkly identify information, which we here call “instructional information” or “biotic information,” not with Shannon, but with constraints or boundary conditions, and the amount of information will be related to the diversity of constraints and the diversity of processes that they can partially cause to occur.

We therefore conclude that constraints are information and information is constraints which we term as instructional or biotic information to distinguish it from Shannon information. We use the term “instructional information” because of the instructional function this information performs and we sometimes call it “biotic information” because this is the domain it acts in, as opposed to human telecommunication where Shannon information operates.

Semiosis

We argue that when an autonomous agent discriminates food or danger/toxins, that this is the rudiment of semiotics. We shall locate biotic semiosis, as a subcase of information as constraints.

Adjacent Possible

We argue that natural selection constitutes the assembly machinery, when coupled with heritable variation, that literally assembles the propagating organization of matter, energy, constraint, work, and information. This constitutes the propagating organization in autonomous agents, whose coevolution drives the biosphere's progressive exploration of what we call the Adjacent Possible.

Human Forms of the Propagation of Organization

We regard language, culture, technology, governance, and economies as other examples of the propagation of organization. This leads me to the second half of my talk on the evolution and origin of language.

I have only a few minutes to review 3 books

The Alphabet Effect

The Sixth Language

The Extended Mind: The Origin of Language, the Human Mind and Culture

The Alphabet Effect (Wm Morrow
1986; 2nd edit. Hampton 2004)

- The Alphabet & Phonetic Writing
- Codified Law •Monotheism
- Abstract Science •Deductive Logic

An autocatalytic set of ideas that
emerged between 2000 and 500 BC in
Mesopotamia, Israel, and Greece

The alphabet teaches the lesson of
analysis, coding, decoding and
classification. The alphabet is both a
communication medium and an
informatic tool.

The alphabet, monotheism, law,
science, logic are media that
interacted with each other and
co-evolved

The Sixth Language (Stoddart 2000,
2nd edit. Blackburn 2004)

Language = communications +
informatics

Speech, writing, math, science,
computing and the Internet form an
evolutionary chain of six languages

Each language has a unique semantics
and syntax

Each new language emerged in a
response to the chaos of the
information overload that the previous
languages could not handle

The Extended Mind: The Origin of Language, the Human Mind and Culture (U of Toronto Press 2007)

Speech emerged as the bifurcation from percepts to concepts and a response to the chaos associated with the information overload that resulted from the increased complexity in hominid life, which included

- Tool making and use;
- Control of fire;
- Social cooperation to maintain the hearth;
- Food sharing,
- Group foraging & hunting;
- Mimetic communication (gesture, hand signals, body language and vocalization)

As complexity increased the percept-based brain couldn't cope — it needed concepts for abstract thought

Speech represented a bifurcation from
percepts to concepts

Our first words were our first
concepts

They acted as strange attractors for
the percepts associated with those
words

The word water unites our percepts of
the water we drink, cook with, wash
with, rain, melted snow, lakes, rivers

Thought is as much silent speech as speech
is vocalized thought.

Merlin Donald claims that mimetic communication was the cognitive lab in which verbal language developed and that it was intentional & representational

If it was such a good communication system why was there a need for verbal language?

It was useful for: 1. conceptualization, 2. symbolic, abstract thought and 3. planning.

By allowing for thought about objects and actions not in the immediate perceptual field language permits planning

Mind = Brain + Language

Before language the brain was basically a percept processor

With language the brain becomes capable of conceptualization and hence bifurcates into the human mind

The emergence of verbal language represents three simultaneous bifurcations:

1. the bifurcation from percepts to concepts,
2. the bifurcation from brain to mind,
3. the bifurcation from archaic Homo sapiens to full fledged human beings
(Logan 2003b, pp. 75-76)

Seven Levels of Biosemiosis

My previous work with the origin and evolution of language and the propagation of organization plus a paper by Hofkirchner has led me to speculate on the existence of seven levels of biosemiosis. But first Wolfgang's quote that inspired this probe:

“Semiosis and self-organization are co-extensional – there are as many different basic types of semiotic processes as there are basic types of systemic self-organizing processes.”

The seven proposed levels of biosemiosis:

1. the digital transmission of information by DNA from one

- generation to another;
2. epigenesis of the phenotype from the DNA influenced by signals from the environment;
 3. the process by which receptors of prokaryotes interpret signals from the environment;
 4. the biosemiosis of learning by virtue of the emergence of a central nervous system in animals;
 5. the transition from percept-based thought to concept-based symbolic thought that emerged contemporaneously with human speech;
 6. the sociosemiosis of human society or culture, a symbolic based phenomenon; and
 7. the semiotics of human generated signs both spoken and notated both oral and notated.