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Nature's Cosmic Intelligence

By Joel Isaacson, PhD

Introduction

Philosophical naturalism holds that all beings and events in the Cosmos are natural and that there is in nature regularity, unity, and wholeness that imply objective laws.[1]

In this paper we will discuss what these laws might be and whether they are indeed entirely objective.

A scientific revolution began in the 17th century, with dramatic changes in our concepts of cosmology (Kepler, Galileo, and Newton) and celestial mechanics, in addition to better understanding of the sciences of mechanics and physics in general.

The modern science we have today is largely rooted in that scientific revolution and the subsequent Age of Enlightenment that followed in the 18th century. Central to the physics that emerged from these shifts, from Newton to Einstein, are two fundamental concepts: matter and energy.

During the second half of the 20th century and into the 21st, notions of information (alongside matter and energy) have increasingly become part of the framework of modern science. We wish to reflect on this third component, information, in this short essay.

Recursive Distinctioning

The modern science of Information Theory was founded by Claude Shannon.[2] Information theory involves the quantification of information (or data) and usually disregards meaning that may be conveyed by bits of data streams. It was initially developed to find limits on signal processing (telephony in particular), including technical issues, such as data compression, storage, and communication.

There have been many applications of information theory in numerous fields, some of which have been very successful, but this discipline was never designed to deal with semantic and pragmatic forms of communication (see C. S. Peirce).

We think that biological information and communication is of a different kind from the data manipulation techniques of conventional information theory.

Bypassing Shannon's information theory, we introduce a naturalistic principle that accounts for many of the patterns and regularities that are observed in our Cosmos. We call it Recursive Distinctioning (RD). What is RD?

In perception, we encounter patterns in a variety of signal modalities that are detected by our various senses, but if there was no capacity for distinction-making of elementary features in patterns there would be no patterns (relative to our perception and cognition). Thus we posit local distinction-making as the most primitive operation in perception and subsequently in cognition.

When distinction-making is applied to a pattern there is a new pattern that is comprised of the variety of distinctions recorded. Thus, a new pass of distinction-making can be applied to the pattern of distinctions and this kind of a process can repeat itself recursively, indefinitely. I have shown elsewhere[3] that such processes are always circular. In addition, they tend to self-organize into dialectical patterns, akin to patterns of dialectics elaborated by Hegel and the German idealists.

The term was coined recently in the course of discussions on an Internet forum of the cybernetic community, CYBCOM,[4] but I had actually developed it myself during the 1960s and the first half of the 1970s. (It was then called BIP, for Basic Intellector Process.) Many people in CYBCOM hold that information that is not interacting with a cognitive entity is of no consequence in the biology of cognition. Meaning takes precedence over bits and bytes and their statistical properties.

For an example beyond CYBCOM, Eshel Ben-Jacob of Tel-Aviv University has written on meaning-based natural intelligence vs. information-based artificial intelligence. Citing from the abstract:

> We reflect on the concept of Meaning-Based Natural Intelligence – a fundamental trait of Life shared by all organisms, from bacteria to humans, associated with semantic and pragmatic communication, assignment and generation of meaning, formation of self-identity and of associated identity (i.e., of the group the individual belongs to), identification of natural intelligence, intentional behavior, decision-making and intentionally designed self-alterations. These features place the Meaning-Based natural Intelligence beyond the realm of Information-Based Artificial Intelligence. Hence, organisms are beyond man-made pre-designed machinery and are distinguishable from non-living systems.[5]

Second-Order Cybernetics and Radical Constructivism[6]

Much of this new way of looking at meaning vs. information constitutes an extended brand of cybernetics, called second-order cybernetics, or “cybernetics of cybernetics”.

Purists even go further and subscribe to radical constructivism. What is radical constructivism? Definitions vary, but in the words of one of its more prominent adherents, Ernst von Glaserfeld:

> It is an unconventional approach to the problem of knowledge and knowing. It starts from the assumption that knowledge, no matter how it is defined, is in the heads of persons, and that the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience. What we make of experience constitutes the only world we consciously live in. It can be sorted into many kinds, such as things, self, others, and so on. But all kinds of experience are essentially subjective, and though I may find reasons to believe that my experience may not be unlike yours, I have no way of knowing that it is the same. The experience and interpretation of language are no exception.[7]

A contemporary explanation from Principia Cybernetica Web states:

> Constructivism has its roots in Kant’s synthesis of rationalism and empiricism, where it is noted that the subject has no direct access to external reality, and can only develop knowledge by using fundamental in-built cognitive principles (“categories”) to organize experience. One of the first psychologists to develop constructivism was Jean Piaget, who developed a theory (“genetic epistemology”) of the different cognitive stages through which a child passes while building up a model of the world. In cybernetics, constructivism has been elaborated by Heinz Von Foerster, who noted that the nervous system cannot absolutely distinguish between a perception and a hallucination, since both are merely patterns of neural excitation. The implications of this neurophysiological view were further developed by Maturana and Varela, who see knowledge as a necessary component of the processes of autopoiesis (“self-production”) characterizing living organisms.[8]

Radical constructivists do not necessarily deny the existence of an independent reality, but assert that the only access we have to the Cosmos is via a cognitively constructed P-Cosmos, that is, our personal perceptions of the Cosmos, as distinct from the “real” Cosmos out there.

On this view, it can be argued, our science is colored by our perceptual processes and, if our perceptions are driven by RD, then science must mirror RD, especially at its most fundamental levels.

Indeed, when we study the properties of the most primitive perception imaginable[9] we obtain emergent patterns that are very similar to the formation of elementary particles, called in physics the "baryon octet", which include patterns of the proton and the neutron, in terms of their quark constituents. So, elementary perception mirrors certain fundamental aspects of our physical theories of particle physics and vice versa.

Dark Information

Ever since the results of NASA's Wilkinson Microwave Anisotropy Probe (WMAP) have been analyzed it has been common for cosmologists to hypothesize the existence of dark matter and dark energy in the Cosmos.

WMAP has mapped the Cosmic Microwave Background (CMB) radiation and produced the first fine-resolution full-sky map of the microwave spectrum. A number of important findings resulted from the WMAP project.[10] Among these are the following:

- Ordinary atoms (baryonic matter, i.e., atoms comprised of protons, neutrons, and electrons) make up only about 4.6% of the universe.
- Dark matter (nonbaryonic matter) makes up about 22.7% of the universe.
- Dark energy makes up about 72.8% of the universe.

These are astounding findings that indicate that more than 95% of the universe is made of dark stuff and only less than 5% is made of baryonic matter, the stuff that we are made of, things that we ordinarily think of as real.

Dark matter cannot be seen directly with telescopes, since it does not emit or absorb light or other electromagnetic radiation. Likewise, dark energy is not detectable directly and can only be inferred from indirect observations; for example, its effect of speeding up the expansion of the universe. So, all in all, our cosmological models of the universe are now replete with both dark matter and dark energy, things that are beyond our senses and our instrumentation.

Is there likewise also Dark Information? The short answer is: very likely.

In the mathematical theory of RD there is a clear indication that, similar to dark matter and dark energy there is dark information, which is embedded in “fantomark” patterns. There is reason to believe that, by analogy, dark information is prevalent in the universe in roughly the same proportion to ordinary information as dark matter is to ordinary matter.

Fantomarks (from phantom marks) are entities that, by definition, are not perceptible via our senses or our instruments. For technical details on fantomarks and streaks, see [3] and [11].

Just as in the case of dark matter/energy, we do not have sensory access to dark information and cannot perceive it directly. However, fantomark patterns emit “streaks” to which we do have access, which may bypass the ordinary five senses. It is very likely that we have receptors, perhaps directly in our brains, that accept streak-patterns of fantomark-patterns and, in that sense, it involves extrasensory perception. (Note that it is extrasensory only relative to the ordinary five senses, but not in an absolute sense.)

Streak patterns code for fantomark patterns but are generally simpler. By merely looking at streak patterns one cannot infer (or even suspect) the underlying fantomark patterns and thus streak patterns generally may appear as random noise. However, in the mathematical theory of RD, there is an operation, called Reclamation (REC), which restores the structures of fantomark patterns from their streak pattern representations. Thus RD processing can be done in streak mode, which is simpler to handle, and conversion to regular RD mode can be done via the application of REC.

We, Eshel Ben-Jacob and myself, think that neurons perform RD in streak mode and this is a key to the design of an experiment whereby live neural tissue is investigated for the possibility of performing RD in streak mode. When successful, we will be able to construct live neural circuitry, in a hybrid with electronic circuitry, that implements RD processes. We believe that such RD processes are plentiful in normal brain activity.

Fantomark patterns that are coded as streak patterns and are then processed in streak mode are many times removed from direct perception. There are multiple layers of masking, which compound the difficulty of their decoding and thus make them inaccessible to us without the application of RD technology. This presents new challenges and implications for SETI projects.

Perception of sensory inputs is predicated on the capacity for local distinction-making in sensory patterns. One of the pioneers of second-order cybernetics, Gregory Bateson, proposed a definition for information in 1972 which stated that “information is a difference which makes a difference." Circa 1969, I independently generalized a similar principle by proposing that information is the dynamical process of recursive distinction-making that is applied in perpetuity. I was able to show that such processes are guaranteed to cycle and are self-correcting and very stable, as they always generate attractors. I dubbed these Hegelian cycles. See [3] and [11].

It turns out that those Hegelian cycles are generic to both dialectical idealism (such as in Hegel) and dialectical materialism (such as in Marx). They arise spontaneously, as by-products (or side-effects) of RD, that is, these are emergent, as opposed to being programmed.

It is proposed that cognition is dependent on RD processes and thus dialectical processes and patterns permeate cognition. Hence, we cannot perceive our P-Cosmos apart from applying RD and thus our Cosmos invariably appears to us as being dialectical through-and-through. Note that all this is independent of any political ideology, such as Marxism, or even Hegelianism per se, because it emerges from first principles relating to information processing via RD.

Summary and Concluding Remarks

It is likely that advanced civilizations elsewhere in the universe are long familiar with this and have adopted modes of communication that are independent of the particular sensory modalities of one intelligent species or another. Thus inter-species communication is pre-processed into streaks and streaks are the *lingua franca* of cosmic communication.

In this paper we argue that RD is a natural law that governs perception and cognition. We also argue that our access to the Cosmos is via a cognitively constructed P-Cosmos. The P-Cosmos construction is driven by a multitude of RD processes and thus mirrors these processes. An RD-based cosmology stipulates Dark Information in the Cosmos, alongside Dark Matter and Dark Energy. Dark Information is embedded in fantomark patterns that may be accessed by us, to a certain extent, via the application of RD technology. We speculate that the preferred mode of communication by intelligent extraterrestrial civilizations is by streak patterns that code for fantomark patterns.

I have been urged by well-meaning colleagues and supporters to compare these findings and their import with those of Newton and Einstein in their own respective times. I respectfully decline to do this. Both the Newtonian and the Einsteinian revolutions have been marvelous, unparalleled contributions to science in particular and civilization in general.

The introduction of RD processes into our arsenal of scientific concepts and tools may be revolutionary as well, but, as of now, I decline to put these in a class with the aforementioned. It is sufficient to point out that this RD theory is meritorious and potentially significant for scientific and technological advancements on a number of crucial frontiers.

Postscript

Some reviewers suggested that I identify some of these potential advancements. Following is a list of some possible research directions.

- Development of an information theory that is extended to fantomark-coded messages and streaks would facilitate the invention of superior intelligent artifacts. It could also hold a key to communication with extraterrestrial modes of intelligence and eventually help us understand our cosmic ancestry and the relationship between the implicate and explicate orders as outlined by David Bohm.

- Recursive distinctioning is fundamental to all perception and, by extension, to cognition and intelligence. This finding is advanced as a law of nature, perhaps on a par with gravity, and is expected to play significant roles in new theories of cognition and intelligence.

- We can build computing machines that are called Recursive Distinctioning automata (RD automata). These machines would process distinctions into further distinctions in perpetuity. Certain circularities and certain characteristic patterns emerge that are consistent with those that are attributed to thought processes by a number of influential philosophies over the span of many centuries. In effect, we may be on the threshold of capturing the essence of perception and intelligence in computing machines.

- The concept of Panspermia relates to the hypothesis that the seeds of life are prevalent throughout the universe and that life on our planet was initiated when such seeds landed from outer space and began propagating themselves. Francis Crick (with Leslie Orgel) suggested in 1973 a theory of directed panspermia, in which seeds of life (such as DNA fragments) may have been purposely spread by an advanced extraterrestrial civilization. Critics, however, argued that this was implausible because space travel is damaging to life due to radiation exposure, cosmic rays, and stellar winds. However, the principles of intelligence described here permit us to introduce now the notion of tele-panspermia, which postulates panspermia guided by

> means of coded fantomark patterns (or their streaks). According to this concept, diffusion of life does not necessarily require the physical transport of actual "seeds" via meteors, comets, and the like. Telepanspermia may be guided by means akin to pilot waves in Bohmian quantum mechanics. So, work on defining such guiding mechanisms in telepanspermia may converge with non-local hidden variable theories in fundamental physics.

Notes

[1] Encyclopædia Britannica Multimedia Edition, s.v. "naturalism" (Chicago: Encyclopædia Britannica, 2012).

[2] C. E. Shannon, "A Mathematical Theory of Communication," *Bell System Technical Journal* 27, (July & October 1948): 379–423 & 623–656.

[3] J. D. Isaacson, "Autonomic String-Manipulation System," US Patent 4,286,330, August 25, 1981, http://www.isss.org/2001meet/2001paper/4286330.pdf.

[4] CYBCOM, Cybernetics Discussion Group, https://hermes.gwu.edu/archives/cybcom.html.

[5] E. Ben-Jacob and Y. Shapira, "Meaning-Based Natural Intelligence vs. Information-Based Artificial Intelligence" (n.p., 2004), http://star.tau.ac.il/~eshel/papers/meaning based.pdf.

[6] As this went to press I obtained a preprint by Ranulph Glanville, current president of the American Society for Cybernetics, on the relationship between Radical Constructivism and Second-Order Cybernetics. See R. Glanville, "Radical constructivism and second order cybernetics", (JCHK, in press). A draft version can be found at www.bobkrone.com/node/220.

[7] E. Von Glaserfeld, *Radical Constructivism: A Way of Knowing and Learning* (London: Falmer Press, 1996), http://www.questia.com/PM.qst?a=o&d=103919722.

[8] http://pespmc1.vub.ac.be/CONSTRUC.html.

[9] J. D. Isaacson, "Steganogramic Representation of the Baryon Octet in Cellular Automata." (Archived in 45th ISSS Annual Meeting and Conference: International Society for the System Sciences, Proceedings, 2001). http://www.isss.org/2001meet/2001paper/stegano.pdf.

[10] http://map.gsfc.nasa.gov/.

[11] J. D. Isaacson, "The Intelligence Nexus in Space Exploration," *Online magazine of the Israel Physical Society*, 8 (2007). http://physicaplus.org.il/zope/home/en/1128811288/isaacson_en.

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About the Author: Joel Isaacson has pioneered in RD Cellular Automata since the 1960s. Recursive Distinctioning was rooted in studies relating to the analysis of digitized biomedical imagery. Dr. Isaacson utilized NASA's computing facilities at the Goddard Space Flight Center in Greenbelt, MD for the initial stages of this research. His research has been supported over the years by DARPA, SDIO, NASA, ONR, USDA and a good number of NIH institutes. Isaacson is Professor Emeritus of Computer Science, Southern Illinois University and Principal Investigator of IMI Corporation.

Editor's Note: One of my very fortunate professional and personal rewards has been the opportunity to be a colleague of Professor Isaacson beginning in 1980 when we shared a NASA Research Summer. He meets every criterion of scientific excellence. His first discoveries were at Goddard Space Flight Center in 1964. His patent was approved 25 August 1981, but he did not publicize it until 2006 because he continued to validate his discoveries and to have them confirmed by global information scientists. With this article Dr. Isaacson makes a huge contribution to Cosmos understanding. Mass and energy are well known. His discovery that our universe contains information and intelligence in a process that is basic also to human perception and cognition is a scientific knowledge paradigm shift. *Bob Krone, PhD.*

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